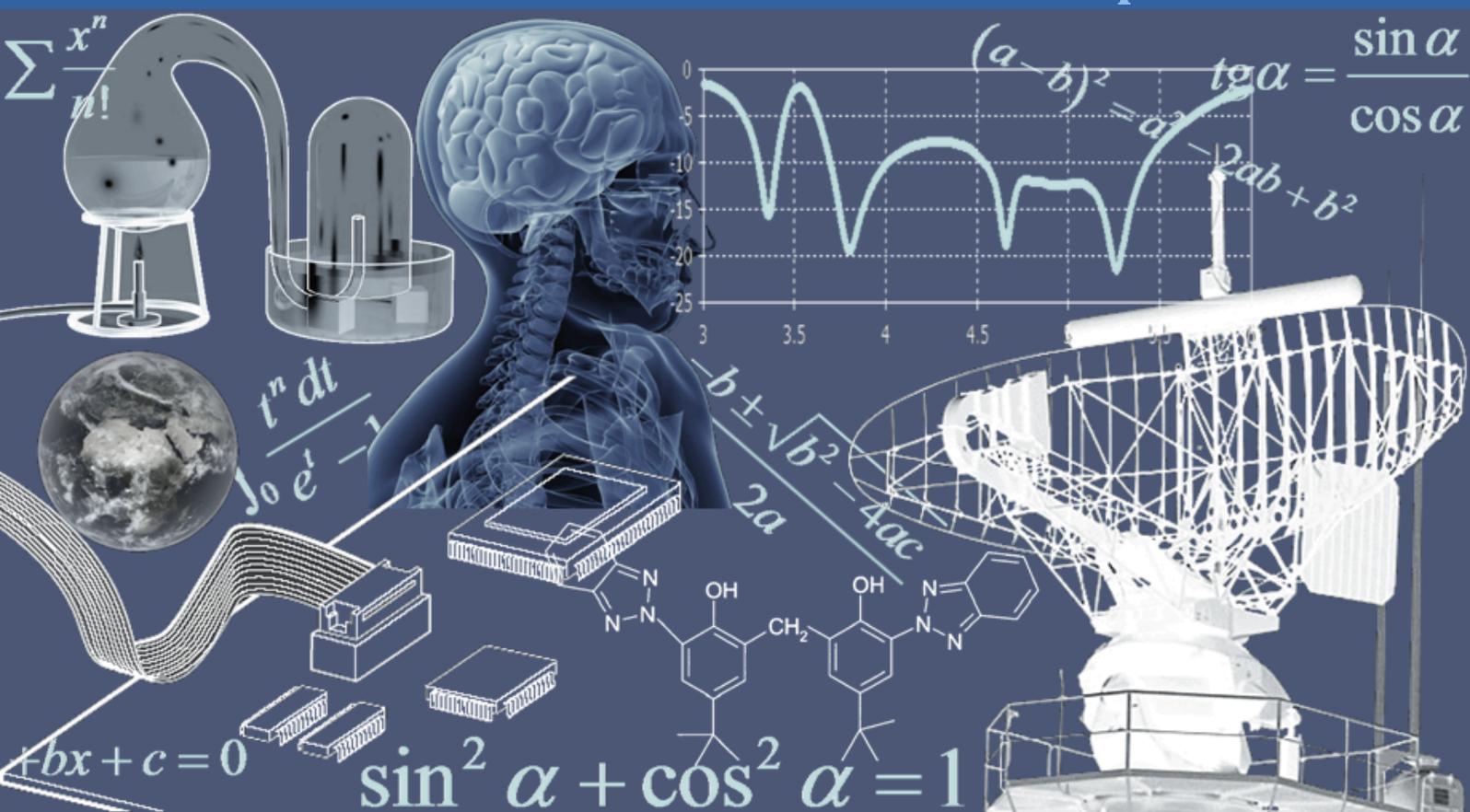# INTERNATIONAL JOURNAL
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Accepted papers are available freely with online full-text content upon receiving the final versions, and will be indexed at major academic databases.

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A Science & Business Equation for Collaborative Corporate Innovation.
Business Strategy, IP Strategy, R&D Strategy: an all-in-one Business Model.
A review with a Bio-Technology & Green Chemistry Focus

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ABSTRACT: Not all the best people work for you... This is likely one of the motivator for open-innovation in terms of future business development. IP, R&D and Business strategies are becoming one. The adjacent technology analysis, ATA©, goes beyond prior art and freedom to operate traditional approaches providing a new role to the IP strategist still preventing excessive lawyering. Coaching and mediating turn out to be part of this role given the broad interdisciplinary and multi-science skills required.

Green chemistry and biotechnology are no exception since in essence they are multi-science founded and still today require an upfront pioneering state of mind. Largely regulatory driven the related businesses may enjoy the open-innovation approach even more or may end-up "not having the choice".

Two cases, involving advanced technologies in the sectors of Advanced Materials for Protection and Bio-based Material Engineering, are been used to illustrate the suitability of the proposed collaborative and participative business equation.

This review, mostly intended for educational purposes, using illustrative situations close enough to reality, establishes a state of the art foundation for the layman and unexposed professionals. A number of fundamental references, more than 12 foundation books are cited to provide to the implementer a self-standing source of established literature.

KEYWORDS: Innovation, collaborative, participative, Collaboratory^{TM}, adjacent technology analysis, ATA©, biotechnology, advanced materials, hybrid vehicles, green chemistry, $4C^2$©.

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INTRODUCTION

About 15 years ago, in the French Chemical News, [1], the author described the innovation path using the skills of the modern business engineer. The selected 4C© skill elements were CONNAISSANCE – CREATIVITY – COMPETENCE – COMMUNICATION. Those skills were to be aligned with the need of the new global business environment. In other words the business engineer would have to be a Creative-Connoisseur and a Competent-Communicator and/or almost of any profile corresponding to any combinatorial arrangements of the four word roots, 4C©.

Would 4C© suffices and survives today? Probably not! What about $4C^2$©? Foresee Square is depicted on Figure 1, with the Collaborative word added to each and every 4C© skill descriptor. Therefore, the business engineer is part of multiple networks of interactions called most of the time the open innovation network.

This study combines and complements the presentation at the Geneva Corporate Innovation Forum of October 6th, 2011 and the plenary lecture given at the International Symposium on Green Chemistry held in La Rochelle on May 21-24th, 2013.

According to the Environmental Protection Agency (EPA), [2],[3], an independent US federal agency, "green chemistry" is defined as:

"…The design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, and use."

As outlined in [4], [5], [6], the Green Chemistry (GC) arena involves multiple Science and Technology know-hows. Food, Bio, Chem. Engineering, Physics and Environmental Sciences are more than essential in the creation of a sustainable business environment based on Green Chemistry. Fundamental understanding, mathematical models and design methods, such as in separation technology [7], [8], and energy rationalization method [9] have been and remain vital in the process anticipations and transfer from their more traditional arenas of applications to the ones of concern hereby, in GC.
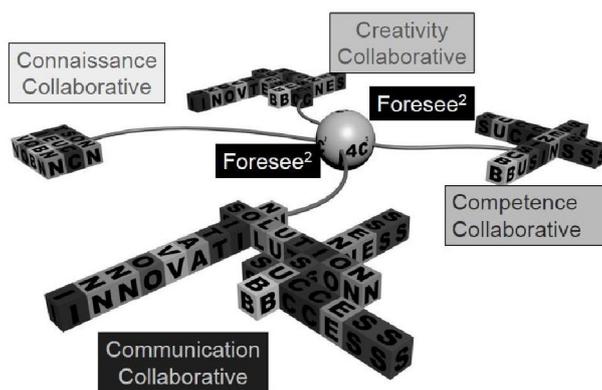
Fig. 1.   Foresee Square, 4C[2] ©

Also underlined in [4] and supported by patent strategy [10], IP awareness and vigilance is critical: offensive and /or defensive, creating value and/or distributing value. The challenges between creating value opportunities and strictly controlling and distributing value, subtend the business opportunity within its rather fast evolving boundaries.

The State Intellectual Property Office (SIPO) of China, [11] recently facilitated examination of patent applications directed to various strategic technology areas, including green technologies, GC therewith.

The explosion of design patents in China, more than 500 000 in 2012, i.e. 10x the USPTO or the EPO numbers, has been reported at several occasions by the specialized press. Also described is an "All-time high for activities of the European Patent Office in 2012" which tend to put patent growth in a worldwide context.

The private sector owns a majority of the green chemistry patents, close to 90%. The university holds a relatively large portion as well, close to 10%, outlining its role as a pioneering entity.

In terms of classifications, the world number one company in terms of portfolio count in 2012 is ranked number 3 in the brand value classification; the company ranked number 6 in the brand value classification in 2012 is also ranked number 6 in terms of the portfolio count ranking. Three of the 6 first patent portfolio counts are part of the 10 first valued brands.

Brand and patent count classification seems to get closer as patent portfolio average quality improves with time, i.e. a better alignment of patent strategy with business strategy. The race for "patent count" might be in obsolescence. But the race is still on, slowly shifting towards a "quality rather than quantity" based race.

Brand is definitely a business asset which is reinforced by the patent portfolio although in the first ten classified brands, there are companies operating on the basis of trade secrets or owning very few patents.

Patent portfolios are part of acquisitions which can reach several billions only for the patent asset part; monetizing patent assets is definitely an element of the business equation. Computer/software related patents are leading the way, as well as smartphones and social networks.

To place things in prospective, in the same study, Oliver Wyman underlines that 90% of high technology patents, including GC classified ones, are priced less than $50k; 9% between $200k and $500k and 1% worth above $1m.

According to "Updating TRIZ: 2006-2008 Patent Research Findings," minor and continuous improvements constitutes about 60% of the average patent portfolio while only 5% are of pioneering nature which in turn accounts for more than 70% of the portfolio overall value. Then the majority of the patents accounts for less than 25% of the value of the given portfolio.

Despite the refining and improvement of the examination process of patents, there is still a focus on eligibility versus quality.

Given previous considerations and related reflections, is there a new business equation?

A RATHER NEW BUSINESS EQUATION

In summary most of the time IP strategy, R&D strategy and Business strategy can no longer be separated and need to be linked. The three are to be integrated and harmonized in order to lean towards a more adapted and ideal business equation with an upfront business model analysis and implementation roadmap, i.e.:

1- Maintain Superior Competitive Position

- Minimizing elapsed time from idea to market

2- Ensure Business Flexibility

- Maintaining and expending the freedom to operate

3- Secure Business Profitability

- Minimizing legal/competition exposure

IS IT THAT COMPLICATED?

The artist "BSR" has interpreted, Figure 2, a virtual patent claim relating to the hospitality industry, "Apparatus and method to serve hot beverages, preferably coffee, without losing the human touch".
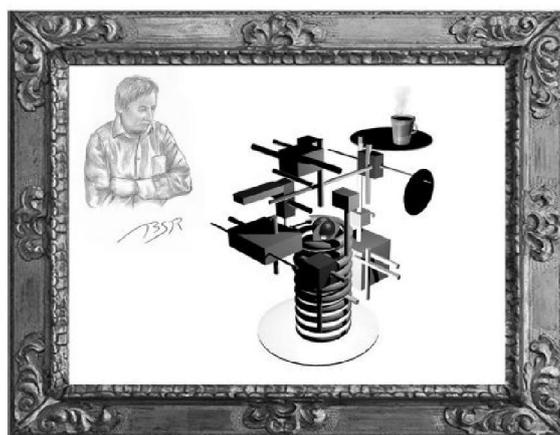
Fig. 2.   That Complicated?

Obviously it can be complicated to interpreter some claims, isn't it? The GC area isn't apart from the raising complexity and length of patent applications related to bio matters.

The IP and Innovation strategies definitions need to be synchronized with the business models establishment phase using well adopted business development and IP stage gate processes. The latter being part of an evergreen monitoring process (in term of strength and weakness awareness) which should also be in place to:

1-Monitor the IP progress

2-Refresh awareness of already in place secured technologies, via express inventories

3-Identify wish and must happen filings and acquisitions or divestitures

4-Broadly recognize (manpower, resource, time) limitations of wide-ranging implications

5-Regularly revisit lists of unexploited and unexplored technological traits

6-Reformulate the ideal stage

7-"Looping" back to most appropriate stage 1-5

The aspects above will be illustrated in the remainder of this paper using a bio vs. a non-bio undertaking and various company IP profiles.

THE GREEN CHEMISTRY AND THE REGULATORY IMPACT

Let's now focus on the GC sector and have a closer look at the ISGC2 international GC symposium [12] using it to unveil various trends and to analyse the alignment between the key players.

As a matter of curiosity, as soon as we have been invited by the organization committee to present a plenary session on the open-innovation matter, we decided to conduct a relevance analysis and alignment check of different subject matters covered in this symposium.

Regional authorities, with "ex" national and international political mandates, are persons of choice to deliver introductive opening speeches; no exception for the current symposium [12].

Using the main address of the meeting ISGC2, we performed a technology and business model relevance analysis using state of the art patent mining engines [13] and tailored methods and sequences therewith, as well as non-patent literature (NPL) computerized analysis with "artificial intelligence" capabilities. Especially tailored for this sort of purpose, combinatorial sequential analysis was used involving those engines' capabilities. In the remainder of the text we will use the acronym ATA©, adjacent technology analysis, when referring to those tools and methods.

Those computerized approaches remain for the most a bit murky in defining the used algorithms and procedures therewith. The main unique characteristics of the patent and NPL mining sequence that we tailored and use for our purpose, ATA,(that distinguish it from traditional patent search systems), are to the best of our knowledge as follows:

 (1) topic-idea-driven; (2) heterogeneous networks co-searching; (3) smart competitive analysis incorporation, and (4) whole patent or NPL integration.

A seminal reason for deviating from traditional keyword and patent classifications based searches is grounded with the following type of studies.

As reported by Ulrich Schmoch, of the Fraunhofer Institute for Systems and Innovation Research located at Karlsruhe in Germany, to the WIPO organisation in June 2008:

"Various technology classifications have been used by different institutions for many years. These classifications generally follow the systematic of specific patent classifications, either the International Patent Classification or the US Patent Classification.

However, these classifications have proved to be quite inconsistent in various aspects."

Note: References to commercial brands and to potentially interest conflicting specific matters are being proscribed in the ISGC2 presentations. Therefore tool names, such as search tools, are simply not mentioned at all. Furthermore the tools are being used in combinatorial fashion, and then it would be hard to evenly and fairly represent the contribution of each of them. (The same restrictions are applied to company names and product names all along this presentation, which is based mostly on the plenary lecture given by the author at that symposium).

Among the 100 most relevant references, deriving from the patent mining and NPL ATA analysis of the main address of the symposium (available in the proceedings of the event [12]), came in position 3 the following reference title:

"Ethically coherent and scientifically logical method for allocating assets in portfolios of investments"

Without any partisan predisposition, this happens to constitute a "discovery". Somehow it is also a compliment which can be addressed to the mentoring supportive authorities and the scientific committee, since this reference supports hand-in-hand relevance and coherence within the GC context.

Let's the abstract tells us more:

"The present…concerns the technical aspects of applying ethics to the field of investment industry. It provides an ethically coherent and scientifically logical Method for allocating assets in portfolios of investments and a model Fund product that applies this Method to detract systemic tensions…This is a novel mechanism to provide equality in access to both information and credit and thereby contributes to: - a stable increase in financial return on investments;- an optimal allocation of human resources through the creation of employment in both hard and soft currency countries, and - an environmentally optimal depletion of natural resources…. The implementation of the project is assisted by a computer program and a data base product, and monitored through an ethically coherent business organization method."

This may contain the right wording to complement the previously cited EPA definition of Green Chemistry where ethical coherence and scientific logic pairs towards and environmentally optimal use of natural resources, an harmonized use of human resources and assets…in global collaborative industrial undertakings. It also brings to the front stage, the regulatory aspects which have led the way to the Green Chemistry (GC) journey since a number of years.

Additionally this excerpt is pertaining to a patent document published on June 7th, 2007.

IP is at the heart of the GC development. The creating value opportunity may overpass the traditional distributing value paradigm. The role of the regulations is prominent, but will not be further covered in this paper beyond the following assenting citation [14]:

"Empirical data have identified legislative and regulatory pressures as the main external forces that promote the adoption and innovation of cleaner technology and environmental management systems, followed by cost savings and market opportunity."

GREEN CHEMISTRY AT THE WORKBENCH

There are some level of correlation between public R&D and patents for alternative energy technologies (wind, nuclear fusion, photovoltaic); but not to the same extend in the case of fuel cells, probably since private R&D is very important, [15].

The above suggests that patent numerals and R&D allocation can be a reasonable proxy of not only inventive activity but also innovative activity.

Therefore let's attempt to verify some of the above in the case of the current symposium, [12].

Given the interconnected areas of GC in general, the identification of eco-patents requires adequate knowledge of the technology under consideration in order to determine:

1. How much is being patented?

2. In which regions and which sectors is it being developed?

3. How does the related patent activity compare across different topics, such as the one selected for this symposium?

4. What does this patent activity reveal about the drivers for innovation? Which type of innovation? Is there a choice?

Using the above 100 most relevant references, related to the editorial address [12] ATA analysis, a further ATA analysis is performed to determine the most relevant clusters representing recurrent concepts; in other words, "relevant ideas" sum-up by key words called text clusters.

The analysis therewith is shown on the left side of the graphic of figure 3 wherein the credits cluster is dominant followed by carbon dioxide, sustainability, renewable energy and power generation. This representation can be, for an illustrative purpose, considered as representing the authorities' vision, directions and somehow expectations for that event and the GC prospects in general.
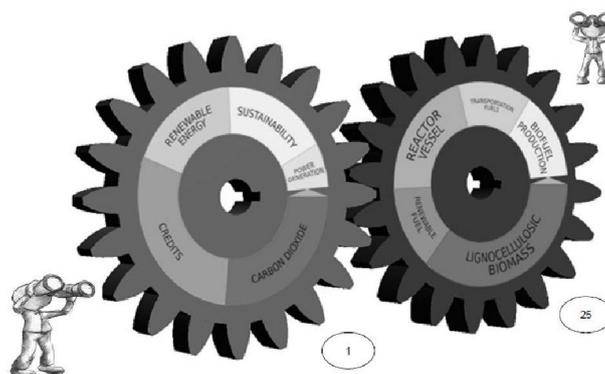
Fig. 3. Authorities vs., Experts

In terms of alignment and coherence analysis, a logical extension of this type of analysis can be undertaken with further comparisons involving the domains of interest of the three categories of ISGC2 intervening presenters; i.e. the authorities as being the visionaries, the plenary and key-note lecturers as being the experts and the oral and poster presenters being the trained in the art senior researchers and the workbench actors.

For that matter, titles of plenary lectures and keynotes as well as round table subject matters, [12] (25 in total), are processed via ATA, patent mining and NPL analysis, to obtain the 100 most relevant references related to those. The resulting text clustering analysis and the disc representation is provided on the same figure 3, on the right side this time. The resulting domains are for the most relevant: lignocellulosic biomass, followed by reactor vessel, renewable fuels, biofuel production, transportation fuels. Let's assume for an illustrative purpose that this analysis represents the experts' vision, directions and somehow expectations for that event and the GC prospects in general.

A quick comparison between the authorities' clusters and the experts' clusters reveals strong overlaps such as the renewable energy and the bio-fuel domain in particular. But also a difference, i.e. on the authorities' side appears: credits, carbon dioxide, which may be related to the debated climate changes, sustainability. On the experts side the production and engineering aspects are differences worth being remarked.

Overall there is no conflict in the cluster analysis and all matters remain part of a logical vision and directions therewith.

Still keeping an educational purpose in mind, the figure 3 analysis can be extended. Figure 4 provides the results of the analysis combining the authority and the experts together on the left side and the researchers on the right side. For the latter more than 600 entries have been used namely the oral and flash presentations titles and the posters titles, [12].

Let's adopt that the researchers are mostly the workbench actors using the currently available research tools. Figure 4 translates a focus on the biomass which is also a major focus for the combined authorities and experts. Otherwise a product orientation, rather than a process and a production penchant, appears in this analysis. Once more this is an illustration of the use of ATA IP/NPL processing tools. One can freely derives other conclusions from the proposed disc charts.
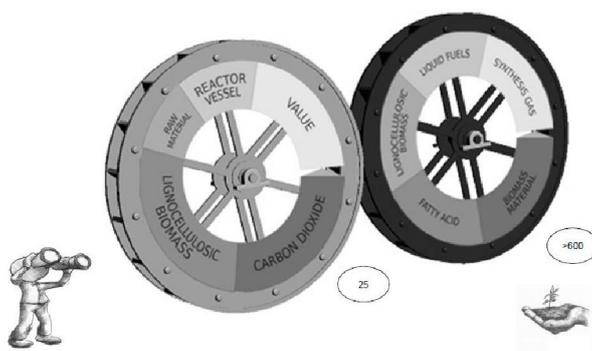
Fig. 4. Authorities & Experts vs. Researchers

IS IT HAPPENING NOW? ESTABLISHING PRIORITY AND REGIONAL DISTRIBUTION

Each topic, selected by the ISGC2 symposium scientific committee, was submitted to an ATA to qualitatively determine whether their relative attractiveness and their regional distribution are homogeneous or rather spread around.

Namely the following topics were considered, [12]:

- **Topic 1:** "Conversion of lignocellulosic biomass.
Pre-treatment, deconstruction and conversion of lignocellulosic biomass to chemical platforms or transportation (renewables: wood, corns, beets…)
Conversion of carbohydrates to higher value added chemicals"
- **Topic 2:** "Conversion of vegetable oils, derivatives and by-products.
Conversion of vegetable oils
Reactions involving (unsaturated) fatty acids/esters, glycerol or minor compounds (esterification, transesterification, oxidation, metathesis, hydroformylation, hydrogenation …)"
- **Topic 3:** "Valorisation of by-products (including CO2), waste and recycling.
Chemical valorisation of waste
All processes involving biogas and more generally agricultural waste
Chemical valorisation of CO2"
- **Topic 4:** "Eco-efficient processes.
Design of energy (and atoms)-saving processes for the rational conversion of renewable carbon
Chemical and physical pre-treatments of biomass, green solvents, alternative media, catalysis,
Process design, process intensification..."
- **Topic 5:** "Catalytic materials specifically dedicated to innovative processes incorporating bio-based materials.
Preparation and characterization of materials for the selective conversion of biomass: eco-design, green synthesis, bio-sourced precursors..."
- **Topic 6:** "Environmental impact of all actions implemented.
All works evaluating the ecological impact of chemicals and processes on the environment."

Figures 5 and 6 show the filing dates of the series of patents, which were found most representative of each topic, by means of our ATA analysis.
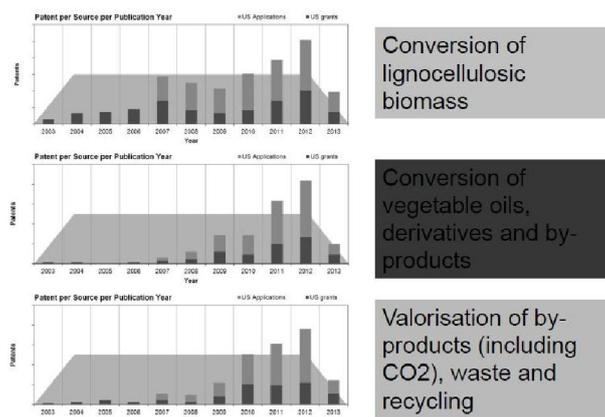
Fig. 5. US Applied vs. Granted

All topics enjoy recent filings, the period from 2005 to 2012 encompasses the peak periods for all topics, which means that all topics are paving the way to the GC innovation; within the symposium topic selection of course. Topic 1 related to biomass conversion presents a more continuous filing trend. Topic 4 related to catalytic innovation exhibit a filing peak in 2009.
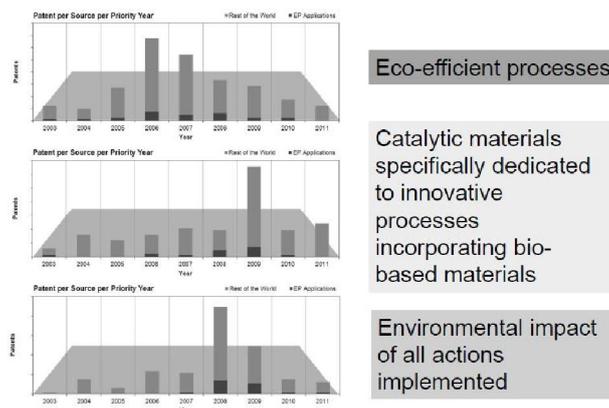
Fig. 6.   EP Applications vs. Rest of the World

On Figure 5 one can segregate applications vs. grants in the USA. Filing dominates which means that one should expect enforceability of those patents in a near future. Within the limitations of a qualitative interpretation, if the ground has been set by those patent family applications, then, the "new" business equation could be a predictor of the potential success.

Extending the ATA analysis to the world IP distribution, Figure 6 confirms a rather well anticipated dominant position of the rest of the world, versus the European applications. This trend seems to be a relatively long lasting one, [16].

Is there something to learn from the innovation models in place and could newer models be of value to GC (Green Chemistry) technology worldwide; more specifically in balancing the attractiveness and enforceability of innovative GC?

INNOVATION PROFILES: WHAT'S NEW AND APPLICABLE TO GC?

There are multiple ways to handle partnership and IP strategy, [17], [18], [19], [20]. In a bipolar classification of those, one pole corresponds to the almost totally externalized IP and innovation activities and the other pole relates to the strictly internal R&D and IP protection scheme.

a- The Open Structure & Network Therewith [21]

An illustrative structure corresponding to the open structure pole is depicted on Figure 7 wherein the relationships are mostly defined by two ways agreements. The resulting IP, most of the time patents, is shared. On this slide one can appreciate the IP fluxes, e.g. number of patents shared and licenses, from the thickness of the lines which connect the main entity (Comp.1 on Figure 7) to its contractors and partners (2,3,4,5… on Figure 7) – the higher the flux the thicker the connecting line. This of course goes beyond known in the art "passive" co-ownership.

It is worth to notice that partners and contractors do establish their own networks with other actors of the open structure.

This type of working relationship with partners, suppliers, etc., being able to establish their own networks within the principal network, has been frequently questioned with regard to loyalty and strategic "solo" opportunism.

There are means to minimize and monitor this type of risk as well as to discourage the opportunistic behaviour. Neither traditional policing nor "hostage taking" dispositions are necessary. Reversely, encouraging and enabling, and creative value development may favourably replace distributive value creation such as traditional price, volume, time pressure "incentives".
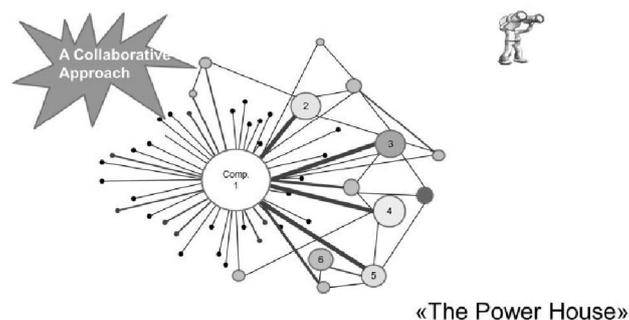
Fig. 7.   An Open-Innovation Supplier Network [17], [21]

Most encountered eight dispositions to create a reasonably virtuous partnering network, with sub networks as depicted on Figure 7, are listed below using self-explanatory semantic.

1. Establishing and managing a reciprocal commitment process

2. Adopting a process for the avoidance of the most common pitfalls

3. Clarifying the prospect of future deals

4. Favouring reciprocal value exchanges and value creation versus strictly value distribution schemes

5. Monitoring constructively and putting in place early warning mechanisms

6. Instituting efficient and easy to manage compensation mechanisms rules

7. Avoiding hard bargaining tactics and excessive-lawyering

8. Anticipating and eliminating "need" for hostage taking tactics and/or narrow minded strategies to strictly insure return on investment

This networking and partnering approach, is frequently referred to the "Power House" when describing a major car manufacturer, number 10 in the current brand value classification.

On purpose, we are skipping the psychological and cultural hurdles that may affect the implementation, nurturing, maintenance, monitoring, etc. of the open structure. Those are to be appreciated on a case by case basis. They seem to surface mostly when regional versus global selective needs and wishes are expressed. The advent of emerging economies and blocs, such as BRICS, represents a significant pressure testing in that field too.

b- The Strictly "Internalized-close" Structure & Controlling Network Therewith [22]

Between overconfidence in internal means, i.e. tools and creative resources "being considered as the best in kind" – and – the rational confidence based on well managed and long established state of the art controlling organization, there are numerous intermediate scales.

Today most of the time the overconfident internally focus organization suffers from an outside perception of obsolescence, related to a rather long admired internal "university" format consisting of the centralized research and development of most large corporations. Those R&D organizations were generally used to generously allocated high quality manpower and funds; therefore producing Nobel-class science and discoveries therewith.
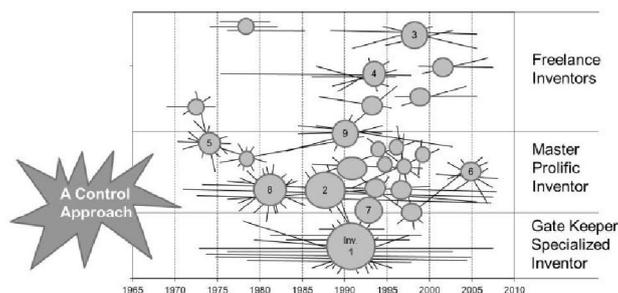
Fig. 8.   A Patent Portfolio and Inventor Profiles [17], [22]

As a matter of fact, there is nothing wrong about the controlling scheme depicted on Figure 8. Different innovator profiles can be characterized from this strictly internal innovation structure.

One can easily identify, bottom-up:

-        The legendary gate-keeper focusing year after year on the maintenance and evolution of trade secrets and patent fortress therewith.

-        The, coaching style, technology master, capable of creating year after year evolving generational technology packages with awareness of the routes to market and the business models. The coach style technology master (CSTM) is well versed to communication, nurturing and empowerment of less experienced innovator generations or to help redirect already in place more experienced researchers.

-        Freelance profiles, sometime perceived as "unmanageable" intrapreneurs (conversely entrepreneurs), take part to such controlling organization and are likely to bring non-core innovative solutions. They come generally from the problem solver side of the research organization; generally originating from the sometime less appreciated problem spotter side of the business organization. One often refers to the famous yellow tag discovery story when referring to such a freelance approach.

Additionally, one can also mention successful business entrepreneurs who developed computerized social networks from a problem solving approach; most of the time "improving and transferring" rather than discovering.

Undoubtedly, the controlling structures of interest in this paragraph can benefit from those innovators, gate keepers, and coach masters' styles beyond the layman's view.

In the shaving business, the continuing innovation, - in razor evolving from one blade to beyond 3 and 4 blades -, is almost self-protected by its innovation history and well established background. Furthermore, the multiple integrations of various patented accessories, well-engineered around the shaving core technology, add durability to this protection; sometime resulting in a fencing of more than 50 to 70 patents surrounding the main base product. The number 16 in brand value current classification, deserves some attention in that respect.

With more than 1000 granted patents, razors have evolved as one of the most patented consumer products.

 Among other tied accessories and products, using control mechanisms to ensure market dominance, are:

•   Printers and ink cartridges / Coffee machines and capsules / Mobile phones and shared time / iPods, MP3s and iTunes and the likes / Low cost computers with linked Internet services / Cameras and lenses / Game consoles and games / Electric toothbrushes and brushes…

Some chemicals and their associated delivery / conditioning / dispensing systems could fall within that category. Some GC products are well adapted to such an approach given, for example, their shelf life, dosage recommendations and eco disposal requirements.

c- Adopting either an Open or a Controlling Profile; anything else? [17]

In between the open and closed innovation models described previously, number of collaborative patterns and IP protection schemes exist. Several matrix representations have been proposed to outline the various business risks versus the IP strength of various partnering dynamics.

We propose to maintain the usual four quadrants positioned in a dual axis as represented on Figure 9 with some modifications relevant to our pertinent experience.
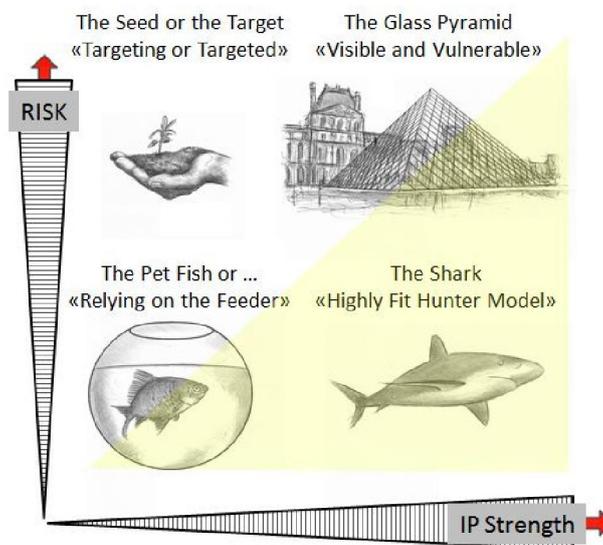
Fig. 9.   IP Strength vs. Risk Profiles [17]

The lower left corner depicted with a pet fish in its close reduced bowl environment corresponds to a low risk, low IP strength zone, furthermore lacking privacy in our representation. Diagonally, opposite to that zone the glass pyramid, recently designed to serve as the lobby of the Louvre notorious museum in Paris, represents the high risk but highly rewarding IP strength zone. Worth noticing the analogy between the valuable fine arts located in heavily protected areas and the IP protection, with regard to trade secrets, etc…

Rather logically the lower right corner quadrant is the high IP strength-low risk area where the fit professional hunter, such as the shark, can dedicate most of his time to food hunting given the guaranteed reward; although… Buying and selling patents, bargaining and challenging IP positions is a recent tactic, familiar to capital ventures generally driven by and for the promotion of innovation.

The last quadrant, i.e. high risk-low IP strength, could be either voided since this voided zone may be the place where any actors, of the three already defined areas, may unfortunately end up. It may also be populated as we did with a tree in its early stage. The pet fish may for example starve as soon as his dominant construction customer tends to suffer from a building confidence crisis. Similarly the shark may venture across highly contaminated water frontiers and the glass pyramid tenant maybe targeted by competitive intelligence abusers well-armed to capture trade secrets. Then all three are likely to end-up in the high risk- low IP strength zone.

That last quadrant may also be the start-up companies' zone looking at the best strategy to value, monetize and cherish their blue sky ideas and discoveries. It may be a temporary position pending on the real or inspiring value of the technology which they nurture. The discovery may reveal a high potential rather soon than later. This quadrant is also the one for low cost, close to no IP owning businesses.

This specific quadrant reaches beyond the scope of our paper. Nonetheless in a few words, here are aspects to take into consideration:

-    for most start-up companies, conceptualizing and mounting a comprehensive patent portfolio can be exorbitantly expensive

- therefore the need to establish, earlier-on, business objectives, IP and product roadmaps and multigenerational business models, with adequate external support; without excessive lawyering but well-tailored IP strategizing.

Of course many undertakings may enjoy a tremendous collaborative life style, with growth and sustainability, having elected for combinatorial positions on the orthogonal axes of Figure 9, pending on products and technology maturity, recent acquisitions or divestitures.

d- Avoiding the Most Common Pitfalls

There are several processes which may be used to safeguard joint developments and to help establish a multigenerational product roadmap with secured IP and business models therewith.

The House-of Quality, the Quality Function deployment (QFD), the Voice-of-Customer (VOC), the Theory-of-Constraints (TOC), the integrated Theory of Inventive Problem Solving (TRIZ), Six Sigma, etc. have paved the way to promote best practices, boost and secure the innovation processes and routes to market of multigenerational products and processes, [23], [24], [25], [26], [27].

Most of these approaches, individually or integrated in innovation management processes, have now got Wall Street's attention and became prerequisite to a good design of a portfolio of products. Although not so long ago Business Models were missing or developed as an after the fact "justification" or became the "most natural" way to proceed without being truly engineered for it.

An innovation pathway, for defining and meeting customer desires in an open innovation frame, was adapted and named by the author as "Z-process".

Z-process includes the following steps:

- Market Survey

- Target Definition – Research and market Targets based on:

☐ Customer Visits, Trade Literature, Technical Symposia, Competitive Activity, Patent Literature,

- Speculative Research and Discovery Process involving:

☐ Testing and Evaluation Iterations, Candidate Selections

- Process Development with:

☐ Early assessment by SHEA (Safety Health Environmental Affairs) department vis-à-vis REACH and other registrations and compliances,

- Pilot Scale Manufacture

- Full Scale Manufacture

- Launch Phase

- Establishment Phase

None of the above steps can reasonably be conducted without an IP and Innovation gate process to establish, validate, consolidate, reinforce the IP sustainability in terms of patents, trade-secrets, trademarks, internal records and agreements therewith (e.g. CDAs, MTAs, JDAs, PRIs (patent right agreements), CSA (Commercial Supply Agreement), BUA (Brand Use Agreement)…).

Each and every step of the Z-process involves multiple partners, internal as well as external, in field trials, customer evaluation and/or validation for example. Therefore the pioneers, researchers, technologists, customer service groups, marketing specialists, financial experts, consultants, salesmen, and business strategists are all at a certain stage involved with external partners, agencies, specification bodies…

The open innovation format implies the joining and active involvement of external resources at each and every step of the innovation process, and, not only at the final commercial stages such as in most close innovation paths. Those external resources are coming from outside in the same direction of, or, parallel to the usual operational boundaries of the firm. Those are generally described with a funnel shape, directed towards the market adoption.

One of the major pitfall lies with the management of such complex level of interactions, occurring in iterative simultaneous processes. The IP protection insurance and the innovation strategy are of evergreen vital importance. Close coaching and consultancy beyond administration and legal attention, is ideally performed by the innovation strategist well versed in IP matters, with a broad experience and knowledge of business and technology functions – a rather new and emerging role requiring strong mediation skills.

In order to limit adverse consequences, a best practice policy within an open innovation context shall take place along the following lines.

Here are three phases of the open innovation journey with most cited deliverables:

1. Exploration – the parties explore the possibility of working together, a mutual one-way or two-way confidentiality agreement being in place. Sample and/or material transfer agreements may be used in this incubation phase.

- "Identification of Interest Areas, Business and Cultural Fit

- Clear Understanding of what each Party Brings: Technology Expertise & Areas of Interest

- Open Discussion

- Agreement on Vision for Success"

2. Joint Development – the collaboration/joint development/research agreement is written and work takes place. Triggering milestones in the integrated joint work plan shall be well defined to cascade to commercial joint undertakings. An exploratory separated research agreement may be recommended for uncertain or hard to define complementary joint purposes. A Patent Right Agreement (PRA) shall preferably be included in the forms of integrated obligations or a commitment to establish, based on well laid down preliminaries, a foundation usable on due course.

- "Initial Testing to Develop Joint Technical Statement of Work

- Successful Laboratory Test & Proof of Concept

- Joint Technical Plan

- Understand Value Chain"

are the expected most common deliverables.

3. Commercialization - a product or technology is made ready to take to market and to produce financial benefits under licence, acquisition or other customized commercial agreements.

- "Successful Field Test & Valuation Model

- Market Success for Both Firms

- Understand Valuation Thoroughly

- Equitable Division of Profits"

are associated deliverables.

e- There is barely no sustainable IP strategy without evergreen business models and reversely: their alignment is paramount and vital [28]

In the US more than 80% of the patents applications are granted. In Europe, the EPO grants about 70% of the patents applications. This cannot be generalized in all sectors and some changes are occurring. There are not many monetizing or investment offers that can provide such a return %. Let's remind this Steven Covey principle:

"If you don't know how you are going to monetize a patent before you apply, you are never going to monetize that patent."

IP is truly part of the business model, which among others, defines the routes to market, the technology and IP roadmaps, the multigenerational product offerings.

Figure 10 shows an example of a supporting roadmap, starting from ingredients on the left side to meet end-users' needs on the right side *(depicted cie names and logos have been created from scratch for illustration)*. The multiple paths are all secured with IP gates (vertical ovals).
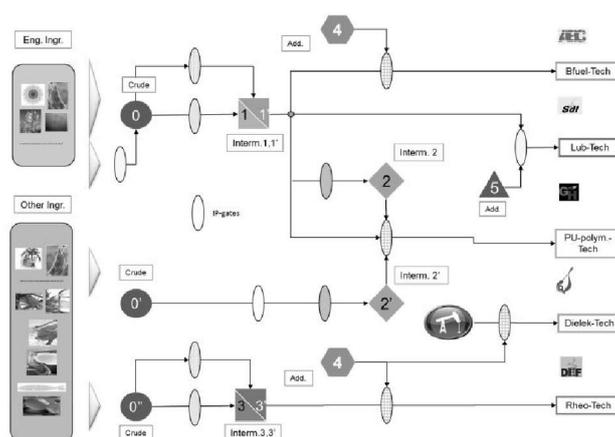
Fig. 10.   An IP and Technology Roadmap – illustration only

Such a roadmap is the result of an evolution process taking place over several years; most frequently starting from a discovery exploited in a sequential or parallel manner to deliver right on time the desired goods. Ideally those deliverables are in line with the business models' best prediction of the right-on-time monetization or profit optimization vs. external and internal driving or inhibiting forces. Acquisitions or divestitures are also part of this market dynamic and may reveal much faster and more profitable than internal developments or licensing in/out.

- **Special or "trendy" or becoming the norm: business models and patent strategies in multi-invention contexts.**

One could dedicate a full course on this matter. A paper proposal is under preparation on this aspect. At least one ought to make reference to this aspect given its prominence in the biotechnology sector and GC in particular.

Frequently said, the more technologically interrelated the multi-invention offerings, the bigger is the challenge to manage with other partnerships and to follow an open innovation course. On the other hand the bigger is the business opportunity, in spite or thanks to non-core technology challenges.

Maintaining a comprehensive technological benefit across multiple arenas can be hard, if not unbearable. The larger and more diverse the set of technology fields, the faster they are rolling, and, the more an integrated model will suffer to stay competitive. In those situations we refer the reader, to Figure 7 and 8 and to the proposed ATA approach to keep abreast, well connected and supported by the surrounding functions of the firm.

DISCUSSION & CONCLUDING REMARKS: WHAT CAN WE LEARN FROM SOME ILLUSTRATIVE EXAMPLES?

1- Pertaining to the Green Chemistry Field: an emerging Science and Technology, [29], [30], [31]

Non fossil oils, such as vegetable oils, animal fats and wood derivatives, have several advantages to petroleum-based oils including lubricity, lower volatility and a high flash point. However, they may suffer from a lack of oxidative stability that can prevent their use in certain high temperature environments. High oleic containing oils, such as soybean oils, have exceptional heat and oxidative stability and can be used in high temperature and extended use applications where conventional commodity oils are not an option.

Lou Honary, [30], has done extensive work on the evaluation of those products.

Applications may include:

1. Lubricant formulations
    i.   Industrial and food grade hydraulic fluids
    ii. Metal working fluids

          iii.   Greases
          iv.   Chain bar fluids
          v.   Motor and gear oils
          vi.   Marine
          vii.   Automotive

2. Dielectric fluids
3. Polyols, plastics, foams, adhesives
4. Source of oleic acids for oleochemical production

Let's imagine that a major discovery in the field of high oleic oil took place back and close to year 2000.

On Figure 11 we are providing a representation of the backward and forward citation levels of this breakthrough, using our own phase descriptors and sequence therewith, i.e. Incubation, Breakthrough & Impetus, Momentum and Inducement.

As shown on the Figure 11, the considered invention has developed into a well forward cited breakthrough, therefore a breakthrough as per the verbatim definition, and not a well sold and masked continuous improvement.

The number of patents that this breakthrough, induced or inspired is far superior to the patents that may have served an incubation role prior to the discovery.
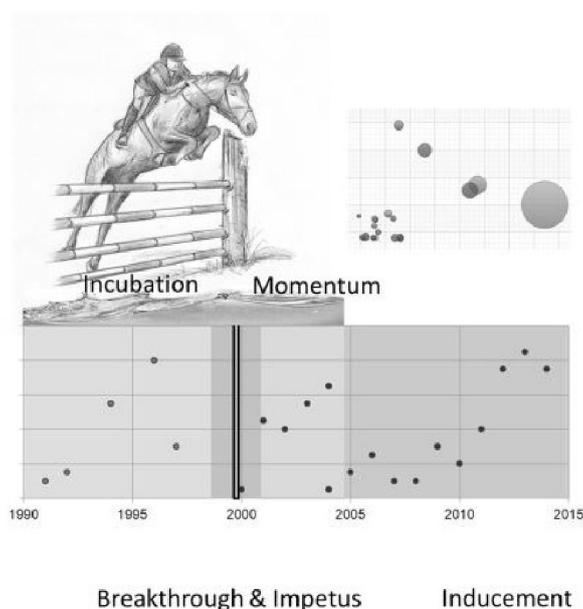
Fig. 11. An Inspiring Breakthrough

Conclusion 1: each GC discovery ought to be treated as a potential breakthrough then the above phases are "manageable" and should be managed preferably in an open-innovation process.

Otherwise as depicted on the circle representation of the upper right corner of Figure 11, the follower, possibly your contractor/processor, represented here by the biggest circle, may take over and leave you little room to manoeuvre given his skills to formulate the ore.

2- Pertaining to the more Traditional Field of High Performance Materials and Protective Systems, [32], [33], [34], [35], [36], [37], [38]

The job of keeping the public safe requires a combination of high-level protection and high-level comfort. It's why firms have recently developed the next-generation of patented fabric technology used for Soft Body Armor.

Situations can change drastically in just a matter of seconds. Law enforcement officers need to react on instinct. That's why a combination of comfort and protection was made as a priority.

This protection business started from a patented woven fabric technology that helps enable vests to weigh less than those made of other available least advanced technologies, such as the ones deriving from Nylon materials.

The dynamic mechanical properties of the aromatic polyamide fibres, as well as their viscoelastic behaviour, which can be tailored via suitable resin reinforcement, are perfectly adapted to their use in impact-resistant systems for low or high velocities circumstances. As early as the 1970s, this opportunity was rapidly recognized and translated into concrete applications such as protecting the lives of military personnel and then of civilians, as well as shielding vital strategic equipment.

This type of application implies the use of a fairly large variety of materials, reinforced or not, in various forms, exposed to a fairly wide range of threats with different geometrical shapes being directed at the target, with variable dynamic impact profiles in terms of energy and velocity. Rebouillat et al. did a large contribution in that field, [32], [33], [34], [35], [36], [37], [38].

The diversity of components and parameters renders the task of the scientists, the designers and the engineers extremely complex and furthermore, multidisciplinary.

As represented on Figure 12 the multigenerational path started with woven fabric quite early on as mentioned above. Let's imagine the following scenario, which is close to a realistic situation.
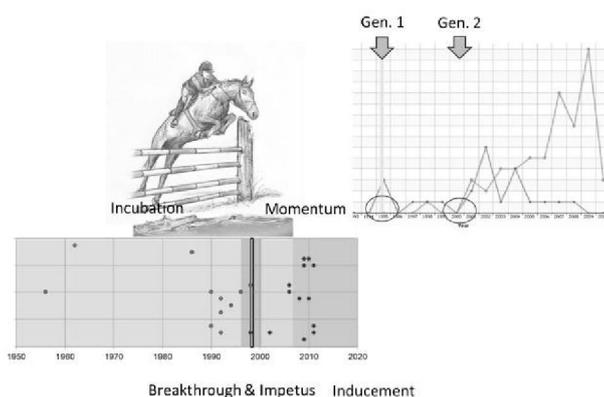
Fig. 12.   Boosted Continuous Improvement

Back around 1995 a generation 1, Gen.1, of ballistic resistant laminates was invented by a start-up. Gen. 1 was followed more recently, around year 2000, by a generation 2, Gen.2, based on a multi-axial & multi-layered unidirectional based technology.

Generation 2 was subject to an acquisition by a larger firm.

The most central observation can be made from Figure 12 where the line chart in the upper right corner shows a bimodal distribution of the forward citations, with a large increase after the acquisition of 2000.

This type of technology, although advanced, remains evolutionary rather than revolutionary; one may associate with it the rather balanced forward and backward citation levels, visible on the chart.

The number of patents that this breakthrough, induced or inspired is almost equal to the patents that may have served an incubation role prior to the discovery.

Conclusion 2: open-innovation may boost the technology attractiveness; acquisitions may be favoured versus internal development in terms of development pace.

3- And the Hybrid Vehicles Technology

"Who holds the power?"

The Cie, which started earlier. The same Cie now enjoys a portfolio of patent families representing 43% of the worldwide count. The second in class hold about 15% of the "in kind" patent families; all US car manufacturers 8% and all Euro car manufacturers 7%.

"Cie T has become synonymous with hybrid cars: three out of four hybrid cars sold in the US are made by T. This is no accident. T set out in 1994 to develop hybrid cars and to protect their development with patent filings. T has now sold more than two million hybrid cars."; as Mike Lloyd and Justin Blows explain in GH newsletter.

Figure 7 may represent a behaviour corresponding to the above business approach.

Conclusion 3: start early! The sooner the better...

MAIN CONCLUSION

Our design of an equilibrist's accomplishment and the artistic interpretation performance therewith, depicted on Figure 13, should make the main conclusion brighter than a thousand words.
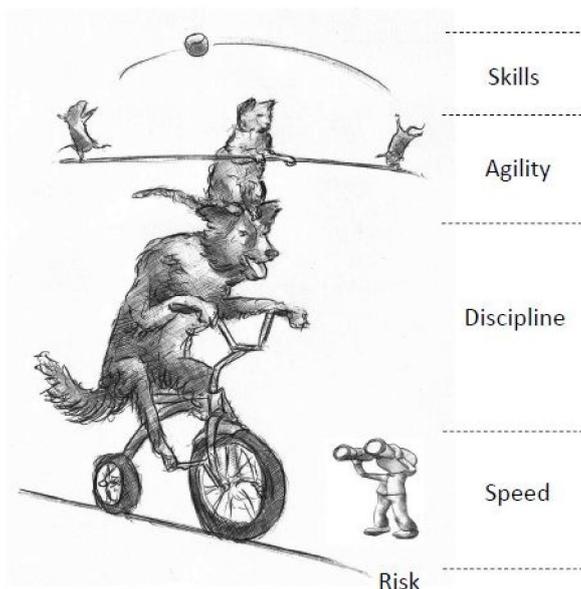
Fig. 13. A Matter of Balance

In a less pictorial fashion, the discipline of adopting a process, such as ATA and the ATA-4C^2© of the author, is essential to the integration of IP and NPL in the business model and roadmaps therewith. The key associated "search" phases are:

- Xpress inventory
- Unexploited assets
- Unexplored areas
- Ideal & dreamed approaches
- Perceived Limitations & Frustrations

Sequences, which involve 8 to 12 participants, 4 hour session repeated 4 times. With a convergence mind-set, this dynamic, involving sufficiently diverse* teams, has proven successful and rather reasonable with regard to dedicated time.

(*) meaning from various business units, of different ages, with different areas of expertise, of different seniority levels, with multiple experiences and from different cultural backgrounds...

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Modelling a Multi-car Elevator System using Witness

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ABSTRACT: Elevators are considered a necessity in buildings with multiple floors. In tall buildings there is a need for efficient control of the elevator system in order to obtain satisfactory service levels. To achieve an efficient elevator control strategy a variety of diverse and sometimes conflicting constraints has to be resolved. To investigate the effectiveness of a vertical transportation system, we have developed a simulation model to analyze the call strategy of a multi-car elevator system. In this paper the main steps in the methodology for modelling elevator performance and passenger traffic in a public building are explained. Elevator dynamics and control, call allocation and passenger traffic modelling are described resulting in a Witness model. Witness simulation software has been used as a test-bed for model building, simulation and experimentation. Three different strategies were devised and experimented on the model and the results were compared to find the best average waiting time. Results indicate that the average waiting time of passengers was slightly improved when using the shortest distance strategy. In addition to passenger waiting time it has been realised that elevator performance depends on the passenger traffic patterns and, during heavy traffic, service level is greatly affected by the call allocation algorithm. The research concludes with the need to carefully select the data set as the basis for simulation comparisons.

KEYWORDS: Multi-Car Elevator, Discrete Event Simulation, Witness. Passenger lifts, Elevator dispatcher.

1   INTRODUCTION

Quality of service is demanded everywhere in today's world requiring an efficient and well organised system. As the construction of tall buildings, flats, hospitals and offices are a priority in any modern city it is therefore important to have an efficient elevator system to cope with peak times [1]. Buildings often experience elevator congestion as a result of their heavy traffic, complex user types [2]. Long wait times for passengers at floor call-points are an inconvenience especially in tall public buildings [3].Ways to improve elevator efficiency in tall buildings has become a significant problem [4].

During peak time the wait for an elevator increases causing frustration and delay which also increases the queues in the hall calls [5]. An elevator dispatching system that considers peak time is essential to prevent long queues in hall calls and most importantly reduce the average waiting time [6]. Performing real life experiments is one approach that can be taken to test the system although it will cause huge disturbance, cost and time to apply different strategies often not very practical. However computational simulation method can be applied to mimic real life behaviour of the system taking into account of passenger's random arrival rate, loading and unloading times, number of cars and the total capacity of the car can all be obtained without incurring the risk of a disturbance [7].

Computational simulation model are used in various different industries mainly to help to study behaviour of a real life system and be able to experiment with system to alter the results [8]. The benefits of using simulation model are to reduce operating cost, reduce lead time, reduce risk and improve customer services. The only disadvantage using simulation is that it is not 100% accurate. Often simulations are used in flight simulators, business games due to their distinct advantages.

In this project the aim was to explore and compare different call strategies to reduce the average passenger waiting time at the North Elevators in the MMU business school building. The North Elevator comprises of 4 cars operating on 7 floors plus the ground floor with a capacity of 17 persons in each car.

On a normal working day the building experiences three peaks of elevator traffic. These are morning up peak, lunch period and evening down peak. Morning up peak is when the students and staff are coming into classes and offices from around 8:00am – 9:30am. Lunch time peak between 12:00pm – 2:00pm and evening peak between 3:00pm – 7:00pm where everyone is making the way home and uses the elevators to exit the building. Based on the data collected the lunch time traffic was the busiest time of the day where the elevators were used often in two way traffic.

WITNESS simulation software [9] was selected as a suitable tool to perform the model building, simulation and experimentation of the system under investigation primarily because of its ease of use and availability.

2 DATA COLLECTION

To guarantee the elevator simulation model is built as accurate as possible to a real life system, it is important to run an in-depth research and gather accurate data. The building of the model will be based on the research and the data collected.

There were 3 types of data collected; firstly data was collected through observation. Outside every car on each floor was a volunteer who stood and counted how many people who entered the car and how many passengers exited. These observations were made for thirty minutes during peak time. Secondly data and travelling preferences was based on the results of a questionnaire completed by participating passengers and thirdly a physical layout and specification of the elevator system was obtained from building services.

Before manually collecting the data it was important to know when peak time occurs during the day. By observation lunch time was the busiest time of the day. One method used to collect data was to observe the volume of passengers that used the elevators. This observation was made on each floor of the building and were conducted 15 minutes before the hour and 15 minutes after the hour for period of 30 minutes. Analysing the data obtained showed that the passengers were arriving at the ground floor call point with an inter-arrival time of 2 seconds (exponentially distributed).

A self-complete questionnaire was obtained from 50 passengers covering quantitative data. This method of gaining data was specifically chosen, as it was the most efficient way of gaining valuable information. The results were then observed, analysed and used to input the statistical data.

3 ELEVATOR DETAILS

Before building the simulation model, it was necessary to determine how and why the elevator operates in its present manner. According to the online research, elevators behave differently depending on the type of building they are built in. So for instance, elevators in a hotel will behave differently to elevators in an office building. Office building elevator will only operate for set period of the day whereas hotel elevators run 24 hours a day. The university building acts like an office building as they operate in the same manner throughout the day.

Elevator systems have strategic ways of operating during peak times and have different methods of detecting these peak times. Since the peak time occur randomly. The current elevator does not estimate peak time hours, as it has another way of detecting peak time. The North Elevator in the business school utilises weight sensors to detect peak time. These sensors are placed in the floor of each car to measure the total weight. If that weight exceeds a curtain value than it will alert other cars that it is busy on a specific floor.

Elevator information:

- Elevator in group: 4 cars
- Rated car load: 17 persons
- Rated speed: 1.75 m/s
- Door opening type: Centre
- Door width: 1100mm

- Door closing time: 2.7 s
- Door opening time: 1.2 s
- Transfer time: 2.0 s

4   MODELLING THE SYSTEM

To successfully build a dynamic model representing an elevator, some essential simulation elements need to be setup. Witness is equipped for this task as it uses a variety of elements to represent real world elements. These elements are described next.

Passengers (entity): This is the first step of the process when the passengers enter the building and they will either call for the car or join a queue if the car is already been called for. The passengers are pushed into an activity and grouped to be transported by the car.

Exit (Activity): Exit activity represents the passengers leaving the building and this occurs once the passengers are back down to the ground floor.

Qin & Qout (Queue): Qin simply shows the number of queues in each floor waiting for the elevator car to arrive however one entity (passenger) does not represent one passenger as they have been grouped. Qout out is not really a queue it just shows that the passengers have exited from the elevator car on to that floor.

Lift Car (Vehicle): There are four cars for the elevator system with each operating on its own track. The car spends at least 5.9 seconds on each floor and this is because it takes 1.2 seconds to open the door, 2 seconds for transfer time and 2.7 to close the door. Sometime the transfer time might increase based on the number of passengers entering and leaving the car. The car takes 5 seconds to travel between each floor.

Lift track (track): Lift track consists of eight floors and 35 tracks. In every 5th track is 1 floor so up to track 5 is first floor and track 10 is second floor. Each track takes one second for the cart to travel on which means in every 5 track it takes 5 seconds. The total height distance of the real life track is 26.6 metres from ground floor to the 7th floor and the height between each floor is 3.8 metres.

Floor & Stairs (Conveyor): The floor conveyor represents how long the passengers spend on a floor usually 55 minutes since they are in classes most of the time. The stairs conveyor allows passengers to use the stairs instead of the elevator on the way down. Actual decisions were based on observational data that was implemented as a varying percentage.

4.1   MODEL BUILDING

The operational sequence was passengers arrived at an elevator call point on any floor, waited for the car, entered the car and either travelled to an upper floor or travelled to the ground floor. At this stage it was deemed appropriate to only consider passengers entering or leaving the building. Inter-floor movements were not considered.

Based on observations it was realised that not all the passengers on the upper floors used the elevators to go back down therefore stairs were added to the model. Passenger from third, second, and first floor mostly used the stairs to get down whilst passengers on the fourth and above floors mostly used the elevator to get to the ground.

Once all cars were operating successfully conveyor elements were used to represent the time spent on the floor and also to represent stairs.

Table 1 shows the mapping of the Witness modelling elements into the developed multi-car elevator system.

Table 1. Mapping of witness elements

WITNESS Graphic Element	WITNESS Feature	Description
	Vehicle	Lift car
	Track	Lift track
	Activity	Which floor: dispatcher Building Exit
	Conveyor	Time on floor Stairs
	Queue	Queue waiting for lift and exiting the lift
	Variables	Displays information in number e.g. distance_travelled1: 200
	Function	Applying formulas
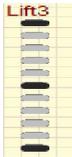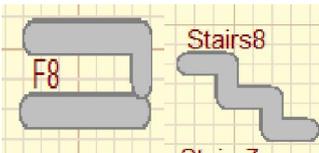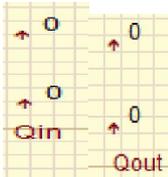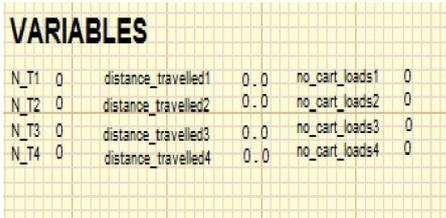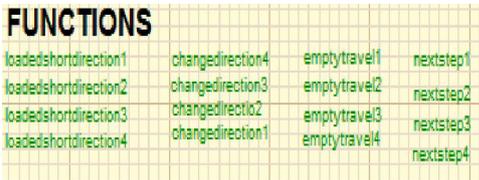
4.2   BASE MODEL

Building the base model was complex because of having to use four cars to work as a group and in many occasions they interfered with each other sometimes causing confusion. An overlying theme of the model building was to minimize the model size and usage of elements. The final model built is shown in figure 1.
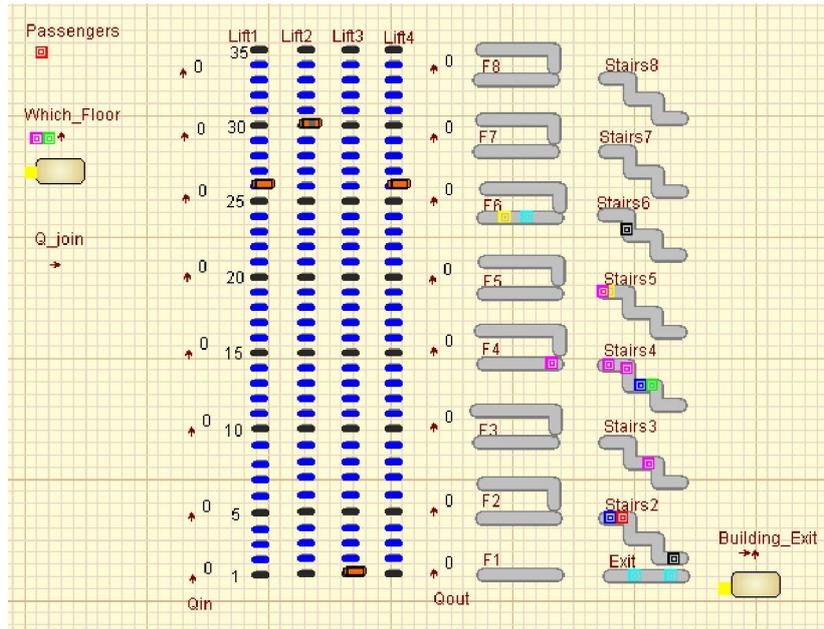
Fig. 1.   Base model of elevator

4.3   MODEL VALIDATION AND VERIFICATION

Verification and validation were separately performed on base model essentially to confirm the accuracy of the model. Verification was applied during model building to test the behaviour of each element as if it would be in the real world. Validation was performed by exploring the consistency and credibility of the model results.

5   SIMULATION SCENARIOS

The base model was simulated for one hour of peak time operations and the results obtained are shown in table 2. Two new strategies were devised and applied which were zone strategy and track position.

5.1   BASE MODEL

The base model represents the "as is" elevator system. The system detects peak time by using weighing sensors. This method uses a sensor which is installed in the surface of the vehicle of the elevator which calculates the total mass inside the lift and if it exceeds a certain value than it will know its peak time. Once a car experiences peak activity then it will communicate with the other three cars requesting that busy floor to become the loading floor for the other 3 cars.

5.2   ZONE STRATEGY

This type of strategy is mainly used in tall office buildings because usually the problem occurs when the car is going up it will stop at each floor and pick up passengers on the way. By the time the car reaches higher floors it will be full resulting in longer wait times for higher floor passengers. The zone strategy essentially splits the demand load and assigns two cars to operate between ground and floor 3. Whilst the remaining two cars will operate between floors 4 to 7 and the ground floor.

5.3   TRACK POSITION

This strategy uses a shortest distance to call point strategy which is simple and effective. The closest elevator car will respond to the call based if they are free which is normally how an elevator will operate during non-peak time.

6   SIMULATION RESULTS AND DISCUSSIONS

The aim was to reduce the average waiting time. The three models were run for one hour using identical passenger arrivals and the results were gathered and are as shown in table 2 for comparison.

Table 2.   Average waiting time at call point

Floors	Average Waiting Time (seconds)		
	Base model	Zone model	Track position
Qin(1)	7.63	9.31	3.81
Qin(2)	5.71	9.53	13.71
Qin(3)	7.54	5.41	3.81
Qin(4)	14.82	12.91	9.73
Qin(5)	13.41	51.31	8.72
Qin(6)	11.42	15.93	14.42
Qin(7)	7.83	82.80	14.67
Qin(8)	23.54	261.42	15.81
Total Average (sec)	**11.49**	**56.08**	**10.59**

Table 2 shows the average waiting time on each floor for all 3 strategies. The base model has a consistently distributed waiting time for all the floors and not a big difference between each floor apart from the 7th floor. The zone strategy highlights issues with excessively large queue waiting times especially on the 7th floor. Track position strategy waiting time shows really good times in the lower floors but also shows passengers in upper level floors will wait longer than passengers at the lower levels.

From table 2 track position strategy has the best average waiting time of 10.59 seconds and 11.49 seconds for the base model. However the zone strategy has an unacceptable average waiting time of 56.08 seconds. From the average waiting times in table 2, it is evident that the zone strategy appears not to be effective for the higher floors due to longer travel time incurred to service the higher floors.

Clearly the track position strategy would be advantageous for this data set

Table 3.   Usage of elevator cars

Elevator Car Free (%)			
Name	Base Model	Zone strategy	Track position
Car 1	32.42	45.75	50.6
Car 2	27.03	38.48	46.19
Car 3	22.05	35.54	38.7
Car 4	20.44	38.09	34.95
Average %	**25.49**	**39.47**	**42.62**

Table 3 indicates the usage percentage of each elevator car for the three scenarios over the course of the one hour's simulation. It can be seen in table 3 that base model appears to be most productive and the track position strategy as least productive. From these results it can be deduced that the track position strategy would have more spare capacity than the other two scenarios producing a better option.

Distance Travelled (m)			
Name	Base Model	Zone strategy	Track position
Car 1	3765	1729	2572
Car 2	2745	1322	2204
Car 3	2454	3563	2211
Car 4	1947	2521	2777
Average (m)	**2728**	**2284**	**2441**

From table 4 it can be seen that in the base model car 1 has covered the most distance which suggest that car 1 has the most work load and car 4 has the least work load. This means when the call is made it will always check if car 1 is free first then car 2, car 3 and then car 4 regardless which one was free first. The zone strategy shows that car 1 and 3 have covered the longer distance and same method is applied as base model but this time from ground floor to the 4th floor the dispatcher will always check for car 1 and then car 2. From 5th floor to 7th it looks at car 3 first and then car 4. Track position has a more evenly distributed work load as the distances covered are close to each other. Overall the zone strategy produces the lowest average distance travelled

Overall the track position strategy has produced the least (average) queue waiting time with minimum effort (maximum % free). Since the main aim of the project was to explore a reduction in queue waiting time then the track position strategy appears to be advantageous over the other two strategies.

7 CONCLUSION

The use of a visually interactive simulator has been shown to effectively and dynamically simulate the behaviour of a multi-car elevator system. The technique of representing people as a series of entities enables the use of high quality animation in the simulation which improves the display at the human/computer interface.

A simple multi-car control strategy has been developed and simulated using Witness software with reasonable success. Various variants of the simple baseline strategy were devised, developed and simulated producing interesting results. However it became evident that the data set obtained drives the model and affects the simulation results in a very serious way.

The main aim of this project was to explore elevator call strategies that would ultimately reduce the average waiting time experienced by passengers at floor call points. The investigation gathered observation data and also using questionnaires/interview. A base model representing the multi-car elevator system was built and the system simulated to represent operations during a peak hour of demand. The model was built satisfactorily; it was validated and verified to insure that it behaved realistically. The result obtained from the base model was verified with reasonable accuracy with observational data demonstrating confidence of the results.

Two varying strategies, Zone and Track position, were devised and implemented to test and compare against the original strategy. The most efficient strategy experimented with was the track position. This produced the least average queue waiting time which was the main aim of the project. However it is realised that these results are very dependent on the data set used and minor changes to the model can have a serious effect on the results. Clearly there are many avenues for investigation and potential improvements to the model. These will be explored in future work.

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Technical Communication of Automation Control System in Water Treatment Plant

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ABSTRACT: This paper presents technical communication of automation industry which describes the technical issues of automation control system in operation development, improving management level and high efficiency process in water treatment system. Today's water treatment plants are applied for water conservancy projects, emerged by the technology of automation control system is to ensure safe, continues, high quality water supply to municipal and for multi-purpose usage. Along with automation technology, computer technology, network communication development, advanced water treatment monitoring system is realized in Nantong pengyoa water purification plant. The Nantong pengyoa water purification plant has an important beneficial industry relationship to People's Republic of China improving living status and environment condition mainly expounds the water supply, to build well-off society, comparatively improving the labor production growth & level of implementation of targets as well as high water quality requirements. In this paper, it develops the task and tells the technical solutions of water treatment plant which has been centralized in fully automated operation in some developed industries since many years. And also append short description of its current practices such as networking, and real-time monitoring control, composition & structure, process flow and automatic process control which are performed in water treatment plants to achieve high efficiency in quality of productivity.

KEYWORDS: Automation Control, Water Treatment System, Computer Technology, Networking, Monitoring Control, Nantong Pengyao Water Purification Plant.

1 INTRODUCTION

The population of China is gradually growing fast since the world has been entered in 21st century [1]. At the same time, there is large demand of water is required in large magnitude, which has become one of the main contradictions of sustainable urban development. Urban water system is vital infrastructure and widely distributed in Chinese society [2]. At present with the automation technology, mode of utilizing PLC to carried out automatic control and upper computer to monitor and set the parameters is normally adopted in water/water waste Treatment system [3]. Typically, a PLC co-ordinates all functions of an outstation including monitoring and control and supervision the acquisition of measurement data, pre-processing and filtering network. Therefore it checks for function, status and limits, calculation of control action,

temporary data storage and receives and reporting from and to the central station [4]. Basing on Nantong Water Purification plant, this paper mainly introduces the structure and function of control system. An automation system, commonly referred to as a Process Control System or Supervisory Control and Data Acquisition (SCADA) System, is critical to the efficient operation, safe and reliable of so many industrial processes. Process Control System (PCS) is used widely in manufacturing operations and in various infrastructure subsidiaries [5]. Commonly process control needs sensors and analyzers for continues on-line implementation [6]. Many recent years the technology of water treatment system is localized by control automation system for multi-purpose usage. This paper describe the technical communication of automation control system including network and computer monitoring system of water treatment plant and also append short communication of networking, monitoring & control of process flow of Nantong pengyao water purification plant. Nantong pengyao water purification plant working behavior & control treatment system has placed as typical same as highlighted in this paper. Therefore, this paper intends the innovation research work associated with Nantong pengyao water purification plant and develops the task on technical communications of its composition & structure and process control of automation system.

2 OVER VIEW OF WATER TREATMENT PLANT

The water treatment system is mainly composed of water source intake system (water intake pumping station), feed water treatment system (water purification plant), water supply pipe network (including pipe network and booster pump station), drainage pipe network, wastewater treatment system (sewage treatment plant) and discharge and reuse system, etc.

A set of water treatment system is adapted with different process flow which depends on the quality of water sources; target purpose of water is industrial, commercial utilization and domestic usage. The selected flow basically includes three parts of treatment: pretreatment system, terminal processing system and micro processing system. The water treatment system basically is used to treat municipal and industrial waste water, clean water for beverage manufacture & food, water for city water supply, beer deistic fermentation and water for boiler, drainage system, high pure water for electronic &electrical industry or relative industry, water for large hospital service, injection and pharmaceutical industry, and propose river water desalination system. Polluted water needs to be dully treated to minimize its negative effects on public environment and unsuitable for drinking, recreation, agriculture and industry [7].

Fig. 1. *Water Treatment System for Multi purpose Uage Manufacturing by Guangzhou Tech-Long Packaging Machinery Co., Ltd, China.*

3 SYSTEMS OF WATER TREATMENT & CONTROL OBJECT

Almost few years back water/ waste water treatment plants have been commuted into control system since after automation system; commonly referred to as a Process Control System is introduced [1],[5]. The computer automation Control system of water treatment is applied to city water purification plant, sewage plant and other water conservancy projects. The system mainly includes network communication system, computer monitoring system and video image monitoring system of water purification plant (sewage plant).

The network communication system is used to transmit data of all subsystems. The computer monitoring system is in charge of data acquisition and real-time control & adjustment of all pumping houses, dosing and chlorination, filter, clean-water reservoir and other subsystems of the whole plant. The video image monitoring system is applied to realize the remote

image monitoring of all pumping houses, dosing rooms, filters and other key parts of the whole plant. The automatic control system of water treatment is used for the purpose of realizing the full-automatic control of water purification plant and sewage plant, achieving unattended operation and improving management level and efficiency. The city water-purification plant is mainly composed of water intake pumping room, dosing and chlorination, filter, clean-water reservoir, water supply (booster) pumping room and other subsystems. The control object of water plant automation system refers to the electromechanical devices in each subsystem.

4   COMPOSITION & STRUCTURE OF SYSTEM

With layered and distributed structure, the system is mainly composed of upper computer & local control unit (LCU) and Automation element. It can be longitudinally divided into master station of control layer (upper computer) and LCU.

1)   Upper computer system: mainly include host computer, operator workstation, data server, communication server, network communication and other functional nodes and is composed of software and hardware devices.

Hardware: IPC, server, workstation, network device and printer, etc.

Software: configuration software

Overseas: InTouch, iFix, WebAccess, Citect and Wincc, etc.

Domestic: Kingview, NC2000, EC2000 and H9000, etc

2) LCU: base of data acquisition and control of system; usually composed of PLC, touch screen and auxiliary devices.

Applied PLC mainly includes:

 Schneider: Quantum, Premium, M340 [8]

Siemens: S7-400, S7-300, S7-200 [9]

GE: 9070 (PAC RX7i), 9030 (PAC RX3i), VersaMax [10]

 AB: Controllogix, CompactLogix, FlexLogix, MicroLogix [11]

 NARI: MB80, MB40, MB20 [12]

3) Automation element

Mainly include: water/liquid level gauge, chlorine-leakage alarm detector and pressure sensor, etc.
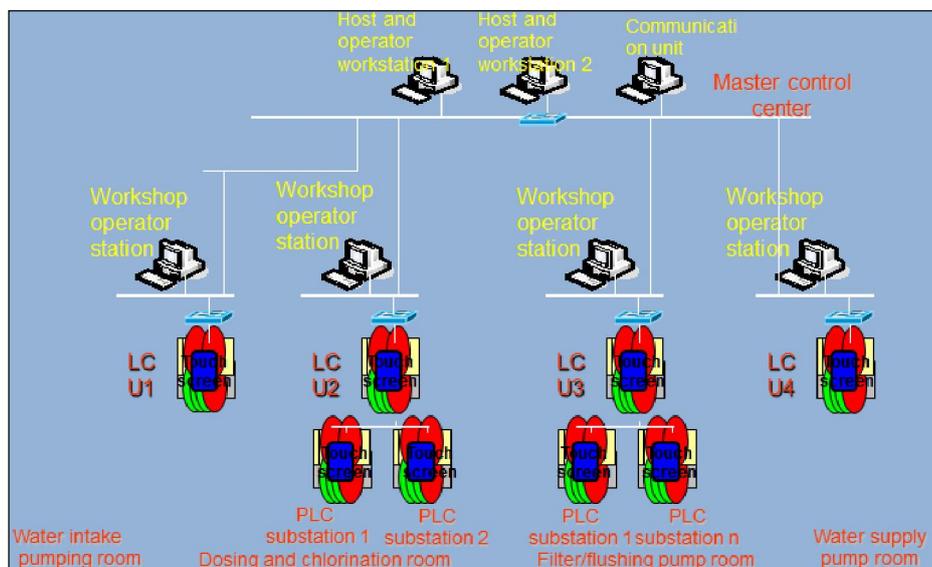
Fig. 2.   Composition & structure of system of water Treatment plant

5   WATER PURIFICATION PLANT : CURRENT PRACTICE

5.1   SYSTEM FUNCTION

- Realize data acquisition and processing of all systems and devices of whole station;

- Realize accident analysis and processing of whole station, such as safety operation monitoring, event alarm, trend analysis and SOE and so on.

- Realize the time synchronization of automatic control system and GPS.

- Realize the independent control and full-automatic control and regulation of all pump houses, dosing, chlorination, filters and other subsystems of whole plant.

- Realize statistics and recording of operation parameters and production management.

- Realize communication with other systems and superior dispatching.

- Realize self-diagnosis and redundancy switching of system.

- Realize WEB release and browse.

- Realize ON-CALL and other alarm functions

5.2   CONTROL MODE

a)   Remote automatic control

The master control center and workshop remotely switch on/off, shut down, and set objective or objective flow for devices of each subsystem through man-machine interface of computer.

b)   Local automatic control

The operator locally switches on/off, shut down or set objective flow for devices of each subsystem through man-machine interface (touch screen) on LCU.

c)   Local manual control

In case of emergency or maintenance, the operator locally switches on/off and shuts down water plant through button and handle on LCU.

d)   PLC automatic control

PLC automatically starts the control flow of each system according to acquired signal status to ensure the normal operation of system, which is the main functional operation mode of water plant.

5.3   SYSTEM FEATURE

Have complete network structure and support multiple networking modes, such as single computer with single network, single computer with dual network, dual computer with dual network and distributed IO and so on; Support real cross-platform and adopt full-open and distributed design; Have perfect PLC communication protocol with sorted storage of data, improving the correctness and reliability of communication; Have abundant external communication interface to meet the access of different intelligent devices of pump station; Have reliable sequence control flow, ensuring the safety and correctness of automatic control; Support SOE, which understands the action time and sequence of field devices, for convenience of accident analysis; Make full use of advanced automatic control technology and computer network and communication technology and adopt layered and distributed network structure;

Today, digital Programmable Logic Controller (PLC) is largely replaced analogue controllers [4]. PLC automatically starts the control flow of each system according to acquired signal status to ensure the normal operation of system, which is the main functional operation mode of water plant. Follow the principle "centralized management, distributed control and data sharing"; Have a dynamic and vivid man-machine interface and analog simulation of the physical environment; realize the full-automation control of all processes; realize the automatic statistics of device operation time and troubleshooting to help operation management.

Sewage Tank Process Monitoring   Process Flow of alum Addition system
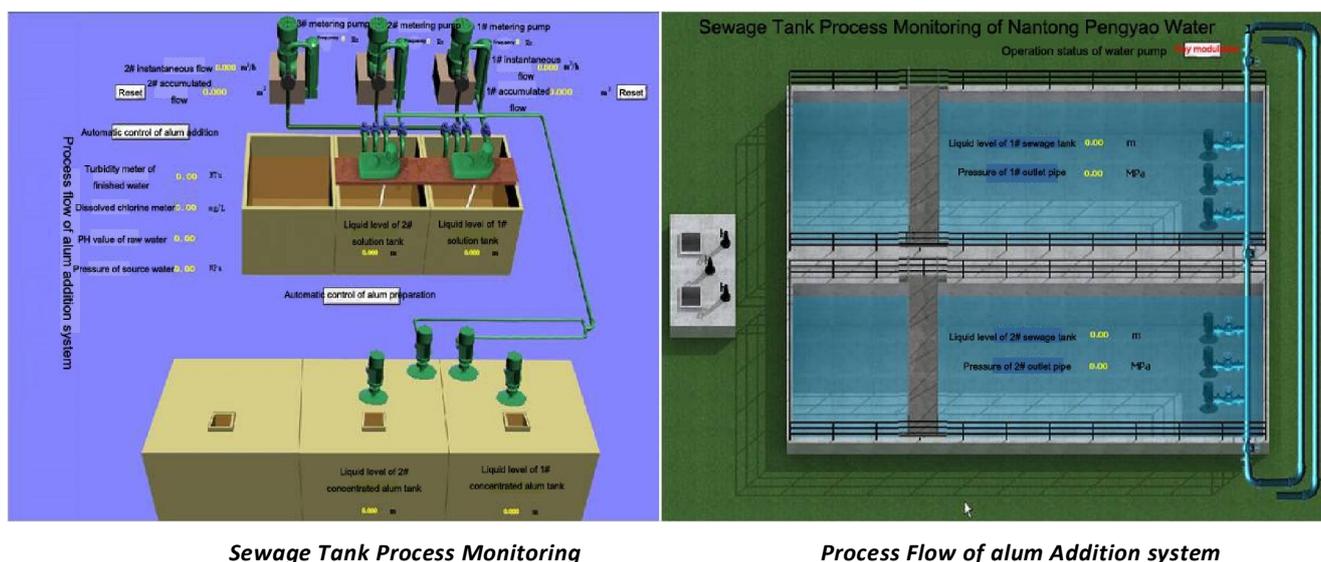
Fig. 3.   Nantong Penyao Water Purification Plant system featured monitoring by Nantong Penyao Water Supply Co., Ltd

6   KEY TECHNIQUE- AUTOMATIC PROCESS CONTROL

The main device of water intake pumping house is source pump with control principle as follows: ensure the operation of one source water pump and automatically start or stop the pump according to finished water flow and water level of clean-water reservoir.

a)   Control of dosing and chlorination

PLC sets and controls the operation frequency of frequency converter with flow proportional control ring according to detected turbidity and flow of source water and then carries out fine adjustment of converter operation frequency with composite control ring as per the detected water turbidity after reaction and sedimentation.

b)   Control of V-shaped filter

Automatic control of constant water level filtering: PLC ceaselessly adjusts the opening of discharge regulating valve according to detected water level of filter to keep stable water level in filter grating, to ensure that the filtering is carried out with constant water level.

c)   Control of filter automatic backwash: The filtering time reaches to setting filtering period; or water head loss of filter reaches to presetting value; or mandatory backwash order is received. It mainly includes three stages: air washing, air-water mixed washing and water washing.

d)   Control of water supply pump house

The main device of water intake pumping house is water pump with control principle as follow: at least ensure the operation of one water pump and automatically start or stop the pump according to factory water flow and discharge pressure.

7   TYPICAL PROJECT- NANTONG PENGYAO WATER PURIFICATION PLANT

In order to increase the efficiency and stable water quality, Water supply companies are gradually changing to an advance centralized, fully automated operation [13],[14].The increasing demand of water treatment plants to require more efficient use of water resources, both in urban and rural environment [15]. The Nantong Penyao project was aimed to develop the conceptual design of an effective and economically responsible water purification plant for the municipality of Nantong [16]. The project of Nantong Pengyao Water Purification Plant is located in the west area of Nantong regional water-supply planning. It water-supply scope includes Rugao, Hai'an and partial regions of Tongzhou. The project is composed of water intake works, water purification plant, water transmission main pipe and booster pump station with total design scale of 0.6 million m3/h. The production network for phase I automation control system of water purification plant is composed of centralized control center, local control center, PLC master station and PLC substation. The communication network between

centralized control center, local control center and PLC master station adopts Ethernet (TCP/IP protocol). The control network among master station and substation of filter are used DH485 network for communication. Meanwhile, connect all supervisory computers of water purification plant and each functional department together to form intranet, which then connects with production network through Ethernet switch.
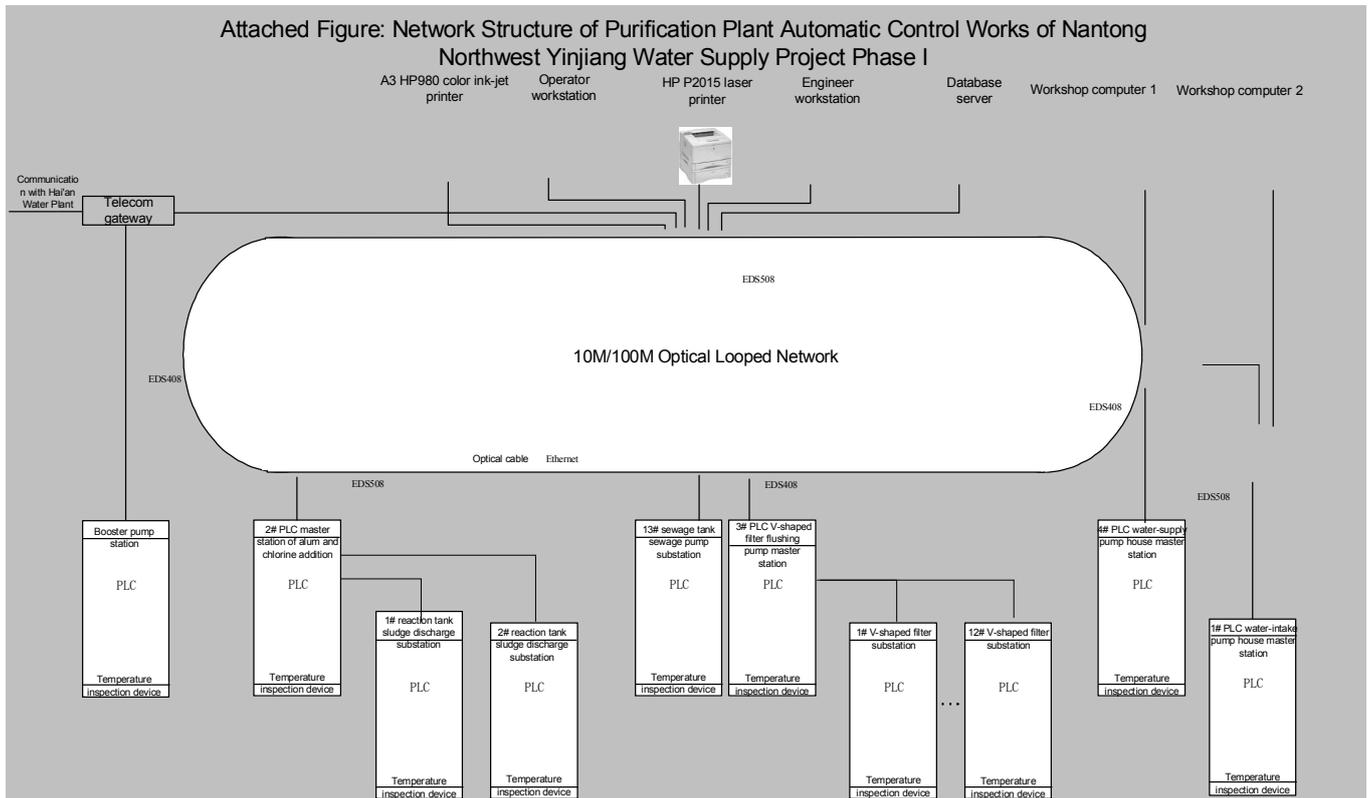
Fig. 4. *Network Structure of Purification Plant Automatic Control works of Nantong Northwest Yinjiang water supply Project Phase I*

The backbone of whole network is loop optical topological structure (10/100M self-adaptation) to realize data and resources sharing of all devices in same network. The signal transmission between water intake pumping station, booster pump station and water purification plant is realized through optical cable, to establish network connection on same logic, which carries out real-time transmission of control information and other data. The system is used to monitor the status and parameters of water intake pumping station, alum preparation, alum addition, chlorination, sludge disposal of sedimentation basin, V-shaped filter, sludge tank, second-order pump station and other devices and automatically control all processes. The main advantage of the project is the plant capability of being remotely controlled via a complex data communication network over the internet so it's easy control & maintain [17].
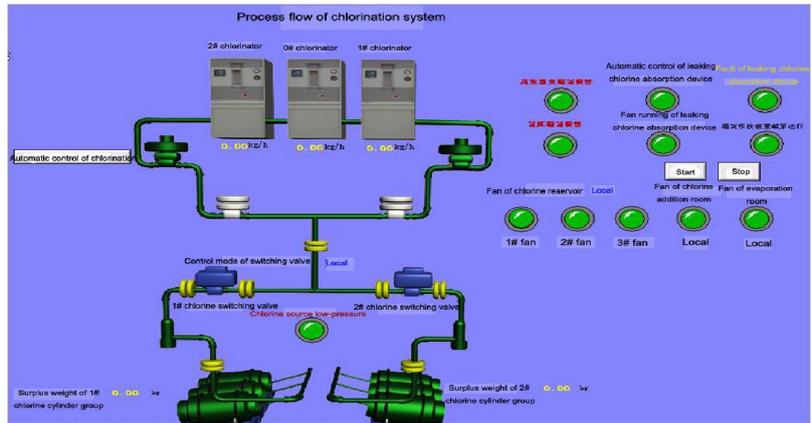
Fig. 5.   Process Flow of Chlorination System of Nantong Pengyao Water Purification Plant
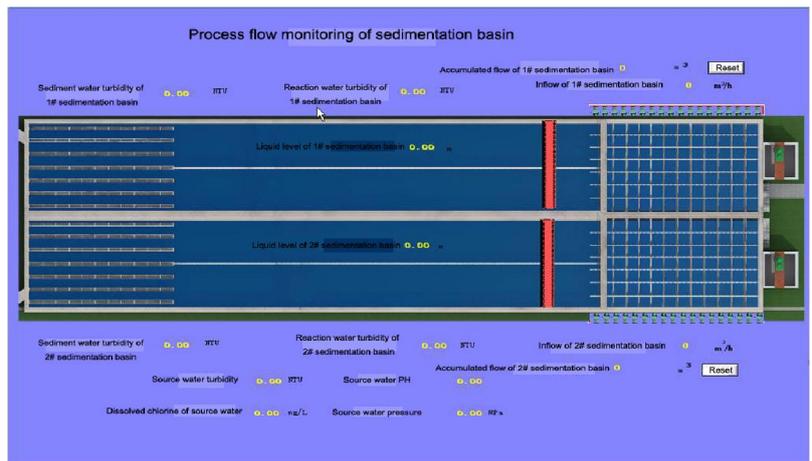
Fig. 6.   Process Flow Monitoring of Sedimentation of Nantong Pengyao Water Purification Plant
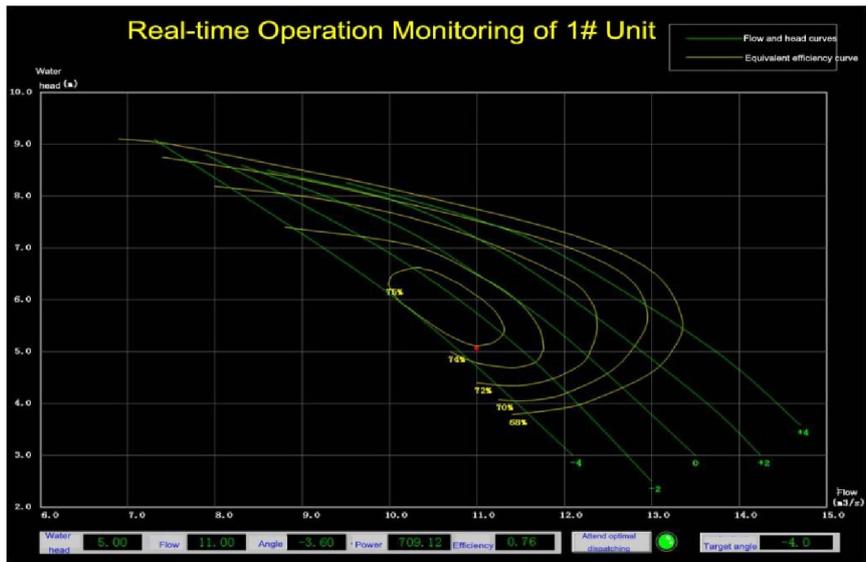
Fig. 7.   Performance Calculated of Real-Time operation Monitoring Phase-1

8 CONCLUSION

The increasing demand of automatic control system has taken up great achievements in polluted environment to resolve the issue for high quality of water supply, drinking, sewerage network (water waste treatment plants), drainage pipe network, discharge and reuse system. Therefore, Water resources are explored widely and research & development is implemented fast and secure in all over the world [18]. This study established on technical communication of automation system in water treatment plants. Technical levels of control system in water/water waste treatment are helped to improve their productivity, flexibility and reliability. The same work is done in this paper which introduces the technical work in approaches and benefits of the industries [19]-[20]. Nantong Pengyao Water Purification Plant as water supply planning project which produces the environmental, social and economic impacts as benefit to Rugao, Hai'an and partial regions of Tongzhou. Therefore this paper is also highlighted by the performance of production network and Process flow of Nantong Pengyao Water Purification Plant as a reference [21].

ACKNOWLEDGMENT

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E-commerce Propagation in The Middle East Economies: an Application of a Revised Technology Acceptance Model

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ABSTRACT: E-commerce is the technology of conducting commercial transactions via electronic media. The Internet has provided this media to the extent that commerce is being increasingly made through it. However, another side of commerce, which included the (heavy lifting) of physical goods are still traversing the distribution channels and employing the traditional transportation infrastructure with varying efficiency and cost. This paper examines the employment and adoption of this technology within the Middle East businesses, and what are the barriers that hinder this adoption. The famous Technology Acceptance Model, TAM is implemented with some variations to identify the difficulties associated with implementing e-business models through a survey of key stakeholders in this industry, namely procurement professional and logistics managers. One hundred forty five participants filled the survey questionnaire aimed at measuring their responses to perceived usefulness (PU), perceived ease of use (PEOU), attitudes towards usage (ATU) and behavioral intention to use (BIU) the e-business system The results shows that the main factors holding the propagation of e-commerce in these countries, and in spite of growing interests and belief in implementing e-commerce, are related to the inertia of the legacy operating systems, the lack of compatible infrastructure, the security of information, and the level of business ethics. A conceptual mathematical probability model is developed to estimate a new TAM as an MTAM where the acceptance is computed as an average probability of six interaction factors. Several conclusions were arrived at including the need for the development and installation of a legal framework for safeguarding against abuse and illegal schemes of defrauding consumers.

KEYWORDS: E-commerce, Technology Acceptance, logistics, distribution channel.

1 INTRODUCTION

The main difficulty in assuring success of introduction of any technological innovation is the ability to accept the technology and willingness to integrate it in the common day-to-day work. However, an implementation of new technology will bring with it challenges of understanding and difficulty of application. This is true if the application involves a number of people working in different entities. This issue of introducing a new technology has been researched extensively. It is estimated that more than Two thousand papers were published on this subject. Most of them are extensions of the technology Acceptance Model, TAM that was published by [1].

Essentially it is a set of questions about the ease of use and acceptance of different technologies. The questionnaires were validated through their use by different researchers and arriving at similar conclusions in a process called replications.

This research is attempting to examine the difficulty of accepting the e-commerce collection of technologies within the business community in the Middle East countries. The research question that is being investigated is that the difficulty arises from the elements of technology acceptance, namely the perceived usefulness and the perceived ease of use only or the existence of favourable infrastructure that supports the implementation? The e-commerce is assumed to be composed of two distinct categories the transactional information based, and the physical, that is the trade and movement of goods and services.

Background and Theoretical framework

It is important to define the main characteristics of the e-commerce and the purpose and functionality of any e-commerce application. The term e-commerce is a generic name to indicate that transaction is no longer executed using pencil and paper, but conducted through the electronic media.

The employment of Internet to this purpose is ever increasing globally and many businesses started to use it for the procurement process. It may include exhibiting the product or service, registering a request and customer information databases, to processing sales, to issuing picking orders, to the entire logistics of delivering the product to the customer door step. It may involve the reverse logistics, and after sale customer care. Thus e-commerce contains all the facets of information technology and all the factors related to acceptance of this technology as modeled by the TAM and its extensions.

As Internet usage keeps expanding, many businesses keeps acquiring internet based applications. In addition, they would bring in their own applications to promote their businesses. The home grown e-business applications are been challenged by specialized applications. This is true to the point that e-business applications are becoming standard and it is the least of concern when engaging in e-business. The research will show that the main concern of participants was on the existence of reliable infrastructure to support the logistics of material. In the Middle East countries, e-business is struggling against the inertia of an age old trade practices. The entire supply chain must accommodate the e-business schemes. This does not exist in few of the countries, like Iraq, Syria and Saudi Arabia. The gulf countries and judging from the responses enjoy a better status and does accommodate smoother material movement. However in the entire area the legal system does not provide cover against illegal or customer rights [2,3].

In spite of the fact that e-business applications may offer robustness and ease of control, the underlying design models could be limited and rigid in terms of how to manage the flow and appearance of content. The employment of a web-based forms and presentation of goods and services is heavily utilizing built in forms and established workflows to facilitate the transactions. The main part is two directional flows of material and funds. The banks play a major role in facilitating this movement, but the rigid government rules controlling the flow of money hinders the expansion of the e-business transactions.

One of the challenges is to determine if an established e-business infrastructure can offer a favorable environment for companies to make effective exchange of information and processing of transactions. [5] showed that journals, for example, and reports can improve the users' learning curves. The only limitation is the time limitation that forces the users to by-pass the details, which is the heart of the e-business. This is ironic but the application developers can circumvent this drawback by providing user friendly interfaces and makes the user experience more pleasant and intuitive.

The technology acceptance model (TAM), developed by [2], states that the success of a system can be determined by user acceptance of the system, measured by three factors: perceived usefulness (PU), perceived ease of use (PEOU), and attitudes towards usage (ATU) of the system [2]. If a system is not easy to use then it will probably not be perceived as useful. According to the model, a user's perceptions about the system's usefulness and ease of use result in a behavioral intention to use (or not to use) the system ([2], [4]). Thus, the objective of this study is to examine the relationship of users' behavioral intention to use (BIU) in the e-business system with selected factors of perceived usefulness (PU), perceived ease of use (PEOU), and attitude towards usage (ATU), and develop a general model of e-business acceptance.

Application of the TAM model would seem to be favorably indicated for understanding conceptual issues related to e-business use. Use of the TAM is predicated on individuals having control over whether or not they use the system [3]. The factors in the model, namely perceived usefulness(PU), perceived ease of use (PEOU), and attitudes towards usage (ATU), represent attributes or characteristics of the system, such as the overall design and features of the system, the user's skills and capabilities, and the user's beliefs and attitude towards the system ([2], [3],[4]). The behavioral intention to use (BIU) is an important factor that determines whether users will actually utilize the system. For example, [4] found a direct and significant influence ($\beta = 0.19$; $p < 0.001$) between behavioral intention and actual usage of the web-based environment in their study. Use of the TAM model for understanding users' perceptions of the e-business system and potential future use is therefore based on the following assumptions:

1. When users think that the e-commerce as one that is useful and easy to use, then they may have a favorable inclination in adopting the system.

2. When users think that the e-commerce system as one that is easy to use in view of the availability of infra-structure supporting the system, then they may have an inclination towards the usefulness of the system.

3. When users have a positive attitude towards the system, they may use the system frequently and intensively and may have a favorable intention towards using the system [5].

And add to this:

4. When users have a positive attitude towards the system, from the view of knowing that it is applicable and implementable by the infrastructure that takes its demands into a higher level of reality, then they may have a favorable intention towards it and may use the system frequently and intensively.

Many models have been developed in the past three decades to investigate variables ([1],[2]). The technology acceptance model (TAM) proposed by [2] is the classical information systems model developed to explain computer-usage behavior and factors associated with acceptance of technology. According to this theory, information system usage behavior is predominately explained by behavioral intention that is formed as a result of conscious decision-making processes. Behavioral intention, in turn, is determined by two belief factors, namely, perceived usefulness (PU) and perceived ease of use (PEOU). By manipulating these two factors, system developers can have better control over users' beliefs about the system, and subsequently, their behavioral intention and usage of the system. Ref [7] defined technology acceptance as "the demonstrable willingness within a user group to employ information technology (IT) for the tasks it was designed to support". The dominant themes in research focus mainly on instrumental influences, which investigate acceptance decisions involving beliefs as to how using technology will result in objective improvements in performance

Aizen et al. [1] argued that this approach may have had a limiting effect on technology research and broadened their research to include concepts related to non-instrumental influences on technology acceptance. The TAM suggests that perceived usefulness (PU) and perceived ease of use (PEOU) determine an individual's behavioral intention to use (BIU) a system. [6] suggested that many factors influence initial acceptance of technology, but fundamental determinants (e.g. perceived ease of use and perceived usefulness) play a greater role in continued acceptance.

Perceived usefulness (PU) is defined as "the degree to which a person believes that using a particular system would enhance his or her performance" [2]. Perceived ease of use (PEOU) refers to "the degree to which a person believes that using a particular system would be free of effort" [2]. TAM presumes that behavioral intention is a result of conscious decision making processes [6]. The model specifies three belief factors that are salient in the context of information technology usage and acceptance: perceived usefulness (PU), perceived ease of use (PEOU), and attitude towards usage (ATU) [1]. Perceived usefulness and perceived ease of use can be considered as cognitive factors. Attitude towards usage (ATU) refers to the "the degree to which an individual evaluates and associates the target system with his or her job" [2]. Attitude towards usage has been identified as a factor that guides future behavior or the cause of intention that ultimately leads to a particular behavior. However, none of the researchers touched on the availability of the infrastructure that support the use of the system especially when it is only a link between information processing and action that takes place in the field. Users would become cynical if a system cannot be propagated in a day to day usage if it is lacking the ability to execute decisions and orders,, in the field. This is exactly the case with the e-commerce. In TAM, attitude towards usage is referred to as the evaluative effect of positive or negative feeling of individuals in performing a particular behavior [1]. In order to ascertain that for the collected evidence from data must make sure that the questions are valid and predict the phenomenon we are trying to explore. A random sample of purchasing managers, employees and individuals involved in dealing with procurements were sent a questionnaire, there were about 45% response. The collection of data was achieved through a computerized system that allows the data to be compiled and listed. There were twelve presented questions asked that address the main points of the research inquiry.

Results of numerous researches [7]-[8] suggested that TAM is a solid theoretical model where its validity can extend to an e-commerce context.

It is empirically plausible that the larger the business entity, the more likely it would tend to adopt a new technology that provide a promise for better business, see Fig. 1.
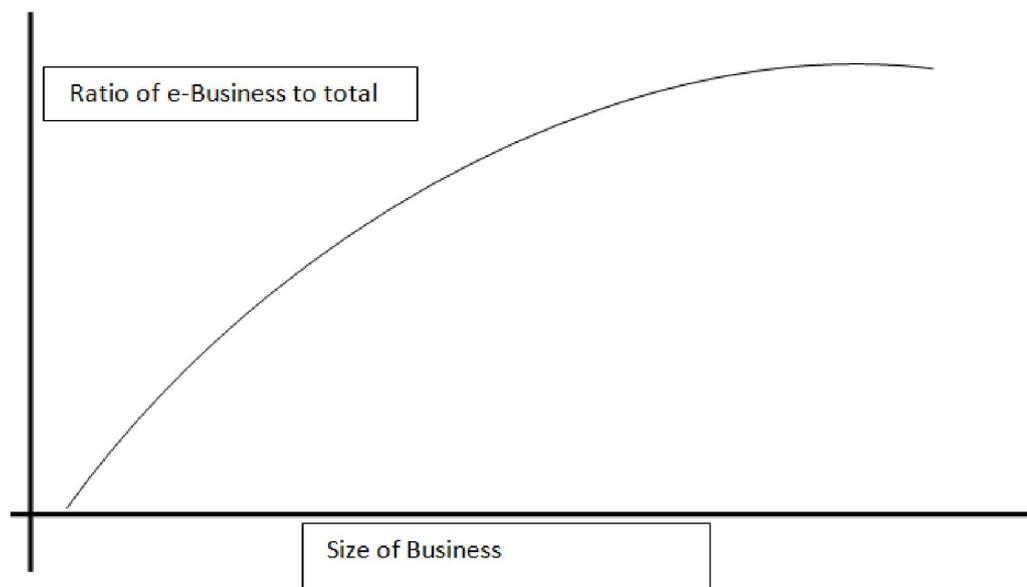
Fig. 1.   Relation of size of business and ration of e-business

The following research question seeks to examine users' usage of a system utilizing the technology acceptance model (TAM): what are individual user's perceptions of usefulness (PU), ease of use (PEOU) and attitude towards usage (ATU) of an e-business system that inform their behavioral intention to use (BIU) the system?

In order to understand how these factors support technology acceptance in the context of an e-business system. A thorough understanding of the TAM model may help us to analyze the reasons for resistance toward the technology and would further enable us to take efficient measures to improve user acceptance/usage of the technology. According to Davis (1989), practitioners evaluate systems for two purposes: 1) to predict acceptability; and 2) to diagnose the reasons resulting in lack of acceptance and to take proper measures to improve user acceptance. Overall, the technology acceptance model (TAM) has received empirical support for being robust in predicting technology adoption in various contexts and with a variety of technologies ([1],[2],[3],[4]). The relevance for this study is that an examination of users' usage of an e-business system could contribute to their acceptance of an emerging business technology that has been developed specifically to respond to current demands of the retail market.

In accordance with the research objective and consistent with the related literature, this study tested the following hypotheses:

H1: Perceived usefulness (PU) will have a significant influence on attitude towards usage (ATU).

H2: Perceived ease of use (PEOU) will have a significant influence on attitude towards usage (ATU).

H3: Perceived ease of use (PEOU) will have a significant influence on perceived usefulness (PU).

H4: Attitude towards usage (ATU) will have a significant influence on users' behavioral intention to use (BIU) the e-business system.

H5: Perceived level of infrastructure (PLI) will have an effect on usefulness.

These hypotheses give rise to the research model (Figure 1) represented as a causal relationship schema and used as a point of departure for this research. The boxes represent the constructs which were measured by a set of items, with arrows representing hypotheses 1 to 5.
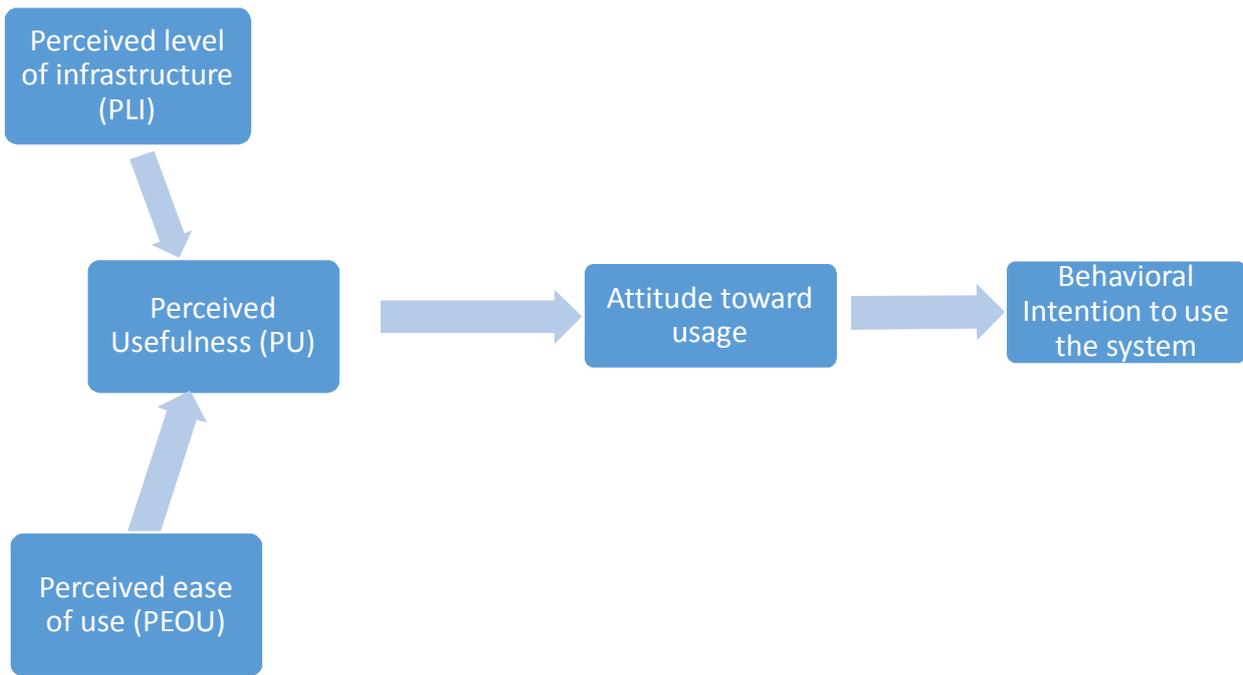
Fig. 2.   Modified Conceptual research model

2   A NON-LINEAR INTERACTIVE MODEL

Let us assume that three important elements determine the acceptance of the e-business model in the marketplace, namely, the Business user, the e-commerce system developer, and the transportation infrastructure usability. There are six interactions or interfaces. These are:

1. The Business feedback
2. The business usage
3. The developed system usability
4. The developed system mapping
5. The infrastructure network
6. The infrastructure data

Let us define the following variables:

1. $P(BF)$ as the probability of the business user feedback, or the likelihood of a system user provides a feedback of the performance of the system to the developer.
2. $P(BU)$ as the probability of a favorable perception of the business user of the infrastructure expressed as the perception of the adequacy of the infrastructure to the success of the e-business practice.
3. $P(SU)$ as the likelihood of a favorable system usability measured as the number of system versions over the number of complaints received.
4. $P(IM)$ as the percentage of the infrastructure mapping within the developed system as perceived by the system developer.
5. $P(IN)$ as the percentage of the infrastructure network covering the business needs as perceived but e users.
6. $P(ID)$ as the level of the data provided by the infrastructure to the system's developer .

Let us define the e-business acceptance indicator, MTAM as follows:

$$MTAM= \{P(BF)*P(SU)+P(BU)*P(IN)+P(ID)*P(IM\}/3$$

Figure 3 explains these relationships. The MTAM ranges from 0 to 1, where 0 indicate total failure while 1 indicate total success probability.
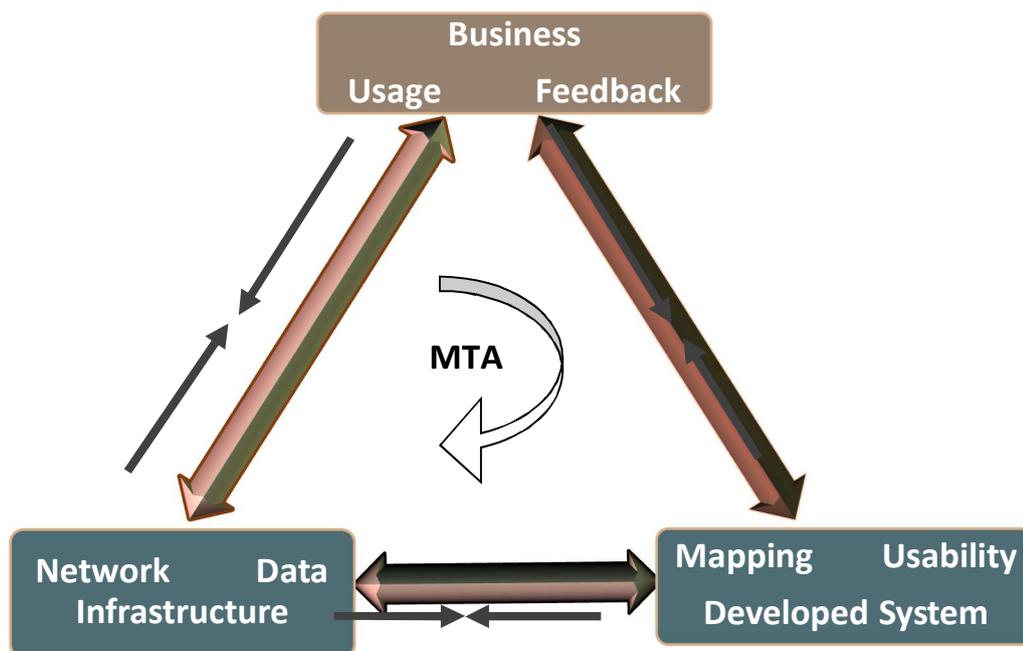
Fig. 3.   The conceptual MTAM

3   CONCLUSION

This research is a step toward understanding the reasons behind the sluggishness of adopting the e-business technology in the Middle Eastern economies. There was some significant to the hypothesis that the perceived level of infrastructure has an effect on the perceived usefulness. This will give rise to the assumption that e-business might not move forward unless there is a mature logistics systems in place. Further research is needed to explore the infrastructure deterioration influence in the implementation of e-business. The MTAM conceptual model can become a powerful indicator of the probability of success of an e-business model in any country or community. Further research is needed to validate this model and standardize its precepts.

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Innovative Law Old Services: Application and Limitations in the Application of Restorative Justice in Italy: Description and Analysis of a Case Study

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ABSTRACT: This study aims to present how restorative justice is applied in the context of the Italian legislature through a case study. In particular, the relationship between a judge of the Juvenile Court, the local Social Services and the drug addiction service is presented. After a brief presentation of the history of Italian juvenile justice and a comment on the current model of juvenile justice, a number of critical issues, organisational and technical, will be analysed. From this, the need to renew some local services will emerge, in relation to the cultural and judicial approach to minor offenders.

KEYWORDS: Restorative Justice, Juvenile Justice, Diversion, Probation, Addiction.

1 INTRODUCTION

In many states today juvenile offenders are tried by tribunals for adults as there is no legislation specifically aimed at minors [1][2]. This means that detention is imposed on many children without any rehabilitative purpose [3]. Lawyers and scholars, both of whom deal with prison, agree that the punitive approach is insufficient in tackling crime and its recurrence [4][5]. From many quarters, not least the various recommendations of the United Nations [6][7][8][9], there is a clear need to change direction and to research and develop diversion programmes [10][11]. This means that detention is just a last resort, as indicated by the International Convention on the Rights of the Child approved by General Assembly of the United Nations 20 November 1989 art. 37. The alternative to detention programmes today are based on the model of restorative justice [12][13], implemented in Italy through the DRP.488/88 and considered a flagship of Italian legislation [14]. As will be shown later, a practical application is not always as good as the law. In fact, not all local services are built on the basis of the innovative nature of the law, making the law itself less effective in relation to its premise. Although the DPR. 488/88 is an excellent example of restorative justice; it is the product of a decade long legislative process, whose starting point was not recognised as such. For this reason we felt it useful to describe in a short paragraph the history of juvenile justice in Italy.

2 HISTORY OF JUVENILE JUSTICE IN ITALY

The juvenile justice system in Italy began in 1934 (20/07/1934 RD. n.1404), the year in which the Juvenile Court, a specialised body whose membership consists of two worthy 'social assistants' (art. 2), was established. The juvenile court dealt with not only criminal cases, but also the civil and administrative divisions that still exist today [15][16]. The R.D. n. 1404 entrusts institutions with the task of observing and accommodating children, assessing the personality and indicating the measures and the rehabilitative treatment best suited in order to reintegrate the child into society (Article 8). These institutions were: re-educational houses, juvenile boarding-houses (working community), medical-psycho-pedagogic cabinets (counselling structure), observation institutes, prison-schools, reformatories and the social services. However, these institutions were more like prisons and the ultimate task of these institutions was not to re-educate, but to protect the community from young offenders [17][15][16]. According to this decree, the intervention of reintegration of the child continued even in the case of release on parole, by the placing of the subject, if under 21 years, into a reformatory or if greater than this age, into a penal settlement (farm-settlement) or a working-house (working communities) [17][16].

However, the task of these institutes was, rather than to re-educate, to protect society from young offenders [18]. The amount of time they will spend in these structures will be equal to the penalty that the person still has to serve (Art 21).

Moreover, Articles 23 and 24 bestow upon the Court absolute control over the child and the supervisory structures to which he or she is committed [16].

If the juvenile is proved to be, after repeated discussions with the court, completely reformed and worthy to participate in any social activity, he can be declared rehabilitated [19]. In the case of the juvenile's misconduct or being a victim of sexual offences, as provided for by Article 25 and 25 Bis, the court may take the necessary measures for their recovery and reintegration into society, through the custody of the child to social services or its placement in a rehabilitation community. In the treatment of juvenile misconduct, the costs of care are the parents' responsibility, if their assets permit.

The last articles of the decree govern the relationship between the child, the parents, the rehabilitation facilities in which the subject is inserted and society, and how to reintegrate the rehabilitated young person into society; as well as modifications, changes and the end of educational measures taken.

"In 1948 came into force the Constitution of the Italian Republic, which contains articles about family and children" [15].

Several articles have remarkable importance: Article 2, which guarantees the fundamental human rights [20]; Article 10, in which the legal system is automatically adapted to recognise the rules of international law; Article 30, where the rights and duties of parents and the parental measures in the event of incapacity are described; Article 31, which provides economic measures of various kinds to facilitate family life as the best way to avoid juvenile crime[18][20]; Article 32, which states that the Italian Republic must safeguard health as a fundamental individual right and interest of the entire society and finally, Article 34, which provides compulsory education open to all.

The enforcement of the Constitution symbolised the passage from the fascist regime to democracy. Rehabilitation was favoured as an ideology, and so programmes and institutions of care and rehabilitation were implemented, and a new professional role of social worker was established.

This was achieved by law n. 888 of 25/07/56.

In 1956, the law n.888 introduced new re-education institutions, including social services and educational measures, such as the new 'reliance on social services'. Furthermore, the law ordered that a child pending trial could not be kept in prison, but at an observation institute [15][16].

This led to the creation of a large variety of facilities giving the opportunity to use the diversion in a better way and give to youngsters what they need [16].

The re-education of juveniles structured in this way did not give the desired results. The idea began to prevail that only prevention would work and thus the Law n.431 of 05/06/67 was created, which put in place a fundamental work of prevention: the special adoption of abandoned children in institutions [15]. This action was created to remove the children from institutions and to promote their growth by giving them a family [17].

Between the 1970s and 1980s a fundamental legislative decree in the history of juvenile justice was implemented: the DPR n. 616 of 1977. With this decree, the administrative measures were moved under the control of the municipalities, which proved to be totally unprepared and unable to fulfill a re-educational function.

In 1983 Law 184 of 04/05/1983 led to the regulation of family custody as a way to protect the child but claiming, at the same time, the child's right to live with his /her family.

The real breakthrough in the field of juvenile justice occurred in 1988 with the enforcement of the new Code of Criminal Procedure for the child DPR 448 of 22/09/88 [16][15].

3   THE NEW ITALIAN JUVENILE CODE OF CRIMINAL PROCEDURE: DECREE 488/88

Starting from several international references, in 1998 Italy decreed a new Juvenile Code of Criminal Procedure (d.P.R. 22/9/88 n. 448). The ultimate aim was to avoid jail time for young people. In particular, there have been significant references to: a) no interruption to the ties with the institution of the territory in which the offender is placed; b) to direct, participatory involvement of the child and the family; c) to define a penal intervention commensurate with the developmental needs of the children involved and d) to foster new forms of alternative interventions to detention, creating the conditions for reparation of the act committed, for example through the institution of probation, diversion etc.

A. The non -interruption of the ties with the territory is mediated by Articles 6, 19, 20, 21, 22, 2. Article 6 states that "at every stage and level of the proceedings the court uses the services set up by the local authorities", which has the function of mediating between the procedural requirements and the educational needs of the child. In articles 19-23 the need "not to interrupt the educational processes in place" is expressed by defining various protective measures in the unique interest of the child. For example, in art. 20 (prescriptions) and art. 21 (stay at home) there are a series of measures that intervene with the child, without distancing him from his family, and have the aim of the child being the family's responsibility. The first states that "the court, after hearing the operator of parental authority, may give the minor specific provisions concerning the activities of study or work or other activities useful to his education"; while in the second, the judge requires the minor to "stay at the family home or other private residence". In paragraph 2 of art. 21 the opportunity is given to the judge to "allow the minor to move away from the residence in relation to the requirements of the activities of study or work or other activities useful for his education."

B. The involvement of the minors and their families is provided for by articles 1, 2 and 12 of d.P.R. 448/88. Paragraph 2 of art. 1 states "the judge specifies to the accused the meaning of the court activities that take place in his presence and the content and the ethical and social reasons of the decisions." Art. 2 describes the roles that the minor may encounter on its path: "a. the Public Prosecutor at the Juvenile Court, b. the judge for preliminary investigations at the Juvenile Court, c. the Juvenile Court, d. the Attorney General at the Court of Appeal, e. the section of the court of appeal for minors, and f. the supervising judge for minors." Section 12 argues that "the emotional and psychological assistance to the accused minor is ensured at every stage and level of the proceedings, by the presence of parents or other suitable persons." Therefore, this covers not only the technical help from the defence attorney to draw up an adequate defence plan (pursuant to article 11, based on the provisions of article 97 of the code of Criminal Procedure), but also that of the parent and services.

C. The correspondence between penal action and the needs of minors is defined by articles 5, 9, 30 of the Presidential Decree 448/88. Art. 5 provides for the establishment of specialised sections of the judicial police for minors, where the staff must be "endowed with specific skills and competencies", designed to capture the peculiarity of the specific situation. Section 9 states that "the public prosecutor and the judge acquire elements about the conditions and personal, family, social and environmental resources of the minor in order to ascertain whether he is imputable and the degree of responsibility, evaluate the social meaning of the facts and also take the appropriate criminal measures and adopt any possible civil actions." The conditions of minors are therefore put in the foreground, compared with the criminal act of which they are accused. In addition, section 30 identifies alternative sanctions to imprisonment, even after the judgment, and "taking into account the personality and needs of work or study of the child and its family social and environmental conditions"(section 30).

D. The new forms of alternatives to detention are outlined in article 27, which states that the judgment of non-suit may be given for irrelevance of the fact. This article is an opportunity for the re-education of the child in the preliminary investigation stage, since it provides a comparison at a hearing between the judge, the parental authority, and the offended party. The judgment of non-suit can be given on the basis of the "tenuous nature of the offence and the occasional behaviour" and also in the event that "the further course of the proceedings affect the educational needs of the child." Thus, the emphasis is on the conditions of the child investigated, rather than on predetermined and objective criteria.

Article 28 of Presidential Decree 22/09/88 n. 448 provides for the possibility of suspension of the process and for probation of the minor, "the judge, after hearing the parties, may issue a ruling suspending the process when it feels the need to assess the personality of the minor to the outcome of the trial." In the case of success, the consequence is the declaration of extinction of the crime as an alternative to the criminal penalty. According to the requirements of Article 29 "after a period of suspension, the judge sets a new hearing in which he states with a judgment the offence is extinguished if, taking into account the behaviour of the minor and personality assessment, he believes that the test has given a positive result. " This institution, with a primarily rehabilitative and restorative function, should improve the life of minor and give greater accountability to the young. Prevailing on the punitive aspect is therefore the function of re-education. This is in line with the instructions contained in art. 27 of the Italian Constitution which states that the penalties "must aim at the rehabilitation of the offender." With regard to probation "object of the process is no longer a criminal act, but the person"; thus, education fully enters into the programme. It is also the only tool available to make sure that there is a direct confrontation between the minor offender and the victim, to ensure that there is mediation between the opposing parties.

4   RESTORATIVE JUSTICE

Many of the articles previously presented are a first systematic attempt in Italy to access the restorative justice model. It is a legal system that differs from the punitive paradigm, which continues to be valid for adult legislation, as well as the

reference point for many states in the world [21]. This approach bases its activities on the penalty of the subject offender [22][23] and as an elective strategy, the detention in prison. Given the current critical situation of prisons in Italy, and in many places of the world, and the inefficiency of the punitive system in terms of education, a different legal approach was born, which is opposed to the punitive system, the model of restorative justice. It is a model that involves all the parties involved in the crime in an attempt to conciliate the implications and requirements of the same, especially taking care of the relationship between offender and victim [24][25]. In a reparative system the focus is on the consequences of the offence and the problems created by the crime to the victim. Indeed, the restorative approach considers the crime as a conflict that causes the breakdown of social expectations symbolically shared. The strategy is therefore to create conditions so that the offence can be repaired [26], and the offender placed in a position to take responsibility towards the victim and the community [27]. Interventions such as conciliation or mediation are therefore elective to implement the idea of the repair. However, it is not a simple technique for the treatment of conflicts, but a device that can produce new socialisation, to regenerate new bonds between people and to develop skills in dealing with difficult situations or criminal law. The setting of the restorative model can then be placed in the "de-legalisation " of the conflict [28], which shifts the focus from conflict resolution to the expert management of the same, with the involvement of all institutions and parties in accordance with their available resources.

5 DATA ON OFFENSES COMMITTED BY JUVENILES IN ITALY (2000-2008)

The Department of Juvenile Justice has created a report that allows us to get a better idea, on the national presence of juvenile delinquency through statistical data. The Department of Juvenile Justice has created a report that allows us to get a better idea, on the presence of juvenile delinquency on a national basis through statistical data.

From the document, juveniles reported to the courts between 2000 and 2007 are mostly male (the presence oscillates in the several years between 82% and 84%), females have a variation, across different years, between 16-18%. These guys are aged between 14 and 17 years for the 82-84% while the presence of children under 14 years has a range from 15% to a maximum of 18%.

As for the differences according to nationality, if in 2000 the percentage of Italian juveniles reported is higher that foreigners (77% VS 23%) with the approach of 2007, the number of foreign children went slightly growing (73% Italians vs 27% foreigners), probably due to increased immigration and the parallel lack of policy-making.

Focusing on the latest data, in 2007, according to statistics ISTAT juveniles reported were for 83% males, while for the remaining 17% females. In the same year age groups of children reported were threefold: to 57% were children between 16-17 years, to 30% between 15 and 14 years, while 17% were aged less than 17 years.

Specifically, regard to the age group 14-17 years, males are still more numerous with 85% while females settle to 15% ; in the group of children aged less than 14 years, males decreased to 75% while females appeared to be more present with a 25%.

In 2007, the percentage of Italians is 73% while foreigners are reported to a 27%, for a total of young Italians and foreigners reported to prosecutors in 2007 alone, amounted to 38,193 units.

About the percentage of foreigners reported in 2007, the 70.02 % of these children most come from European countries (Italy excluded), the 19.05% from Africa and the 6.63% from America, 3.86% from ' Asia, for a total of 10,390 guys.

With regard to the nature of their offenses for the 53% it comes to heritage crimes, to 26.2% against the person, for the 12.8% offenses against the safety, the economy and the public faith; to 4.8% against the state and other institutions of public policy, for the 2.2% for other offenses, to 0.5% for offenses against the family, morality and decency.

The data on the use of juvenile justice services refer to the year 2008.

In 2008, the children who lived in juvenile prisons were to 90% male and 10% female.

The age group most represented were between 16 and 17 years for the 52%, to 33% are 18 years old or more (young adults), whereas 15% have between 14 and 15 years.

Based on the type of legal position we can observe how children waiting for the first judgment and residing in juvenile detention are 53%; quelli con giudizio definitivo 21%; appellants 16%; the applicants 5% , and those with position legal mixed and judgment 3%, and finally those with mixed legal position and without judgment to a 2%.

If we look at the data provided by the Department of Juvenile Justice on the legal position and nationality of children in penal institution in 2008, we can observe how in 2008 italians in custody were 66%, while who are serving a sentence are the 34%; in the same year foreigners in custody are 72%,while who are serving a sentence are the 28%.For a total of juveniles who are in custody to 69% and youngsters who are serving a sentence to 31%.

In 2008, on 741 crimes, the most commited crimes (taking into account that there may be more accusations for the same guy) in order of major frequency are: 375 crimes against property; Other Offences 215 units (such as breach of the laws on drugs, illegal possession of weapons, violence, outrage and resistance to PU, weapons law violations ... etc..) Offences against the person 151 units.

The subjects reported to social services in 2008, are still, with a clear majority, male users, and for 86% of female users in 14%.

The subjects entrusted to social services are 10% girls and 90% boys.

The percentage of foreign is 38% while the Italians are 68% for a total of 3552 boys. Of all these guys, 9% are girls compared to 91% of boys; most are aged between 16 and 17 years (66%), 18% between 14-15 years, and 15% have 18 years or more, only 1% are younger than 14 years.

In conclusion we can see that the type of people who commit serious crimes, statistically, are Males aged around 16-17 years, and that the crimes are mostly related to damage to property but also the fact that there is a broad use as a measure precautionary to penal institutions, which, however, does not follow an equally easy to give a fair judgment in a short time, as evidenced by the percentage of children living in institutions and still awaiting judgment.

6   FROM "PUTTING TO THE TRIAL" TO "PUT IN THE PILLORY": AS A DRUG SERVICE COUNTERACTS THE RESTORATIVE JUSTICE APPROACH

Description of the case study

This situation concerns the application of the legal arrangement of the "pre-trial probation" ordered by the Court of Milan within the normative framework of DPR 448/88, valid in juvenile legislation. It is applied to a minor under 16, under investigation for drug dealing.

The "probation" is a tool issued by the judge for the purpose of enabling the offender, within a specific time, to demonstrate the randomness of the crime. The same court will make its assessment on the basis of reports that are periodically sent by social services, in this case composed of a social worker and a psychologist. If there are no relapses and the reports sent to the judge are positive, the minor is taken "out" from the circuit court, as reference standards.

In the situation shown here, the judge ordered a toxicological control (urine) for the entire period of probation, about 9 months. The social worker, assisted by a social educator, followed the minor for the period of probation and organised a series of meetings with the person involved. In order to follow the orders of the judge, a SerT (Service of Drug Addiction) in Lombard (North Italy) were contacted, with the objective of initiating the collaboration between the services and the subject. The initial agreement was that the minor accesses the service for periodic testing of urine as directed by the Court. The SerT determined that the control takes place once a week and, as a condition, they were to be contacted directly by the minor. After a preparatory meeting with the social worker, the minor autonomously made contact with the person in charge at SerT and went there the first time, accompanied by his mother (October 2010).

The minor had an interview with A. S. of SerT., who asked him to provide a description of his personal and family history (anamneses). He then talked with the referring physician, who repeatedly stressed the diseased condition of the minor, and informed him that he had to access the SerT once a week for the urine tests. He also explained that the minor would have a further interview with the service psychologist and that the mother was required to attend a support group for family members of drug addicts at the same SerT. In the same interview the boy said he did not feel sick and that he did not have any disease. The manager replied that "everyone says so in the beginning, they do not really realize that you have a disease, and that the doctor is one and that he should be treated". Following the interview, the boy turned to the educator telling her that he does not feel sick, is not a "toxic" and he does not want to go to the SerT. He also asked if she believes that he is ill. This study has omitted the intervention made by the educator and the strategies used to bring the attention of the boy on the restorative project, as irrelevant to the purpose of this contribution. A month later, the educator and the social worker held a meeting with the Head of SerT to clarify the objectives of the path taken by the minor, share the possibilities of collaboration, and explain the activities already undertaken by the boy (relationship with the teacher, external path of psychological counselling, socially useful activity). During the meeting (attended by the minor, the mother and the educator),

the doctor in charge reiterates the diseased condition of the child and the importance of a permanent verification; stressing the need for the minor, despite just coming of age, to be constantly accompanied by his mother during the weekly urine checks.

The service is attended by people who are addicted to drugs for many years. The access hours at SerT are a fixed day of the week at 7:30 am. Despite the difficulties of the minor relating to school attendance and being accompanied by the mother, who works shifts, it does not provide other possibilities for easy entry. The minor began weekly access to the service, in the morning before going to school and was always accompanied by his mother (who regularly logged on to work an hour late). The access time at SerT meant that the minor arrived at school about 40 minutes late and had to justify to the headmaster, teachers and students the reason for the delay. Later, during one of the required inspections, he was asked to meet with the psychologist of the SerT (as a practice of service) and to undergo psychological testing. The minor met the psychologist who asked him to do a historical overview of himself and his family (anamneses) and administered some tests. In the form completed by the psychologist the minor is defined as a consumer of cocaine. The same subject argued that this is not true, that he is not a consumer and that the offence was smuggling of hashish. The psychologist said that this is the practice, and he must write something. The minor turned to the educator, asking if the fact that he had sold hashish means that he is a cocaine addict.

One morning, during the usual access to SerT for the urine test, the mother of the minor did not physically enter the service with him, but waited for him outside in the car. As a result, the minor was severely reprimanded by the manager. This episode disturbed the continuation of the project as both the boy and his mother were declared "irresponsible" by the facility manager.

Three months later a monitoring meeting was organised between SerT and Social Services, with the presence of the educator of reference. The meeting, organised with many difficulties, affirmed the lines previously established by the SerT and did not accept the proposal of social services to limit the accompaniment by the mother who, in addition to having almost run out of vacation days, was in serious danger of losing her job. The child continued to access the SerT regularly, accompanied by his mother.

The exam results were always negative. One morning, during the month of July, the nurse present during the urine test asked the child to meet the doctor on duty to talk about some blood tests. The doctor, who had never previously been encountered by the minor, asked for an overview of their personal and family circumstances (anamneses). She then told him that he should submit the blood samples for the control of hepatitis and HIV and provided forms to fill out to get an exemption (valid for 2 years) because of his addiction. The child turned to the educator with alarm and concern. The tests were negative; only after it turns out that it was operating practices.

7 ARCHITECTURE OF SERT.: PRACTICES THAT BUILD THE ROLE OF THE DEVIANT?

From the description it is possible to highlight how certain practices activated by SerT do not correspond to the logic underlying the model of restorative juvenile justice, showing an institutional ambiguity that can lead to contradictory messages. This is done by placing the child in the state of repair or regarding the child as a taxable person to treat. This analysis intends to offer some observations on the effects of certain laws and practices that are activated by these institutions and does not constitute a criticism of colleagues or individual professionals involved.

1. First, the procedure of receiving the minor reported only if they are present alone and spontaneously has been criticised. Due to a spontaneous request for help, they prefer to risk losing those who do not show up on their own. This is probably mediated by the theory that if a person does not want to be healed you cannot intervene. This belief is also shared by many psychologists, and can be summed up in the saying: "if he is not motivated cannot be done." The "motivation" is considered to be a characteristic inherent in the individual, before objectifying and then delegating the outcome of this meeting with the user. In a sense, what generates such a belief is a lack of responsibility in the technical intervention service on the user.
2. For minors for which there is a legal provision, the spontaneity required by SerT is invalidated from the start. You cannot ask a person to be spontaneous if they are not in the condition to be spontaneous. They should be able to discuss the decision of the judge. If you ask him to discuss it you are basically inducing the de-legitimisation of the court itself.
3. If the justice system intends to apply a reparative logic, it is critical to point the blame only at the smaller, as is the responsibility of all parties involved. Consequently, the means of engagement should empower operators in the first place, both of the court and the health and social services.

4. The decision to make an appointment for weekly urine testing at 7.30 irreversibly led to the disruption of school timetables, and especially the fact that the '"legal event" pervades all the other areas of life, as with that of school. Imagine precisely how this prerogative is viewed by other minors, their parents or teachers of the school.

5. Attending school an hour late every day for 9 months certainly limits attendance at some lessons, with all that this implies in terms of teaching.

6. The request to ensure that the minor was accompanied by his mother at the weekly appointment endangered the occupation of the mother, already in receipt of single parent income. This also implies the possibility that the "legal event" permeates the working environment of the mother, or the mother, justifying her delay, may be considered to be a "parent with child deviant" or "addict" by her colleagues.

7. Assigning the term "sick" to a drug addict is a questionable operation from the scientific perspective. This label is often assigned by a doctor from the need to find a diagnosis helpful to recognise similar diseases, predict the course from prior knowledge about the disease itself and choose or recommend a treatment. This approach has proved effective and relevant when applied to the "body" and chemical mechanisms related to it. When applied to the so-called "drug addict" the term carries with it the risk of generalised inclusion and ambiguous treatment, creating potentially critical diagnostic labels in their effects, but also it is not a strict application of the same medical practice. In fact, in order to define such a disease the following criteria of medical practice should be applied: the prognosis, prevention, assessment, medical history, treatment and diagnosis. With regard to the prognosis, within SerT no operator, physician or psychologist can define in a rigorous way the prognosis. Often the future scenario is delegated to the user and how he will "come out" of the situation. Although the user is asked to stick to their treatment and care, no one is able to control the timing in a precise way, as a doctor could for acute bronchitis. Prevention in the medical field refers to the possibility of intervention in the mechanisms of cause and effect, and this is possible if the scope is the body. As the addict is not a "body" the intervention of these mechanisms is quite critical, as the effects of the actions of the so-called drug addict cannot be traced to a definite cause. The evaluation or follow-up of efforts to combat drug addiction is considered critical for the mix of behavioural and biochemical indicators, from two totally different application areas, narrative and chemical. It is noted that, with regard to the anamneses, SerT has as its object, the story of the person in general with reference to his mind, unlike in anamneses as an object, instead of having medical body, something that is found. Therapy exists, but it is predominantly pharmacological and is not always able to eliminate drug addiction. With regard to the diagnosis on which the disease based it is necessary to specify two types of classes of medical diagnosis: etiology - certain ones in which it is proved in the causal relationship between a specific agent and the disease, as in the case measles, and those of uncertain etiology, for example syndromes such as AIDS and SARS. The syndrome in fact organises the symptoms into a consistent clinical framework; while in diseases with a certain etiology we have signs (semiology medical), so called because they are released from the categories of knowledge of the operator. The historical transition is illustrated by the findings on genetic diseases, for example, from the "Down Syndrome" to "trisomy 21". The set of symptoms are semiological, despite it being common sense to keep calling him "handicapped"; this is the same as an "addict". The assignment of the sick to "addict" lies clearly in the uncertain etiology , so it is primarily the improper scientific application of structural labels such as "sick" or "disturbed" or "depressed." The effect can also have a critical result in users of a service intended for health. The correct term would be "drug addiction syndrome" [29][30].

8. Assignment of a lower label of illness involves a different role from the boy's previous life. The assignment of "offender," which is the reason why the boy is there, becomes in the entrance in Ser as ill, without any justification in the medical-legal forensic or scientific-technical.

9. The communication "all addicts do not realise they are sick," or the belief that the addict has its own characteristics and definitions, not only reflects a generalisation of common sense, but it tends to place the minor in a stereotypical category marking it as sick.

10. Prescribing that the mother must attend self-help groups for parents with children who use drugs indicates the risk that she has issues with the role of mother and needs to get help. It also makes her similar to other parents with children who use drugs, in the absence of any evidence about the biographical history.

11. Filling out the form by entering the anamnestic "cocaine" in the absence of other plausible voices is an attempt to adapt the minor to the schemes of the service and the procedures for reference, disclosing a nomothetic and self-referential approach.

12. Offering to the minor the use of the exemption form (valid for two years) as drug addict, although mediated by the benevolent intent of saving, indicates a further allocation of the position of the addict offender, with an attached prophecy for the future.

8   DISCUSSION AND CONCLUSION

The operating procedures used by the SerT with reference to the institution of pre-trial probation ordered by the court seem to trigger a series of author attributions for minor offences in the direction of the sick addict. The effects of this intervention can be found in the requests for invalidation posed by the minor to the educator and social worker: " Am I mentally ill? '" Or "I look like a junkie?".

Another effect concerns the lack of understanding of those aspects that can stop activities of educational value. For example, the prejudice that the school will have on the lateness of the minor and on the risk that school performance is affected. It is good to be clear, as Becher [31] reminds us that the labelling does not occur only in the face of negative reviews, but in relation to what a person is considered to be due to some specific characteristics. With regard to the exemption ticket this could generate, in the "eyes" of pharmacists, nurses and various employees, a further and collective attribution of the role of drug addict. It is so easy to think that the minor will be in a position of having to manage the responsibilities that the institution holds out and that he does not share. The management of all this involves the use of social skills that can hardly be attributed to a minor and therefore, devoid of conceptual tools, the minor can more easily be exposed to inadequacies.

These entire elements led us to consider the encounter with the establishment SerT as a joint biography, in order to confirm the deviance rather than opportunity to repair after the event, as had been thought in the model of juvenile justice. From this it can be said that the DPR 448/88, while internationally regarded as a flagship of Italian juvenile legislation, may not always demonstrate this in its implementation and effectiveness. This is, in fact, greatly reduced when there is collaboration with local services with obsolete organisational and technical architecture, exclusively oriented to care and medicalisation. In fact, this approach does not reflect the efforts of national legislation and international action which, from evidence in the law and the social sciences, is more geared to the empowerment of the subject, rather than the guilt of the potential criminal. This should give pause to the legislature, as the effectiveness of the restorative model will be reduced.

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L'information au service du management des risques opérationnels dans les environnements incertains : Cas de la détection précoce des venues durant les forages pétroliers et gaziers

[The information for the operational risk management in uncertain environments: Case of Early Kick Detection while drilling of the oil or gas wells]

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ABSTRACT: Identification and management of risks related to an uncertain operating environment is especially important when it is an oil or gas wellsite where risks can go beyond the physical and financial losses: human lives. Early identification of an uncertain event can significantly reduce this risk. The aim of this study is to use the information as intangible assets for purposes of identification and management of risks. We are particularly interested in a hazardous event: the gas inflow while drilling of an oil or gas well, through three sources of information: general information on the internet, technical and scientific publications on Google Scholar and patent publications on Google Patent, WIPO or Esp@cenet.
Early identification of a potentially dangerous event is not an easy task. It requires advanced tools and technologies, but also a particular attention and human expertise. Information on tools and technologies are available in various forms on the internet: manufacturers and service providers' brochures, technical and scientific publications and also in patent databases. How to find and exploit this wealth of information? This study shows the importance of information and its appropriate use at the right time to reduce risks related to operational activities in uncertain and potentially dangerous environments. We used any tools of research and analysis of information such as Google, Google Scholar, Google Patent, and Matheo Patent Matheo Web.

KEYWORDS: Early Kick Detection, oil & gas wellsite, information, patent, decision-making under uncertainty, risk management.

RESUME: L'identification et la gestion des risques associés à un environnement opérationnel incertain sont importantes notamment lorsqu'il s'agit d'un chantier de forage pétrolier ou gazier où les risques peuvent aller au-delà des pertes matérielles et financières : des vies humaines. L'identification précoce d'un événement incertain réduit considérablement ces risques. Le but est d'utiliser l'information comme capital immatériel à des fins d'identification et de management des risques. Nous nous intéressons en particulier à un événement dangereux : la venue de gaz durant le forage d'un puits pétrolier ou gazier à travers trois sources d'informations : l'information générale sur internet, les publications techniques et scientifiques sur Google Scholar et enfin les publications de brevets sur Google Patent, WIPO ou Esp@cenet.
L'identification précoce d'un événement potentiellement dangereux n'est pas une tâche facile. Elle nécessite des outils et des technologies sophistiqué mais aussi une attention et expertise humaine. L'information sur les outils et les technologies existent et disponibles sur internet sous divers formes : brochures des fabricants et des fournisseurs de services, les

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publications techniques et scientifiques mais aussi dans les bases de données de brevets. Comment trouver et exploiter cette masse d'information ? Cette étude démontre l'importance de l'information et son utilisation adéquate au bon moment pour la réduction des risques liées aux activités opérationnelle dans des environnements incertains et potentiellement dangereux. Pour cela, nous avons utilisé des outils de recherche et d'analyse de l'information tels que Google, Google Scholar, Google Patent, Mathéo Web et Matheo Patent.

MOTS-CLEFS: Early Kick Detection, forage pétrolier, brevet, information, décision, management des risques, environnement incertain.

1   INTRODUCTION

L'identification et la gestion des risques associés aux activités opérationnelles dans un environnement incertain, est importante surtout lorsqu'il s'agit d'un chantier de forage de puits pétrolier ou gazier où chaque décision ou manœuvre a pour conséquence un danger potentiel où les risques peuvent aller au-delà des pertes matérielles et financières : des vies humaines et des catastrophes environnementales [1].

L'identification précoce d'un événement incertain réduit considérablement ces risques. Pour cela, il y a lieu de capitaliser sur la connaissance de l'environnement soit par le biais des expériences passées ou bien par l'information disponible et exploitable. Chaque information concernant l'environnement ou l'opération en cours de réalisation, peut s'avérer utile voir indispensable. Chaque attitude des acteurs (en particulier le superviseur forage) est salvatrice ou au contraire néfaste.

Le but est d'utiliser l'information comme capital immatériel à des fins d'identification et de management des risques sur les chantiers de forage.

Nous nous intéressons en particulier à la recherche et l'analyse de l'information disponible sur un phénomène redoutable : la venue de gaz durant le forage d'un puits pétrolier ou gazier.

L'étude sera menée à travers trois sources d'informations : l'information générale sur internet, les publications techniques et scientifiques sur Google Scholar et enfin les publications de brevets sur Google Patent, WIPO ou Esp@cenet.

2   PROBLÉMATIQUE

L'identification précoce d'un événement potentiellement dangereux n'est pas une tâche facile. Elle nécessite des outils et des technologies sophistiquées mais aussi une attention particulière et une expertise humaine avérée.

L'information sur les outils et les technologies existent dans tous les domaines du management, de l'engineering et des opérations. Elle est disponible sur internet sous divers formes : brochures des fabricants et des fournisseurs de services, les publications techniques et scientifiques mais aussi dans les bases de données de brevets.

Comment trouver et exploiter cette masse d'information ? Comment tirer la pépite d'or qui mènera à la bonne décision au bon endroit et au bon moment ?

"Celui qui trouve ce qu'il cherche fait en général un bon travail d'écolier ; pensant à ce qu'il désire, il néglige souvent les signes, parfois minimes, qui apportent autre chose que l'objet de ses prévisions. Le vrai chercheur doit savoir faire attention aux signes qui révéleront l'existence d'un phénomène auquel il ne s'attend pas" [2]. Cette citation illustre parfaitement les recherches qui peuvent être menées sur l'Information en général et le "brevet" en particulier [3].

Les systèmes d'informations et particulièrement ceux construits autour du brevet et couplée à une vision créative « out of the box « permettent de dépasser la stricte fonction de base du brevet [3]. Ceci est d'autant vrai lorsqu'ils sont utilisés pour apporter des solutions efficientes à des problématiques critiques telles que les événements qui peuvent survenir sur un chantier de forage.

Nous essaierons de mettre en perspective la contribution de l'information dans l'identification et le management des risques dans des environnements opérationnels incertains. Nous nous intéresserons aux chantiers de forages pétrolier et gazier en général et aux événements inattendus et indésirables tels que les venues de gaz communément appelé "KICK".

Un essai de recherche sur les procédés dits de "Detection Précoce de Venues" connus sous l'appellation anglophone "Early Kick Detection" ou "EKD". Nous les relions dans la mesure du possible avec des ressources actualisées, en se limitant volontairement aux gratuites et accessibles sur internet (pour que le coût ne soit pas un frein à la diffusion), ainsi que des

brochures de vulgarisation qui permettraient, avec une lecture graduée, d'acquérir une base pour encourager des recherches dans ce sens [3].

3 ANALYSE

3.1 DES RISQUES ET DES INCERTITUDES

Les risques sont intimement liés à trois sources d'incertitudes [4] :

1. **Environnement :** Contexte de l'environnement ;
2. **Information :** Informations captés de l'environnement ;
3. **Décideur :** Interprétation des informations de l'environnement.

3.1.1 RISQUES LIÉ À L'ENVIRONNEMENT

Les risques liés à l'environnement sont soit internes ou externes à l'environnement où opère l'organisation. Les incertitudes liées au contexte sont des variables de cet environnement. Il s'agit dans notre cas d'un chantier de forage pétrolier ou gazier.

3.1.2 RISQUES LIÉ À L'INFORMATION

Le risque lié à l'information serait une mauvaise compréhension et interprétation des signaux captés de l'environnement. Les incertitudes liés à l'information sont des propriétés de l'information [5], tels que : Absence, Incomplétude, Centralisation, Importance, Ambiguïté, Subjectivité, Contradiction, Multidisciplinarité, Volatilité, Erreur de mesure ou d'estimation [4], [5]. Il s'agit dans notre cas d'étude des données provenant en temps réel d'une Unité de Mud Logging ou tout autre instrument de mesure.

3.1.3 RISQUES LIÉ AU DÉCIDEUR

Le décideur peut être un individu ou un collectif. Le risque lié au décideur est sa mauvaise réaction face aux signaux et aux événements de l'environnement. Les incertitudes liées au décideur, ne se limitent pas à la personnalité de l'individu. Ses expériences, ses savoirs et ses savoir-faire y jouent aussi un rôle important [4]. Quels interprétation denneront les opérateurs et particulièrement le supervisuer de forage, à ses informations ? et comment vont-ils se comporter face à l'image qu'ils ont donné à ces informations ?

Nous nous intéressons durant cette étude aux risques de l'environnement opérationnel incertain, la masse d'informations qui peut être rendue disponible sur cet environnement ainsi que les interprétations et l'exploitation de cette masse afin d'identifier et manager les risques.

3.2 UN KICK … C'EST QUOI AU JUSTE ?

Plusieurs Scénarios de catastrophes peuvent être imaginés :

- Sur un chantier de forage, le superviseur forage a constaté que l'équipe Mud Logging ont raté des signes critiques d'un kick durant le forage. S'ils étaient détectés à temps, ils auraient permis à l'équipe de forage de fermer le puits avant la montée des fluides et prévenir ainsi l'éruption.

- Sur un autre chantier, le superviseur forage n'a pas correctement apprécié l'information donnée par le Mud-logger sur un gain de fluides dans le puits. Evidemment, s'il avait vérifié que le gain n'était pas le résultat d'un remplissage des bacs, il aurait donné l'ordre de fermer le puits et éviter l'éruption.

- …

Dans tous les cas, il s'agit bien d'un environnement hostile, incertain et méconnu. L'information est disponible mais non détectée au temps opportun ou mal interprétée et enfin l'acteur (décideur) qui agit selon l'image construite de l'environnement via l'interprétation de information.

Une venue (kick) est un afflux indésirable de fluide ou de gaz dans le puits. L'afflux est provoqué dans le puits lorsqu'un obstacle tel que le ciment ou la boue, n'a pas réussi à vaincre la pression du fluide dans la formation [6]. En d'autres termes, il s'agit d'un problème de contrôle de puits dans lequel la pression à l'intérieur de la formation forée est supérieure à la pression hydrostatique de la boue agissant sur la paroi de cette formation. Dans ce cas, la plus grande pression de formation tend à pousser les fluides de formation dans le puits.

Afin de contrôler le kick, il faut d'abord le détecter et puis l'empêcher de progresser en ajoutant une ou plusieurs barrières. Si le débit est contrôlé avec succès, le kick est tué (killed).

L'opérateur doit pour cela, faire circuler l'afflux hors du puits. S'il ne réagit pas correctement, les fluides vont continuer à entrer dans le puits. Ce qui finira par dégénérer en écoulement incontrôlé du puits. Plus grave encore, conduit à ce qui est connu comme une « éruption ».

Afin de détecter un kick, il y a lieu d'examiner divers indicateurs sur les conditions de surface et de fond. Ces indicateurs comprennent le gain du puits (pit gain), le flux de sortie (flow-out) en fonction du débit d'entré (flow-in), la pression des tiges de forage (drill pipe pressure) et la teneur en gaz dans la boue. Généralement, ces informations sont données en temps réel par l'Unité de Mud Logging.

Plusieurs facteurs influent sur la gravité du kick [7] :

- **Les propriétés petro-physiques de la roche :** Une roche avec une perméabilité élevée et une porosité élevée a un plus grand potentiel pour un kick sévère par rapport à une roche avec une faible perméabilité et une faible porosité. La perméabilité est la capacité à permettre au fluide de passer à travers la roche. La porosité mesure la quantité d'espace dans la roche contenant des fluides. Par exemple, le grès est considéré comme ayant un potentiel kick plus élevé que le schiste, car le grès possède une plus grande perméabilité et une porosité supérieure que le schiste.

- **La pression différentielle :** C'est la différence entre la pression du fluide de formation et la pression hydrostatique de la boue. Si la pression de formation est supérieure à la pression hydrostatique, il existe une pression différentielle négative.

- **Facteurs combinés :** Si cette pression différentielle négative est couplée avec une perméabilité élevée et une porosité élevée, un kick sévère peut se produire.

Un kick peut être qualifié de plusieurs manières [6] :

1. En fonction du type de fluide de formation qui entre dans le puits, comprennent: le gaz, le pétrole, l'eau salée, l'eau de chlorure de magnésium, le sulfure d'hydrogène gazeux (aigre) et le dioxyde de carbone. Si le gaz pénètre dans le puits, le kick est dit « gas kick ».

2. En fonction de l'augmentation du poids la boue nécessaire pour contrôler le puits et tuer une éruption potentielle. Si un kick nécessite une augmentation de poids de la boue de 0.7 lbm/gal (84 kg/m3) pour contrôler le puits, il pourrait être qualifié de « 0.7 lbm/gal kick ». Il y a lieu de noter qu'un kick nécessite en moyenne, une augmentation de poids de la boue d'environ 0,5 lbm/gal (60 kg/m3) ou moins.

3.3 CAUSES PROBABLES DES KICKS

Les éruptions surviennent lorsque la pression de formation est supérieure à la pression hydrostatique de la boue. Dans la quasi-totalité des opérations de forage, l'opérateur tente de maintenir une pression hydrostatique supérieure à la pression de formation et par conséquent, empêcher les kicks. Toutefois, si par malchance, la pression de la formation va dépasser la pression de boue, un kick se produira.

Les raisons de ce déséquilibre peuvent être à l'origine d'un kick [8], [9], [10] :

- Poids (Densité) de la boue insuffisant ;
- Mauvais remplissage lors des remontés des tiges ;
- Pistonnage (swabbing) ;
- Perte de circulation de la boue (lost circulation) ;
- Boue coupée avec du gaz (gas cut mud).

3.3.1 POIDS DE LA BOUE INSUFFISANT

C'est la principale cause des kicks. La pression de la formation est supérieure à la pression du puits, les fluides commencent à couler de la formation vers le puits et le kick se produit. Ces pressions de formation anormales sont souvent associées aux kicks. Durant les opérations de contrôle des puits (well control), les pressions de formation supérieures à la normale sont la plus grande préoccupation. Les propriétés pétro-physiques de la roche (perméabilité et porosité) sont dans ce cas déterminantes pour prévoir la production d'un kick.

Un certain nombre d'indicateurs de pression anormale peut être utilisée pour estimer les pressions de formation de sorte que les kicks causés par l'insuffisance du poids de la boue, soient empêchés.

3.3.2 MAUVAIS REMPLISSAGE LORS DES REMONTÉS

Un mauvais remplissage du trou lors des remontées est une autre cause importante des kicks. Lorsque la tige de forage est tirée hors du trou, le niveau de la boue baisse, le trou doit être rempli périodiquement avec de la boue pour éviter de réduire la pression hydrostatique et permettre à un kick se produire.

Plusieurs méthodes peuvent être utilisées pour combler le trou, mais l'opérateur doit être capable de mesurer avec précision la quantité de boue nécessaire ou le cas échéant, utiliser un dispositif avec la pompe volumétrique capable de mesurer les coups de pompe nécessaires pour combler le trou.

3.3.3 PISTONNAGE

Tirer la tige de forage du puits crée des pressions de pistonnage « swabbing ». Ces pressions sont négatives et réduisent la pression hydrostatique efficace tout au long du trou et en dessous de l'outil de forage. Si cette réduction de pression réduit la pression hydrostatique effective en dessous de la pression de la formation, il y a une production potentielle d'un kick.

3.3.4 PERTE DE CIRCULATION (LOST CIRCULATION)

Parfois, les kicks sont causés par une perte de circulation. Une diminution de la pression hydrostatique se produit à partir d'une courte colonne de boue. Un volume important de fluide du kick peut entrer dans le puits avant que le niveau de la boue montant soit observé à la surface. Il est recommandé de remplir le puits avec un certain type de fluide et de surveiller attentivement les niveaux des fluides si une perte de circulation se produit.

3.3.5 BOUE COUPÉE AVEC DU GAZ (GAZ CUT MUD)

La boue contaminée par le gaz peut provoquer des kicks. Ce phénomène est rare mais probable. Le gaz est distribué à la surface, se dilate et réduit ainsi la pression hydrostatique globale conduisant à la production probable d'un kick.

3.4 SIGNES PRÉCOCES D'UNE VENUE

Les signes d'avertissement d'éventuels kicks peuvent être observés en surface. Les opérateurs ont la responsabilité de reconnaître et d'interpréter ces signes et prendre des mesures et décisions appropriées.

Certains signes ne permettent pas d'identifier aisément un kick, d'autres permettent simplement la prévention d'une production potentielle de kicks.

Les signes clés à surveiller sont [6], [9], [10] :

- Augmentation brusque du débit : comparaison des taux (flow-out / flow-in) ;
- Augmentation du volume des bacs : comparaison volumétrique (pit gain) ;
- Puits débitant avec des pompes à l'arrêt ;
- Diminution de la pression de la pompe et augmentation de la course de pompage ;
- Mauvais remplissage de boue durant les remontées de l'outil ;
- Variation du poids des tiges ;
- Pause forage (Drilling break) ;
- Réduction du poids de la boue.

Chaque signe est identifié comme un signe d'alerte primaire ou secondaire selon son importance dans la détection du kick.

3.4.1 LES SIGNES D'ALERTE PRIMAIRES

- **AUGMENTATION DU DEBIT :**

Une augmentation du débit sortant du puits, lors du pompage à débit constant, est un indicateur principal de kicks. L'augmentation du débit est interprétée par la formation aidant les pompes de forage par le déplacement du fluide de l'espace annulaire vers le haut et en poussant les fluides de formation dans le puits de forage.

- **AUGMENTATION DU VOLUME DES BACS (PIT GAIN) :**

Si le volume du bac n'est pas changé à la suite de mesures de contrôle en surface, une augmentation indique qu'un kick est en cours. Les fluides entrant dans le puits de forage, déplacent un volume équivalent de boue à la conduite d'écoulement, ce qui entraîne un gain (pit gain).
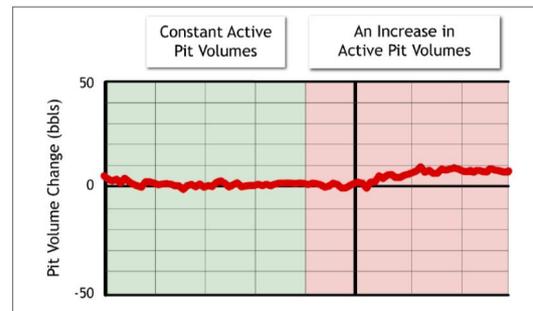
Fig. 1. Une augmentation du volume doit être facilement détectable par une pente positive dans la ligne de tendance [9]

- **PUITS DEBITANT AVEC DES POMPES A L'ARRET :**

Lorsque les pompes de forage ne déplacent pas la boue, un flux continu à partir du puits indique qu'un kick est en cours. Exception faite lorsque la boue dans la tige de forage est nettement plus lourde que dans l'espace annulaire, par exemple dans le cas d'un bouchon.

- **MAUVAIS REMPLISSAGE LORS DES REMONTEES :**

Lorsque le train de tiges est tiré hors du trou, le niveau de la boue devrait diminuer en un volume équivalent de l'acier retiré. Si le trou ne nécessite pas le volume calculé de la boue pour amener le niveau de la boue à la surface, on suppose qu'un « kick fluide » est entré dans le trou et remplit partiellement le volume du train de tiges déplacé. Même si le gaz ou l'eau salée entre dans le trou, il ne peut y avoir circulation jusqu'à ce qu'il y ait suffisamment de fluide afin de réduire la pression hydrostatique en deçà de la pression de la formation.

- **DIMINUTION DE LA PRESSION ET AUGMENTATION DE LA COURSE DE POMPAGE :**

Le changement de pression de la pompe peut indiquer un kick. L'entrée du fluide initiale dans le puits peut entraîner une floculation de la boue et une augmentation temporaire de la pression de la pompe. Comme l'écoulement est continu, l'afflux de basse densité va déplacer des fluides de forage plus lourds et la pression de la pompe peut diminuer. Lorsque le fluide dans l'annulaire devient moins dense, la boue dans la tige de forage à tendance à diminuer et la vitesse de la pompe peut augmenter.

D'autres problèmes de forage peuvent également présenter ces signes. Il s'agit alors d'établir une procédure appropriée pour vérifier la présence d'un kick si ces signes sont observés.

3.4.2 LES SIGNES D'ALERTE SECONDAIRES

- **VARIATION DU POIDS DES TIGES :**

Le fluide de forage fournit un effet dynamique à la tige de forage et réduit son poids réel supporté par l'appareil de forage. Les boues plus lourdes ont une force de flottabilité supérieure que les boues moins denses. Lorsque survient un kick, des fluides de formation à faible densité commencent à entrer dans le puits, la poussée d'Archimède du système de boue est réduite et le poids des tiges observé à la surface, commence à augmenter.

- **LA PRESSION DANS LES TIGES DE FORAGE « DRILL PIPE PRESSURE » :**

La pression de la tige de forage est une mesure de la pression exercée par les fluides à l'intérieur du la tige. Lorsque les pompes sont éteintes, la pression de tiges de forage devrait rester constante. Une Fluctuations inexpliquées de la pression dans les tiges peut indiquer un kick. Le plus souvent, c'est la diminution de la pression qui indique un kick. Mais cette diminution peut simplement indiquer une perforation de la tige de forage.

Dans tous les cas, les fluctuations inexpliquées de la pression dans la tige de forage sont une cause d'inquiétude et méritent qu'on s'y intéresse.

- **PAUSE FORAGE (DRILLING BREAK) :**

Une brusque augmentation de la vitesse de pénétration, appelé « pause forage », est un signe d'alerte pour un kick potentiel. Une augmentation progressive du taux de pénétration (ROP) est un indicateur de pression anormale et ne doit pas être interprété comme une augmentation brusque du taux de pénétration.

Lorsque le ROP augmente soudainement, nous supposons qu'il y a changement de formation rocheuse. Aussi, le potentiel kick est important dans cette nouvelle formation (comme dans le cas d'un grès), alors que la formation précédente ne présentait pas cette possibilité (comme dans le cas des schistes). Même si une pause forage ait été observée, il n'est pas certain qu'un kick se produira, mais seulement qu'une nouvelle formation forée pouvant présenter un kick potentiel.

- **REDUCTION DU POIDS DE LA BOUE :**

La réduction du poids de la boue observée à la conduite d'écoulement peut parfois provoquer des kicks.

3.5 DÉTECTION DES KICKS ET SUIVI AVEC LES OUTILS DU MUD LOGGING

Pendant la circulation et les opérations de forage, le Mud Logging permet de surveiller :

- Les propriétés de la boue
- Les paramètres de la formation
- Les paramètres de forage et particulièrement le train de tiges

Le Mud Logging est un système de surveillance largement utilisés durant le forage. Nous ne pouvons plus aujourd'hui imaginer qu'un forage puisse débuter sans la présence d'une unité de Mud Logging.

Cette recherche (paragraphes 3.2 à 3.4) est adaptée à partir de sources disponibles gratuitement sur internet. Elle aurait pu être l'œuvre d'un collégien à qui on a demandé de faire un exposé sur un sujet qu'il ne connaissait pas du tout. Le professeur Luc demande à l'élève Abdelkader : Tu me présente demain un exposé sur « Early Kick Detection ».

L'élève Abdelkader part sur Google et tapote « Early Kick Detection » et appuis sur le bouton « Recherche Google » ou « J'ai de la chance ». Des milliers de liens défilent, il se dit : Tiens, il y a « Wikipédea » (www.wikipedea.org) qui parle du sujet … ah ! Voilà un autre site qui en parle aussi « Encyclopedia of Earth » (www.eoearth.org) ou encore « PetroWiki » (www.petrowiki.org). Ce n'est pas exactement comme cela que ça se passe … mais presque !

4   RESULTATS & DISCUSSION

Nous avons utilisé des outils de recherche et d'analyse de l'information selon la nature de l'information :

1.   Information générale sur le sujet « Early Kick Detection » ;
2.   Information « Scientifique et Technique » sur le sujet « Early Kick Detection » ;
3.   Information « Brevets » sur le sujet « Early Kick Detection ».

4.1   INFORMATIONS GÉNÉRALES SUR LE SUJET « EKD »

La recherche a été effectuée avec Google et un outil de recherche, de surveillance et d'analyse des données sur le Web « Mathéo Web ».

Pour cette partie, notre étude a porté sur l'interrogation du moteur de recherche « Google » et à partir d'un seul mot clé composé « Early Kick Detection » et nous nous sommes intéressées aux 146 premières réponses à la requête trouvée par « Mathéo Web ».

Les réponses sont diverses et hétérogènes. En effet, la panoplie de réponses regroupe les brochures publicitaires des compagnies de services pétroliers, des sites commerciaux, des sites gouvernementaux, des blogs et CV de personnes, des encyclopédies en lignes telles que « Wikipedia », « Encyclopedia of Earth » ou « PetroWiki », des renvois sur « Google Scholar » pour les publications techniques ou même des renvois sur « Google Patent » pour des brevets.

Du fait cette hétérogénéité, cette recherche ne peut être considéré comme efficiente. En effet, à l'exception des informations contenues sur certains sites spécialisés, on ne peut juger de la pertinence et de la fiabilité de l'information recueillie.
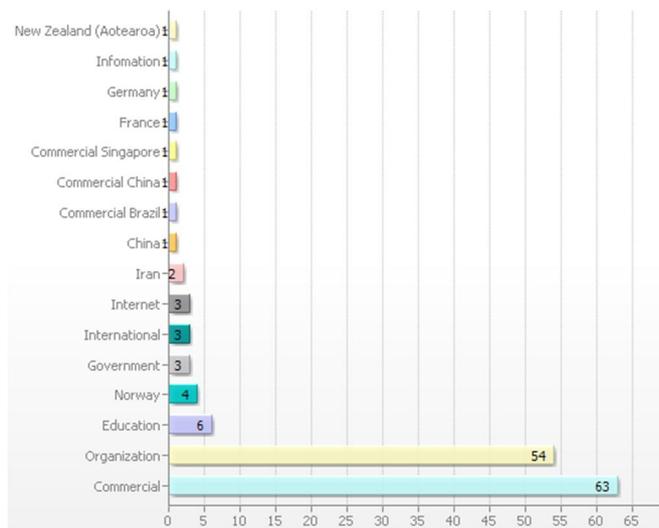
Fig. 2.   Répartition des réponses selon le type de domaine internet

Comme le montre la figure 2, les informations sont réparties selon 16 types de domaines : 09 Pays, COM, ORG, NET, GOV, EDU, INT & INFO.

Les sites commerciaux (.COM) viennent en tête avec 63 réponses soit 43,15 % des réponses.

Les sites des organisations non gouvernementales (.ORG) viennent en deuxième position avec 54 réponses soit 36,99 % des réponses.

Les sites des organismes d'éducation (.EDU) tels que les universités avec 06 réponses soit 4,11 % des réponses.

Le reste des types se partagent les 15,75 % restant des réponses.

Ceci confirme l'hypothèse selon laquelle nous avons avancé que l'hétérogénéité de l'information recueillie via le Web sur un sujet aussi délicat que « Early Kick Detection », risque d'entacher sa fiabilité scientifique ou technique.

En s'intéressant cette fois ci aux domaines internet avec un zoom plus fin que les types [figure 3], le top est de 30 réponses soit 20,55 % de l'échantillon, proviennent d'un domaine de type (.ORG).

Il s'agit d'un site payant spécialisé « OnePetro », une bibliothèque en ligne de la documentation technique pour l'exploration et production (E&P) de l'industrie pétrolière et gazière. Elle contient plus de 145000 documents produits par 18 éditeurs partenaires. Elle est gérée par la Society of Petroleum Engineers (SPE). La bonne nouvelle est que l'information est fiable, la mauvaise est qu'elle payante.

Le second répondant est un site commercial d'une compagnie de services pétroliers « Weatherford » avec 19 réponses soit 13,01%. Il s'agit généralement de brochures publicitaires sur des outils et des services liés à la détection précoce de kicks qu'offre la compagnie à ses clients. On y trouve aussi des études de cas réels de détection de kick réalisés par la compagnie sur des chantiers de forage.

En troisième position « Google » avec 08 réponses (5,48 %), il s'agit de renvois sur « Google Patent » pour les publications brevets.
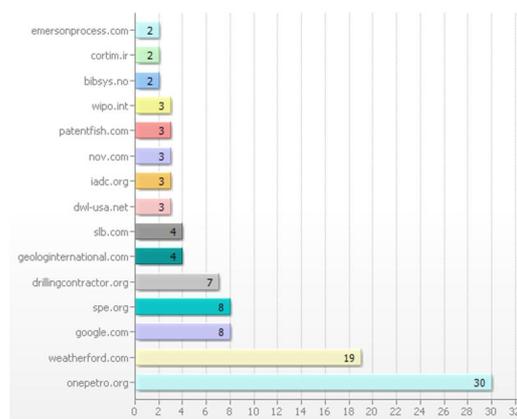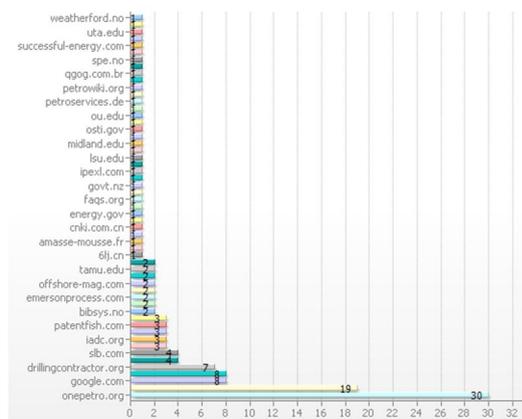
Fig. 3.   Répartition des réponses selon les domaines internet

Fig. 4.   Top15 des réponses selon les domaines internet

Un classement TOP15 des 15 domaines répondants à la requête « Early Kick Detection », représente 101 réponses soit 69,18 % de notre échantillon [figure 4]. Dans ce classement, nous trouvons des :

1. Organisations non gouvernementales (.GOV) : OnePetro (bibliothèque en ligne), SPE (Association des professionnels dans l'Engineering Pétrolier), DrillingContractor (Revue spécialisée dans le forage et édité par IADC), IADC (Association internationale des Entrepreneurs de Forage).
2. Sites commerciaux des compagnies dont la majorité dans le domaine pétrolier (.COM) : Weatherford, Google (Brevets), Schlumberger, Geolog, Patentfish (Brevets), NOV (National OilWell Varco), Sumobrain (Brevets), Offshor-Mag (Revue spécialisée), DWL-USA (Diversified Well Logging), EmersonProcess (Instrumentation).
3. Sites d'organisations internationales (.INT) : WIPO (World Intellectual Property Organization)

Ces constats nous permettent d'avancer une autre hypothèse : Le sujet « Early Kick Detection » est un domaine qui reste dans la sphère des spécialistes et particulièrement les compagnies de services pétroliers.

4.2   INFORMATION « SCIENTIFIQUE ET TECHNIQUE » SUR LE SUJET « EKD »

La recherche a été effectuée exclusivement avec « Google Scholar » qui est un moteur de recherche spécialisé dans la documentation et publications scientifiques et techniques. Il est convivial et permet une recherche aisée selon les dates de publication.

Pour cette partie, notre étude a porté sur l'interrogation du moteur de recherche « Google Scholar » et à partir de deux mots clés composés « Early Kick Detection » et « Kick Detector ». Nous nous sommes intéressées à toutes les réponses au nombre de 211 (après élimination des publications redondantes) et ce depuis 1960 à 2013.
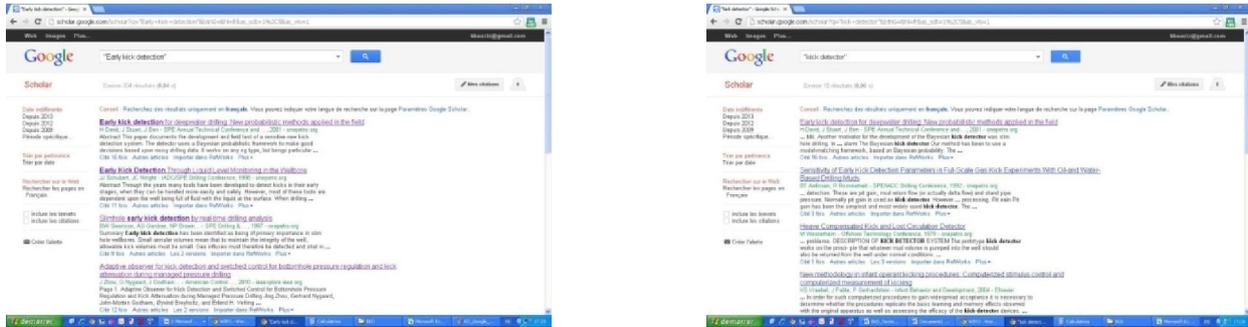
Fig. 5.   Recherche « Early Kick Detection » et « Kick Detector » sur « Google Scholar »

La recherche pour la période (1900 – 1960) a donné ZERO réponses. Nous avons conclu que le sujet « Early Kick Detction » n'a fait l'objet d'aucune recherche avant l'année 1960.

Il est clair que « Google Scholar » n'offre de réponse que sur des publications mises en ligne sur le Web et ce quelque soit son format : numérique d'origine pour les publications récentes ou numérisées pour les anciennes publications.
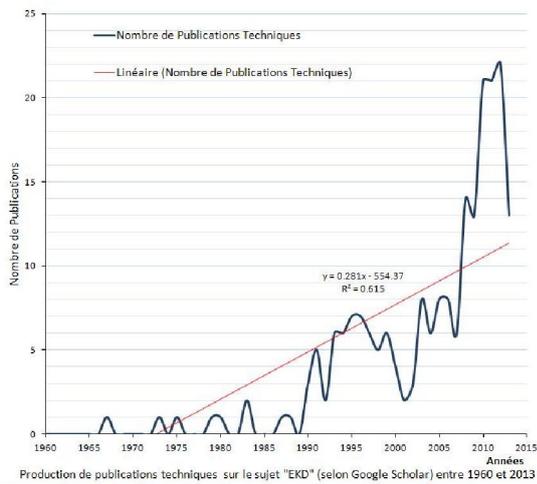
Fig. 6.   Production de publications scientifiques sur le sujet « EKD » selon Google Scholar, entre 1960 et 2013

La première recherche scientifique trouvée sur le sujet « EKD » date de 1967 : Griffin, Phil. « Early Kick Detection Holds Kill Pressure Lower » SPE Mechanical Engineering Aspects of Drilling and Production Symposium. 1967.

De 1967 à 1990, les publications scientifiques sur le sujet sont rares et il n'a visiblement pas requis l'intérêt qu'il fallait.

A partir des années 90, le sujet intéressait de plus en plus la communauté scientifique et technique.

Durant la dernière décennie, notamment avec le développement des domaines tels que le Risque Management et le Q-HSE (Quality – Health Security Environment), le sujet « EKD » est devenue plus qu'une actualité, une exigence sur les chantiers de forage. Le but étant de minimiser les risques de pertes humaines et matérielles. Durant cette période, les travaux scientifiques et techniques ont eu un essor considérable.

4.3   INFORMATION « BREVETS » SUR LE SUJET « EKD »

Les brevets sont une source d'information unique et inestimable car les informations qui s'y trouvent, ne sont généralement pas publiées ailleurs. De plus, ils ont une durée limitée après laquelle ils peuvent être exploités sans droits. Ils peuvent aussi être déchus (pour non paiement des annuités par exemple) et peuvent dans ce cas, être utilisés librement. Enfin ils peuvent n'être publiés que dans certains pays et donc s'ils ne sont pas étendus dans d'autres, les exploitations de leurs résultats dans ces pays peuvent être faites librement.

L'accès aux brevets peut être manuelle par une recherche pêle-mêle dans les bases brevets ou mieux, assisté par un outil gratuit tel que Google Patent. Par contre l'utilisation d'une application d'analyse de données telle que Matheo-Patent, permet une recherche globale, téléchargement et analyse automatiques des données. Ce processus a été adopté lors de cette étude. Nous avons utilisé pour cela les outils suivants :

- Google Patent : pour la recherche de l'information brevet
- Esp@cenet : base de données Brevets Européens et Monde de l'Office Européen des Brevets ;
- WIPO : base de données des Brevets Monde et de classification IP
- Mathéo Patent : pour l'analyse qualitative de l'information Brevets.

Mathéo Patent est un logiciel simple et performant permettant d'assurer une veille technologique efficace. Il permet la recherche, l'analyse et la surveillance des brevets.

L'analyse automatique des brevets consiste à utiliser les informations contenues dans un brevet par un logiciel d'analyse afin de présenter des résultats en facilitant au maximum le travail des experts pour comprendre les évolutions, les acteurs et les sujets apparaissant dans la recherche effectuée.

On fait ainsi apparaître les corrélations nécessaires pour répondre aux questions classiques :

- Importance du sujet et évolution dans le temps ;
- Différentes technologies et applications concernées ;
- Qui fait quoi et comment (benchmarkinbg automatique des entreprises) ;
- Quelles sont les tendances de recherche et d'application par déposants, inventeurs ou groupe d'inventeurs ou par pays ;
- Quelles sont les technologies porteuses d'innovation, etc.

4.3.1 MÉTHODOLOGIE

Notre étude a porté sur l'interrogation de la base de donnée brevet à partir des mots clés composés suivants : « Early Kick Detection », « Kick Detection », « Early Kick Detect », « Kick Detect », « Early Kick Detector », « Kick Detector », « Early Kick Detecting », « Kick Detecting », « Inflow Detection », « Inflow Detect », « Inflow Detector », « Inflow Detecting », « Détection Précoce Venue », « Détection Venue », « Détecteur Venue » dans le titre et le résumé des brevets déposés et ce depuis 1960 à 2013.

Certaines littératures anglophones utilisent « INFLOW » au lieu de « KICK » pour désigner une « VENUE ».

La recherche pour la période (1900 – 1960) a donné ZERO réponses. Nous avons conclu le sujet « EKD » n'a fait l'objet d'aucun brevet avant l'année 1960.

Une fois la recherche effectuée, nous avons constitué des groupes de brevets sur la base des mots clés portant sur des spécificités des brevets selon des classifications CIB normalisées.

4.3.2 RÉSULTATS

Nous avons obtenu 64 brevets réparties sur 10 familles et classés en 3 IP Class 4 digits, comme suit :

Inventeurs	*19*
Déposants	*8*
IP Class 4 digits	*3*
IP Class Full	*20*
E Class	*15*
US Class	*19*
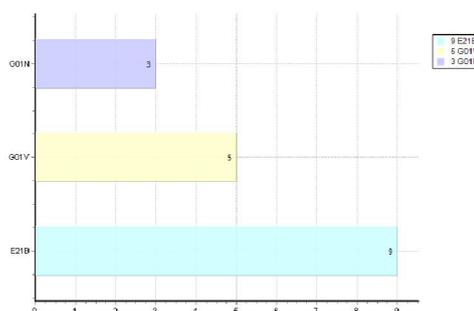
Fig. 7. *Répartition des familles de brevets selon la classification CIB Class 4 digits*

Les trois (03) IP Class 4 digits sont :

E21B   *FORAGE DU SOL OU DE LA ROCHE*

G01N   *RECHERCHE OU ANALYSE DES MATERIAUX PAR DETERMINATION DE LEURS PROPRIETES CHIMIQUES OU PHYSIQUES*

G01V   *GEOPHYSIQUE; MESURE DE LA GRAVITATION; DETECTION DES MASSES OU OBJETS; MARQUES D'IDENTIFICATION*

4.3.3 HISTORIQUE DES DÉPÔTS DE BREVETS (PAR FAMILLE) SUR LE SUJET « EKD »
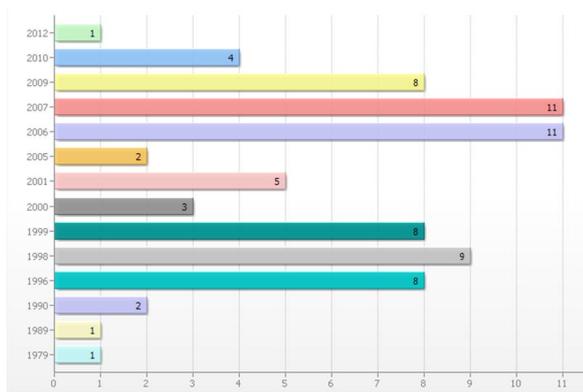
Fig. 8.   Brevets en fonction des dates de Priorité (PR)
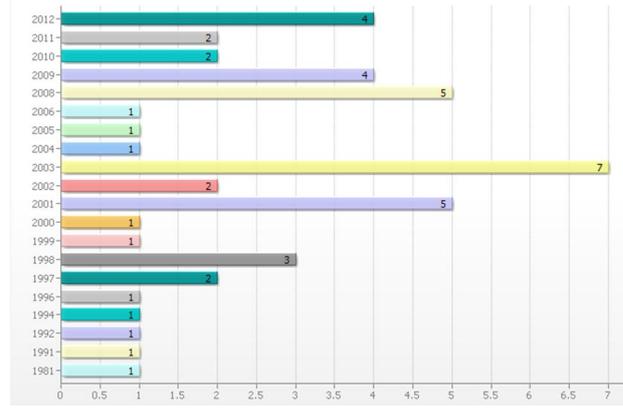
Fig. 9.   Brevets en fonction des dates de publication

Le plus ancien brevet sur EKD, date de 1997 et la première publication du brevet fut en 1981.

Un (01) seul brevet sur EKD a été déposé en 2012 alors que les dernières publications sur le sujets en 2012 sont au nombre de quatre (04).

Table 1.   Cette matrice montre l'évolution des dépots de brevets sur le sujet EKD entre 1979 et 2012

	1979	1989	1990	1996	1998	1999	2000	2001	2005	2006	2007	2009	2010	2012
BAKER HUGHES (us)									2	3	3	2	1	1
WESTINGHOUSE ELECTI	1													
HONEYWELL INC (US)		1												
SHELL (US)		1												
UNION OIL CO (US)							1							
ANADRILL INT SA (PA)			1	1										
SCHLUMBERGER (us)				1				1						
ELF EXPLORATON PROD					1	1								

Westinghouse était précurseur avec le dépôt du premier brevet sur un detecteur de kicks en 1979.

Entre 1989, Shell en collaboration avec Honeywell déposent le second brevet sur un autre type de détécteurs de kicks.

En 1990, Anadrill dépose son premier brevet sur EKD.

En 1996 et suite au rachat d'Anadrill par Schlumberger, le fruit de cette fusion a donné lieu à un deuxième dépôt de brevet sur EKD.

Elf en cavalier solitaire a déposé deux brevets sur deux années de suite 1998 et 1999.

Alors que le dernier brevet déposé par Schlumberger date de 2001, une activité innovation sur EKD a été reprise par Baker Hughes durant les 06 dernières années avec un dépôt total de 12 familles de brevets.
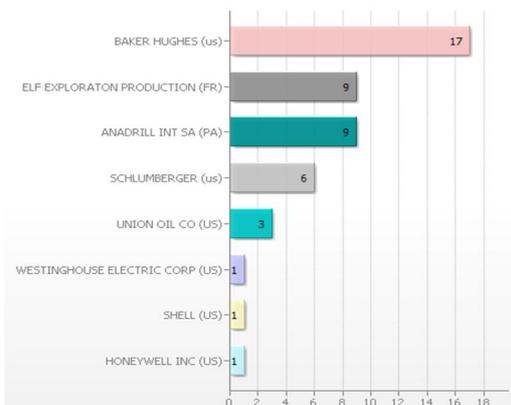
Fig. 10.   Brevets par Appliquants
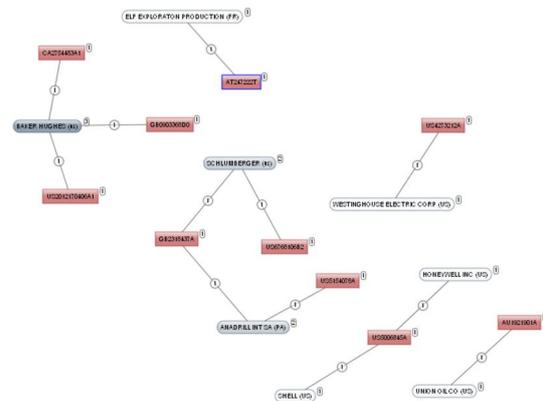
Fig. 11.   Réseaux de coopération entre Appliquants

Les compagnies pétrolières s'interessent autant que les sociétés de services au sujet EKD.

Pour les sociétés de services : Baker Hughes vient en tête avec 17 brevets suivi de Schlumberger et Anadrill avec 15 brevets (Anadrill a été acquise par Schlumberger). Pour les sociétés pétrolières : Elf E&P vient en tête avec 09 brevets.

Cette domination des sociétés de services est logique parcequ'ils sont tenues de trouver des solutions techniques et technologiques pour les problèmes de KICK sur les chantiers de forage de leurs clients.
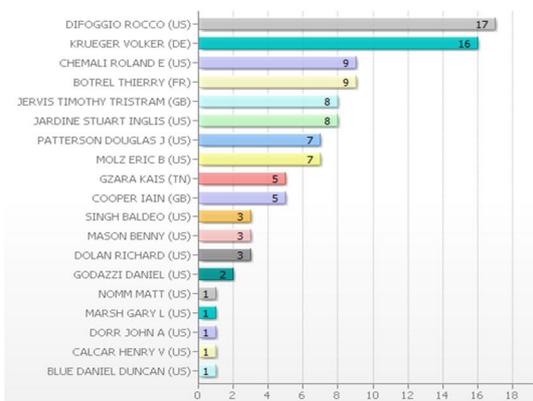
Fig. 12.   Brevets par Inventeurs
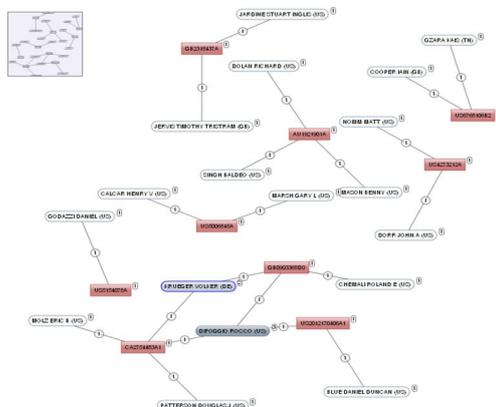
Fig. 13.   Réseaux de coopération entre Inventeurs

Alors que la majorité des compagnies pétrolières et de services pétroliers focalisent leurs inventions sur les processus et procédés de detection précoce de kicks, d'autres tels que Union Oil (société pétrolière), Westinghouse et Honeywell (sociétés d'engineering) en association avec Shell, s'orientent sur les moyens de réalisation du procédé (En langage CIB, Full IP Class : E21B21/00 ce qui corespond en langage habituel à "Procédés ou appareils pour nettoyer les trous de forage par jet de fluide").

Nous avons recensé 64 brevets « EKD » partagés par 18 inventeurs. Il y a lieu de noter la présence d'un inventeur du Maghreb (Tunisie) avec un actif de 05 brevets.
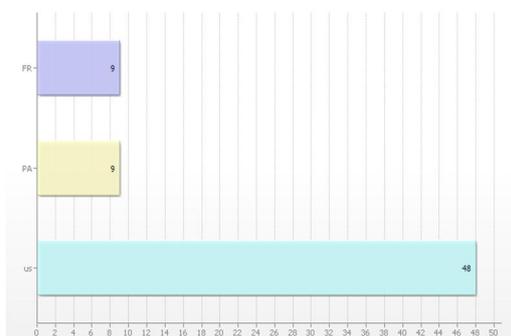
Fig. 14.   Brevets par pays des Appliquants
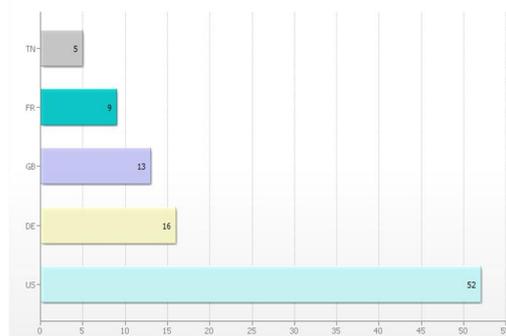
Fig. 15.   Brevets par pays des Inventeurs

Les Appliquants sont réparties sur trois (03) pays : les Etats Unis d'Amérique, le Panama et la France. Avec une domination nette des USA sur l'ensemble.

Les inventeurs sont répartis sur cinq (05) pays : les Etats Unis d'Amérique, l'Allemagne, le Royaume Uni, la France et la Tunisie.

4.3.4 COOPÉRATION ENTRE INVENTEURS ET/OU APPLIQUANTS

Cette matrice permet de voir les classes CIB couvertes par les Appliquants de brevets sur le sujet « EKD ».

La concentration des brevets sur le sujet « EKD » se situe (en termes d'IP Class 4 digits) sur la classe E21B c'est-à-dire « FORAGE DU SOL OU DE LA ROCHE ».

Les Full IP Class les plus sollicités par les compagnies pétrolières et de services pétroliers sont :

- E21B47/10 : Localisation des fuites, intrusions ou mouvements du fluide.
- E21B21/08 : Commande ou surveillance de la pression ou de l'écoulement du fluide de forage, p.ex. Remplissage automatique des trous de forage, commande automatique de la pression au fond.

Curieusement, Baker Hughes et Schlumberger ne couvrent pas la classe E21B21/08. Pour la seconde, elle est complétée par sa filiale Anadrill.

Fig. 16. Réseau d'Interaction Appliquants / CIB

Les compagnies qui couvre plus de classes est Baker Hughes, suivie par Schlumberger/Anadrill.

4.4 DISCUSSION DES RÉSULTATS DE L'ANALYSE
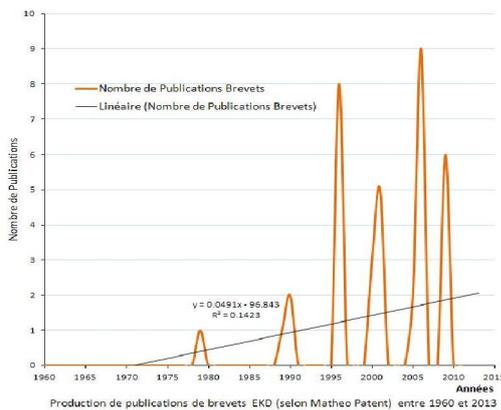
Fig. 17. Evolution des publications des Brevets « EKD » entre 1960 et 2013
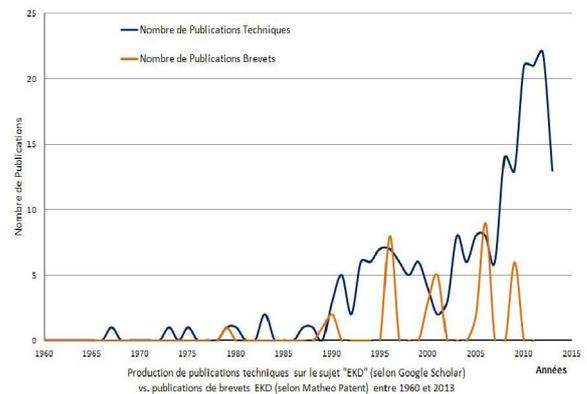
Fig. 18. Evolution des publications des Brevets « EKD » vs. publications techniques, entre 1960 et 2013

Le premier dépôt de brevet sur le sujet « EKD » date de 1979 : « Oil & Gas Well Kick Detector » par les Inventeurs : Dorr John A & Nomm Matt pour le compte de l'appliquant : Westinghouse Electric Corp.

Le deuxième brevet sur le sujet a été déposé dix (10) ans après par Honeywell & Shell.

Ce n'est qu'à partir de 1995 que les dépôts de brevets sur le sujet deviennent signifiants. Même si la tendance est en progression, elle reste moins importante que celle des publications scientifiques (coefficient de progression est de **4,91%** contre **28,10%** pour les publications scientifiques).

Cette faible progression par rapport aux publications scientifiques peut s'expliquer par les coûts exorbitants de la R&D et de l'innovation dans le domaine pétrolier mais aussi par les conditions draconiennes imposées par les offices des Brevets, notamment en matière de recherche d'antériorité de l'invention et les preuves d'innovation. Contrairement aux publications scientifiques dont les règles sont plus élaborées et plus souples.

La seconde raison et la plus plausible à notre avis, les compagnies préfèrent ne plus publier des brevets sur des sujets aussi critiques parce qu'ils constituent un avantage concurrentiel certain qu'ils n'aimeraient pas partager avec d'autre. Parce qu'un brevet publié c'est un transfert technologique assuré pour les concurrents qui peuvent s'en inspirer s'ils ne peuvent pas détourner son utilisation. Sinon comment expliquer le cas de la compagnie Weatherford qui n'a déposé aucun Brevet sur le sujet « EKD » mais qui est en tête des compagnies commerciales du TOP15 qui offre ce service à ses clients ?

Une autre preuve de la véracité de cette supposition, ces dernières années, seule la compagnie Baker Hughes (absente du TOP15), continue à déposer des Brevets sur le domaine « EKD ».

5   CONCLUSION

Cette étude démontre l'importance de l'information et son utilisation adéquate au bon moment pour la réduction des risques liées aux activités opérationnelle dans des environnements incertains et potentiellement dangereux.

Les incertitudes explicitées permettent d'orienter le travail de production de savoirs. En effet, dès lors qu'elles sont explicitées, les incertitudes constituent une ressource impressionnante pour les décideurs qui sont en position de les réduire, sans pour autant les éliminer tout-à-fait.

Une étude de cas sur la détection précoce des venues durant le forage pétrolier et gazier dit « Early Kick Detection ». Ce cas est exceptionnel parce qu'il présente réellement une situation de risque permanent dans un environnement incertain.

Nous avons utilisé pour cette étude, des outils de recherche et d'analyse de l'information tels que Google, Google Scholar, Google Patent, Mathéo Web et Mathéo Patent. Les outils utilisés exception faite de Mathéo sont gratuits et disponibles sur le Web.

RESSOURCES À CONSULTER

- ✓ Encylopedia of Earth, est une ressource en ligne gratuite sur la Terre, ses milieux naturels et leur interaction avec la société. Les articles sont écrits dans un langage simple par des universitaires, des professionnels et d'autres experts agréés, qui collaborent et passent en revue le travail de chacun. Ils sont destinés aux étudiants, enseignants, chercheurs, professionnels ainsi que pour le grand public. Lien : www.eoearth.org
- ✓ EPO (OEB), site officiel de l'Organisation Européenne des Brevets. Lien : http://www.epo.org
- ✓ Esp@canet, base de données Brevets Européens et Monde hébergée par l'OEB. Lien : http://worldwide.espacenet.com
- ✓ Google Patent, est un moteur de recherche de Google qui indexe les brevets et demandes de brevets de l'USPTO (United States Patent and Trademark Office). Lien : http://www.google.com/patents
- ✓ Google Scholar, est un moteur de recherche de Google qui indexe les publications scientifiques et permet d'effectuer des recherches étendues portant sur des travaux universitaires sur un grand nombre de domaines et de sources : thèses, livres et articles. Ces travaux peuvent provenir des éditeurs scientifiques, des sociétés savantes, des référentiels de prépublication, des universités et d'autres organisations de recherche. Lien : http://scholar.google.com
- ✓ Mathéo Software, propose une suite logicielle (Patent, Analyzer & Web) pour les spécialistes de l'information, de l'innovation, de la R&D, de la propriété intellectuelle, des brevets, de l'intelligence économique, de la veille et de l'analyse de données. Lien : http://www.matheo-software.com
- ✓ PetroWiki, est une Encyclopédie en ligne gratuite spécialisée dans l'industrie pétrolière et gazière, publiée par SPE (Society of Petroleum Engineers). Lien : http://petrowiki.org
- ✓ WIPO (OMPI), site officiel de l'Organisation Mondiale de la Propriété Intellectuelle. Lien : http://www.wipo.int
- ✓ WIPO GOLD, est une ressource publique gratuite permettant d'accéder directement aux collections mondiales de données relatives à la propriété intellectuelle de l'OMPI. Lien : http://www.wipo.int/wipogold/fr/

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Le Repente et Le Stand up-Comédie: Performances Interactives

[Repente and Stand-up Comedy: Interactive Performances]

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ABSTRACT: The purpose of this study is to examine the tradition of *repente* and the practice of stand-up comedy on their similarities and dissimilarities, through certain points such as the space, the interaction with the public, the social aspects and the media. Furthermore, find the possible solutions to the problem of laughter in music. The results of the comparison between the repente and the stand-up comedy showed that the relation between the artist and the audience is fundamental so that the performances can occur, as well as the space demands of each type of presentation must be respected. Concerning the laugh, the music appears as a factor which strengthens its effects. Finally, it discusses the insertion of the repente and the stand-up comedy in the digital era as well as its introduction in different cultures. Alternative solutions to the presentations of repente and the stand-up comedy in distinct contextes can be explored with the intersemiotic translation.

KEYWORDS: Repente, stand-up comedy, technologie, laugh, public.

RESUME: Cet article a pour objet faire une approche de la tradition du *repente* et de la pratique du stand-up comédie concernant les points communs et les différences entre les deux, par le biais de certains points tels que l'espace, l'interaction avec le public, le caractère social et les médias. En outre, trouver les solutions possibles à la problématique du rire en musique. Les résultats de la comparaison entre le repente et le stand-up comédie ont montré que le rapport entre l'audience et l'artiste est fondamental pour que les performances puissent se produire, ainsi que les demandes de l'espace de chaque type de présentation doivent être respectées. En ce qui concerne le rire, la musique apparaît comme un facteur qui renforce ses effets. Pour conclure, l'article aborde des solutions alternatives d'insertion du repente et du stand-up comédie dans l'ère du numérique, et de leur introduction dans différentes cultures. Les nouvelles solutions de présentation du repente et du stand-up comédie dans diverses sociétés se déroulent avec la traduction intersémiotique.

MOTS-CLEFS: Repente, stand-up comédie, technologie, rire, public.

1 INTRODUCTION

1.1 LE REPENTE

La traduction du mot repente en français signifie tout à coup. Il concerne une tradition folklorique typique du nord-est du Brésil dont l'origine est dans les troubadours médiévaux. Il s'agit d'un mélange entre la poésie et la musique, dont l'improvisation est la principale caractéristique. Quand il vient accompagné par une viola, il se définit comme une *cantoria*, et quand il vient accompagné d'un *pandero*, il s'agit d'un *coco de embolada*, dans celui-ci on trouve de l'humour.

Le repente se caractérise par une dispute entre les chanteurs, sous la forme d'un dialogue poétique où le public choisit qui est le meilleur. Ils construisent leurs strophes selon les règles de la rime, de la métrique [1] et de la thématique. Ils doivent aussi suivre les règles d'un Portugais grammaticalement correct.

1.1.1 LES CHANTEURS ET LE PUBLIC

L'interaction entre les chanteurs et le public fournit une éducation à travers la poésie chantée. Le public établit une 'communication' avec les chanteurs, ce qui rend leurs travaux conforme aux intérêts du public à certaines thématiques (la plupart sociales et quotidiennes). De ce fait, les chanteurs doivent être toujours au courant de sujets qui portent sur les connaissances générales et les connaissances locales. Dans le cas du *coco de embolada*, les chansons acquièrent un ton ironique et critique sur la société et la politique.

La régularité de la musique et de la poésie constitue une norme, un code, qui porte une énorme puissance communicative et soulève et intensifie les significations de messages chantés [1].
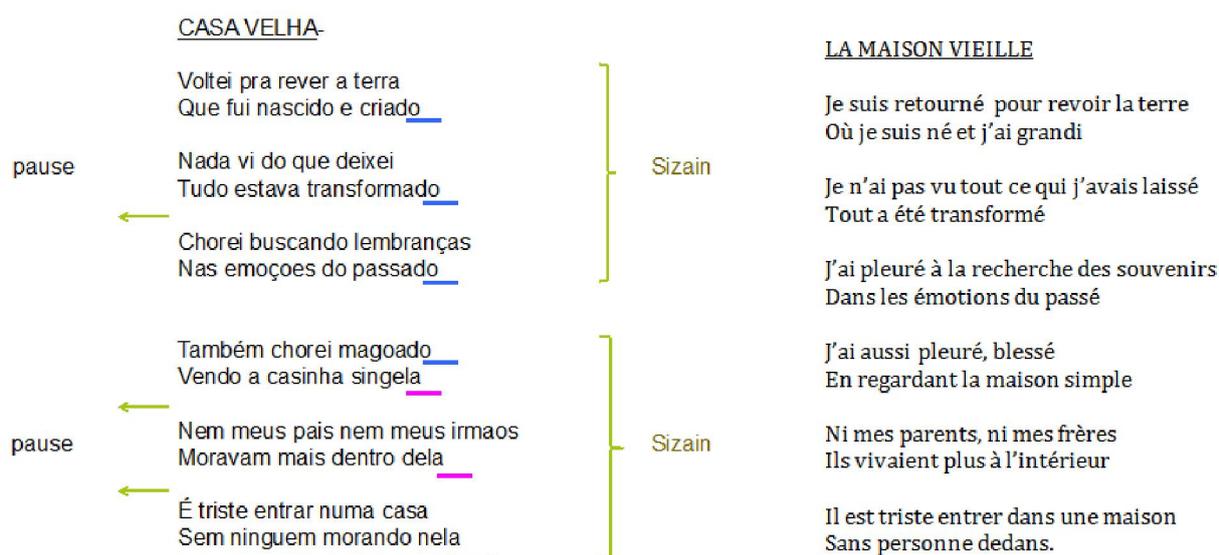
Fig. 1.   La structure de construction de la rime et des strophes

La construction des vers du repente est en sizains, strophes de six vers. Chaque deux vers le chanteur fait une pause pour penser la structure des prochains. Dans la chanson *Casa Velha* (*La maison vieille*) [2], les mots finissant par ADO (soulignés en bleu) sont les rimes qui le premier chanteur utilise et avec lesquelles le deuxième chanteur doit créer son premier vers. Ensuite, en rose sont démontrées les rimes créées par le deuxième chanteur. Les artistes construisent souvent les sizains par un processus à l'inverse, autrement dit, ils pensent avant tout à la fin de la strophe qu'ils iront construire pour après créer les premiers vers.

Deux exemples de chanteurs du repente sont le couple *Caju et Castanha (Cajou et Marron)* et le couple *Valdir Teles et Sebastiao da Silva*. *Caju et Castanha* sont inscrits dans le genre du repente appelé *coco de embolada,* où on peut trouver de l'humour et *Valdir Teles et Sebastiao da Silva* sont inscrits dans le genre de poésie orale appelé *la cantoria*. L'utilisation de l'humour est devenu plus notable lors de l'émigration des *repentistas* (chanteurs du repente) du Nord-Est du Brésil à la ville de Sao Paulo. Dans les grandes villes, certains problèmes comme la difficulté de trouver du travail, les issues politiques et sociales ont demandé des nouveaux moyens d'aborder le repente. Par conséquent, les *repentistas* ont commencé à créer les *coco de emboladas,* notamment dans les trains, dans les rues et d'autres espaces alternatifs, pour pouvoir s'insérer dans le marché du travail. Les espaces alternatifs demandaient des créations qui ironisaient les règles sociales. L'un des couples qui est devenu célèbre dans ce genre musical c'est *Caju et Castanha*.

1.2   LA CANTORIA ET LE COCO DE EMBOLADA

En faisant la comparaison entre la *cantoria* et le *coco de embolada* par rapport à une étude d'image sur le sonagramme (logiciel Audacity) des musiques *Sogra Boa e Sogra Ruim (De bonne et de mauvaise belle-mère)* [3] de *Caju et Castanha* et

Casa Velha (La maison vieille) de *Sebastiao da Silva et Valdir Teles*, il est possible d'observer certaines différences par rapport à la construction des *repentes*. Chacun se construit selon ses propres règles. Dans le premier cas, les voix des deux chanteurs se ressemblent. Il n'est pas possible de vérifier certaines différences par rapport à la hauteur de la voix, les deux fréquences sont presque égales, les différences sont ténues. Par ailleurs, dans le *coco de embolada* les artistes créent leurs strophes suivant leurs propres règles, mais le rythme musical est plus rapide par rapport à celui de la *cantoria*. Pour ce qui touche à la cantoria, une analyse d'image sur le sonagramme de la chanson *Casa Velha* nous montre les fréquences qui distinguent la voix d'un chanteur de l'autre chanteur. Les sizains et les pauses entre chaque deux vers sont aussi bien définis à l'Audacity. Un autre aspect observé dans *Casa Velha* c'est le prolongement du mot final chanté au dernier vers du sizain. Ce type de prolongement caractérise presque un vibrato [1] et donne une force expressive au poème chanté.
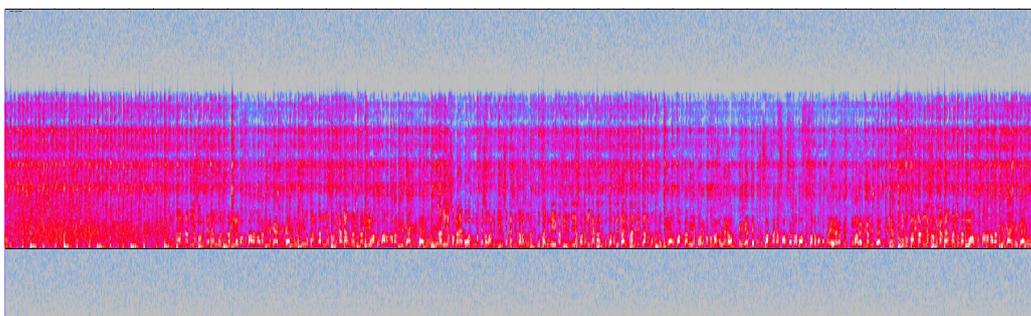
Fig. 2.   Sogra Boa e Sogra Ruim (De bonne et de mauvaise belle-mère)
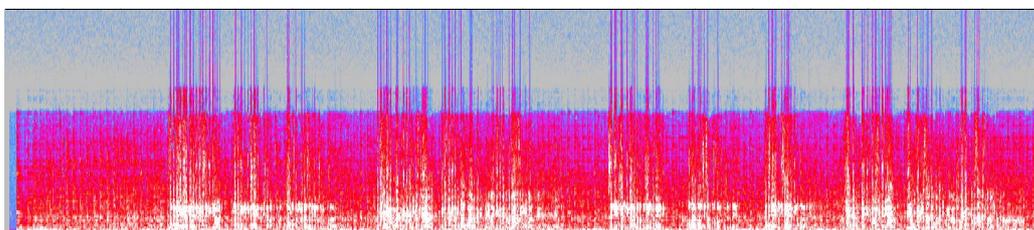
Fig. 3.   Casa Velha (La maison vieille)

2   LE STAND-UP COMEDIE

Le stand-up comédie, selon certaines théories découle d'une pratique des monologues de la Grèce antique, monologues [4] qui ont servi à amuser le public. Après un certain temps, ils ont été dotés d'un ton satirique, et ils ont commencé à être présentés à la population. Ainsi, le public a été déporté dans des nouveaux points de vue auxquels il pourrait s'identifier.

Dans le stand-up comédie la responsabilité du rire est déplacée sur le public [5].

2.1   LE COMEDIEN ET LE PUBLIC

Il existe une interaction entre le comédien et le public, où le rire n'est pas un facteur de stimulus-réponse, selon d'autres types de théories portant sur une analyse des raisons pour lesquelles nous rions, mais fait partie de la réaction réciproque entre le comédien et le public.

L'Audience va interrompre l'écoulement de la plaisanterie et réorganiser la séquence en prenant leurs propres commentaires, des questions et des mots d'esprit. L'Audience peut bien finir la blague lancée par quelqu'un d'autre, fournir des fins alternatives ou même changer de sujet pour empêcher l'achèvement de la plaisanterie. Cela ne veut pas interférer avec l'expérience d'humour parce que c'est l'expérience humoristique [5].

Le public commence à prendre un rôle actif dans les performances, ils peuvent remodeler et répondre à certaines questions de manière à créer un dialogue avec le comédien. Le rire dans un contexte social dépend de facteurs tels que la taille de l'espace, la place où les gens s'assoient, le sexe [5] mais aussi et surtout le fait d'être tout seul ou en groupe.

Notamment, le directeur de théâtre Jack Morrison, [5] a pu constater à travers une expérience, que les plus grand l'audience plus grande la quantité de rires.

Un stand-up est un événement public. Il implique d'être en compagnie des inconnus pendant un certain temps. Les personnes présentes dans l'auditoire n'ont pas de contrôle sur le lieu choisi pour réaliser la performance, ni sur ce qui sera présenté par le comédien [5].

Le stand-up n'impose aucune limite sur qui peut voir la performance ou non, il n'y a pas de sièges réservés, toutefois il y a certaines méthodes de comportement qui doivent être respectées par le public.

2.2 ÉTUDE DE CAS

Dans L'avion de Barbie [6] de Florence Floresti et Job or Career [7] de Chris Rock on peut trouver certains éléments qui illustrent les concepts abordés auparavant. Dans les deux cas il est possible d'observer la participation directe du public dans la performance au moment où l'artiste la demande, ou quand l'artiste réagit à certaines réponses de l'auditoire. Selon les réactions du public, l'artiste mène la présentation de façons différentes.

Un autre point observé de la comparaison entre les deux spectacles c'est par rapport à la différence des cultures. D'abord le rire est un comportement lié à facteurs sociaux, par conséquent l'appréciation de ce genre de spectacle est différente selon les cultures. Ce qui est drôle pour certains n'est pas forcément humoristique pour d'autres qui appartiennent à des cultures différentes. Les langages et les contenus présentés dans chaque stand-up définissent un certain type de public. Pour conclure, le stand-up comédie n'impose pas des limites sur qui peut voir la performance mais définit certaines classes sociales et les publics cibles qui partagent d'idées et la réalité abordée par l'artiste.

« La référence [5] montre que la bande dessinée, pour Bogardus, ainsi que la plaisanterie, est un instantané de l'opinion populaire et une représentation des sentiments d'une culture ».

3 LES SIMILITUDES TROUVEES ENTRE LE REPENTE ET LE STAND-UP COMEDIE ET LES QUESTIONS POSEES

3.1 L'ESPACE

Le repente se présentait souvent dans des petits espaces tels que des petites salles, bars [8] et restaurants. Espaces similaires ont été utilisées pour les présentations de stand-up comédie, ils étaient des lieux informels, pas trop grands, qui fournissaient une meilleure interaction artiste-public. Selon les points abordés précédemment, le rire est un facteur social et alors il est nécessaire plus d'une personne pour qu'il se produise. Par conséquent, selon une recherche réalisée par Jack Morrison, comme mentionné précédemment, le plus grand l'audience, le plus grande la quantité de rires, puisque qu'il y aura plus de personnes ensembles. Les présentations du repente et du stand-up comédie se produisent souvent dans les petits espaces, néanmoins, dans le cas du repente, il peut encore se manifester dans les festivals et dans le cas du stand-up comédie certaines présentations sont faites dans les espaces créés pour recevoir une plus grande quantité de personnes.

Cependant, la taille de l'espace devient relative de ce point de vue, car il existe d'autres facteurs tels que la distance entre les gens, la position dans laquelle ils se trouvent par rapport aux autres (assis en face ou à côté de la personne) [5] ainsi que des questions de genre sont pris en compte dans l'évaluation de l'espace. Souvent l'organisation des grands espaces pour la présentation des repentes et du stand-up comédie part d'initiatives des secteurs publics qui ne tiennent pas compte de l'ambiance intimiste que ces genres de présentations évoquent, mais qui voient le point de vue lucratif de l'ampliation de l'espace des performances. On peut conclure que la relation audience-espace peut intervenir dans le rire et dans l'interaction public-artiste c'est pour cette raison qu'il faut respecter les demandes de l'espace de chaque type de présentation artistique.

Pour de nombreux chanteurs, les grandes compétitions, impliquant un plus grand nombre de participants, bien qu'ils représentent un bon moyen de faire connaître le repente dans la métropole, ce qui finit par attirer de nouveaux téléspectateurs, ils n'ont pas une telle légitimité à la consécration du « meilleur » chanteur [9].

3.2 L'INTERACTION AVEC LE PUBLIC

Dans le chant du repente, le dialogue entre le public et les repentistas permet d'extraire le sens collectif de l'interprétation qui indique que la pensée du chanteur communiquée par la poésie chantée comprend également les «paroles» [8] de l'auditoire.

Dans les stand-up comédies les silences et les rires entendus dans les spectacles sont une réponse du public à la performance du artiste et servent de paramètres afin qu'il puisse savoir comment conduire la performance. Selon mentionné précédemment, l'artiste du stand-up comédie peut poser des questions ou réagir aux rires de l'audience.

Le repente et le stand-up comédie sont des présentations à effectuer qu'une seule fois, autrement dit sont effectuées à partir d'un échange simultané artiste-public dont chaque exposition est différente, chaque spectacle est différent. L'appréciation de l'œuvre se produit au moment de l'interaction, exprimée comme une conversation.

3.3 Caractère social

Les artistes du stand-up comédie créent des lacunes à être répondus par le biais de l'interprétation du public. Grâce à une relation ironique, les thématiques sociales et politiques sont discutés et réfléchies ensemble.

Le stand-up sert de correctif aux inégalités sociales puisqu'il met en question nos valeurs sociales les interrogeant par l'intermédiaire de sujets tels que la race, la sexualité, le sexe, etc. [5].

Identique au stand-up comédie, le repente est extrêmement lié à la société. Dans les constructions des poèmes chantées les artistes doivent savoir les thématiques qui sont les plus demandées par les spectateurs, ils doivent se mettre à jour sur les événements actuels qui se produisent dans leur région et dans le monde, afin de construire leurs rimes et gagner la dispute contre l'autre chanteur quand le public les demande un certain sujet. Les thèmes souvent abordés sont des domaines d'apprentissage généraux, l'enfance, le désir, [1] entre autres et ils sont attribués de valeurs sociales.

Ensuite, le stand-up comédie ou le repente, abordent des thèmes qui sont importants pour le public puisque sont intrinsèquement liés à leurs vies quotidiennes. L'humour devient dans le stand-up comme dans le coco de embolada, une façon critique de démontrer et poser des questions sur l'actualité sociale sous la forme d'un dialogue avec le public. Il est une façon de réfléchir sur les situations politiques, économiques et sociales.

3.3.1 Les sentiments evoques par les chansons du repente

Les chansons du repente évoquent certains types de sentiment. Par exemple, il y en a certaines qui sont considérées comme agressives (destinés aux challenges), en raison d'un timbre strident, d'autres sont considérées comme douloureuses (utilisées pour les thèmes tristes, par exemple les ruptures amoureuses, les hommages posthumes, etc.) en raison de récurrences dans les 3eme et 6eme tons, en provoquant la sensation d'une tonalité basse [1].

La musique sert à soutenir les chanteurs donc ils peuvent se guider dans la construction du rythme de la chanson.

En parallèle avec le sens du rire, on peut dit que certains types d'instruments tels que le *pandeiro*, utilisé dans les *coco de emboladas* (Sogra Boa et Sogra Ruim), et le rythme rapide de ce genre de chansons, donnent le sentiment du comique. La liaison entre les facteurs précédents, la construction de phrases improvisées et la participation du public, génère le rire.

Un autre aspect qui pointe des solutions sur comment le rire peut être exploitée dans la musique et sur les réactions de l'auditoire qui regarde les présentations du repente et du stand-up comédie, c'est l'idée que le rire est typique de l'homme. Les caractéristiques ancestrales du rire provoquent le sourire sur ceux qui l'écoutent.

La forme du rire est simple et temporellement symétrique, ce qui suffit pour être reconnaissable quand on l'entend. Cela suggère « une forte base génétique » [5].

En conclusion, les musiques ont le pouvoir de renforcer la capacité à nous faire rire, soit invoquant les situations caractérisées comme drôles présentes dans l'imaginaire des individus, soit parce que le son ressemble à un rire humain. Cet aspect peut être abordé par plusieurs artistes qui veulent utiliser à travers une pratique multimédia, l'ironie et le rire pour potentialiser conceptuellement leurs œuvres.

3.4 Média

Une des seules choses qui ne souffre pas de changements dans le repente est sa caractéristique d'improvisation, c'est l'une des causes du repente n'attirer pas beaucoup d'attention de l'industrie culturelle. Les repentistas ont trouvé nouveaux défis quand ils ont émigré du nord-est au sud-est du Brésil. Les repentes ont commencé à être réalisés dans les studios d'enregistrement, révélant unné transformation importante du repente quand alliée à la technologie par le biais des dispositifs de médiation. A partir de ce changement certaines chansons ont devenu un succès national comme par exemple la chanson *Asa Branca (La blanche aile)* des auteurs Luiz Gonzaga et Humberto Teixeira.

3.4.1 LE ROLE DES MEDIA DANS LE STAND-UP COMEDIE

Dans le stand-up comédie les médias sont souvent utilisés pour transmettre la performance à la télévision pour ceux qui veulent la regarder de nouveau et pour ceux qui ont raté la performance en direct. À partir des divers expérimentes réalisés par les psychologues Robert Provine et Kenneth Fischer [5], ils ont pu constater que les individus qui regardent les programmes de l'humour à la télé rient moins que dans les situations sociales. Ils ont également montré que le rire enregistré utilisé dans les programmes aide à augmenter les taux de rire, mais les niveaux ne sont pas tellement importants comparativement au rire social.

Table 1. L'Influence des facteurs sociaux et des médias sur le rire

	LAUGHING			SMILING			TALKING		
	Media	No Media	Total	Media	No Media	Total	Media	No Media	Total
Alone	.072	.012	.082	.064	0.74	.130	.130	.168	.250
Social	.064	.397	.428	.106	.473	.538	.281	.721	.814
Total	.129	.395	.494	.169	.514	.624	.359	.781	.900
n	28			22			22		

Comment la technologie peut-elle aider à augmenter les taux du rire quand on est tout seul et on veut sentir les mêmes sensations qu'on a eu dans la présentation en direct, après la performance ? Les tentatives de répondre à cette question seront abordées ensuite.

4 LES ALTERNATIVES TECHNOLOGIES POUR LA PRODUCTION DE PRESENTATIONS DU REPENTE ET DU STAND-UP COMEDIE

Insérés dans un monde en changement vers les nouvelles technologies, le repente et le stand-up comédie peuvent se bénéficier de nouveaux modes de présentations numériques. Parmi des nouvelles solutions la traduction des œuvres semble être une bonne alternative. Le rôle de la traduction consiste à ajouter une valeur créative à l'esthétique de la présentation. Une traduction qui tend à reconstituer l'oeuvre originale génère un appauvrissement de l'information. Plutôt que reconstruire les aspects originaux de la performance il faut trouver solutions artistiques inédites, cet aspect va enrichir les informations esthétiques de l'œuvre.

Au moyen d'une approche numérique de traduction de l'œuvre, appelé la traduction intersémiotique, la participation du spectateur est demandée. L'interactivité est une façon de recréer l'expérience d'être devant l'œuvre original. Ce fait pourrait continuer le processus d'interaction artiste-l'œuvre de façon numérique, autrement dit, pour ceux qui ne pouvaient pas regarder l'œuvre en temps réel peuvent toujours interagir avec elle par le biais de nouvelles solutions traductrices de l'expérience. L'interaction est fondamentale pour la création d'œuvres et performances en temps réel, ainsi que dans les traductions ultérieures.

Ainsi, il est fondamentale cerner et se concentrer sur les nouvelles présentations esthétiques d'une œuvre à travers la traduction intersémiotique, qui fournit « déplacer un contenu esthétique de différents manières » [10].

Ce type de traduction qui englobe la technologie est bénéfique, car la poésie a une forte relation avec le temps passé, le souvenir et la mémoire. De ce fait, le repente et le stand-up comédie, selon abordé précédemment, ont une liaison avec l'époque et la société, il faut qu'ils choisissent les thèmes actuels. Par l'intermédiaire de la traduction intersémiotique et de l'utilisation de la technologie, le repente et le stand-up peuvent s'adresser à tout type de public, n'importe où dans le monde, autrement dit, leurs présentations peuvent s'adapter aux différents contextes sociaux. Cet aspect est fondamental pour la préservation du repente dans les grandes villes comme par exemple la ville de Sao Paulo. La traduction intersémiotique et l'interactivité peuvent être une solution à cette affaire, car ils ne détruisent pas le caractère fondamental du repente et ils l'adaptent aux nouvelles exigences sociales. On peut conclure que les différents contextes sociaux requièrent nouvelles expérimentations avec les techniques numériques.

5 CONCLUSION

Le repente et le stand-up comédie sont deux genres de « performance » artistique qui ont certains points en commun. Les deux ont de l'humour comme l'une des principales caractéristiques de leurs présentations et prennent en considération les facteurs sociaux.

La musique peut augmenter les taux de rire. Ce résultat peut être exploité dans le stand-up comédie par le biais de sons de fond dans les présentations. Un exemple d'artiste qui a fait cette expérience c'est Bernard Heidsieck [11], artiste français né à Paris en 1928. Il mélange la présentation scénique à la présentation enregistrée transmise par les haut-parleurs simultanément. L'effet de ce mélange sont deux lectures qui se complémentent. La partie enregistrée renforce le concept diffusé par la poésie scénique.

Une possible solution serait aussi de créer une interface interactive au modèle de Siri, application IPhone. Cette interface interactive intelligente permet un dialogue entre l'individu et le programme. Il s'agit d'une voix qui interprète les questions posées par l'individu et les répondent de façon créative et avec le humour. Ce modèle d'interface pourrait être réalisé par les artistes du stand-up comédie selon une interaction question-réponse (préalablement programmée) où se passerait une communication entre l'image vidéo de l'artiste et l'individu.

Le fait que chaque présentation du stand-up et du repente soit unique et s'établit dans un lieu et une date donnée, n'empêche pas que d'autres alternatives soient pensées pour ceux qui ne pouvaient pas voir la performance ou qui voulussent la revoir. Les nouvelles solutions de présentation du repente et du stand-up comédie dans diverses sociétés se déroulent avec la traduction intersémiotique. Cette traduction comprend l'utilisation de la technologie et de la programmation de sorte qu'elle inclut aussi l'interactivité. Ce serait un moyen de ne pas intervenir dans la structure de base du repente et du stand-up, mais créer des résultats similaires de l'expérience avec l'œuvre par le biais de nouvelles traductions intersémiotiques.

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A Quantitative Approach for Measuring Technological Forecasting Capability

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ABSTRACT: Successful technological forecasting is important to invest scarce funds to emerging technologies. A generic model to measure the success of forecasting overall technological changes is introduced in this paper, called degree of Technological Forecasting Capability. It measures the success rate of forecasts in manufacturing processes based on four important aspects of a manufacturing system; Flow Time, Quantity/Day, Scrap Ratio, and New Investment Revenue. The proposed approach has been verified with a case study in manufacturing industry, where each of 4 facets have been calculated based on the data provided and aggregated into the degree of forecasting capability.

KEYWORDS: Technological Forecasting, Metric, Degree, Capability, Manufacturing.

1 INTRODUCTION

Technological forecasting is the process of predicting the future characteristics and timing of technology. If it is possible, the prediction will be quantified, made through a specific logic, and will estimate the timing and degree of change in technological parameters, attributes, and capabilities [1]. The importance of Technological Forecasting appears to be a principal impetus in economic development. Based on this importance, technological forecasting has often been used to support policy making processes in technical issues [2]. Companies and even the countries perform technology foresight programs, which are mostly assessed with Delphi method by the expert estimates [3]. Companies capable of undertaking technology forecasting can benefit in numerous ways including maximizing financial gains and minimizing the losses [4]. For example regarding a study performed by Linstone [5], which sets three eras of technology foresight and for the future era imposing the importance of nano and bio technologies, can provide benefits for the companies dealing in this sector. Since technological forecasting is an important concept, various studies attempt to find a proper way to perform, can be classified into 2 types of studies; Numerical Techniques, and Judgmental Techniques, and summarized below (See for examples, [1], [4], [6], [7], [8], [9], [10].

1.1 NUMERICAL TECHNIQUES

These are the ones, which generally base on numerical computations and less subjective compared to the Judgmental Techniques. *Trend Extrapolation*, which assumes a stream of technological change to continue from past to future, includes Statistical Curve Fitting, Limit Analysis, Trend Correlation, and Multivariate Trend Correlation techniques (See for more detail [9]. *Growth Curves* are based on the parameter estimation of a technology's life cycle curve including; introduction, growth, maturity, and decline phases [11]). Combination of trend analysis and growth curves forms the *Envelop Curves*, which is more suitable in case of rapid technological transformations. *Substitution Model* basically demonstrates the advantages of future technologies over past technology in case of a substitution.

1.2 JUDGMENTAL TECHNIQUES

Since performing technological forecasting is not only an issue of numbers and calculations, subjective perspectives are also required to anticipate future trends in technology. *Monitoring* allows the forecaster to stay abreast of technologies as they develop through 7 stages namely; Initial Idea, Postulation of Theory, Verification of Theory, Laboratory Demonstration, Field Trial, Commercial Introduction, Widespread Adoption [9]. *Scenarios*, which proposes different conceptions of future technology and each alternative scenarios (for Pessimistic, Base, and Optimistic situations) are based on certain assumptions and conditions [12]. *Relevance Trees* are used to select a specific research project by defining objectives, goals, tasks, and sub-objectives in a hierarchical order to ensure to achieve all possible ways for the main objective. *Delphi Method*, which is the best known judgmental approach, gathers subjective judgments from individuals as written or remote distance to prevent interactions. These judgments are summarized and presented to participants. The past and the future evolution of Delphi method is well summarized in the literature [13].

Moreover, a study is performed to set emerging forms of technological forecasting including; Scenario Management, TRIZ, Multiple Perspectives, Co-evolution of Technology, Scientometrics, Bibliometic Analysis, and Datamining Tools (see for more detail, [14]. Within these, TRIZ needs to be more clarified, which is a Russian acronym for the "Theory of Inventive Problem Solving" developed by G.S. Altshuller and his colleagues in the former U.S.S.R. between 1946 and 1985. It is an international science of creativity that relies on the study of the patterns of problems and solutions, not on the spontaneous and intuitive creativity of individuals or groups (see for more detail, [15]. Although it is widely accepted from different areas of innovation and forecasting studies, the manufacturing perspective is missing in case of technological forecasting. On the other hand technological forecasting is proved to be a method for a decision making tool in respect to the analysis [16].

As seen above there are so many different techniques for technological forecasting. Since the quality of forecasts greatly depends on proper selection and application of appropriate techniques, a method is proposed in selection of complementary and appropriate techniques for a technology [17]. One of the crucial factors about choosing a forecasting strategy is the potential economic value of the forecast compared with the cost of making the forecast. Some methods are much more expensive than others, and some tend to give better results for certain situations. Since data are generally available for short range forecasting problems, extrapolation techniques work best for short term. For long range forecasts, the judgmental methods are more suitable because, as time periods are extended, the dangers of unjustifiable extrapolation grow rapidly.

Hence the discussion of the selection of technology forecasting method is crucial, a recent study adopted the Fuzzy Analytical Hierarchy Process method to obtain professionals' opinions on this issue [18]. However, its main focus is on the prediction of new materials development, so it is not a generic model for manufacturing systems. Also, in the literature a foresight method is proposed for detecting areas in the Information Technology (IT) industry by applying Delphi and AHP methods [19]. In addition, a data envelopment analysis (DEA) based methodology has been used to predict the future wireless communication technologies in the study which presents a framework to characterize, assess and forecast new technologies [20]. Although they are well organized study, they focus on IT systems not the manufacturing systems. Since the assessment of forecasting is important a study has been performed to analyze forecasting accuracy of wind power technologies across different countries [21]. Although the forecast accuracy is assessed using multiple different measures [22], [23], the aim of forecasting is bounded with technology diffusion models for wind powers only. However technological forecasting for manufacturing systems requires more specific properties to be enlightened.

The emphasis of this study particularly goes towards to set a quantifiable model to measure the capability of performing technological forecasting for manufacturing systems. Since it is more risky to make blind-investments to inconvenience technological improvements especially for the manufacturing processes, it is required to anticipate the outcomes in advance. This can only be held by successful forecasting methods. Although the aforementioned literature delineate some methodologies for technological forecasting, it is hard to observe an evidence of measuring the success rate of performing these forecasts. Selecting the best promising technological developments among various unprofitable and inconvenient ones, the performance to forecast the new technologies needs to be measured especially for the manufacturing systems.

To the best knowledge of the authors, a limited amount of literature is available on measuring the capability of technological forecasting performance especially focusing on the manufacturing processes. Besides, setting a quantifiable metric scale to measure the capability of performing technological forecasting is as well important as performing the forecast. Hence, the main aim is not to measure forecasting but to measure the forecasting capability. Therefore the main motivation of this study is to develop a quantitative approach to measure the success rate of technological forecasting regarding the manufacturing systems. This novel method sets a metric scale relying on 4 important technological aspects of manufacturing systems, which will be elaborated while setting the model to measure the degree of technological forecasting, in the next section.

2 TECHNOLOGICAL FORECASTING CAPABILITY

Most of the studies to forecast the technology are dependent on the specific attribute of the products, for example the flight range or the bomb capacity of the air fighters are examined to be forecasted [24]. However the main aim of this study is to establish a generic methodology to measure the capability of the technological forecasting in different manufacturing areas. Therefore, the focus to measure the technological forecasting capability will be on the general technological aspects of manufacturing systems. These aspects, which should be mutually exclusive and collectively exhaustive to represent the changes in technology, are proposed to be *Flow Time, Quantity/ Day, Scrap Ratio,* and *New Investment Revenue*. In order to measure the capability of technological forecasting, actual values of these aspects should have been recorded. Depending on the existence of a technological development, a forecasting study should have been carried out to find the outcomes of this development. Then by comparing the forecasted and actual outcomes, the degree of forecasting capability is found. Note that, if there is not a technological development then there is nothing to deal with measuring the forecasting capability of the new technology because it does not exist. On the other side, if there is not a forecasting study although a technological development exists, then forecasting capability is assumed to be zero.

In the next sections each of the 4 aspects of manufacturing systems are explained by defining the reason to be selected as the indicators to measure the capability of technological forecasting. In addition the methodology to compute the degree of forecasting capability for each indicator is revealed.

2.1 FLOW TIME (F)

It is the period required for a material, part, or subassembly to pass through the manufacturing process. It is obvious though, the technological developments, for example a new machine or tool usage, will definitely decrease the flow time of the production. Basically forecasting capability in estimating the flow time is calculated by comparing the actual and forecasted values for each product. However it is cumbersome to cope with and record the actual and forecasted values when there are hundreds of product types. Therefore the average flow time can be found by dividing the available working hour by total production amount, resulting a unit production time on average.

In order to measure the capability in estimating the flow time in this way, the first step is to look for the existence of a technological improvement; note that, when there is no technological improvement whatsoever then there will not be a need to forecast the effects of it. At the second step, actual flow time for the products should be recorded. However, the flow time for each product may vary. Instead of dealing with flow time of each unit, actual average flow time of the products (F) can be calculated by dividing the available working time (T), by the actual total production amount (N) of the system as shown in Eq. 1.

$$F = T/N \qquad (1)$$

At the third step, forecasted flow time is required to measure for the sake of comparison of actual and forecasted values. Similarly, average forecasted flow time (F') is calculated by dividing the available working time (T), over the forecasted total production amount (N') as shown in Eq. 2.

$$F' = T/N' \qquad (2)$$

At the last step, the capability of forecasting is assessed by comparing the forecasted and actual average flow times (Eq.3.). This comparison represents the capability of performing technological forecasting with respect to flow time aspect of the manufacturing system.

$$FC_F = 1 - (|F' - F|/F) \qquad (3)$$

Where;

FC_F: Forecasting Capability of "Flow Time"
F': Forecasted value of "Flow Time"
F : Actual value of "Flow Time"

2.2 QUANTITY/DAY (Ø)

This is another important aspect of technological change. Although it looks like similar to flow time, it has some differences. The flow time indicates the production *speed*, whereas, the quantity/day represents the production *capacity* of the system. This capacity is not only dependent on the employees working rate, but also high technology machinery usage or

highly trained- skilled workers. Hence, forecasting the capacity of the system is an indicator of forecasting the outcomes of the technological machinery used in the system assuming the employees working rate as constant.

Similar to Flow Time, in order to measure the capability of the performance of forecasting the Quantity/Day (Ø), actual monthly production levels (Ᵽ) for each year should be recorded at first. Dividing this value by the number of working days (Ð) in a month provides the actual daily production level. Note that this should also be divided by the number of workers (Ŵ) to eliminate the effect of worker size (Eq. 4.).

$$\emptyset = Ᵽ/(Ð * Ŵ) \tag{4}$$

Beyond this, monthly production levels have to be forecasted due to technological changes (if any) for each year. Forecasted production level ($Ᵽ'$), should also be divided by the number of working days (Ð) and the number of workers (Ŵ) to achieve forecasted daily production level ($\emptyset'$), of the same production line (Eq. 5.).

$$\emptyset' = Ᵽ'/(Ð * Ŵ) \tag{5}$$

Consequently the comparison between the forecasted and actual daily production levels provides the forecasting capability of "Quantity/Day" ($FC_\emptyset$) as shown in Eq.6.

$$FC_\emptyset = 1 - (|\emptyset' - \emptyset|/\emptyset) \tag{6}$$

2.3   SCRAP RATIO (Š)

This is in fact the indicator of quality and an important aspect of the technology in manufacturing systems. If the main aim is to measure the capability of performing technological forecasting successfully, the changes in this respect should be foresighted and the quality of the products should naturally be improved through them. It is clear that, the scrap ratio will most probably diminish in case of implementing new technological machinery or systems even if working with the same workers and environment. Successful capability of forecasting the Scrap Ratio is therefore important as it is definitely affected by the changes in technological investments. By comparing the actual (Š) and forecasted (Š') scrap ratios, capability of performing technological forecasting regarding "Scrap Ratio" ($FC_Š$) aspect, could be assessed as shown in Eq.7.

$$FC_Š = 1 - (|Š' - Š|/Š) \tag{7}$$

2.4   NEW INVESTMENT REVENUE (Ř)

This is another example of technological aspects of the manufacturing system. To manage the technological changes, new investments on machinery or other systems are inevitable. But, it is desired to know how much revenue, the new investment will gain. In order to achieve this information, a forecasting study should be carried out. The capability of forecasting the "Revenue" ($FC_Ř$) from new technologies is calculated by comparing the actual revenue (Ř) and forecasted revenue (Ř') values if any new technology is implemented as shown in Eq.8.

$$FC_Ř = 1 - (|Ř' - Ř|/Ř) \tag{8}$$

2.5   DEGREE OF FORECASTING CAPABILITY

Four aspects namely; *Flow Time*, *Quantity/Day*, *Scrap Ratio* and *New Investment Revenue* are stated to be important indicators that are highly affected by the changes in technologies. In order to analyze the outputs of technological changes, forecasting studies should be carried out for each of these facets. Degree of Forecasting Capability (δ FC) is calculated as the weighted summation of these 4 indicators as represented in the following equation (Eq. 9).

$$\delta FC = \sum_{i=1}^{4}(W_i * FC_i)/\sum_{i=1}^{4} W_i \tag{9}$$

Where;

δ FC: Degree of Forecasting Capability
FC_i: Forecasting Capability of Aspect i.
W_i: Weight of Aspect i.
i: Aspects (Flow Time - Ƒ-, Quantity/Day -Ø-, Scrap Ratio -Š-, and New Investment Revenue -Ř-)

Note that the weight values related to respective indicators are required to normalize the effect of each aspect and can be determined by a survey conducted by both the academicians and industrial representatives.

3   CASE STUDY

The proposed model is implemented as a proof of concept with analyzing the capability of technological forecasting in a manufacturing company producing flex pipes, called KAS FLEX Ltd. It is intended to check the capability of forecasting in the manufacturing process after some attempts of technological improvements achieved within the time period from 2006 to 2009.

Within the analysis period, it is realized that there was no technological change implemented on the flex production process in 2006 and 2007. Therefore, there is no need to make a forecast of the outcomes of the technological change for these two years. However, in 2008 welding technology is changed from induction welding to tig welding. Additionally, in 2009 a new welding machine with 4 handles is added to welding center. The actual outcomes of these changes should therefore be compared with the forecasted ones according to pre-defined 4 technological aspects in flex production process namely; *Flow Time, Quantity/Day*, *Scrap Ratio*, and *New Investment Revenue*. Since only in 2008 and in 2009, technological improvement occurs, forecasting capabilities of each aspect, which are found by Eq. 3, 6, 7, and 8, should be averaged for 2 years-period.

3.1   ANALYSIS OF "FLOW TIME"

In order to measure the capability to forecast the flow time, actual and forecasted capacity in each shift -accompanying with the working time- for each year is taken from the company records in KAS FLEX production facility and given in the "Data" part of Table 1.

Depending on this information, actual and forecasted flow time of each unit can be calculated by dividing the working time over the capacity values by Eq. 1 and Eq.2. Forecasting capability for flow time can be measured by comparing the actual and forecasted values by Eq. 3 for each year. The overall forecasting capability is the average of the third and fourth years and found as 85.42% for this respect as shown in "Analysis" part of Table 1.

Table 1.   Forecasting Capability for "Flow Time - Ⅎ-"

	"Flow Time" Forecasting	2006	2007	2008	2009
DATA	Actual Capacity/Shift (unit)	700	700	1250	5000
	Working Time/Shift (min.)	540	540	540	540
	Forecasted Capacity/Shift (unit)	No Forecast	No Forecast	1200	4000
ANALYSIS	Actual Flow Time (min/unit) (Eq. 1)	540/700= 0.771	0.771	0.432	0.108
	Forecasted Flow Time (min/unit) (Eq. 2.)	Not Applicable (NA)	(NA)	0.450	0.135
	Forecasting Capability (%) (Eq. 3.)	Not Measured	Not Measured	95.830	75.000
	Average Forecasting Capability of Flow Time (%)	$\dfrac{95.83 + 75.00}{2} = 85.42$			

This score represents a high degree for this capability since the forecasted and actual respective values are very close. Hence the company can be stated as successful to measure the capability of performing technological forecasting regarding the "Flow Time" aspect of the manufacturing process.

3.2   ANALYSIS OF "QUANTITY/DAY"

In order to measure the capability of forecasting "Quantity/Day" value, actual and forecasted average monthly production levels -accompanying with the number of workers and working days- for each year is taken from the company records and given in the "Data" part of Table 2.

Depending on this information, actual and forecasted daily production levels can be calculated by dividing the monthly production level over the number of working days and number of workers (Eq. 4 and Eq. 5, respectively). Technological Forecasting capability for each year is calculated by Eq. 6, and the average forecasting capability for Quantity/Day for KAS FLEX are calculated as 72.05% and given in "Analysis" part of Table 2.

Table 2. Forecasting Capability for "Quantity/Day -Ø-"

	Quantity/Day" Forecasting	2006	2007	2008	2009
DATA	# of Workers	7	10	22	36
	# of Working Days/Month	22	22	22	22
	Actual Average Monthly Production Level	30000	50000	75000	117000
	Forecasted Monthly Production Level	No Forecast	No Forecast	60000	75000
ANALYSIS	Actual Daily Production/Worker (Eq. 4)	30,000/ (7*22) = 194.805	227.273	154.959	147.727
	Forecasted Daily Production (Eq. 5)	(NA)	(NA)	123.967	94.697
	Forecasting Capability (%) (Eq. 6)	Not measured	Not measured	80.000	64.100
	Average Forecasting Capability for Quantity/Day (%)	$\dfrac{80.00 + 64.10}{2} = 72.05$			

This result indicates that, company is aware of the yield of technological changes in accordance with this aspect with 72.05%. When the forecasted and actual average monthly production levels are compared, it is seen that the company has underestimated production levels. Although the actual levels are greater than the forecasted values, the differences between these values diminish the forecasting capability of "Quantity/Day" aspect of the manufacturing system.

3.3 ANALYSIS OF "SCRAP RATIO"

Similarly, to be able to measure the forecasting capability for Scrap Ratio, actual and forecasted scrap ratios for each year is sought from company records as shown in the "Data" part of Table 3.

Table 3. Forecasting Capability for "Scrap Ratio -Š-"

	"Scrap Ratio" Forecasting	2006	2007	2008	2009
DATA	Actual Scrap Ratio (%)	15.00	15.00	8.00	3.00
	Forecasted Scrap Ratio (%)	No Forecast	No Forecast	11.00	5.00
ANALYSIS	Forecasting Capability (%) (Eq. 7)	No Need	No Need	62.50	33.33
	Average Forecasting Capability for Scrap Ratio (%)	$\dfrac{62.50 + 33.33}{2} = 47.92$			

Based on this information the forecasting capabilities for each year are calculated by Eq. 7. The average capability for forecasting the scrap ratio is calculated as 47.92% and shown in "Analysis" part of Table 3. Although it seems good for the actual scrap ratio being less than the forecasted value, forecasting capability is not very high. The company can only estimate the 48% of the decrease in actual scrap ratio.

3.4 ANALYSIS OF "NEW INVESTMENT REVENUE"

In order to measure the capability to forecast the capability for "New Investment Revenue" of the company, actual and forecasted revenues for each year is used from the company records and shown in "Data" part of Table 4.

Table 4. Forecasting Capability for "New Investment Revenue -Ř-"

	"New Investment Revenue" Forecasting	2006	2007	2008	2009
DATA	Actual Revenue (TL)	2,565,461	4,456,065	6,224,000	8,058,268
	Forecasted Revenue (TL)	No Forecast	No Forecast	No Forecast	No Forecast
ANALYSIS	Forecasting Capability (%) (Eq. 8)	Not measured	Not measured	0	0
	Average Forecasting Capability for New Investment Revenue (%)	0			

Based on the information obtained, the forecasting capabilities for each year are calculated by Eq. 8. The average capability for forecasting the scrap ratio is calculated as 0% and shown in "Analysis" part of Table 4. Since there is not any forecasting value for the revenue aspect, the overall forecasting capability for the revenue is set to zero. This means that; although two important technological changes occur in the flex production process, there is a lack of information and forecasting study about how the changes will affect the revenue.

3.5 DEGREE OF FORECASTING CAPABILITY OF KAS FLEX

After analyzing the forecasting capability of 4 technological aspects in KAS FLEX, the overall technological forecasting capability is assessed by taking the weighted average of each aspect. These weights have been determined from the expert views retrieved of 386 replies to a questionnaire sent to 784 academic and industrial experts in field. Table 5 summarizes the result of this survey as well as listing the forecasting capability of each aspect and the overall degree of technological forecasting capability, which is found to be 49.62%. That was achieved by Eq. 9;

Table 5. Degree of Technological Forecasting Capability

Technological Aspects	Weight	Forecasting Capability
Flow Time	0.3	85.42
Quantity/Day	0.2	72.05
Scrap Ratio	0.2	47.92
New Investment Revenue	0.3	0.00
Degree of Technological Forecasting Capability (%) (Eq. 9.)		49.62

It can be concluded that KAS FLEX is only about 50% capable of performing forecasting 4 important technological change aspects. This score indicates the existence of some forecasting studies, but in average it is not fully successful. Although it is highly and moderate successful of forecasting "Flow Time" and "Quantity/Day" aspects respectively, it is not capable to estimate the "Scrap Ratio" correctly. The remarkable point is about the "New Investment Revenue" aspect. Since there is not any forecasting study for this one, the company can be stated to be unconscious of the return on investment of new technologies. Although there is a high increment in the new investment revenue from new technologies implemented, the company does not make any study to forecast the expected returns from these technologies. In other words, they are successful in implementing the new technologies but not in forecasting the outcomes of these new developments.

4 CONCLUSION

This paper presents a novel performance indicator, called degree of forecasting capability, for monitoring and measuring the capability for technological forecasting in manufacturing processes based on four important aspects of a manufacturing system. We call these facets, which are namely *Flow Time, Quantity/Day, Scrap Ratio, and New Investment Revenue*. The idea behind this approach has flourished after a thorough literature survey, which has been provided in the paper, feeling the requirement of a quantifiable application to make technological forecasts for manufacturing systems. Although there are various techniques for technological forecasting, many of them cannot be applied to manufacturing systems as they require particular attention on unique aspects. Moreover, most of the studies in the literature depends on qualitative metrics, which are hard to define and subjective to set a scale. Hence the main motivation of this study is to fulfill this gap by developing a quantifiable approach to measure the technological forecasting capability focusing on manufacturing systems. The methodology relies on defining 4 important technological aspects of manufacturing processes. It tries to find the capability of technological forecasting based on these 4 aspects, whenever a technological improvement has occurred.

The proposed approach has been verified with a case study in manufacturing industry, where each of 4 aspects have been calculated based on the data provided and aggregated into the degree of forecasting capability. The weights, to normalize the impact of each sub-indicator, have also been compiled of expert views. The results suggest that it is also important to forecast the outcomes of the technological improvements before implementing them. Since even the company in analysis has significantly increased its technological outputs regarding these 4 aspects, it has not successfully forecasted these gains as much. So it is a signal of a threat of investing quite amount of founds in unpromising technologies blindly in the future. This study has also proved that a quantitative indicator can be implemented for measuring the forecasting capability in manufacturing processes based on key technological components of manufacturing processes.

Further aspects of manufacturing processes can be considered to enhance the degree of forecasting capability indicator and the impact of each sub-indicator can be fine-tuned with further verified expert views as well as with the use of analytical hierarchical process (AHP) in the future. Besides, the approach itself can be enhanced with emergent computing technologies such as multi agent systems.

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Semantic Representation of Moving Entities for Enhancing Geographical Information Systems

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ABSTRACT: Geographical Information Systems have become useful for fleet control, hurricane tracking, tourism analysis and some other critical fields that include decision making processes. The analysis have been mainly focused on historical movement, movement prediction and motion patterns detection, which have a tremendous impact in traffic analysis, finding locations of interest and most visited places, estimating hurricane damage and so more. Recently, ontology driven GIS have shown to the scientific community the advantages of making semantic analysis based in ontology models. In this work we present the advantages of using ontologies for representing moving entities and enriching information with semantics. We also present some experimental results of using an ontological model and making semantic queries over the laying information, encouraging on several obtained benefits and aiming to state a basis for enhanced ontology driven GIS.

KEYWORDS: GIS, ontologies, moving objects, semantics, hurricane tracking.

1   INTRODUCTION

Based on needs, researchers have been focusing they efforts on developing algorithms and techniques for facing challenges like: the analysis of data concerning on trajectory or historical trajectories of moving entities given by GPS feeds, finding movement patterns for predicting future movement or change, or water level change on river margins or inundations, or dealing uncertainty associated to unpredicted movement of hurricanes.

The Geographical Information Systems(GIS) developing area is growing fastly, supporting such enhanced functionalities for decision making systems. There are many GIS applications that allow processing of moving entities information, examples of this are fleet control and hurricane tracking. The utility is related to up-to-date position visualization, traffic control, efficient resource assignation, path optimization and trajectory analysis among others. The problem arises when analyzing the laying representation models, that falls short for considering deeper semantic elements.

The real fact is that the answers we receive from laying spatio-temporal models are mainly based on quantitative data. The main interest is to find how elaborate more qualitative queries over spatio-temporal data, and it surely relies over a more qualitative and semantically rich representation. We actually have some notion of how representing and reasoning over spatio-temporal data, and we have (approximately) the necessary means to do that but, are they really semantically rich enough? Could we represent the information of moving entities, hurricanes for example, in a semantic way?

Related to this is the rising of the Ontology Driven Geographical Information Systems (ODGIS), as stated in [1], with a tremendous importance in GIS research and development fields. But most of existing systems only consider spatial and geographical semantics (with all aspects it involves), nothing included from the needed movement semantics, totally focused

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in the spatio-temporal domain. The solution could be to think in an enhanced kind of ODGIS, starting from new spatio-temporal ontologies for the moving objects domain, not only the existing spatial or geographical ones.

2   SEEING EVOLVING ENTITIES AS MOVING OBJECTS

In the field of GIS development for fleet control the "fleet" concept have been generalized beyond vehicles, ships or any other transportation mean. Today we can catalogue as fleet to a person moving around with his mobile phone, or a biker with his GPS device. For meteorologists the tracking of hurricanes is a key issue, mostly in the Caribbean. It does not matter which kind of moving entity we are dealing with, we can gather information and make some behavioral analysis:

- Historical movement analysis
  - Trajectory analysis
  - Movement patterns recognition
  - Outliers detection
- Future movement prediction
  - Uncertainty treatment

Thus, we can see a contact point between what we call fleet and the moving object concept given in [2], where evolving entities that can *"move or change their shape over time"* are called *moving objects*. There are three kind of moving objects: moving point, moving line and moving region. If we deeply analyze, the moving point concept entirely fits the fleet concept, so we can treat all fleet elements as *moving points* and, moreover, the aforementioned analysis is exactly the one carried out in moving objects domain. On the other hand, for hurricanes, taking into account the type of analysis we have to do, we can choose the *moving point* or a *moving region* concept. Having this, we can use in the GIS domain the results obtained in the moving objects researching field.

3   CHALLENGES ON SEMANTIC REPRESENTATION OF MOVING OBJECTS

For representing moving objects we should consider their spatio-temporal behavior. But if we need to improve GIS, we need to also consider a semantic perspective. When analyzing data models [3,4], there are some restrictions, on one hand attached to the poor location-based semantics considered and in the other hand the little consideration of semantics associated with relationships between objects. All this can be improved considering more relationships (e.g. the core three: topological, mereological and mereotopological), represented as concepts and relations between concepts. The data models mainly describe common data types and operators but have a lack on the formal definition of the motion semantics associated to moving objects. It is possible with existing techniques and data models to answer some spatial, temporal and spatio-temporal questions over spatial or geographical data, but they fall short when we need to understand the meaning of the laying information on received answers.

On the other hand, when dealing spatio-temporal information and specifically movement, there are some variables like uncertainty, tightly associated to the random nature of the movement of real entities, and motion patterns, given that common behavior is also a natural practice of humans, animals and some other tracked entities. The correct understanding of motion patterns and uncertainty as they mean remains as open issue. Data mining techniques seem to be the more suitable and useful way for dealing this problem, but there are not enough and well established approaches and sometimes to understand results or make them optimal for users presentation is a hard task.

We need more semantic approaches for achieving this goal; samples of previous efforts are [5] and [6]. Here enters ontologies and ontology based applications. Existing ontologies capture domain concepts, elements and information and link them in a very semantic way, improving humans and applications understanding. But as ontologies seem better when compared with database and logical approaches considering semantic richness, they fall short when taking into account the possibility of handling high amount of information. Thus, we see a contact point between historical researching areas: each one of them can be used as a partial component of an integrational approach that will finally solve existing problems. Database area has been considering semantic enrichment (sometimes using ontologies) of the information for better understanding and deeper analysis; ontology researchers are proposing the usage of rules for ontology reasoning capacity enhancement. On the other hand, logical approaches are applicable to all other approaches as the final goal more and more consist on logical and semantic issues. The solution then is to drive efforts to develop suites, tools or mechanisms that integrate and combine data mining, logical and ontological approaches. Then, the development of ontological approaches for moving objects domain is a primary goal.

3.1 THE FACED PROBLEM AND EXISTING SOLUTIONS

For obtaining the desired semantic representation we need to face a big challenge: finding suitable models for representing moving entities considering movement semantics that fully support semantic reasoning over the laying information. To do that, and considering ontologies as an important part of the possible solution, the researching path should be routed to one of the next tasks:

- To develop an integrational approach which merges actual geospatial ontologies with formal ones and including spatio-temporal elements.
- An improvement to previous ontologies that consider spatio-temporal aspects or the development of an Ontology for Moving Objects.
- Addition of temporal dimensions to existing spatial ontologies considering them as "snapshots" cases of a given instant in the spatio-temporal domain.

Given that we consider in this paper the second case, it is important to say that the modeling of spatio-temporal aspects using ontologies have some others problems to be solved, most of them related with the limitations of existing ontology languages. To the best of our knowledge, there is not a work that summarizes the strength or weaknesses of existing ontology languages on representing spatio-temporal issues, but for the aspect of the unsupported ternary relation, like the (x,y,t) needed for representing movement. Anyway, there are some approaches and models for solving existing problems, like reification, versioning and the 4D-fluents approach. They are mainly useful given the binary-relation-centered support of most ontology languages, like OWL. Each one have its own advantages and disadvantages. Versioning is commonly used for representing the evolution in time of an ontology. On the other hand, reification and 4D-fluents [7] are the widely used methods for representing spatio-temporal concepts.

4 PROPOSAL DESCRIPTION

We have developed an ontology for the moving objects domain, aiming to have a common vocabulary for representing moving objects and reasoning over their motion semantics. For do that, we followed the 4D-fluents approach including Semantic Web Rule Language (SWRL) rules. On this model we use a semantic representation by concepts, handling the spatial and spatio-temporal information by it meaning. This provides better results in queries, given that: (1) can be done as semantic queries (high abstraction), (2) can use inferred information, which could be not explicitly defined and (3) can integrate (or homogenize) information of several elements treated as the same concept: moving object.

4.1 EXPERIMENTAL RESULTS

We have represented data as an adaptation from a real dataset from USA NHC hurricanes database published in http://www.aoml.noaa.gov/hrd/hurdat/easyread-2011.html, using Jena[1] framework for adding individuals as moving objects. Using the Pellet reasoner[2] in a Java application, the added hurricanes were classified, demonstrating the capability of the ontology reasoners for identifying moving objects using equivalent classes, restrictions and SWRL rules.

Then, we tested the spatio-temporal analysis capacity with more specific queries (using ad-hoc queries from [8]) like:

Give me all tropical cyclones that crossed a given Region between some (or before or after) Initial date and End date (in other words, a given interval) or a given date (instant). The equivalent SPARQL query is:

```
SELECT ?hurr WHERE ?hurr rdf:type onto:MovingObject. ?hurr onto:hasTrajectory ?traj. ?traj
onto:is_cross ?reg. ?trajts fluent:tsTimeSliceOf ?traj. ?trajts fluent:tsTimeInterval
?interval. ?interval time:hasEnd ?end. ?end time:inXSDDateTime ?date. FILTER (?date < "1990-
07-25T18:00:00Z"xsd:dateTime)
```

After creating one special scenario using real and artificial data, the obtained output was:

```
onto:Arthur
onto:Charlie
```

For cross-field analysis we imported some data from the Geolife [9] GPS Trajectories, which includes data from several GPS devices associated with people, cars or phone users movements on real scenarios, recording their trajectories. The obtained ontology model was the same as the one for the previously analyzed dataset, which allows similar queries to be made, now also allowing mixing data of two scenarios. For example, a meteorological system could use the available information for analysis like: *"Show the number of people directly affected when Hurricane (or Tornado) X crossed Y state in 1990"*. If the trajectories of people and hurricane one are intersected or the hurricane region includes their position in the same instant, we suppose they were affected and count them.

Table 1. Comparing ontology model and conventional MOD

Criteria/Model	Proposed model	Conventional MOD
Spatio-temporal Queries Possibilities	+	+
Rapidity of Queries	+	+
Support for Querying Big Amounts of Data	-	+
Possibility of Querying Inferred Information	+	-
Less Abstraction Level	+	-
Less Cross-Domain Query Complexity	+	-

Table 1 shows a summary of comparing conventional Moving Objects Database (MOD) models with ontology models like our proposal. The plus (+) sign means *more advantageous* and minus (-) *less advantageous* for the given criteria. When analyzing the possibilities of spatio-temporal queries in both cases it is possible using several existing techniques. Those queries have similar execution time in SQL and SPARQL, but can be done in higher abstraction level using SPARQL over an ontology model, also using inferred information, which is not possible in databases. The database community has ensured the possibility of manipulating big amount of data, and querying the laying information; on the other hand, conventional ontology reasoners fail in similar cases. Even that, there are approaches like DBOWL [10] for facing this problems (because of this, the criteria appears highlighted in the table). One important application field for ontology models is the information standardization for cross-field analysis. The conventional database models imply database linking or query complexity using several joins. In the ontology models, similar real entities can be treated as the same concept, allowing query disambiguation and low complexity in cross-domain analysis.

5   CONCLUSION AND FUTURE WORK

After we have created and tested the proposed ontology model we can be sure that this can be used as the laying model in a ODGIS for moving objects representation. It can be done even if used together with a conventional MOD, as an abstraction layer for semantic integration or semantic query answering. The representation of evolving entities information as moving objects using this ontology can help on high abstraction level spatio-temporal queries, using inferred information and including information of several fields by the common moving objects representation, facts that have been demonstrated by experimental issues. For the future, remains as goal the inclusion of the presented model as a basis model inside an ODGIS. Regarding spatial representation issues for completing the elements of an enhanced ODGIS, it could be solved using the Map4RDF[3] proposal, which allows visualization of geospatial ontologies over maps.

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[3] http://oeg-dev.dia.fi.upm.es/map4rdf/

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Effect of opening girth and some latex physiological parameters on yield of Rubber (*Hevea brasiliensis*)

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ABSTRACT: Field experiment was conducted to investigate the possibility of exploiting rubber (*Hevea brasiliensis)* for latex at a lower stem girth (40 and 45 cm) and physiological yield parameters were monitored to establish factors responsible for differences in yield due to opening girths or tapping systems tested. Three different *Hevea* genotypes, i.e. RRISL 211, RRIC 121 and RRIC 102 were exploited at different growth stages, i.e. girth of 40 cm (G_{40}), girth of 45 cm (G_{45}) and girth of 50 cm (G_{50}), using different tapping systems. Significant clonal differences were observed for the initial rate of latex flow (IFR), plugging index (PI), total volume of latex (vol), dry rubber content (DRC) and dry rubber yield when tapping commenced at different opening girths. The overall results of the present study clearly showed that the plugging index was relatively high in trees opened at lower girths, i.e. 40 cm (G_{40}) than in trees opened at higher girths, i.e. G_{45} and G_{50}. Yield differences between trees of the same clone were mainly caused by differences in IFR, while differences between clones were mainly associated with differences in flow time. There is a highly significant positive correlation between PI and DRC irrespective of the tapping systems and opening girths. This study clearly showed that the DRC, PI and IFR vary according to year of tapping, tapping system and opening girth. At the immature phase (especially G_{40} trees during the first year) were probably not mature enough to show normal latex flow relationships. Furthermore, variations in yield determining parameters have to be taken in to account in devising strategies for yield improvement in different clones.

KEYWORDS: Rubber, opening girth, physiological yield parameters, clone, yield.

1 INTRODUCTION

The physiology of *Hevea brasiliensis* is unique. Biosynthesis of latex, the economically important product of the plant, is confined to the latex vessels which exclusively occur in the phloem tissue. Biosynthesis of latex takes place within the latex vessels of the plant using sucrose, i.e. end product of photosynthesis, as the substrate [1]. The volume of latex biosynthesized by a plant depends on the number, diameter and anatomical characters of the latex vessel system and some related physiological and biochemical factors [2]. The physiological aspects that govern the balance between growth and yield are another thrust area of research in rubber. The productivity of a rubber tree is largely determined by genetic and edaphic factors. These genetic differences are expressed through differences in the structure and volume of latex vessels [3]. Latex flow involves a series of physiological changes occurring in the drainage area of the cut. Since latex production is closely correlated with the rate of partitioning of assimilates, water balance and nutritional status of the tree, from a broad point of view, the physiological changes associated with latex flow affects the entire tree [4]. The latex yield is primarily controlled by factors that influence latex production and latex flow. Genetic, environmental and physiological factors are known to

influence these two components that determine latex yield [5],[6].The yield determining factors of a rubber tree are identified as, i.e. initial flow rate, plugging index, dry rubber content and length of tapping cut [7]. Previous findings regarding the variability and correlation of these factors with yield reveals that plugging index and total yield are highly correlated among clones. Further, the yield differences between trees of the same clone are mainly due to differences in initial flow rate.

Plugging index is related to many other clonal characters. It is negatively correlated with yield and incidence of dryness and positively correlated with girth, dry rubber content of latex and the magnitude of response to yield stimulation [8]. The girth at opening is of significance in this context and a lower girth is an indication of slower growth and maturity [9]. It is commonly believed that commencement of tapping when *Hevea* trees are too young significantly retards the subsequent growth of the tree. Moreover, it is known to lead to a low yield during the entire tapping cycle of a tree as the girth of the tree is positively correlated with yield [10], [11]. During the juvenile phase of a rubber tree, i.e. up to 4-5 years, food produced by the plant is used primarily for biomass production. Commencement of tapping during this phase may lead to physiological and mechanical problems due to partitioning of assimilates towards latex production [12].

The long immature period between planting to opening for tapping is considered as one of the major constraints in rubber industry when compared with other economic crops. Therefore, early opening would result in revenue being earned earlier and bring forth additional returns. Hence, the main objective of work reported in this paper was to look into the possibility of exploiting *Hevea brasiliensis* for latex at a younger age. Further, the physiological yield determining parameters were monitored to establish factors responsible for differences in yield due to different opening girths or tapping systems tested.

2 MATERIALS AND METHODS

2.1 EXPERIMENTAL SITE

The present study was a supplement to a longer experiment to determine the feasibility of early commencement of tapping in three contrasting *Hevea* genotypes. A field experiment was carried out at the Dartonfield Estate of the Rubber Research Institute of Sri Lanka (RRISL), situated in Agalawatta, in the District of Kalutara located in the low country wet zone (WL$_1$) of Sri Lanka. The Latitude and longitude are 6° 32' N and 80° 09' E respectively (Survey Department of Sri Lanka, 1988). The climate of this region is characterized by a mean monthly temperature of 22 – 31°C, ample rainfall around the year with no marked dry periods, high ambient humidity (88%), moderate wind and bright sunshine. The soil type belongs to the Agalawatta series, which is silty clay loam in texture and strong brown to yellowish red in colour (Red Yellow Podzolic).

2.2 PLANTING MATERIAL

Hevea brasiliensis plants of genotypes RRISL 211, RRIC 121 and RRIC 102 were selected for the experiment and tapping in each of the three clones commenced at different growth stages, i.e. when 60% of trees reached a girth of 40, 45 and 50 cm measured at a height of 120 cm from the union. Data on dry rubber yield and related parameters were gathered during the period from January 2000 to April 2003.

2.3 EXPERIMENTAL TREATMENTS AND DESIGN

The experimental treatment structure was a three-factor-factorial with three rubber genotypes, three opening girths and three tapping treatments as the main effects. For the study, 100 trees of 40 cm girth were selected from each clone and each of the 100 trees were grouped into four with three groups having 30 trees each and the other with 10 trees. Tapping commenced immediately in the first group of all three clones (30 trees of 40 cm girth). Rest of the 30 tree groups of each clone were tapped when 60% of trees reached a girth of 45 and 50 cm at 120 cm from the union. The 10 tree group of each clone remained untapped. Thirty trees selected from each clone for the commencement of tapping at different girths were randomly separated into three sub groups with each sub group having 10 trees. For each sub group, tapping treatments was introduced randomly on a single tree plot design. Ten trees were assigned for each tapping treatment of all three clones. The three tapping treatments were; (i) 1/2S d/2 – high frequency tapping (HFT); (ii) 1/2S d/3 – low frequency tapping without stimulation (LFT); (iii)) 1/2S d/3 plus Ethrel (E) application - low frequency tapping with stimulation (LFT+E). Ethrel (2.5%) was applied to a 2.5 cm band of the *stem* just below the tapping cut four times per year at a rate of 1.6g per tree {2.5 % ET, Ba 1.6 (2.5) 4/y}. Colour bands were painted to differentiate trees in the different groups. The trees were rainguarded and tapped throughout the year according to the tapping systems assigned. A single tapper was employed for tapping throughout the experiment.

2.4 DATA ANALYSIS

Data for each period were analyzed as a three-factor factorial with single trees as replicate plots. Analysis of variance was used to determine the significance or otherwise of the main effects (opening girths, tapping systems and genotypes) and their interactions. Means were separated by standard error of means with appropriate degrees of freedom. When the interaction effects were not significant at $p > 0.05$, data for the relevant factors were pooled. Linear correlation analysis was used to determine the strength of relationships between yield and yield components and between the different yield components. Correlation analysis was first performed for the overall data set in which the data for the three factors and the three time periods of comparison were pooled. At the next step, separate correlation analyses were performed for the three genotypes, again pooling the data from the three periods, different opening girths and tapping systems.

3 RESULTS

3.1 DRY RUBBER YIELD PER TREE PER TAPPING (G TREE $^{-1}$ TAPPING $^{-1}$)

When averaged across all tapping systems, during the first two years after commencement of tapping, yield per tree per tapping (g/t/t) increased with opening girth (Table 1). Yields of G_{40} trees were the lowest and the highest dry rubber yield was given by G_{50} trees in all clones tested. When averaged across all girth classes, low frequency tapping with stimulation recorded higher g/t/t levels and this true for all clones. During the first two years after commencement of tapping g/t/t showed a gradual increase with increasing opening girths. It showed a significant increase when the opening girth increased from 40 cm to 45 cm in all three clones Generally the highest g/t/t was obtained from low frequency tapping with stimulation. This trend was more prominent in trees opened at 50 cm in clone RRIC 121.

Table 1.   Mean dry rubber yield per tree per tapping of selected genotypes of rubber at different opening girths and tapping systems during selected periods after the commencement of tapping

		Dry rubber yield per tree per tapping (g tree $^{-1}$ tapping $^{-1}$)						Tapping treatment mean		Clone mean	
Clone	Tapping treatments	1st Year			2nd Year						
		G_{40}	G_{45}	G_{50}	G_{40}	G_{45}	G_{50}	1st yr	2nd yr	1st yr	2nd yr
RRIC 102	1/2S d/2	5.89	13.35	18.07	8.14	15.24	26.59	12.44^b	16.65^b		
	1/2S d/3	6.48	11.46	23.73	7.24	16.32	29.49	13.89^{ab}	17.68^b	13.81^c	18.27^b
	1/2S d/3+E	8.25	15.04	22.06	9.85	20.70	30.83	15.12^a	20.46^a		
RRIC 121	1/2S d/2	13.23	12.26	21.47	20.20	21.45	26.18	15.65^b	22.61^b		
	1/2S d/3	5.80	14.72	22.11	13.71	25.88	28.55	14.21^b	22.72^b	17.23^b	28.24^a
	1/2S d/3+E	9.10	21.65	34.73	24.39	45.49	48.33	21.83^a	39.40^a		
RRISL 211	1/2S d/2	10.26	21.83	31.57	17.19	25.46	36.15	21.22^b	26.27^b		
	1/2S d/3	11.52	27.67	31.78	19.59	29.18	34.81	23.66^{ab}	27.86^{ab}	23.78^a	28.87^a
	1/2S d/3+E	13.85	26.89	38.62	22.07	31.98	43.43	26.46^a	32.49^a		
Opening girth Mean		9.38^c	18.32^b	27.13^a	15.82^c	25.74^b	33.82^a				

Means of each category with the same letter are not significantly different at P >0.05

3.2 TOTAL DRY RUBBER YIELD PER TREE PER ANNUM

In all clones tested, both the annual mean and the total yield per tree per annum were less in trees opened at 40 cm (G_{40}) and 45 cm (G_{45}) when compared with 50 cm (G_{50}) (Table 2). Furthermore, total dry rubber yield per tree per annum increased with increasing girth in all clones. During first two years after commencement of tapping, the highest dry rubber yield per tree per annum is given by clone RRISL 211. On the other hand, irrespective of the opening girth, clone RRIC 121, performed better under low frequency tapping with stimulation.

Table 2.   Mean cumulative dry rubber yield of selected genotypes of rubber at different opening girths and tapping systems during selected periods after the commencement of tapping

Clone	Tapping treatment	Cumulative dry rubber yield (kg tree^{-1})									
		1st Year			2nd Year			Tapping Treat mean		Clone Mean	
		G_{40}	G_{45}	G_{50}	G_{40}	G_{45}	G_{50}	1st yr	2nd yr	1st yr	2nd yr
RRIC 102	1/₂S d/2	0.98	2.22	3.04	1.40	2.59	4.55	2.08^{a}	2.84^{a}	1.80^{c}	2.39^{b}
	1/₂S d/3	0.74	1.31	2.73	0.83	1.84	3.36	1.59^{b}	2.01^{b}		
	1/₂S d/3+E	0.94	1.71	2.54	1.13	2.34	3.51	1.73^{b}	2.33^{b}		
RRIC 121	1/₂S d/2	2.21	2.03	3.61	3.47	3.65	4.48	2.62^{a}	3.87^{b}	2.25^{b}	3.64^{a}
	1/₂S d/3	0.66	1.68	2.54	1.58	2.92	3.25	1.63^{b}	2.59^{c}		
	1/₂S d/3+E	1.04	2.47	3.99	2.80	5.14	5.51	2.50^{a}	4.48^{a}		
RRISL 211	1/₂S d/2	1.71	3.62	5.30	2.96	4.33	6.18	3.55^{a}	4.49^{a}	3.09^{a}	3.79^{a}
	1/₂S d/3	1.31	3.15	3.65	2.25	3.30	3.97	2.71^{b}	3.17^{b}		
	1/₂S d/3+E	1.58	3.06	4.44	2.54	3.61	4.95	3.03^{b}	3.70^{b}		
Opening girth mean		1.24^{c}	2.36^{b}	3.54^{a}	2.11^{c}	3.30^{b}	4.42^{a}				

Means of each category with the same letter are not significantly different at P >0.05

3.3   YIELD COMPONENTS OF HEVEA

3.3.1   PLUGGING INDEX (PI)

During the first two years after commencement of tapping, when averaged across tapping systems, plugging index was relatively high in trees opened at G_{40} than in trees opened at G_{45} and G_{50} (Table 3). Among the three clones tested, plugging index was relatively high in RRIC 121 in all girth classes tested. Among the three clones tested, plugging index was relatively high in RRIC 121 in all girth classes tested. When averaged across opening girths even in the second year of tapping, the lowest PI was in stimulated trees while the highest was from un-stimulated trees This was true for all clones and girth classes tested (Table 4).

3.3.2   INITIAL FLOW RATE (IFR)

During the first two years after commencement of tapping, initial flow rate was lower in trees opened at G_{40} than in trees opened at G_{45} and G_{50} (Table 3). Initial flow rate increased with girth in all clones tested. When averaged across tapping systems, RRISL 211 gave the highest IFR and the lowest was in RRIC 102 (Table 4). During the first two years after commencement of tapping, initial flow rate was lower in trees opened at G_{40} than in trees opened at G_{45} and G_{50}. Initial flow rate increased with girth in all clones tested. When averaged across tapping systems, RRISL 211 gave the highest IFR and the lowest was in RRIC 102. During the first year after commencement of tapping, in all tapping systems and in all clones the initial flow rate increased with increasing opening girths. Furthermore, during the second year after commencement of tapping also, the highest initial flow rate was from trees tapped at G_{50} (Tables 3 and 4).

3.3.3   DRY RUBBER CONTENT (DRC)

During the first two years after commencement of tapping, when averaged across clones, RRIC 121 gave the highest DRC whilst it was lowest in RRISL .Furthermore, DRC decreased with increasing opening girth in RRISL 211. When averaged across the girth classes, a lower DRC was given by stimulated trees than the non-stimulated trees (Tables 3 and 4). During the first two years after commencement of tapping, when averaged across clones, RRIC 121 gave the highest DRC whilst it was lowest in RRISL 211. Furthermore, DRC decreased with increasing opening girth in RRISL 211. When averaged across the girth classes, a lower DRC was given by stimulated trees than the non-stimulated trees. Dry rubber content was relatively high in the second year of tapping than in the first year in all tapping treatments and clones tested. The pattern of variation in DRC across the different opening girths and tapping treatments was different in the three clones and for the two years of tapping (Tables 3 and 4).

Table 3.   Mean plugging index (PI), Mean initial flow rate (IFR) and Dry rubber content (DRC) of selected genotypes of rubber at different opening girths during selected periods after the commencement of tapping

Clone	Opening girth	Mean PI		Mean IFR (ml min^{-1})		Mean DRC	
		1st year	2nd year	1st year	2nd year	1st year	2nd year
RRIC 102	G$_{40}$	3.509^a	3.720^a	0.853^c	1.140^c	33.745^b	36.589^a
	G$_{45}$	3.246^a	3.264^b	1.726^a	1.401^b	34.100^b	36.021^a
	G$_{50}$	3.342^a	3.125^b	1.488^b	1.675^a	35.551^a	36.942^a
RRIC 121	G$_{40}$	4.926^b	4.473^c	1.178^b	1.527^c	43.420^b	41.099^b
	G$_{45}$	5.741^a	5.721^a	2.693^a	2.276^b	44.465^a	42.263^a
	G$_{50}$	4.849^b	5.123^b	2.747^a	2.549^a	31.648^c	42.238^b
RRISL 211	G$_{40}$	3.192^a	4.379^a	1.713^c	2.046^b	32.379^a	35.922^a
	G$_{45}$	3.002^a	2.970^b	3.323^a	2.452^a	31.234^b	33.501^b
	G$_{50}$	3.050^a	2.520^c	2.916^b	2.626^a	31.648^b	31.098^c

Means of each category with the same letter are not significantly different at P >0.05

Table 4.   Mean plugging index (PI), Mean initial flow rate (IFR) and Dry rubber content (DRC) of selected genotypes of rubber on different tapping systems during selected periods after the commencement of tapping

Clone	Opening girth	Mean PI		Mean IFR (ml min^{-1})		Mean DRC	
		1st year	2nd year	1st year	2nd year	1st year	2nd year
RRIC 102	1/2S d/2	3.446^a	3.683^a	1.297^b	1.456^a	34.022^b	37.068^a
	1/2S d/3	3.831^a	3.837^a	1.519^a	1.535^a	36.168^a	38.262^a
	1/2S d/3+E	2.820^b	2.594^b	1.252^b	1.225^b	33.206^b	34.222^b
RRIC 121	1/2S d/2	5.349^b	5.205^b	2.143^a	1.914^b	39.165^b	41.328^b
	1/2S d/3	5.796^a	5.735^a	2.119^a	2.107^b	41.361^a	45.929^a
	1/2S d/3+E	4.370^c	4.397^c	2.356^a	2.331^a	39.008^b	40.546^c
RRISL 211	1/2S d/2	3.181^a	3.661^a	2.426^b	2.229^b	31.762^b	33.369^b
	1/2S d/3	3.286^a	3.528^a	2.900^a	2.533^a	33.432^a	36.103^a
	1/2S d/3+E	2.777^b	2.680^b	2.626^{ab}	2.363^{ab}	30.068^c	31.049^c

Means of each category with the same letter are not significantly different at P >0.05

3.4   CORRELATION ANALYSIS FOR YIELD AND YIELD COMPONENTS

3.4.1   CORRELATION ANALYSIS FOR THE OVERALL DATA SET

When correlation analysis was performed on yield and yield components for the overall data set (i.e. clones, opening girths and tapping treatments pooled together) during the first and second years after commencement of tapping, yield showed a highly significant ($P < 0.001$) positive correlation with latex volume (Table 5). Yield also had a highly significant positive correlation ($P < 0.001$) with the initial flow rate. Furthermore, plugging index had a highly significant negative correlation with yield. However, strength of relationships of all these components showed reductions during the second year. Dry rubber content had a significant negative correlation with yield in the first year. The correlations between initial flow rate and latex volume and between DRC and PI were highly significantly ($P < 0.001$) positive while highly significant negative correlations were shown between DRC and latex volume and between PI and latex volume. During the first year, PI and IFR did not have a significant correlation, but in the second year there was a significant positive correlation (Table 6).

Table 5.   Correlation coefficients between yield and yield components for the overall data set

Overall	Yield vs Vol	Yield vs IFL	Yield vs PI	Yield vs DRC
1st year	0.80***	0.62***	-0.32***	-0.31***
2nd year	0.53***	0.32***	-0.24***	-0.11ns

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01; ***significant at P = 0.001.*
Vol: latex volume; IFR: initial flow rate; PI: plugging index; DRC: dry rubber content

Table 6.   Inter- relationships between yield components

Overall	DRC vs PI	DRC vs IFR	DRC vs VOL	PI vs VOL	PI vs IFR	IFR vs VOL
1st year	0.52***	-0.13*	-0.49***	-0.49***	0.06 ns	0.64***
2nd year	0.60***	0.27***	-0.38***	-0.57***	0.26***	0.42***

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01; ***significant at P = 0.001.*

3.4.2   CORRELATION ANALYSIS FOR DIFFERENT OPENING GIRTHS

When correlation analysis was done for yield and yield components for different opening girths during first year after commencement of tapping, latex volume had a highly significant positive correlation with dry rubber yield in all girth classes. Anyhow, the correlation was stronger in G_{40} trees and it reduced with increasing girth. Also, the strength of the relationship had reduced during the second year of tapping in all girth classes (Table 7). The Initial flow rate (IFR) was also significantly correlated to yield in all girth classes, but the strength of the correlation had reduced during the second year. The correlation between yield and plugging index (PI) was negative and significant for all girth classes and the intensity of the relationship appear same during the two years tested. The dry rubber content (DRC) showed a significant negative correlation with yield with increasing girth (Table 7). During the first year in G_{40} trees, DRC and IFR did not have a significant correlation (Table 8). However, in the second year, significant positive correlations were observed in both G_{40} and G_{45} trees. Furthermore, G_{50} trees showed an appreciable, but non-significant correlation during both first and second years of tapping. The DRC and latex volume had significant negative correlations during the first two years in all girth classes. The correlation between PI and latex volume, during second year was significant for G_{40}. Furthermore, G_{45} and G_{50} trees showed significant correlations during both years. During the first two years after commencement of tapping, IFR had significant positive correlations with latex volume irrespective of opening girths (Table 8).

Table 7.   Correlation coefficients between yield and yield components for different opening girths

Opening girths	Yield vs Vol	Yield vs IFR	Yield vs PI	Yield vs DRC
G_{40} trees 1st year	0.90***	0.44***	0.003 ns	-0.18 ns
2nd year	0.45***	0.31*	-0.27*	-0.12 ns
G_{45} trees 1st year	0.75***	0.53***	-0.39**	-0.35**
2nd year	0.44***	0.23*	-0.26*	0.25 ns
G_{50} trees 1st year	0.64***	0.53***	-0.34*	-0.36**
2nd year	0.48***	0.26*	-0.33*	-0.24*

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01; ***significant at P = 0.001.*

Table 8.   Inter- relationships between yield components for different opening girths

Opening girth	DRC vs PI	DRC vs IFR	DRC vs Vol	PI vs Vol	PI vs IFR	IFR vs Vol
G_{40} 1st year	0.30**	-0.18 ns	-0.31**	-0.08 ns	0.21*	0.56***
2nd year	0.56***	0.38**	-0.35**	-0.55***	0.24*	0.36**
G_{45} 1st year	0.67***	0.11 ns	-0.49***	-0.61***	0.12 ns	0.53***
2nd year	0.60***	0.38**	-0.31**	-0.57***	0.47***	0.30**
G_{50} 1st year	0.50***	-0.17 ns	-0.59***	-0.53***	0.14 ns	0.58***
2nd year	0.63***	0.18 ns	-0.42***	-0.69***	0.10 ns	0.53***

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01; ***significant at P = 0.001.*

3.4.3   CORRELATION ANALYSIS FOR DIFFERENT TAPPING SYSTEMS

When correlation analysis was done for yield and yield components separately for different tapping systems, during first and second years after commencement of tapping, yield had a highly significant (P < 0.001) positive correlation with latex volume (Table 9). It was broadly similar to the pattern showed in the overall correlation analysis (Table 5). Inter-relationships between yield components for different tapping systems (Table 10) were broadly similar to the pattern showed in the overall correlation analysis (Table 6).

Table 9.   Correlation coefficients between yield and yield components for different tapping systems

Tapping systems	Yield vs Vol	Yield vs IFL	Yield vs PI	Yield vs DRC
1/2S d/2 1st year	0.78***	0.57***	-0.24*	-0.28*
2nd year	0.42***	0.28*	-0.29*	-0.14 ns
1/2S d/3 1st year	0.80***	0.68***	-0.36**	-0.34*
2nd year	0.49***	0.15 ns	-0.18 ns	-0.14 ns
1/2S d/3+E 1st year	0.80***	0.63***	-0.17 ns	-0.28*
2nd year	0.52***	0.53***	0.06 ns	0.07 ns

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

Table 10.   Inter-relationships between yield components for different tapping systems

Tapping systems	DRC vs PI	DRC vs IF	DRC vs Vol	PI vs Vol	PI vs IF	IF vs Vol
1/2S d/2 1st year	0.55***	-0.09 ns	-0.49***	-0.47***	0.05 ns	0.60***
2nd year	0.54***	0.09 ns	-0.38**	-0.56***	0.17 ns	0.54***
1/2S d/3 1st year	0.56***	-0.21 ns	-0.51***	-0.57***	-0.08 ns	0.76***
2nd year	0.69***	0.33*	-0.41***	-0.57***	0.34*	0.35**
1/2S d/3+E 1st year	0.44***	-0.10 ns	-0.43***	-0.34**	0.23*	0.62***
2nd year	0.49***	0.32*	-0.24*	-0.44***	0.31*	0.48***

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

3.4.4   CORRELATION ANALYSIS FOR DIFFERENT CLONES

When correlation analysis was done for yield and yield components of different clones during the first and second years after commencement of tapping, yields of RRIC 121 and RRIC 102 had highly significant (P < 0.001) and positive correlations with latex volume (Table 11). In clone RRISL 211, DRC showed a significant negative correlation with yield during the first two years of tapping. Furthermore, strength of the relationship between latex volume and yield was reduced considerably during the second year in clones RRIC 102 and RRISL 211.

Table 11.   Correlation coefficients between yield and yield components for different clones

Clones	Yield vs Vol	Yield vs IFR	Yield vs PI	Yield vsDRC
RRIC 102 1st year	0.98***	0.32*	-0.40***	0.10 ^{ns}
2nd year	0.81***	0.29*	-0.38**	-0.04 ^{ns}
RRIC 121 1st year	0.93***	0.79***	-0.15 ^{ns}	-0.38**
2nd year	0.91***	0.47***	-0.44***	-0.14 ^{ns}
RRISL 211 1st year	0.71***	0.48***	-0.55***	-0.33*
2nd year	0.29*	0.22*	-0.25*	-0.26*

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001*

Table 12.   Inter-relationships between yield components for different clones.

Clones	DRC vs PI	DRC vs IFR	DRC vs Vol	PI vs Vol	PI vs IFR	IFR vs Vol
RRIC 102 1st year	0.18 ^{ns}	0.11 ^{ns}	0.06 ^{ns}	-0.47***	0.32*	0.32*
2nd year	0.23*	0.35**	0.01 ^{ns}	-0.57***	0.07 ^{ns}	0.31*
RRIC 121 1st year	0.21*	-0.29*	-0.41***	-0.20 ^{ns}	0.04 ^{ns}	0.70***
2nd year	0.32*	0.12 ^{ns}	-0.14 ^{ns}	-0.59***	0.07 ^{ns}	0.50***
RRISL 211 1st year	0.26*	-0.15 ^{ns}	-0.35**	-0.71***	-0.35**	0.75***
2nd year	0.25*	-0.01 ^{ns}	-0.18 ^{ns}	-0.55***	-0.13 ^{ns}	0.72***

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

3.4.5   FURTHER CORRELATION ANALYSIS FOR DIFFERENT OPENING GIRTHS

When further correlation analysis was done for yield and yield components for different opening girths (clones pooled) under different tapping systems during the first two years after commencement of tapping, yield and latex volume had highly significant positive correlations at all opening girths and tapping systems during the first year. Correlations of DRC, PI and IFR with yield varied according to year of tapping, tapping system and opening girth (Tables 13, 14 & 15).

Table 13.   Correlation coefficients for trees opened at 40 cm (G_{40}) under different tapping systems

Tapping systems	Yield vs Vol	Yield vs IFR	Yield vs PI	Yield vs DRC
$1/_2$S d/2 1st year	0.87***	0.04 ns	0.30 ns	0.44*
2nd year	0.65**	0.68***	-0.21 ns	0.03 ns
$1/_2$S d/3 1st year	0.94***	0.81***	0.28 ns	-0.53*
2nd year	0.37 ns	0.12 ns	-0.20 ns	-0.22 ns
$1/_2$S d/3+E 1st year	0.92***	0.67***	0.47*	-0.28 ns
2nd year	0.27 ns	0.53*	0.36 ns	0.33 ns

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

Table 14.   Correlation coefficients for trees opened at 45 cm (G_{45}) under different tapping systems

Tapping systems	Yield vs Vol	Yield vs IFL	Yield vs PI	Yield vs DRC
$1/_2$S d/2 1st year	0.64***	0.51*	-0.29 ns	0.36*
2nd year	0.15 ns	0.09 ns	-0.28 ns	-0.08 ns
$1/_2$S d/3 1st year	0.75***	0.67***	-0.50*	-0.32 ns
2nd year	0.26 ns	0.04 ns	-0.16 ns	-0.07 ns
$1/_2$S d/3+E 1st year	0.75***	0.53**	-0.16 ns	-0.30 ns
2nd year	0.34 ns	0.75***	0.47*	0.63**

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

Table 15.   Correlation coefficients for trees opened at 50 cm (G_{50}) under different tapping systems

Tapping systems	Yield vs Vol	Yield vs IFL	Yield vs PI	Yield vs DRC
$1/_2$S d/2 1st year	0.69***	0.54**	-0.27 ns	-0.43*
2nd year	0.30 ns	0.28 ns	-0.35 ns	-0.08 ns
$1/_2$S d/3 1st year	0.55**	0.41*	-0.30 ns	-0.59 ns
2nd year	0.55*	0.09 ns	-0.34 ns	-0.26 ns
$1/_2$S d/3+E 1st year	0.61**	0.68***	0.05 ns	-0.28 ns
2nd year	0.31 ns	0.37*	0.18 ns	-0.24 ns

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

Correlations between DRC and PI and between IFR and latex volume were consistent in G_{45} and G_{50} trees. However, G_{40} trees did not show significant correlations during the first year. During first two years after commencement of tapping, DRC versus IFR did not show consistent correlations in all opening girths and tapping systems (Tables 16, 17 and 18). In all girth classes, irrespective of the tapping systems, DRC versus latex volume showed consistent negative relationships. Further, PI versus latex volume had consistent negative relationship in trees opened at G_{45} and $G_{50.}$ In contrast, G_{40} trees did not show such a relationship during the first year. There was no consistent relationship between PI and IFR, irrespective of the opening girths and tapping systems (Tables 16, 17 & 18).

Table 16. Inter-relationships between yield components for trees opened at 40 cm (G_{40}) under different tapping systems

Tapping system	DRC vs PI	DRvs IFR	DRC vs Vol	PI vs Vol	PI vs IFR	IFR vs Vol
1/2S d/2 1st year	0.16 ns	-0.29 ns	0.24 ns	0.24 ns	-0.10 ns	0.26 ns
2nd year	0.46*	0.08 ns	-0.44*	-0.68***	0.20 ns	0.39*
1/2S d/3 1st year	0.33 ns	-0.37*	-0.61*	0.18 ns	0.33 ns	0.84***
2nd year	0.55*	0.22 ns	-0.20 ns	-0.62**	0.07 ns	0.54*
1/2S d/3+E 1st year	0.30 ns	0.04 ns	-0.37*	0.39*	0.66***	0.73***
2nd year	0.41*	0.58*	-0.20 ns	-0.35 ns	0.45*	0.30 ns

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

Table 17. Inter-relationships between yield components for trees opened at 45 cm (G_{45}) under different tapping systems

Tapping system	DRC vs PI	DRC vs IFR	DRC vs Vol	PI vs Vol	PI vs IFR	IFR vs Vol
1/2S d/2 1st year	0.68***	0.13 ns	-0.48*	-0.62**	0.03 ns	0.63**
2nd year	0.63**	0.06 ns	-0.39*	-0.45*	0.29 ns	0.55*
1/2S d/3 1st year	0.66***	0.10 ns	-0.46*	-0.65***	-0.08 ns	0.71***
2nd year	0.68***	0.50*	-0.46*	-0.61**	0.65**	0.08 ns
1/2S d/3+E 1st year	0.63**	0.03 ns	-0.46*	-0.49*	0.33 ns	0.41*
2nd year	0.50*	0.46*	-0.09 ns	-0.12 ns	0.57*	0.33*

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

Table 18. Inter-relationships between yield components for trees opened at 50 cm (G_{50}) under different tapping systems

Tapping system	DRC vs PI	DRC vs IFR	DRC vs Vol	PI vs Vol	PI vs IFR	IFR vs Vol
1/2S d/2 1st year	0.60**	-0.12 ns	-0.66***	-0.52*	0.28 ns	0.51*
2nd year	0.43*	0.13 ns	-0.23 ns	-0.74***	-0.14 ns	0.68***
1/2S d/3 1st year	0.61**	-0.23 ns	-0.59**	-0.66***	0.01 ns	0.65***
2nd year	0.81***	0.22 ns	-0.58**	-0.73***	0.25 ns	0.39*
1/2S d/3+E 1st year	0.41*	-0.14 ns	-0.48*	-0.36*	0.35 ns	0.61**
2nd year	0.55**	0.13 ns	-0.36*	-0.51*	0.28 ns	0.58**

*ns, non-significant at P = 0.05; *significant at P = 0.05; **significant at P = 0.01;   ***significant at P = 0.001.*

4   DISCUSSION

In this study, significant clonal differences were observed for the initial rate of latex flow, plugging index, total volume of latex, dry rubber content and dry rubber yield when tapping commenced at different opening girths. The overall results of the present study, clearly showed that plugging index was relatively high in trees opened at lower girths, i.e. 40 cm (G_{40}) than in trees opened at higher girths, i.e. G_{45} and G_{50}. Further it was lower in stimulated trees than in un-stimulated trees in all girth classes and clones tested (Tables 3 and 4). Anyhow, [13] had reported that the plugging index was relatively constant within a clone. An analysis of variance of the data of the present study also showed that the trees of a given clone varied

more in initial flow rate than in plugging index. A clone with a low plugging index is expected to give a higher latex yield [14] and PI can also be reduced by the application of yield stimulants [15].

It is clear that stimulants delay the plugging of latex vessels and prolong the latex flow resulting in a higher dry rubber yield. Therefore, yield increases through stimulation were mainly due to increases in latex volume and reduction in PI. Among the clones tested, PI was relatively high in clone RRIC 121 (Table 4). Among the girth classes tested, the yield per tree per tapping of clone RRIC 121 responded positively to yield stimulation and it was associated with a lowering of the PI. In contrast, in RRIC 102 lowering of PI did not result in an increase of yield per tree per tapping. [13], [16] showed that a clone with a high PI on $1/2$S d/2 tapping will respond better to stimulation than one with a low PI. Results obtained from this study confirmed the above observations.

The initial flow rate was also associated with yield differences observed with different tapping systems at G_{40} but to a lesser extent to that of PI (Tables 3 and 4). It has been reported that the relative importance of initial flow rate as a factor determining the yield is less than that of PI [17], [18]. However, in this study, the high yield per tree per tapping of clones RRIC 121 and RRISL 211 with stimulation was linked to an increased initial flow rate as well (Table 4). Nevertheless, in the case of RRIC 102, even in the second year of tapping, stimulation did not increase IFR.

Besides clonal characteristics, age of the tree also influenced the DRC in their latticifers [19]. Results of this study showed that the DRC was relatively high in the second year of tapping than in the first year in all clones and tapping systems tested irrespective of the opening girth (Tables 3.7 and 3.8). The DRC was relatively low in stimulated trees than in non-stimulated trees as reported by [20]. Since, stimulated trees have given a higher g/t/t, DRC may not be a significant factor in determining g/t/t. However, RRIC 121 was capable of maintaining higher values of DRC over the other two clones even with stimulation (Table 4).

In order to interpret the variation in yield, it is necessary to understand the inter-relationships that exist between yield and yield components. In this study, it is apparent that irrespective of the opening girth, latex volume showed a highly significant positive correlation with dry rubber yield (Table 5). Especially in G_{40} trees during the first year, the most important factor influencing the yield was latex volume with the other factors being of secondary importance. But in the second year, other yield components were also important in determining yield. This principle was common for all opening girths and clones tested (Tables 13, 14 and 15).

Overall correlation analysis clearly showed that the initial flow rate was positively correlated with the total yield. Similarly the plugging index and DRC were negatively correlated with yield (Table 5). In agreement with the previous findings regarding the variability of these factors, the correlation between IFR and total yield was particularly high within clones (Table 11) while the correlation between PI and yield was higher between clones. Yield differences between trees of the same clone were mainly caused by differences in IFR, while differences between clones were mainly associated with differences in flow time. There is a highly significant positive correlation between PI and DRC irrespective of the tapping systems and opening girths (Tables 8 and 10). In agreement with these findings, [13] also found that PI was highly correlated with DRC. This suggests that a higher DRC, therefore a higher latex viscosity, causes an earlier plugging of the latex vessels.

During the first year, PI did not have a significant positive correlation with IFR (Table 6). This may be due to the fact that PI and IFR behaved independently during the first year after commencement of tapping. However, in the second year, PI versus IFR had a significant positive correlation. During the first year, in G_{40} and G_{45} trees, IFR was mainly determined by the number of latex vessels and size of the latex vessels and not by the DRC. This could have been responsible for the absence of a significant correlation between DRC and IFR. But, in the second year, with age the number of latex vessels and size of the vessels increase. Hence, restriction for IFR may be reduced resulting in a significant positive correlation between DRC and IFR. Similarly G_{50} trees (higher girth trees) have more latex vessel rings and a greater size of the latex vessels. Thus, there would not be any limitations for IFR. This may the cause for the absence of a significant correlation in G_{50} (Table 8).

Furthermore, during the study period, initial flow rate showed a significant positive correlation with latex volume irrespective of opening girths. Therefore, latex volume may be determined by the IFR. Yield versus IFR also had a significant positive correlation for all opening girths. This reveals that, when the IFR increases, the latex volume also increases and finally it increases the yield. This study clearly showed that the DRC, PI and IFR vary according to year of tapping, tapping system and opening girth. At the immature phase (lower girth trees) physiological functions may not occur properly. Therefore, lower girth trees (especially G_{40} trees during the first year) were probably not mature enough to show normal latex flow relationships.

5 CONCLUSION

The study clearly revealed that the variations in latex yield either due to different girths at opening or tapping systems were controlled by the yield-determining latex parameters such the initial flow rate, plugging index and dry rubber content. There are significant clonal variations in these parameters and these variations have to be taken in to account in devising strategies for yield improvement in different clones. Accordingly, to improve latex yield in RRISL 211, the dry rubber content has to be improved. In contrast, to improve latex yield in RRIC 102, total latex volume has to be improved by greater initial flow rate and/or lower plugging index. RRIC 121 showed relatively less yield variation, both within and between years, in comparison to the other two clones, irrespective of the opening girths and tapping systems. This character of yield stability in the face of fluctuating environmental conditions is highly useful in some growing environments. Though this study has demonstrated the possibility of exploiting some new *Hevea* clones at a younger age, such knowledge when confirmed and extended could be beneficial not only in the exploitation of *Hevea* but also possibly in its breeding for crop improvement.

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Biodegradable waste to biogas: Renewable energy option for the Kingdom of Saudi Arabia

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ABSTRACT: Energy recovery from waste is not a new field of study, but its implementation continues to be a challenge in some Arab countries. Although there is abundance of useful waste in the urban markets, practices aiming at waste to energy conversion are still negligible. In the kingdom of Saudi Arabia, so-called green markets are abundant with renewable energy potential, but the practical implementation of this potential is missing. Therefore the objective of this paper is the evaluation of waste generation in KSA for the energy recovery purpose, and to show that the conversion of green waste into biofuel is not only environmentally friendly but also financially rewarding. Since the result illustrate that the major portion of the waste generated is organic waste, anaerobic digestion is proposed   waste to energy technology because of its feasibility for biodegradation of moist organic wastes into biogas. Diversion of waste into biogas and bio-fertilizer will ensure that it is treated in such a way that it becomes a useful product instead of harmful one. Furthermore as the policy makers and planners in renewable energy sector have intended for kingdom of Saudi Arabia to be "kingdom of sustainable energy" as well, hence they are needed to give special attention toward the largest Saudi Arabia's green market and should invest more to implement this plan.

KEYWORDS: Waste management, Biodegradable waste, Renewable energy, Biogas, Anaerobic digestion.

1   INTRODUCTION

Arab countries are presently faced with problems such as increasing urbanization and demands for more food and shelter to sustain a standard life pattern. Organic waste primarily composed of food waste, especially in the major cities of these countries which are facing with solid waste problems because of an increasing population and urbanization. Solid waste mismanagement is one of the main reasons for environmental deprivation. [1]. Statistical data from the International Energy Agency [2] shows that conventional energy resources like oil continue to be the most important sources of energy, accounting for approximately 80% of the total primary energy supply (TPES); oil is followed by coal and gas as sources of energy. The second-most important contributor is combustible renewable energy (CRE), which accounts for 10% of the world's TPES share. CRE, or traditional biomass energy, constitutes 80% of the total renewable energy consumed mainly in developing countries. King Abdullah research centre for atomic and renewable energy (K.A.CARE) in Saudi Arabia is planning to get 16 GW from PV, 25 GW from ,17 GW nuclear,9 GW from wind, 3 GW from waste to energy and 1GW from geothermal by the year 2032 [3]. With fossil energy sources eventually dwindling and becoming increasingly more expensive, waste-to-energy routes are gaining future attraction [4]. Cities account for approximately two-thirds of the world's primary energy consumption and 71% of global fossil fuel related direct greenhouse gas emissions [5]. To ensure that cities maintain their vital social and economic functions, there is a need to develop urban energy systems that are more efficient and emit less

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carbon dioxide. One option is to switch from fossil fuels to renewable energy sources such as wind, solar or biomass. The average greenhouse gas emissions per capita in the WTET are much lower, representing 80% - 87% reductions over the gas boiler case [6]. Biomass is an interesting renewable energy source for several reasons. The main reason is that bio-energy can contribute to sustainable development [7]. The fruit and vegetable markets produce large amounts of waste each year, and the disposal of these wastes is costly, both financially and environmentally. Studies [5–11] have revealed that by utilizing the physiochemical properties of these wastes, they can be upgraded to products of higher value that have a place in the market. Vegetables, fruits, and flowers are sold in large quantities in markets, and wastes thereof are disposed of along with municipal solid wastes (MSW) in landfills or dump-sites; this creates a breeding ground for vector, pest, odor, and greenhouse gas (GHG) emissions into the atmosphere. Renewable waste materials from agriculture, industries, and domestic sources are converted to useful energy forms such as bio-hydrogen, biogas, and bio-alcohols through waste-to-energy routes for global sustainable growth. Biomass energy can play an important role in reducing green house gas emissions, the use of biomass for energy offsets fossil fuel greenhouse gas emissions. At present, biomass is mainly used as a traditional fuel, contributing to about 38±10 EJY^1, modern biomass to about 7 EJY^{-1} [8]. Many energy scenarios suggest large shares of biomass in the future energy system .The availability of this biomass are not always separately analyzed. Furthermore, large-scale utilization will have large consequences for land demand and biomass infrastructure, which should be assessed. Many studies have been undertaken to assess the future biomass energy potential [9- 12].

To produce renewable energy from green waste, there is great potential of waste in KSA. If the generated waste is properly utilized, it could add greatly to the energy needs of the kingdom. Therefore, the aim of this study is a preliminary but yet challenging step to conduct research on the green markets in KSA. The main purpose of this study is to review the prospective of producing biogas from the waste generated locally, and in order to point up that the conversion of waste-to energy is environmentally friendly. The study is divided into five section: the introduction; KSA's biomass energy potential, a case study of waste generation and management in KSA, a brief comparison of waste-to-energy technologies and selection of suitable one based on waste composition, cost analysis and yield prediction of biogas, and finally the concluding remarks. The study provides important information in order to enhance the development of this industry in KSA in the future.

2   BIOMASS ENERGY

Biomass energy is a renewable energy resource derived from the carbonaceous waste of various human and natural activities. It is derived from numerous sources, including the by-products from the timber industry, agricultural crops, raw material from the forest, and major parts of household waste. Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as a fuel. Biomass is the most important fuel worldwide after coal, oil and natural gas. Bio-energy, in the form of biogas, which is derived from biomass, is expected to become one of the key energy resources for global sustainable development. Biomass can be converted into three types of useful product namely, electrical energy, transport fuels and chemical feed stock.

2.1   BIOMASS RESOURCES IN KSA

Huge amount of waste is generated in KSA mainly in the form Municipal Solid Waste (MSW), Industrial Organic waste, and sewage. It has been estimated that the total biomass energy potential of KSA is 3.0 (mtoe) [13] and it stands fourth in the Arab world after Morocco, Egypt and Sudan, Fig:1. Solid waste generation in Arab countries is increasing rapidly. Fig.2 shows [14] the solid waste generation comparison of some industrialized and emerging Arab countries; it is obvious that solid waste generation in KSA is much higher comparatively. This could be due to tourism to the Islam's holiest places in kingdom, rapid urbanization, construction, and/or population density. Thus for, KSA's per capita generation of waste per day (1.75Kg) is superior compared to other countries in the region that have less than one, Fig. 2.
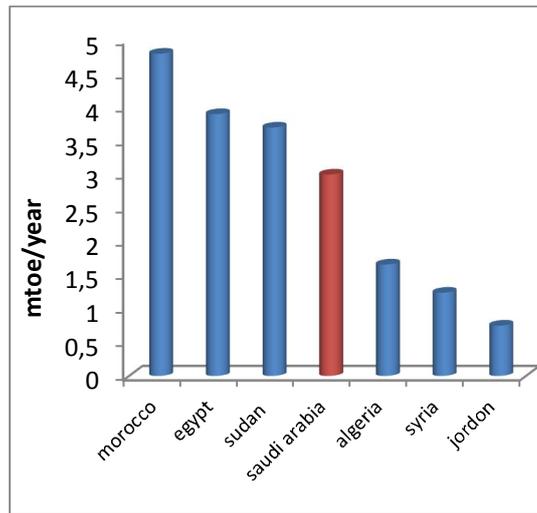
Fig. 1.   *Figure 1: Biomass energy potential (mtoe)*
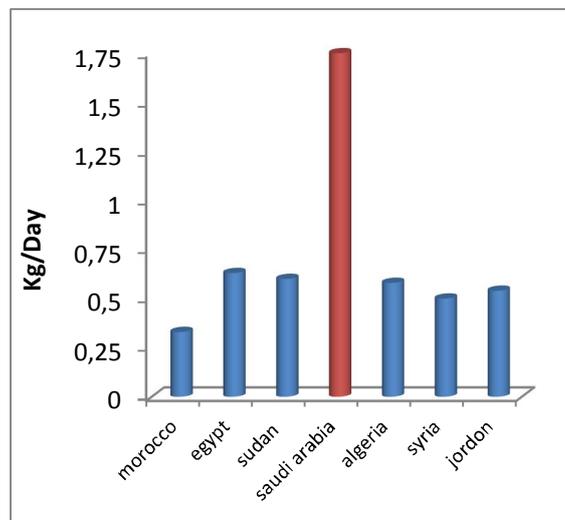
Fig. 2.   *Solid waste generation rate per capita*

As per indicative levelized cost of renewable energy sources against gas-fired entrants in KSA [15] it is evident from figure:3 that the cost of energy produced from biomass is comparable to that of energy obtained from the other available resource (Solar thermal & PV, Tidal energy) in the kingdom, and if the biomass energy available is effectively utilized then it can provide energy at about $101/MWh which is 65.65% and 57.23% cheaper than solar and tidal energy respectively.
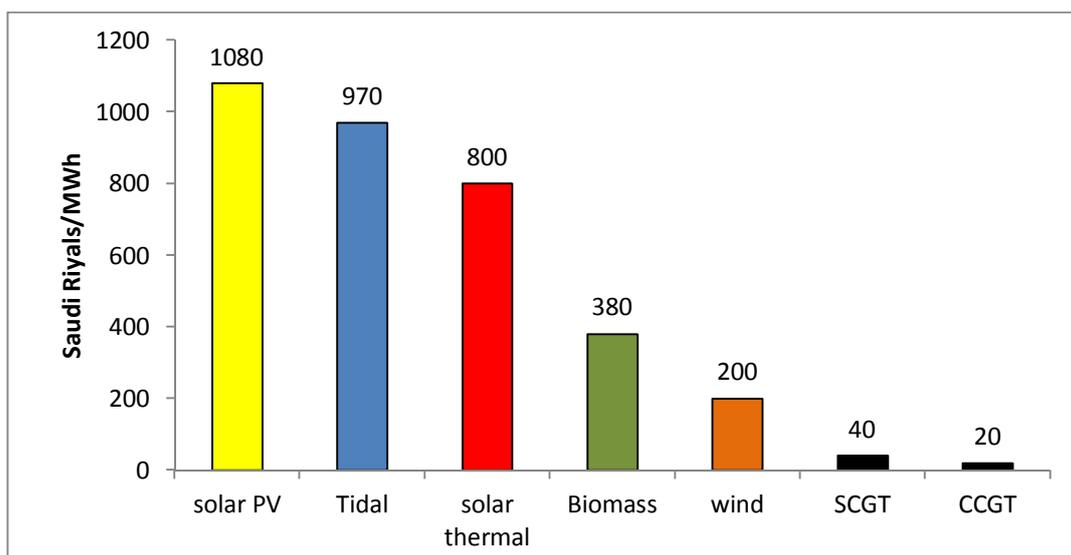
Fig. 3.   Comparison of Renewable Energy costs in KSA

2.1.1   ORGANIC WASTE GENERATING INDUSTRIES IN KSA

Industries in the kingdom produce a large amount of organic residues and by-products whose disposal is a major problem to the municipal authorities, and also affect the environmental standards. There are many technologically-advanced dairy products, bakery and oil processing plants in the kingdom that produces a huge amount of organic waste [16-17]. In recent decades, the fast-growing food and beverage processing industry has remarkably increased the organic waste generation. Since the early 2008, the increased agricultural output stimulated an increase in fruit and vegetable canning as well as juice, beverage, and oil processing in the country. Over 30 types of industry have been identified as having organic waste production in KSA [18] that is amenable to anaerobic digestion treatment, including food e.g Dairies ,beverages, meat processing, olive oil, pulp and paper, pharmaceutics, cosmetics fish oil and fish processing plants.

Dairy industrial production began in Saudi Arabia since 1970s and there are now 17 dairies in KSA [19]. Each plant produces waste of a distinctive composition, depending on the kind of product that is produced e.g milk, cheese, butter, milk-powder, condensate etc. Total of 1039 MT of milk is produced daily in KSA with proportional amount of other dairy products. An average of about 2400 kg waste is generated per ton of the dairy products [20]. The main solid waste produced by the dairy industry is the sludge resulting from waste-water purification [19].

Olive oil production in KSA increased from 1000MT in 2001 up to 3000 MT by the year 2013 [21] and hence there is proportional increase in the waste produced. The nature of solid waste produced depends mostly on the processing method of olive oil, and consists of about 25%- 33% organic matters. The average yield of waste olive cake is about 50% of the total waste, but varies greatly [22].

Beef and veal meat production started in KSA with 8000 MT in the year 1975 and continuously increased up to 25000 MT by 2013 [21], and this industry contributes to the highest loads of organic waste in the food sector.

2.1.2   AGRICULTURAL WASTES

Saudi Arabia's agricultural produce may offer a potential for biomass energy. KSA produces, in order of importance, wheat, barley, tomatoes, melons, dates, and citrus fruits; the main livestock are mutton and chickens. Various crop/vegetable production (2.5 million tons in 2004) and animal waste could be used as feedstock to generate electricity. However wheat production gradually reduced, requiring reliance on other sources for biomass [15].

2.1.3   MUNICIPAL SOLID WASTE GENERATION IN KSA

In Saudi Arabia, MSW is collected from individual or community bins and disposed off in landfills or dumpsites. MSW consists mainly of food waste, yard waste, plastic bags, furniture scrap, used tires, home appliances, and waste paper. In KSA, currently only 10-15% of this waste is recycled while the remaining goes to landfill [17]. Organic materials represent the

huge amount of MSW including food waste, paper and wood waste. Fruit and vegetable waste is generated in large quantities with their high biodegradability, in the main cities of the kingdom. Solid waste generation from food e.g meat, fruit, and vegetables etc, in the central sharing market of three largest cities – Riyadh, Jeddah and Dammam, exceeds 6 million tons per annum [18]. During the Ramadan and Hajj season about 600,000 kg, or 4,500 cubic meters, of waste is generated each day, which puts a heavy burden on those responsible for collecting the waste [23]. MSW generation has increased from 12.1 million ton per year to 15.2 million ton in five years since 2007. From the table.1 it is cleared that compared to increase in population the amount of waste generated is much higher, and hence the per capita rate per day raised from 1.4 in the year 2007, to 1.75 by the year 2012.

Table 1. MSW Generation in KSA

Year	Population(approximately) million	Average rate of generated MSW kg/per capita/day	Estimated gross quantity of MSW million ton/year
2007	23.67	1.4	12.1
2012	29.40	1.75	15.20

The percentage of different types of items in food waste sample of KSA is 38.72 (rice), 18.74 (bakery products), 25.15 (meat), 13.03 (fat), 2.19 (bones) and 2.16 (fruits and vegetables) [24]. Waste related to Construction materials and hazardous wastes is not considered in the division here. More than 75% of the population of KSA is concentrated in urban areas and urban population increase by 3% annually [16], which make it necessary for the government to initiate measures to improve recycling and the waste management scenario in the country.
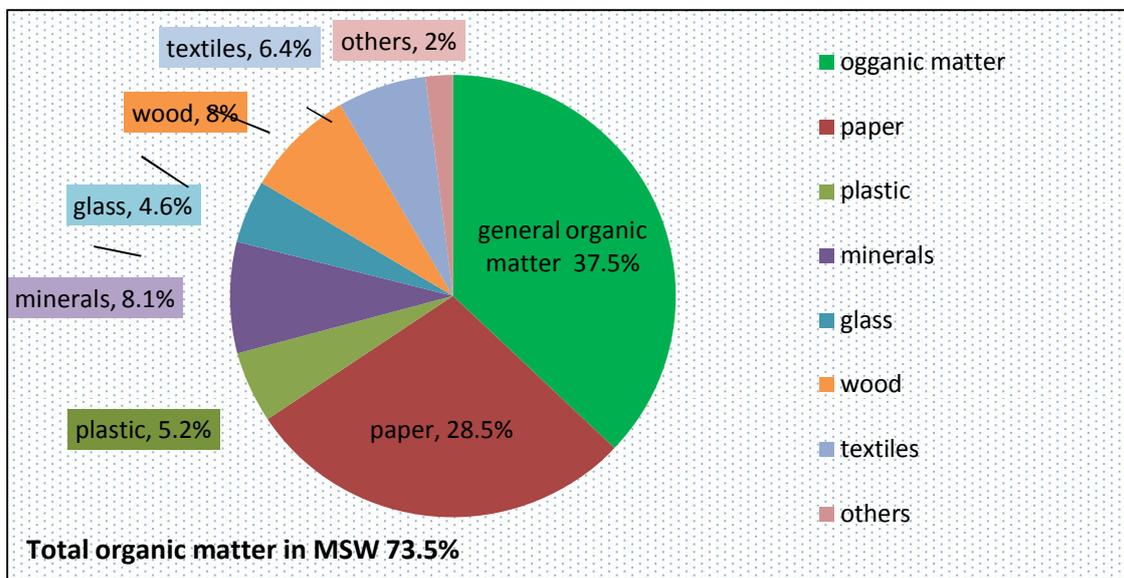
Fig. 4.   Components of MSW in Saudi Arabia

Fig.4 shows that most of the MSW consists of the organic matter and it is 37.5 % of the total MSW generation.

According to the current report by [25] the composition of the overall waste produced in KSA consists about 75% of organic wastes, including paper, food and wood waste. The individual food waste percentage is contributing for the 50.57% of the total organic waste, the paper waste is 11.97%, and plastic waste production on overall basis comprise of 17.39%. Other components produced on minor scale in the waste included glass of about 3.5% and cardboard that 6.64%, while textiles, metals, leather and aluminum are less than 4-5% as shown below in the figure 5.
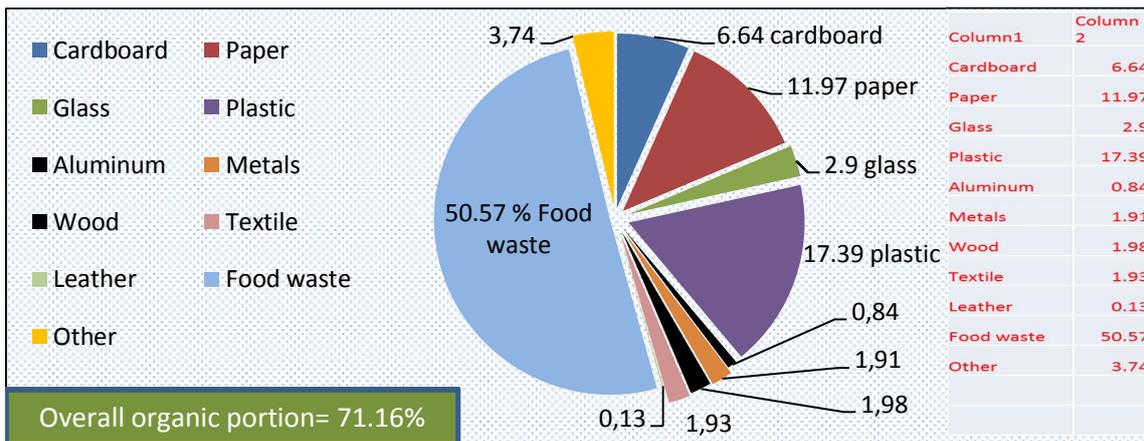
Fig. 5.   Composition of overall waste produced in (mass %) KSA

The Chemical composition of food waste sample in KSA analyzed by [24] is moisture (38.4%), carbohydrates (25.56%), crude protein (17.26%), crude fat (15.27%), fiber (0.3%) and ash (3.21%). The results shows that food waste samples is rich in carbohydrates, crude protein and fat contents while fiber and ash are in small amounts shown as in the Fig. 6.
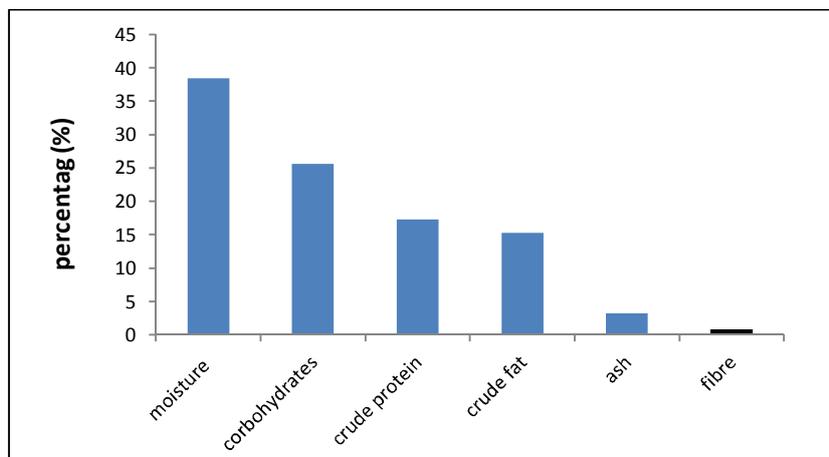
Fig. 6.   Chemical composition of KSA's market organic waste
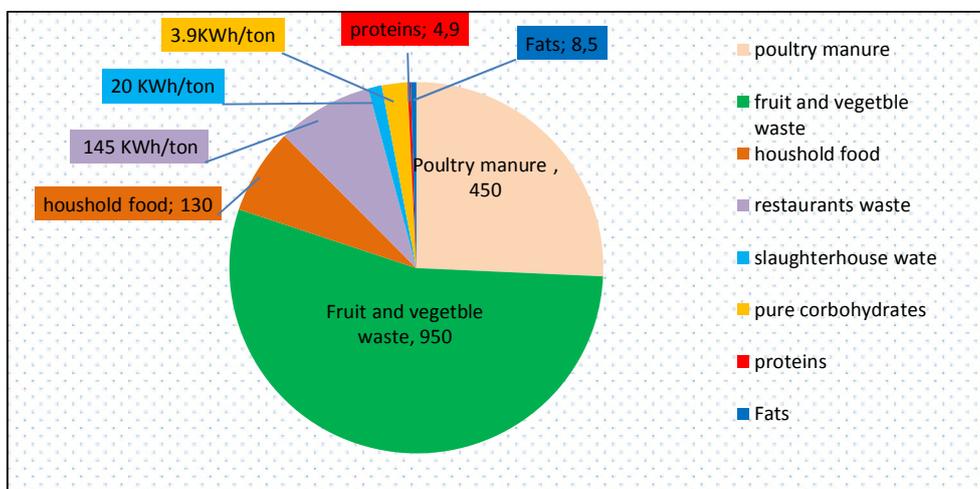
Fig. 7.   Energy contents of different substrates (KWh/ton)

3   WASTE MANAGEMENT IN THE KSA

KSA is one of the promising economies of Arab world and its population is almost 29.4 million according by 2012 [28]. According to world bank report estimation of hazardous waste quantity on GDP basis, KSA has been marked as "High" in classification, with waste hazard coefficient of over 2000 ton/$billion [29]. Conventionally, the municipal authorities and waste collection companies are responsible for waste management in KSA. But, due to the urbanization, waste management problem has become severe, especially in main cities i.e Riyadh, Dammam and Jeddah, and it is one of the significant challenges for the municipal authorities. Recycling, reuse and energy recovery is still at an early stage, although they are getting increased attention. Waste sorting and recycling rate ranges from 10-15%, driven by an active informal sector which extracts paper, metals and plastics from the waste. Currently the organizations for the waste management in the kingdom are working for the safe disposal of the waste only, and not for the energy recovery from it. The Saudi government is aware of the critical demand for waste management solutions, and is investing heavily in solving this problem and efforts are underway to deploy waste-to-energy technologies in the Kingdom. The 2011 national budget allocated SR 29 billion for the municipal services sector [16-18], which includes water drainage and waste disposal. But if the same amount of money is spent on installing waste to energy production plants, profits would increase and equivalently the GHG emissions will also reduce. KSA is the 3rd highest per capita consumer of water in the world, behind the U.S. and Canada [17]. Handling huge quantity of sewage sludge is one of the most significant challenges for municipal authorities in the Saudi Arabia due to high treatment costs and risk to environment as well as human health. According to JETRO (Japan org) survey report [16], an average, wastewater generation is 80-200 liters per person each day in KSA. According to an estimate from the Drainage and Municipality Department of kingdom, sewage generation has increased from 50,000 m^3 per day in 1981 to 450,000 m^3 per day in 2012. Sewage generation across the country is rising by an astonishing rate of 25 percent every year. The dried municipal sewage sludge has organic material content (40 – 45 wt. %) [27], that contributes to the total organic waste produced.

4   WASTES-TO-ENERGY TECHNOLOGIES (WTET)

Waste-to-energy technologies convert waste materials into different types of fuels. Advanced WTET produces biogas, syngas, liquid bio-fuels or pure hydrogen; and these fuels can then be used directly or to generate electricity. WTET is the use of, physical thermochemical and biological technologies to recover energy from the wastes Fig. 8.
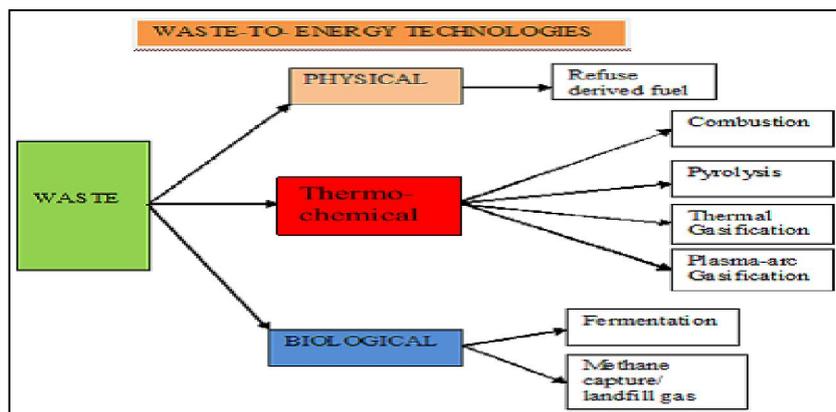
Fig. 8.   Waste-to-energy pathways

4.1   PHYSICAL CONVERSION

Physical WTET treats the waste physically to convert it in to fuel pellets/refuse-derived fuel (RDF). The fuel pellets consists largely of organic materials taken from solid waste streams, such as plastics and biodegradable waste. The waste is first processed to remove glass, metals, and other materials that are not combustible and then treated with high-pressure steam to kills viruses and other potential pathogens. This process reduces the volume of the waste by up to 60%. The combustion of fuel pellets is clean and efficient than incinerating MSW or other solid waste directly, but the processing is additional cost [31-36].

4.2 THERMOCHEMICAL CONVERSION

The principal methods of thermochemical conversion are, combustion in excess air, gasification in reduced air, and pyrolysis in the absence of air and all these are recommended for waste with moisture content less than 20%. Plasma gasification, which takes place at extremely high temperature, is also hogging limelight and is in the early stages yet can produces up to 13,000 °F temperature. This high temperature breaks down the wastes into syngas. All type of waste, including even concrete, steel, and toxic chemicals can be converted to heat energy using plasma converters, but the technology need large energy inputs at the start and that is the only disadvantage [31-36].

4.3 BIOLOGICAL CONVERSION

Biochemical processes, like anaerobic digestion and fermentation, produces clean energy in the form of biogas and ethanol respectively. AD is the natural biological process which biochemically degrades the organic waste in a controlled, oxygen-free environment resulting in the production of bio fuels, it is a reliable technology for the treatment of wet, organic waste. Advance digester systems can now produce biogas with pure methane content higher than 95%. Fermentation uses yeast to generate liquid ethanol from biomass waste [31-36].

From the comparative study of the above mentioned techniques in table.2 it is noted that AD is the most applicable WTET for the organic waste.

Table 2.   Comparative study of WTET

Waste type	Incineration	Anaerobic Digestion	Gasification	Use in power plant
Food	Yes (mixed with high C.value waste)	Yes	No	No
Paper	Yes	Yes	Yes	Yes
Wood	Yes	No	Yes	Yes
Garden	Yes (mixed with high C.value waste)	Yes	No	No
RDF	Yes	Yes	Yes	Yes

5 PROPOSED WASTE TO ENERGY TECHNOLOGY FOR KSA

WTET is selected based on standard criteria i.e considering the amount of substrates, kind of substrates, the composition, the quality, and its energy contents. It is found from Fig: 5 that waste produced in KSA consists of 70.16% organic portion by mass, and its moisture content is 38.45% Fig: 6. From the comparative study of different WTET earlier, we found that biological conversion is the most suitable for converting waste with high moisture content such as organic waste, hence in our study, "high-solids anaerobic digestion with the thermophilic range" is recommended for KSA. According to NREL report 2001, it (high-solids AD with the thermophilic range) is an established technology and many plants are using it. The main benefits provided by this system for the scenario of waste generation in KSA will be e.g hygenizaion of mixed MSW waste, minimum retention time and higher biogas yield. Mixed MSW as well as biowaste can be processed by high-solids AD systems and it is an added advantage. The main benefit of AD is that, it is favorable for the waste with the high moisture contents, and this high moisture content is the main problem for other WTET to treat with. AD of organic wastes is fast gaining popularity worldwide as a means to protect the environment and to recycle biodegradable materials efficiently.
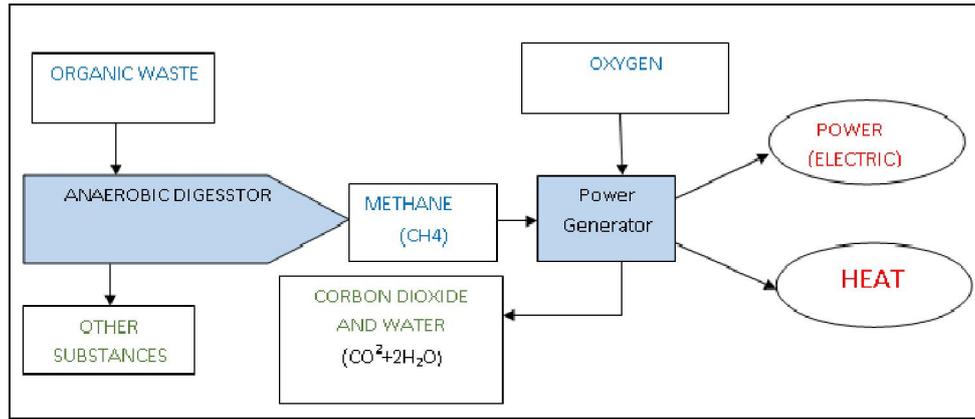
Fig. 9.   Schematic diagram of Proposed Biogas production process from organic waste

AD is four-stage process i.e hydrolysis, acidification, cytogenesis and methanogenesis all these process takes place in the digester tank simultaneously. AD may be at low temperature or under the thermophilic conditions. KSA is a tropical country, where the average ambient temperature is higher than 27 C^o during a period of more than 8 months of the year, so thermophilic AD is readily applicable here. Performance comparison of organic waste anaerobic digestion in the thermophilic (55C^o) , psychrophilic (20 C^o) and mesophilic (35 C^o) conditions experimentally verified that average biogas production from thermophilic digester is higher than from psychrophilic and mesophilic digesters by 14.4% and 41%, respectively. Similarly the net energy production in the thermophilic digester is 196.7 and 48.07 kJ/day higher than that for the psychrophilic and mesophilic digesters, respectively. The relation between the daily production of biogas and the temperature indicated that for the same produced quantity of biogas, the size of the thermophilic digester is small [32-37]. This huge amount of organic wastes produced locally in KSA's largest market is a recommended substrate for the proposed process. The potential of AD for energy production showed that, from organic waste containing organic fraction about 74.50% in the form of biodegradable material with 9.1% cellulose, and 5.4% lignin , AD converts 70–95% of organic matter to methane [33]. AD of food-market waste resulted in a production of 640 m^3 biogas/ton waste added [34]. The biogas yield from canteen wastes, which is a mixture of fruit and vegetable waste, when subjected to AD varies from 820 up to 900 m^3/ton [35]. The biogas yield of the organic feedstock from MSW, correspond to 80.4-100 m^3 methane production per ton feed-stock [31]. Comparison of typical reported biogas yield from different substrate in literature is shown in Fig. 10 [38-39]. It is noted that food waste has a superior yield of biogas/dry tone, compare to other substrates. It shows that biogas yield from food waste is 15 times more than yields from cow manure.

Hence the diversion of generated organic waste in KSA into biogas and bio fertilizer will ensure that it is treated in such a way that it becomes a useful product instead of a harmful one to the environment and can add to the revenue of the kingdom in the form clean energy.
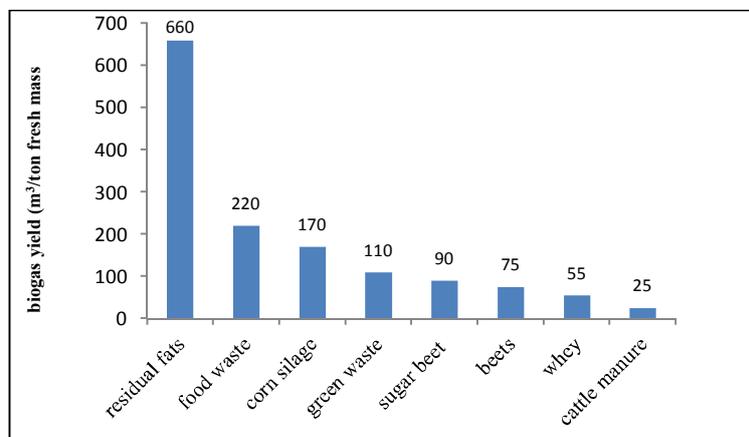
Fig. 10.   Biogas from various substrates in m^3/tone VS

6   BIOGAS YIELD PREDICTION AND COST ANALYSIS BASED ON KSA'S ORGANIC WASTE POTENTIAL

For the KSA to achieve the objectives of the proposed WTEC system, it is necessary to predict the biogas yield and to perform cost analysis in order to investigate whether the waste conversion into biogas is financially feasible or not.

Many techniques are available in literature to predict biogas yield from organic waste e.g ultimate analysis, molecular formula based estimation, and literature review of experimentally determined biogas yields. It's very difficult to find out the percentage of carbohydrates, proteins, and lipids in a heterogeneous market substrate. So for simplicity the literature available, based on experimental results for biogas production from organic waste is used in the study to predict the biogas yield. For example,

(1). Ultimate analysis of food waste for biogas prediction used by [39] gives the result as, for about 40-65% of the organic material conversion, yield up to 402-653 m^3 biogas per ton of various substrate (VS).

(2). Biogas yield prediction from organic waste based on estimation from molecular formula by [39] gives an amount of 490 - 754 m^3/t VS, this value is assuming that all of the volatile solids are destroyed.

(3). Using a tool for biogas prediction in matlab simulink by [39] the biogas yield was 316 m^3/t VS, with a 14% difference compared to the experimental yield of 367 m^3/t VS. **(4).** The experimental biogas yield based on the estimated annual food waste of 216.5 ton/year is 374.25-408.5 m^3/ton food waste, and the corresponding useable energy in the form of heat is 172561.94 KWh and in the form of electricity is 86280.97 KWh annually with calorific value 258843 KWh [24].

Hence with reference to the above mentioned experimental based literature, taking average 450 m^3/tone yield value, the approximate biogas yield from organic waste generated in KSA is about 3420.50 million m^3 per annum when 50% of the organic waste out of 70% in overall composition is converted and only 20% of it is dumped per day.

To analyze the financial feasibility of the proposed technology, the net saving is calculated. For simplicity, the cost analysis is explained from the viewpoint of current budget spends on the waste management by the KSA's government, and its comparison with the proposed scenario. The input costs e.g labor, machinery, capital, etc. are in accordance to the current market prices in KSA. The following formula is used

<p align="center">Gross savings = Total benefit -Total costs</p>

Currently the   municipal service sector spend about 29 billion SR per annum [18] on sewage and solid waste management, however, they get nothing in return, The proposed technology will be useful as instead of spending money they will get revenue back in the form of useful energy. Table: 3 explains firsthand benefit of the current scenario and the benefits obtained by reducing/stopping the dumping of green/organic waste. The typical costs of a biogas plant, including all essential installations but not including land, is between 50-75 US Dollar per m^3 capacity [39]. Two assumptions are made here

(1). The cost of SWM is assumed to be 30% of the total annual budget.

(2). The operational and maintenance cost of the biogas plant is assumed 20% of the total net annual benefit.

Table 3. Benefit/cost analysis of proposed technology

Current SWM cost						
KSA , SWM budget/annum	Total benefit	Direct saving by discontinuing the waste dumping				
8.7 billion SR	Nil---Nil---Nil	Cost/tone of waste	572.36 SR			
		Total quantity/day	21111.67 (tone)			
		Total cost	12.0850 million SR			
		Annual direct saving	4.2105 billion SR			
Proposed biogas technology revenue						
Organic waste	Annual Biogas yield	Equivalent energy in term of Electricity	Total energy output	Electricity Cost/KWh (domestic)	Total benefit	Waste collection/ plant Operational and maintenance cost
7.6million tone/annum	3420.00 (million m^3)	398.528 KWh/ tone	3028.89 million KWh	0.22 SR	666.34 million SR	133.26 million SR

Gross benefit from direct saving and revenue from biogas plants

= (Annual direct saving) **+** (annual revenue from biogas production)

= 4743.58 million SR/annum

7 POSSIBLE USES OF BIOGAS IN KSA TO REDUCE ITS DEPENDENCE ON FOSSIL FUELS

1. There is extreme demand for air-conditioning in the KSA as a result of the high ambient temperatures. Of the total electricity production (45 GW by 2012) in Saudi Arabia, 52.12% is consumed in residential purpose, 17.9% industrial, 11.50% governmental, 2.2% agricultural and 12.20% in commercial areas, and 30% of the total domestic use of electricity, is consumed for refrigeration in Riyadh and Jeddah, each, and 18% in Dammam [39]. Possible option to reduce the amount of electricity consumption for refrigeration purpose is to use biogas-powered novel absorption-refrigeration cycle. It can be used in absorption refrigeration system as heat source for regeneration of refrigerant. For a Refrigerator of 230 KW capacity, the biogas consumption will be approximately 0.044 m^3 [39]. Such systems will significantly share the load of electrical energy generated by burning fossil fuel; hence it will reduce the global warming effects equivalently. Its use can be an interesting alternative for solving problems of electrical over-consumption by conventional vapor compression refrigeration used in KSA.

2. The biogas has high octane rating and calorific value ranges between 4700-6000 Kcal. It has ignition temperature of 640–840 C^0. If it is generated on small scale from the locally generated waste then it is highly recommended for domestic use, e.g cooking etc. It can be used in lamps, as per studies 1 KWh of electricity can be generated from 0.7m^3 of biogas, which can light electric bulbs of 60 watt rating for 1 hour [38-39].

3. The useful products from AD are high purity methane gas and pure CO_2 gas suitable for use in the soft-drink industry, high purity liquid fertilizer, and high purity solid fertilizer for use in small scale plantation inside the cities.

8 CONCLUSIONS AND FUTURE PERSPECTIVES

Preliminary efforts have been made in the study to review the overall waste energy potential of KSA's largest markets. For KSA the task was difficult due to the non availability of the sufficient literature. It was very difficult to compare the study's results with literature, but it can be assured that this study could serve as a point of reference and open up avenues for future research work in this field. The results of this study showed that the KSA market has immense potential of waste, and production of biogas is a better solution instead of dumping waste into landfills. The proposed WTET for the production of biogas can play a pivotal role in KSA to reduce its dependendence on the fossil fuels and thus reduces the environmental impact. Huge amount of organic waste generation make it evenhanded to convert it into useful energy instead of being harmful to the environment as well as human health. Biogas plants will help to reduce the financial burdens on SWM, apart from being an environmentally friendly way to manage the waste, and this makes it the ultimate solution. Cost analysis of the predicted biogas yield showed that the instead of spending money to dispose the waste we can get revenue back. It can also solve the challenges faced by Saudi government in treating waste, because of the enormous increase in the population of the kingdom in urban areas. Foremost is the fact that current anaerobic digestion technologies are not sufficiently efficient .If we are to utilize renewable waste as a bio-energy resource, substantial improvements in the efficiency of energy recovery will have to be made to make these processes more economically viable. Another key factor for the future research is the waste collection in KSA due to its dispersed nature; hence to recover energy from waste its collection and transport is also a significant challenge and this section needs further improvement.

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L'impact des technologies d'information et de communication sur la qualité du système d'information comptable: Cas des PME à la ville Ibb (Yémen)

[Effect of Information Technology and Communication on the Quality of Accounting Information System: a Case of SMEs at Ibb City (Yemen)]

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ABSTRACT: Many companies use information technology and communication in accounting, which show a clear impact on the performance of the accounting information system. The current research presents exploratory results using a questionnaire from 48 small and medium enterprises at Ibb city, in Yemen. The questionnaire was distributed to a number of the accountants, assisting-accountants, internal reviewers and financial managers who are used computer-based accounting information system. The results of this study indicate that there is a positive correlation between information technology and communication and the quality of accounting information system at the level 0.05. Statistically, this correlation is high according to the standard deviation which reaches the level of R= 0.612 between information and communication technology and the quality of accounting information system. Additionally, there is a positive effect on the accounting information system by the information technology according to the conducted comparison between the computed T-values and table-based T value which indicated that the former T-value is higher than the latter one for all the variables. The results were measured through a number of factors and variables which information technology is characterized by. These factors and variables include: information technology time and an access speed to the information, another factor is information technology update, the third factor is the techniques used and the last factor is information technology risks.

KEYWORDS: Information Technology and Communication, Accounting Information System, Quality, Efficiency, Efficacy, Small and Medium Enterprises.

RESUME: De nombreuses sociétés utilisent la technologie d'information et de communication (TIC) en la comptabilité, qui montre un impact clair sur la performance du système d'information comptable (SIC). Cette recherche présente les résultats d'une enquête par questionnaire sur 48 PME situées à la ville Ibb au Yémen, nous avons distribué le questionnaire à des comptables, des comptables assistants, des auditeurs internes et des directeurs financiers qui travaillent avec un système d'information comptable informatisé. A travers ces résultats, on a pu constater qu'il y a une relation positive significative entre la technologie d'information et de communication et la qualité du système d'information comptable (QSIC) au seul de 0,05, l'intensité du lien est estimée par la méthode de régression linéaire qui était de R = 0,612 entre TIC et QSIC, ainsi, il y a un effet positif sur la qualité du système d'information comptable par la TIC d'après la comparaison faite entre les valeurs de T calculées et T tabulaire qui a montré que T calculé est supérieur à T tabulaire pour chaque variable, ce qui confirme la relation précédente. Le résultat ont été mesurés sur la base d'une variété de facteurs qui caractérisent la technologie, d'abord, il y a le facteur temps de technologie et une vitesse d'accès aux informations, le facteur de mise à jour des technologies de l'information, le facteur des techniques utilisées, enfin, le facteur des risques des TIC.

MOTS-CLEFS: Technologie d'Information et de Communication, Système d'Information Comptable, Qualité, Efficience, Efficacité, Petites et Moyennes Entreprises.

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1   INTRODUCTION

Les progrès réalisés au niveau de la technologie de l'information (TI) ont permis aux entreprises de faire appel de plus en plus à l'outil informatique pour exercer leurs activités qui étaient exécutées manuellement auparavant. Cette révolution spectaculaire des technologies s'inscrit dans un contexte socio-économique caractérisé par la mondialisation des échanges, le rythme accéléré des innovations, la segmentation et la diversification croissante des marchés, les complexités des variables politiques et sociales ainsi que la montée des valeurs écologiques, ce qui représente autant de menaces que d'opportunités pour les entreprises.

En effet, l'explosion du multimédia, la numérisation du son puis de l'image et le déploiement des réseaux large bande à base des fibres optiques et des satellites dessinent les contours des sociétés du troisième millénaire qui est la société de l'information. La société de l'information et de l'immatérielle, source première du savoir devient la source de la force économique et de la richesse de l'individu et par la suite de toute la nation. Cette société sera construite autour des voies électroniques communément appelées « les autoroutes de l'information » qui transforment le monde entier en un village planétaire.

Aujourd'hui, presque toutes les organisations utilisent des ordinateurs dans leurs affaires quotidiennes. Comme les ordinateurs deviennent plus petits, plus rapides, plus faciles à utiliser et moins coûteux, l'amélioration de la TI a apporté des améliorations dans les ordinateurs, l'informatisation du travail de la comptabilité va se poursuivre. Les systèmes comptables qui étaient auparavant effectuées manuellement peuvent désormais être réalisés avec l'aide d'ordinateurs. Par conséquent, l'amélioration de la technologie de l'information a facilité l'utilisation du coût et des procédures de gestion comptable.

La révolution en cours dans les technologies de l'information (TI) a eu une influence significative sur la qualité du système d'information comptable(QSIC). Autrement dit, les comptables sont maintenant en mesure d'exercer leurs activités de manière plus efficace et plus efficiente qu'auparavant. Le système d'information comptable (SIC) contient les composants et les éléments de plusieurs logiciels comptables les plus importants, par exemple le système d'information bancaire vise à répondre à des données financières fournies par le biais de son logiciel de comptabilité pour l'extraction de l'information comptable sous forme de rapports, de documents et des états financiers à destination de tous les bénéficiaires du système.

Après la révolution industrielle du XXème siècle et le développement des technologies de l'information, l'ordinateur est apparu sur la scène comme élément central de la révolution dans le domaine informatique, ce qui a aidé à faire sortir l'information qui a été stockée dans des livres, des documents placés sur des étagères de grande échelle pour être stockée sur un simple petit CD ou bien sur d'autres outils de stockage qui ne prend pas assez d'espace mais avec une très grande capacité de stockage.

En fait, les travaux de comptabilité ne diffèrent pas trop d'une organisation à une autre et ne peuvent être liés à un certain type d'entité (public ou privé) ou d'activité (service – commercial - industriel).

Les transactions financières réalisées dans une entreprise sont caractérisées par des mouvements répétitifs et continus, il est donc nécessaire de centraliser ces informations financières dans le cadre des missions effectuées durant les périodes comptables de la saisie des données et de traitement, puis, transformer cette information (rapports comptables) provenant du système informatique sous forme de documents d'analyse, ce qui confirme l'importance évidente de l'ordinateur comme acteur pilier dans le système d'information comptable.

L'importance de l'information comptable dans la prise de décision est claire grâce à la propriété du moment opportun (temps d'accès à l'information) et la propriété de la précision nécessaire pour pouvoir être invoquée à prendre des décisions qui aideront les financiers à réformer en continu leurs structures financières.

Le conseil FASB (Financial Accounting Standards Board) signale que les informations comptables utiles pour les décideurs doivent être disponibles le cas échéant, incluant les critères de la sincérité ou de la fiabilité et comprennent également les caractéristiques spécifiques de la qualité des informations comptables, ce qui implique la nécessité de disposer en temps opportun et réel des différentes propriétés des informations comptables.

L'importance de la recherche en abordant le sujet est important pour les entreprises, où il est prioritaire pour l'organisation de chercher à atteindre ses objectifs à travers les différents systèmes à tous les niveaux et donc le système d'information comptable joue un rôle pivot dans la recherche des éléments qui contribuent à améliorer la qualité des informations pour atteindre les objectifs et les buts, il était nécessaire aussi de se tenir au courant des développements qui ont eu lieu aujourd'hui dans le monde grâce à l'utilisation des technologies de l'information, chose qui a influencé positivement le domaine de la comptabilité et favorisant aussi le développement de la recherche dans le domaine comptable mais aussi de mesurer l'impact de ces technologies sur les systèmes d'information comptables.

Au début de l'XXIe siècle, la plupart des entreprises Yéménites, surtout les grandes entités, investissent dans les technologies de l'information pour la gestion des opérations financières, ces entreprises ont été conscientes que ceci aura un impact évident sur la performance, alors que les PME sont encore à la traîne, il était donc nécessaire d'effectuer de telles recherches pour découvrir les résultats des investissements dans les technologies de l'information et les sociétés de communications dans les petites et moyennes entreprises afin de mesurer la relation pouvant exister entre la technologie et la performance ainsi que son effet les PME Yéménites.

La comptabilité est l'un des domaines qui ont bénéficié des technologies de l'information et de la communication, soit par la saisie des données, le traitement, le stockage ou lors de la présentation des rapports d'un mécanisme, soit par leurs effets sur les différentes branches, telles que l'audit, la comptabilité analytique, etc., la technologie d'information et de communication aurait également un effet sur la relation de l'entreprise avec les tiers ainsi que ses relations au niveau du marché financier.

Il est certain que les systèmes d'information comptables sont des systèmes ouverts sur l'environnement externe, ils sont donc affectés par cet environnement, à cet effet, il est devenu nécessaire de prendre en considération les effets qui peuvent influencer les systèmes d'information comptables ainsi que leur conception et leur fonctionnement dans les entreprises, la problématique de ce travail consiste à répondre à la question suivante: Quelle est la relation entre les technologies d'information et des communications et la qualité du système d'information comptable (QSIC) dans les PME au Yémen ? Et qu'en est-il l'effet sur la QSIC?

2 LES ETUDES ANTERIEURES

En fait depuis le début de1980, certaines études de recherche ont essayé d'étudier la relation entre l'investissent en technologies de l'information et la performance, certains des résultats de ces travaux ont conduit à des résultats conformées, parfois contradictoires, ainsi, le problème de l'impact des technologies de l'information sur la performance est toujours en place, il a également noté que la littérature est pleine d'expérimentations pour arriver à des conclusions sur ce problème, la plupart des résultats sont moins convaincants à divers niveaux et conduisent à des résultats qui ne sont pas conventionnels.

«La référence [1] a observé que le champ de recherche dominant dans les systèmes d'information a été axé sur le problème de l'évaluation des technologies de l'information, a également vérifié que la préoccupation dans l'étude de la relation entre les technologies de l'information et de la performance organisationnelle est un processus continu, la ligne évolue en fonction du temps».

Certain chercheurs ont proposé une série de citations de la littérature qui combine des modèles de recherche ayant examiné la réussite de la technologie, ces auteurs ont identifié six axes de la réussite: la qualité du système, la qualité de l'information, l'utilisation de la technologie, la satisfaction des utilisateurs, l'impact sur l'individu et enfin l'impact sur les performances [2]. Ce modèle qui détermine comment la technologie de l'information devrait à voir un impact positif sur les utilisateurs individuel savant qu'ils ne conduisent à une amélioration de la performance sur le plan de l'organisation.

Par les résultats d'autre travaux qui ont constaté que les gestionnaires ont compris que l'information informatisée est plus utile que les systèmes d'information traditionnels et que les informations informatisées se caractérisent par la vitesse et la précision appropriée aux besoins de l'utilisateur [3].

Une étude a été axée sur les cinq bureaux de la firme comptable publique internationale qui a fait des gros investissements dans la technologie des informations, les données ont été analysées par une analyse de régression et une analyse non-paramétrique des données de la quantité et de la qualité obtenues à partir des programmes de vérification et d'applications de la connaissance commune, ils ont constaté que les résultats se réfèrent à la productivité plus haute significativement selon les applications des technologies de l'information et l'impact de la valeur des documents de la technologie de l'information sur les sociétés comptables publiques. Lorsque l'étude a révélé que l'efficience en 1999 a augmenté de 3% par rapport à l'année 1997, l'étude a également indiqué que l'offre de l'information électronique facilite le processus décisionnel dans la profession d'audit [4].

Certains résultats qui soutiennent l'idée de la relation positive entre la technologie de l'information et de la performance organisationnelle [5]. «La référence [6] montré dans les résultats d'étude qu'il ya une relation positive entre la technologie de l'information et la performance organisationnelle en général». Autre étude a montré qu'il n'ya pas de relation positive entre la technologie de l'information et la performance [7].

Il est nécessaire d'examiner l'impact de la technologie de l'information sur la performance à travers un examen cohérent d'une variété de dimensions, telles que les choix stratégiques, les choix structurelles et les choix technologiques [8]. Un

projet de recherche qui est conçu dans la possibilité de faire des affaires dans les petites entreprises grâce à l'utilisation du système comptable informatisé, les auteurs ont effectué une comparaison entre les entreprises qui utilisent un système comptable informatisé et les entreprises qui n'utilisent pas un système comptable informatisé, afin de voir l'impact sur les décisions prises lors d'une éventuelles utilisation d'un système informatisé, il est devenu clair que l'utilisation d'un système comptable informatisé est nécessaire, par conséquent, il faut élaborer des stratégies visant à encourager une plus grande efficience dans les petites entreprises ainsi qu'une plus grande efficience dans la tenue des registres comptables [9].

3   LA METHODOLOGIE DE COLLECTE DE DONNEES NECESSAIRES

3.1   METHODOLOGIE DE RECHERCHE

Nous avons utilisé une approche descriptive et analytique, qui tente de décrire la relation entre les technologies de l'information et la qualité de système d'information comptable pour voir s'il ya un impact sur la qualité des systèmes d'informations comptables ou non, en se basant sur la recherche sur terrain concernant les PME dans la ville Ibb au Yémen.

3.2   OUTIL DE RECHERCHE

Notre enquête est menée par un questionnaire. L'existence d'un questionnaire, outil principal de l'enquête, limite considérablement la liberté des deux personnages: le premier conduit l'interview selon une suite de questions standardisées, le second doit souvent choisir parmi des réponses préétablies. Le questionnaire structuré est composé par des questions fermées c'est-à-dire des questions dont les réponses sont prédéterminées au choix. Les réponses sont alors susceptibles d'être riches dévoilant des niveaux profonds de la personnalité enquêtée.

Cependant, au moment de l'exploitation, les questions ouvertes posent beaucoup de problèmes. En effet, les réponses à ces questions sont hétérogènes et nécessitent un travail important de codage. En outre, la codification des réponses individuelles comporte des risques d'erreur d'interprétation et présentent par la suite le risque d'être interprétée de façon subjective. Par contre, les questions fermées ne posent pas le problème de codage pour l'exploitation statistique des réponses puisque les réponses vagues sont évitées et le nombre de non-réponses est réduit.

Dès lors, les questionnaires structurés sont plus faciles à élaborer et à analyser que les questionnaires semi structurés. Pour cette raison, le questionnaire élaboré dans le cadre de cette recherche est un questionnaire structuré ne contenant que des questions fermées.

Nous avons joint au questionnaire une lettre d'accompagnement dans laquelle nous avons essayé d'exprimer notre gratitude et notre reconnaissance aux comptables, aux assistants comptables, aux auditeurs et aux directeurs financiers qui sont censés remplir le questionnaire avec soin et diligence. Cette lettre contient le titre du questionnaire, le nom, et l'adresse d'email.

Dans notre questionnaire, nous avons insisté sur le fait que les réponses resteront anonymes et strictement confidentielles pour que la responsabilité du comptable, assistant comptable, auditeur ou directeur financier ne soit pas engagée et aussi pour qu'ils répondent aux questions en dehors de toutes pressions et surtout avec spontanéité.

Pour répondre aux différentes questions nous avons demandé aux répondants de cocher la réponse qui leur semble la plus appropriée. Nous avons distribué le questionnaire aux petites et moyennes des entreprises dans la ville d'Ibb, le questionnaire se compose de deux sections principales qui sont :

- Les caractéristiques personnelles des répondants (le sexe, la qualification, la spécialisation, le travail, l'expérience).
- Les variables de l'étude comprennent quatre variables indépendantes (Le temps, la mise à jour, le type de technologie utilisé et les risques de TIC) et quatre variables dépendantes (l'efficience, l'efficacité, le rendement des employés et la satisfaction des utilisateurs), le questionnaire se compose de 64 paragraphes répartis sur 8 variables comme suit:

Les variables principales		Les variables secondaires
Les variables indépendantes	Technologie d'information et de communication	Le temps.
		La mise à jour.
		la technique utilisée.
		les risques de TIC.
les variables dépendantes	La qualité du système d'information comptable	L'efficience de système d'information comptable.
		l'efficacité de système d'information comptable.
		le rendement de la personne.
		La satisfaction des utilisateurs du SIC.

3.3   LES VARIABLES

Pour faciliter l'analyse du sujet et des hypothèses, nous avons choisi les variables suivantes :

3.3.1   LA VARIABLE DE LA TIC

Les affaires dans les technologies de l'information mesurent le degré d'utilisation de ces technologies sur la base de nombreux facteurs, les valeurs du degré d'utilisation telle que mesurées parle changement du travail, l'utilisation répétée de l'ordinateur [10]. Un certain nombre de contributions à l'information générée par le système [11]. Certains chercheurs ont pris la différence de l'utilisation, la longueur et la sévérité de l'utilisation [12].

Cette recherche du degré d'utilisation a été mesurée grâce à un certain nombre de variables qui contribuent à la compréhension de la relation entre les technologies de l'information et la qualité des systèmes d'information comptable et décrit l'impact sur la qualité du système comptable, nous pouvons les résumer en quatre variables:

- Le temps de TIC: Le temps nécessaire pour obtenir et récupérer les informations.
- La mise à jour de TIC: la modernisation des moyens et techniques de la technologie de l'information, de communication et des logiciels de comptabilité, afin de contribuer à l'amélioration de la qualité du système de comptabilité.
- Les techniques utilisées: les types des TIC utilisées dans les entreprises pour servir le système comptable.
- Les risques TIC: Les risques qui peuvent entraver le travail des systèmes de comptabilité lors de l'utilisation des TIC.

3.3.2   LA VARIABLE QSIC

La qualité du système d'information comptable a été mesurée par plusieurs facteurs:

- L'efficience du SIC: Si le système comptable a réalisé une performance optimale avec un coût moindre, nous pouvons dire alors qu'il y a une efficience.
- L'efficacité du SIC: C'est le fait d'atteindre les résultats en parfait conformité avec les objectifs.
- La performance du personnel sur le SIC: Les efforts qu'un employé fournis sur un système comptable informatisé sont mesurés pour déduire l'effet d'apprentissage.
- La satisfaction des utilisateurs du SIC: La satisfaction obtenue par les utilisateurs (décideurs) en fonction de leurs désirs. On utilisera une échelle à cinq niveaux, comme indiqué dans le questionnaire à l'annexe, ce dit questionnaire est adressé au personnel qui travaillent sur le SIC dans les petites et moyennes entreprises afin de mesurer les variables énoncées dans ce travail.

3.4   LA POPULATION DE RECHERCHE ET DE L'ECHANTILLON

En ce qui concerne la taille de la population choisie, elle a été de 109 PME. Alors que la taille de l'échantillon a été de 48 PME, puisque un certain nombre des interviewés de la population totale n'ont pas répondu en raison de la situation d'insécurité pendant la période de recherche**.**

Voici un tableau récapitulatif de la répartition de la population en fonction de la carrière professionnelle, de la nature de profession et du domaine d'activité:

3.4.1   REPARTITION DES REPONDANTS SELON LE SEXE

Tableau 2.   Sexe d'employeurs

		Effectifs	Pourcentage	Pourcentage valide	Pourcentage cumulé
Valide	homme	32	66,7	66,7	66,7
	femme	16	33,3	33,3	100,0
	Total	48	100,0	100,0	

3.4.2   REPARTITION DES REPONDANTS PAR SPECIALITE

Tableau 3.   Le tableau de la spécialisation d'employeurs

		Effectifs	Pourcentage	Pourcentage valide	Pourcentage cumulé
Valide	comptabilité	18	37,5	37,5	37,5
	management	10	20,8	20,8	58,3
	informatique	16	33,3	33,3	91,7
	Autre	4	8,3	8,3	100,0
	Total	48	100,0	100,0	

3.4.3   REPARTITION DES REPONDANTS SELON LA QUALIFICATION EDUCATIVE

Tableau 4.   Les qualifications d'employeurs

		Effectifs	Pourcentage	Pourcentage valide	Pourcentage cumulé
Valide	Baccalauréat	4	8,3	8,3	8,3
	bac+2	21	43,8	43,8	52,1
	Bac+4	21	43,8	43,8	95,8
	Bac+5	2	4,2	4,2	100,0
	Total	48	100,0	100,0	

3.4.4   REPARTITION DES REPONDANTS SELON L'EXPERIENCE

Tableau 5.   L'expérience d'employeurs

		Effectifs	Pourcentage	Pourcentage valide	Pourcentage cumulé
Valide	moins de 3ans	37	77,1	77,1	77,1
	4à 6 ans	9	18,8	18,8	95,8
	plus de 7 ans	2	4,2	4,2	100,0
	Total	48	100,0	100,0	

3.4.5 REPARTITION DES REPONDANTS PAR FONCTION

Tableau 6.   La poste d'employeurs

		Effectifs	Pourcentage	Pourcentage valide	Pourcentage cumulé
Valide	Directeur Financier	6	12,5	12,5	12,5
	Comptable	20	41,7	41,7	54,2
	Assistant comptable	8	16,7	16,7	70,8
	Auditeur interne	1	2,1	2,1	72,9
	Autre	13	27,1	27,1	100,0
	Total	48	100,0	100,0	

3.5 LES METHODES STATISTIQUES

L'analyse statistique par logiciel SPSS et EXCEL, le chercheur a utilisé comme méthodes principales pour mesurer la relation et l'impact des technologies de l'information et de communication sur la qualité des informations comptables, les méthodes statistiques suivantes:

- Les fréquences et les pourcentages de l'échantillon d'étude selon les caractéristiques et les traits de personnalité
- Le coefficient ALPHA CRONBACH pour déterminer la stabilité des paragraphes du questionnaire.
- Test de KOLMOGOROV-SMIRNOV pour savoir quel type de distribution, si les données sont soumises à la distribution normale ou non.
- Test-T pour échantillon unique afin de vérifier les répondants des réponses si elles atteignent le niveau 3« neutre » ou non.
- La régression linéaire pour vérifier les hypothèses de l'étude et pour trouver la relation entre les variables, l'existence de statistiques significatives ou non, et aussi s'il ya un effet ou non.
- ANOVA à un facteur (ONE WAY ANOVA).pour savoir la significative de relation

4 ANALYSER ET EXPLIQUER LES DONNEES DU TERRAIN

4.1 MESURER LES VARIABLES

Lorsque nous utilisons le sondage d'opinion ou l'enquête par questionnaire, nous cherchons à identifier les orientations générales des opinions, des attitudes, des tendances et ceci en rassemblant les réponses exprimées individuellement. Ces agrégats permettent de dégager une majorité se caractérisant par une certaine attitude favorable ou défavorable, pour ou contre ou bien exprimée en termes quantitatifs plus détaillés. Dans l'établissement de notre questionnaire, nous avons utilisé une série d'affirmation qui sera codée de 1 à 5 pour mesurer l'intensité des attitudes. C'est en quelque sorte une échelle à cinq positions où les positions extrêmes représentent respectivement «Pas du tout d'accord», «Pas d'accord», «neutre», «d'accord» et «Tout à fait d'accord».

Nous avons utilisé pour analyser les données statistiques le logiciel SPSS. Nous avons utilisé aussi EXCEL pour faire des récapitulations des résultats donnés par SPSS. Nous avons, d'abord, saisi les variables, puis nous avons défini chacune d'elles. Chaque question posée dans le questionnaire constitue une variable.

4.2 LA FIABILITÉ DU QUESTIONNAIRE

La fiabilité signifie la stabilité dans les résultats du questionnaire et ne change pas de manière significative s'il y a une redistribution de l'échantillon à plusieurs reprises durant les périodes certain temps. Nous avons réalisé la stabilité du questionnaire à travers la méthode du coefficient ALPHA CRONBACH à l'aide du logiciel SPSS, les résultats ont été présentés comme indiqué dans le tableau (7):

Tableau 7. **La fiabilité du questionnaire par ALPHA CRONBACH**

N °	Les variables	Coefficient ALFA CRONBACH
1	Le temps	0.371
2	Mise à jour	0.737
3	Type de technique	0.467
4	Les risques	0.602
5	L'efficience	0.566
6	L'efficacité	0.818
7	La performance d'employés	0.513
8	Les utilisateurs	0.678
Tous les variables		**0.855**

La valeur du coefficient ALPHA CRONBACH dans le tableau ci-dessus est élevé et proche d'un, sauf la première variable, qui s'élevait à 0,371 qui a été amélioré le résultat à 0,504 en vue de l'exclusion du paragraphe N°6 et la troisième variable, qui s'élevait à 0,467 qui a été amélioré le résultat à 0,658 en vue de l'exclusion du paragraphe N°17 ,la valeur du coefficient ALPHA CRONBACH de tous les paragraphes du questionnaire 0,855, ce qui signifie que le coefficient de la stabilité est élevé.

4.3 DETERMINER LE TYPE DE DISTRIBUTION (KOLMOGOROV-SMIRNOV)

Ce test est utilisé pour déterminer le type de distribution, si les données sont soumises à la distribution normale ou pas, le tableau (8) montre que la valeur potentielle (Sig.) a été supérieure au niveau de signification α = 0,05 pour toutes les variables, indiquant que les données soumises à la distribution normale, conduisant à l'analyse des hypothèses émises par tests paramétriques.

Tableau 8. **Le type de distribution**

N °	Les variables	Z de Kolmogorov-Smirnov	Sig.
1	Le temps	1.015	0.254
2	Mise à jour	0.914	0.374
3	Type de technique	1.055	0.217
4	Les risques	0.857	0.455
5	L'efficience	0.754	0.620
6	L'efficacité	0.631	0.821
7	La performance d'employés	0.837	0.486
8	Les utilisateurs	0.596	0.870

4.4 TESTER LES HYPOTHÈSES

Il y a une relation avec un effet statistique significatif (au seuil a<0,05) entre l'utilisation des TIC et l'efficience du SIC. Pour tester cette hypothèse, nous supposons que:

- **H0**: Il n'ya pas une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et l'efficience du SIC.
- **H1**: Il ya une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et l'efficience du SIC.

Tableau 9. **Récapitulatif de modèle de corrélation de régression linéaire (1er hypothèse)**

Modèle	R	R deux	Changement dans les statistiques			
			Variation de R-deux	ddl1	ddl2	Sig. Variation de F
1	,340a	,116	,116	1	46	,018

a. Valeurs prédites: (constantes), TIC

Tableau 10. *La distribution T (t calculée) et la corrélation (1er hypothèse)*

Modèle	Coefficients non standardisés		Coefficients standardisés			Corrélations
	A	Erreur standard	Bêta	T	Sig.	Corrélation simple
1(Constante)	2,403	,637		3,771	,000	
TIC	,386	,157	,340	2,455	,018	,340

a. Variable dépendante: efficience

Tableau 11. *ANOVA[b] (1ere hypothèse)*

Modèle		Somme des carrés	ddl	Moyenne des carrés	D	Sig.
1	Régression	1,022	1	1,022	6,028	,018[a]
	Résidu	7,796	46	,169		
	Total	8,817	47			

a. Valeurs prédites: (constantes), TIC

b. Variable dépendante: efficience

Le chercheur a utilisé la méthode de régression linéaire pour trouver une relation entre la variable indépendante (TIC) et la variable dépendante (l'efficience du SIC) et aussi, si il ya un effet, les données montrent dans le tableau (9) précédent que la valeur de corrélation (0.340), ainsi, nous notons que la variable indépendante (TIC) explique 11.6 de l'écart de la variable dépendante (l'efficience).

Le tableau (10) nous trouvons que la valeur de T calculée (2,455) est supérieure à la valeur de T tabulaire (2,160) au seuil de 0,05, et le niveau de signification 0,018 (tableau ANOVA «11») inférieur à 0,05, afin de rejeter H0 et d'accepter H1, c'est-à-dire qu'il ya une effet statistiquement significative au seul de 0,05 sur l'efficience du SIC, nous en concluons que TIC ont une influence positive sur l'efficience du SIC et la tic travaille à améliorer l'efficience du sic par l'utilisation optimale de ressources et de réduire les coûts dans toutes les phases de fonctionnement de sic, «Ceci est identique à la référence [13], où elle a dit à l'utilisation d'un système comptable informatisé est utile dans la construction de stratégies visant à encourager une plus grande efficience dans les petites entreprises et une plus grande efficience dans la tenue des registres comptables».

Il y a une relation avec un effet statistique significatif (au seuil a<0,05) entre l'utilisation des TIC et l'efficacité du SIC. Pour tester cette hypothèse, nous supposons que:

- **H0**:Il n'ya pas une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et l'efficacité du SIC.
- **H1**: Il ya une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et l'efficacité du SIC.

Tableau 12. *Récapitulatif de modèle de corrélation de régression linéaire ($2^{ième}$ hypothèse)*

Modèle	R	R-deux	R-deux ajusté	Erreur standard de l'estimation	Changement dans les statistiques			
					Variation de R-deux	ddl1	ddl2	Sig. Variation de F
1	,301[a]	,091	,071	,49017	,091	1	46	,038

a. Valeurs prédites: (constantes), TIC

Tableau 13. *La distribution T (t calculée) et la corrélation ($2^{ième}$ hypothèse)*

Modèle	Coefficients non standardisés		Coefficients standardisés			Corrélations
	A	Erreur standard	Bêta	T	Sig.	Corrélation simple
1(Constante)	2,321	,759		3,059	,004	
TIC	,400	,187	,301	2,140	,038	,301

a. Variable dépendante: efficacité

Tableau 14.   ANOVA[b] (2[ième]hypothèse)

Modèle		Somme des carrés	ddl	Moyenne des carrés	D	Sig.
1	Régression	1,100	1	1,100	4,578	,038[a]
	Résidu	11,052	46	,240		
	Total	12,153	47			

a. Valeurs prédites: (constantes), TIC

b. Variable dépendante: Efficacité

Par la méthode de régression linéaire, on peut déduire à partir de tableau (12) ci-dessus que la valeur du lien entre la variable dépendante et la variable indépendante (0,301) indiquent l'existence d'une corrélation entre deux variables. Le tableau (13) indique que la valeur de (T) calculée (2,140) est supérieure à la valeur de T tabulaire (1,815) au niveau de significative de 0,05% et la valeur p. à (0,038) qui est inférieur à 0,05 (tableau ANOVA «14»), c'est à dire, nous acceptons H1 et de rejeter H0, c'est à dire qu'il y a l'effet statistiquement significatif pour la TIC sur l'efficacité du SIC, qui se traduit en particulier sur les résultats du SIC (information comptabilité) sous la forme de rapports financiers pour aider la prise de décision par les bénéficiaires, ainsi, la technologie aide à accélérer l'arrivée de ces rapports, selon les besoins des bénéficiaires, qui est confirmé des travaux qui ont trouvé que les directeurs ont compris que les information informatisée le plus utile[14], ont ajouté que les informations dans la base des données plus pertinentes et significatives[15].

Il y a une relation avec un effet statistique significatif (au seuil a<0,05) entre l'utilisation des TIC et le rendement du personnel sur le SIC. Pour tester cette hypothèse, nous supposons que:

- **H0**: Il n'y a pas une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et le rendement du personnel du SIC.
- **H1**: Il y a une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et le rendement du personnel du SIC.

Tableau 15.   Récapitulatif de modèle de corrélation de régression linéaire (3[ième]hypothèse)

Modèle	R	R-deux	R-deux ajusté	Changement dans les statistiques				
				Variation de R-deux	Variation de F	ddl1	ddl2	Sig. Variation de F
1	,508[a]	,258	,242	,258	15,979	1	46	,000

a. Valeurs prédites: (constantes), TIC

Tableau 16.   La distribution T (t calculée) et la corrélation (3[ième]hypothèse)

Modèle	Coefficients non standardisés		Coefficients standardisés		T	Sig.	Corrélations
	A	Erreur standard	Bêta				Corrélation simple
1(Constante)	1,945	,546			3,564	,001	
TIC	,538	,135	,508		3,997	,000	,508

a. Variable dépendante: Rendement Du Personnel Sur Le Système

Tableau 17.   ANOVA[b] (3[ième]hypothèse)

Modèle		Somme des carrés	ddl	Moyenne des carrés	D	Sig.
1	Régression	1,985	1	1,985	15,979	,000[a]
	Résidu	5,715	46	,124		
	Total	7,700	47			

a. Valeurs prédites: (constantes), TIC

b. Variable dépendante: Rendement Du Personnel Sur Le Système

En utilisant la méthode de régression linéaire, nous notons que les résultats dans les tableau (15) ci-dessus, la valeur du lien entre les deux variables (0.508), la valeur de la corrélation indique une forte relation entre deux variables, le tableau (16)

montre la valeur calculée de T (3,997) supérieure à la valeur tabulaire de T (3,819) au niveau de 0,05 de la signification, la valeur potentielle à 0.000 (tableau ANOVA «17») inférieure de 0,05, donc nous acceptons H1 et de rejeter H0, c'est-à-dire il y a significative statistiquement au seul de 0,05 pour la TIC sur la performance des employés du SIC , la technologie donne au personnels une satisfaction quand ils travaillent sur système comptable informatisé et la TIC contribue réduire de temps et d'effort dans les calculs, ainsi elle seront exacts lorsque les entrées sont correctes, et de contribuer à la vitesse de communication entre les divers départements pour accomplir les tâches qui lui sont assignées, la TIC devrait être une influence positive sur les individus avant l'amélioration des performances.[16]

Il y a une relation avec un effet statistique significatif (au seuil a<0,05) entre l'utilisation des TIC et la satisfaction d'utilisateur de SIC. Pour tester cette hypothèse, nous supposons que:

- **H0**:Il n'ya pas une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et la satisfaction des utilisateurs du SIC.
- **H1**: Il ya une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et la satisfaction des utilisateurs du SIC.

Tableau 18.   *Récapitulatif de modèle de corrélation de régression linéaire (4^{ième}hypothèse)*

Modèle	R	R-deux	R-deux ajusté	Changement dans les statistiques				
				Variation de R-deux	Variation de F	ddl1	ddl2	Sig. Variation de F
1	,726[a]	,527	,517	,527	51,291	1	46	,000

a. Valeurs prédites: (constantes), TIC

Tableau 19.   *La distribution T (t calculée) et la corrélation (4^{ième}hypothèse)*

Modèle	Coefficients non standardisés		Coefficients standardisés			Corrélations
	A	Erreur standard	Bêta	T	Sig.	Corrélation simple
1(Constante)	-,716	,686		-1,043	,302	
TIC	1,212	,169	,726	7,162	,000	,726

a. Variable dépendante: Utilisateurs

Tableau 20.   *ANOVA^b (4^{ième}hypothèse)*

Modèle		Somme des carrés	ddl	Moyenne des carrés	D	Sig.
1	Régression	10,080	1	10,080	51,291	,000[a]
	Résidu	9,040	46	,197		
	Total	19,120	47			

a. Valeurs prédites: (constantes), TIC

b. Variable dépendante: la satisfaction des Utilisateurs

les résultats dans les tableau (18) ci-dessus montrent la présence d'une forte relation entre la variable de dépendants (la satisfaction des utilisateurs) et la variable indépendant (TIC) et d'expliquer cette relation la valeur du lien dans le tableau de corrélation (0.726), le tableau (19) montre la valeur de T calculée (7,162) est supérieure à T tabulaire (3,819) au niveau de significative de 0,05, et la valeur potentielle à 0,000 (tableau ANOVA «20») inférieur de 0,05, c'est-à-dire, nous acceptons H1 et de rejeter H0, c'est à dire qu'il ya un effet statistiquement significative de TIC sur la satisfaction des utilisateurs de l'information comptable car la tic fournit des informations qui permettent d'améliorer la prise de décision, également elle contribue à renforcer la position concurrentielle des utilisateurs sur le marché, leur faire augmenter leurs investissements en raison de la disponibilité des technologies de l'information qui se caractérise par l'ensemble des caractéristiques requises des utilisateurs ,Cohen et al.(2000) ont trouvé les directeurs peuvent faciliter la recherche d'informations liées à certains clients utilisant la TIC qui les aide dans l'exercice de revue analytique[17].

Grâce à ces quatre hypothèses ci-dessus, il est clair qu'il ya une relation entre la variable indépendante (TIC) et chaque variable des variables dépendantes (efficacité du système de comptabilité, de l'efficacité du système de comptabilité, le rendement des employés sur le système comptable, et les utilisateurs de l'information comptable) et qui est la variable

dépendante (qualité du système d'information comptable), et de découvrir la relation entre les technologies de l'information et de la qualité d'un système indépendant de comptabilité variable d'information que la personne à charge hypothèse cinquième variable ci-dessous illustre cela.

Il y a une relation avec un effet statistique significatif (au seuil a<0,05) entre l'utilisation des TIC et la QSIC. Pour tester cette hypothèse, nous supposons que:

- **H0**:Il n'ya pas une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et la QSIC.
- **H1**: Il ya une relation avec un effet statistiquement significatif (au seuil a<0,05) entre l'utilisation des TIC et la QSIC.

Tableau 21.   Récapitulatif de modèle de corrélation de régression linéaire (5ᵢᵉᵐᵉ hypothèse)

Modèle	R	R-deux	R-deux ajusté	Changement dans les statistiques				
				Variation de R-deux	Variation de F	ddl1	ddl2	Sig. Variation de F
1	,612ᵃ	,374	,361	,374	27,530	1	46	,000

a. Valeurs prédites: (constantes), TIC

Tableau 22.   La distribution T(t calculée) et la corrélation (5ᵢᵉᵐᵉ hypothèse)

Modèle	Coefficients non standardisés		Coefficients standardisés			Corrélations
	A	Erreur standard	Bêta	T	Sig.	Corrélation simple
1(Constante)	2,087	,360		5,797	,000	
TIC	,466	,089	,612	5,247	,000	,612

a. Variable dépendante: QSIC

Tableau 23.   ANOVAᵇ (5ᵢᵉᵐᵉ hypothèse)

Modèle		Somme des carrés	ddl	Moyenne des carrés	D	Sig.
1	Régression	1,489	1	1,489	27,530	,000ᵃ
	Résidu	2,488	46	,054		
	Total	3,977	47			

a. Valeurs prédites: (constantes), TIC
b. Variable dépendante: QSIC

L'utilisation de la méthode de régression linéaire est clair à partir des résultats des tableaux ci-dessus, le tableau (21) montre qu'il y a une forte relation entre la TIC et la QSIC où cette relation confirme la valeur du lien à (0.612), le tableau (22) indique la valeur calculée de T (5,247) supérieure à la valeur tabulaire de T (4,754) au niveau de 0.05, et la valeur potentielle à 0,000 (tableau ANOVA «23») est inférieur de 0,05, c'est-à-dire, nous acceptons H1 et de rejeter H0, ce qui signifie il y a l'effet de TIC statistiquement significatif sur la QSIC, avec l'aide des technologies de l'information et des télécommunications pour améliorer la qualité du système informations comptables de manière à atteindre une performance optimale du système de comptabilité utilisant toutes les ressources disponibles, aussi aide à réduire les coûts, et travaille également sur l'accès aux résultats du système de comptabilité pour servir les utilisateurs selon leurs désirs différents, et d'atteindre une satisfaction globale des utilisateurs, travaille également à améliorer les performances des individus et les aider au potentiel d'améliorer leurs compétences grâce à l'utilisation optimale de la technologie.

5   CONCLUSION

Cette recherche présente les résultats d'une enquête par questionnaire sur 48 PME dans la ville Ibb au Yémen, nous avons distribué le questionnaire à des comptables, des comptables assistants, des auditeurs internes et des directeurs financiers qui travaillent sur un système comptable informatisé.

Nous avons présenté les résultats de notre recherche sur le terrain, d'abord, nous avons présenté la méthodologie de recherche utilisée et des méthodes d'analyse statistiques sur la base du logiciel Excel et SPSS, et alors nous avons testé les hypothèses de recherche et donc nous avons pu constater que les hypothèses énoncées au début de ce travail ont été

vérifiées, par conséquent, il y a une relation positive entre la TIC et la qualité du système d'information comptable, l'intensité du lien en fonction de la méthode de régression linéaire était de R = 0,612 entre TIC et QSIC, l'intensité du lien entre la TIC et chaque variable dépendante liée à la qualité des variables système comptable est de R = 0,340 pour le lien entre la TIC et l'efficience du SIC, R = 0,301 pour le lien entre la TIC et l'efficacité du SIC, R = 0,508 pour le lien entre la TIC et la performance des employés sur le SIC et R = 0,726 pour le lien entre la TIC et la satisfaction des utilisateurs du SIC, c'est-à-dire, les résultats ont conformé aux hypothèses positivement.

Cette relation était significative statistiquement au seul à 0,05 pour toutes les variables, la comparaison entre les valeurs de T calculées et T tabulaire a montré que T calculé est supérieur à T tabulaire pour chaque variable, ce qui confirme la relation, par conséquent, nous pouvons dire qu'il y a un effet sur la qualité du système d'information comptable par la TIC, ce qui améliore les performances du système d'information comptable à travers une variété de facteurs qui caractérisent la technologie, le facteur temps, contribuant ainsi à un traitement rapide des données comptables et une plus grande facilité d'accès aux informations surtout pour les décideurs, le facteur de mise à jour des technologies de l'information, ce qui contribue à l'amélioration et à la diffusion de l'information aux décideurs, le facteur des techniques utilisées à chaque fois les technologies suivre le rythme des changements qui se produisent dans les technologies de mesure a contribué à améliorer l'efficience et l'efficacité du SIC et contribue à la satisfaction des utilisateurs, le facteur des risques de TIC comme un facteur important pour mesurer le degré de risque qui peuvent nuire à la performance du SIC et donc les résultats ne sont pas satisfaisants pour les utilisateurs (décideurs).

A travers ces résultats, nous avons montré que l'utilisation des technologies de l'information contribue principalement à accroître l'efficience du SIC grâce à l'utilisation optimale des ressources disponibles tout en réduisant les coûts et en améliorant la performance du SIC, elles ont également contribué à l'amélioration de l'efficacité du SIC par l'information comptable informatisé qui a l'avantage d'être caractérisée par une plus grande vitesse, une précision élevée et une meilleure pertinence satisfaisant ainsi les besoins des décideurs.

Les résultats ont montré qu'il y a un pourcentage de 41,7% qui travaillent dans la fonction comptable, c'est-à-dire il n'y a pas une grande diversité dans le type d'emplois, ce qui indique un manque d'harmonisation de la structure organisationnelle de l'investissement réalisé dans la technologie de l'information, autrement dit, la majorité des entreprises qui ont déménagé du stade des petites à celui des moyennes ou grandes entreprises ne changent pas de structures organisationnelles et restent comme celles des petites entreprises malgré l'importance de leurs structures financières.

6   PERSPECTIVES

L'utilisation de la TIC dans la gestion des ressources financières est devenue un résultat inévitable de l'évolution des technologies qui ont lieu dans l'ère actuelle et doit donc suivre le rythme de ces développements à travers l'introduction de la TIC sur ses différentes fonctions et se concentrer davantage sur la fonction de la gestion financière, donc il faut jouer un rôle important dans le développement d'une politique d'informatique et de communication au sein de l'entreprise.

Grâce à cela, les entreprises qui utilisent une technologie limitée peuvent améliorer leur affaires grâce à l'utilisation des outils et des technologies actuellement disponibles, tels que les réseaux et les programmes intégrés, qui permettent de réduire le temps et l'effort et améliorer l'efficience et l'efficacité, ainsi, ils peuvent conduire à l'expansion de la taille de l'entreprise.

Ainsi, les entreprises qui n'utilisent pas les moyens de la TIC peuvent sur monter les tracasseries administratives et la lenteur des systèmes traditionnels (de nombreux comptables, le grand nombre de documents et des livres comptables) par l'utilisation de systèmes automatisés leur permettant de progresser rapidement en assurant une meilleure précision des données en vue de prendre des décisions en fonction de l'information informatisée à tout moment et à n'importe quelle place. Le mécanisme de la comptabilisation informatisée contribue à l'expansion de la taille de l'entreprise et de son influence sur le marché et donc renforcer sa position concurrentielle.

Il est possible de généraliser les expériences des entreprises qui ont réussi dans ce domaine afin de développer le processus d'information et par conséquent les investissements en technologie, en tenant compte de l'environnement et des circonstances, la nécessité d'adopter des stratégies de formation, de renforcement de l'infrastructure pour les technologies de l'information et de tenter de profiter de ses applications dans l'amélioration de la performance de l'organisation en général et la gestion des connaissances en particulier, d'adapter la structure organisationnelle "Création de l'intérêt de l'information et de communication "et la nécessité de construire un système d'information qui dépend essentiellement de l'information et qui cherche à décentraliser la gestion de l'entreprise en général et la gestion financière en particulier pour réduire les routines du travail administratif.

Nos contributions à travers cette recherche, c'est que nous avons constaté que les entreprises peuvent effectuer leurs travaux grâce à quelques-uns des outils et des méthodes et des concepts tels que la gestion des bases de données qui aide à stocker une grande quantité d'informations et de dossiers et qui aide à réduire les efforts physiques, ainsi, les logiciels intégrés peuvent connecter plusieurs systèmes au sein de l'entreprise sur la base de plusieurs types de réseaux qui peuvent être utilisés pour économiser le temps et l'effort, ainsi ces moyens contrôle de la quantité d'information avec un bon usage puisque les informations sont la principale source de base pour la prise des décisions stratégiques.

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The Detrimental Effect of Dietary Ginger Rhizome Powder Supplementation on Reproductive Performance of Pubertal Rabbit Bucks

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ABSTRACT: Thirty six crossbred rabbit bucks aged 6 months were used to study the detrimental effects of supplementing ginger rhizome powder (GRP) on reproductive performance of pubertal rabbits. The rabbit bucks were randomly divided into four experimental treatments A_1, B_1, C_1 and D_1 of nine animals and was further replicated three times with three animals per replicate in a Completely Randomized Design (CRD). The animals were fed commercial grower rabbit diet which was supplemented with GRP at the rate of 0g/kg, 5g/kg, 10g/kg and 15g/kg feed respectively for 10 weeks. Prior to the first six weeks of the study, a two week period of training was used to train the bucks to ejaculate artificially into artificial vagina. Semen was collected between 8.00 am and 9.00 am and taken the laboratory for analysis within 30 minutes of collection. Data collected were subjected to analysis of variance. Dietary supplementation with GRP revealed that live sperm cell (%), dead sperm cell (%) as well as live : dead sperm cell ratios differed significantly ($p<0.05$) among the groups. There were also significant ($p<0.05$) differences in sperm motility between rabbit bucks in group A_1 (68.48%) and those in group D_1 (53.34%). Libido scores were similar ($p>0.05$) among the treatment groups. The results of this study indicated that dietary inclusion of ginger rhizome powder supplementation at 15g per kg feed had deleterious effect on sperm motility and % live sperm cells of pubertal rabbit bucks.

KEYWORDS: Rabbits, ginger powder, supplementation, libido, semen.

1   INTRODUCTION

The Nigerian livestock industry has been faced with numerous challenges, such as high cost of conventional feed ingredients, diseases, poor quality forages as well as poor production environment. The association of these factors with reduced fertility rate in farm animals is increasingly a source of concern to livestock producers in Nigeria [1].

The use of synthetic fertility preparations and plant bioactive compounds has been found effective in solving this problem in developed countries [2]. In Nigeria, few studies have been conducted to enhance physiological parameters, especially reproductive traits in farm animals using commercial fertility drugs [1], [2], [3]. However, the variations in research findings, coupled with the high level of expertise needed in the preparation and administration of these drugs has limited their adoption, especially by the small holder livestock farmers in this region.

In view of these adoption constraints, there is the need to enhance the overall physiological well being and in particular the reproductive performance of livestock such as rabbit using cheap and readily available plants with antioxidant ability such as ginger, bitter kola and soy bean in their diet [4], [5], [6]. Generally, plants exhibiting antioxidant activity have been established to enhance physiological parameters, especially the reproductive traits of small laboratory animal models [7], [8], [9], [10].

Previous studies have documented the antioxidant and other physiological benefits of ginger [7], [11]. Most of these studies have been carried out using small laboratory animal models. Thus, most of the information generated, even though

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good, is of no direct use to livestock extension officers and resource poor small holder rabbit farmers. Therefore, there is the need to situate plant antioxidant research within the context of tropical animal production realities in order to generate adoptable and utilizable information.

To our knowledge there is lack of information that deal with the effect of dietary ginger rhizome powder supplementation on reproductive performance of rabbit bucks. Therefore, the objective of this study is to evaluate the detrimental effect of dietary ginger rhizome powder supplementation on reproductive performance of pubertal rabbit bucks.

2   MATERIALS AND METHODS

This study was conducted at the Rabbitry Unit of the Teaching and Research Farm, Department of Animal Science and Technology, Federal University of Technology, Owerri, Nigeria. Geographically, Federal University of Technology, Owerri is located between latitude $4^{o}4'$ and $6^{o}3'$ N and longitude $6^{o}15'$ and $8^{o}15'$E.

Freshly harvested ginger rhizomes used for this study were obtained from National Root Crop Research Institute, Umudike, Nigeria. They were chopped into smaller bits and air dried under shade for 5 days. Thereafter, the dried ginger rhizome samples were milled using Laboratory mill (Arthur Thomas, USA).

Thirty - six healthy New Zealand white rabbit bucks aged 6 months with mean initial weight of 1.16 ± 0.28 kg were used for the study. The animals were randomly assigned into four treatment groups (A_1, B_1, C_1 and D_1) of nine each. Bucks in A_1, B_1, C_1 and D_1 groups were assigned to commercial diets containing ginger rhizome powder at 0 g/kg, 5 g/kg, 10 g/kg and 15 g/kg feed respectively for 10 weeks in a completely randomized design experiment. The compositions and nutrient levels of the basal diet are presented in table 1.

Table 1.   Composition and nutrient levels of basal diet (control).

Parameter	Percent (%)
Crude protein	18.00
Ether extract	6.00
Crude fibre	5.00
Salt	0.30
Calcium	1.00
Phosphorus	0.45
Lysine	0.75
Methionine	0.35
Metabolisable energy (Kcal / kg)	2900

The assessment of the buck for libido was based on the method described by [3]. A matured cycling doe (teaser) was introduced to the buck for 5 minutes weekly to monitor their sex drive. In this study, reaction time was considered as an indication of libido. Libido was scored in the scale of 5, 4, 3, 2 and 1 for high (groom, sniff and mount), normal (groom, sniff only), low (sniff only), very low (groom only) and no libido (does not pay attention to the female) respectively.

Prior to the first six weeks of the study, a two week period of training was used to train the bucks to ejaculate artificially into artificial vagina. Semen was collected between 8.00 am and 9.00 am. A matured cycling doe was used to tease the buck which made thrust in an attempt at intromission and semen was collected from the bucks using the artificial vagina as described by [12]. The semen was promptly evaluated for qualitative and quantitative parameters within 30 minutes of collection.

Semen colour was noted immediately after collection and the volume was measured using graduated collection tube. The pH was measured using a 507 Crison pH-metre. Sperm motility was done using methods described by [13]. Spermatozoa concentration was also evaluated using the improved Neubauer chamber method of counting. Live and dead percentages were determined using eosin-nigrosin staining method whereas live - dead sperm cell ratio was calculated.

Data generated were analyzed using one-way analysis of variance. Significance means were separated using LSD according to the methods of [14].

3   RESULTS

Table 2 presents the effects of ginger rhizome powder supplementations on libido and semen characteristics of pubertal rabbits. There were no significant (p>0.05) differences in the libido score among the treatment groups. Semen colour changed from cream - milky to milky with increasing supplementation level of ginger rhizome powder. Data on semen pH and volume ranged from 7.73 - 8.14 and 0.41 - 0.57 ml respectively. Semen pH and semen volume value were highest for rabbit bucks in A_1 group and lowest for those in D_1 group.

Table 2.   Effect of ginger rhizome powder supplementation on libido and semen quality characteristics in pubertal rabbit bucks

Parameters	Treatment				S.E.M
	A_1	B_1	C_1	D_1	
Libido score (sec)	4.60	4.60	4.72	4.84	0.33
Semen colour	Cream - milky	Cream - milky	Milky	milky	-
Semen pH	8.14	8.11	7.83	7.73	0.16
Semen volume (ml)	0.57	0.50	0.44	0.41	0.04
Sperm conc. ($\times 10^9$/ ml)	0.86	0.80	0.70	0.72	0.03
TSC ($\times 10^9$/ ml)	0.49	0.40	0.31	0.30	0.04
Sperm motility (%)	68.48[a]	60.12[ab]	55.69[ab]	53.34[b]	1.50
Live sperm (%)	84.48[a]	74.30[b]	71.61[b]	66.94[b]	1.36
Dead sperm (%)	15.68[c]	25.70[b]	28.39[ab]	33.06[a]	1.13
Live / dead sperm ratio	5.38[a]	2.89[b]	2.52[b]	2.02[b]	0.45

[a,b,c] Means within rows with different superscripts are significantly different (p<0.05); TSC – Total sperm concentration; S.E.M – Standard error of the mean.

The sperm concentration and total sperm concentration decreased with increasing supplementary level of ginger rhizome powder supplementation. Rabbit bucks on D_1 treatment recorded significantly (p<0.05) lower sperm motility from bucks in group A_1 but similar (p>0.05) to B_1 and C_1 bucks. Rabbit bucks in group A_1 recorded significantly (p<0.05) higher live : dead sperm cell ratio than all the other groups.

4   DISCUSSION

One of the methods of assessing reproductive efficiency of the male is through the measurement of semen quality. Every animal species has its capacity for sperm production, which is determined genetically but it has however, been clearly observed that other factors like nutrition, disease and stress influence the portion of the germinal epithelium that enters into spermatogenesis [15]. In the current study there were some variations in the semen quantity and quality characteristics of rabbit bucks fed diets supplemented with graded levels of ginger rhizome powder.

Results of this study clearly indicated that dietary supplementation with ginger rhizome powder resulted in semen colour change from cream – milky to milky. Gomez [16] reported that correlation exists between semen colour and sperm concentration. The semen pH obtained herein tends to maintain a downward trend as the levels of ginger rhizome powder was increased in the diets. According to [17], semen has a high buffering capacity, much higher than that of most other fluids in the body, but the buffering ability tends to decrease shortly after ejaculation as a result of loss of carbon dioxide by sperm cells. The comparable semen pH values in all treatment groups was an indication that ginger rhizome powder supplementation in buck's diet up 15g/kg feed did not affect the semen acid – alkaline equilibrium adversely.

Nutrition has long ago been established to affect the secretory functions of the accessory sex glands, the products of which constitute the seminal plasma [18]. The progressive decrease in semen volume as the supplementation level of ginger rhizome powder increases was in agreement with the findings of [18], that secretory functions of the accessory sex glands are very sensitive to dietary changes and that the slight changes in feed chemical composition goes a long way in influencing the semen volume.

Sperm concentration and total sperm concentrations are within the normal range reported by [19], but lower than that reported by [20] and [21]. Also, the lower sperm concentration and total sperm concentration values reported for B_1, C_1 and D_1 bucks were at variance [7] and [11] who reported improved sperm concentration in rats and cocks fed ginger rhizome powder - based diets. The observed increase in sperm concentration and total sperm concentration values in rats and cocks

fed ginger rhizome powder - based diets, and the lower values recorded for the same parameters in this study could be attributed to species differences.

Sperm motility is an important index in reproductive assessment because it demonstrates the ability of sperm to move and fertilize an ovum [22]. The significant decline in number of motile sperm cells in the ejaculates of D_1 bucks relative to control bucks is at variance with the observed higher motility recorded in cock fed ginger based diets by [11]. Again, the significant decrease in sperm motility of D_1 bucks is contrary to the reports of [7] and [23] that ginger powder - based diets improve spermatozoa motility in rats. The low sperm motility recorded on D_1 bucks could be attributed in part to the rapidity of sperm cell development in the seminiferous tubules, in the sense that spermatozoa may need a moderate but progressive development for them to have excellent motility.

The results of this present study also indicate that ginger rhizome powder influences percentage live spermatozoa of rabbit bucks negatively. The observed significant decrease in live sperm (%) of B_1, C_1 and D_1 bucks contrasts with the improved semen quality parameters of rats and breeder broiler birds fed ginger powder based diets [7], [11]. It however, agrees with the results of the depressive effects of medicinal plant leaves on spermatogenesis in animal species as reported by [4], [24], [25]. The significant decrease in percentage live sperm of B_1, C_1 and D_1 bucks is an indication that ginger rhizome powder based diets may impede the sperm energy metabolic pathway. This result also revealed significant increase in dead spermatozoa percent in B_1, C_1 and D_1 rabbit bucks when compared with those in control group. This indicates that ginger rhizome powder at these inclusion levels could accelerate the release of immature spermatozoa. The dead spermatozoa percent recorded herein agree with the results of similar study in cocks fed cotton seed meal diets by [26] and [27]).

In this study, reaction time was considered as an indicator of libido. Several factors have been reported to depress libido in farm animals, such as the temperature in rabbit building [28], [29] and / or consequence of feed deprivation [30]. The higher libido scores recorded for bucks in C_1 and D_1 groups could be attributed to ginger rhizome powder since that was the only varying factor in the feed. It is quite shocking to observe that inclusion of ginger rhizome powder in the diet of rabbit bucks increased libido at the same time reduced spermatozoa production. This could be that ginger bioactive principle improves the activities of 3β-hydroxysteroid dehydrogenase (3β-OHSD) and $Δ^{5,4}$- isomerase; 17α-hydroxylase and 17, 20-lyase and 17β-hydroxysteroid dehydrogenase (17β-OHSD) in the testis which will likely enhance extra - gonadal testosterone production since maintenance of sex libido in males are attributed to testosterone.

5 CONCLUSION

It can be concluded that dietary ginger rhizome powder supplementation at 15g per kg feed had deleterious effect on sperm motility and % live sperm cells. Therefore, dietary ginger rhizome powder supplementation is not recommended in the diet of breeding rabbit bucks, as evidenced by reduced number of live sperm cells.

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Aménagement agraire et insécurité foncière dans la vallée de Zio au sud du Togo

[Development of farming area and insecurity of land owning in the Zio valley, South of Togo]

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ABSTRACT: The development of farming area for agro-economic production improves the local exploitation system by introducing new productive forces in terms of equipments. The agricultural development of lands in this process calls for multiple actors in relation to land, and having opposing interests. The promotion of the development of agriculture production structures, and the economic interests that this reinforces, makes the landowning and its conservation the main stakes of production relations. This study describes the insecurity of landowning in the Zio valley, south of Togo, in terms of a fight generated by the discontinuity between the development of farming areas and land reform. The area has been subject to a country planning project in the past which could not lead to the security in landowning by a reform which would take into account the interests of different actors. After the end of the project, this situation has reinforced the power of landowners who use their position to increase their interests. The issues related to the preservation of the existing power struggle, having access to land and to its control are at the source of the strategies opposing the owners to the farmers, as well as among the farmers themselves. The land insecurity stems therefore from the strategies of the actors for the control of the resource that land represents in a context marked by the absence of a right of possession reform.

KEYWORDS: Agrarian development, right of land possession, land insecurity, agricultural production report, strategy of the actors.

RESUME: L'aménagement de l'espace agraire pour la production agro-économique améliore le système d'exploitation local par l'introduction de nouvelles forces productives matérielles. La mise en valeur agricole des terres dans ce processus met en œuvre multiples acteurs différents par le statut foncier des parcelles exploitées, leur rapport à la terre et poursuivant des intérêts opposés. Ce processus favorise le développement des structures de production agricole. Mais les intérêts économiques qu'il renforce font de l'accès au foncier et de sa conservation, les principaux enjeux des rapports de production. La présente étude décrit l'insécurité foncière dans la vallée de Zio au sud du Togo comme une instabilité des rapports fonciers et du droit d'exploitation agricole résultant de luttes engendrées par la discontinuité entre le processus d'aménagement et la réforme foncière. La zone a bénéficié d'anciens projets d'aménagement qui n'ont pas pu aboutir à la sécurisation foncière par une réforme prenant en compte les intérêts des différents acteurs. Après la fin du dernier projet, cette situation a renforcé le pouvoir des propriétaires fonciers qui utilisent leur position pour accroître leurs intérêts. Les enjeux de préservation des rapports de force existants, d'accès à la terre et de son contrôle sont à l'origine des stratégies qui opposent les propriétaires et exploitants ainsi que les exploitants entre eux. L'insécurité foncière résulte ainsi des stratégies des acteurs pour le contrôle de la ressource que représente la terre dans un contexte marqué par l'absence de réforme du droit foncier.

MOTS-CLEFS: Aménagement agraire, droit foncier, insécurité foncière, rapport de production agricole, stratégie des acteurs.

1 INTRODUCTION

La vallée de Zio dans la région Maritime au sud du Togo est un espace agraire pourvu d'un important capital foncier dont une partie a connu dans le passé des aménagements agro-économiques. Située à 22 km au nord-ouest de la ville de Lomé, cette vallée dispose de ressources en sol estimées à 309 hectares propices à la riziculture. Les aménagements des terres de la zone ont successivement passé de la coopération avec la Chine nationaliste à la Chine populaire, selon l'évolution des choix de politique internationale du pays. Ils ont commencé avec Taiwan de 1965 à 1970 et poursuivi avec la Chine populaire de 1972 à 1978. A la fin des interventions de la Chine populaire, la responsabilité du périmètre fut prise en charge par la Direction Régionale du Développement Rural.

Le processus de modernisation du système de production a laissé comme héritage économique et social, le développement des forces productives qui mettent en œuvre une dynamique socio-économique basée sur l'exploitation des installations abandonnées. Le canal principal, les canaux secondaires d'irrigation et les terres aménagées laissées par les projets sont utilisés par différents types de producteurs pour la riziculture essentiellement. Mais la terre contrôlée par les propriétaires locaux favorisés par un régime foncier de statut traditionnel, constitue un enjeu important disputé par les différents partenaires du système de production. Les luttes pour sa conservation et pour son accès sont à l'origine des rivalités et des jeux d'intérêts qui menacent la sécurité des rapports de production et le développement local.

L'insécurité foncière que connaît l'activité productive touche le droit d'exploitation, les rapports entre les producteurs agricoles, le mode d'investissement des gains de productivité ainsi que le mode de consommation. Elle est saisie dans la présente étude comme une rivalité entre exploitants résultant d'une discontinuité entre aménagement de l'espace agricole et l'aménagement foncier, notamment la réforme foncière. Les modes de tenure de terre dans la zone sont décrits et analysés en rapport avec les changements sociaux et économiques engendrés par l'aménagement hydro-agricole. Ces changements n'étant pas suivis d'un aménagement foncier nécessaire, ils créent des conflits dans les rapports fonciers de production rizicole.

2 CONTOURS THEORIQUES DU CONCEPT D'INSECURITE FONCIERE ET SOURCES DES DONNEES D'ANALYSE

2.1 CONTOURS THEORIQUES DU CONCEPT D'INSECURITE FONCIERE

Le foncier est l'ensemble des rapports sociaux qui ont pour supports, la terre ou l'espace territorial, son mode d'appropriation, de tenure et d'accès. Ces rapports sont régis par le droit, coutumier ou moderne, qui définit le statut de la terre, le régime foncier et détermine la structure foncière. A l'origine de ces rapports, on retrouve des facteurs économiques reposant sur le mode d'accumulation du capital, des facteurs juridiques, telles que les normes d'appropriation et modalités de règlement des conflits, les facteurs techniques comme les aménagements de l'espace et les facteurs politiques comme le code foncier, les mesures de réforme foncière.

La sécurité foncière est comprise de diverses façons, perçue comme « l'absence de risque de perdre sa terre » [1] ou pour un producteur, *«l'habileté de disposer ou d'hypothéquer des droits fonciers »* de possession et d'usufruit [2]. Elle renvoie à la stabilité foncière, à la durabilité de l'accès à une portion de terre incitant un exploitant à y réaliser un investissement sur le long terme comme les plantations pérennes.

L'insécurité foncière correspond alors à des rapports et pratiques fonciers qui ne garantissent pas la stabilité des parcelles acquises, la durabilité de l'accès à la terre et du droit d'exploitation agricole. Elle se caractérise par la mise en cause soit des droits de propriété foncière et d'exploitation de la terre ou par la dépossession, l'expropriation suite à une législation déficitaire ne permettant pas d'établir des dispositions durables du droit de propriété. Ses manifestations prennent la forme de litiges et de conflits fonciers. Mais, elle peut également se traduire par des tensions latentes, dépendances sociales, incertitudes institutionnelles et juridiques ou par la précarité économique des assises foncières des exploitations agricoles, pouvant mettre en cause la sécurité minimale de subsistance [1].

Ses sources sont multiples. Elle peut résulter des limites géographiques des emprises foncières d'unités voisines, de la nature des droits sur un même espace ou les restrictions qui leur sont associées, des modalités d'affectation, de cession et de transmission de ces droits, de leurs coûts et portées socio-économiques. Cette insécurité dépend aussi de la stabilité des droits, des niveaux de leur validation et reconnaissance effective dans le cadre de règlement de conflits. La propriété collective de la terre contribue aussi à cette insécurité, en même temps qu'elle ne permet pas le passage de l'agriculture de subsistance à l'agriculture commerciale et l'entrée en scène d'agriculteurs entrepreneurs dynamiques qui s'adaptent rapidement aux changements technologiques et aux conditions du marché en transformation [3]. Les régimes fonciers traditionnels sont contre-productifs lorsqu'ils persistent malgré l'apparition de la compétition pour l'utilisation de la terre,

l'augmentation de la population et de la demande [4]. En persistant, la propriété collective de type traditionnel entrave la formation du capital de type cumulatif.

L'insécurité foncière est décrite comme un frein à l'essor de l'agriculture. Elle constitue un élément, parmi d'autres, qui bloque les processus d'intensification de l'agriculture et de renouvellement des ressources naturelles, car sans véritable assurance de pouvoir conserver sa terre, aucun paysan n'investira du travail et du capital pour la bonification et la durabilité de l'exploitation des terres [5]. Etant une absence de garantie de droits fonciers et d'exploitation, elle n'incite pas des occupants de terre à faire des investissements de long terme pour l'amélioration et la conservation des terres, parce qu'ils craignent que les avantages ne soient saisis par d'autres personnes au lieu de revenir à leurs enfants [4]. Elle défavorise alors l'utilisation intense du travail et du capital.

2.2   SOURCES DES DONNEES D'ANALYSE

L'analyse repose sur des données recueillies auprès des propriétaires fonciers et des exploitants au cours d'entretiens semi-structurés portant sur les modes d'accès à la terre et de sa tenure, les interactions entre les propriétaires fonciers et exploitants ainsi que sur leurs stratégies. L'étude appréhende la vallée de Zio comme un monde rural et une réalité agraire avec sa structure foncière, les mutations qu'elle traverse et les stratégies des acteurs. La description des rapports de production est située dans l'aménagement rural de la zone et permet d'apercevoir la dimension sociale de l'activité agricole, sa dynamique, ses structures et des rapports sociaux qui la constituent. La zone est donc décrite comme une ruralité confrontée à son fonctionnement social caractérisé par des tensions engendrées par une modernisation discontinue dans la production de l'espace agricole. En plaçant au centre de l'analyse de l'insécurité du système agricole, les rapports de production, les stratégies et luttes d'intérêt des acteurs ainsi que les effets de ce système de production, l'étude s'inscrit dans la sociologie des acteurs de l'espace rural et aborde une des questions actuelles qui se posent au développement local.

3   STATUT FONCIER DE LA VALLEE DE ZIO, MODE DE TENURE ET D'ACCES A LA TERRE

Les rapports de production, les rivalités entre producteurs et les réponses stratégiques à l'origine de l'insécurité foncière résultent du statut foncier de la zone, du mode de tenure des terres et d'accès qu'il permet.

3.1   STATUT FONCIER DE LA VALLEE

Les propriétés foncières, plus précisément les droits fonciers reconnus sur les terres de la vallée sont déterminés par la structure de la propriété foncière du territoire togolais instituée par l'ordonnance n° 12 du 6 février 1974 portant réforme agro-foncière. Cette ordonnance engendre une structure de propriété foncière où coexistent le droit coutumier et le droit moderne. Cette structure repose sur la classification de l'ensemble des terres du territoire national en trois catégories de propriété : les terres appartenant aux collectivités, aux individus et le domaine foncier national. La structure de la propriété foncière sur le territoire national est donc constituée du droit collectif, du droit privé et du droit public.

Avec ce régime foncier, les rapports fonciers dans la vallée reflètent les droits de propriété ainsi garantis par l'ordonnance. Les terres y font partie des Zones d'Aménagement Agricole Planifié (ZAAP) selon l'ordonnance n°78-18 du 17 mai 1978. Ce sont des zones dotées de personnalité morale et d'autonomie financière créées par l'Etat en vue de réaliser des travaux d'aménagement rural. Les terres y sont inventoriées, évaluées, immatriculées au nom des propriétaires et de l'État pour ce qui concerne les terres du domaine foncier national. De nouvelles structures agro-foncières doivent y être mises en œuvre, en procédant à l'expropriation des terres situées sur les emplacements réservés aux travaux d'aménagement collectif et en rendant obligatoire l'exploitation communautaire. La ZAAP implique la purge de tous les droits fonciers antérieurs sur les terres qu'elle comprend et la possibilité de cession de ces terres aux coopératives, organismes ou collectivités existants pour l'exploitation collective.

Le contexte foncier et le système de production de la vallée ont connu donc une évolution marquée par la transformation des terres en ZAAP, les projets d'aménagement, l'introduction de la riziculture par les Chinois, la modernisation des moyens de production avec les semeuses, batteuses et les décortiqueuses apportées par ces derniers et la réorganisation sociale de l'exploitation marquée par l'organisation des groupements. Malgré ces évolutions, la restructuration foncière n'a pas été réalisée. Les anciens droits fonciers fondés sur les modes d'appropriation par transmission intergénérationnelle et l'achat se sont maintenus offrant aux propriétaires un pouvoir dominant sur les exploitants sans terre. Avec les opportunités qu'offre l'aménagement, c'est de ce droit foncier que dépendent le mode de tenure des terres et la relation entre propriétaires et exploitants. Ces processus reflètent le rapport de propriété foncière, le

processus de modernisation agraire, les logiques de recherche d'optimisation du profit, les rivalités et les stratégies qui les accompagnent.

3.2   MODE DE TENURE DES TERRES

Le droit foncier jusqu'alors reste à l'avantage des propriétaires de terres, en majorité des autochtones, qui les ont acquises par voie d'héritage. Le mode de tenure des terres est le faire-valoir indirect, la plupart des propriétaires fonciers n'exploitant pas eux-mêmes leurs terres avec une main-d'œuvre familiale. Par ce mode, ils ne se constituent pas en forces productives agricoles. Ils font exploiter ou mettent en valeur les terres par délégation en les confiant à des exploitants, à la différence du faire-valoir directe et mixte.

Tableau 1.   Les modes de tenure des terres

Les modes de tenure des terres	Effectif	Pourcentage
Faire-valoir direct	06	5
Faire-valoir indirect	78	74
Faire-valoir direct et indirect	22	21
Total	106	100

Trois modes de faire-valoir des terres se pratiquent dans la vallée : le faire valoir-direct, le faire-valoir indirect et le faire-valoir mixte. Ce dernier mode comprend des parcelles en toute propriété et des parcelles en location [6]. Parmi les trois modes de tenure foncière, le faire-valoir indirect domine avec 74% des propriétaires qui la pratiquent. Le faire-valoir direct représente 5 % des exploitations agricoles et le faire-valoir mixte 21%.

La prédominance du faire-valoir indirect fait partie des transformations sociales engendrées par l'aménagement. Ce dernier a accru le statut social des propriétaires. Si dans le système antérieur, ceux-ci vivaient de la production issue de leur force de travail utilisé jusqu'à un âge mature et de l'exploitation familiale entretenue par des descendants, l'aménagement du périmètre et la demande consécutive du foncier diminue cette contrainte. La valorisation du foncier par l'aménagement leur permet de vivre d'une économie nouvelle par la concession du droit d'usage des terres, sous forme de location ou de prêt, contre des garanties de biens en nature ou en espèce. Sans être contraints à l'emploi de la force de travail dans une activité productive de type agricole, l'usage du droit foncier les intègre dans un système d'échange économique qui leur apporte les revenus pour survivre. Mais ils restent dépendants de la contrepartie de ressources que leur doivent les exploitants, contrepartie contenue dans les termes de l'accord du droit d'exploitation.

La prédominance du mode indirect de tenure des terres est un changement du rapport des propriétaires à la terre crée par le développement de l'agriculture marchande. Ce développement de l'économie agricole est favorisé par l'amélioration du système de production, l'accroissement des enjeux fonciers qu'entraînent l'espace aménagé et les rivalités consécutives qui opposent les exploitants. L'importance que prend le rapport de propriété se traduit par l'instabilité des rapports entre propriétaires et exploitants.

3.3   MODE D'ACCES A LA TERRE

Le faire-valoir indirect comme mode de tenure de terre ne peut donc exister qu'avec des modes d'accès à la terre fondés sur la logique du marché foncier. Cette relation apparait dans les principales procédures d'acquisition de droits d'exploitation de parcelles par les exploitants.

Tableau 2.   Les modes d'accès des exploitants à la terre

Les modes d'accès des exploitants à la terre	Effectif	Pourcentage
Location	188	94
Don	11	6
Total	199	100

Les pratiques foncières dans la zone montrent que les exploitants dans leur majorité sont liés aux propriétaires fonciers par la location. La quasi-totalité des exploitants, soit 94% sont des locataires des parcelles qu'ils exploitent, 6% ont acquis leur droit d'exploitation à partir du système de don.

Avec l'importance que prend la location comme rapport foncier, l'exploitant agricole n'est pas lié au propriétaire par la solidarité traditionnelle, ni par la communauté d'intérêt ou d'appartenance sociale, mais tient son droit d'exploitation de la parcelle acquise, de l'interdépendance fondée sur la réciprocité réglée par l'intérêt mutuel de type économique. Un tel rapport foncier n'est donc pas orienté par les normes et valeurs traditionnelles, le partage, l'exploitation communautaire, l'attachement aux normes, la recherche de l'intérêt communautaire, l'attachement aux engagements. Il est dicté par des avantages comparatifs. Dans cette évolution de la logique des rapports fonciers marquée par l'importance de l'intérêt personnel, des biens matériels et monétaires dans les échanges économiques, la sécurité de la mise en valeur agricole ne pourra dépendre que des garanties qui protègent aussi bien l'exploitant que le propriétaire. La nature informelle, interpersonnelle des rapports contractuels devient une source d'insécurité foncière et d'arbitraire des rapports de production. Ce contexte dont se plaignent les exploitants est lié à la tension entre le processus de modernisation agraire et les rapports de production. L'insécurité foncière résulte de cette scission entre l'implantation de l'aménagement et la rationalisation des rapports fonciers.

4   RAPPORTS DE PRODUCTION AGRICOLE ET STRATEGIES DES ACTEURS

Les principaux acteurs identifiés au centre de l'activité agricole sur le périmètre sont les propriétaires fonciers et les exploitants. Les rapports fonctionnels qui participent à l'insécurité foncière sont ceux qui les opposent.

4.1   RAPPORTS ENTRE PROPRIETAIRES FONCIERS ET EXPLOITANTS AGRICOLES

Les aménagements agricoles ont créé une modification de l'organisation sociale de l'activité productive qui renforce la position des propriétaires fonciers. Ceux-ci, fort du contrôle qu'ils détiennent sur la propriété foncière, se servent de l'espace agricole comme ressource pour imposer aux rapports de production, une structure qui les avantage.

Entre les propriétaires fonciers et les exploitants, la location est le rapport de production dominant. Selon les termes du compromis, pour un hectare de terre louée, l'exploitant est tenu de rembourser 100kg de riz égrené par saison. Le contrat conclu repose sur un accord verbal qui correspond à la forme du contrat de type traditionnel, non rationalisé par des termes formels. Les conditions de rupture sont tacites. La rupture obéit à une règle générale contenue dans la conscience collective, mais non exprimée expressément lors de la conclusion du contrat. La règle prend la forme d'un principe selon lequel, le non-respect des engagements entraîne la perte du droit d'exploitation au profit d'un autre exploitant. La redevance due au propriétaire est payée à la fin de la récolte. La surface de l'exploitation est convenue au départ lors de l'échange de volonté. La durée du contrat qui couvre deux saisons agricoles de l'année est indéterminée, mais le renouvellement dépend de la volonté du propriétaire.

Les pratiques des propriétaires décrits par les exploitants montrent que ces conditions de contrat ne suffisent pas pour les protéger et garantir la sécurité de l'exploitation. Les exploitants sont tenus de respecter les engagements en payant la contrepartie quels que soient les aléas climatiques et le rendement. Pour répondre à cette contrainte, certains exploitants, suite à une faible production due aux aléas climatiques et aux prédateurs, recourent à des endettements ou à l'épuisement de leur réserve. Des propriétaires, avant même la période de récolte, réclament déjà une avance sur la production sous forme d'argent. Les enjeux de renouvellement du contrat de location et de préservation du droit d'usage de la terre contraignent les exploitants à accepter les demandes et à des dépenses pour satisfaire ce dernier, sans avoir la garantie de la réussite de l'exploitation au cours de la saison. Lorsque face à une demande, l'exploitant se montre incapable d'y répondre, cette attitude est interprétée comme un refus ou un manque de solidarité. La difficulté de l'exploitation provient même des récoltes qui ne sont pas encore faites et de l'épuisement des fonds épargnés ou empruntés auprès des usuriers et des institutions de crédits.

Les rapports de pouvoir qui placent l'exploitant en situation de domination ont pour enjeux, l'accès et le contrôle du foncier. Ces rapports sont marqués par une contradiction entre les termes du contrat de location et les rapports fonctionnels. Les demandes de solidarité et les menaces de rupture de contrat résultent du conflit entre le droit foncier et les contraintes sociales hors contrat. Le droit de propriété foncière devient une ressource qui permet aux propriétaires d'instrumentaliser leur statut social pour acquérir des avantages parallèles.

Cette attitude révèle une logique de rapport de force dans laquelle se situent les propriétaires fonciers. Le conflit dans cette situation est évident et devient une composante des rapports fonciers. Pour justifier le devoir de reconnaissance, les

demandes de solidarité et les ruptures éventuelles de contrat, les propriétaires s'appuient sur des motifs qui renvoient aux fonctions sociales du foncier. Les terres concédées sont perçues comme une garantie de sécurité économique, un secours en cas de besoins. C'est une sécurité à laquelle on fait recours en cas d'infortune. Lorsqu'un propriétaire a un problème et l'exploitant n'intervient pas pour le secourir, son incapacité à intervenir ou son refus sont vécus et perçus comme un manque d'engagement, un refus de solidarité.

La génération des propriétaires, leur rapport au travail et la valorisation du capital foncier dans la vallée avec les aménagements hydro-agricoles contribuent à construire cette idéologie qui fait du foncier pour le propriétaire, une retraite, un système de protection sociale, un secours face aux risques et aux infortunes. Les propriétaires forment une génération vieillissante d'héritiers qui pratiquent comme mode de tenure de leur terre, le faire-valoir indirect dans lequel, la mise en valeur de l'exploitation agricole est réalisée avec le concours d'une main-d'œuvre salariée, soit par métayage ou par location. C'est donc un groupe social dont le modèle culturel n'est pas l'investissement direct dans l'agriculture comme activité productive. La terre en tant que facteur de production est transformée en patrimoine auquel ils sont liés en tant que titulaires présents et dont la fonction est d'assurer la permanence de la communauté à travers les différents moments de son existence [7].

4.2   RIVALITE ENTRE EXPLOITANTS AUTOUR DES ENJEUX FONCIERS

La population des exploitants dans la zone est estimée à 677 exploitants repartis entre 63 groupements différents selon les types de production [8]. Avec la dynamique démographique, les aménagements hydro-agricoles qui favorisent la diversification socio-économique, la productivité des exploitations et une demande croissante de la terre dans la vallée, l'accès à la terre et sa conservation deviennent les principaux enjeux des rapports sociaux. Ces processus modifient les logiques foncières [9] en introduisant une logique marchande dans les pratiques traditionnelles fondées sur l'intégration, la communauté, l'indivision et le partage. Cette économie foncière est définie par la capitalisation agraire fondée sur la mise en valeur économique de la terre et la possibilité de la traiter comme un produit, qui peut être librement transféré, acheté ou vendu [10]. Les groupes locaux qui font fonctionner l'activité productive sont devenus des acteurs d'un nouveau mode de production, d'une nouvelle société qui s'approprie l'espace, c'est-à-dire organise à ses fins, l'espace préexistant, modelé auparavant. Les anciens projets d'aménagement ont transformé la vallée en un monde agricole dont le mode de production organise, produit, en même temps que certains rapports sociaux, son espace et son temps [11].

L'exploitant dans son activité productive est entraîné par la recherche d'un surplus de terre, son maintien et sa protection dans une rivalité faite de sabotage, de délation et de trahison. Pour accroître sa parcelle, un exploitant fait des offres plus compétitives au propriétaire d'un autre pour négocier un surplus de terre sur une parcelle en cours d'exploitation. Cette stratégie orientée négativement contre les intérêts et les droits fonciers de l'exploitant voisin est, dans l'imaginaire des exploitants, combinée avec l'usage de maléfice humain. Pour rendre inapte son rival exploitant aux fins d'acquérir la partie de terre que ce dernier exploite, un autre lui jette un mauvais sort par des moyens surnaturels. Dans cet imaginaire social, un exploitant qui prospère par la productivité élevée de son exploitation s'expose aussi à des maléfices humains. Il doit faire face à la convoitise et à la sorcellerie des autres exploitants. Quant à l'exploitant se sentant menacé, il fait aussi recours à l'usage du fétiche pour se protéger. Le fétiche renvoie à des pratiques religieuses de type traditionnel ou à des objets matériels, naturels ou fabriqués, choisis non arbitrairement, mais en considération du rôle fonctionnel qu'ils sont supposés jouer, par rapport au code de la magie et de la religion [12]. Avec la rivalité dans les rapports de production, c'est l'imaginaire de l'infortune, sous forme de maladie, d'accident ou d'un quelconque malheur, qui fonde l'interprétation d'un évènement malheureux. Tout évènement-malheur est relié à la nature des relations avec les autres où il prend son sens en tant que fait persécutif ou sort jeté sur soi par un autre exploitant déterminé par la convoitise ou la jalousie.

Le recours à la sorcellerie et l'usage du fétiche que fait intervenir le conflit social entre exploitants renvoient à des formes symboliques qui font partie de l'économie agricole et du foncier. Dans les discours des exploitants, la sorcellerie évoquée correspond au double sens de *witches*, en tant qu'une manière de nuire en vertu d'une qualité propre, et de *sorcerers* en tant qu'une manière de faire du mal à distance en accomplissant des rites magiques au moyen de mauvaises médecines [13]. Les terres occupées par les exploitants concurrents et les rendements prospères des autres font l'objet de convoitise. Les infortunes, notamment les maladies, les accidents, les pertes d'argent et les décès sont, dans l'imaginaire collectif, imputés au maléfice des exploitants rivaux. Ce rapport de l'économie et de la sorcellerie révèle « *de près les enjeux du changement social et de la modernité en Afrique : les phénomènes économiques n'obéissent pas qu'à la pure rationalité économique formalisée mais subissent de la part des acteurs, des lectures dans l'imaginaire, des traductions dans l'idiome sorcellaire.* » [14]. Le foncier et les réussites économiques de l'exploitation sont le lieu de tensions qui se règlent par la sorcellerie ou l'usage du fétiche. On voit à travers ces pratiques, comment, malgré le capitalisme agraire et le processus de modernisation de l'activité agricole, survivent des discours manipulant les énoncés sorcellaires, au cœur des rapports et des institutions qui

tendent à se rationaliser. Ce discours fait donc partie du système d'imaginaires à travers lequel les rapports et les enjeux fonciers sont vécus.

5 DISCUSSIONS

5.1 INSECURITE FONCIERE DANS LA VALLEE

L'insécurité foncière se manifeste sous divers aspects. Les rapports contractuels entre les propriétaires fonciers et les exploitants sont de type verbal, informel, sans garantie écrite. Les engagements et leur mise en œuvre ne sont que des pratiques qui reposent sur un droit encore semi-traditionnel malgré un début de formation du capital et la valorisation de l'échange marchand portant sur la terre. Cette forme juridique des rapports fonciers placent les exploitants dans une position de faiblesse face aux propriétaires. Les exploitants se retrouvent dans une inquiétude qu'entraîne l'incertitude permanente de l'évolution de leur rapport avec les propriétaires. Cette incertitude se caractérise par l'imprévisibilité des orientations de conduite d'un propriétaire, qui à tout moment, peut se présenter à l'exploitant avec un problème nécessitant une intervention financière dont ce dernier n'est pas directement capable. Les rapports de production, selon la situation et son interprétation par le propriétaire, se transforment alternativement ou successivement, en tension, évitement, rapprochement ou cohésion.

De fait, une inégalité se maintient dans de tels rapports. Si les bénéfices sont réciproques, la contrepartie est garantie au propriétaire, alors que la réussite du rendement n'est pas toujours garantie à l'exploitant, étant donné les aléas climatiques et les contraintes éventuelles du marché. Le propriétaire a la liberté de transformer la contrepartie obtenue en capital, investissement ou en moyen d'acquisition d'un bien de consommation désiré pour son bien-être. L'exploitant se voit contraint de s'abstenir d'exposer dans sa vie sociale certaines dépenses, investissements, acquisition de biens en évitant de montrer qu'il prospère dans l'exploitation des terres et de susciter chez le propriétaire, le sentiment de jalousie d'être triché. Or, sa condition économique et son existence matérielle reposent sur la valeur marchande du rendement agricole lui revenant dans la répartition.

Les rivalités opposant les exploitants les mettent en situation de faiblesse face aux propriétaires. Elles portent atteinte à la fois à leurs droits fonciers respectifs acquis auprès des propriétaires, mais aussi entravent la construction d'une position de contre-pouvoir visant à modifier les rapports de domination qu'ils subissent. Les divisions qui les opposent autour des enjeux fonciers contribuent à les affaiblir en tant que force sociale face aux logiques d'intérêt des propriétaires. La conscience de classe si elle existe, n'arrive pas dans cette confrontation interne à se transformer en lutte organisée construite sur une méthode d'action et sur un système idéologique suffisamment élaborée pouvant leur permettre de s'imposer comme une nouvelle base sociale des rapports fonciers. L'intervention de l'Etat pour organiser et formaliser les rapports de production est évoquée et sollicitée. Mais les rivalités, l'importance que prennent les jeux et les calculs individuels de renforcement ou de défense du droit acquis sur les terres exploitées, détournent les exploitants des actions collectives de modification de la structure des rapports sociaux et de changement des règles du jeu. Actuellement, les rapports sont laissés à leur autorégulation. Les relations se font, se défont et se refond d'elles-mêmes. Les exploitants participent à un système de relations qui profite moins à leur cause qu'aux intérêts des propriétaires fonciers. Les rapports entre les exploitants affaiblissent leur marge de pression sociale et renforcent le statut social de leur adversaire.

5.2 SCISSION ENTRE PROCESSUS D'AMENAGEMENT AGRICOLE ET RAPPORTS DE PRODUCTION

La dissymétrie des rapports fonciers marquée par le pouvoir dominant des propriétaires, l'inexistence de garanties institutionnelles et formelles de sécurité des contrats de location, les rivalités entre les exploitants divisés par des luttes d'intérêt foncier, créent la situation d'insécurité foncière. Cette insécurité se situe dans les changements agraires et sociaux intervenus avec l'aménagement. Elle se déroule dans un contexte caractérisé par une évolution de l'organisation de l'espace agricole avec l'aménagement et le maintien d'un statut foncier qui ne répond pas au système agraire actuel, avec ses aspects spatiaux, techniques et socio-économiques introduits par l'aménagement. Les projets d'aménagement hydro-agricole dans la vallée ont créé un début d'aménagement rurale de la zone, modifié le mode d'exploitation agricole avec le développement du faire-valoir indirect. Mais ces aménagements n'ont pas été suivis d'un aménagement du foncier rural pour améliorer la structure foncière des propriétés, des exploitations agricoles et pour permettre la transformation des conditions d'appropriation du sol dans le périmètre [15]. L'insécurité foncière qui affecte les rapports de production est la discontinuité entre le processus de modernisation agricole à travers l'aménagement et la réforme foncière. Elle manifeste la tension entre la modernisation des systèmes agraires et pratiques informelles, entre l'innovation agricole et l'arbitraire.

6   CONCLUSION

Les anciens projets d'aménagement hydro-agricole, en introduisant la riziculture avec une nouvelle organisation technique et sociale de production, ont modifié le système agraire local. Cette innovation engendre une nouvelle interaction entre le système bioécologique représenté par le milieu naturel et le système socioculturel, à travers des pratiques issues de l'acquis technique. Elle correspond à un changement de la forme de mise en valeur des anciennes terres, qui transforme celles-ci en ressources plus productives et augmente leur valeur d'échange [16]. Sur les terres aménagées, les anciennes conceptions et méthodes de mise en valeur se trouvent remplacées par le nouveau système agraire qui se trouve ainsi installé. Mais ce changement du système d'exploitation laisse sans réforme les rapports fonciers entre propriétaires et exploitants sans terre.

La dissymétrie des rapports fonciers affaiblit la position des exploitants et entraine des manques à gagner. La sécurisation foncière dans ce contexte, nécessite l'implication du pouvoir régulateur. Celle-ci passe par la mise en œuvre de la réforme foncière à travers la réorganisation des droits d'accès à la terre et d'exploitation sur une base contractuelle proposée, négociée, mise en œuvre, garantie et suivie par les pouvoirs publics. Cette base institutionnelle de la sécurisation foncière permet de fonder les rapports fonciers d'exploitation sur des règles de droit moderne par leur formalisation. Cette réforme permettra de protéger les exploitants de l'arbitraire des propriétaires, de légaliser par voie rationnelle les droits fonciers de ces derniers et d'assurer la durabilité du droit d'exploitation.

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Enhancing the Quality of Urban Space by Pedestrian Grid Design Using Space Syntax Technique: A Case Study of the Historical Neighborhood of Jolfa in the City of Isfahan (Iran)

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ABSTRACT: One of the common problems of the contemporary urbanization worldwide has its origins in its excessive loyalty to the vehicular movement overlooking the maintenance and organization of walkways spaces and pedestrian movement. This, it turn, has led to the disintegration of the social and cultural and visual values in the urban spaces and the decrease of its performance and efficiency. It is noteworthy that the presence of pedestrians in the cities is advantageous to enhancing the social interactions of the citizens. To design paths conforming to the pedestrian movement in the urban fabric, due to their public use, requires flexibility, variation in the activities and spaces, the provision of urban safety and sense of belonging to the space the same factors which will consequently result in the promotion of the quality of the routes, the enhancement of social relations and interactions and the flourishing of the urban life. This research intends to study the enhancement of the urban space by pedestrian grid design using space syntax technique in the historical neighborhood of Jolfa, the Armenian quarter in the city of Isfahan (Iran).

KEYWORDS: Isfahan, urbanization, safety, Pedestrian Grid Design, Armenian quarter.

1 INTRODUCTION

Industrial revolution and machine invention have made critical changes in the spatial configuration of the cities and how to use it. The growth in the vehicular movement and transit-oriented development of the urban space has caused the collapse of valuable urban fabrics such as historical places and buildings. This has been accompanied by the displacement of the values in the urban space i.e. moving and mobility instead of stop and immobility in such a way that it has led to the decline of quality elements of the urban space including collectivity, co-presence, vitality, safety etc. . According to medical findings, social interactions have positive bearings on the individual health. However, unfortunately nowadays, excessive devastation and construction on the pretext of resurrection following a quantitative approach has led to bodily disintegration and consequently, sense of alienation of the people towards each other. Accordingly, due to such conflicts, urban fabric has failed to preserve its semiotic load it has gained during its long history unlike the past times. The emergence of the youth generation unaware of the fabric and the entrance of outsiders with different cultures and insights have caused weakening of social bonds of the fabric leading to inhabitants' indifference, alienation and finally their lack of sense of belonging. Conducting research on issues such as which factors are embedded in the quality of the urban space (focusing on pedestrianways)? How can the quality indicators of the environment be improved by pedestrian grid design? Which features of the walkways and urban spaces act as attractors of the tourists? May be somehow effective for the recovery of the urban fabric? [9].

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2 URBAN SPACE

As one of the spatial elements of the cities, urban space is formulated and transformed along with the history of a nation during different periods. This element embodying various cultural, economical, social and political activities had always pulsated with the heart of the history of the city deciding the fate of the city. To put it differently, it has always been of remarkable significance as one of the basic components in the structure of the city. Urban pedestrianways as one of the indicators of the urban space are designed in such a way that be located in the everyday passways of the people without requiring going a long distance for using them locally. Due to their potentiality for creation of urban and collective spaces along their length and at certain intervals as joints, pedestrian axes may be helpful for removing the existing vacuums in the urban life and the resolving the lack of interactive space. [1, 3]

3 THEORETICAL PERSPECTIVES ON THE URBAN ENVIRONMENT QUALITY

Apart from focusing on the concept of quality and its meaning, ideas found for it among the theories on the quality of urban environments are triple. Emphasizing on the "objective" nature of the thing, the first group of the theories have regarded the quality of urban environment as an attribute and construct intrinsic to the bodily environment and existing independently of the observer. For the second group which focuses on the "subjective" or "abstract" dimension of the individual, urban design quality is deemed as a matter of mental phenomenon and taste constructed by the observer with no relevance to the bodily structure and attributes. Finally, the third group defines urban environment quality as a "phenomenon" or "event" formulated in the course of interaction between bodily and tangible characteristics and observer's cultural patterns and codes and mental capabilities. Experimentalist theorists including Lynch, Eplliard, Leng and Nether are among the major advocates of such a view of the urban environment quality. Kevin Lynch has emphasized on the existence of a mutual association exploring the effect of urban environment quality on the life quality of the city inhabitants. As he argues, if urban planning and design is to be useful, it must be able to promote the quality of human life through enhancing the bodily environment quality [2, 8].

He has proposed a model including 5 functional aspects which in his opinion covers all the main axes of the quality of a city along with two super-criteria i.e. efficiency and justice being considered as the comprehensive model version for the quality of the city. These aspects are as follows:

1-Vitality: Provision of the possibility of human's biological and sociological survival in the urban environment;

2- Sense (meaning): Abstract functioning and meaningfulness of urban places;

3-Adaptability: Conformity of the urban form with various activities and behavior patterns;

4-Accessibilty: Provision of ease of "physical penetration" into different sections of the urban fabric;

5- Control and monitoring: Provision of the possibility of selection and intervention made by citizens in issues related to the management and usage of public area of the city.

The existing mode of the quality
Individual's subjective domain
Thing's objective domain
The qualities related to the subjective domain are embedded within one's ego.
Desirable qualities
Capacity qualities
The qualities related to the "objective domain" are object-oriented attributes that are subjected to the mind as an "external entity" interacting with outside events
Hardly quantifiable and measurable
Ugly-beautiful
Desirable-undesirable
Measurable
Weight, height, speed [7, 6].

4   SPACE SYNTAX THEORY

Everything is both the product of its past and the producer of its future. Space syntax theory has stemmed from this statement. If urbanization is regarded as a phenomena trying to resolve urban problems and promote the qualitative level of the life of the citizens, it must be said that urban problems have arisen when following the excessive growth of the cities and the development of the urbanization, urban constructors made their desirable changes to the body of the city but they could not reach their desirable results. In fact, urban architects, designers and authorities could not predict the behaviors and changes of their own city due to their insufficient knowledge and cognition about the environment and society.

Developed and originated in the late 1970s, space syntax theory was introduced by Bill Hillier and Julienne Hanson at University College of London to tackle such problems.

The axial map helps us to divide the urban spaces into convex spaces in all of which the accessibility and visibility principles are established i.e. every point taken within each space is visible and accessible to all other points within the same space.

The following picture shows how space syntax theory has been used [4, 5].

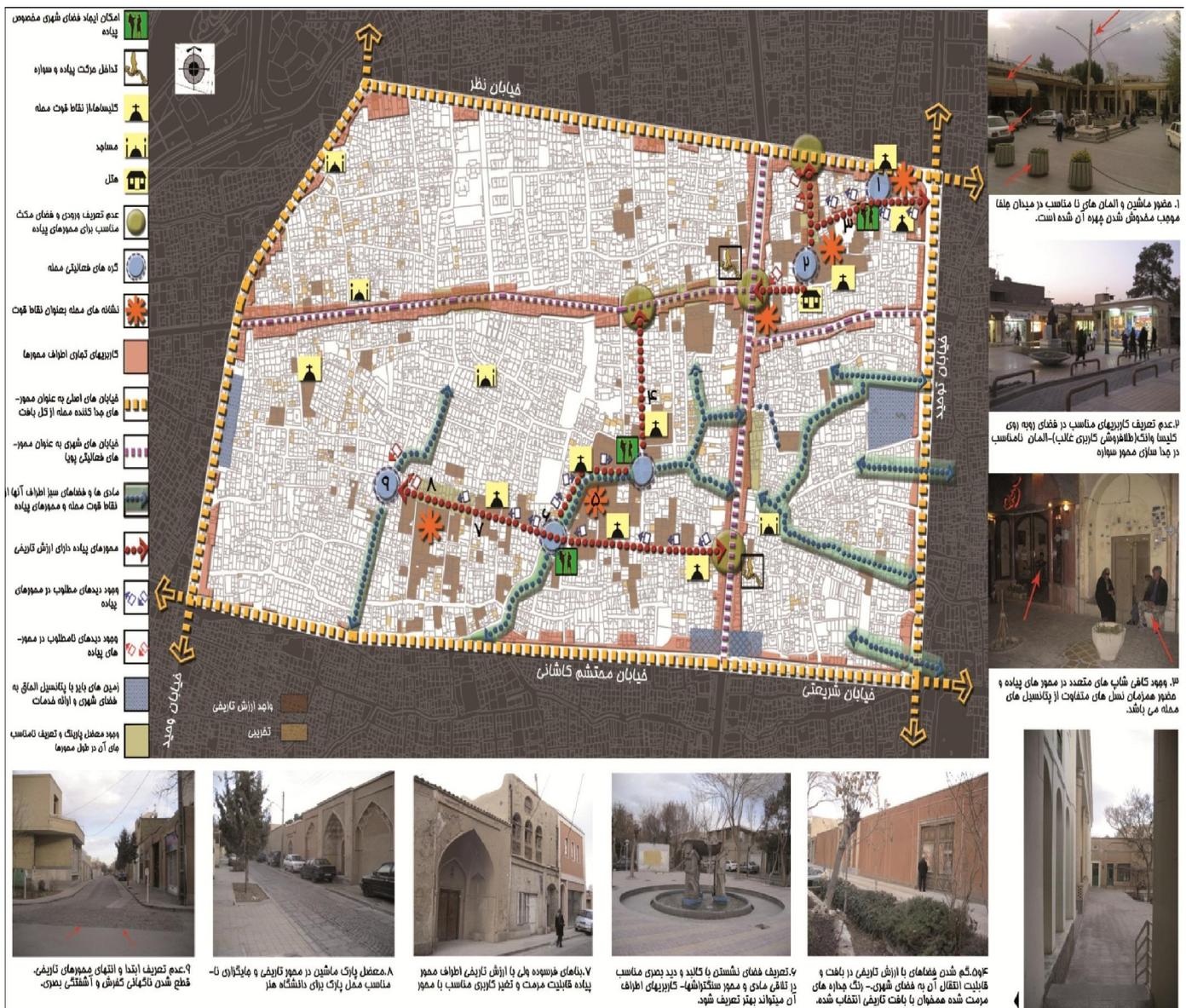The Analysis of Isfahan's Jolfa Neighborhood.

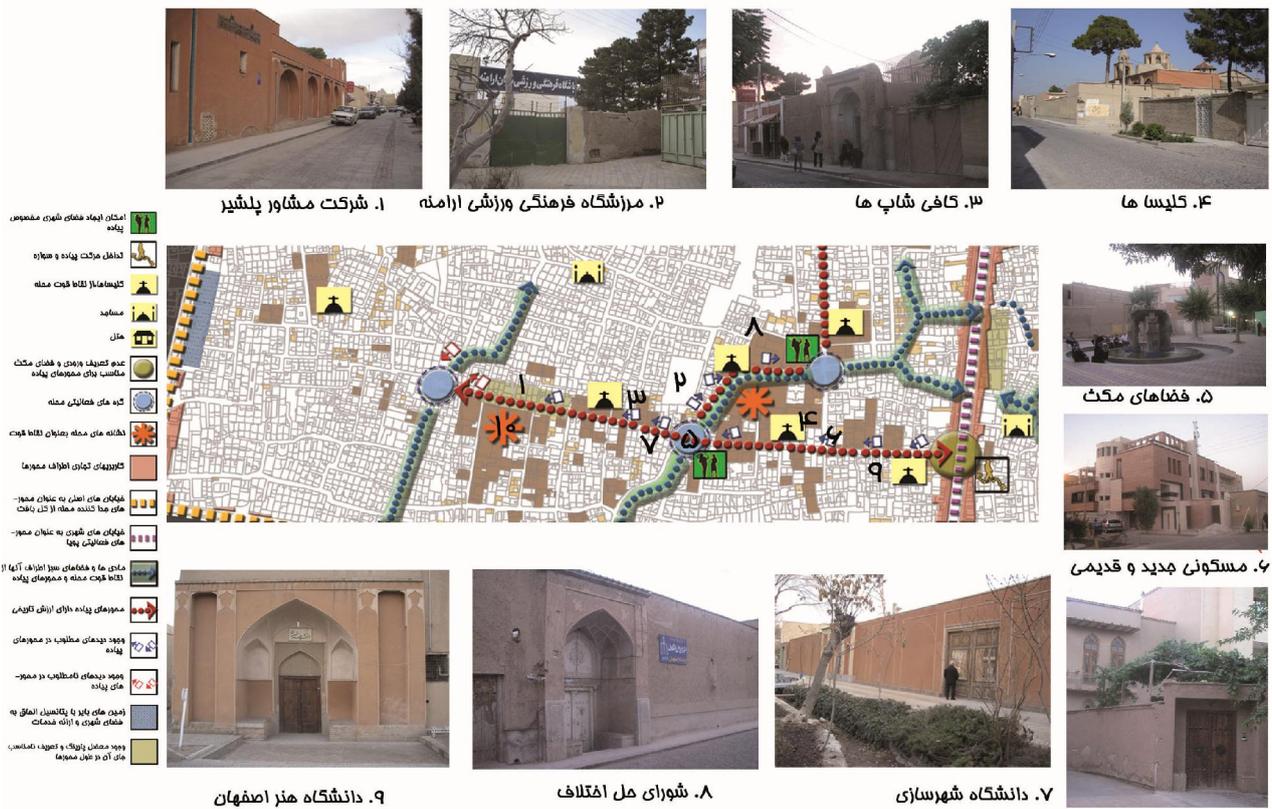*Fig. 1.   Integrated Analysis of Jolfa neighborhood*

Fig. 2.   Marked Functionality Analysis of Sangtrashha Axis [11]

4.1   CONCLUSIONS BASED ON THE PERFORMED ANALYSES

Putting together the results of the analyses, an integrated analysis of the neighborhood was achieved presented below in detail. The most remarkable part in this analysis was the position of historical axis of *Sangtarashha* in the Jolfa neighborhood. *Sangtarashha* axis as the historical pedestrian-based route with meta-quarter and even meta-urban services (due to the existence of the universities) is currently functioning at best. The passage of Shayej irrigation canal through the axis, rich historical background, marked functions, pedestrian stop spaces etc. all are among the potentialities of this axis. As it is evident in the above analysis, given its prominent potentialities, *Sangtarashha* axis despite all designs made for it (pavement, repair and resurrection of the walls, etc.) suffers from remarkable weaknesses so that it can be claimed an optimum design can be yielded by handling them. [13]

4.2   THE ANALYSIS OF JOLFA NEIGHBORHOOD USING SPACE SYNTAX TECHNIQUE

Based on analyses, it was revealed that *Sangtarashha* axis is a historical-functional route of prominent value. Now, to complete the analyses and understand the communicative role as well as the integration degree of the axes of this neighborhood, space syntax technique is used.
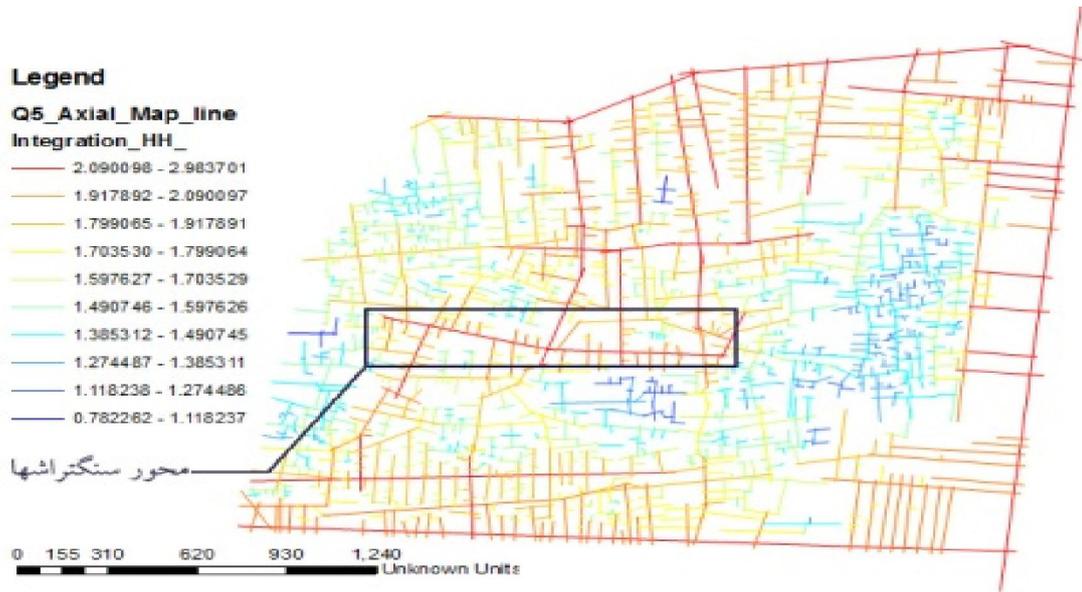
Fig. 3.   Radius-N integration map in the previous fabric of the neighborhood before constructing new avenues

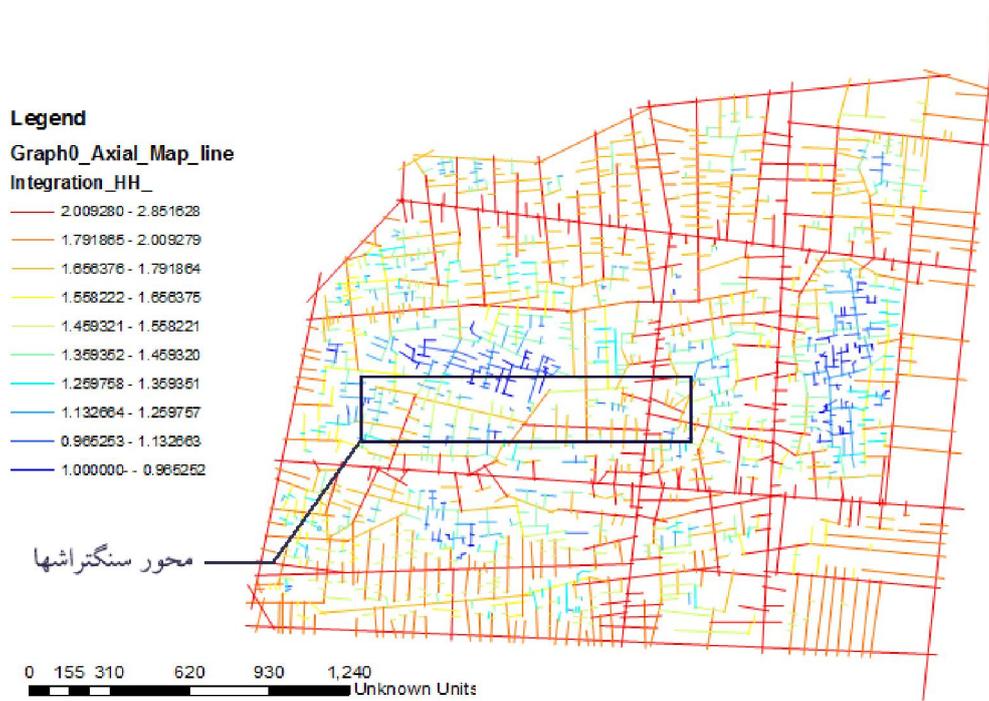*Fig. 4.   Integration map in the previous fabric of the neighborhood before constructing new avenues*

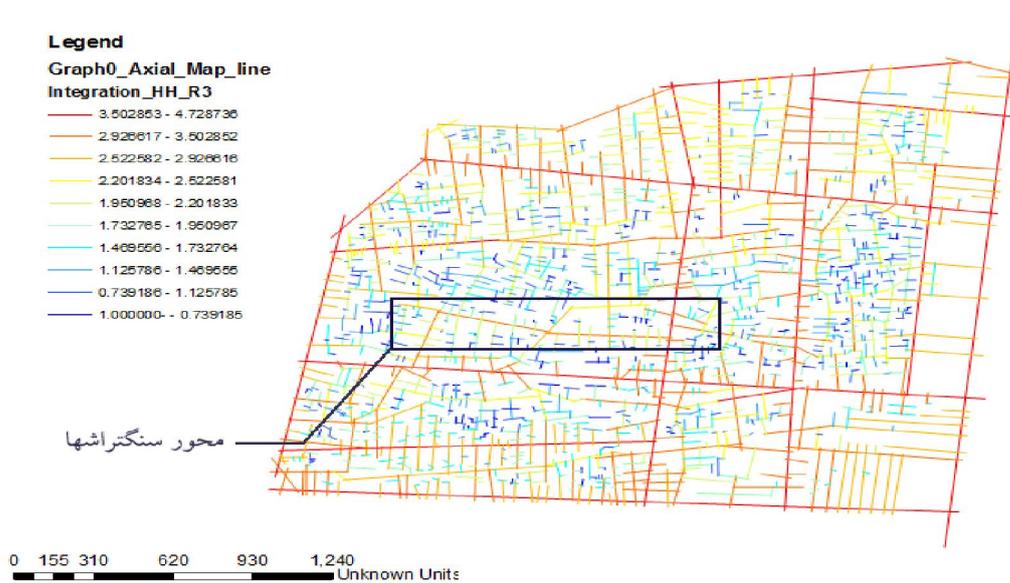**Fig. 5.   Radius-N integration map in the current fabric**

Fig. 6.   Radius-3 integration map in the current fabric

Table 1. The mean values of the integration degrees obtained from the old and current maps of the entire zone and the Sangtarashha axis

	The mean value of global integration(Rn-Integration)		The mean value of local integration (R3-Integration)	
	Whole area	*Sangtarashha* axis	Whole area	*Sangtarashha* axis
Before construction of the new avenues within the last 30 years	1.588	1.32	1.860	3.41
Current status (after construction of the new avenues)	1.593	1.98	1.867	3.14

The results of the space syntax analysis for this zone have been presented in the above table showing the degree of integration of the spaces constituting this zone. Integration map plays a significant role in understanding the behavior patterns of the constitutive elements of the city. Based on the results of numerous researches, there is a high correlation between the value of integration throughout the city and various events in the city including pedestrian movement. Since space syntax is also responsive to even trivial changes and modifications made in the structure of the city representing them in mathematical and graphical forms, this technique can be used at historical bodily transformations analysis step as a guide tool for design, design step and consecutive steps (to monitor what effects the design will have on the general structure of the region). In the integration map, the lines whose colors are closer to red represent the spaces of greater integration. Spaces of greater integration enjoy greater spatial connectivity with the whole of the city. Hence, it can be inferred that these spaces attract the highest number of movements due to their greater visibility within the overall fabric (high integration). As it is evident in the obtained maps, there has been a decrease in the integration of the historical axis of *Sangtarashha* following the construction of new streets. The integration of new streets with the whole city, however, has increased and consequently, with more movements along them. Of course, it is noteworthy that this inference does not mean that *Sangtarashha* axis currently has no function in the structure of the neighborhood, but it still exists as an influential element in the structure of the city. This claim can be justified by the reddish color of the first half of this axis. The degree of integration in the second half has decreased that given its strong performance and marked applications, when designing this problem must be taken into account and resolved [17].

4.3   PRESENTING DESIGN ALTERNATIVES

Analyses performed on the area in question using space syntax technique, the values of the degree of integration and the area's weaknesses in this regard guided the author for design purpose. Accordingly, considering the respective principles and criterion, here two alternatives for design are proposed. Then, using space syntax technique, that alternative which is found to be of a greater integration value shall be selected for design purpose. This alternative will be discussed in detail.

It is worth mentioning that design alternatives merely present a general layout and structure without going into required particulars. Furthermore, it must be noted that some of the items proposed towards achieving the goals are integral to both alternatives i.e. they form the underlying basis of all the alternatives with having trivial differences [1, 16].

4.4   THE PROPOSED DESIGN ALTERNATIVES

Here, firstly, the map of proposed changes in the axes within the zone and its pedestrian-based route has been represented. Then, using space syntax software, the degree of integration of the axis with the whole fabric has been calculated at radius of n and 3 [18, 13].

4.4.1 DESIGN ALTERNATIVE NO. 1

Fig. 7.   Design Alternative no. 1: Proposed Modifications in the Axes within the Area and Selection of Pedestrian-based Route

Legend
Graph1_Axial_Map_line
Integration_HH_

—	2.021670 - 2.901690
—	1.825025 - 2.021669
—	1.711076 - 1.825024
—	1.629675 - 1.711075
—	1.538726 - 1.629674
—	1.442362 - 1.538725
—	1.309276 - 1.442361
—	1.107290 - 1.309275
—	0.786584 - 1.107289
—	0.402965 - 0.786583

0   155 310   620   930   1,240
Unknown Units

Fig. 8.   Space Syntax Analysis on Alternative no.1 with a movement radius of n

Fig. 9.   Space Syntax Technique Analysis on Alternative no.1 with a Movement Radius of 3

4.4.2   DESIGN ALTERNATIVE NO.2

Fig. 10.   Alternative no.2 for the design: Proposed modifications in the axes within the area and Selection of Pedestrian-based Route

Fig. 11. Space Syntax Analysis on the Alternative no.2 with a Movement Radius of n
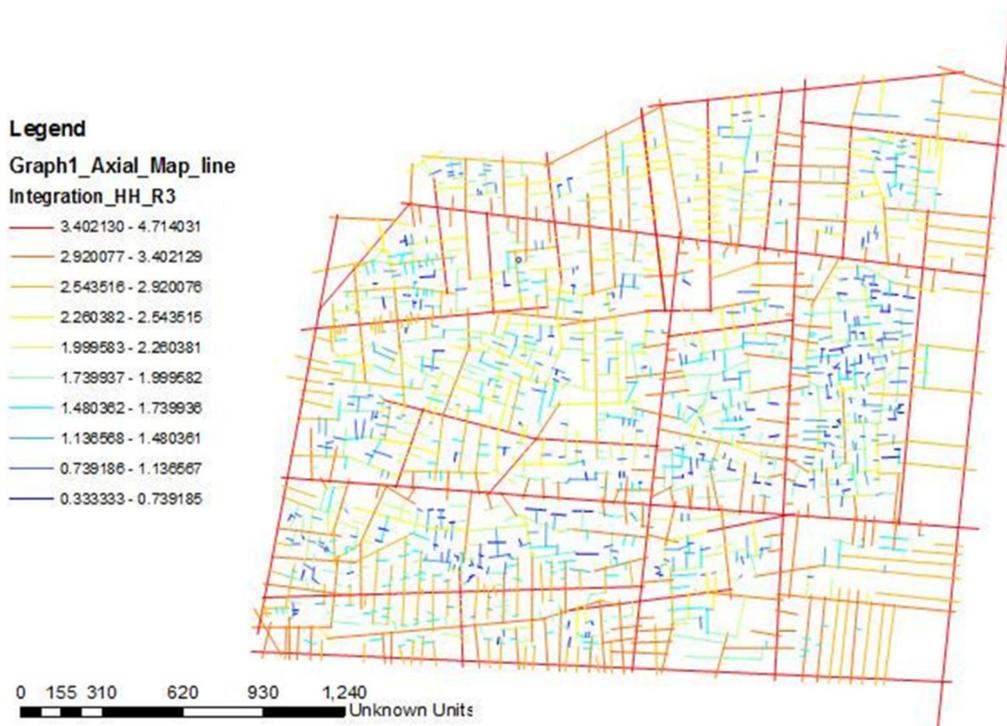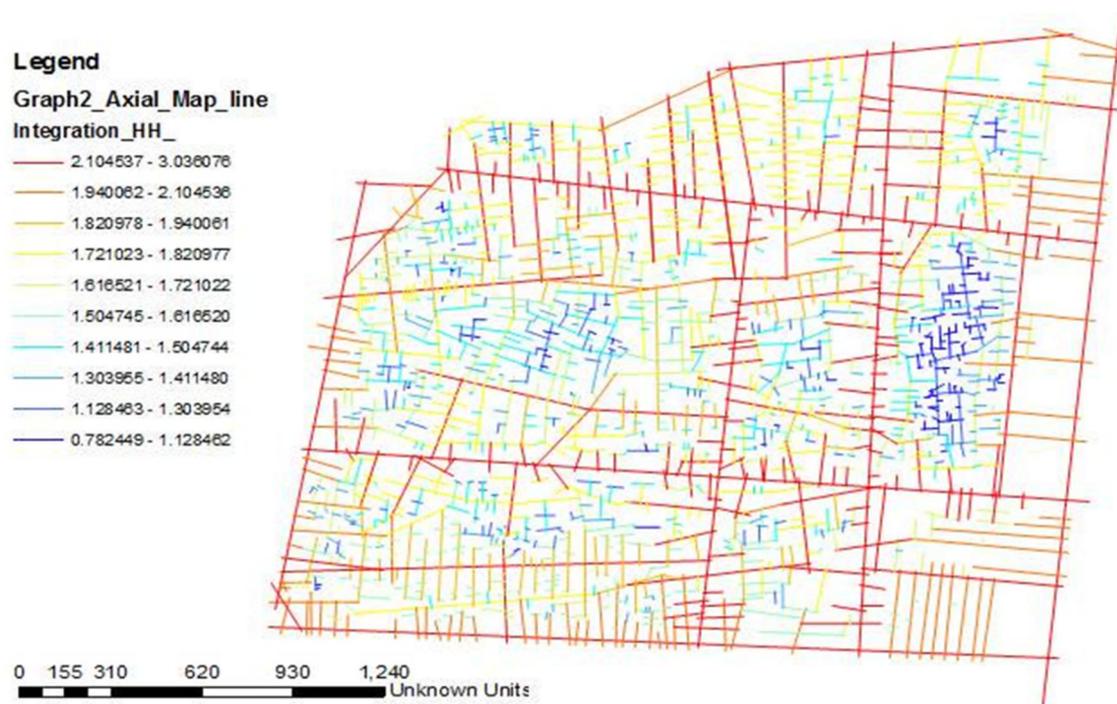

Fig. 12. Space Syntax Analysis on the Alternative no.2 with a Movement Radius of 3

4.5   EVALUATION OF DESIGN ALTERNATIVES BASED ON SPACE SYNTAX TECHNIQUE ANALYSES

Table 2. The Mean Values Obtained for the Integration for the Design Alternatives of the Area and the Sangtarashha Axis

	Mean Value of Global Integration (Integration Rn)		Mean Value of Local Integration (Integration R3)	
	Whole Area	***Sangtarashha* Axis**	**Whole Area**	***Sangtarashha* Axis**
Design Alternative no.1	1.569	1.992	1.897	3.184
Design Alternative no.2	1.631	2.06	1.922	3.289

As it can be inferred from the results of the analyses, alternative no.2 enjoys a higher mean global and local integration. As a result, it is selected as the best option. In this way, an axis was selected that could be connected to the main axis with the lowest changes required. Hence, it contributes to the urban permeability, legibility or way-finding and social safety. The selected alternative enhances the functionality and vitality of the area. However, this is not sufficient and the quality of the urban space needs to be promoted. Therefore, based on mentioned criteria, this axis has been designed and its details are discussed [9].

4.6   PRESENTING DETAILED DESIGN ZONE

Detailed design for the optimal alternative has been defined from the beginning of *Sangtarashha* axis and *Shahid Rahimi* alley up to the end of the axis (its intersection with *Vahid* Street). It is noteworthy that the goal of this research is to promote the quality of the end section of the axis [2].

Fig. 13. Presenting Detailed Design Zone

Proposed Design
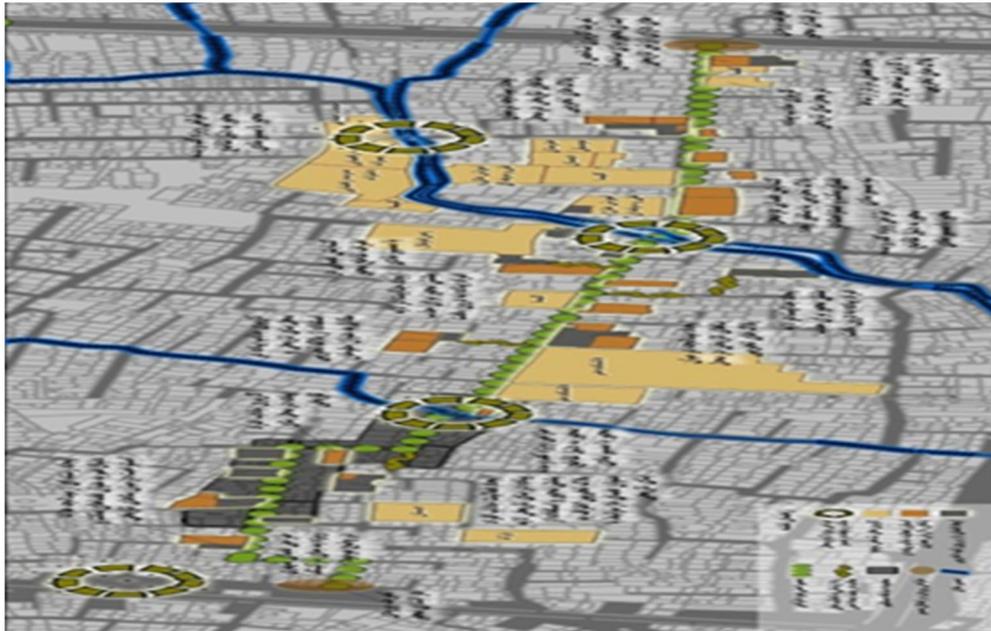
Fig. 14.   The Proposed Plan for the Design Zone

Fig. 15.   The Area after Direct Intervention

5   CONCLUSION

Having a valuable historical background, Isfahan's Jolfa neighborhood is of unique and distinctive attributes as evidenced by 13 churches existed in this neighborhood. Having various cultural functions besides providing localized and globalized services, this neighborhood acts as a tourist attractor or magnet. Old houses with a change in their applications are functioning at best. The existence of small nodes and squares in the neighborhood with service centers all around them is one of the extant historical attributes of this neighborhood with high rate of pedestrian movement.

Unfortunately, like other historical neighborhoods, Jolfa neighborhood has experienced new transformations and alternations among which construction of new streets without paying attention to the remained historical axes, inappropriate bodily changes, not identification of the status of the historical axes and their cutting can be mentioned. Given the obtained analyses, *Sangtarashha* axis is the strongest historical axis of Jolfa neighborhood embedding significant local and global functions. Besides, it is clear from the results of space syntax technique analysis that the first half of this axis has a greater integration with other spaces of the fabric, while the second half is of a lower integration. Given the high potentialities existing within it, it seems necessary to devise some strategies to improve the connectivity of this axis with other urban spaces. This can be attributed to the fact that the status of a space in the macro-structure of the city is the primary factor which has a bearing on the entrance of the pedestrian as well as tourists into an urban space.

Using space syntax technique and integration analysis, the present research tried to render a design for pedestrianway for the Jolfa neighborhood with the purpose of promoting its integration. The greater the degree of integration, the higher visibility, accessibility and pedestrian movement rate in the selected route. This, in turn, is accompanied by an increase in the tourist attraction. Furthermore, tourists' requirements in the urban space have been taken into account in the design, some of which are as follows: giving consideration to climatic comfort, welfare facilities' flexibility at different times, to the space's attractive functions on suitable intervals in the urban spaces and passways and variety and diversity of the activities, to the roads and appropriate accessibilities to and from the space, to the cleanliness and beauty of the view given the audience's desires, etc. These are all among parameters which are effective for promoting the quality of pedestrian-based urban space leading to the continuity of tourists' attraction to the urban space. Accordingly, a design was presented for promoting the quality of pedestrian urban space [4, 5, 6].

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Impact de *Phoma sabdariffae* Sacc. sur quelques paramètres de la fructification des cultivars de roselle (*Hibiscus sabdariffa* l. var. *sabdariffa*) au Gabon

[*Phoma sabdariffae's* impact on roselle (*Hibiscus sabdariffa* l. var. *sabdariffa*) fructification parameters in Gabon]

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ABSTRACT: *Phoma sabdariffae* Sacc. (Sphaerioidaceae) is the main pathogenic fungus agent of roselle (*Hibiscus sabdariffa* L. var. *sabdariffa*), in Gabon. It does induce wet rot on every part of the infected plant's organs. This work was initiated to evaluate in greenhouse the impact of this pathogenic fungus agent on 13 roselle cultivars through the study of some morphological and biochemical parameters of the fruits. Morphological parameters evaluated have been fruit's number, weight and contamination rate. Concerning biochemical study, parameters measured have been roselle fruit's acidity, proteins and phenolics compounds levels. The results revealed that excepted 3 cultivars VV1, RV1 and RR1, *Phoma sabdariffae* caused significant decrease in the fruits number and weight of most of the roselle's cultivars. The decrease rates have been higher than 60% and 20% respectively. The improvement in acidity, protein and phenolics compounds levels were not significant, in contrary to those of the 3 cultivars above mentioned. In these 3 roselle's cultivars, biochemical parameters (pH, oxalic acid, ascorbic acid, proteins and phenolics compounds) levels have been superior to 20%. This work showed the disastrous impact of this fungus on the roselle's fructification and revealed that, some of the cultivars of roselle bright develop resistance mechanisms against *Phoma sabdariffae*.

KEYWORDS: *Phoma sabdariffae*, roselle, fruits, disease, morphology, biochemistry.

RESUME: *Phoma sabdariffae* Sacc. (Sphaerioidaceae) est le principal agent pathogène de la roselle (*Hibiscus sabdariffa* L. var. *sabdariffa*), au Gabon. Son action se traduit par une induction de pourriture humide sur tous les organes de la plante infectée. Le présent travail a été initié pour évaluer en serre l'impact de ce champignon sur la fructification de 13 cultivars de cette plante, à travers l'étude de quelques paramètres morphologiques et biochimiques des fruits produits. Les éléments morphométriques étudiés étaient : le nombre, la masse et la contamination des fruits. Au niveau biochimique, les paramètres évalués étaient l'acidité des fruits et leur teneur en protéines extractibles et en composés phénoliques. Les résultats obtenus ont révélé qu'à l'exception de 3 cultivars VV1, RV1 et RR1, *Phoma sabdariffae* provoquait des réductions significatives du nombre et des masses des fruits produits par l'ensemble des cultivars de roselle. Les taux de ces baisses ont été supérieures respectivement à 60% et à 20%. Les hausses d'acidité et des composés protéiques et phénoliques n'ont pas été significatives, sauf pour les 3 cultivars précités. Dans ces dernières plantes, les augmentations de teneur de ces éléments ont dans l'ensemble dépassé le seuil de 20%. Ces résultats traduisent l'impact néfaste de ce champignon sur la fructification, et l'existence de quelques mécanismes de résistance naturelle chez certains cultivars.

MOTS-CLEFS: *Phoma sabdariffae*, roselle, fruits, maladie, morphologie, biochimie.

Impact de *Phoma sabdariffae* Sacc. sur quelques paramètres de la fructification des cultivars de roselle (*Hibiscus sabdariffa* l. var. *sabdariffa*) au Gabon

1   INTRODUCTION

Phoma sabdariffae Sacc. est un champignon Deutéromycète de la famille des Sphaerioidaceae (ou Phomaceae). Il est principalement connu au Gabon pour son agressivité vis-à-vis de la roselle (*Hibiscus sabdariffa* L. var. *sabdariffa*, Malvaceae), une plante maraîchère sur laquelle il occasionne de sévères lésions nécrotiques [1]. La maladie engendrée par cet agent est une pourriture humide qui affecte aussi bien les feuilles que les tiges, les fleurs et les fruits, et conduit à des pertes de production et de valeur marchande de la plante infectée. Si la pathogénicité de ce champignon est aujourd'hui incontestée, les travaux de quantification des dégâts liés à son agressivité font encore défaut. C'est pour cette raison que notre laboratoire a initié une série de travaux en vue d'évaluer l'impact de cet agent sur la croissance et le développement des cultivars contaminés de roselle. Les premiers résultats ont permis de conclure que *Phoma sabdariffae* induisait de fortes réductions des croissances longitudinales et radiales, pouvant dépasser des valeurs de 30%, chez certains cultivars [2]. Dans le présent travail nous nous proposons d'étudier l'effet perturbant de ce champignon sur le développement des mêmes cultivars de roselle, à travers l'évaluation de quelques paramètres morphologiques (nombre, masse et contamination) et biochimiques (acidité, teneurs protéiques et phénoliques) des fruits produits.

2   MATERIEL ET METHODES

2.1   MATERIEL

Le matériel utilisé comprenait un champignon pathogène, *Phoma sabdariffae* Sacc., un *fongi imperfecti* de la famille des Sphaerioidaceae, et 13 cultivars de roselle (*Hibiscus sabdariffa* L. var. *sabdariffa*, Malvaceae), différents les uns des autres par la forme, la taille et la couleur des tiges et des feuilles. Ces différences morphologiques nous ont alors permis de les codifier de la manière suivante : VV1, VV2, VV3, VV4, VV5, VR, RV1, RV2, RV3, RV4, RV5, RR1 et RR2 [3].

2.2   METHODES

2.2.1   CULTURE ET INOCULATION DES PLANTES

Des semences de roselle provenant des greniers de l'Université de Sciences et Techniques de Masuku (USTM) ont été stérilisées par trempage pendant 5 min. dans 1 dm^3 d'une solution de H$_2$PO$_4$, et mises à germer dans des sacs plastiques contenant 30 kg de terre fertile de texture argilo limoneuse. Dix sacs de culture ont ainsi été constitués par cultivar ; ce qui a correspondu à un échantillonnage global de 130 sacs pour l'ensemble des 13 cultivars étudiés. Les cultures ont ensuite été placées dans une serre en polyéthylène étanche et transparent de dimensions 15 x 10 x 2,5 m^3, et arrosées quotidiennement (chacune) avec 1 dm^3 d'eau distillée stérile. Les inoculations ont été effectuées après 7 j. de culture, par pulvérisation (Atomiseur type Desaga Sprayplast) d'une suspension sporale de *Phoma sabdariffae* concentrée à 10^6 spores/ml [1]. Une seconde serre identique à la première, mais hébergeant des plantes non inoculées a été construite pour servir de témoin. Les conditions atmosphériques en vigueur dans cette zone sont de type équatorial, avec des températures moyennes de 26,8 °C, des humidités relatives de 93% et des photopériodes de 12h/12h. Tous les paramètres morphologiques et biochimiques ont été évalués uniquement sur des fruits sélectionnés, âgés de 2 semaines au 120e jour.

2.2.2   MESURE DES PARAMÈTRES MORPHOLOGIQUES

2.2.2.1   BAISSE DE FRUCTIFICATION

La baisse de fructification (BF) de chaque cultivar a été calculée au 120e jour de culture par la formule suivante :

$$BF = \frac{FT - FE}{FT} \text{ x } 100 \tag{1}$$

Où Ft est le nombre total de fruits de chaque cultivar dans la serre témoin (plantes non inoculées), et Fe le nombre total de fruits de chaque cultivar dans la serre essai (plantes inoculées)

2.2.2.2   PERTE DE MASSE DES FRUITS

L'étude de la perte de masse a été réalisée sur des fruits âgés de 2 semaines, au 120e jour, à raison de 50 fruits par cultivar. Les échantillons ont été récoltés à l'aide d'un sécateur manuel (Gardena BP 10 Premuim, UK), et pesés sur une

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balance de précision (Ohaus Analytic 60, USA). Les réductions de masse ont été calculées par rapport aux fruits témoins selon le modèle d'équation présenté à la formule (1).

2.2.2.3 TAUX DE CONTAMINATION DES FRUITS

Pour évaluer le taux de contamination (TC) des fruits (âgés de 2 semaines, au 120e jour) de chaque cultivar, une échelle de cotation (variant entre 0 et 5) de la sévérité de la maladie a été utilisée. Le taux de contamination a été déterminé à l'aide de la formule suivante [2].

$$TC = \frac{\Sigma(Xi-1)ni}{[E(Xi)-1]\,N} \text{ x } 100 \qquad\qquad Avec ; \qquad\qquad\qquad (2)$$

Xi : Note de la maladie par fruit
ni : Effectif de la catégorie Xi
N : Nombre total de fruits observés
E(Xi) : Etendue de l'échelle.

2.2.3 ETUDE DES PARAMÈTRES BIOCHIMIQUES

2.2.3.1 MESURE DE LA VARIATION DE L'ACIDITE

- Extraction des acides organiques

Pour extraire les acides organiques de la roselle, 100 g des calices de fruits (âgés de 2 semaines, au 120e jour) de chaque cultivar, préalablement rincés avec 1 L d'eau distillée stérile, ont été broyés à l'aide d'un mixer (Waring Blendor 1L, Italy) pendant 5 min. à 20 000 rpm. Le broyât a ensuite successivement été filtré sur papier Wathman n°2, et sur filtre millipore de 0,2 mm de diamètre [4]. Pour chaque cultivar, 2 extraits (essai et témoin) ont été préparés.

- Mesure du pH des extraits

Les pH des extraits de roselle (essais et témoins) ont été mesurés, à l'aide d'un appareil pH-mètre (Cyberscan Eutech Instruments, Singapour). Pour chaque extrait, 25 ml de chaque solution ont été utilisés, et les taux de variation calculés selon le modèle de l'équation (1).

- Dosage de l'acide ascorbique

L'acide ascorbique a été dosé par les techniques iodométriques [5]. Pour cela, 25 ml de chaque filtrat (essai et témoin), préalablement mélangé à 1 mg d'empois d'amidon et stabilisé avec 5 gouttes d'acide phosphorique 98%, ont été titrés par une solution de diiode 0,5 M, jusqu'à l'apparition d'une coloration bleu-noire. Les teneurs en acide ascorbique des filtrats (essai et témoin) ont été déterminées par stoechiométrie, et leurs variations calculées par analogie à l'équation (1).

- Dosage de l'acide oxalique

L'acide oxalique des calices de roselle a été dosé par manganimétrie [6]. 25 ml des filtrats ont pour cela été titrés par une solution acidifiée de KMnO4, de concentration 0,1 M, jusqu'à la décoloration. Les teneurs en acide oxalique de chaque extrait (essai et témoin) ont été déterminées par stoechiométrie, et leurs variations calculées sur le modèle de l'équation (1).

2.2.3.2 VARIATION DES TENEURS PROTÉIQUES EXTRACTIBLES

Pour mesurer la variation des teneurs protéiques en réponse à l'infection parasitaire, 5 g de calices fraîches (âgés de 2 semaines, au 120e jour) de chaque cultivar ont été broyés dans 10 ml de tampon phosphate 0,1M, pH 6,5 en présence de 0,5 g de PVP, et centrifugés pendant 15 min. à 15 000 rpm. Le surnageant a été récupéré dans un bécher, précipité avec 5 ml de sulfate d'ammonium 80%, et à nouveau centrifugé comme précédemment. Le culot protéique obtenu a été repris dans 5 ml de tampon d'extraction, homogénéisé et dosé par réaction au bleu de Coomassie [7]. Les taux de variation protéique (en %) des fruits ont été calculés par rapport aux teneurs (exprimées en mg de protéines/g de matière fraîche) des plantes témoins, sur le modèle de l'équation (1).

2.2.3.3 MESURE DE LA VARIATION DES TENEURS EN COMPOSES PHENOLIQUES

La teneur en composés phénoliques des fruits (âgés de 2 semaines, au 120e jour) de roselle a été déterminée à partir de 5 g de calices prélevés sur chaque cultivar. Le matériel végétal a été broyé au mortier, incubé pendant 24 h à 4 °C et centrifugé pendant 15 min. à 15 000 rpm. Les extraits phénoliques ont été dosés selon les techniques de Folin et Ciocalteu [8], et les variations de teneur déterminées par analogie à l'équation (1).

2.2.4 RÉPÉTITIONS ET ANALYSES STATISTIQUES

Toutes les expériences décrites dans ce travail ont été répétées 3 fois, et les données récoltées soumises à une analyse de variance au logiciel Statistica 6.0. Les différentes moyennes ont été discriminées par les tests de comparaisons multiples de Newnan-Keuls, au seuil de 5%.

3 RÉSULTATS

3.1 EFFETS DE *PHOMA SABDARIFFAE* SUR LA FRUCTIFICATION DES CULTIVARS DE ROSELLE

Les résultats de l'action de *Phoma sabdariffae* sur la fructification de différents cultivars de roselle ont été résumés à la figure 1. Leur analyse a révélé que ce champignon provoquait des baisses généralisées des quantités de fruits produits par tous les cultivars. Ces réductions ont relativement été faibles chez les cultivars VV1 (20%), RV1 (17%) et RR1 (19%), mais significativement élevées chez les 10 autres cultivars (Tableau I). Les impacts les plus sévères ont été notés chez les cultivars VV2 (61%), RV2 (60%) et RR2 (60%). L'analyse comparative de ces baisses a montré que les valeurs des cultivars VV1, RV1 et RR1, n'étaient pas statistiquement différentes entre elles, mais se sont avérées toutes significativement inférieures à celles des autres plantes (Tableau II).
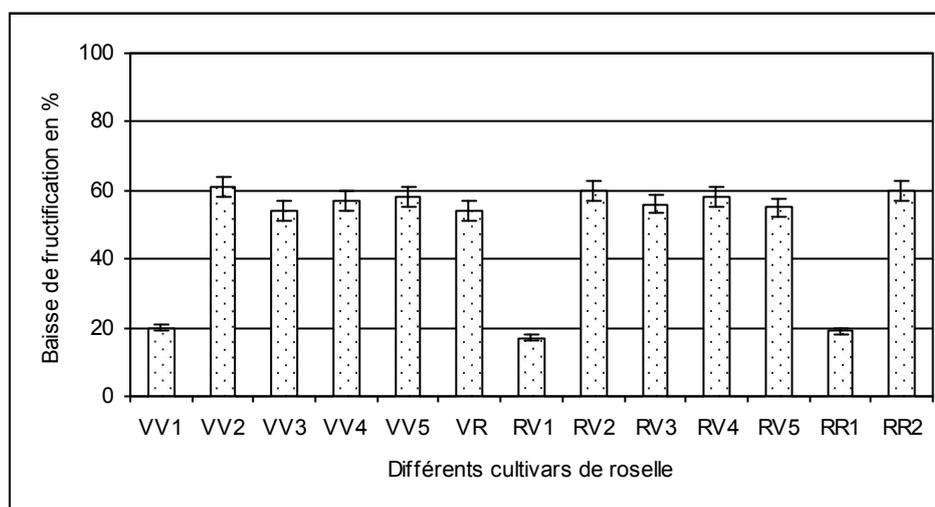

Fig. 1. *Baisse de la quantité de fruits produits en serre par différents cultivars de roselle, après 4 mois d'infection à Phoma sabdariffae*

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Tableau 1.   **Impact de Phoma sabdariffae sur la production des fruits de différents cultivars de roselle en serre.**

Cultivars	Nombre de fruits essai	Nombe de fruits témoin	Variation (%)
VV1	240 ± 2,5 a	300 ± 2,3 a	20
VV2	125 ± 3,4a	320 ± 3,1b	61
VV3	151 ± 3,1a	330 ± 3,2b	54
VV4	135 ± 2,4a	314 ± 2,6b	57
VV5	136 ± 1,8a	324 ± 1,3b	58
VR	141 ± 1,6a	306 ± 2,0b	54
RV1	287 ± 2,5a	346 ± 2,1a	17
RV2	125 ± 3,2a	312 ± 3,0b	60
RV3	140 ± 3,0a	318 ± 2,6b	56
RV4	128 ± 2,4a	304 ± 2,2b	58
RV5	142 ± 3,2a	316 ± 3,1b	55
RR1	270 ± 2,3a	334 ± 2,5a	19
RR2	129 ± 2,1a	322 ± 2,6b	60

Pour chaque cultivar, les moyennes du nombre de fruits suivies de la même lettre ne sont pas significativement différentes entre l'essai et le témoin, au seuil de 5%.

Tableau 2.   **Comparaison des baisses de productions des fruits de différents cultivars de roselle infectés par Phoma sabdariffae en serre**

STAT. STAT. ELEMENT. — Test Newman-Keuls; Variable: VAR2 (base stat.sta)
Différences significatives marquées à p < ,05000

VAR1		{1} M=20,000	{2} M=61,000	{3} M=54,000	{4} M=57,000	{5} M=58,000	{6} M=54,000	{7} M=17,000	{8} M=60,000	{9} M=56,000	{10} M=58,000	{11} M=55,000	{12} M=19,000	{13} M=60,000
VV1	{1}		,000188*	,000146*	,000133*	,000143*	,000129*	,172132	,000162*	,000134*	,000140*	,000169*	,541863	,000149*
VV2	{2}	,000188*		,006400*	,169022	,271679	,005317*	,000149*	,541863	,062045	,365545	,019158*	,000142*	,811534
VV3	{3}	,000146*	,006400*		,365545	,210017	1,000000	,000169*	,023395*	,609957	,169022	,811534	,000129*	,019158*
VV4	{4}	,000133*	,169022	,365545		,811534	,271679	,000143*	,365545	,541863	,541863	,442960	,000140*	,271679
VV5	{5}	,000143*	,271679	,210017	,811534		,169022	,000162*	,442960	,609957	1,000000	,365545	,000149*	,227376
VR	{6}	,000129*	,005317*	1,000000	,271679	,169022		,000134*	,019158*	,442960	,128045	,541863	,000169*	,015170*
RV1	{7}	,172132	,000149*	,000169*	,000143*	,000162*	,000134*		,000142*	,000140*	,000149*	,000133*	,227376	,000188*
RV2	{8}	,000162*	,541863	,023395*	,365545	,442960	,019158*	,000142*		,169022	,609957	,062045	,000188*	1,000000
RV3	{9}	,000134*	,062045	,609957	,541863	,609957	,442960	,000140*	,169022		,442960	,541863	,000133*	,128045
RV4	{10}	,000140*	,365545	,169022	,541863	1,000000	,128045	,000149*	,609957	,442960		,271679	,000143*	,442960
RV5	{11}	,000169*	,019158*	,811534	,442960	,365545	,541863	,000133*	,062045	,541863	,271679		,000134*	,048014*
RR1	{12}	,541863	,000142*	,000129*	,000140*	,000149*	,000169*	,227376	,000188*	,000133*	,000143*	,000134*		,000162*
RR2	{13}	,000149*	,811534	,019158*	,271679	,227376	,015170*	,000188*	1,000000	,128045	,442960	,048014*	,000162*	

3.2 EFFETS DE *PHOMA SABDARIFFAE* SUR LA MASSE DES FRUITS DES CULTIVARS DE ROSELLE

L'étude de l'action de *Phoma sabdariffae* sur la masse des fruits des cultivars de roselle a donné les résultats présentés à la figure 2. De leur analyse, il est ressorti que cet agent pathogène induisait des pertes significatives de masse des fruits de roselle étudiées, à l'exception des cultivars VV1 (10%), RV1 (12%) et RR1 (11%). Les plantes les plus affectées ont été VV2 (31%), RV2 (32%) et RR2 (32%). L'analyse comparative de ces perturbations a montré que les baisses de masse des cultivars VV1, RV1 et RR1 (statistiquement non différentes entre elles), étaient significativement inférieures à celles des 10 autres cultivars étudiés.
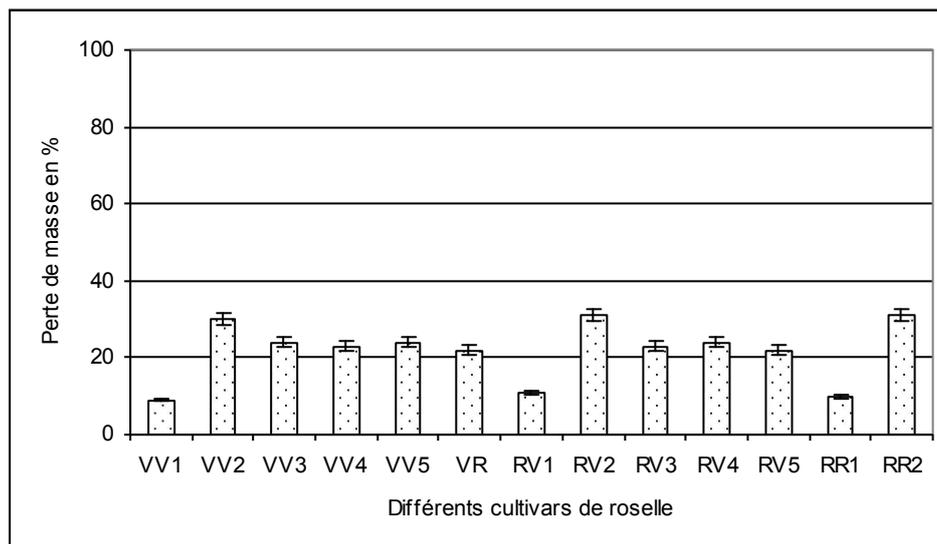
Fig. 2. Perte de masse des fruits produits en serre par différents cultivars de roselle, après 4 mois d'infection à Phoma sabdariffae

3.3 CONTAMINATION DES FRUITS DE ROSELLE

Les résultats de l'étude du pouvoir infectieux de *Phoma sabdariffae* sur les fruits de roselle ont été résumés à la figure 3. Leur examen a montré que ce champignon infectait significativement les fruits de tous les cultivars étudiés, à l'exception de VV1 (18%), RV1 (21%) et RR1 (19%). Les échantillons les plus contaminés étaient majoritairement constitués des fruits issus des cultivars VV2 (81%), RV2 (86%) et RR2 (79%). La comparaison de ces divers taux de contamination fongique a montré que les affections des cultivars VV1, RV1 et RR1 (non différentes entre elles) étaient significativement inférieures à celles des 10 autres cultivars.

Fig. 3. Taux de contamination des fruits produits en serre par différents cultivars de roselle, après 4 mois d'infection à Phoma sabdariffae

3.4 EFFET DE *PHOMA SABDARIFFAE* SUR L'ACIDITE DES FRUITS DE ROSELLE

Les résultats de ce travail ont montré que les différents cultivars de roselle infectés par *Phoma sabdariffae* présentaient une plus grande acidité que les plantes témoins (figure 4). Les taux de pH et des acides ascorbique et oxalique ont alors été

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plus élevés chez ces plantes que chez les témoins. Ces augmentations ont toutefois été faibles chez l'ensemble des cultivars, avec des pH inférieurs à 16%, et ne se sont révélées significatives que chez les formes VV1 (34%), RV1 (33%) et RR1 (32%). Les acides ascorbique et oxalique ont présenté les mêmes tendances évolutives. La comparaison de ces élévations, pour les 3 indicateurs d'acidité sus-évoqués, a montré que dans chaque cas, leurs valeurs chez les 3 cultivars précités n'étaient pas statistiquement différentes entre elles, mais se sont révélées significativement supérieures à celles de toutes les autres plantes.

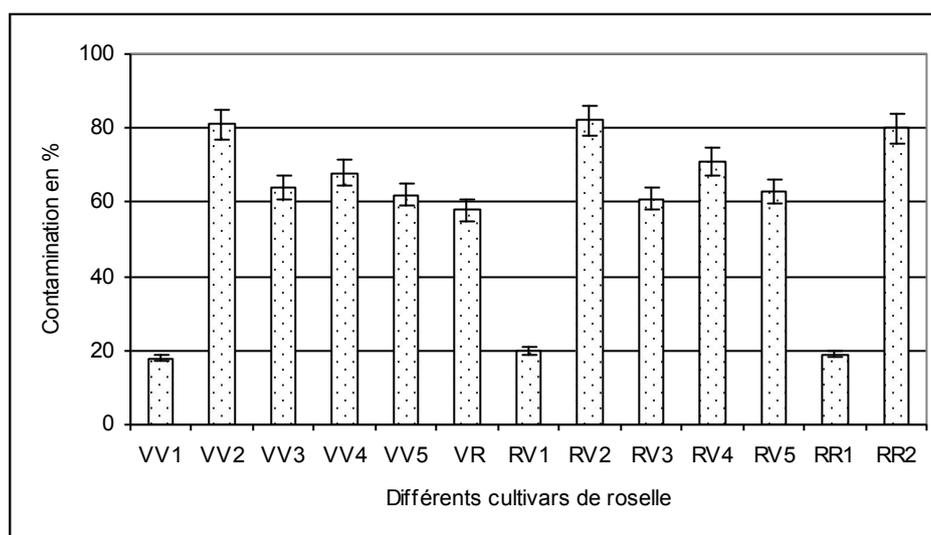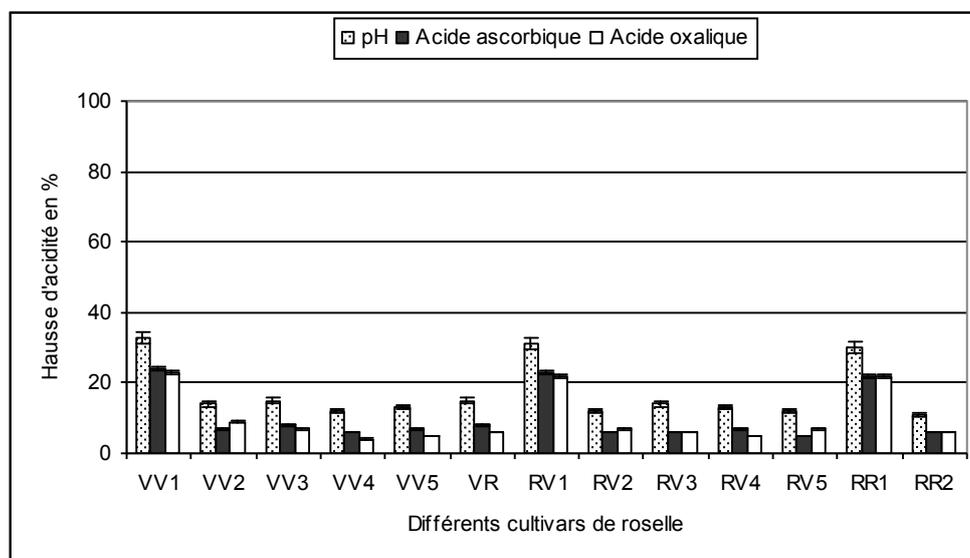**Fig. 4.   Elévation du taux d'acidité des fruits produits en serre par différents cultivars de roselle, après 4 mois d'infection à Phoma sabdariffae**

3.5   EFFET DE *PHOMA SABDARIFFAE* SUR LA TENEUR DES PROTEINES DES FRUITS DE ROSELLE

Les résultats de l'effet pathogène de *Phoma sabdariffae* sur les teneurs protéiques des fruits de différents cultivars de roselle ont été rapportés à la figure 5. Ils indiquent, de façon générale, que l'infection parasitaire de ce champignon induit une augmentation variable de teneurs protéiques des plantes de roselle. Les hausses les plus significatives ont été observées chez les cultivars VV1 (38%), RV1 (42%) et RR1 (40%). L'étude statistique a montré que ces 3 plantes constituaient un groupe distinct aux valeurs protéiques élevées, et significativement supérieures à celles des autres cultivars.
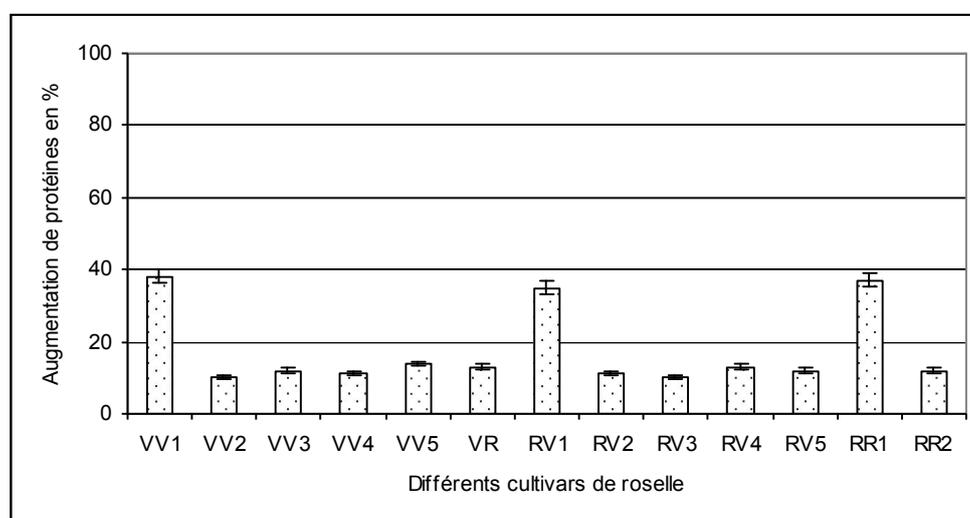

Fig. 5.   Elévation du taux de composés protéiques des fruits produits en serre par différents cultivars de roselle, après 4 mois d'infection à Phoma sabdariffae

3.6 EFFET DE *PHOMA SABDARIFFAE* SUR LES COMPOSES PHENOLIQUES DES FRUITS DE ROSELLE

La synthèse des résultats de l'effet de *Phoma sabdariffae* sur les composés phénoliques a été présentée à la figure 6. Elle permet de noter que l'infection engendrée par ce pathogène provoque une augmentation de la teneur des composés phénoliques dans tous les fruits des cultivars étudiés. Les élévations les plus significatives ont été observées chez les cultivars VV1 (38%) RV1 (40%) et RR1 (37%). L'étude comparative a montré que les élévations de composés phénoliques de ces 3 cultivars étaient significativement supérieures à celles des 10 autres plantes étudiées.
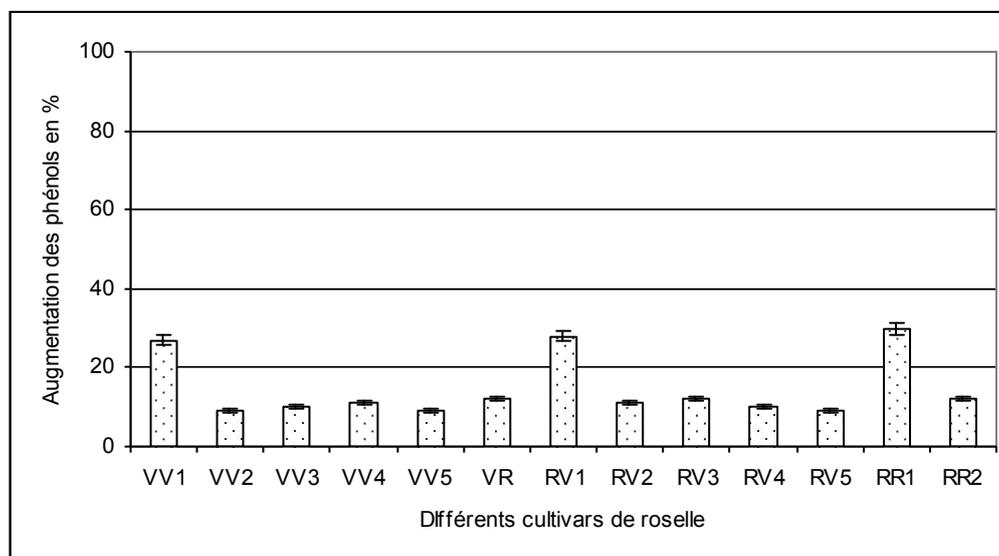

Fig. 6. Hausse du taux de composés phénoliques des fruits produits en serre par différents cultivars de roselle, après 4 mois d'infection à Phoma sabdariffae

4 DISCUSSION

Les résultats de ce travail ont révélé les baisses significatives du nombre et de la masse de fruits des plantes de roselle infectées, à l'exception des cultivars VV1, RV1 et RR1. Ces réductions sont vraisemblablement liées à la pression parasitaire exercée par *Phoma sabdariffae*, qui perturbe les mécanismes physiologiques de croissance et de développement des plantes de roselle [2]. L'action de ce champignon provoquerait une baisse de la floraison, l'abscission des fleurs et des fruits, et plusieurs autres phénomènes de stress conduisant à la baisse du nombre et de la masse des fruits produits. Chez les cultivars VV1, RV1 et RR1, cet impact serait limité, par la mise en place des mécanismes internes de résistance, comme l'ont suggéré [4]. Des effets similaires ont déjà été rapportés chez quelques espèces de soja résistantes à *Phytophtora megasperma* par Lepoivre et Semal [9].

Les résultats de cette étude ont également révélé une forte contamination des fruits de tous les cultivars de roselle étudiés, à l'exception de VV1, RV1 et RR1. De tels résultats, qui sont l'expression d'une forte pathogénicité, pourraient être liés à la forte dynamique de croissance et de propagation de ce champignon révélée par Mouaragadja et M'batchi [10]. Ces auteurs ont, en effet, montré que *Phoma sabdariffae* était non seulement capable de défolier une plante de roselle en l'espace d'une semaine, mais aussi de coloniser la totalité de ses organes aériens : tiges, feuilles, fleurs, fruits et graines. Les fortes contaminations des fruits de certains cultivars observées dans cette étude sont donc en accord avec l'agressivité et la polyvalence d'actions de ce champignon.

Les analyses biochimiques ont révélé une augmentation générale de l'acidité des plantes en réponse à l'agression parasitaire. Ces hausses étaient particulièrement remarquables chez les cultivars VV1, RV1 et RR1. De tels résultats pourraient être l'expression d'une réaction de défense des plantes agressées, comme l'ont suggéré Geiger *et al* [11] chez certaines plantes d'hévéa. En effet, les végétaux, de façon générale, contiennent dans leur système vacuolaire, de nombreuses molécules d'acides organiques, qui sont rapidement mobilisés en cas de stress [12]. Cette action augmente la pression osmotique du cytoplasme et renforce la plasticité pariétale permettant de rehausser la capacité de résistance à l'agression extérieure. Les principaux acides déployés sont généralement le citrate, le succinate, le fumarate et l'oxalate [12]. Les augmentations des acides ascorbiques et oxaliques observées dans notre étude consolident donc cette thèse, et

Alexis Nicaise LEPENGUE, Jean Fabrice YALA, Judicaël LEBAMBA, Isaac MOUARAGADJA, Daouda KONE, and Bertrand M'BATCHI

constitueraient des stratégies de défense contribuant à l'augmentation de la résistance des plantes. Toutes ces molécules seraient plus rapidement mobilisées chez les cultivars VV1, RV1 et RR1, expliquant leurs fortes acidités, par rapport aux autres cultivars de roselle.

Les résultats de cette étude ont aussi révélé une augmentation différentielle des composés protéiques et phénoliques entre les différents cultivars de roselle. Ces hausses suggèrent une mise en place des mécanismes de défense par les plantes agressées, comme l'ont proposé Vernenghi *et al.* [13] sur les Citrus. En effet, de nombreux végétaux excrètent, en réponse à un stress biotique ou abiotique, des substances de défenses, comprenant plusieurs composés protéiques et phénoliques [14]. Les composés protéiques généralement rencontrés dans ce contexte sont les protéines PR (pathogenesis-related) et les enzymes (chitinases, catalases, peroxydases polyphénoloxydases ...) [14]. Les composés phénoliques excrétés sont également de différentes sortes : plumbagone chez *Plumbago europea* ; juglone chez le noyer ; shikonine chez *Lithospermum erythrrhizon* etc. [11].

Les différentes teneurs de ces composés biochimiques entre les cultivars VV1, RV1 et RR1 et les autres plantes pourraient être liées à la variation de leurs vitesses d'accumulation, comme l'ont proposé Akhtar *et al.*, [15], sur quelques espèces de citrus infectées par *Phytophtora* sp. Des résultats similaires ont également été rapportés par Darvill et Albersheim [16] chez la fève infectée par *Botrytis cinerea* (interaction compatible) et *Botrytis fabae* (interaction incompatible).

5 CONCLUSION

Au terme de cette étude, il ressort que *Phoma sabdariffae* affecte le développement des cultivars de roselle, par perturbation de quelques mécanismes physiologiques de la fructification. Ce qui engendre la réduction des paramètres morphologiques (nombre et masse), et l'augmentation des variables biochimiques (acidité, protéines et composés phénoliques) des fruits produits. Trois cultivars VV1, RV1 et RR1, présentent de fortes résistances aux perturbations provoquées par ce champignon. De tels résultats laissent entrevoir des possibilités d'amélioration variétale des autres cultivars, par transferts des gènes de résistance des plantes immunes vers les plantes sensibles.

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Intelligent Churn prediction for Telecommunication Industry

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ABSTRACT: Customer churn is a focal concern for most of the services based companies which have fixed operating costs. Among various industries which suffer from this issue, telecommunications industry can be considered at the top of the list. In order to counter this problem one must recognize the churners before they churn. This work develops an effective and efficient model which has the ability to predict the future churners for broadband internet services. For this purpose Genetic Programming (GP) is employed to evolve a suitable classifier by using the customer based features. Genetic Programming (GP) is population based heuristic used to solve complex multimodal optimization problems. It is an evolutionary approach use the Darwinian principle of natural selection (survival of the fittest) analogs with various naturally occurring operations, including crossover (sexual recombination), mutation (to randomly perturbed or change the respective gene value) and gene duplication. The intelligence induced in the system not only generalizes the model for a variety of real world applications but also make it adaptable for dynamic environment. Comprehensive experimentations are performed in order to validate the effectiveness and robustness of the proposed system. It is clear from the experimental results that the proposed system outperforms other state of the art churn prediction techniques.

KEYWORDS: Genetic Programming, Churn Prediction, Artificial Neural Networks, Support Vector Machines, Broadband Networks.

1 INTRODUCTION

In today's business world services based companies with fixed operational cost are recognizing that customer value and increased revenue is more likely to come from their existing customer-base than from new customer acquisition. There are several reasons why retaining existing customers is important. The first reason is that markets have become saturated to a point where new customer in the business is scarce. The second reason is cost. New customer acquisition can be costly to a business for a numerous reasons. It has been reported that the acquisition of new customers can be over ten times more costly to a business than retaining existing customers. This is largely because in saturated markets, the acquisition of new customers often involves enticing customers away from competitors through offers of expensive special deals [1].

Customer retention addresses the issue of customer churn, where churn describes the turnover of customers, and churn management describes the efforts a company makes to identify and control the problem of customer churn [2]. There are a number of contemporary techniques in literature that address this issue. Jadhav and Pawar [3] used Back Propagation neural

network algorithm for customer churn prediction. Euler [4] used Decision Tree for finding out the number of churners in near future. Radosavljevik et al. [5] proposed a churn prediction model which incorporates different outcome churn definitions in customer churn and also measure the impact of this change in definitions on the model performance. In addition, there are a variety of other hybrid intelligent techniques that explore capabilities of Artificial Neural Networks (ANN) and Decision Trees (DT) [6-9].

In order to manage customer churn within a company it is important to build an effective and accurate customer churn prediction model. Some techniques used in literature are as follows:

- Classification and regression trees (CART)
- Logistic regression models (LRM)
- Artificial neural networks (ANN)
- K-means Cluster Algorithm
- Support Vector Machine (SVM)

In this work we propose an intelligent churn prediction system based on Genetic Programming (GP). The advantage of using such technique comes from the fact that GP is able to exploit hidden dependencies in feature space that are skipped otherwise. Another benefit is that once a suitable and generalized mathematical expression is evolved through GP simulation, it can be used for future customer churn predictions.

The rest of the paper is organized as follows. Some preliminaries of churn prediction and GP are discussed in section 2. Section 3 describes the proposed GP based churn prediction technique. Experimental results are presented and discussed in section 4. Section 5 concludes this work.

2 CUSTOMER CHURN AND GENETIC PROGRAMMING

The problem of customer churn can be viewed in a number of ways. Knowing exactly what contributed to a specific customer's churn decision is far beyond the scope of a generalized research. As reported in [6], there are many contributing factors towards customer churn as shown in figure 1. From the figure it is clear that price is the main reason for customer churning in telecommunications industry.
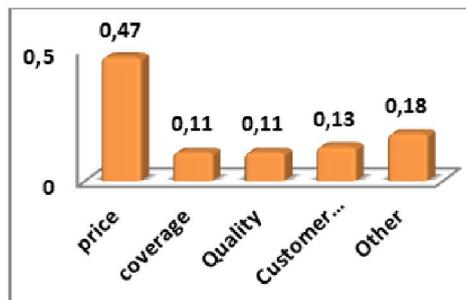

Fig. 1. Main churn contributors for the telecommunications Industry as reported in [6]

2.1 GENETIC PROGRAMMING

Genetic Programming belongs to a class of stochastic search techniques which imitate biological evolution. The process is comprised of generational search of populations. The population in each generation is evaluated using some fitness function and then numerically scored. The best individuals (candidate solutions) in a population are then passed on to the next generation by applying genetic operators namely, crossover, mutation and replication. Further information on GP can be found in [10].

3 PROPOSE INTELLIGENT CHURN PREDICTION TECHNIQUE

The features selected regarding customer attributes in our proposed scheme are listed in table 1. Due to limitations on data availability, we have considered seven features in this work. Introduction of additional features will, however, enhance the performance of the proposed system. Figure 2 shows the basic architecture of the proposed technique which comprises of training and testing modules.

Table 1. Customer Dataset fields

Field Name	Description
Age	Age of the customer.
Paid amount	Billing amount paid in a month
Net Local Calls	No. of local calls
NWD Call	No. of Nationwide calls
Local Mobile calls	No. of local mobile calls
NWD Mobile	No. of Nationwide mobile calls
OS Calls	No. of Overseas calls

3.1   GP BASED CLASSIFIER EVOLUTION

3.1.1   GP MODULE

To represent a possible solution with a GP tree, one needs to define suitable functions, terminals, and fitness criteria according to the optimization problem.
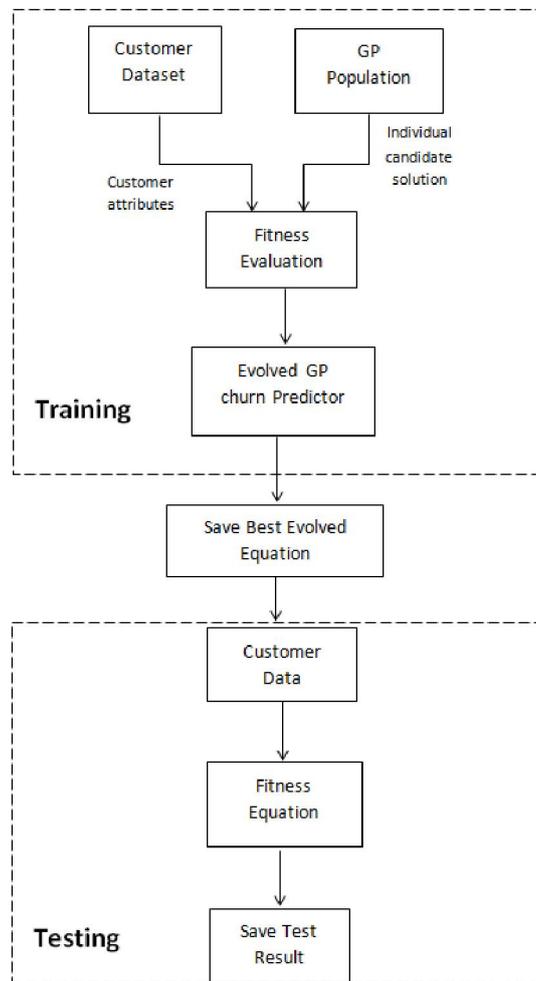

Fig. 2.   Research approach

3.1.2   BASIC FUNCTIONS USED FOR GP SIMULATION

Function set in GP is a collection of functions available to the GP system. In our GP simulations, we have used simple functions, including four binary floating arithmetic operators (+, -, *, and protected division), *LOG, EXP, SIN, COS, MAX and MIN*.

3.1.3   TERMINAL USED IN GP SIMULATION

To develop initial population of customer churn prediction the following terminals are used in GP simulation: Age, Paid amount, NET LOCAL CALLS, NWD Call, Local Mobile, NWD Mobile, and OS Calls. Their descriptions can be found in table 1.

3.1.4   FITNESS EVALUATION

In a generation, every individual candidate solution is evaluated and scored using the following algorithm based upon fitness of ith individual in GP population.

```
For i=1 to N_cust
{
      If {fitness_candidate > 0}
            Churn_Result= 1;
      Else
            Churn_Result =0;
      If {Churn_Result (XOR) Churn_ID=1}
            Fitness_i=1;
      Else
            Fitness_i=0;
      Fitness=Fitness+Fitness_i;
}
Fitness=Fitness/ N_cust;
```

Where, N_{cust} is the total number of customers. $Fitness_{candidate}$ is the evaluation of different customer features on the candidate expression. $Churn_{ID}$ is the actual churn status of a record in the training data. $Fitness_i$ is the fitness of ith record in the training data.

Fitness value corresponding to an individual candidate solution is the mean value computed against the total number of customers in the training data set, and depicts the performance of an individual candidate solution. Likewise, fitness value of every individual in a population is calculated and the process is repeated generation by generation through genetic evolution.

4   EXPERIMENTAL RESULTS

The proposed method is implemented in MATLAB version 7.0. To employ GP, we use the MATLAB-based GPLAB toolbox. In our simulations, we have used Intel Core 2 Duo 2.2 GHz processor with 2 Gb RAM. A total record size for training was 16000 customers. The training data was preprocessed with eliminating records with some missing values. After a best expression is evolved, it took only a fraction of second to make a churning decision in the testing phase.

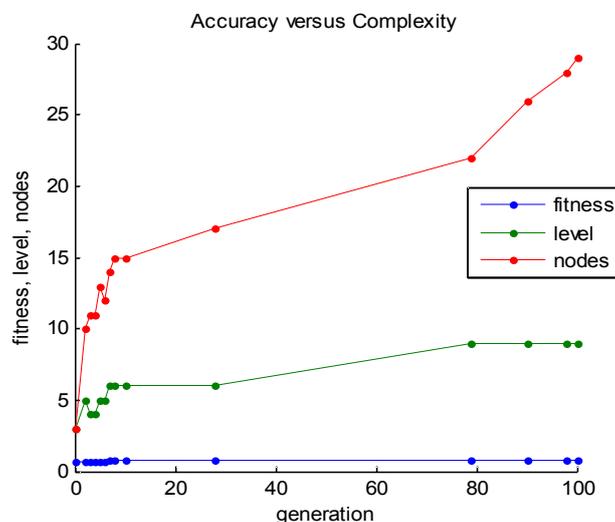### 4.1   ACCURACY VERSUS COMPLEXITY

Fig. 3.   Accuracy versus complexity produced from the GP simulation.

Accuracy versus complexity plot in figure 3 demonstrates the convergence of the algorithm towards an ideal fitness value of 1. With each generation, the complexity of the evolved GP expression also increases.

4.2 COMPARISON WITH OTHER MODELS

Figure 4 demonstrates the performance comparison of the proposed technique with other state of the art techniques presented in literature.
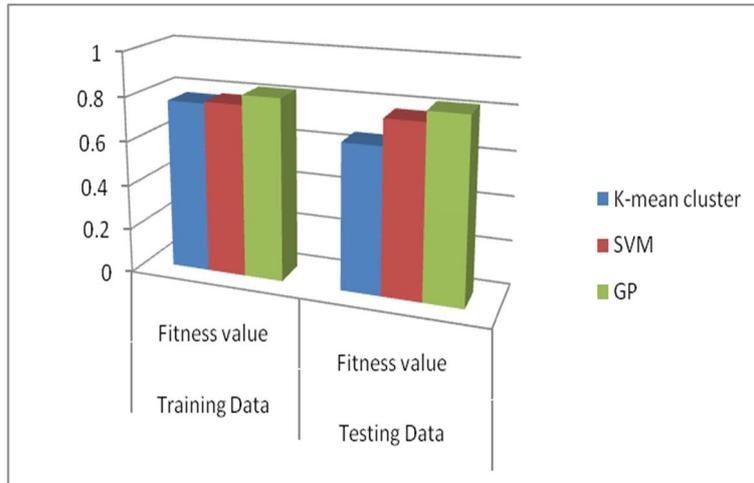
Fig. 4.   Comparison of Fitness values of different predictive models

From both training and testing it is cleared from the figure that the result of SVM is much better than K-mean cluster. On similar data, performance of GP based approach is much better than that of other two predictive models.

Figure 5 shows the performance of the proposed technique with other techniques in terms of probability of error. Again we can see the induced error in the proposed technique is much less than SVM and K-mean cluster based approaches.
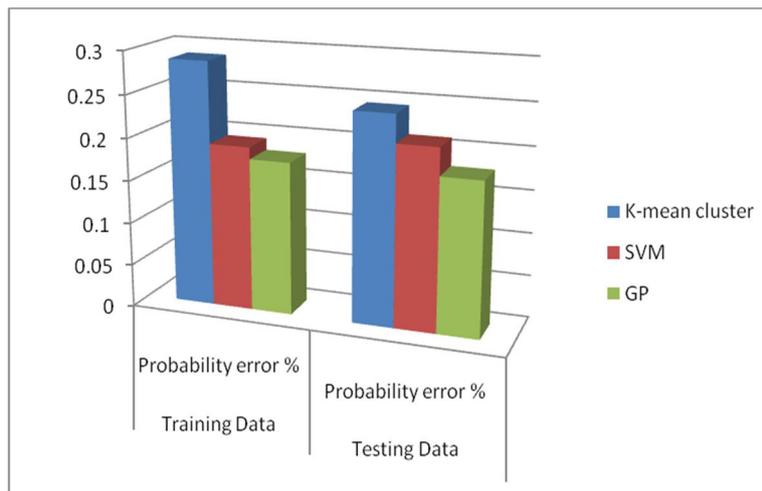
Fig. 5.   Probability error percentages for different predictive Models

5   CONCLUSION

The main objective of this research was to develop a predictive model for customer churn in service based companies which is able to distinguish between customers who are likely to churn in close futures and the ones who are stuck with the company. We used GP based predictive model which outperformed earlier approaches. As the cost of acquiring a new customer is 10 times more than retaining one, thus since the churn predictive model is capable of indicating the future

churners, the companies that are intended to maintain their customer base can focus on retention approaches instead of acquisition approaches which is clearly less costly.

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Impact of the atomic density on the uncertainty of the effective multiplication factor due to nuclear data uncertainties

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ABSTRACT: The main objective of this study is the knowledge of the impact of the atomic density on the uncertainty of the effective multiplication factor (Keff) due to the uncertainties in elastic and inelastic scattering, capture and fission cross sections. Six thermal cases of the benchmark (HEU-SOL-THERM-001) have been studied by using a recently updated nuclear data evaluation JENDL4 to calculate the sensitivity vectors for ^{1}H, ^{16}O, ^{235}U and ^{238}U isotopes. These sensitivity profiles are calculated by using the adjoint-weighted perturbation method based on the Kpert card; and we validated them with the KENO code results, with the differential operator technique of the MCNP5 code and with two nuclear data evaluations (ENDF/B-VI.8 and ENDF/B-VII.0). Kpert card is used by the Monte Carlo code MCNP6. Thus, the Keff uncertainties induced by nuclear data uncertainties have been calculated by combining the sensitivity vectors with the covariance matrices that are generated by the ERRORJ module of the recently updated of the nuclear data processing system NJOY99. This study shows that: it must the cross sections and covariance matrices adjustment of the isotopes that have the great atomic densities and it must the cross sections and covariance matrices adjustment of the fissile isotopes even if they have small atomic density in nuclear reactors.

KEYWORDS: Atomic density, cross section, Keff, sensitivity, covariance matrix, nuclear uncertainty, MCNP6.

1 INTRODUCTION

The average of neutrons from one fission that cause another fission or the effective multiplication factor (Keff) is related to the nuclear interaction probabilities (cross sections), these cross sections have the experimental uncertainties; then, these uncertainties have the effects on the Keff. Now, these experimental uncertainties are available in the covariance files, as in the JENDL4 [1] nuclear data evaluation.

The Monte Carlo code MCNP6 [2] computes the sensitivity on the Keff using the adjoint-weighted methodology [3], [4] and the ERRORJ module of the recently updated of the nuclear data processing system NJOY99 [5] process the covariance matrices. This sensitivity profiles and covariance matrices are combined in order to obtain the final uncertainties in Keff [6].

In this work, a sensitivity and uncertainty analysis is performed for certain cases of the benchmark 'HEU-SOL-THERM-001'[7], the impact of the atomic density on the total uncertainty produced by elastic, inelastic, capture and fission nuclear data on the Keff uncertainty is studied.

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2 METHODOLOGY AND STUDY APPROACH

2.1 ADJOINT-WEIGHTED TECHNIQUE

Starting from the nuclear transport equation and applying a first-order perturbation, the following expression for the change in reactivity ρ can be derived [3]:

$$\Delta\rho = -\frac{<\psi^+, P\psi>}{<\psi^+, F'\psi>} \tag{1}$$

The reactivity is related to Keff in the typical way, $\rho = \frac{(Keff-1)}{Keff}$. The angular flux in the unperturbed system is ψ and its adjoint is denoted by ψ^+. P is the operator for the perturbation taking the form: $P = \Delta\Sigma_t - \Delta S - \lambda\Delta F$. The eigenvalue λ= $\frac{1}{Keff}$, and the tree terms from left to right, are the change in the total cross section, the change in scattering operator, and the change in the fission multiplication operator. F' is the perturbed fission operator.

Monte Carlo technique can be used to sample the numerator and the denominator in continuous-energy forward calculation [4] and the change in reactivity can be estimated by taking the ratio in Eq.(1).

We express change in cross section as: $\quad \Delta\sigma_x = f\sigma_x$

We apply the relationship: $\quad \Delta K_{eff} = K_{eff}\frac{K_{eff}\Delta\rho}{1-K_{eff}\Delta\rho}$

We compute sensitivity coefficients by: $\quad S_{K_{eff},\sigma_x} \approx \frac{1}{f}\frac{K_{eff}\Delta\rho}{1-K_{eff}\Delta\rho}$

The quantity $K_{eff}\Delta\rho$ scales linearly with f; can make arbitrarily small until sensitivity becomes sufficiently precise.

2.2 STUDY APPROACH

During this study:

- We have selected a six of the criticality safety cases of the thermal benchmark 'HEU-SOL- THERM-001' from IHECSBE [8], they have different atomic densities.
- We have studied the impact of the atomic density on the effective multiplication factor uncertainty due to nuclear data uncertainties for ^{1}H, ^{16}O, ^{235}U, and ^{238}U isotopes in each selected case. The selected isotopes are generally known by their important contribution in the effective multiplication factor calculation.
- The sensitivity vectors for multiplication factor were generated by using Kpert card of MCNP6 code in 15 energy groups, are represented in (table 1).

Table 1. Fifteen energy groups used in our sensitivity and uncertainty analysis

Groups numbers	Energy groups (Mev)
1	0.00E 00 - 1.10E-07
2	1.10E-07 - 5.40E-07
3	5.40E-07 - 4.00E-06
4	4.00E-06 - 2.26E-05
5	2.26E-05 - 4.54E-04
6	4.54E-04 - 2.04E-03
7	2.04E-03 - 9.12E-03
8	9.12E-03 - 2.48E-02
9	2.48E-02 - 6.74E-02
10	6.74E-02 - 1.83E-01
11	1.83E-01 - 4.98E-01
12	4.98E-01 - 1.35E00
13	1.35E00 - 2.23E00
14	2.23E00 - 6.07E00
15	6.07E00 - 19.60E00

- The covariance matrices generated by ERRORJ module of the NJOY99 processing system based on the same discretization of the sensitivity energy. Results for ^{1}H are based on JENDL3.3 [1] data since JENDL4 does not contain uncertainty information for this isotope. The values of the covariance were computed for fifteen energy groups mentioned above by using a weighting flux that corresponds to the $1/E$ + fission spectrum + thermal maxwellian shape. For all cases, an infinite dilution condition was assumed ($\sigma_0=1 \cdot 10^{10}$ barns) and the temperature was considered to be 300K.
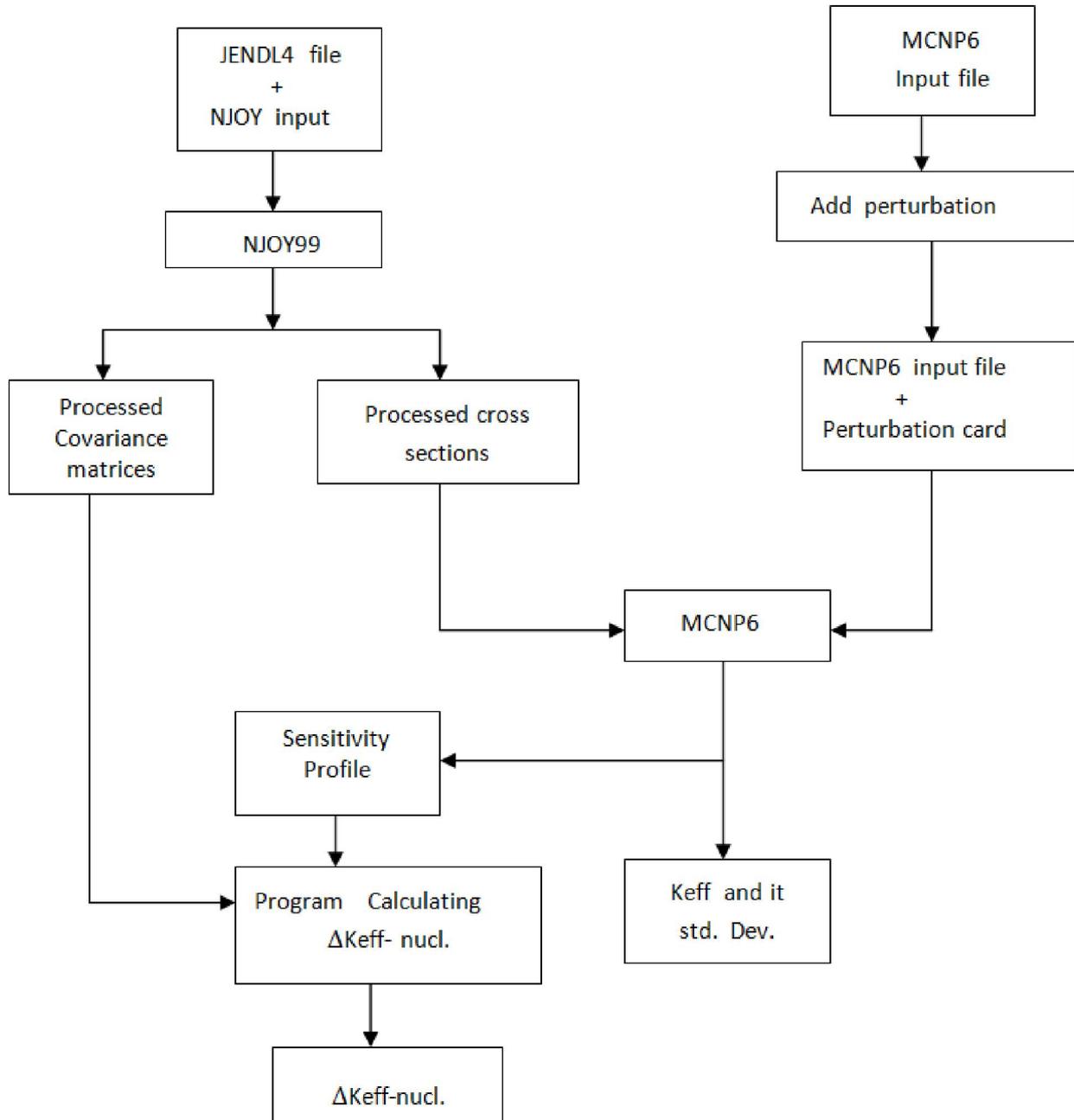- The steps adopted in this study are presented in fig.1.

Fig. 1.   flowchart of the uncertainty calculation by MCNP6 and NJOY99 codes

- The perturbation approach is generally based on the NJOY99 processing system, the MCNP6 code and the program for calculating the total uncertainty produced by nuclear data (ΔKeff-nucl.).
- Inputs are the MCNP6 input file and JENDL4 file containing the matrices of covariances. As shown in fig.1, JENDL4 file is processed by NJOY99 in order to produce cross sections in the ACE format and covariance matrices used by program for calculating ΔKeff–nucl. .
- The sensitivity vectors were calculated by using the most commonly used radiation transport code MCNP6. The sensitivity profiles $S_{Keff,\sigma_{x,g}}$ are defined as the relative change in a response Keff(the effective multiplication factor) with respect to cross section σ_x in a particular energy group g, is defined as:

$$S_{Keff,\sigma_{x,g}} = \frac{\sigma_{x,g}}{Keff}\frac{\Delta Keff}{\Delta\sigma_{x,g}} \approx \frac{1}{f}\frac{K_{eff}\Delta\rho}{1-K_{eff}\Delta\rho} \qquad (2)$$

- The sensitivity profile $S_{Keff,\sigma_{x,g}}$ was obtained by using the perturbation option of MCNP6 that is defined in Kpert card by using the first-order perturbation by the adjoint- weighted technique.
- The cross sections were perturbed as described in the following steps:

  1. Four cross sections will be considered: elastic, inelastic, capture and fission cross section, and only one specific cross section in one energy group and one isotope varied each time.
  2. Then a material card is created in which the atomic density for the relevant isotope is increased by 1% .
  3. The Kpert card is then created specifying that: the relevant material is replaced by the perturbed material in each of the cells in which the material is present. Perturbation cards are given for all energy groups.
  4. Finally, MCNP6 is run with this modification in the input; and in the output file a table is given with the results of different perturbations and their related statistical uncertainties.

- These sensitivity vectors must be combined with covariances matrices (see eqs. (4) and (5)), by using a program calculating Keff uncertainties in similar energy groups.
- The total uncertainty is calculated by using the following equation:

$$\frac{\Delta Keff}{Keff} = \sqrt{\sum_i \sum_{\sigma_x} \sum_g [\frac{\Delta Keff}{Keff}]^2_{i,\sigma_x,g}}$$

i: index of material.
σ_x: index of reaction cross section.
g: index of energy groups.

- The contribution of every nuclide-reaction was calculated as follows:

$$\left[\frac{\Delta K_{eff}}{K_{eff}}\right]_{(\sigma_{x,g},\sigma_{y,g'})} = \begin{cases} \sqrt{S_{Keff,\sigma_{x,g}}cov(\sigma_{x,g},\sigma_{y,g'})S_{Keff,\sigma_{y,g'}}} & (4) \\ -\sqrt{\left|S_{Keff,\sigma_{x,g}}cov(\sigma_{x,g},\sigma_{y,g'})S_{Keff,\sigma_{y,g'}}\right|} & (5) \end{cases}$$

If $S_{Keff,\sigma_{x,g}}cov(\sigma_{x,g},\sigma_{y,g'})S_{Keff,\sigma_{y,g'}} \geq 0$, we have to use equation (4).

If $S_{Keff,\sigma_{x,g}}cov(\sigma_{x,g},\sigma_{y,g'})S_{Keff,\sigma_{y,g'}} < 0$, we have to use equation (5).

$S_{Keff,\sigma_{x,g}}$: Sensitivity coefficient for Keff to neutron cross section σ_x, and energy group g.
$cov(\sigma_{x,g},\sigma_{y,g'})$: Covariance matrix that comprises covariance data for two cross sections (σ_x,σ_y) in the energy groups g and g'.

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3   OVERVIEW OF EXPERIMENTS (CASES) BENCHMARK

HEU-SOL-THERM-001 is teen   critical experiments (cases) were performed in the mid-1970's at the Rocky Flats Plant which was operated at the time by Rockwell international, each involving a tank of highly enriched uranyl nitrate. The critical height for each experiment was determined by linear interpolation between reactor periods of slightly supercritical and slightly subcritical states. The tanks were cylindrical in shape and suspended in approximate center of a large room. Critical configurations had height to diameter ratios less than 1.2. Uranium concentration varied between 50 and 360 grams of uranium per litre. All teen cases are considered acceptable for use as benchmark experiments [7].

In the following parts, we analyse six cases of this benchmark by MCNP6 code for K_{eff} and its related nuclear uncertainty due to the different reactions types for ^{235}U, ^{238}U, ^{1}H, and ^{16}O isotopes and we conclude how varied the effective multiplication factor uncertainty with the atomic density of these isotopes.

4   MULTIPLICATION FACTORS CALCULATED BY MCNP6

The K_{eff} values with its related standard deviation for thermal systems studied throughout this study are listed in table 2. The third column represent values from the International Criticality Safty Benchmark experements (IHECSBE) and our results calculated by MCNP6 code and JENDL4 nuclear data evaluation are represented in the second column.

Table 2.   HEU-SOL-THERM-001-cases Keff and its standard deviation

Benchmark	$Keff \pm std.\,dev.^{1}$ (MCNP6)	$Keff \pm \Delta Keff^{2}$ (IHECSBE)
HEU-SOL-THERM-001-001	0.98531 $\pm$ 0.00012	1.0004 $\pm$ 0.0060
HEU-SOL-THERM-001-002	0.99453 $\pm$ 0.00021	1.0021 $\pm$ 0.0072
HEU-SOL-THERM-001-003	0.98765 $\pm$ 0.00020	1.0003 $\pm$ 0.0035
HEU-SOL-THERM-001-004	0.99574 $\pm$ 0.00021	1.0008 $\pm$ 0.0053
HEU-SOL-THERM-001-005	0.97169 $\pm$ 0.00017	1.0001 $\pm$ 0.0049
HEU-SOL-THERM-001-006	0.97612 $\pm$ 0.00017	1.0002 $\pm$ 0.0046

^{1}*This uncertainty means the statistical uncertainty or standard deviation in MCNP6 calculated with the Monte Carlo technique.*

^{2} *This uncertainty means the experimental uncertainty due to uncertainties in critical heights, uncertainties in Solution constituents, and in isotropic constituents [7] .*

5   VALIDATION OF SENSITIVITY RESULTS

The calculation of the sensitivities coefficients with the adjoint-weighted technique is new in the code MCNP6; for this, we compared the results of this technique with the results of the MCNP6 differential operator technique [2] (old technique) and with the sensitivities coefficients calculated by the KENO code [8]. Also, we compared the results of the adjoint-weighted technique by two nuclear data evaluations ENDF/B-VI.8 [1] and ENDF/B-VII.0 [1]. This comparison is used in 30 energy groups, are represented in table 3.

Table 3.   Thirty energy groups used in our sensitivity validation

Groups numbers	Energy groups (Mev)
1	0.00E+0 - 1.00E-02
2	1.00E-02 -2.15E-02
3	2.15E-02 - 4.64E-02
4	4.64E-02 - 1.00E-01
5	1.00E-01 - 2.15E-01
6	2.15E-01 - 4.64E-01
7	4.64E-01 - 1.00E+00
8	1.00E+00 - 2.15E+00
9	2.15E+00 - 4.64E+00
10	4.64E+00 - 1.00E+01
11	1.00E+01 - 2.15E+01
12	2.15E+01 - 4.64E+01
13	4.64E+01 - 1.00E+02
14	1.00E+02 - 2.15E+02
15	2.15E+02 - 4.64E+02
16	4.64E+02 - 1.00E+03
17	1.00E+03 - 2.15E+03
18	2.15E+03 - 4.64E+03
19	4.64E+03 - 1.00E+04
20	1.00E+04 - 2.15E+04
21	2.15E+04 - 4.64E+04
22	4.64E+04 - 1.00E+05
23	1.00E+05 - 2.00E+05
24	2.00E+05 - 4.00E+05
25	4.00E+05 - 8.00E+05
26	8.00E+05 - 1.40E+06
27	1.40E+06 - 2.50E+06
28	2.50E+06 - 4.00E+06
29	4.00E+06 - 6.50E+06
30	6.50E+06 - 6.50E+06

The figures below show the results of the sensitivity validation in rapid benchmark Godiva (highly enriched uranium sphere) for four reactions: elastic and inelastic scattering, capture and fission.
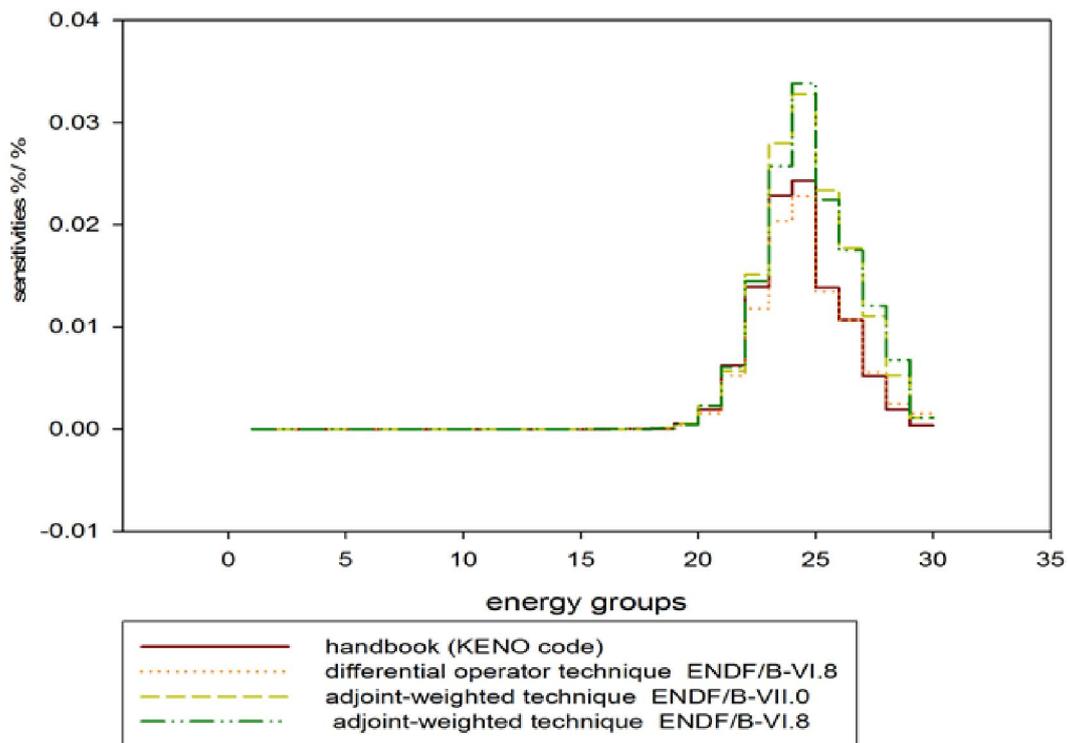
Fig. 2.   Sensitivities of ^{235}U elastic scattering cross section in Godiva
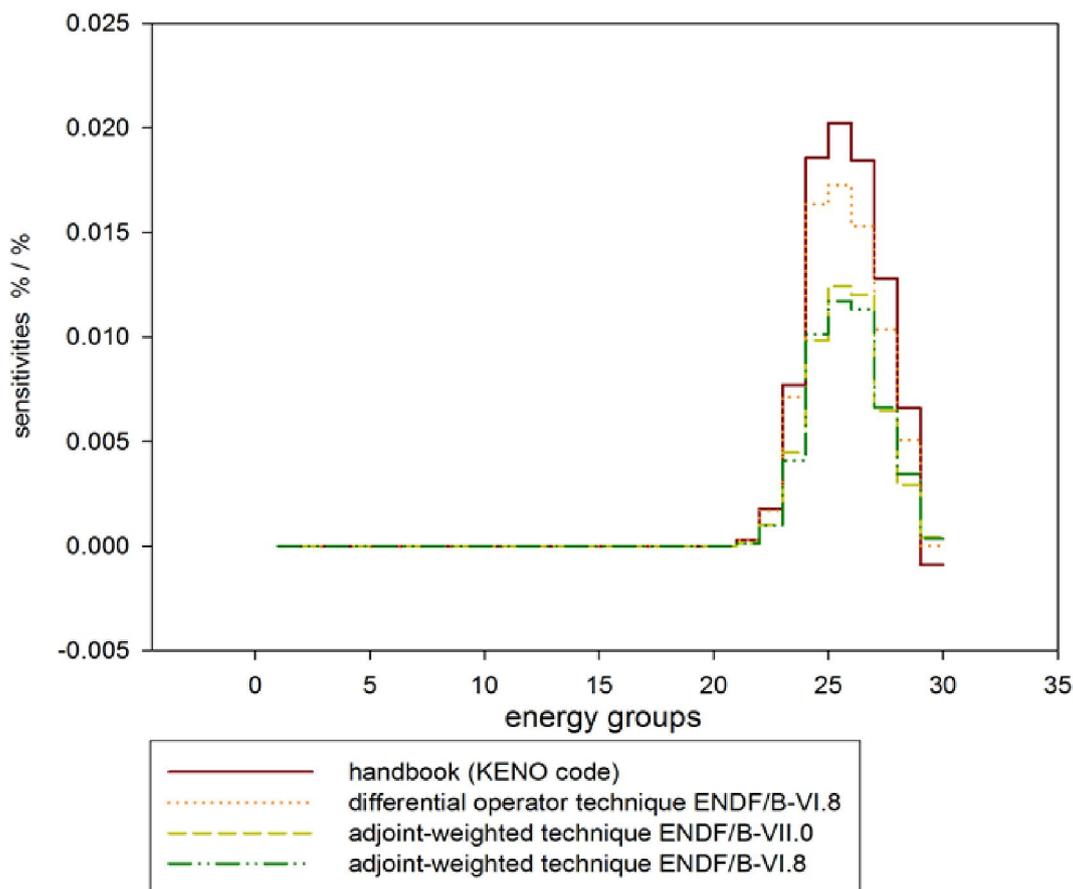
Fig. 3.   Sensitivities of ^{235}U inelastic scattering cross section in Godiva
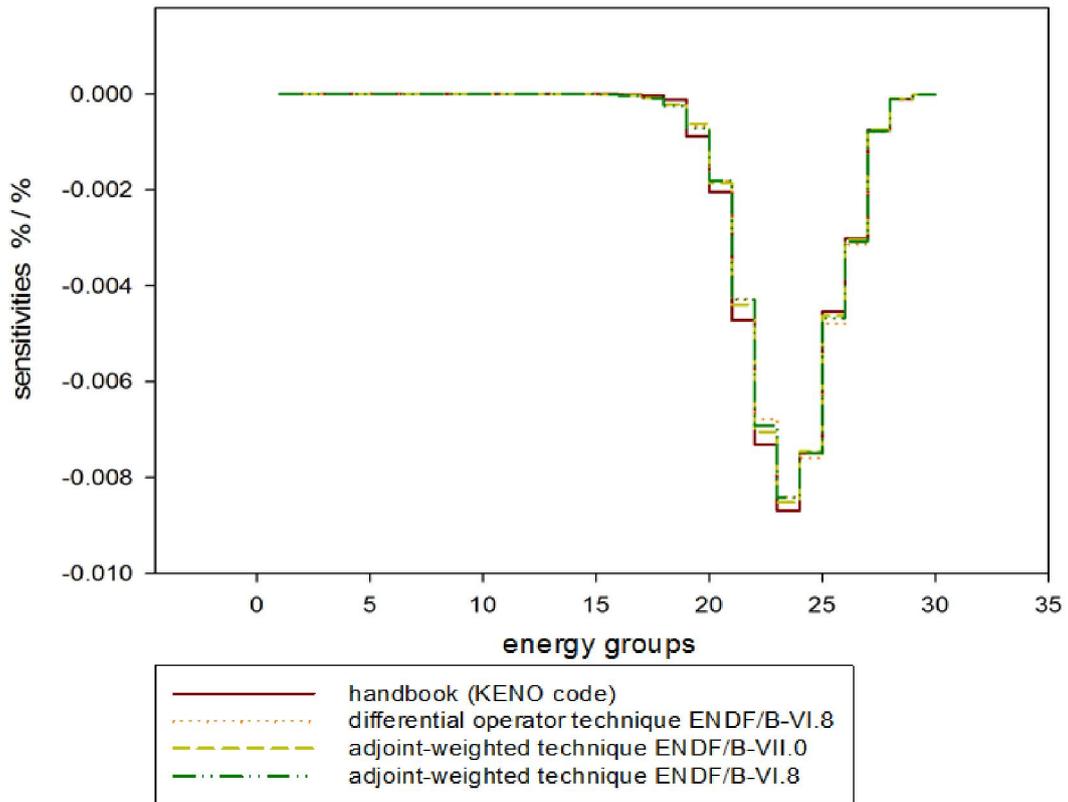
Fig. 4.   Sensitivities of ^{235}U capture cross section in Godiva
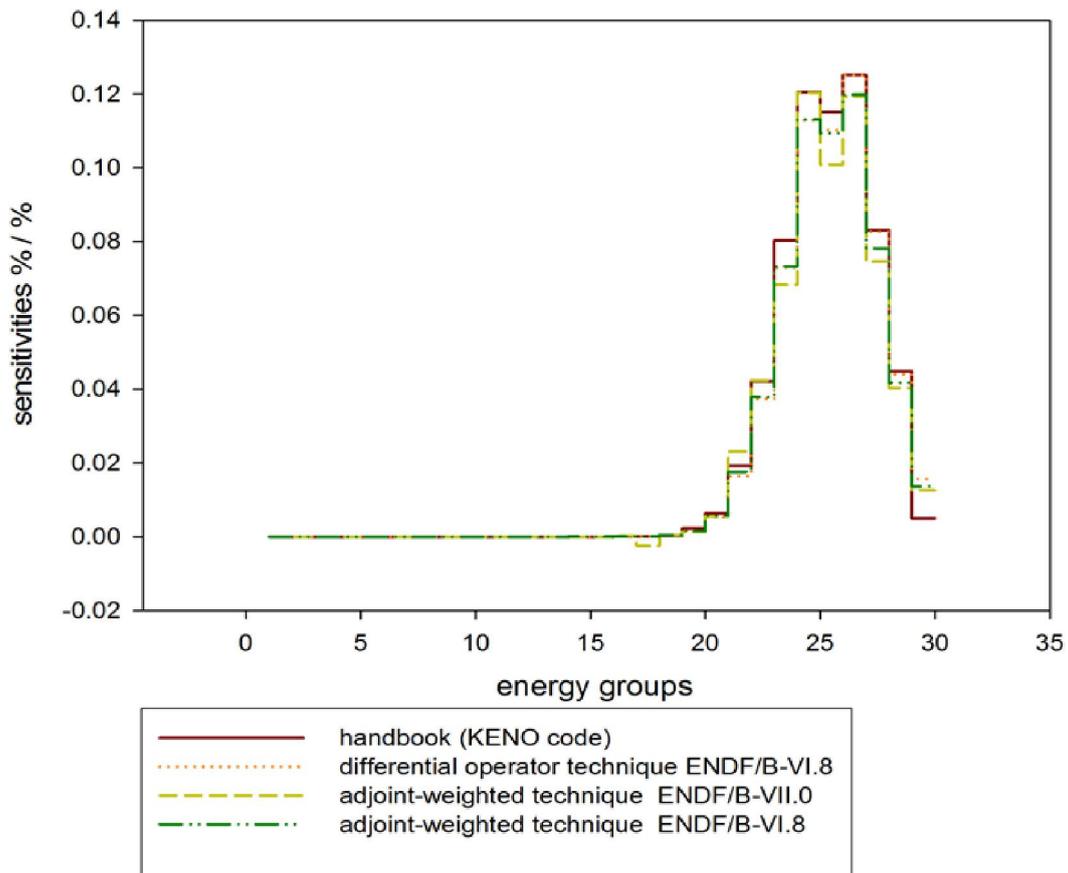
Fig. 5.   Sensitivities of ^{235}U fission cross section in Godiva

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The differences between the results of sensitivities in the above figures (figs.:2,3,4,5) are due to:

- The difference between the nuclear data evaluation used.
- The difference between the techniques used.

In general, the adjoint-weighted technique is validated.

6   IMPACT OF ATOMIC DENSITY ON THE NUCLEAR UNCERTAINTY IN EFFICTIVE MULTIPLICATION FACTOR (Keff)

In this part, we analyse the nuclear uncertainty in Keff due to the elastic, inelastic, capture and fission uncertainties for [235]U, [238]U, ^{1}H, and [16]O isotopes in six cases of the HEU-SOL-THERM-001 by MCNP6 code and we conclude how varied the effective multiplication factor uncertainty with the atomic density of these isotopes (see the figures below).
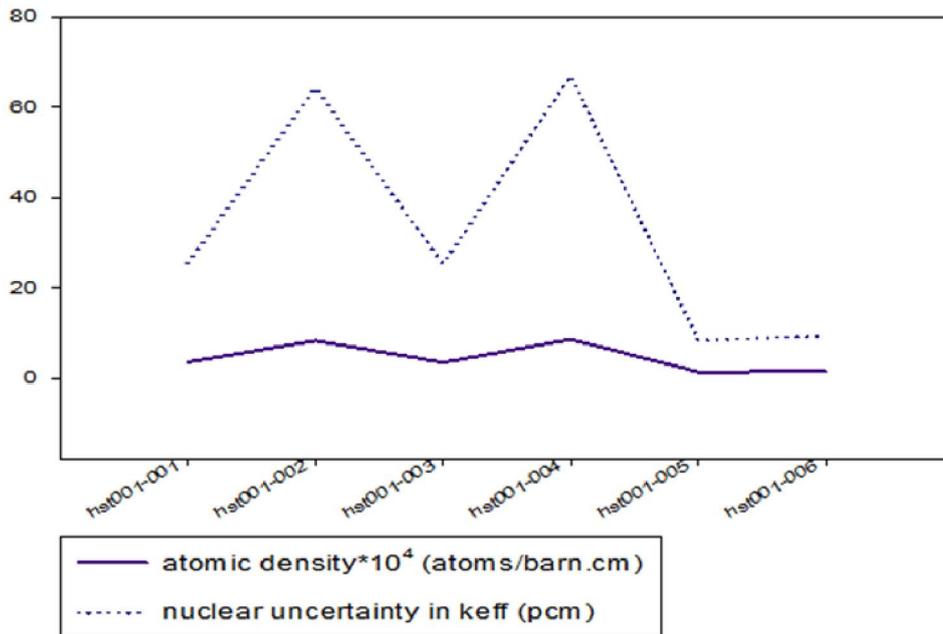
Fig. 6.   Variation of the atomic density and ΔKeff-nucl. for [235]U in six cases of the benchmark hst001
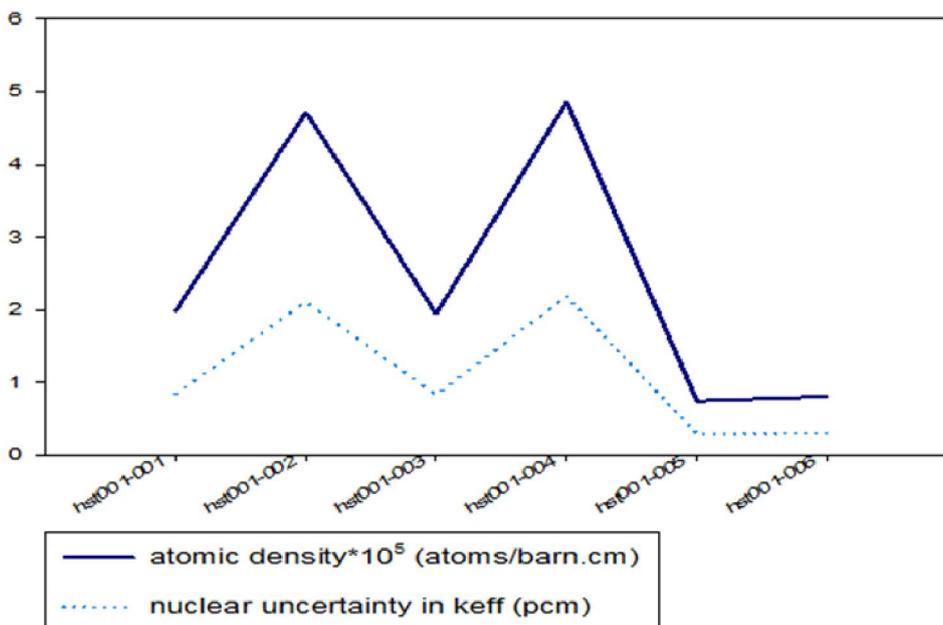
Fig. 7.   Variation of the atomic density and ΔKeff-nucl. for [238]U in six cases of the benchmark hst001
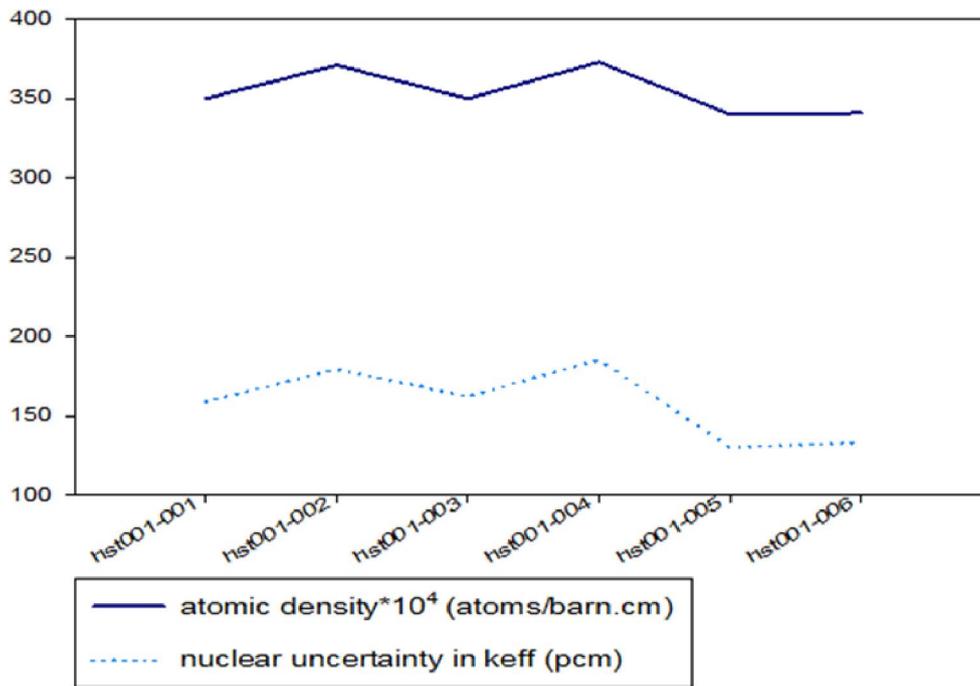
Fig. 8. *Variation of the atomic density and ΔKeff-nucl. for ^{16}O in six cases of the benchmark hst001*
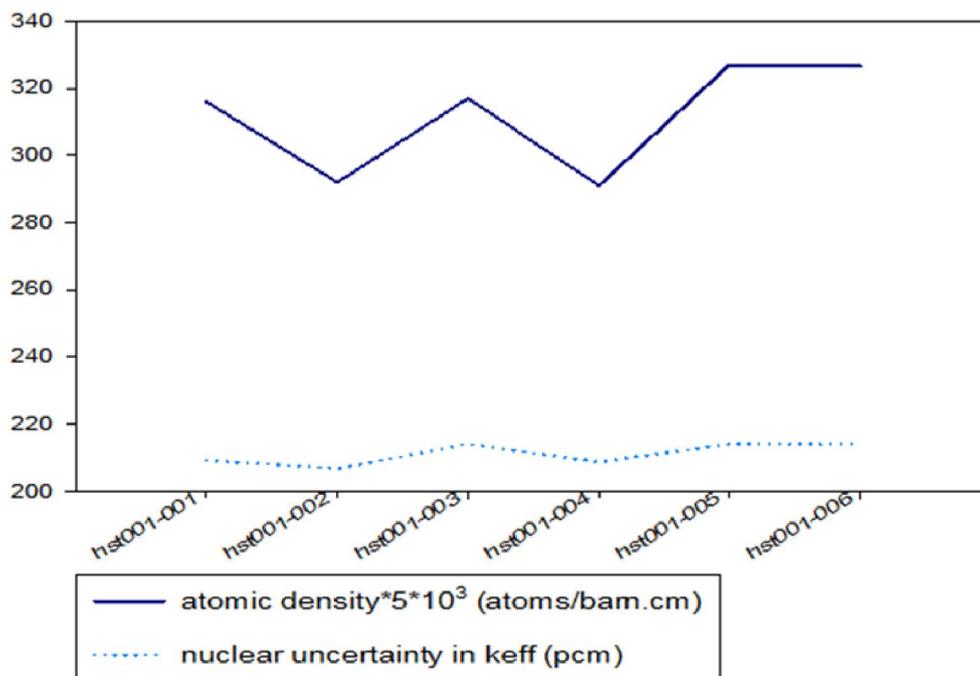
Fig. 9. *Variation of the atomic density and ΔKeff-nucl. for ^{1}H in six cases of the benchmark hst001*

7 DISCUSSION

- We observed the nuclear uncertainties on Keff due to the elastic, inelastic, capture and fission uncertainty for ^{235}U, ^{238}U, ^{1}H, and ^{16}O isotopes increase when its atomic densities increase. Therefore; it must the adjustment of cross sections and its covariace matrices of the isotopes that have the great atomic densities in nuclear reactors.
- We observed the nuclear uncertainties on Keff due to the elastic, inelastic, capture and fission uncertainty for ^{235}U increase greatly with small increase of the atomic densities than the ^{238}U, ^{1}H and ^{16}O uncertainties. This is due to the large contribution of ^{235}U cross sections uncertainties on the Keff uncertainty. Therefore; for small

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atomic density it must the cross sections and covariance matrices adjustement of the fissile isotopes such as [235]U in nuclear reactors.

8 CONCLUSION

In this work we have analysed the sensitivities and uncertainties on the effictive multiplication factor Keff produced by nuclear data; espicially the elastic and inelastic scattering, capture and fission cross sections and their correlations in the ^{1}H,[16]O,[235]U and [238]U by the adjoint- weigted technique ; six critical and thermal cases of the 'HEU-SOL-THERM-001' benchmark have been selected in this study by using the Monte Carlo code MCNP6 and the ERRORJ module of the last update NJOY99 to calculate the sensitivities vectors and to process the covarionce matrices. And we studied the impact of the atomic density on the total uncertainty produced by elastic, inelastic, capture and fission nuclear data on the Keff uncertainty. As a conclusion, it must the cross sections and covariance matrices adjustment of the isotopes that have the great atomic densities in nuclear reactors. And for small atomic densities it must the cross sections and covariance matrices adjusement of the fissile isotopes such as [235]U in nuclear reactors.

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Web Document Clustering Using Cuckoo Search Clustering Algorithm based on Levy Flight

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ABSTRACT: The World Wide Web serves as a huge widely distributed global information service center. The tremendous amount of information on the web is improving day by day. So, the process of finding the relevant information on the web is a major challenge in Information Retrieval. This leads the need for the development of new techniques for helping users to effectively navigate, summarize and organize the overwhelmed information. One of the techniques that can play an important role towards the achievement of this objective is web document clustering. This paper aims to develop a clustering algorithm and apply in web document clustering area. The Cuckoo Search Optimization algorithm is a recently developed optimization algorithm based on the obligate behavior of some cuckoo species in combining with the levy flight. In this paper, Cuckoo Search Clustering Algorithm based on levy flight is proposed. This algorithm is the application of Cuckoo Search Optimization algorithm in web document clustering area to locate the optimal centroids of the cluster and to find global solution of the clustering algorithm. For testing the performance of the proposed method, this paper will show the experience result by using the benchmark dataset. The result obtained shows that the Cuckoo Search Clustering algorithm based on Levy Flight performs well in web document clustering.

KEYWORDS: Web Document Clustering, Cuckoo Search, Levy Flight, Clustering Algorithm, Relevant information.

1 INTRODUCTION

The World Wide Web continues to grow rapidly a vast resource of information and services. Powerful search engines have been developed to aid in locating unfamiliar documents by category, contents, or subjects. However, queries often return inconsistent results, with document referrals that meet the search criteria but are of no interest to the user [1].

Clustering's goal is to separate a given group of data items (the data set) into groups called clusters such that items in the same cluster are similar to each other and dissimilar to items in other clusters or to identify distinct groups in a dataset [1]. The results of clustering could then be used to automatically formulate queries and search for other similar documents on the web, or to organize bookmark files, or to construct a user profile. In contrast to the highly structured tabular data upon which most machine learning methods are expected to operate, web and text documents are semi structured. Web documents have well defined structures such as letters, words, sentences, paragraphs, sections, punctuation marks, HTML tags and so forth. Hence, developing improved methods of performing machine learning techniques in this vast amount of non-tabular, semi structured web data is highly desirable.

Text clustering, which has been extensively studied in many scientific disciplines, plays an important role in organizing large amounts of heterogeneous data into a small number of semantically meaningful clusters .In particular, web collection clustering is useful for summarization, organization and navigation of semi-structured Web pages.

One of the best known and most popular clustering algorithms is the k-means algorithm [2]. The algorithm is efficient at clustering large data sets because its computational complexity only grows linearly with the number of data points. However, the algorithm may converge to solutions that are not optimal [3].

PSO is algorithm is presented as document clustering algorithm in [4]. It outperforms K-means clustering algorithm.

In [5], to cluster the web pages, they use the dictionary (standardized) to obtain the context with which a keyword is used and in turn cluster the results based on this context.

A combine approach is proposed to cluster the web pages which first finds the frequent sets and then clusters the documents in [6].

In [7], the Cuckoo Search Clustering Algorithm (CSCA) is proposed. The algorithm is validated on two real time remote sensing satellite- image datasets. In their algorithm, new Cuckoo is calculated by their new equation. In their new Cuckoo solution, the current best solution is considered.

The other new Cuckoo equation for CSCA algorithm is proposed in [8].The new Cuckoo solution is calculated by using both current solution and current best solution.

In [9], the KEA-Means algorithm is proposed and it is used for web page clustering. This algorithm combines key phrase extraction algorithm and k-means algorithm.

This paper describes the application of a new optimization algorithm called Cuckoo Search via Levy Flight [10] to find global solutions to the clustering problem in web document clustering area. The optimization algorithm is based on the obligate brood parasitic behavior of some cuckoo species in combination with the Levy flight behavior of some birds and fruit flies. The algorithm has been successfully applied to different optimization problems including the practical design of steel structure [11] and face recognition [12].

The rest of this paper will present the following. Web document Clustering and Cuckoo Search, the theory background of the algorithm, will be discussed. Then, Cuckoo Search Clustering Algorithm based on Levy Flight will be proposed. Experimental Setup will be presented and results and discussion will also be presented. Then, we will conclude this paper and suggest future work.

2 WEB DOCUMENT CLUSTERING

Articles Web document clustering is widely applicable in areas such as search engines, web mining, information retrieval and topological analysis. Most document clustering methods perform several pre-processing steps including stop words removal and stemming on the document set. Each document is represented by a vector of frequencies of remaining terms within the document. Some document clustering algorithms employ an extra pre-processing step that divides the actual term frequency by the overall frequency of the term in the entire document set.

The text content of a web document provides a lot of information aiding in the clustering of a page. There are many document clustering approaches proposed in the literature. They differ in many parts, such as the types of attributes they use to characterize the documents, the similarity measure used, the representation of the clusters etc. The different approaches can be categorized into *i.texbased, ii.linkbased and iii.hybrid one*. The text-based web document clustering approaches characterize each document according its content, i.e the words (or sometimes phrases) contained in it. The basic idea is that if two documents contain many common words then it is likely that two documents are very similar.

In most clustering algorithms, the dataset to be clustered is represented as a set of vectors $X=\{x_1, x_2, ..., x_n\}$, where the vector xi corresponds to a single object and is called the feature vector. The feature vector should include proper features to represent the object. The web document objects can be represented using the Vector Space Model (VSM) . In this model, the content of a document is formalized as a dot in the multidimensional space and represented by a vector d, such as d= { w_1, w_2, w_n..... } , where w_i (i = 1,2,…,n) is the term weight of the term t_i in one document. The term weight value represents the significance of this term in a document. To calculate the term weight, the occurrence frequency of the term within a document and in the entire set of documents must be considered. The most widely used weighting scheme combines the Term Frequency with Inverse Document Frequency (TF-IDF) . The weight of term i in document j is given in Eq (1):

$$w_{j\,i} = tf_{ji}*idf_{ji} = tf_{ji}*log_2(n/df_{ji}) \tag{1}$$

Where tf_{ji} is the number of occurrences of term i in the document j; df_{ji} indicates the term frequency in the collections of documents; and n is the total number of documents in the collection. This weighting scheme discounts the frequent words with little discriminating power.

3   CUCKOO SEARCH

All Cuckoo Search optimization technique is introduced by Yang and Deb recently [10]. Cuckoos have a belligerent reproduction tactic that involves the female laying her fertilized eggs in the nest of another species so that the surrogate parents unwittingly raise her brood [13]. Sometimes the cuckoo's egg in the nest is revealed and the surrogate parents throw it out or dump the nest and start their own brood elsewhere. The cuckoo search optimization algorithm considered various design parameters and constraints, the three main idealized rules on which it is based are as follows[10 [14] :

1) Each cuckoo lays one egg at a time, and dumps its egg in randomly chosen nest;

2) The best nests with high quality of eggs will carry over to the next generations;

3) The number of available host nests is fixed, and the egg laid by a cuckoo is discovered by the host bird with a probability pa€ [0, 1]. In this case, the host bird can either throw the egg away or abandon the nest, and build a completely new nest.

For simplicity, this last assumption can be approximated by the fraction pa of n nests in current iteration which need to be replaced by new nests (with new random solutions) in next iteration. In addition, each nest can represent a set of solutions; CS can thus be extended to the type of metapopulation algorithm.

The number of parameters to be tuned in Cuckoo Search is less than other nature inspired techniques, and thus it is potentially more generic to adapt to a wider class of optimization problems. The technique has been demonstrated successfully on some benchmark functions and is far better, than other approaches including the advanced particle swarm optimization approach [10].

4   CUCKOO SEARCH CLUSTERING ALGORITHM BASED ON LEVY FLIGHT

Cuckoo Search Clustering Algorithm based on levy flight is designed as a clustering algorithm from Cuckoo Search Optimization algorithm to locate the optimal centroids of the cluster. In web document clustering area, it is possible to view the clustering problem as an optimization problem that locates the optimal centroids of the clusters rather than an optimal partition finding problem. This algorithm aims to group a set of input samples (data points) into clusters with similar features. It will work without the knowledge of the class of the input data during the process. In this algorithm, new cuckoo solutions will be moved by using levy flight.

The Cuckoo Search Clustering Algorithm based on Levy Flight is as Fig. 1.

```
1.  Begin

      (Parameter Initialization- no of clusters, no of host nests)
2.  Consider NH host nests containing 1 egg (solution) each

3.  For each solution of host i

4.       Initialize xᵢ to contain k randomly selected cluster centroids    (corresponding to k clusters), as xᵢ = (mᵢ,₁,....,mᵢ,ⱼ,...mᵢ,ₖ)
             where mᵢ,ₖ represents the kth cluster centroid vector of ith  cluster  centroid vector of iᵗʰ host.

    End for loop

5.  For t iterations

6.          For each solution of host i of the population

7.              For each data document zₚ

8.                  Calculate distance d(zₚ,mⱼ,ₖ) from all cluster centroids Cᵢ,ₖ    by using Cosine Similarity Distance eq-2

9.                  Assign zₚ to Cᵢ,ₖ by

                    d(zₚ,mⱼ,ₖ) = minₖ₌₁...ₖ { d(zₚ,mⱼ,ₖ) }
                    End for loop in step 7
10.                 Calculate fitness function f(xᵢ) for  each host nest i by eq-3

11.          End for loop in step 6

12.          Replace all the nests except for the best one by new Cuckoo eggs produced with levy flight from their positions

13.          A fraction pa of worse nests are abandoned and new ones are  built  randomly

14.          Keep the best solutions (or nests with quality solutions)

15.          Find the current best solution

        End for loop in step 5
16. Consider the clustering solution   represented by the best solution
17. End
```

Fig. 1.   Cuckoo Search Clustering algorithm based on Levy Flight

$$\cos(m_p, m_j) = m^t_p m_j / |m_p| \, |m_j| \tag{2}$$

Where: $m^t_p m_j$ = the dot product of the two vector

$$f = \frac{\sum_{i=1}^{N_c} \{ \frac{\sum_{j=1}^{p_i} d(o_i, m_{i,j})}{p_i} \}}{N_c} \tag{3}$$

$m_{i,j}$ = j^{th} document vector which belong to cluster i;

o_i = the centroid vector of ith cluster

$d(o_i, m_{i,j})$= distance between document $m_{i,j}$ and the cluster centroid o_i

p_i = the number of documents which belongs to cluster C_i

N_c= number of clusters

4.1   NEW CUCKOO SOLUTION BASED ON LEVY FLIGHT

The cuckoo laid eggs which correspond to a new solution set. The cuckoo will move from the current position to the new position determined by the levy flight as follows:

$$x_i^{(t+1)} = x_i^{(t)} + \alpha * \text{levy}(\lambda) \tag{4}$$

$$x_i^{(t+1)} = x_i^{(t)} + \alpha * S (x_i^{(t)} - x_{best}^{(t)}).r \tag{5}$$

Where

$x_i^{(t)}$ = current solution

$x_i^{(t+1)}$ = next solution

$x_{best}^{(t)}$ = current best solution

S= random walk based on levy flight

α = step size parameter

r = random number

In Mantegna's algorithm, the step Length can be calsulated by [11].

$$S = \mu / |v|^{1/\beta} \tag{6}$$

Where β is a parameter between [1,2] and considered to be 1.5. μ and v are drawn from normal distribution as

$$\mu \sim N\left(0, \delta_\mu^2\right), \ v \sim N\left(0, \delta_v^2\right) \tag{7}$$

$$\delta_\mu = \left\{ \frac{\tau(1+\beta)\sin(\pi\beta/2)}{\tau[(1+\beta)/2] \ \beta \ 2^{(\beta-1)/2}} \right\}^{1/\beta}, \delta_v = 1 \tag{8}$$

The block diagram of the proposed method is as shown in Fig. 2.
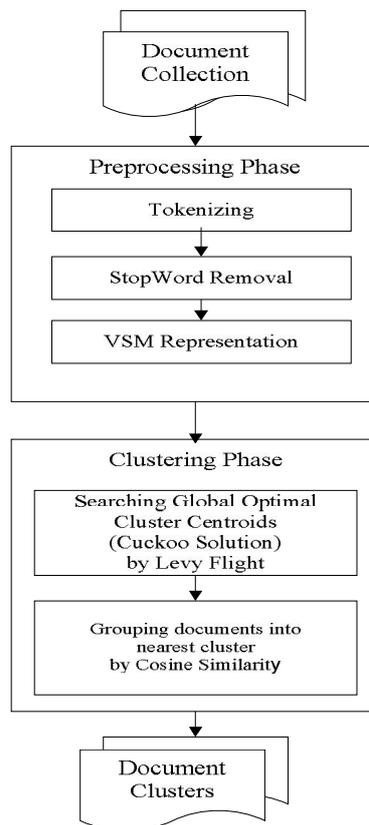
Fig. 2.   Block Diagram of the proposed method in web document clustering

In Fig.2, the documents to be clustered must be collected first. The proposed method includes two phases: preprocessing phase and clustering phase. In preprocessing phase, each document will be tokenized and the stop words such as a, an, the etc., will be removed. The remaining words will be represented in Vector Space Model with their TFIDF weight values. In clustering phase, the distance from the center documents to the other documents will be measured by Cosine Similarity measure. The documents to the nearest center will go to this cluster. For next center document selection, the old center will be moved to the new center by Cuckoo Solutions based on levy flight.This clustering process will be performed for a defined number of criteria. The algoithm will finally produce the user-defined number of document clusters.

5 EXPERIENTIAL SET UP

The Cuckoo Search Clustering Algorithm based on levy flight is tested on 7 sector benchmark data set. It is a dataset of collection of web pages of 7 classes. For our testing process, 300 web pages are randomly selected from the dataset and clustered into 3 classes. The algorithm is tested by using Cosine Similarity as distance similarity measure of the two documents. The algorithm executes for 100 iterations and uses 10 cuckoos. The parameter pa is tested for 0.2, 0.25, 0.3 and 0.35. With pa=0.3, the algorithm executes the best fitness value around 50 iterations. So, 0.3 is selected as the pa value of our algorithm. The tested pa values and its cluster quality is as shown in Table.1.

6 RESULT AND DISCUSSION

The fitness equation is also used for the evaluation of the cluster quality. The smaller the cluster quality value, the more compact the clustering solution. The different cluster quality values for the different pa values are as shown in Table 1. The cluster quality values over the number of iterations are as shown in Fig 3.

A famous method for evaluating measure in information retrieval (IR) is F-measure. The cluster results of the system are also evaluated using F-measure. It considers the precision (P), recall (R) and is shown in Eq (9). Eq (10) shows F-measure formula.

$$P = \frac{TP}{TP+FP} \qquad R = \frac{TP}{TP+FN} \qquad (9)$$

$$F = \frac{2.P.R}{(P+R)} \qquad (10)$$

Table 1. pa values and cluster quality

pa	0.2	0.25	0.3	0.35
Cluster Quality	0.014 ± 0.017	0.012 ± 0.029	0.010 ± 0.014	0.012 ± 0.016
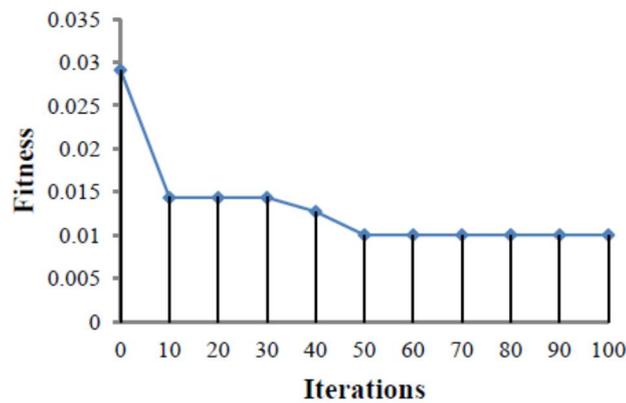
Fig. 3. Performance of Cuckoo Search Clustering Algorithm based on Levy Flight over iteration

Table 2. Precision, Recall and F - measure

Precision	Recall	F-measure
0.711	0.673	0.691

Table.2 illustrates the F-measure of the proposed method. High F-measure shows the high accuracy. The proposed method achieves 0.691 of F-measure in clustering 300 web documents into 3 clusters.

7 CONCLUSION AND FUTURE WORK

Cuckoo Search Clustering Algorithm based on Levy Flight is proposed and applied in web document clustering area. The result shows that the cluster quality and the evaluation measure obtained are good. As our future work, the clustering accuracy can be improved by semantic web document clustering with the help of wordnet, ontology or wekipedia. Our proposed method has been applied in web document clustering area. This Cuckoo Search Clustering Algorithm based on Levy Flight can also be applied to other datasets. And it can also be compared to other swarm intelligence clustering algorithms.

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Application of ELECTRE III and Shannon Entropy for Strategy Selection

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ABSTRACT: One of the potential problems in ports, which are expected to be compounded with the growth of the volumes of trade, is the dwelling of goods and its consequent costs. Container dwell time equals the duration containers are discharged and transported from ships to depots in order to be stored until the time the goods owner has released containers and dismissed it from terminals. The dwelling of goods results in taking up storage yards and port lots through congestion as well as decreasing Executive efficiency in loading and discharging which may cause an increase in lay time and demurrage costs. The purpose of the current study is an Application of ELECTRE III and Shannon Entropy for Strategy Selection for decreasing the Containers Dwell Time in Iranian Seaports. Firstly, factors involving in the Containers dwell time were dealt with in a review of the literature. Secondly, Executive strategies to decrease the Containers dwell time were formalized employing Delphi method. Thirdly, the strategies, formalized at the second stage, were prioritized by use of Shannon Entropy and ELECTRE III. According to The final results of the ELECTRE III method following strategies gained highest priority, using electronic systems, reducing the paperwork and parallel processes in cargo clearance, employing road and rail intermodal transport, round-the-clock customs operation, enhancing coordination and collaboration among organizations involved in the issuance of cargo clearance, respectively.

KEYWORDS: Container, dwelling, Shannon Entropy, ELECTRE III, Strategies, Iran's ports.

1 INTRODUCTION

Ports traffic is steadily increasing; ships are getting larger and types of goods being transported are varying. As larger ships are built and more means of transportation join terminals, more and more their times of arrival coincide [1]. From international perspective, the ports whose capacities do not meet these changes in demand in terms of infrastructure and services will lose their competitiveness in goods transport [2]. Temporary storage of containers in trade ports is one of the essential steps in maritime transport, which is comprised of two major parts including carriage of goods from the vessel to depots, and vice versa, termed as "container admission and departure operation" [3].

However, the admission and departure operations are not always maintained in balance that subsequently could create problems in ports regarding the storage of massive volumes of goods which is termed as "the dwelling of goods" [4]. In other words, the dwelling of goods is defined as the difference between the amounts of goods entering depots for a definite period of time with the amount of goods exiting depots in this period for any reason [5]. These goods could be used for many reasons such as export or delivery to the end users. Moreover, the inventory of goods remained needs to be added to this amount [6]. One of the potential problems in ports, which are expected to be compounded with the growth of the volumes of trade, is the dwelling of goods and its consequent costs [7]. The dwelling of goods results in taking up storage yards and port lots through congestion as well as decreasing Executive efficiency in loading and discharging which may cause an increase in lay time and demurrage costs.

By definition, this could be said that the dwelling of goods is a major issue in Iran's ports and Shahid Rajaie's port is just a

case in point and the effects of this phenomenon is all encompassing [8]. As an instance, Anzali's port had 806,000 tons of dwelled goods in 2009 with an increase of 40% compared to the previous year [9]. The total quantity of discharged goods in the port amounted 3/4 million tons [10]. The statistics show ports of Amirabad and Noushahr contained 300,000 and 500,000 tons of dwelled goods respectively [11]-[12]. Concerning the abovementioned issues, the aim of present study is to identify and prioritize the Executive strategies to decrease the Containers dwell time in Iranian seaports.

2 MATERIAL AND METHOD

The present study is considered as an applied research because its results could be used to reduce the Containers dwell time in ports. A descriptive method is used based on the type and nature of the research, its objectives and questions. On the other hand, to collect data a survey is conducted. To obtain its objectives, this research has been performed at three stages: Firstly, factors involving in the dwelling of goods and container in country will be dealt with in a review of the literature. Secondly, Executive strategies to decrease dwelling of goods and container will be collected employing Delphi method. Thirdly, the strategies, collected at the second stage, will be prioritized using Shannon Entropy and ELECTRE III in terms of the practicability and efficacy, implementation costs, time needed, on the dwelling of goods.

The population in this research is the whole experts in Port and Maritime Organization. Since no data was available as to their exact number, a preliminary questionnaire was sent out to 18 experts in Port and Maritime Organization. An estimation of the first variance analysis with a 95% confidence level resulted in 120 subjects.

2.1 ELECTRE III

The acronym ELECTRE stands for: *ELimination Et Choix Traduisant la Realité* (Elimination and Choice Translating Reality). It is a well-known outranking decision aid methodology which helps a decision maker in either choosing a subset of best alternatives from a given set of alternatives, or in ranking the alternatives from the best to the worst, or in sorting the alternatives to some pre-defined and preference-ordered classes, based on evaluation of the alternatives on a consistent family of criteria. A characteristic feature of ELECTRE is the use of an outranking relation for the representation of decision maker's preferences. The underlying idea is that, if strong mathematical hypothesis which demands complex answers from decision makers, can be avoided, a better but less rich result (outranking relation) can be obtained by systematically comparing the alternatives on each criterion [13].

Since the development of the ELECTRE method by Bernard Roy in the mid 60"s, several versions of the method have been proposed, starting from ELECTRE I and Is, for the selection of alternatives in a multiple criteria choice problems, ELECTRE II, for constructing a ranking of alternatives using true criteria (without thresholds), ELECTRE III and IV, also used for constructing ranking of alternatives but differs from ELECTRE by its application of pseudo criteria (indifference and preference threshold), and ELECTRE TRI, is designed to solve sorting problems [14].

These thresholds are shown with $p_j(p_j \ (*)), q_j \ (g_j \ (*))$ and $v_j(g_j(*))$, respectively. Actually, they are used to estimate outranking relations as well as inclusion of uncertainty in the gathered data about alternatives. The values of these thresholds and weights (or importance) w_j for each of the criteria must be defined for all criteria. If we consider two arbitrary options a and b, the concordance index (C (a, b)), is calculated using following equation [15]:

$$c(a,b) = \frac{a}{w} \sum_{j=1}^{n} w_j \, c_j \, c(a,b) \ \text{ and } W = \sum_{j=1}^{n} w_j \qquad (1)$$

If option a is better than or equivalent to b minus the indifference threshold for criterion j then, C (a, b) =1. However, if the performance of option a plus the preference threshold is less than that of option b then option a is treated as not better than b for this criterion and C (a, b) = 0. Otherwise, the value of concordance index is between these two extremes and is determined as a linear variation between them these concepts are defined as bellow [16]:

$$\begin{cases} c(a,b) = 1 \ \text{ if} \rightarrow w_j(a) + q_j(g_j(a)) \geq g_j(b) \\ c(a,b) = 0 \ \text{ if} \rightarrow g_j(a) + p_j(g_j(a)) \leq g_j(b) \\ \quad \text{otherwise} \rightarrow \frac{g_j(b) - g_j(a) + p_j(g_j(a))}{p_j(g_j(a)) - q_j(g_j(a))} \end{cases} \qquad (2)$$

Where $q_j \ (*)$ and $p_j \ (*)$ denote the indifference and preference thresholds, respectively, on criterion j and $g_j(a)$ and $g_j(b)$ are the assessments for the j the criterion of the project options a and b, respectively.

Also the veto threshold for each criterion must be assigned to allow discordance to be introduced into the outranking relations. Existence of discordance indicates the overrule of concordance index at the presence of any criterion for which option b outperforms option a by at least the veto threshold [13]:

$$g_j(b) \geq g_j(a) + v_j(g\,j\,(a)) \tag{3}$$

If option is better than option b in general, there may be some criteria for which option a is worse than option b that it moderates any overall preference for option a. In that case the discordance index for that criterion reflects this. It can have a value from 0 to 1. A value 0 indicates that option b is not better than option a by more than the preference threshold, and a value 1 indicates that option b is better than option a by a margin greater than the veto threshold. It is written as $D_j(a, b)$ and is defined as follows [15]:

$$\begin{cases} D(a,b) = 1 \ \text{if} \to G_j(a) + V_j(g_j(a)) \leq g_j(b) \\ D(a,b) = 0 \ \text{if} \to g_j(a) + p_j(g_j(a)) \geq g_j(b) \\ \text{otherwise} \to \dfrac{g_j(b) - g_j(a) + p_j(g_j(a))}{V_j(g_j(a)) - P_j(g_j(a))} \end{cases} \tag{4}$$

Finally, the degree or credibility of outranking (S (a, b)) is defined by [15]:

$$S(a,b) = S(a,b) \ \text{if} \to D_j(a,b) \leq C_j(a,b), \forall j$$

$$S(a,b) = s(a,b) \prod_{j \in \gamma(a,b)} \frac{1 - D(a,b)}{1 - C(a,b)} \tag{5}$$

Where γ (a, b) is the set of criteria for which $D_j(a,b) > C_j(a,b)$.

2.2 SHANNON ENTROPY

Shannon and Weaver proposed the entropy concept, which is a measure of uncertainty in information formulated in terms of probability theory [17]. Since the entropy concept is well suited for measuring the relative contrast intensities of criteria to represent the average intrinsic information transmitted to the decision maker, conveniently it would be a proper option for our purpose [18]. Shannon developed measure H that satisfied the following properties for all pi within the estimated joint probability distribution:

It is proved that the only function that satisfied these properties is:

$$H_{shannon} = -\sum_i p_i \log(p_i) \tag{6}$$

Shannon's concept is capable of being deployed as a weighting calculation method, through the following steps [19]:

Step 1: Normalize the evaluation index as:

$$p_{ij} = \frac{x_{ij}}{\sum_j x_{ij}} \tag{7}$$

Step 2: Calculate entropy measure of every index using the following equation:

$$e_J = -K \sum_{i=1}^{m} P_{ij} \ln(P_{ij}) \tag{8}$$

$$\text{Where } K = (\ln(m))^{-1} \tag{9}$$

Step 3: Define the divergence through:

$$div_j = 1 - e_j \tag{10}$$

The more the div_j is the more important the criterion jth.

Step 4: Obtain the normalized weights of indexes as:

$$p_{ij} = \frac{div_j}{\sum_j div_j} \tag{11}$$

3 RESULTS

Container dwell time equals the duration containers are discharged and transported from ships to depots in order to be stored until the time the goods owner has released containers and dismissed it from terminals. Where this period exceeds the prescribed time, it is said that the container or goods have been dwelled. The duration of this depends on several factors and at the same time indicates the efficiency and performance of the organizational and managerial structure of a port. That is to say, when goods dwelling time is shorter it may, to some extent, imply that the port is performing efficiently at all stages from discharging of cargos until clearing from the customs. At this stage, factors involving in the Containers dwell time in country are dealt with in the review of literature. Labor force means all those who work in different departments of ports and the customs. [1]. The technical infrastructure includes advanced and efficient cranes in dock and container yard, the latest methods of goods and container inspection, the latest and effective administrative automation for reducing human error [4]. The customs, the principal administrator of cargo release, can influence a country import and export procedures [5]. The inadequacy of transportation in a country increases production costs of various products and decreases the competitiveness of its industry in the global market [10]. Electronic systems could digitally transfer the requisite information including bill of lading, insurance policy, invoices, etc. without any hard copy and perform economic activities as fast as possible [5]. Undoubtedly, the majority of problems that result in the dwelling of containers in ports of Iran are related to goods owners. [12]. the entry of every goods into a country depends on obtaining permits from different organization which will vary for different goods [8]. Another issue that could affect the Containers dwell time in Iran could be political issues and the consequences. These problems may severely decrease a direct connection between the owners and vendors abroad or the ease of money transfer. The bureaucracy has always been posing problems in the issuance of permits and requisite documents for releasing goods. To some extent, the dwelling of goods may arise out of geographical and social issues. Although their roles in the dwelling of goods seem immaterial, their influence however should not be overlooked [9].

At the Second stage, Executive strategies to decrease the Containers dwell time were formalized employing Delphi method as presented in Table 3.

At the Third stage, the strategies, formalized at the second stage, were prioritized by help of Shannon Entropy and ELECTRE III in terms of the practicability and efficacy, implementation costs, time needed, and the dwelling of goods. Foremost, the indicators were determined by help of Shannon Entropy as shown in Table 1.

Table 1. Weight of indicators according to Shannon Entropy

Indicators	Practicability And Efficacy	Cost	Time
Initial	P	C	T
Weight	0.27000	0.32000	0.41000

Then the identified strategies were formed according to elites' comments on a 1-9 scale based on weighed indicators and decision-making ELECTRE III method as shown in table 2 below.

Table 2. ELECTRE III method decision making matrix

NO	MAX	MIN	MIN	NO	MAX	MIN	MIN
	P	C	T		P	C	T
1	5	1	2.5	12	7.8	6	5
2	4	7	5	13	7.9	4	5.1
3	3	7.5	8	14	6	5	5.2
4	5	6	4.9	15	7.5	2	3
5	6	5	6	16	6.9	8	7
6	4	4.90	5.33	17	8.3	3.56	4.1
7	8	3.99	4.11	18	6	5.36	4.90
8	7.11	5.9	3.8	19	6.9	9	7.5
9	7	4	5.2	20	8.5	3.2	2.6
10	7.11	3	6.5	21	8.6	2	2
11	6.12	4.5	6.44	22	8.7	2.3	1.9

Finally by use of ELECTRE method above mentioned strategies have been prioritized. The final result of ELECTRE method presented in table 3.

Table 3. Final Priority of the strategies

No.	Strategy	Priority
1	Levying heavy fine on dwelled goods in port warehouses to be paid by goods owners	6
2	Improving transportation tariff to encourage truck owners	13
3	Stabilizing the market and reducing great fluctuations which may stimulate high demands	18
4	Utilizing periodical training to boost efficiency of staff and operators in the customs	16
5	Improving banks and goods owners collaboration to facilitate opening credit	10
6	Omitting extra declarations	15
7	Expediting cargo clearance procedures	8
8	Issuing customs permit through computers	17
9	Using a single form in the issuance of permits	9
10	Developing appropriate relationships with other international companies	9
11	Providing better facilities for importers and exporters	15
12	Better training for staff and employees in order to master the customs law	7
13	Reducing complicated paperwork	16
14	Improving the costs of warehousing	4
15	Improving organizations` correlation and collaboration to issue clearance permits	3
16	Building specialized warehouses at different parts of country	14
17	Considering appropriate incentives for goods owners in case of early clearance	5
18	Employing specialized companies and workers to transfer goods	11
19	Increasing the numbers of trucks and locomotives in a country	12
20	The customs round-the-clock operation	3
21	Employing rail and road intermodal transport	1
22	Using electronic systems to reduce paper work and parallelism in goods clearance	2

4   CONCLUSION

The present study has been performed at three stages aiming at identifying and prioritizing Executive strategies to decrease the Containers dwell time in the Iranian seaports. Firstly, factors involving in the Containers dwell time were dealt with in a review of the literature. Secondly, Executive strategies to decrease the Containers dwell time were formalized employing Delphi method. Thirdly, the strategies, formalized at the second stage, were prioritized by help of Shannon Entropy and ELECTRE III in terms of the practicability, implementation costs, time needed, and the efficacy of goods dwelling. The eventual results of the ELECTRE III method indicate the priority of these strategies as following: Employing rail and road intermodal transport, using electronic systems to reduce paper work and parallelism in goods clearance, the customs round-the-clock operation, Improving organizations` correlation and collaboration to issue clearance permits, respectively.

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Modélisation et simulation de la cellule solaire de structure pin à base de silicium polycristallin

[Modeling and simulation of the pin structure of solar cell based on polycrystalline silicon]

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ABSTRACT: In this work we propose the modeling of rear passivation effect on the performance of the polycrystalline solar cell. The rear passivation layers can reflect photons to the interior of the cell. Thus, prolonging their target and making easy their absorption while decreasing the surface recombination velocities of minority carriers at the base area. The conversion efficiency is estimated at 10.49 % for an optimal rear passivation using thin oxide /Silicon Nitride/Silicon oxide. In addition, Front passivation by the silicon nitride of polycrystalline solar cell has been proposed. We noted a very clear improvement of the efficiency for high Ammonia (NH_3) to Silane (SiH_4) gas flow ratio, the efficiency reaches 12.88% for R=10. We have also contributed in the modelling of grain boundaries current density in polysilicon. Electrical simulation shows the influence of grain boundaries surface recombination velocity in the optimization of the conversion efficiency. We noted that the sufficient and optimal surface recombination velocity 10^4 cm/s at the emitter heavily doped gives the optimum output. Therefore, the reduce of the grain boundaries surface recombination velocity at base region slightly doped increases the performance of the cell, it's about 10 cm/s. The current density at the grain boundaries is closely related to the potential barrier at grain boundaries. Indeed, the increase in current density indicates a decrease in potential barrier. Finally, we can conclude that Silicon nitride/ P^+ N / thin oxide /Silicon Nitride/Silicon oxide multilayer structure can be preferment for photovoltaic applications.

KEYWORDS: Polycrystalline silicon, rear passivation, silicon nitride, grain boundary, conversion efficiency.

1 INTRODUCTION

A cause des différentes techniques d'élaboration, les performances des cellules solaires au silicium multicristallin sont limitées par la présence de défauts de structure tels que les joints de grains et les impuretés. En effet, la conduction dans le silicium polycristallin est influencée par le piégeage des porteurs de charges dans les joints de grain [1]. De plus, la réalisation de structures performantes nécessite un passivant avec de bonnes propriétés électriques d'interface, une bonne uniformité et une faible densité de pièges. Ainsi, la passivation frontale sera faite par le nitrure de silicium qui est déposé par LPCVD à partir d'un mélange de gaz de dichlorosilane (DCS), SiH_2Cl_2 et d'ammoniaque NH_3 à basse pression [2], [3]. Les couches de passivation arrière peuvent refléter des photons à l'intérieur de la cellule. Ainsi, ils prolongent leur trajet, facilitant leur absorption, tout en diminuant la vitesse de recombinaison en surface. La réflectivité interne devrait être aussi élevée que possible permettant un bon piégeage des photons.

Parmi les différents types de cellule photovoltaïques, les photodiodes sont considérées comme les dispositifs de base qui fonctionne sur les principes d'une jonction PN où les densités des porteurs minoritaires dans les régions neutres de la diode et dans la zone de charge d'espace sont déterminé par la génération de paires électrons-trous crées par le rayonnement.

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2 MODEL THÉORIQUE

La formulation du coefficient d'absorption $\alpha(\lambda)$ obéit à deux lois différentes selon deux domaines de longueurs d'onde allant de λ_{min} à λ_{max}, séparés par une valeur λ_c appelée longueur d'onde de coupure.

$$\alpha(\lambda) = \begin{cases} \alpha_1(\lambda) = \dfrac{\beta^2}{E}\left(E - E_g\right)^2 \quad pour E_0 \leq E \leq E_{max}; \lambda_{min} \leq \lambda \leq \lambda_c \\[2em] \alpha_2(\lambda) = \alpha_0\, e^{\frac{E-E_0}{E_u}} \quad pour E_{min} \leq E \leq E_0; \lambda_c \leq \lambda \leq \lambda_{max} \end{cases} \tag{1}$$

Où E est l'énergie (ev), E_g le gap optique (ev).

E_u, α_0 et B, qui représentent respectivement, l'énergie caractéristique d'Urbach (elle dépend linéairement du gap optique E_g), le coefficient d'absorption issu de la condition de continuité $(\alpha_1 = \alpha_2)$, et un paramètre de valeur constante (B =690 (ev.cm)$^{-1/2}$) [4].

Un paramètre important à considérer pour la modélisation, car il intervient dans l'équation de continuité des porteurs minoritaires est le taux de génération des porteurs. Il dépend du coefficient d'absorption $\alpha(\lambda)$ par la relation:

$$g(\lambda, x) = \varphi_0(\lambda)\, \alpha(\lambda)\, \left(1 - R(\lambda)\right)\, e^{-\alpha x}$$

Avec R est le coefficient de réflexion. $\phi_0(\lambda)$ est le flux incident du rayonnement.

En tenant compte de la réflectivité interne R_r, qui peut être aussi appelé réflectivité de retour (due à la couche arrière de passivation), nous obtenons:

$$g(\lambda, x) = \alpha(\lambda)\, \varphi_0(\lambda)\, \left(1 - R(\lambda)\right)\, e^{-\alpha x} + \alpha(\lambda)\, \varphi_0(\lambda)\, \left(1 - R(\lambda)\right)\, e^{-\alpha L}\, R_r\, e^{\alpha(L-x)}$$

$$g(\lambda, x) = \varphi_0(\lambda)\, \alpha(\lambda)\, \left(1 - R(\lambda)\right)\, e^{-\alpha x}\left(1 + R_r(\lambda)\right) \tag{2}$$

Avec L est l'épaisseur totale de la cellule.

Le champ électrique dans les trois régions P, I (intrinsèque), N de la cellule étudiées, qui est basé sur la résolution de l'équation de Poisson est représenté comme suit:

$$E(x) = \begin{cases} E_p(x) = \dfrac{-e p_i}{\varepsilon}\left(x - x_{in}\right) \\[1.5em] E_i(x) = \dfrac{-e n_i}{\varepsilon}\left(x_{ip} - x_{in}\right) = cons\tan te \\[1.5em] E_n(x) = \dfrac{e n_i}{\varepsilon}\left(x - x_{ip}\right) \end{cases} \tag{3}$$

Avec les notations $E_p(x), E_i(x), E_n(x)$ qui représentent respectivement le champ dans les régions P, intrinsèque I et N.

La densité de courants des porteurs minoritaires dans la région P à titre d'exemple est la somme de courant de diffusion et de conduction :

$$j_P(\lambda) = e n \mu_n E_p\left(x_p\right) + e D_n \left.\frac{\partial n(x)}{\partial x}\right|_{x=x_P} \tag{4}$$

μ_n est la mobilité des électrons porteurs minoritaires de la région P.

D_n est le coefficient de diffusion.

Partant de l'équation de continuité en régime permanent :

$$\frac{\partial n}{\partial t} = g_n - r_n - n\mu_n \frac{\partial E_P}{\partial x} - \mu_n E_P \frac{\partial n}{\partial x} + D_n \frac{\partial^2 n}{\partial x^2} = 0 \qquad (5)$$

g_n est le taux de génération des paires électron-trou par des agents externes.

r_n est le taux de recombinaison interne des électrons, il est de la forme : $r_n = \frac{\Delta n}{\tau_n}$

Où $\Delta n = n - n_0$ est la concentration des électrons en excès et $n_0 = \frac{n_i^2}{N_a}$ est la concentration des électrons

à l'équilibre.

La relation donnant l'équation de continuité sous forme d'une équation différentielle de deuxième ordre à coefficients variables avec second membre qui dépend de *x* :

$$\frac{\partial^2 n}{\partial x} - A_1(x)\frac{\partial n}{\partial x} - B_1 n = K_1(x)$$

Avec : $K_1(x) = -\frac{\phi_0.\alpha(1-R)e^{-\alpha x}}{D_n} - \frac{n_i^2}{L_n^2.N_a}$; $B_1 = \frac{\mu_n.e.p_i}{D_n.\varepsilon} + \frac{1}{L_n^2}$; $A_1(x) = -\frac{\mu_n}{D_n}.\frac{ep_i}{\varepsilon}(x_{in} - x)$

La concentration des porteurs minoritaires $n(x)$ est déterminée numériquement par la méthode de Taylor en discrétisant la région P représentée par l'intervalle $[0, x_p]$ en k+1 intervalles de longueur $\hbar$, le système d'équation peut s'écrire sous forme matricielle. La résolution se fait par l'algorithme de Thomas qui est spécifique à la résolution des matrices tri diagonal [5].

Sachant que: $\left.\frac{\partial n(x)}{\partial x}\right|_{x=x_p} = \frac{n(x_p) - n_k}{\hbar} = \frac{\frac{n_i}{N_a} - n_k}{\hbar}$

D'où : $j_P(\lambda) = e\ n\mu_n\ E_p(x_p) + eD_n \frac{\frac{n_i^2}{N_a} - n_k}{\hbar}$ $\qquad (6)$

Le courant des électrons minoritaires excédentaires aux joints de grains s'exprime par [6] :

$$J_{gb}(x) = qD_n \frac{\partial(n_p - n_{p_0})}{\partial x} \qquad \text{dans la région P de la cellule}$$

$$= qS_{gb}\left(n_p - n_{p_0}\right)$$

Où S_{gb} est la vitesse de recombinaison des électrons minoritaires.

À $x = x_p$ de la région émettrice, nous avons en effet la condition aux limites imposée par la continuité de la densité de courant donnée par :

$$S_{gb}\Delta n = D_n \frac{dn}{dx}\bigg|_{x=^+_-d}$$

Où d représente la limite de l'étalement de la région de la ZCE (zone de charge d'espace) autour du joint de grain.

Dans notre travail nous supposons la présence du joint de grain à $x = x_p$ de la région émettrice nous pouvons écrire donc :

$$J_{gb} = qS_{gb}\left(\frac{n_i^2}{Na} - n_k\right)$$

Où $\frac{n_i^2}{Na}$ est la concentration des porteurs minoritaires au point $x = x_p$ dans la région P de la cellule.

Le comportement des joints des grains sous illumination s'explique par le fait que les états d'interface ajustent leur charge par capture des électrons (type P), et cela réduit le potentiel au joint de grain. D'après l'expression de la concentration des minoritaires $n(d)$ aux joints de grains [7]:

$$n(d) = n_0 \exp\frac{q\phi_b}{kT}$$

Nous obtenons : $J_{gb} = qS_{gb}n_0\left(\exp\frac{q\phi_b}{kT} - 1\right)$

Cette dernière expression nous permet d'estimer la valeur de la hauteur de barrière au joint de grain, connaissant la valeur de J_{gb}.

Finalement, l'expression de la photo courante total générée dans la cellule, en tenant compte de l'influence des joints de grain dans l'émetteur et dans la base va s'écrire :

$$J_{ph\ total} = J_{ph} - \left(J_{gbe} + J_{gbb}\right)$$

$$J_{ph\ total} = J_{ph} - J_{gb}$$

Sachant que la densité du photocourant $j_{ph}(\lambda)$ est donc la somme des densités de courant dans chacune des régions de la cellule P, I, et N, d'où :

$$j_{ph}(\lambda) = j_p(\lambda) + j_i(\lambda) + j_n(\lambda)$$

Enfin, la caractéristique J (V) pour la cellule idéale s'exprime par :

$$J = J_{ph} - J_s\left(\exp\left(\frac{eV}{nKT}\right) - 1\right) \tag{7}$$

n est le facteur de qualité, j_s est le courant de saturation de la jonction PN.

3   RESULTATS ET DISCUTIONS

L'influence de la présence d'une couche de passivation arrière améliore l'intensité de la densité de courant, en fournissant un meilleur courant, qui augmente considérablement avec l'empilement SiOx/SiNx/SiOx (r=90%, S$_p$=200 cm/s) [8], et SiO$_2$ seul (oxyde de silicium (r=90%, S$_p$=300 cm/s)), par rapport à une couche d'aluminium diffusé (r=50%, Sp=1800cm/s) [8]. Ceci confirme les propriétés adéquates du nitrure de silicium SiNx pour son utilisation en tant que couche anti-reflet dans la cellule solaire.
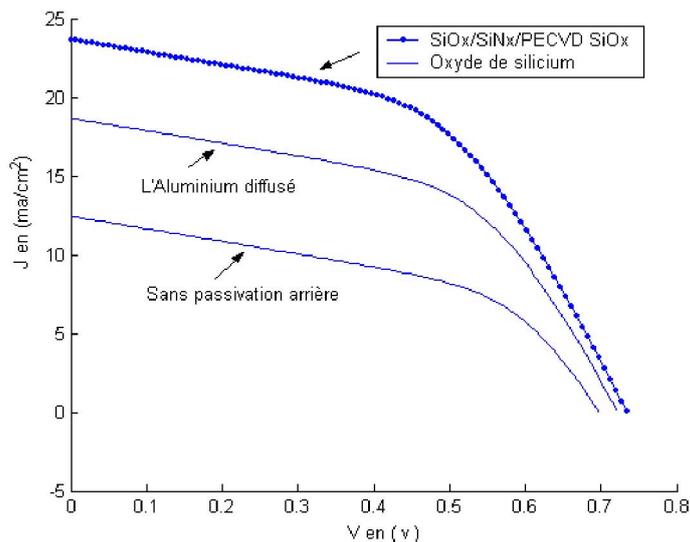
Fig. 1.   L'influence de la couche de passivation arrière sur la caractéristique I(V)

Ce résultat prouve que la réflectivité interne devrait être aussi haute que possible, et ceci en corrélation avec de bonnes propriétés de passivation.

Nous étudions à présent la comparaison de la passivation frontale par une couche mince de SiO_2 (100 nm) et par une couche de nitrure de silicium obtenue avec différents débits gazeux. Pour notre simulation, nous prenons les valeurs de la vitesse de recombinaison en surface issues de la littérature qui sont de l'ordre de 10 cm/s pour le SiO_2 [9] et de 20 cm/s pour le Si_3N_4 [10], respectivement. Le rendement obtenu atteint   12.08% avec l'oxyde thermique comme couche de passivation frontale. La passivation par dépôt d'une couche de nitrure de silicium de (Si_3N_4) sur la couche avant de la cellule, permet de réduire le coefficient de réflexion de la structure ainsi que la vitesse de recombinaison en surface de la couche frontale, ce qui devrait améliorer le rendement. Connaissant l'influence du rapport des débits gazeux $[NH_3]$/ $[SiH_4]$, sur l'indice de réfraction mesuré par ellipsométrie [3], par conséquent nous déduisons son effet sur l'indice de réflexion de la structure.
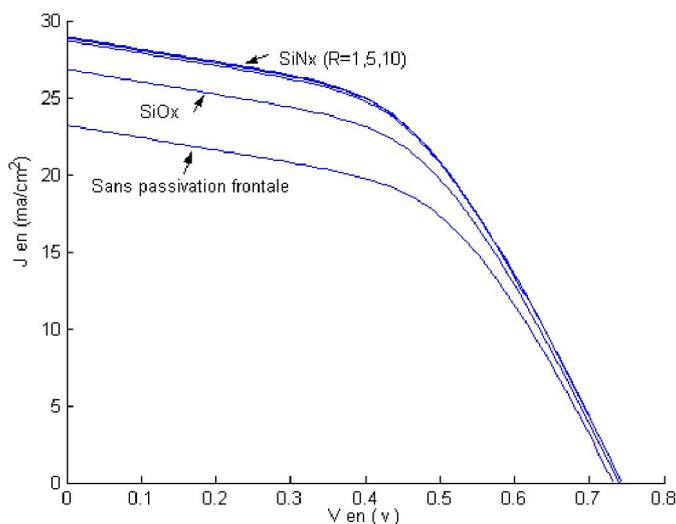
Fig. 2.   Caractéristique J-V en fonction du rapport des débits de gaz de la couche de passivation frontale nitrure de silicium

Pour un faible rapport des débits R=1, le rendement de conversion est estimé à 12.79%. Ce dernier croît avec l'augmentation du rapport des débits jusqu'à atteindre 12.88% pour une valeur de R=10. Nous avons constaté donc une très nette amélioration du rendement pour des rapports R élevés.

Dans notre étude, pour un fort dopage de l'émetteur (petite taille des grains, ce qui implique joint de grand dimension), les valeurs de la vitesse de recombinaison aux joints de grains varient de 10^4 à 10^7 cm/s [11]

L'évolution du rendement de conversion avec l'augmentation de la vitesse de recombinaison aux joints de grains est remarquable où le rendement atteint une valeur minimale de 10.95% pour une vitesse de l'ordre de 10^7 cm/s. Cependant, la valeur optimale de la vitesse de recombinaison aux joints de grains (10^4 cm/s) donne un rendement optimum de 12.88%.
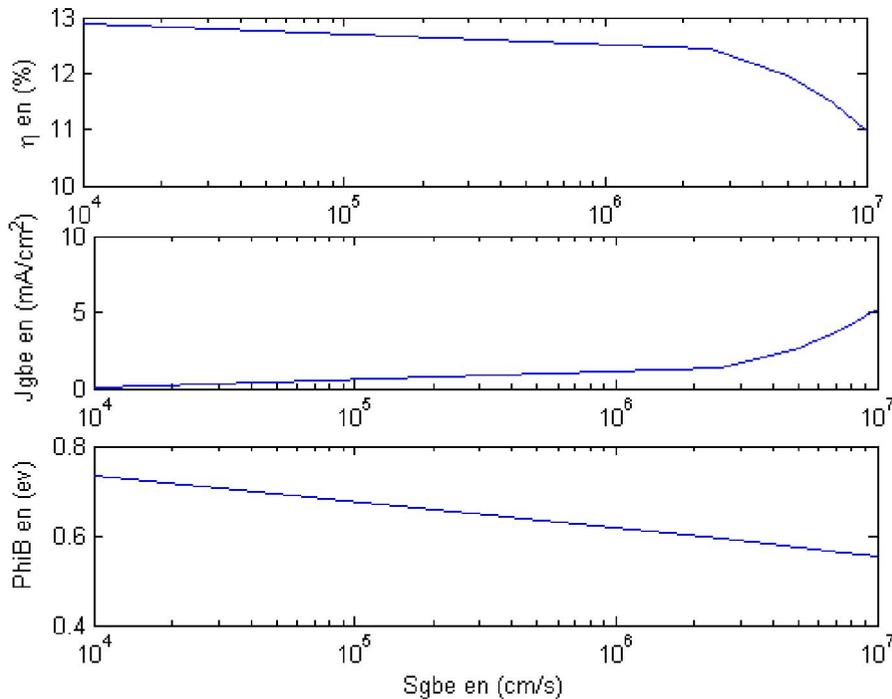
Fig. 3. *Effet de la vitesse de recombinaison aux joints de grains de l'émetteur*

La variation de la barrière du potentiel aux joints de grains est directement liée à la variation densité de courant aux joints de grains. Cette dernière diminue avec l'augmentation de la densité de courant aux joints de grains. Elle est de l'ordre de 0.7 eV pour une vitesse de 10^4 cm/s (faible densité de courant aux joints de grains) et elle diminue jusqu'à atteindre 0.5 eV pour 10^7 cm/s (grande densité de courant aux joints de grains).

Pour un faible dopage de la base (grande taille des grains, joint de faible épaisseur), les valeurs de la vitesse de recombinaison aux joints de grains varient de 10 à 10^4 cm/s [11].

La figure (4) montre clairement que la diminution de la vitesse de recombinaison aux joints de grains fait augmenter le rendement, ceci est expliqué par le faite que la densité de courant aux joints de grains diminue avec la diminution de la vitesse de recombinaison aux joints de grains, et par conséquent nous obtenons l'augmentation de la barrière de potentiel avec la diminution de la vitesse de recombinaison aux joints de grains.
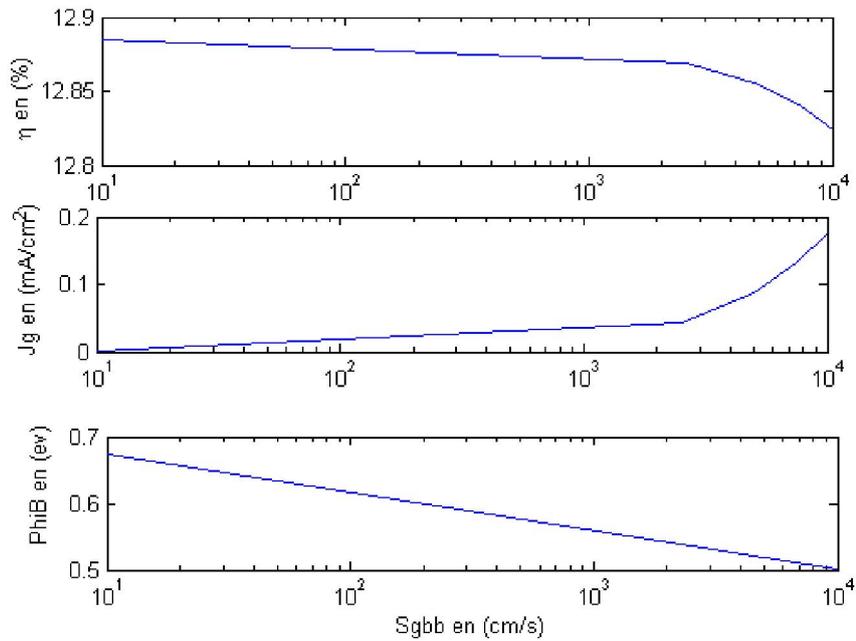
Fig. 4.   Effet de la vitesse de recombinaison aux joints de grains de la base

Enfin, d'après notre étude l'influence des joints de grains se manifeste dans la zone de l'émetteur seul. Le photo courant total diminue avec l'augmentation de la densité de courant aux joints de grains (Figure 5), sur cette figure nous avons constaté que la contribution du courant au joint de grain est de l'ordre de 2 à 6 mA/cm^2, alors que le photocourant total vari entre 26 et 31 mA/cm^2. Soit environ une contribution de 8% à 20% du courant total.
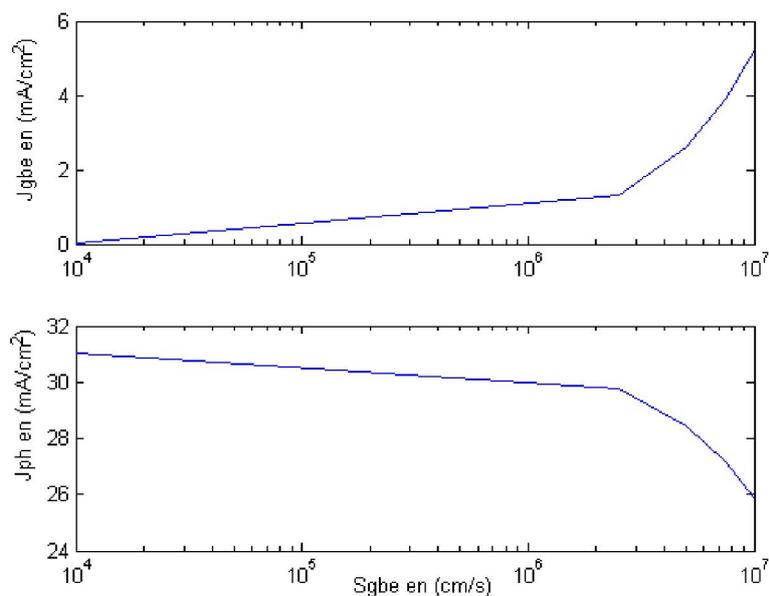
Fig. 5.   Variation de la densité totale de courant en fonction de la densité de courant aux joints de grains

4   CONCLUSION

Dans ce travail, nous nous sommes intéressés à l'étude d'une cellule solaire à base de silicium polycristallin et à sa passivation arrière et frontale au moyen de différentes structures, notamment l'empilement multicouches oxyde mince/ SiN$_x$ / SiOx PECVD, et le nitrure de silicium Si$_3$N$_4$. Nous avons constaté une amélioration du rendement avec une passivation arrière par une couche empilée oxyde mince / nitrure de silicium /oxyde de silicium PECVD, où le rendement atteint 10.77%. Pour la passivation frontale, le nitrure mince a prouvé son efficacité, dans le sens où il réduit considérablement le coefficient de réflexion de la structure. Le rapport des débits gazeux [NH$_3$]/ [SiH$_4$], durant le dépôt de ce nitrure, contrôle précisément le rendement de conversion. Ce dernier croît avec des rapports de gaz élevés. En effet, le rendement est estimé à   12.88 % pour R=10.

Les résultats de la simulation montrent que la vitesse de recombinaison optimale aux joints de grains de l'émetteur qui est de l'ordre de 10^4 cm/s donne un rendement optimum. Similairement, dans la région base, la diminution de la vitesse de recombinaison aux joints de grains fait augmenter le rendement, la vitesse de recombinaison optimale est avérée 10 cm/s.

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Les barrières comme déterminants de l'innovation au Maroc: Cas de la région de Tanger-Tétouan

[Barriers as determinants of innovation in Morocco: The case of Tangier-Tetouan region]

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ABSTRACT: Developed, so-called "emerging" countries have strategies and policies of innovation country. However, many developing countries face difficulties in the implementation of innovation strategies. In general, the research has mainly concerned the development of innovation tools. By cons, little work has concerned the factors that prevent or inhibit the activity of innovation, known in the literature: "barriers to innovation", especially in the Arab and Muslim countries and developing countries. Our research has rightly focused on the barriers to innovation in Morocco and especially in the region of Tangier-Tetouan. The purpose of this research is to develop a model to measure the interactive effects of barriers in the innovation system. For this it was necessary to identify barriers to the innovation in the region of Tangier-Tetouan process, and investigate the interrelationships between them. The approach is based on a review of the scientific papers; analysis of available statistical data; national development documents; empirical researches and other secondary data. An in-depth study of fourteen barriers to innovation has been made with industry, teachers and students. This work can be considered, in our opinion, as the first study of the barriers to innovation in the Tangier-Tetouan region and one of the few work on this subject in Morocco. Its contribution to the conceptual level is the development of models that can be used to solve the barriers of innovation at regional and national levels.

KEYWORDS: Innovation, Barriers, Strategies, Model, Morocco.

RESUME: Les pays développés ainsi que les pays dits « émergents » disposent des stratégies et politiques propres à l'innovation. Cependant un grand nombre de pays en développement rencontrent des difficultés pour la mise en place de stratégie d'innovation. De manière générale, les travaux de recherche ont concerné surtout le développement des outils de l'innovation. Par contre, peu de travaux ont concerné les facteurs qui empêchent ou inhibent l'activité d'innovation, appelés dans la littérature: «barrières de l'innovation», particulièrement dans les pays arabo-musulmans et les pays en voie de développement. Notre travail de recherche a justement porté sur les barrières d'innovation au Maroc et en particulier dans la région de Tanger-Tétouan. Le but de cette recherche est d'élaborer un modèle qui permet de mesurer les effets interactifs des barrières dans le système d'innovation. L'approche est basée sur l'examen des documents scientifiques et l'analyse des données statistiques disponibles: documents nationaux de développement, recherches empiriques et d'autres données secondaires. Une étude en profondeur de quatorze obstacles à l'innovation a été faite suite à des enquêtes menées auprès

des industriels, des enseignants chercheurs et des étudiants. Ce travail peut être considéré, à notre avis, comme la première étude concernant les barrières à l'innovation, dans la région « Tanger- Tétouan » et parmi les rares travaux relatifs à ce sujet au Maroc. Son apport au niveau conceptuel est le développement des modèles qui pourront être utilisés pour résoudre les obstacles de l'innovation au niveau régional et national.

MOTS-CLEFS: Innovation, Barrières, Stratégies, Modèle, Maroc.

1 INTRODUCTION

Depuis quelques années, l'innovation est au cœur des préoccupations des entreprises et des pays et les difficultés économiques actuelles ne freinent en rien la nécessité d'innover. Il est vital de continuer à innover en temps de crise pour se différencier des concurrents. L'innovation est synonyme de valeur ajoutée, donc de compétitivité pour les entreprises. Le processus de mondialisation influe sur l'innovation de plusieurs manières: il accroît la concurrence internationale et il permet de voir le monde comme un marché large, un flux de biens, de services et de savoirs par-delà les frontières et les interactions internationales [1]. La capacité à introduire de nouveaux produits et adopter de nouveaux procédés en premier et dans un temps plus court est devenu un impératif de compétitivité [2]. Il faut aussi relever que « la mondialisation a des conséquences bien plus profondes que la seule délocalisation d'ateliers de manufacture. Elle plonge les entreprises dans une nouvelle arène où la compétition ne se joue plus seulement au niveau des performances des produits, mais aussi sur l'efficacité globale de leur Innovation » [3]. Les pays développés exploitent les résultats de leurs innovations grâce au cumul d'expériences et surtout en interdisant aux autres de faire la même chose en protégeant leurs résultats grâce aux brevets et aux autres techniques de protection industrielle.

Une question s'impose pour les pays en voie de développement: Peut-on vraiment s'attendre à ce que ces pays connaissent une croissance aussi rapide que celle des pays développés, alors que ces derniers n'ont pas cessé de bénéficier des avantages de l'innovation technologique au cours des siècles. Il est certain, en tout cas, qu'ils devront surmonter pour cela un certain nombre d'écueils parmi eux les barrières de l'innovation.

Dans plusieurs pays en développement, les études sur l'innovation restent relativement rares soit en raison de la faiblesse des capacités d'innovation de leurs entreprises soit en raison de l'inexistence d'informations et d'enquêtes statistiques permettant de mener des études, soit en raison de l'absence même d'une stratégie nationale d'innovation. Au Maroc ainsi qu'en Tunisie, les orientations politiques affichent clairement leur conscience de l'importance de l'innovation, ces pays font de l'innovation un objectif national en parallèle avec l'emploi. Comme corollaire, différents programmes et actions législatives ont été mis en œuvre pour encourager l'innovation à la fois dans le secteur public et dans le secteur privé. Avec l'instauration conjointe d'un programme de mise à niveau de l'entreprise, plusieurs unités ont adhéré au projet de promotion de l'innovation, mais après plus d'une décennie d'expérience, les résultats de ces différentes mesures sont restés méconnus, faute de la disponibilité d'informations statistiques détaillées et fiables.

Les travaux de recherche sur l'innovation ont étudié en détail les pilotes et les sources de l'innovation, en accordant une attention particulière aux capacités technologiques et organisationnelles que les entreprises doivent développer pour devenir des innovateurs (par exemple [4], [5] et [6]). Cependant, cette littérature a moins traitée les facteurs qui bloquent l'innovation. La référence [7] souligne que la nature et l'impact des barrières doivent être étudiés avant qu'un pays mette en place sa politique d'innovation nationale. La non-compréhension de la structure et de l'intensité des barrières risque de provoquer des réactions politiques inefficaces. L'enquête sur l'innovation des entreprises dans des nombreux pays européens a permis de faire la lumière sur la «boîte noire» que représente le processus d'innovation développé par les entreprises.

2 LES BARRIÈRES DE L'INNOVATION

L'approche par les obstacles de l'innovation est nettement plus récente que celle qui aborde les déterminants de l'innovation ([8] et [9]). Elles permettent d'identifier les obstacles de l'innovation et d'en connaître leur nature, origine, importance et impact sur le processus d'innovation. Son objectif est aussi d'en mesurer les effets et conséquences, ce qui n'est pas chose aisée [10]. Cette approche permet aussi d'évaluer l'efficacité des actions publiques et de déterminer les mesures correctives pour dépasser ou éliminer ces barrières.

Une analyse générale des travaux qui portent sur les obstacles de l'innovation, nous montre un vrai manque des études qui portent sur les pays en voie de développement. A notre connaissance, seules quatre principales contributions ont explicitement étudié cette problématique: les travaux de [10] pour le cas du Chypre, de [11] sur un échantillon d'entreprises

indiennes de petites et moyennes tailles, de [12] sur des données d'enquêtes Malaisiennes et de [13] pour le cas de la Tunisie. Les études sur les obstacles de l'innovation sont généralement très rares dans les pays arabo-musulmans.

Le but de cette recherche est de déterminer les obstacles dans le processus d'innovation au Maroc.

Les obstacles de l'innovation sont de nature différente, et ils peuvent jouer un rôle clé dans la définition des caractéristiques de l'environnement technologique externe. Ils influencent aussi dans la détermination de l'attractivité d'une région pour les entreprises multinationales et locales. La décision de localiser les entreprises dans des domaines particuliers et de s'engager dans des activités innovantes pourrait être affectée, par l'évaluation des difficultés qui seront rencontrées dans le processus d'innovation.

Les barrières de l'innovation peuvent être classées de différentes manières et typologies, par exemple: origine, source…Les chercheurs ont utilisés plusieurs classements pour les barrières de l'innovation. Dans certains cas, elles sont classées par rapport aux domaines de compétence. Par exemple, la référence [14] classent les barrières de l'innovation en: barrières financières, barrières de marketing, barrières humaines…, la référence [9] classent les barrières de l'innovation en: barrières de coûts, barrières de connaissance du marché...la référence [15] classent les obstacles de l'innovation en: obstacles financiers, obstacles liés au risque, obstacles de compétences organisationnelles et obstacles juridiques. Aussi les barrières liées aux compétences en marketing tels que l'orientation client ([16], [17] et [18]), contact face à face avec les clients [19] et l'intelligence marketing ([20] et [21]) ont été citées comme les plus critiques des obstacles à la réussite du nouveau produit.

Certains chercheurs classent aussi les barrières de l'innovation sous une autre forme:

- ✓ Les obstacles formels tels que: le gouvernement, le faible niveau de la R&D, l'instabilité des politiques fiscales, trop de lois d'affaires, les droits de propriété insuffisantes et trop de règlements et de normes…
- ✓ Les obstacles informels: la corruption, l'impact de l'économie informelle, les attitudes culturelles trompeuses et les obstacles des compétences (manque de personnel qualifié, le manque d'information sur les marchés et le manque de transparence).
- ✓ Les obstacles environnementaux: risques économiques, le coût élevé de l'innovation, une forte inflation des taux d'intérêt et le manque de sources de financement approprié, le manque d'information sur la technologie…

3 MÉTHODOLOGIE

Afin de mieux comprendre l'influence des obstacles sur l'innovation dans la région de Tanger-Tétouan, nous avons opté pour:

- Méthode quantitative: questionnaire
- Méthodes qualitatives: Entretien semi-directif

Méthode quantitative: le questionnaire

Enquête préliminaire avec notre population d'étude afin d'affiner nos questions (Avec les étudiants, les enseignants chercheurs et les industriels).

 Méthodes qualitatives:

Entretien semi directif : Trois séries d'entretiens (entre 2010 et 2012) ont été réalisé auprès des deux principaux acteurs de l'innovation:

- Au niveau de l'université: étudiants, enseignants et administrateurs.
- Au niveau de l'entreprise: Dirigeants, responsables développement, responsable production, GRH…

Ces entretiens d'une durée moyenne d'une heure et demi, avaient pour objectif de comprendre la situation actuelle de l'innovation chez les entreprises interviewées, ainsi que de classer les obstacles de l'innovation selon leurs expériences.

Dans notre étude, la technique la plus appropriée dans notre cas semble être:

- En premier lieu les analyses statistiques classiques (classement, moyenne, écart type et coefficient de corrélation).
- En deuxième étape on utilisera la méthode d'enquête Delphi pour établir les relations entre les barrières.
- En troisième étape, l'analyse structurelle de Mic Mac.

Coefficient de corrélation

En probabilités et en statistiques, étudier la corrélation entre deux ou plusieurs variables aléatoires ou statistiques numériques, c'est étudier l'intensité de la liaison qui peut exister entre ces variables. La liaison recherchée est une relation affine. Dans le cas de deux variables numériques, il s'agit de la régression linéaire. Le coefficient de corrélation est compris entre -1 et +1. Plus il s'éloigne de zéro, meilleure est la corrélation, et on considère généralement que si sa valeur absolue est supérieure à 0,9, qu'il y a une très forte liaison entre les deux barrières.

Une erreur courante est de croire qu'un coefficient de corrélation élevé induit une relation de causalité entre les deux phénomènes mesurés. En réalité, les deux phénomènes peuvent être corrélés à un même phénomène-source (une troisième variable non mesurée, et dont dépendent les deux autres). Dans ce sens, et afin d'établir les liens entre les barrières d'innovation, on utilisera la méthode Delphi.

Méthode Delphi

La méthode Delphi a pour but de mettre en évidence des convergences d'opinions et de dégager certains consensus sur des sujets précis, souvent avec un caractère prospectif important, grâce à la consultation d'experts à travers un ensemble de questionnaires [22]. L'objectif le plus fréquent des études Delphi est d'apporter l'éclairage des experts sur des zones d'incertitude en vue d'une aide à la décision.

Le terme « expert » ne doit pas faire croire que cette méthode est réservée à la consultation d'autorités scientifiques de haut rang. IL faut entendre par « expert » toute personne ayant une bonne connaissance pratique, politique, légale ou administrative d'un sujet précis et ayant une légitimité suffisante pour exprimer un avis représentatif du groupe d'acteurs auquel elle appartient.

Analyse MicMac

L'objectif de l'analyse MICMAC (Matrice d'Impacts Croisés- Multiplication Appliquée à un Classement) est d'analyser le pouvoir conducteur et la puissance dépendance des variables [23]. MicMac est un outil de classement indirect. Ce classement est obtenu après élévation en puissance de la matrice. La comparaison de la hiérarchie des variables dans les différents classements (direct, indirect et potentiel) est riche d'enseignement. Elle permet de confirmer l'importance de certaines variables, mais également de dévoiler des variables qui, du fait de leurs actions indirectes, jouent un rôle prépondérant (et que le classement direct ne permet pas de déceler).

Le but d'une analyse MICMAC consiste à analyser les barrières conductrices en fonction de leurs relations avec les autres barrières. Ceci est pour identifier les principaux obstacles qui pilotent le système. Sur la base de leur pouvoir conducteur et de leur pouvoir de dépendance, les obstacles peuvent être classés en quatre catégories, comme suit:

- Le premier groupe se compose de «*barrières autonomes*» qui ont le pouvoir conducteur faible et faible dépendance. Ces obstacles sont relativement déconnectés du système, avec lesquels ils n'ont qu'un quelques liens qui peuvent être fortes.
- Le deuxième groupe se compose des barrières à charge «*facilitateurs*» qui ont le pouvoir conducteur faible mais une forte dépendance.
- Le troisième groupe «*les barrières de liaison*» qui ont un pouvoir d'impulsion importante, mais aussi la forte dépendance. Ces obstacles sont instables dans le fait que toute action sur ces barrières a un effet sur les autres et aussi un retour sur elles-mêmes.
- Le quatrième groupe comprend «*les barrières indépendantes*» ayant une puissance motrice importante, mais une faible dépendance.

4 RESULTATS

4.1 CONTEXTE RÉGIONAL

Au Maroc, il existe 16 régions économiques. Chaque région à ses propres caractéristiques au niveau de sa situation géographique, son tissu industriel et économique, son bassin de ressources humaines qualifiées, …Tanger-Tétouan est une région dynamique, elle se considère comme un important centre industriel au niveau national et elle occupe la deuxième place industrielle au Maroc avec 10% de valeur ajoutée nationale, près de 8% de la production et 14% des exportations en 2011. Actuellement, la région connaît un essor considérable, avec des projets structurels majeurs, tels que le projet Tanger Méditerranée.

4.2 ORGANISATION DE L'EXPÉRIMENTATION

Notre démarche pour chercher la validation des barrières dans le cas de la région Tanger-Tétouan est la suivante:

- Revoir les barrières grâce à un groupe d'expert: sélection de barrières importantes pour le cas de cette région parmi les barrières citées dans la littérature;
- Enquête auprès des établissements de l'université Abdelmalek Essaadi avec les étudiants, doctorants, enseignants et administratifs.
- Enquête auprès des industriels de la région.

Etape 1: étude des experts

Dans cette étape, la littérature liée aux barrières de l'innovation a été entièrement revu. A la suite de l'examen, plusieurs barrières ont été jugés efficaces dans les processus de l'innovation. Un groupe de résolution des problèmes est formé, il se compose de deux académiciens qui ont des études et expériences en matière d'innovation, deux experts de l'innovation à l'échelle nationale et trois industriels de la région. Le groupe a été invité à analyser les barrières internes et externes afin de sortir une liste des barrières à étudier dans la région de Tanger-Tétouan. Au total 14 barrières ont été déterminées:

1. La stratégie de la direction
2. Le risque économique
3. Le coût élevé de l'innovation
4. La politique gouvernementale
5. Personnel non qualifié
6. Problème de culture d'innovation
7. Résistance aux changements
8. Difficulté de trouver un partenaire
9. Manque d'accès au réseau de connaissance
10. Absence de relation avec l'université
11. Manque des résultats de la R&D
12. Le manque d'information sur la technologie
13. Le manque d'information sur le marché
14. Manque d'une politique de protection des droits de propriété intellectuelle.

Etape 2: Enquêtes

➢ Enquête au sein de l'université de la région « Université Abdelmalek Essaadi »

Afin d'avoir une image réelle de l'innovation et de ses barrières au sein de l'université Abdelmalek Essaadi. Deux types d'enquêtes ont été réalisés:

- Une enquête avec les étudiants et les doctorants.
- Une enquête avec les professeurs et les administrateurs.

➢ Enquêtes avec les entreprises de la région de Tanger-Tétouan

Pour examiner les barrières de l'innovation chez les entreprises de la région, un questionnaire a été élaboré. Tout d'abord, une étude pilote est réalisée: le questionnaire a été envoyé à 5 entreprises de la région et au directeur de l'association R&D Maroc afin de le valider. Puis, en fonction des réponses, des ajustements ont été réalisés et le questionnaire final a été envoyé aux 142 entreprises. Après plusieurs mois d'enquête, les entreprises ayant bien voulu répondre à notre questionnaire et dont les données sont exploitables sont au nombre de 76 entreprises, soit un taux de réponse de 53,5%.

Un point important à préciser avant de passer à l'exposition des résultats est que la région de Tanger-Tétouan a un statut particulier concernant la nature des entreprises installées. La présence des zones franches, des avantages fiscaux...ont fait de la région une destination des entreprises internationales pour la fabrication. Dans ce sens, on a trouvé judicieux suite à notre étude théorique de séparer nos résultats et de traiter d'une manière parallèle les barrières d'innovation chez deux types d'entreprises installées dans la région: entreprises marocaines nationales et entreprises internationales étrangères.

Les entreprises étrangères: Sont celles qu'ont choisies le Maroc pour le faible coût de la main d'œuvre, et la région de Tanger-Tétouan pour sa proximité de l'Europe et la qualité de ses infrastructures « Ces entreprises n'ont pas choisies la région pour des raisons commerciales (leurs produits fabriqués au Maroc sont désignés exclusivement au marché extérieur)». Ce type d'entreprise, s'installe principalement dans la région pour produire.

Les entreprises nationales: Sont souvent des PME/PMI marocaines répartis en grande partie dans les secteurs de textile et d'agroalimentaire. Ainsi que les petites entreprises de service. Ces entreprises souffrent souvent des moyens financiers et humains assez limités par rapport aux entreprises étrangères.

4.3 EXPOSITION DES RÉSULTATS

4.3.1 ENQUÊTE AVEC LES ÉTUDIANTS

Durant cette enquête, on a pu enquêter 759 étudiants et doctorants sur les barrières qu'elles empêchent les étudiants à innover au sein de l'université Abdelmalek Essaadi. La figure 1 présente les résultats :
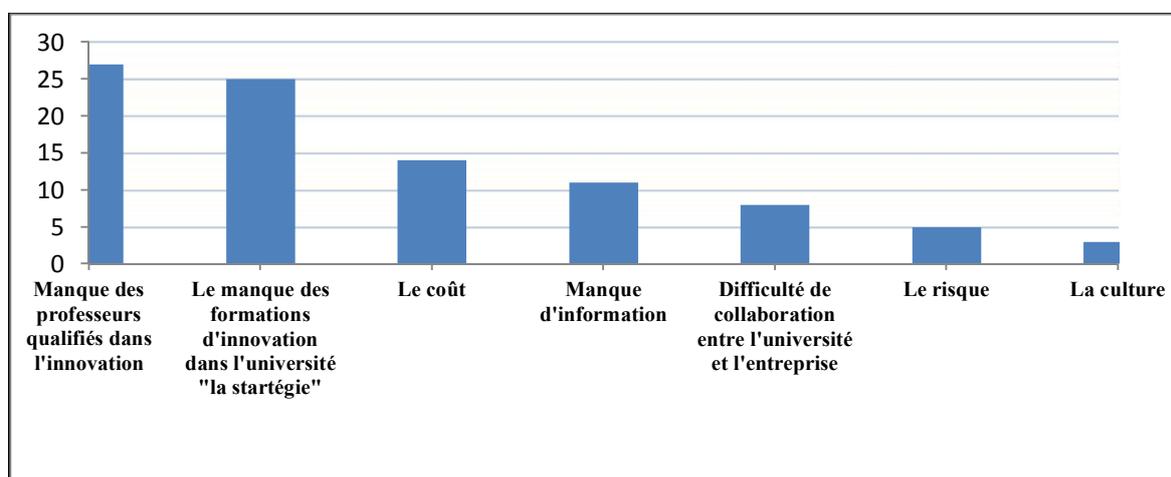

Fig. 1.   Le classement des barrières de l'innovation par les étudiants

Les étudiants ont classés le manque des professeurs et des formations en innovation comme l'obstacle le plus important de l'innovation dans l'université. La présence d'un encadrant spécialisé dans l'innovation les aideront à mieux faire face aux barrières techniques et opérationnelles. Ensuite viendra le financement de ces projets ainsi que le manque d'information concernant la nouveauté internationale dans les domaines concernés. La difficulté de trouver une entreprise partenaire et la notion de risque sont aussi des barrières importantes qui bloquent les étudiants à innover.

4.3.2 ENQUETE AVEC LES PROFESSEURS ET LES ADMINISTRATEURS

La population ciblée comprend environ 20% des professeurs de chaque établissement de l'université Abdelmalek Essaadi ayant un cursus soit scientifique, technique, commercial ou managérial. Soit une somme de 80 professeurs qui ont répondu à l'enquête.

L'enquête a été composé en 3 parties principales: le professeur et l'innovation, la relation université-entreprise en innovation, les obstacles et les moteurs de l'innovation au sein de l'université.

Concernant la première partie, les résultats montrent que seulement 2,5% des professeurs enquêtés ont déjà déposé un brevet. Un pourcentage qui reste très faible par rapport à la stratégie du Maroc dans le développement de l'innovation au sein des universités. En ce qui concerne le contact régulier avec le milieu industriel, 46,9% des professeurs déclarent avoir des contacts réguliers dont seulement 12,34% ont des relations dans le cadre des recherches, le reste c'est plutôt dans le cadre des PFE (Projets de Fin d'Etudes des étudiants). Concernant la mise en œuvre d'une action innovante (soit réalisée dans le cadre de la recherche ou dans le cadre de la pédagogie sous forme des projets innovants), 12% des professeurs rencontrés ont des idées des projets innovants. Ainsi il a était proposé à chacun des enquêtés de classer les obstacles selon leur degré de gravité.

Afin de déterminer les obstacles de l'innovation des professeurs et administrateurs de l'université, nous avons demandé aux professeurs et administrateurs de classer les barrières d'innovation par degré de gravité.

L'échelle de gravité des obstacles utilisée est la suivante :

- 1 = obstacle qui n'a causé aucun retard
- 2 = obstacle qui a légèrement retardé
- 3 = obstacle qui a modérément retardé
- 4 = obstacle qui a sérieusement retardé
- 5 = obstacle qui a rendu impossible

Dans le questionnaire, les interviewés donnent une note de 1 à 5 à chaque obstacle proposé afin d'étudier le degré d'influence de chaque obstacle sur l'innovation.

Pour être plus subjectif dans notre démarche de recherche, on a séparé les résultats du classement du degré de la gravité des barrières par type des professeurs :

1. Les professeurs qui ont une relation avec l'innovation (ont déjà déposé un brevet, ont déjà innové, ont travaillé en partenariat avec une entreprise pour l'amélioration d'un produit ou d'un procédé ou ceux qu'ont suivi une formation en innovation)…, nous allons les appeler *professeurs «innovateurs»*.
2. Les professeurs qui n'ont aucune relation avec l'innovation (ils n'ont jamais innové, ils n'ont jamais suivi une formation en innovation, ne possèdent aucun brevet..), on va les appeler *les professeurs «non innovateurs».*
3. La troisième catégorie, *les professeurs «administrateurs»,* ce sont les professeurs chargés de la partie administration et stratégie au sein de l'université, exemple des vice-doyens chargé de la recherche, le vice-président chargé de la recherche, les doyens et les directeurs des établissements…

Le tableau 1 présente la moyenne des réponses par type des professeurs :

Tableau 1.   La moyenne des réponses par obstacle et par catégorie des professeurs enquêtés:

Les barrières d'innovation	Prof. innovateurs	Prof. non innovateurs	Prof. Administrateurs
Absence d'encadrement	2,80	3,73	3,40
La notion de risque	3,20	2,93	3,20
L'éducation et la formation	3,60	4,13	3,60
La culture	4,00	2,87	3,40
La résistance au changement	3,20	3,47	3,00
La confiance entre les universitaires et les industriels	3,40	3,80	3,80
L'individualisme	2,60	3,60	2,60
Le tissu politique marocain	4,00	4,13	3,40
Le coût	2,80	4,13	4,80
Le manque de temps pour innover	1,40	1,73	1,80
Le manque d'information	3,40	2,93	2,40
Difficulté de collaboration entre l'industrie et l'université	4,00	3,73	3,60
Formation insuffisante en innovation	2,60	3,47	4,20
Tissu économique	4,40	3,60	4,20

- Professeurs innovateurs-Professeurs non-innovateurs

Si on compare les obstacles d'innovation chez les professeurs innovateurs et les non-innovateurs, une grande différence concernant les barrières «coût élevé de l'innovation» et « la culture de l'innovation » est remarquée. Dans un niveau de différence moins marquant, on trouve les barrières: Individualisme, formation insuffisante en innovation et absence d'encadrement comme des barrières plus importantes chez les professeurs innovateurs que les non-innovateurs.

Mais les deux catégories les classent comme obstacles qui retardent modérément ou légèrement l'innovation sans l'empêcher.

- Professeurs innovateurs-Professeurs administrateurs

La remarque la plus importante est que sur presque la moitié des barrières étudiées, les professeurs innovateurs et administrateurs partagent le même classement concernant le degré de gravité et d'importance de ces barrières. Cependant,

il existe quelque différence au terme de certaines barrières, par exemple : «le coût de l'innovation» et «Formation insuffisante en innovation». Les professeurs administrateurs considèrent le coût élevé de l'innovation ainsi que l'absence des formations en innovation comme des barrières importantes qui pourront empêcher l'innovation au sein de l'université. Pour les professeurs innovateurs, ils les classent seulement comme obstacles retardataires de l'innovation et non empêcheurs.

Concernant «la culture», «le tissu politique» et «la difficulté de collaboration entre l'université et les entreprises», ils ont été jugés comme sérieux par les professeurs innovateurs et juste retardataires modérément de l'innovation dans le cas des professeurs administrateurs.

- Professeurs non-innovateurs- Professeurs administrateurs

Il n'existe pas des grandes différences de moyenne du degré de gravité des obstacles entre les professeurs administrateurs et non-innovateurs. Les quelques petites différences existantes concernent principalement les barrières: «Individualisme» et «le tissu politique» qui sont jugés comme obstacles qui retardent sérieusement l'innovation dans le cas des professeurs non-innovateurs, et qui retardent modérément l'innovation dans le cas des professeurs administrateurs. Concernant l'obstacle «formation insuffisante en innovation», les professeurs administrateurs le trouvent un obstacle sérieux qui peut même aller jusqu'au empêcher l'innovation, tandis que les professeurs non-innovateurs le considèrent comme un obstacle qui peut retarder légèrement l'innovation au sein de l'université.

4.3.3 ENQUÊTE AVEC LES ENTREPRISES

Au Maroc, les PME sont caractérisées par un effectif permanent qui ne dépasse pas 250 personnes. D'après la Fédération de la PME (affiliée à la CGEM), les PME marocaines constitueraient 95% du tissu économique du pays et seraient implantées pour 72% dans le commerce et les services. En 2012, elles auraient occupées plus de 50% des salariés du secteur privé et auraient contribuées à la hauteur de 30% aux exportations marocaines et de 50% aux investissements privés nationaux. Toutefois, alors qu'elles représenteraient environ 40% de la production nationale, elles ne participeraient qu'à hauteur de 20% de la valeur ajoutée du pays. Le tableau 2 présente la taille des entreprises participantes dans l'enquête.

Tableau 2.   *La taille des entreprises participantes dans l'enquête*

	TPE	PME/PMI	Grande entreprise
Pourcentage des sociétés enquêtées	5,26%	55,27%	39,47%

L'enquête nous a permis de déduire que les entreprises les plus innovantes dans la région sont les PME suivi des grandes entreprises. Ce qui reste logique par rapport à leur stratégie dans la région. La majorité des grands groupes s'installent dans la région pour la main d'œuvre et pas pour la recherche et le développement. La composition en termes d'affiliation des entreprises de la région explique ces résultats. En effet, 63% des sociétés enquêtées qui forment le tissu industriel de la région sont des entreprises étrangères exécutantes des ordres de fabrications envoyés et désignés par les maisons mères installées dans les pays d'origines. Ces entreprises présentent plus de 90% de la catégorie «grande entreprise» traitée dans ce document. Dans la suite, nous allons distinguer les entreprises nationales et étrangères dans la recherche des principaux obstacles de l'innovation dans la région.

Le tableau 3 présente la moyenne de degré de gravité des 14 obstacles par taille d'entreprise:

Tableau 3.   *La moyenne du degré de gravité des obstacles par taille d'entreprise*

Obstacles	La moyenne de degré de gravité des obstacles par taille de l'entreprise		
	TPE	PME	GE
La stratégie de la direction	2,0	3,3	3,3
Le risque économique	4,5	2,3	2,4
Le coût élevé de l'innovation	4,7	3,6	2,3
La politique gouvernementale	3,0	2,6	3,1
Personnel non qualifié	4,5	3,1	2,4
La culture	3,6	3,4	3,4
La résistance aux changements	2,3	2,7	3,4
La difficulté de trouver un partenaire	4,5	2,4	2,5
Le manque d'accès au réseau de connaissance	4,5	2,0	2,4
L'absence de relation avec l'université	4,0	2,4	2,5
Le manque des résultats de la R&D	2,7	2,6	2,6
Le manque d'information sur la technologie	4,0	3,2	2,3
Le manque d'information sur le marché	4,3	2,2	2,8
Le manque d'une politique de protection des droits de propriété intellectuelle	3,8	2,0	2,8
% des entreprises participantes dans l'enquête	**5,26%**	**55,27%**	**39,47%**

La taille de l'entreprise semble jouer un rôle important dans la configuration des obstacles rencontrés par toutes les entreprises. La conclusion la plus immédiate est que les petites entreprises évaluent tous les obstacles d'une importance moyenne ou élevée. Ce qui est en accord avec les études réalisés au niveau international. Les différences les plus marquantes entre petites et grandes entreprises sont des barrières financières et humaines. Le manque du personnel qualifié est un facteur qui est clairement perçu le plus souvent dans les petites entreprises. Aussi l'absence des relations avec l'université, la difficulté de trouver des partenaires et d'accès aux réseaux des connaissances sont autant des barrières qui empêchent les TPE de la région à innover. Ces facteurs sont également en accord avec les conclusions de l'analyse théorique qui met en lumière les défis particuliers auxquels font face les petites entreprises en raison de leur taille. Cette différence est moins marquée pour les autres obstacles tels que la politique gouvernementale, la culture ou le manque des résultats sur la R&D.

Entreprises nationales

Pour les 30 entreprises nationales enquêtées, le tableau 4 présente la moyenne du degré de gravité de chaque obstacle.

Tableau 4.   *La moyenne du degré de gravité des obstacles dans le cas des entreprises nationales*

	Moyennes	Ecart type
Stratégie de la direction	4,4	1,034
Risque économique	2,4	1,432
Coût	3,4	0,845
Politique gouvernementale	4,2	1,064
Personnel non qualifié	3,6	1,051
La culture	3,6	1,067
Résistance aux changements	2	1,501
Difficulté à trouver des partenaires	3,6	1,067
Manque d'accès aux réseaux de connaissance	3,4	0,98
Absence de relation avec l'université	1,4	1,67
Manque de résultats de R&D	2,8	1,064
Manque d'information sur la technologie	3,4	1,116
Manque d'information sur le marché	3	1,172
Manque de protection de la Propriété Industrielle	1,6	1,165

Le résultat le plus marquant concernant les barrières de l'innovation chez les entreprises nationales installées dans la région de Tanger-Tétouan, est le nombre des obstacles dont la moyenne ≥ 3. Plus de 71% des barrières sont considérées comme des obstacles importants pour l'innovation dans la région. La stratégie de la direction et la politique gouvernementale sont les deux obstacles jugés comme les plus sévères par les entreprises nationales. Selon ces entreprises, si l'état met en place des dispositifs encourageants en termes de conseil, d'exonération d'une partie des impôts pour les entreprises innovantes…le pourcentage des entreprises innovantes augmentera.

La culture, le manque des personnels qualifiés, la difficulté de trouver des partenaires, le coût, le manque d'accès aux réseaux de connaissance, l'absence de relation avec l'université, le manque d'information sur la technologie et le marché, sont les obstacles les plus importants qui empêchent les entreprises nationales à innover.

Il faut noter que dans le cas des entreprises nationales, peu d'obstacles sont jugés non influents sur l'innovation.

Entreprises étrangères

Le même travail a été réalisé pour les 46 entreprises étrangères enquêtées. Le résultat est présenté dans le tableau 5:

Tableau 5.   La moyenne du degré de gravité des obstacles dans le cas des entreprises étrangères

	Moyennes	Ecart type
Stratégie de la direction	3,89	0,89
Risque économique	2,44	1,14
Coût	2,78	1,2
Politique gouvernementale	2,33	1,23
Personnel non qualifié	3	1,13
La culture	3	1,3
Résistance aux changements	2,67	1,43
Difficulté à trouver des partenaires	2,44	1,026
Manque d'accès aux réseaux de connaissance	1,89	1,02
Absence de relation avec l'université	2,89	1
Manque de résultats de R&D	2,33	1,1
Manque d'information sur la technologie	2,33	1,1
Manque d'information sur le marché	1,89	1,16
Manque de protection de la Propriété Industrielle	2	1

Pour cette catégorie des entreprises, le nombre des obstacles considérés comme sérieux est beaucoup plus limité que les entreprises nationales. Pour ces entreprises étrangères, l'obstacle le plus important qui rend l'innovation très difficile est « la stratégie de la direction ». Les deux autres obstacles déclarés comme importants dans le processus d'innovation pour ces entreprises sont la culture et le manque des personnels qualifiés, deux barrières qui pourront influencées sur le choix du changement de stratégie de ces entreprises.

4.4   LES RELATIONS ENTRE LES BARRIERES DE L'INNOVATION : ENQUETE DELPHI

Afin de trouver les relations entre les barrières de l'innovation, on appliquera la méthode Delphi.

Étape 1 : Critères de sélection d'experts

Lors de cette étape, le principal critère que nous avons retenu pour la sélection des experts est que ces derniers devaient avoir « une expérience dans le domaine de l'innovation ». Par exemple, pour les académiques, le participant devait ainsi avoir été auteur ou coauteur d'un article scientifique dans le domaine de l'innovation ayant comme orientation le management de l'innovation de façon générale.

Étape 2 : Élaboration de la liste d'experts

Afin d'avoir une vue globale sur les relations entre les barrières de l'innovation dans la région de Tanger-Tétouan, nous avons choisi des experts industriels, académique et étatique. La qualité des 12 experts participants dans l'enquête est la suivante:

✓ 3 universitaires qui ont travaillé sur différents thèmes de l'innovation dans la région de Tanger-Tétouan,

✓ 1 expert en marketing d'innovation,

✓ 1 arbitre indépendant du groupe qui est très impliqué dans le sujet de l'innovation au niveau national,

✓ 7 industriels dont 4 sont des entreprises avec une performance notable en innovation (entreprises innovantes). Les trois restants sont des entreprises qu'ont été obligé d'abandonner leurs projets d'innovation dans des états d'avancements différents suite à la présence du plusieurs barrières.

Étape 3: Contact avec les experts listés et référés

Au cours de cette troisième étape, nous avons contacté les experts listés à l'étape 2. Les attentes ainsi que la procédure ont été bien expliqué pour tous les experts. Ainsi cette étape à valider la motivation et l'encouragement des experts de nous accompagner jusqu'au trouver un consensus entre l'ensemble des experts.

Étape 4 : Invitation des experts à participer à l'étude

La quatrième étape a consisté à inviter chacun des 12 experts à prendre part à notre enquête et à leur expliquer les devoirs liés à leur participation afin de garantir les chances de succès de l'étude.

Processus d'administration du questionnaire

Au cours des étapes 5, 6 et 7, nous avons demandé aux experts de se prononcer sur les objets suivants:

1) Les liens entre les 14 barrières de l'innovation dans la région de Tanger-Tétouan.
2) Le sens de relation entre ces barrières.
3) Détermination de matrice des liens entre les barrières.

L'enquête a demandé trois tours avant d'arriver à un accord entre les 12 experts. Ces différents tours nous ont permis de trouver et de valider la matrice des relations entre les barrières présentée dans le tableau 6.

La matrice est constituée de l'obstacle lui-même et d'autres obstacles, ce qui peut aider à atteindre l'accessibilité. Tandis que la série des antécédents est constituée de l'obstacle lui-même et les autres obstacles, qui peuvent aider à y parvenir. Puis l'intersection de ces ensembles ou séries est dérivée de tous les obstacles.

Tableau 6.   La matrice initiale d'accessibilité

Barrières		Les numéros des barrières												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Stratégie de la direction	1	1	1	1	1	1	1	1	0	1	1	0	0	1
2	Risque économique	1	1	0	0	1	0	1	0	0	0	1	1	1	1
3	Coût élevé de l'innovation	1	1	1	1	1	0	1	1	1	1	1	0	1	1
4	Politique gouvernementale	1	1	1	1	1	1	0	1	0	1	0	1	1	1
5	Personnel non qualifié	0	1	0	0	1	1	1	1	0	1	0	0	0	0
6	Problème de culture d'innovation	1	0	0	0	1	1	1	0	0	1	0	0	0	0
7	Résistance aux changements	1	0	0	0	0	0	1	0	0	0	0	0	0	0
8	Difficulté à trouver des partenaires pour l'innovation	1	1	0	0	0	0	0	1	1	1	0	1	1	0
9	Manque d'accès aux réseaux de connaissance	1	1	1	0	1	0	0	0	1	0	1	1	1	0
10	Absence de relation avec l'université	0	1	1	0	1	0	1	0	1	1	0	0	0	0
11	Manque de résultats de R&D	1	1	0	1	0	0	0	1	1	1	1	0	0	1
12	Manque d'information sur la technologie	1	1	0	0	0	0	0	0	0	1	1	1	1	1
13	Manque d'information sur le marché	1	1	1	0	0	0	0	1	0	0	1	1	1	0
14	Manque de protection de la Propriété Industrielle	0	0	1	0	0	0	0	0	0	0	0	0	1	1

4.5 ANALYSE MICMAC

Après incorporation de la transitivité, et après le calcul des sommets de la matrice, le graphe des influences et des dépendances directes entre les barrières « nommé aussi le diagramme MicMac » est présenté dans la figure2.

Notons que la puissance conductrice de chaque barrière est le nombre total d'obstacles (y compris lui-même), qui lui peut contribuer à la réalisation. Ces puissances de conduite et de dépendance seront utilisées plus tard dans la classification des barrières dans les quatre groupes: Autonomes, dépendants, indépendants, et les obstacles de liaisons.
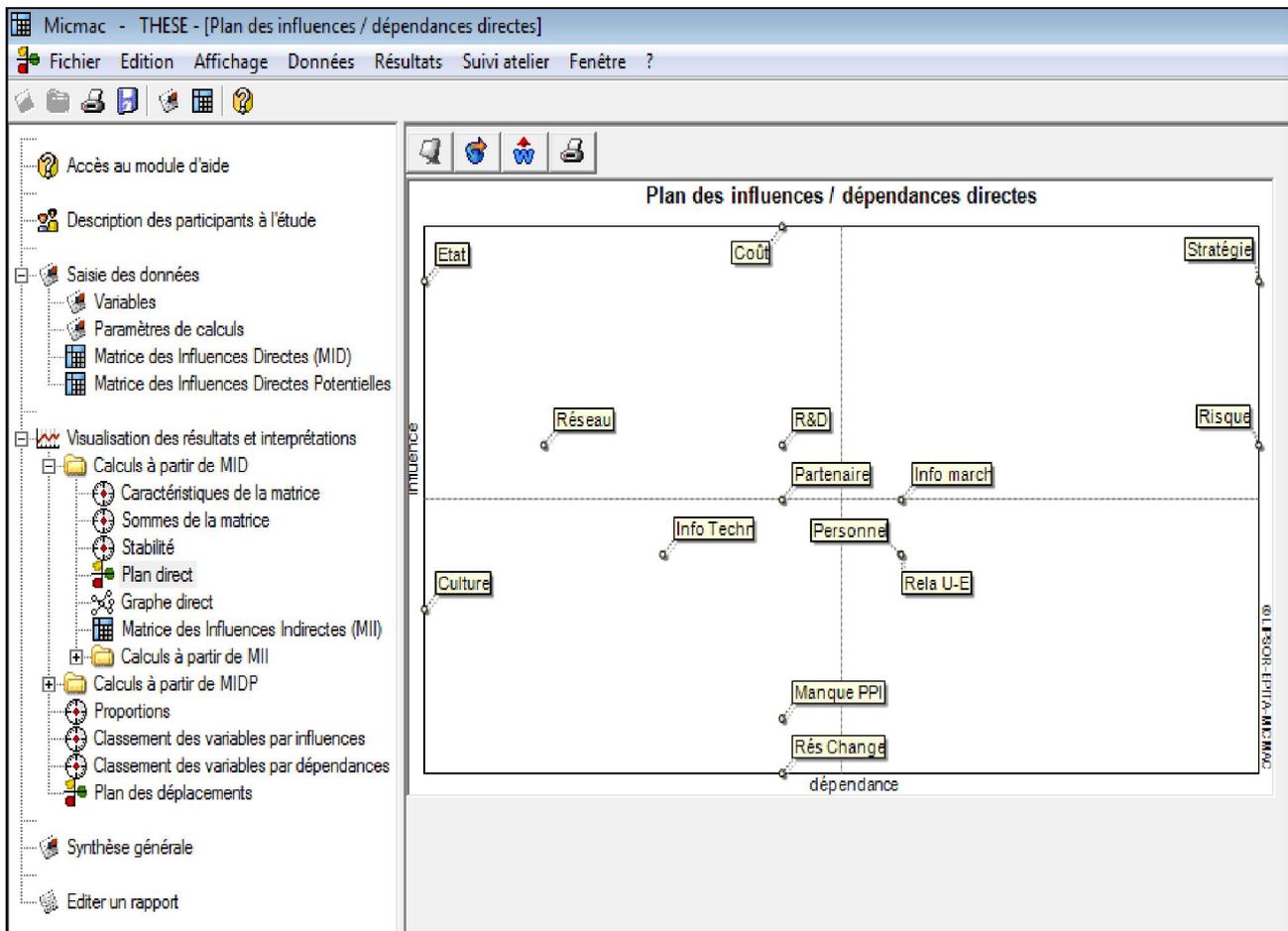

Fig. 2. *Le plan des influences et des dépendances directes (Logiciel MicMac)*

La stratégie de la direction et le risque économique sont considérés comme des obstacles de liaison qui ont une forte puissance d'entraînement ainsi que la forte dépendance. Un petit changement dans la stratégie de la direction ainsi que dans le risque économique affecte le système d'une manière considérable.

L'absence de relation avec l'université et le manque du personnel qualifié sont des pilotes faibles mais fortement dépendent des autres obstacles. Elles sont considérées comme des barrières facilitatrices.

La politique gouvernementale, le coût de l'innovation, le manque de la R&D et le manque d'accès aux réseaux de connaissance sont des obstacles qui ont des forts pouvoirs de conduite. Ainsi, il faut les attaquer premièrement si on cherche le dépassement des barrières de l'innovation.

La culture, la résistance aux changements, le manque de la protection de propriété industrielle et le manque des informations sur la technologie sont des obstacles avec un faible pouvoir de dépendance et ils sont des faibles pilotes. Ils sont considérés comme des obstacles autonomes.

5 MODELE DES BARRIERES DE L'INNOVATION DANS LA REGION

Le modèle des barrières de l'innovation est le résultat de l'analyse des classements des barrières de l'innovation par degré de gravité et les relations entre ces dernières qui résultent de l'enquête Delphi et de l'analyse MicMac.

Les figures suivantes présenteront les modèles des barrières de l'innovation au niveau académique et industriel.

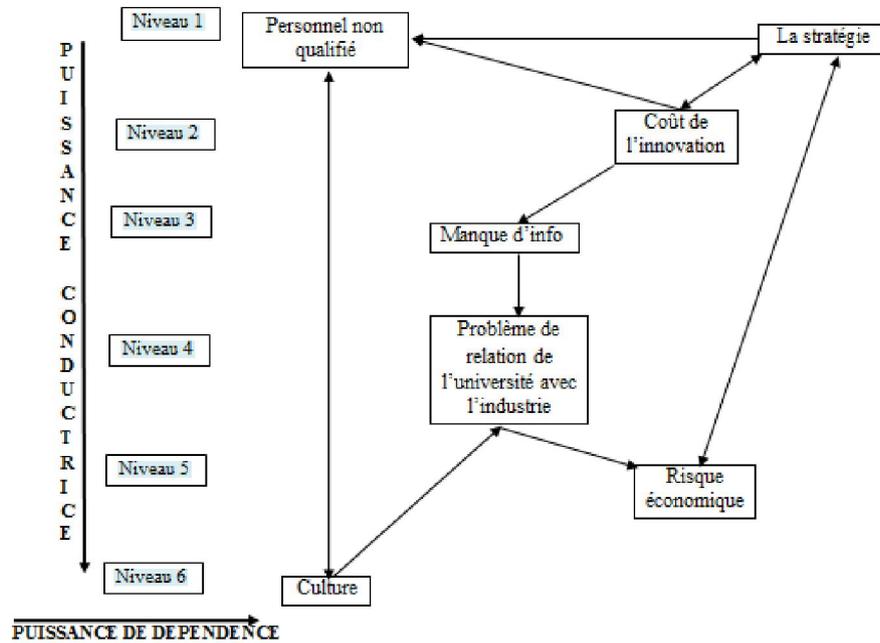### 5.1 MODELE DES BARRIERES DE L'INNOVATION CHEZ LES ETUDIANTS

Fig. 3.   Modèle des barrières d'innovation par degré de gravité pour les étudiants

Pour les étudiants, le problème de l'innovation dans l'université est purement stratégique. C'est l'absence d'une stratégie qui vise l'innovation au niveau de l'université qui a entrainé le manque des professeurs spécialistes dans l'innovation qui pourront les encadrer et les orienter dans des projets innovants. Au deuxième niveau, on trouve les problèmes financiers. L'étudiant doit innover et chercher un partenaire extérieur qui prend en charge et sponsorise son innovation. Chose non évidente surtout pour les petites innovations et dans la culture et le cadre de la relation actuelle entre l'université et les entreprises. Cette relation qui ne répond pas aux attentes des étudiants, influence sur les sources d'information de ces derniers et augmente le risque du non correspondance de leurs innovations aux demandes du marché.

5.2 MODELE DES BARRIERES DE L'INNOVATION DES PROFESSEURS INNOVATEURS
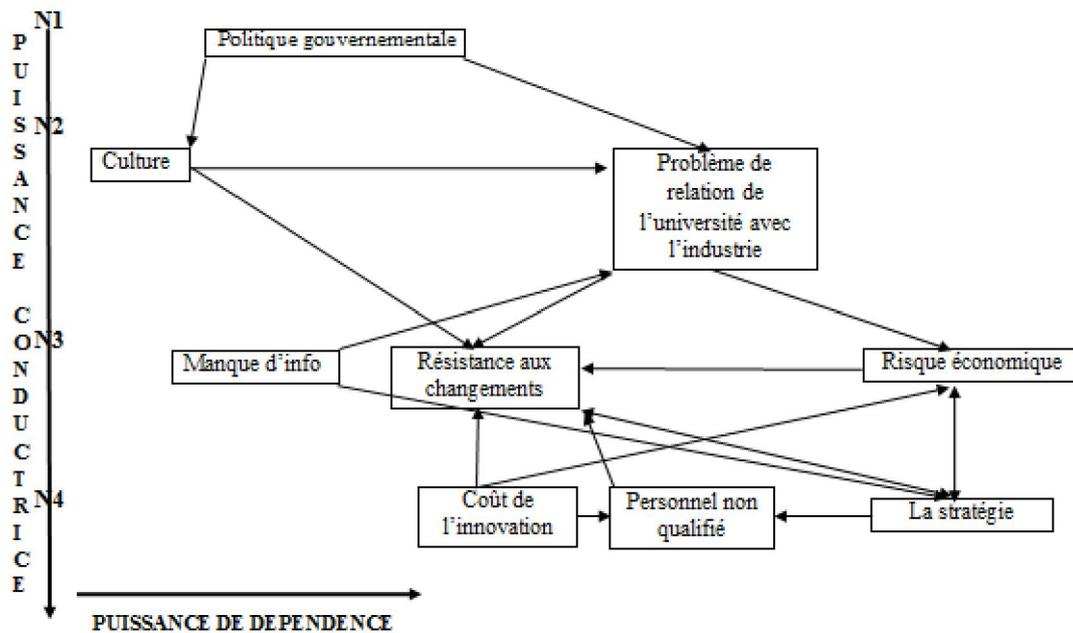

Fig. 4.   Modèle des barrières d'innovation par degré de gravité des professeurs innovateurs

Pour les professeurs innovateurs, la politique gouvernementale est classée au primer niveau du modèle, c'est la barrière la plus importante en terme de degré de gravité. Cette barrière influence sur la relation de l'université avec son milieu socio-économique et aussi sur la culture d'innovation au Maroc. Au deuxième niveau du modèle, on trouve le problème de relation entre l'université et les entreprises. Ce problème qui fait naître le manque d'information sur le marché et l'industrie et un risque de non-exploitation des projets innovants de l'université par les concernés.

5.3 MODELE DES BARRIERES DE L'INNOVATION DES PROFESSEURS NON INNOVATEURS

Contrairement aux professeurs innovateurs, les professeurs non-innovateurs trouvent que le coût de l'innovation est une barrière importante pour l'innovation et ils le classent au premier niveau du modèle avec la politique gouvernementale. Le coût élevé de l'innovation influence sur la résistance aux changements et le manque des personnels qualifiés. Et il est influencé par la stratégie, le problème de relation entre l'université et l'industrie et la politique gouvernementale. Cette dernière influence sur la stratégie universitaire en innovation.
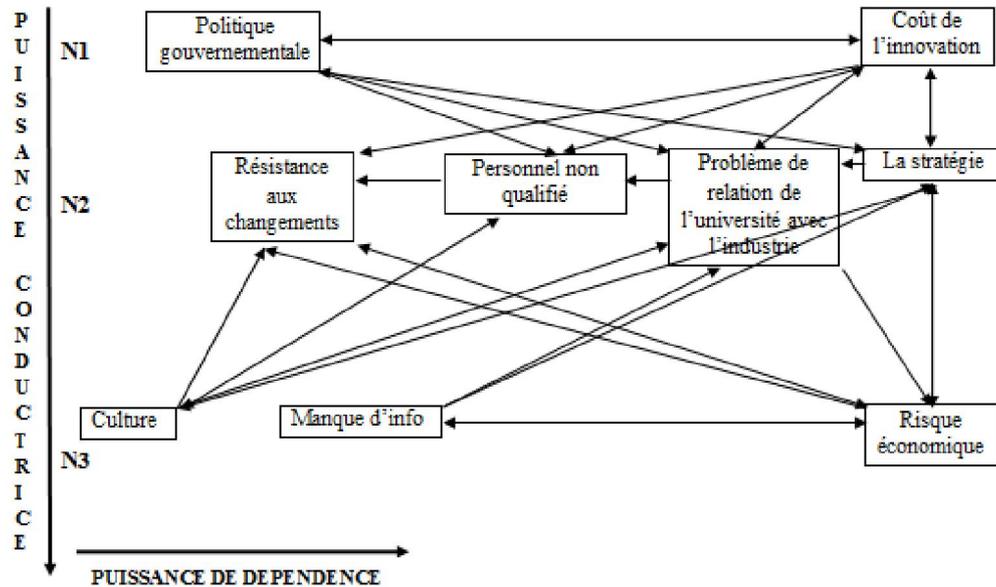
Fig. 5. *Modèle des barrières d'innovation par degré de gravité des professeurs non innovateurs*

5.4 **MODELE DES BARRIERES DE L'INNOVATION DES PROFESSEURS ADMINISTRATEURS**
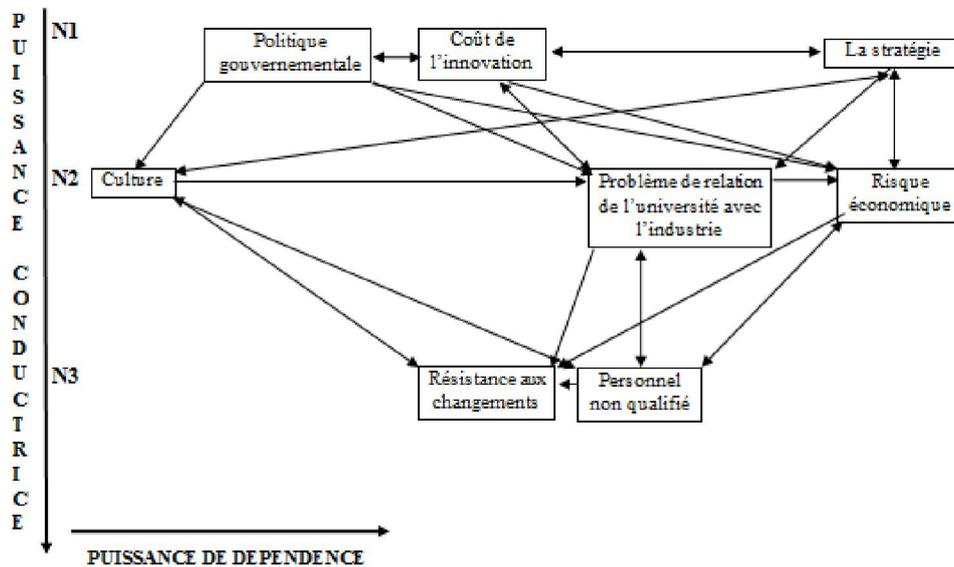

Fig. 6. *Modèle des barrières d'innovation par degré de gravité des professeurs non innovateurs*

Pour les administrateurs: le coût, la stratégie et la politique gouvernementale sont les principaux obstacles de l'innovation au sein de l'université

En générale, on peut dire que le modèle des professeurs administrateurs est plus proche du modèle des professeurs non-innovateurs que celui des professeurs innovateurs concernant le classement de principales priorités. Les administrateurs partagent l'avis des professeurs non-innovateurs concernant le coût de l'innovation et la stratégie. Ils partagent l'avis des professeurs innovateurs concernant le rôle de la culture et son influence sur la résistance aux changements des professeurs. Les administrateurs ou les décideurs dans l'université sont conscients des principaux obstacles de l'innovation au sein de l'université. Par contre deux barrières principales dépassent leur niveau d'intervention, à savoir la politique gouvernementale et l'absence d'un budget dédiée à l'innovation au sein de l'université.

5.5 MODELE DES BARRIERES DE L'INNOVATION DES ENTREPRISES NATIONALES

Pour le cas des entreprises nationales, la politique gouvernementale est l'obstacle le plus important en raison de son degré de gravité le plus élevé ainsi que sa grande puissance d'entraînement. Cela peut être validé par les précédents résultats d'enquête. Cette barrière est positionnée au niveau le plus haut dans la hiérarchie du modèle. La politique de gouvernement est une barrière indépendante liée avec plusieurs autres barrières (la stratégie, le personnel non qualifié, la culture, le coût de l'innovation, la difficulté à trouver des partenaires, le manque d'information sur la technologie, le manque d'accès au réseau de connaissance…). Ceci dit que cette barrière doit être traitée prématurément pour pouvoir améliorer le système d'innovation des entreprises d'origine nationales. Cette politique doit être ciblée par type d'entreprise et par secteur. La barrière «résistance aux changements», est positionnée au niveau le plus bas du modèle. Ceci dû à sa forte puissance de dépendance et à sa faible puissance d'entraînement et aussi son degré de gravité faible par rapport aux autres barrières.

Les obstacles qui sont au deuxième et troisième niveau du modèle, jouent un rôle clé dans le partage et la recherche des connaissances et également dans la collaboration. Ces obstacles nécessitent une plus grande attention de la part du top management et des décideurs. La puissance d'entraînement et diagramme de dépendance donnent quelques indications sur l'importance relative et les interdépendances de ces obstacles.
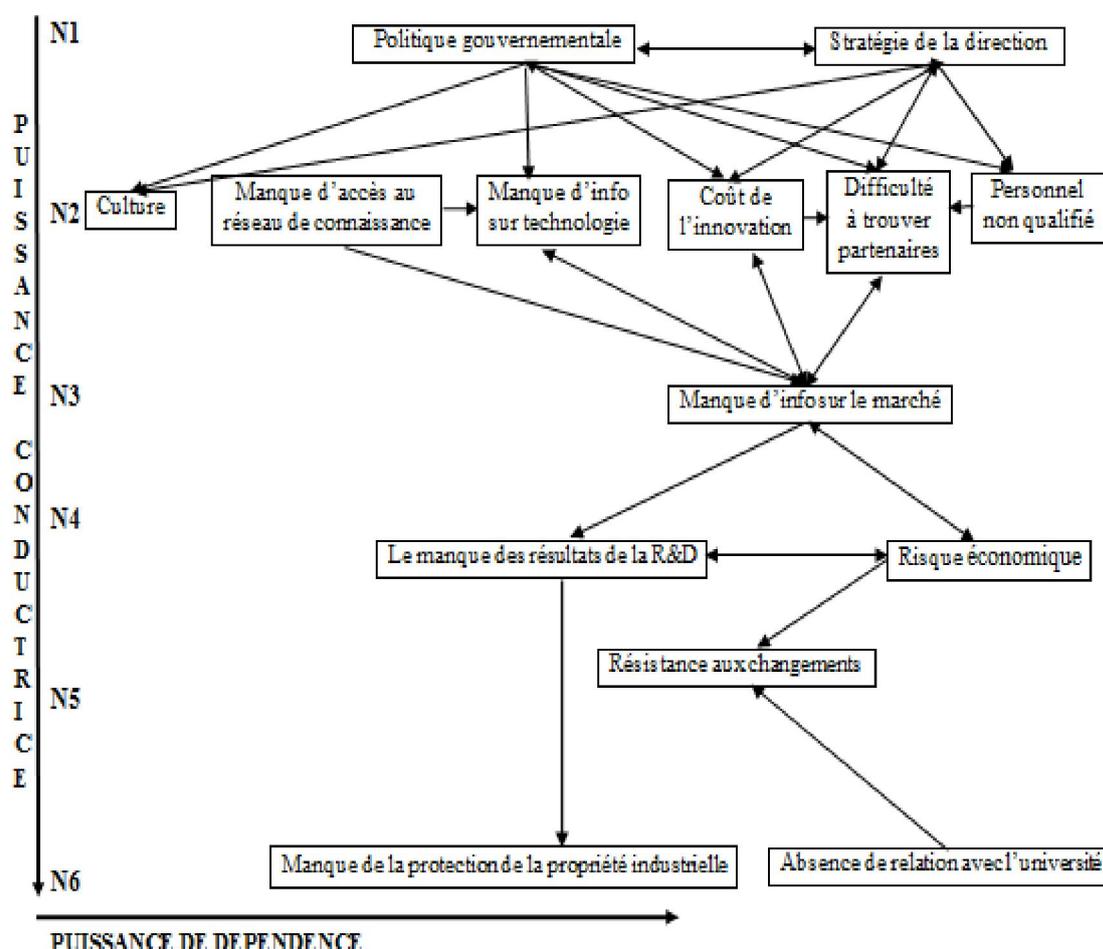
Fig. 7.   Modèle des barrières d'innovation par degré de gravité des entreprises nationales

5.6 MODELE DES BARRIERES DE L'INNOVATION DES ENTREPRISES ETRANGERES

La barrière «stratégie de la direction» est l'obstacle le plus important à l'innovation dans le cas des entreprises étrangères installées au Maroc. Si l'entreprise étrangère ne possède pas une stratégie d'innovation au Maroc, tout le système d'innovation est bloqué. Cet obstacle se classe tout seul au premier niveau du modèle des barrières de l'innovation, c'est une

barrière de liaison où le pouvoir d'impulsion est important, mais aussi une forte dépendance. Cet obstacle est instable dans le fait que toute action sur cet obstacle a un effet immédiat sur les autres et aussi un retour sur elles-mêmes.

Les deux barrières «culture» et «personnel non qualifié» se positionnent au deuxième niveau du modèle. La culture influence et influencée par «la stratégie de la direction». Par conséquent, tracer une bonne stratégie d'innovation dans l'entreprise, c'est aussi agir sur le développement de la culture d'innovation dans l'entreprise. Bien qu'il s'agisse d'une barrière autonome, la culture participe indirectement dans les interactions de causalité des plusieurs autres barrières.

La barrière «personnel non qualifié» influence et influencée par: la culture, la résistance aux changements et l'absence de relation entre l'entreprise et l'université. Cette barrière est très importante vu que les ressources humaines sont la base de toute innovation. La présence des personnels qualifiés dans l'innovation aidera l'entreprise à s'engager plus rapidement dans un projet innovant, et surtout sans que les salariés pratiquent de la résistance par manque de compétence.

Au quatrième niveau, on trouve la barrière «la politique gouvernementale». Cette barrière qui a été classée au premier niveau dans le cas des entreprises nationales, a aussi de l'importance pour les entreprises étrangères.

Une remarque importante concerne «le manque d'accès au réseau de connaissance»: dans le cas des entreprises nationales cette barrière a été classée en deuxième position, dans le cas des entreprises étrangères, elle est classée en dernière position avec un niveau d'importance et d'influence faible sur les barrières de l'innovation. Le statut des entreprises étrangères permettra à ces entreprises d'accéder plus facilement que les entreprises nationales aux réseaux de connaissance, via les maisons mères, les autres filiales…Ce qui diminue l'importance de cette barrière dans ce cas.
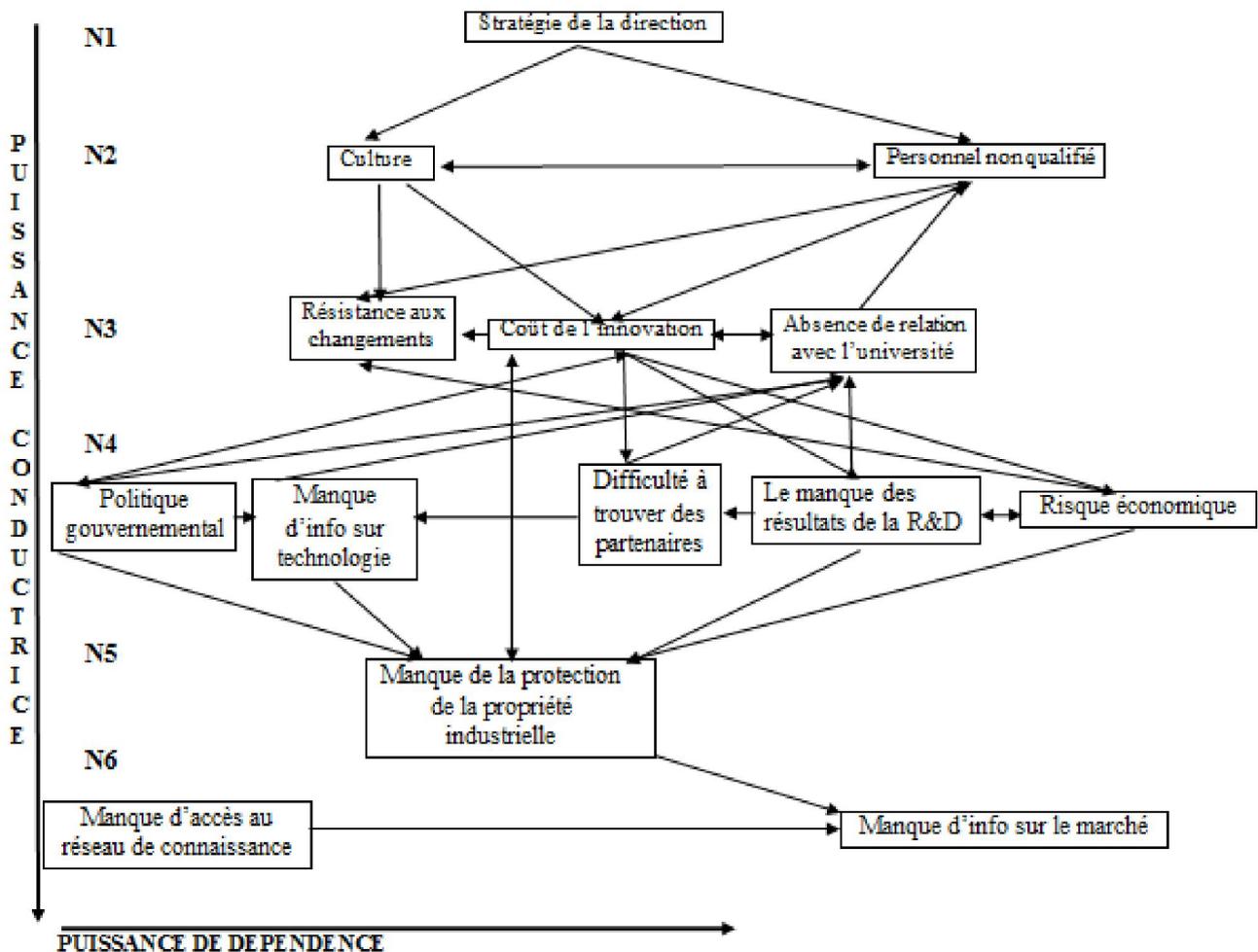

Fig. 8. *Modèle des barrières d'innovation par degré de gravité des entreprises étrangères*

6 CONCLUSION

Les principaux résultats de cette recherche montrent que le développement de l'innovation dans la région de Tanger-Tétouan passe essentiellement par :

1. La mise en place d'une politique gouvernementale adaptée à la spécificité de la région et l'introduction de l'innovation dans la stratégie tracée par la direction,

2. Le renforcement des liens entre les structures privées et publiques (université, centres de recherches…),

3. La proposition d'aides aux problèmes financiers liés à l'innovation et l'instauration et la stimulation d'une culture d'innovation scientifique et technique,

4. L'importance du rapprochement entre l'université et l'entreprise afin de développer des innovations. C'est que par l'expérience que les avis et les convictions des gens peuvent changer.

Ces déterminants de l'innovation sont ses leviers principaux. Leur mise en place pourra être réalisée par plusieurs instruments. Ci-dessous on va présenter les principales mesures à mettre en place pour que la région profite d'une manière la plus optimale possible de chaque déterminant résultant de notre présente recherche.

A partir de l'enquête que nous avons menée avec les acteurs de l'innovation dans la région de Tanger-Tétouan (entreprises, université, experts…), un problème concernant la politique gouvernementale de l'innovation est souligné.

Il faut choisir les points d'excellence de la région et d'orienter la stratégie d'innovation dans ce sens. Sachant que les principaux secteurs porteurs de la région de Tanger-Tétouan sont l'automobile, le textile et la logistique. Un maximum des ressources dans ces trois secteurs pour leur donner des chances réelles de succès en projets d'innovation s'impose. D'autre côté, chaque région a une ou plusieurs niches d'excellence universitaire qui peuvent être ainsi des éléments de leur stratégie de différenciation. Les échanges ou le transfert de connaissances passent principalement par l'intensité et la qualité des relations «université-industrie».

Le problème de financement de l'innovation a été classé parmi les principaux obstacles de l'innovation dans notre région. La mise en place des incitations fiscales pour encourager l'innovation dans la région semble s'imposer. Les études effectuées sur les effets des incitations fiscales accordées aux dépenses R&D, le plus souvent au niveau national, donnent des résultats variés mais plutôt positifs car les incitations fiscales ont un effet de levier réel sur la R&D des entreprises et donc sur la productivité de ces dernières ([24], [25] et [26]). Au niveau national, il faut inciter les banques à jouer le jeu avec des crédits en faveur de l'innovation.

Ouvrir l'innovation sur tous les acteurs, on recommande d'aller vers l'open innovation: modèle d'innovation ouverte basé sur le partage et la coopération. A titre d'exemple: depuis quelques années, l'idée des Fab Lab prend du terrain. Une idée basée sur l'open source qui permet à ses utilisateurs de réaliser leurs objectifs en s'appuyant sur l'aide d'autres utilisateurs du réseau. Cela permet aussi d'être à la pointe de la technologie sans avoir besoin d'un important apport financier.

Le quatrième obstacle majeur de l'innovation dans la région est d'une dimension culturelle. On pourra voir la culture d'innovation de plusieurs horizons. La question qu'on se pose: comment instaurer une culture d'innovation dans la région? Dans ce sens, plusieurs instruments pourront être efficaces: la mise en place des compétitions, le renforcement de la créativité dans l'enseignement et la stimulation de l'esprit innovant chez les tout-petits, l'organisation des conférences, des rencontres et de partage d'expériences sur le thème de l'innovation et de la créativité…Mais le point le plus important qu'il faut signaler aussi, c'est que la notion de l'innovation sera instauré indirectement par la mise en place de tous les instruments cités ci-dessus.

En résumé, les modèles des barrières de l'innovation que nous avons proposés dans ce document représentent un premier pas vers une maîtrise des déterminants de l'innovation dans la région, ce qui devrait contribuer à augmenter les chances du succès des futures stratégies d'innovation au niveau régional.

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Business Process Reengineering in e-Governance: Maintenance of People Records with Implementation of Relational Database Management System

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ABSTRACT: Good governance has become a subject of interest in every day discussions among political social, economical and business circles. All governments are willing and trying hard to formulate new strategies for effective public service delivery. e-Governance is one of the strategies for good governance, which helps effective service delivery. But mere computerization or inclusion of ICT will not be helpful to serve the cause. Rather we need an overhauling of the entire system. The solution resides in the idea of BPRE: Business Process Reengineering. Indian government has started its journey by implementing the idea of UID which will further lead to the concept of one centralized database. The author visualizes the maintenance of centralized database which will come into existence after the complete execution of the idea of UID. The current paper aims at the maintenance of centralized database by fusing together e-governance with BPRE, with special reference to UID and applying the fundamental concepts of Relational Database Management System (RDBMS). In the current paper the author suggests the implementation of RDBMS by which this centralized database could be maintained keeping in mind different events which adds and modifies the details of this database. Finally author plans to discuss the benefits of the proposed system over the existing system.

KEYWORDS: e-Governance, Business Process Reengineering, Relational Database, Inventory, Management system.

1 INTRODUCTION

A.P.J. Abdul Kalam, former President of India visualizes e-governance as a transparent smart e-governance with seamless access, secure and authentic flow of information crossing the interdepartmental barrier and providing a fair and unbiased service to the citizen. Bringing the internet and governance together means bringing the greatest technology of our times to bear on the most fundamental concerns of our society. "E-governance is about redefining the vision and the scope of the entire relationship between citizen and government. It will enable us to specifically address some of the long stalemated issues in public affairs with appropriate conceptual breakthroughs. Government online as a concept is different from the traditional model of the Government" [1]. E-government just cannot be achieved only with computerizing the existing system and fusing it with ICT tools. We have to analyze the entire system, its input and outputs demanded at different levels. The overall change could be implemented only if we reengineer the entire system rather than just reformulating it.

Reengineering suggests that generally an organization is constructed by consolidating several sub units together into one. In this procedure units are defined and categorized by defining tasks separately, but it is observed that in such scenario these sub units are not taking responsibility for the overall performance of the organization. Reengineering observes that the overall performance of the organization can be improved only if we implement fundamental changes in the structuring of the organization.

1.1 E-GOVERNANCE

In simple terms, E-governance refers to governance processes in which Information and Communication Technology (ICT) play an active and significant role. E-Governance (from electronic governance, also known as e-gov, digital governance,

online governance or in certain context transformational governance) refers to government's use of information technology to exchange information and services with citizens, businesses, and other arms of government [2]. But it is WRONG to equate Digital Governance with simply digitalization, or automation of governance services. It is much more than that. E-governance should not be just another facet of Governance or one more interface between citizen and government. E-governance must go far beyond mere computerization of back office operations. E-governance has to fundamentally change the operations of government and implies a new set of responsibilities to citizens and the government. E-governance is one of the strategies for good governance, which helps effective service delivery. Good governance has become a subject of interest in every day discussions among political social, economical and business circles. E-governance in its widest sense is the application of modern communication and information technologies for reengineering governing processes to make them more citizen-friendly, cost-effective and transparent.

Digital Governance has to be seen as a 'tool' for good governance and human development. E-Government may be applied by the legislature, judiciary, or administration, in order to improve internal efficiency, the delivery of public services, or processes of democratic governance.

1.2   BUSINESS PROCESS REENGINEERING (BPRE): A NOVEL APPROACH TO RADICAL IMPROVEMENT

In 1990, Michael Hammer, a former professor of computer science at the Massachusetts Institute of Technology (MIT), published an article in the Harvard Business Review, in which he claimed that the major challenge for managers is to obliterate forms of work that do not add value, rather than using technology for automating it [3]. This statement implicitly accused managers of having focused on the wrong issues, namely that technology in general, and more specifically information technology, has been used primarily for automating existing processes rather than using it as an enabler for making non-value adding work obsolete.

Hammer's claim was simple: Most of the work being done does not add any value for customers, and this work should be removed, not accelerated through automation. Instead, companies should reconsider their processes in order to maximize customer value, while minimizing the consumption of resources required for delivering their product or service. A similar idea was advocated by Thomas H. Davenport and J. Short in 1990 [4] at that time a member of the Ernst & Young research center, in a paper published in the Sloan Management Review

2   GOVERNANCE IN INDIA: WITH A VISION OF TRANSFORMING INTO E-GOVERNANCE

Collection of data about the populace is a very important and significant part of government functioning. From revenue collection to development schemes, all planning, execution and monitoring depends on availability of detailed and up to date data of the governed masses. This database is "dynamic" and the main challenge is of keeping it up to date. At present this challenge is met by frequent surveys/ enumerations .E-governance should necessarily look at this major and critical aspect of government function. BPRE (Business Process Re-Engineering) has been a major tool for improvement of governance processes. This paper applies the principles of BPRE to this aspect of governance. It also correlates this proposal with the UID project of the government by implementing a centralized database designed through RDBMS. The author collected details of all the data being maintained of different aspects of people in different sections from district collectorate Khargone.

2.1   EXISTING SYSTEM OF DATA COLLECTION AND MAINTENANCE OF CITIZENS INFORMATION USING AADHAR (UID)

The Unique Identification Authority of India (UIDAI), is an agency of the Government of India responsible for implementing the AADHAAR scheme, a unique identification project. It was established in February 2009, and will own and operate the Unique Identification database. The authority aims to provide a unique id to all Indians. The authority will maintain a database of residents containing biometric and other data. But still this is not clear that whether this data will be stored in the form of a database consisting of several related tables or not. Till now, this UID authority of India is working for the collection of data only focusing on UID.

2.1.1   SALIENT FEATURES OF AADHAAR

AADHAAR is a 12-digit unique number which the Unique Identification Authority of India (UIDAI) will issue for all residents in India (on a voluntary basis). The number will be stored in a centralized database and linked to the basic demographics and biometric information – photograph, ten fingerprints and iris – of each individual. It is easily verifiable in an online, cost-effective way. It is unique and robust enough to eliminate the large number of duplicate and fake identities in government

and private databases. The random number generated will be devoid of any classification based on caste, creed, religion and geography [5].

Addressing illegal immigration into India and terrorist threats is another goal of the program In January 2012, the government of India reiterated the goal of the UID project, "... is primarily aimed at ensuring inclusive growth by providing a form of identity to those who do not have any identity. It seeks to provide UID numbers to the marginalized sections of society and thus would strengthen equity. Apart from providing identity, the UID will enable better delivery of services and effective governance." National Population Registry (NPR) project, a distinctly separate initiative by the Home Ministry, is meant to issue national identity cards to enhance national security.

Most reports suggest that the plan is for each Indian resident to have a unique identification number with associated identifying biometric data and photographs by 2011. However, other reports claim that obtaining a unique number would be voluntary, but those that opt to stay out of the system "will find it very inconvenient: they will not have access to facilities that require you to cite your ID number."

Government distributed benefits are fragmented by purpose and region in India, which results in widespread bribery, denial of public services and loss of income, especially afflicting poor citizens. As the unique identity database comes into existence, the various identity databases (voter ID, passports, ration cards, licenses, fishing permits, border area ID cards) that already exist in India are planned to be linked to it. The Authority is liaising with various national, state and local government entities to begin this process. The Union Labor Ministry has offered its verified Employment Provident Fund (EPFO) database of 42 million citizens as the first database to be integrated into the unique ID system. Contrary to various previous reports, UIDAI does not use any existing databases citing problems of fraud and duplicate/ghost beneficiaries in the existing databases. Instead, it will enroll the entire population using its multi-registrar enrollment model using verification processes prescribed by the UIDAI. This will ensure that the data collected is clean right from the beginning of the program. However, much of the poor and underserved population lack identity documents and the UID may be the first form of identification they will have access to. The Authority will ensure that the Know Your Resident (KYR) standards do not become a barrier for enrolling the poor and has devised suitable procedures to ensure their inclusion without compromising the integrity of the data. The NPR is an important partner registrar in the enrollment process.

Based on the analysis, the UIDAI confirms that the enrollment system has proven to be reliable, accurate and scalable to meet the nation's need of providing unique 'Aadhaar' numbers to the entire population. It is asserted that the system will be able to scale to handle the entire population. The analysis resulting from such a large data set (8.4 crore enrollments) is empirically repeatable and statistically accurate.

2.2 FUSION OF BPRE AND E-GOVERNANCE WITH SPECIAL REFERENCE TO DATA COLLECTION OF CITIZENS:

Creation of centralized database

The government of India has concentrating on the idea of collecting information and issuing UID to every section of the society. But it is not yet revealed how the collected data will be maintained or how the collected information will be used in context with several departments issuing ID proofs to a single citizen.

The author wishes to suggest the idea of centralized database, having foundations on the UID and then maintaining that database using the concept of Relational Database Management System (RDBMS). In the current paper the author suggests that a centralized database should be created which can be modified by different events that occur in the life of a person like birth, death, marriage, migration etc.

Generally, the database includes several attributes which may be classified into four categories, as follows:

a) Permanent data (like name, father's name etc.)
b) Changing attributes which can be automatically updated (like age etc.)
c) Changing attributes which can be updated by various processes in the collectorate (birth registration, death registration, marriage reg.)
d) Data which cannot be updated by any of the processes.

Accordingly tables were designed by the principles of "master tables" and "transaction tables". The category 'd' attributes were further analyzed to probe if new processes need to be introduced for updation. It was found that it is possible to maintain a dynamic database without periodic surveys/enumerations by implementing principles of BPRE and introducing very few changes in the processes.

3   PROPOSED SYSTEM OF MAINTENANCE OF PEOPLE'S RECORD : (CREATION AND MAINTENANCE OF CENTRALIZED DATABASE)

Data about citizens and its statistical analysis has always been important for governing a country. In fact the word "statistic" has the same origin as statesman. This data has gradually grown in magnitude and complexity. Thus it was the complexity of 1890 US census which led the invention of punched card which later became a computer input device. In India also, district wise data is kept regarding many aspects of citizen's life. The data has been always collected through census or surveys. Since many of the attributes change over time, updation is necessary. Traditionally this updation has been done by subsequent surveys or census. However if we look at the problem of data updation ab initio, it is evident that many of the attributes can be updated automatically. Also the updation of the remaining attributes can be mostly done by "transactions" (like birth, death) which are already being processed by the same government machinery. But these are being done in isolation to the "census" activity.

Taking an industrial analogy, there may be millions of items in the inventory of a large, complex engineering enterprise. Yet their enumeration is not done by frequent census. Rather a master data, once entered, is as frequently updated as any transaction takes place.
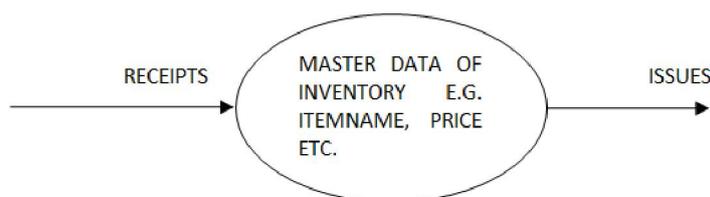
Similarly, the population data can be started as "master" on a particular date, say a census, and then updated.
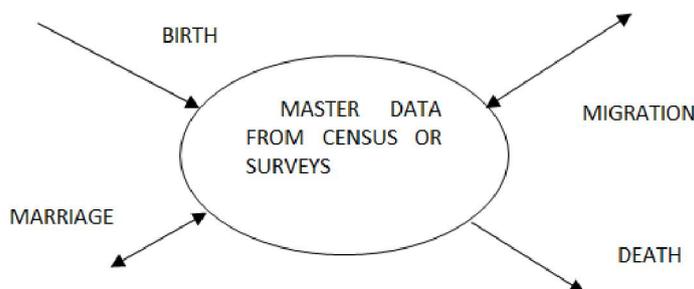
In the proposed system, the database is designed in order to store all the relevant information about citizen. Unlike the existing way of storing data in district collectorates, this is an integrated centralized database. Also it is dynamic in the sense that the attributes are updated regularly with events like births, deaths, marriages, emigration, and immigration. These events are treated as "transactions'" and the "master records' are updated with the help of these. Births introduce new records in the populace. Deaths mark certain records as deleted.

3.1   DOMAIN OF ATTRIBUTES USED IN EXISTING SYSTEM

At present, the following attributes are used and stored in a database by the district government for different purposes:

- Family id
- Name
- Gender
- Caste
- Date of birth
- Father's name
- Mother's name
- Spouse name
- Country of birth
- Citizenship
- Permanent address

- Age
- Duration of stay
- Marital status
- Relationship with head of the family
- Land ownership
- Drinking water
- Present address (including village, block, district, state)
- New family id
- Educational qualification
- Job/profession
- Average monthly income

4   PROPOSED SYSTEM

The proposed system identifies and categorizes the attributes as permanent, updatable automatically, updatable by government processes, updatable by just one new process proposed (immigration/emigration) and finally those few which do require surveys, as follows:

4.1   PERMANENT ATTRIBUTES

- Family id
- Name
- Gender
- Caste
- Date of birth
- Father's name
- Mother's name
- Country of birth
- Citizenship
- Permanent address

4.2   AUTOMATICALLY UPDATED ATTRIBUTES

- Age
- Duration of stay

4.3   ATTRIBUTES UPDATED BY GOVERNMENT PROCESSES

- Marital status
- Spouse name
- Relationship with head of the family
- Land ownership
- Drinking water
- Additional processes (emigration/immigration):
- Present address(including village, block, district, state)
- New family id

4.4   REMAINING ATTRIBUTES TO BE SURVEYED

- Educational qualification
- Job/profession
- Average monthly income

It is, thus, found that lot of updation can be done without frequent surveys.

5 DATABASE DESIGN WITH CONCEPTS OF RDBMS: CODD'S RULES AND NORMALIZATION

The fundamental idea behind the relational database design is that we need very little effort to maintain a large set of information stored in it. This can be achieved by creating a database by implementing Codd's Rules and performing Normalization. The idea of normalization will focus on minimum of redundancy and data anomalies in the database [6]. Updation in the database can be done with the help of small queries which provides facilities to database administrator and users, for instance searching information, adding and deleting information, updation of stored information and many more. The query can be one line statement to do large tasks in databases without giving much pain to the end user.

Following tables are designed to store above mentioned data in normalized form:

Table 1.   Populace table

This is THE MASTER table which holds the general information about citizen, like his village, family, name, relation with head of the family. This table is updated with events like birth, marriage, death and migration etc. It refers to various master tables for codes of village, block, district, state on the one hand and codes of relation, education and income, on the other.

Table 2.   Birth table

Birth table is a transaction table which carries the attributes to store the details of a new born. It carries the information of a child with reference to his family, parents etc. with the help of some attributes like familyid, memberidfather, memberidmother etc. With every new birth, a record is added in the table which ultimately updates the master table populace which holds the data of citizens.

Table 3.   Death table

Death is an important event which modifies the family structure especially if the person is head of the family. This table store and records the details of every death in district which ultimately modifies the populace table. It stores the details of Death and if the dead person was head of the family, then id of the family member who becomes the new head. Other attributes like familyid, memberid, date of death are also recorded.

Table 4.   Marriage table

Marriage is an important event which changes the structure of family. So, it is mandatory to modify the details. Marriage table is designed as a transaction table which is updated every time with the event of marriage in a family. It carries details like date of marriage, spouse name and id etc.

Table 5.   Migration table

This is THE NEW DATA BASED ON A NEW PROCESS BEING PROPOSED. It is proposed to take the district as a "closed store" in which "receipts" and "issues" take place by births, death, marriages and immigration/emigration. It is proposed to introduce the process of registration of immigration. It may be voluntary but, like UID, mandatory for all government transactions.

Table 6.   BPL table

BPL table is a transaction table, created to store information about citizens who are listed under below poverty line. For the benefit of poor, government has a provision of survey to enlist poor, after an evaluation. The score obtained by the citizen decides whether he should be treated as poor or not. All these information are stored in this table with the help of attributes like, bplscore, income etc.

Table 7.   Relation table

This is a master table which defines various relations with their codes.

Table 8.   Education table

This is a master table which holds the information of educational status. It carries only two attributes education code which is of numeric type to hold the unique code assigned to different qualifications and education, of type character to describe the educational status. This table is not supposed to be modied frequently and other tables can only refer to this table to get the information about education.

Table 9.   Village code table

This table is a master table which carries the master data about village. It only defines the code of the village and name of the village. This information is used by many transaction tables where village name is to be used.

Table 10.   Panchayatdistrict 13

This is a master table about panchayats of an example district number 13. It defines all the panchayats in a district with the help of attributes like panchayat code, panchayat name etc. whenever any information is required about panchayats of district number 13 then this table can be referred.

Table 11. Nationblocks table

This is a master table which holds the details of blocks in a district. It carries all the relevant information of a block i.e. Block code, block name, block headquarter name, number of villages in a block etc. Different tables refer to this table to get the information about blocks.

Table 12. Nationdistrict table

Like block master, this is also a master table which carries the information about districts. It stores information like district name, district code, number of blocks in a district etc. Different tables are connected to this table to get the information about districts of nation.

Table 13. States table

This is a master table which holds the details of states of nation. All the states were listed in this table and for any interstate transaction, details of state is necessary, for example state name, state code, state capital etc. so these and other attributes are listed and hence used by other transaction tables.

6   UPDATION IN DATABASE

Here the author has given some sample queries to show how simple queries can maintain a large database of population of a district. The author has included some fundamental tasks like, addition of a record in populace table on the event of birth, deletion of a record from populace table on the event of death, updation of information of a family on the event of marriage etc.

QUERY 1: *Appending a Record in Populace on Birth*

INSERT INTO populace (dob, gender, familyid)SELECT births.dob, births.gender, births.familyid FROM births;

This is a query which fetches information from birth table like dob, gender and familyid of a new born and insert into populace table.

QUERY 2: *Updating Record in Populace Table*

UPDATE populace SET populace.dob = Date()-populace!Age*365;

This is an update query which modifies the date of birth from populace table

QUERY 3: *Update on Marriage:*

UPDATE populace SET populace.familyid = trim(Str(populace!villagecode))+Trim(Str(populace!NewFamily_id));

This query will update populace table on marriage by updating the information of familyid attribute.

QUERY 4: *Delete On Death :*

DELETE populace!familyid AS Expr1, populace!dob AS Expr2, [populace]![familyid], [populace]![dob], * FROM populace WHERE ((([populace]![familyid])="17130030010113") AND ((([populace]![dob])=CDate("6/Nov/2009")));

This query deletes a record from populace table on death of a citizen. One has to enter the familyid and date of death of the citizen.

7 BENEFITS OF THE PROPOSED SYSTEM

The design and implementation of the above mentioned database in the present administrative scenario may bring about a revolutionary change. Because it not only eradicates the need of frequent surveys but also simplifies the tedious job of storing complex information of a nation having population more than a billion. The benefits of this new change are numerous if implemented properly in coordination with training of the staff who handles the job. Following are some of the major advantages:

- Less surveys will be required to collect and modify the information about citizen
- Time, money and effort will be saved as the creation and maintenance of centralized database will minimize the need of surveys and data collection and different levels.
- Searching process of information will be simplified because the entire set of data will be maintained in a centralized database maintained through some query language.
- If the concept of centralized database is implemented, then there will be no need of having different registration processes for certificates like, birth, marriage, caste, license, passport, death etc. only UID will be given and rest of the details will be available through the centralized database

The entire scenario of the government processes and administration will be changed by having e-governance implemented with the ideas and mechanism of BPRE.

8 CONCLUSION

The paper proposes maintenance of people records based on the model of industrial inventory with "receipts" being births, marriages, immigrations and "issues" being deaths and emigration. It is proposed to take the district as a "closed store" in which these "transactions" take place. At present processes of births, deaths and marriages are mandatorily registered. It is proposed to introduce the process of registration of immigration also. It may be voluntary but, like UID, mandatory for all government transactions.

Some changes which cannot be trapped by the system are:

- Change in educational qualification
- Change in profession/job
- Change in income

These may require periodic surveys but they will be more specific, less frequent and easier. Once the UID scheme of central government is implemented, some of these may also be possible to do within the system. UID may be included in all personnel databases in all organizations and that may help updation of all attributes.

The new process of registration of immigration/emigration may be made voluntary on the lines of UID. However, like UID, it may be mandatory for all registration with the government. This rider will make it popularly accepted.

ACKNOWLEDGEMENTS

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A Novel Approach for Gain and Bandwidth Re-Configurability in Helical Antenna

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ABSTRACT: A Pi-wall shaped partial cavity backed 1½ turn helical antenna has been designed. The helix turns are kept low to provide compact design. The gain and bandwidth re-configurability is achieved by placing the helix in center of the Pi-wall shaped partial cavity which thus can be rotated about its axis providing reflections from the walls at various rotation angle. The rotational angles of the helix are varied with the incremental step size of 45° in anticlockwise direction. The odd number of turns will provide asymmetry of the helix with respect to the cavity walls and will thus excite various resonant bands as the helix is rotated inside the designed cavity. A Computer Simulation Tool is used for the design verification. The antenna is operating in the range of 5-15 GHz and has a peak gain of 7.5 dB and a highest bandwidth of 3.69 GHz. The Pi-shaped partial cavity is fabricated with lightweight aluminum metal and the helix is made of copper. Slight geometrical modification was made during the process of fabrication to improve the bandwidth response of the antenna. The antenna being conformal and robust in design may find its application for personal wireless communication and rough terrain areas.

KEYWORDS: Pi-shaped Partial Cavity, Antenna, Rotation Angles, Re-configurability, Return Loss.

1 INTRODUCTION

The helical antenna was first introduced by Kraus in 1946 [1] and in the past five decades it has gone through various design modifications with aim of improving basic antenna parameters. Now a days helical antenna finds its application in WLAN, satellite communication, military applications etc. and therefore a demand arises to employ a design with conformal shape, reconfigurable characteristics and robustness which can significantly help in communication at various bands as and when application demands. So to incorporate all such features, a partial cavity has been designed in the shape of "Pi" which back a 1½ turn helical antenna.

It is important to find the best suited orientation of helix inside the cavity which results in desirable resonating bands. This is done by rotating the helical antenna with an offset angle of 45° degree in anticlockwise direction inside the cavity. At these various angles, the antenna response is extracted using Computer Simulation Tool.

2 ANTENNA DESIGN

Initially a Pi-wall shaped partial cavity has been designed as shown in Fig. 1. The cavity has a width of 24mm, wall height of 20mm and wall thickness are kept as 2mm. With the employment of Pi shaped for the design of cavity, not only it provides conformability but also helps to confine the electric field vector and thus improves the resonant bands. A rectangular helix with strip width of 2mm and thickness of 1mm is designed which is loaded inside the cavity. Fig. 2 shows the helix geometrical configuration. Here the turns of helical antenna are compromised and limited to values 1½ only. This is done to provide compactness to the design and also 1½ turn will provide an odd symmetry with respect to the cavity walls and will help in achieving different resonant bands as it is rotated inside the partial cavity. Fig. 3 shows the various rotation angle performed inside the partial cavity.

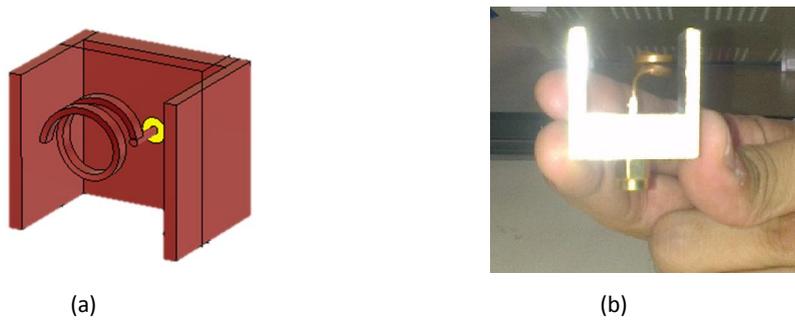(a)

(b)

Fig. 1.   Design of Pi-wall partial cavity backed 1½ turn helical antenna

(a)

(b)

Fig. 2.   Helix geometrical configuration

(a) 0° position

(b) 45° position

(c) 90° position

(d) 135° position

(e) 180° position

(f) 225° position

(g) 270° position
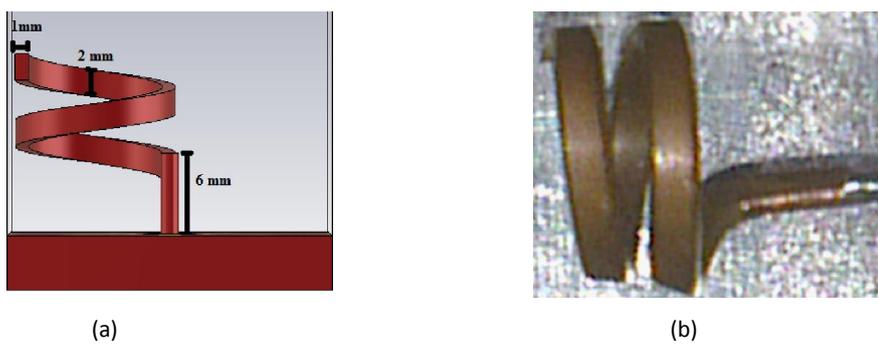
(h) 315° position
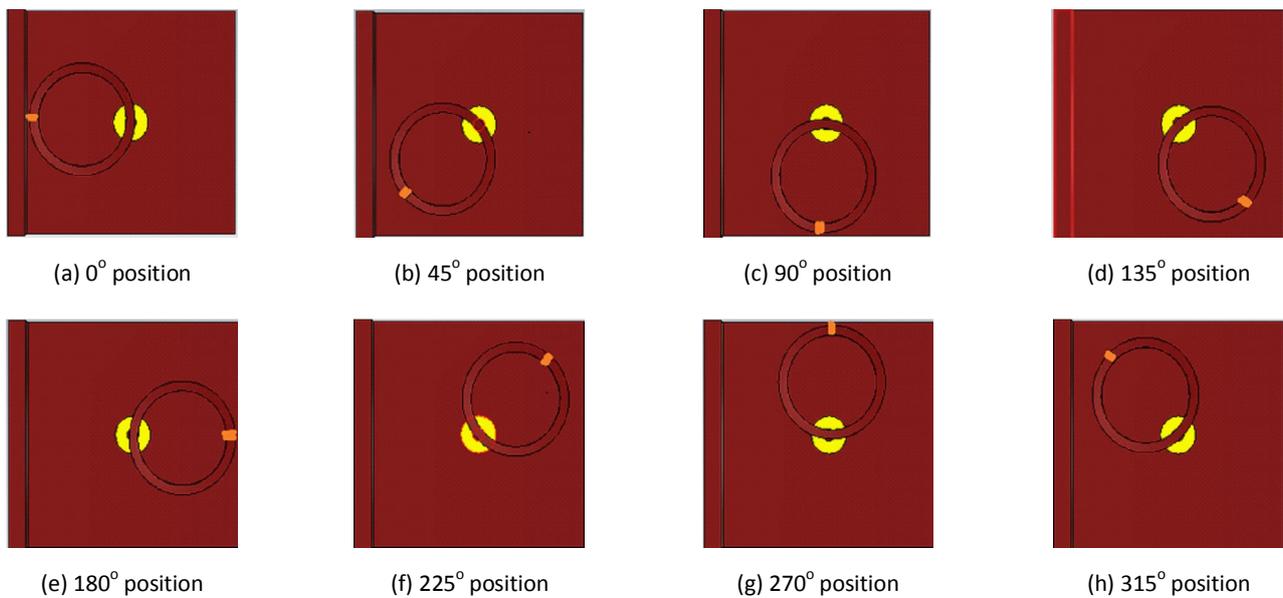
Fig. 3.   Top view of helix rotation inside the Pi-wall shaped cavity

3   RESULTS AND DISCUSSION

This section illustrates the response of helical antenna as it is rotated inside the partial cavity. The extraction of antenna basic parameters like gain, reflection coefficient, near E-field distribution etc. are done using time domain solver of CST Microwave Studio Suite. The analysis begins with the extraction of reflection coefficient plot as shown in fig.4. From Fig. 1b, as the walls location are at 0° and 180° facing opposite to each other, reflection from both the metallic walls give appreciable bandwidth. At 0° position, the frequency bands are at 7.72-9.2 GHz and 13.39-15.3 GHz with a total bandwidth of 3.39 GHz, whereas at 180° position the frequency bands are at 7.75-9.94 GHz and 13.38-15.38 GHz possessing a bandwidth of 3.69 GHz which is the highest bandwidth available in this design.
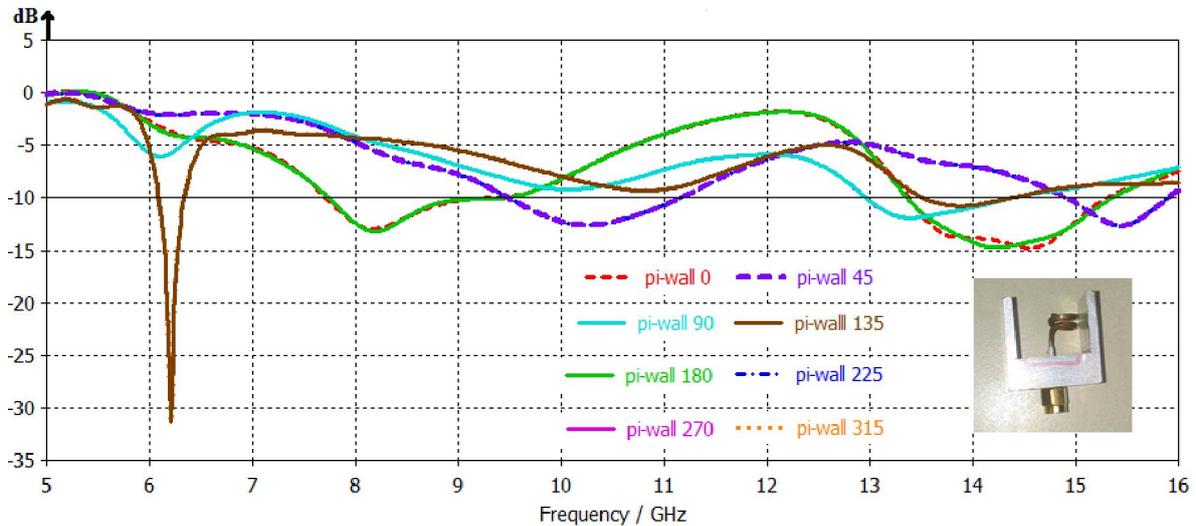
Fig. 4.   Comparative plot of reflection coefficient at various helix rotations

The other dual bands are comparable at 45° and 225° with a bandwidth of 2.71 GHz and 2.62 GHz respectively as shown in Fig.4. The next pair is comparable at 90° and 270° with a bandwidth of 1.39 GHz and 1.45 GHz respectively. The last pair of similar frequency response is at 135° and 315° with a bandwidth of 1.10 GHz and 1.09 GHz. It is important to note that the highest bandwidth is at 0° and 180° position due to the fact that spacing between walls and the helical antenna is less and thereby increasing the reflections from the walls. The intermediate bandwidth which is at 90° and 270° position is due to orientation of helix end towards the open space. So an observation has been made that along with the spacing parameter, helix tip end orientation also plays significant role in bandwidth variation. The complete bandwidth analysis is shown in Table.1

Table 1.   Bandwidth analysis of Pi-wall partial cavity

Sr. No	Helix Position	No. of Bands	Frequency Bands (GHz)	Bandwidth(GHz)
1	0°	Dual	7.72-9.2 & 13.39-15.3	3.39
2	45°	Dual	9.48-11.19 & 14.9-15.9	2.71
3	90°	Single	12.98-14.37	1.39
4	135°	Dual	6.09-6.34 & 13.526-14.385	1.10
5	180°	Dual	7.75-9.44 & 13.38-15.38	3.69
6	225°	Dual	9.53-11.19 & 14.94-15.9	2.62
7	270°	Single	12.98-14.43	1.45
8	315°	Dual	6.10-6.35 & 14.37-13.53	1.09

Similar to bandwidth analysis, a comparative gain plot is also extracted at various helix rotations inside the cavity as shown in Fig.5. It is found that a highest gain of 7.5 dB is available at 45° position and a similar gain is available at 225° position. So taking the diagonals into consideration, the gain is at 45° and 225°. Similarly at 90° and 270° the gain is 7.2 dB, and at 135°, 315° the gain is 6.6 db.

The gain is symmetrical in the diagonals due to symmetry of the walls which can be observed from the Fig. 1a. The complete gain analysis is shown in Table.2.
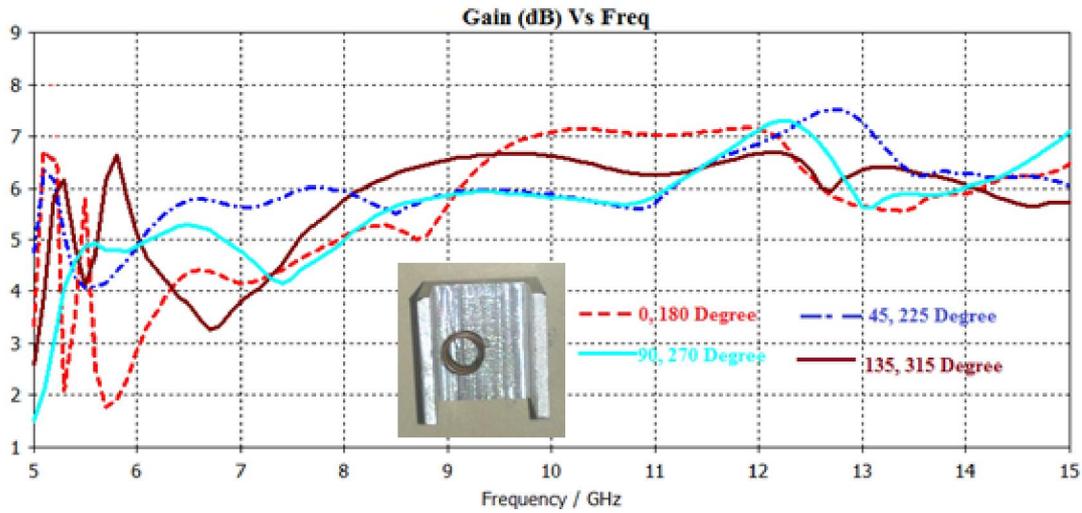
Fig. 5.   Comparative gain plot at various helix rotation angles

Table 2.   Comparative Gain analysis

Sr. No	Helix Position	Peak Gain (dB)
1	0°	7.1
2	45°	7.5
3	90°	7.2
4	135°	6.6
5	180°	7.1
6	225°	7.5
7	270°	7.2
8	315°	6.6
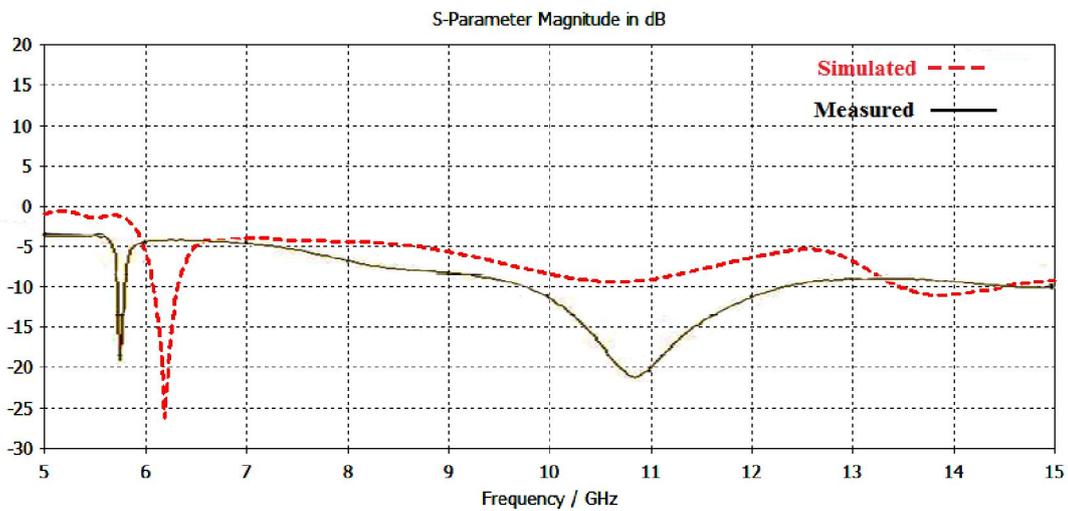
Fig. 6.   Plot of reflection coefficient at 135° helix rotation
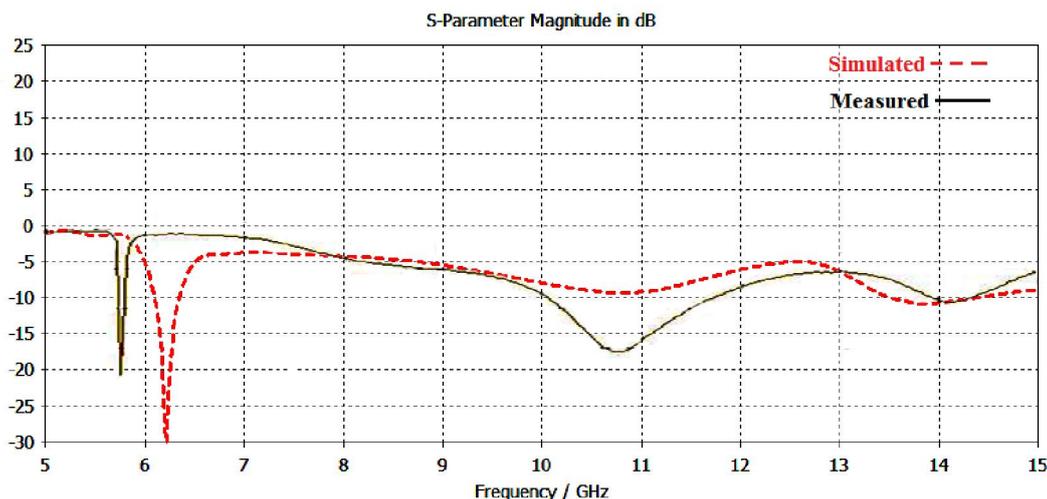
Fig. 7.   Plot of reflection coefficient at 315° helix rotation

The comparative plot of measured and simulated results for some the helix rotation is shown in Fig. 6-7. It is observed that, the measured bandwidth for 135° helix rotation is 2.9 GHz whereas the simulated bandwidth is found to be 1.10 GHz only. So an increase of 1.8 GHz in the bandwidth is observed and similar is the case of 315° position where the measured bandwidth is 1.9 GHz and the simulated bandwidth is 1.09 GHz only. This increase in the measured bandwidth is due to the lofting of helix base and feed pin joint in practical implementation whereas in simulation, the joining point between feed pin and helix base is abrupt which can be clearly seen in Fig.2a-2b. So a peculiar observation has been noted down that, lofting between helix base and feed pin helps to improve the geometry continuity and thereby improves the current distribution along the antenna.

The maximum power handling capacity of the antenna is also investigated here. With the intensity of near field electric vector as 10692 V/m as shown in Fig.8 and assuming breakdown threshold of copper as 50 MV/m, the maximum power handling capacity comes out to be 21.86 MW which is given by [2]-[13].
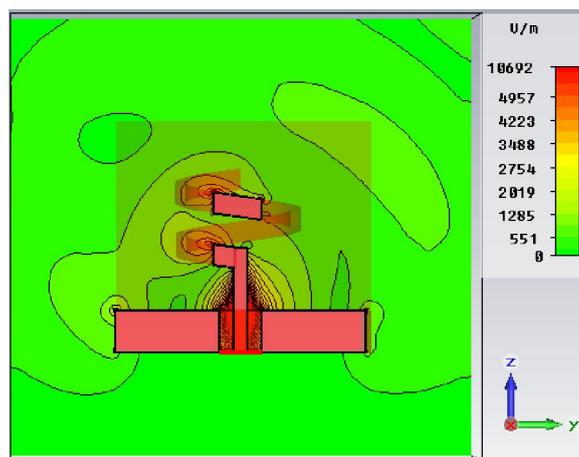
Fig. 8.   Near E-field distribution in Pi-wall cavity

4   CONCLUSION

The designed Pi-wall partial cavity backed 1½ turn helical antenna meets the requirement of re-configurable gain and bandwidth, conformability and robustness making it suitable to use for the applications which demands such features. It is found that by varying the spacing between helical antenna and the walls, an application oriented response can be achieved. Also it observed that the practical results were having improvement over simulated results.

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Pigment Ink Formulation for Inkjet Printing of Different Textile Materials

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ABSTRACT: Cotton, polyester, and cotton polyester blended woven fabrics were printed using an ink jet print using by means of a prepared pigment ink. Literature indicated that the development of insoluble pigment-based inks presents enormous challenges to the ink formulator. Meanwhile, pigments face several application problems in terms of their dispersion stability within the ink formulation, and consequently blocking the nozzles within the inkjet print head.

Upon this, Two pigment colors : M.D. Blue 15:3 and Daicofast Yellow 1252 were successfully formulated and factors affecting the final color yield of inkjet printed fabrics such as, pigment concentration and other ink contents: dispersing agent, ethylene glycol and diammonium Phosphate concentrations, thermo-fixation time and temperature for the three printed substrates pretreated with binder were investigated in detail.

The study was done on two route bases, first: the preparation of pigmented inks for inkjet printing and the application of the ink on the three substrates, in order to determine the optimum concentration of pigment ink contents. Second: increasing the wash and crocking fastness properties of the printed fabrics with pigment inks. In addition, the two pigment inks physical properties: density, viscosity and surface tension were measured as well as fastness levels of their prints.

KEYWORDS: Binder system, Dispersing agent, Fastness properties, Ink formulation, Inkjet printing, Pigment colors.

1 INTRODUCTION

In recent years, there has been an increasing application of digital printing to textile substrates. This interest has been fueled by the rapid advances that have been made in digital printing technology. Inkjet is a non impact, dot-matrix printing technology in which droplets of ink are jetted from a small nozzle directly to a specified position on a media to create an image [1].

The size of the smallest drop determines the finest detail that can be reproduced in the inkjet process. Dots as small as 3 Pico-liter (diameter about 18 microns) can be generated at the present level of ink jet technology. Ink jet printing is the only non-contact printing method and because of this, it is the most ideal of all printing methods [2].

There are two kinds of inkjet inks on the market: one is a dye-based ink and the other is a pigment-based ink. Most inkjet printing inks involve multiple components making the design and optimization of the formulations a challenging task [3].

Such inks, depending on the printer for which they are intended, must meet very stringent criteria with regard to viscosity, surface tension, conductivity, storage stability and good fastness on the substrate [4]. However, most dye-based inkjet printing inks suffer from poor wet-fastness properties when printed on common office printing paper. Therefore, various attempts to develop colorants capable of improved water-fastness have been carried out [3].

Pigment inks need low viscosity for good jet-ability, because many print head for aqueous ink work at low viscosity. Consequently, highly functional dispersions are needed not only for preventing precipitation in low viscosity solution, but also for jetting well in the print head [5].

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The single most significant fact the formulator must always keep in mind is the (keep it simple) fact. Having a large number of raw materials in the formulation will do two things: First, it will be very difficult to solve a problem should one arise in production. Secondly, a formulator who utilizes a large number of components in a formula will be very unpopular with the manufacturing supervisor [6].

Pigment binders play an important role in pigment printing. Binder is a film forming substance; the film encloses the pigment particles and adheres to the fiber. The rubbing, washing and dry-cleaning fastness of a pigment print is determined by the fastness of the binder film and the quality of the print depends on the quality of the binder [7].

Binders are generally made of polymer dispersions in water. These can include polymers and copolymers that are produced by the reaction of monomers in the presence of initiators or catalysts. Acrylics are commonly the best all-around binders, having good color fastness and good dry/wet strength. They also provide good durability and a wide range of fabric hand properties [8].

The present study aims to fulfill the preparation of pigment based inks to be applied on cotton, polyester and their blend via inkjet technique which reduces printing time and treatments of fabrics. The prints should have best color yield as well as satisfactory fastness properties.

2 MATERIALS, METHODS AND MEASUREMENTS

2.1 MATERIALS

A 100% singed, desized, scoured and bleached cotton fabric was used with 135 g\m^2 fabric weight, polyester fabric with 135 g\m^2 fabric weight and cotton\polyester 65\35 blended fabric with 118 g\m^2 fabric weight were used in the present study. These fabrics were supplied by Misr for Spinning & Weaving Co., Mehalla El-Kobra, Egypt.

Two pigment colors are used: M.D. Blue 15:3 and Daicofast Yellow 1252, a synthetic thickener Daicothick1600, Scaural CA (non-ionic detergent) all kindly supplied by Daico Chemicals Industry, Egypt. Ethylene glycol and diammonium phosphate supplied by El-Nasr Pharmaceutical Chemicals Co., Egypt. Also, a dispersing agent (Avolan IW) supplied by Bayer AG Co., Switzerland, a defoamer (Nofoam SE) supplied by Sybron-Tanatex, Egypt and Printofix binder N86 supplied by Clariant Co., Egypt have been used.

2.2 METHODS

2.2.1 PRETREATMENT OF FABRICS

For samples that will be printed later on with the blue pigment-based ink, the fabrics are pretreated by overprinting using an opened silk screen with a paste containing 40 g\kg Printofix binder and 960 g\kg Daicothick1600 stock thickener for cotton, 60 g\kg binder and 940g\kg stock thickener for both polyester and blended fabrics. On the other hand, samples to be printed with the yellow pigment-based ink are pretreated with 100 g\kg Printofix binder and 900 g\kg stock thickener for cotton and blended fabrics, 80 g\kg Printofix binder and 920 g\kg stock thickener for polyester fabrics.

2.2.2 INKJET INKS FORMULATION

The following recipe is prepared as an inkjet ink formulation (with stirring):

X	gm	Pigment color (varies according to color and fabric)
10	ml	Avolan IW (dispersing agent)
100	ml	Ethylene glycol
4	ml	Nofoam SE (defoamer)
40	gm	Diammonium phosphate
Y	cm^3	Distilled water
1000	gm	

The prepared inks are filtered with (Whitman) filter paper to remove large particles and impurities.

2.2.3 PRINTING

The pretreated samples are then printed and subjected to thermofixation at 150° C for 5 min. after which they are thoroughly rinsed in cold and hot water and washed off using 1.5 g/l non-ionic detergent at 70° C for 10 min. All the inkjet printed patterns reported here were fabricated using a Hewlett Packard (hp) Office Desk Jet 656c inkjet printer. Although a piezo-based inkjet print head offers a greater range of ink compatibility than thermal inkjet heads, we preferred to use a simple thermal head printer because of the simplicity of filling cartridges with the ink. For the purpose of passing the fabric samples through the inkjet printer, the samples were glued (in the edges) to a sheet of A4 paper.

2.3 MEASUREMENTS

The color strength (K\S) of the printed samples was evaluated by color reflectance technique at λ maximum. The used spectrophotometer was of model ICS-Texicon Ltd., England. The viscosity of the pigment–based ink was measured using Ostwald viscometer. The surface tension of the ink was measured using Stalagmometer. The density of the ink was measured using Pycnometer.

Color Fastness Properties

The color fastness to washing, rubbing, and perspiration were determined according to AATCC test methods (61, 8, 15 – 1989, respectively). Fastness to light was evaluated according to AATCC test method (16-1990).

3 RESULTS AND DISCUSSIONS

3.1 EFFECT OF PIGMENT CONCENTRATION

The effect of pigment concentration of the inkjet ink is investigated through adding different pigment concentrations and the K/S values of the printed fabrics are plotted in Figs. (1&2).

The results imply that, maximum color strength values are obtained using the concentrations 20, 30, and 30 g\l for cotton, polyester and blended fabrics, respectively using the blue pigment. These concentrations caused increasing in the K/S by 126.6, 88.7 and 97% for cotton, polyester and cotton /polyester blended fabrics, respectively compared with adding 10 ml/l pigment to the ink.

The maximum color strength values are obtained using a concentration of 50 g\l for all fabrics using the yellow pigment since this concentration resulted in enhancements in K/S values by 14, 8 and 12.7% for cotton, polyester and cotton /polyester blended fabrics, respectively also compared with adding 10 ml/l pigment to the ink. The variation of K/S enhancements from one color to another may be referred to both pigment chemical structure and the dispersion level of pigment particles inside the printing ink.
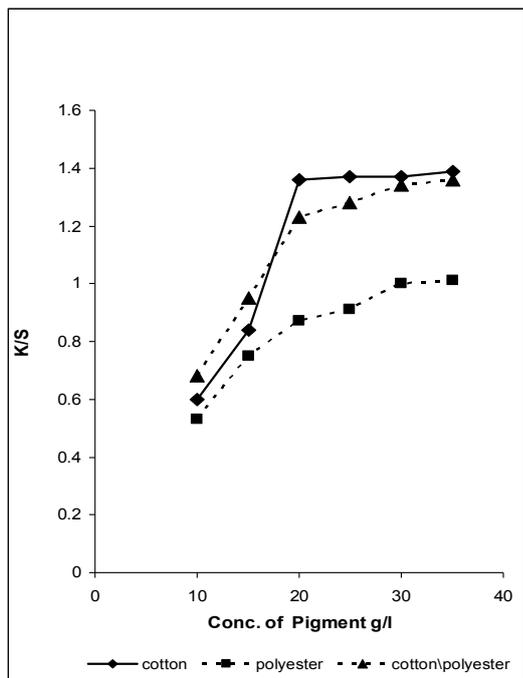
Fig. 1. *Effect of blue ink concentration on K\S of printed fabrics*
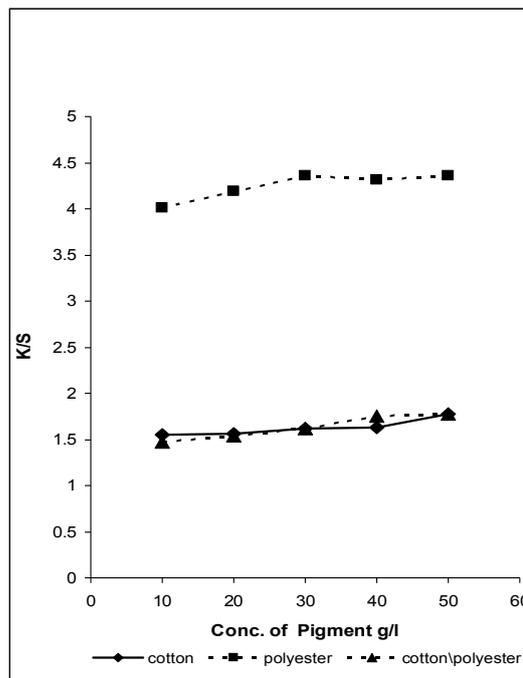
Fig. 2. *Effect of yellow ink concentration on K\S of printed fabrics*

3.2   EFFECT OF DISPERSING AGENT CONCENTRATION

The dispersing agent helps in dispersing the pigment particles and keeps them in a stable dispersing state in the ink. [9] Surfactants frequently increase the affinity of pigment and ensure that wetting proceeds rapidly. To break down the agglomerates, sufficient force must be exerted to overcome the forces holding the agglomerates together: (1) by physical impact, (2) by particle-particle attrition and (3) by shear transmitted through an intermediate fluid layer [10]. All types of surfactant systems are known to dissolve insoluble dyes, break-up dye aggregates into monomers or partially soluble dyes via incorporation into surfactant micelles [11].

According to the literature, [9] there are three main types of forces which determine the stability of pigment dispersion: (1) the electrostatic forces of repulsion which arise from the ions or charged groups on the particle surface, (2) the Van Der Waals' forces of attraction which arise from the difference in dielectric constant between the particles and the medium and (3) steric stabilization which arises from the presence of uncharged groups on the particle surface.

The action of the dispersing agent as one of several ink components and its effect on K/S values of the prints was studied using various concentrations of dispersing agent and the results are plotted in Figs. (3&4).

It may be concluded from the figures that, maximum color strength values are obtained using 12, 4 and 10 ml\l of the dispersing agent for cotton, polyester and blended fabrics, respectively using the blue pigment. Concerning the yellow pigment, maximum K\S values are achieved by using 10 ml\l dispersing agent for the three fabrics.

The direct relation between dispersing agent concentration and K/S of cotton samples is logical since on increasing dispersing agent concentration, the optimum pigment particles dispersion is obtained which enhances cotton affinity to pigment. While for polyester samples, increasing dispersing agent concentration increases pigment particles dispersion inside the ink which makes the particles lose some of their hydrophobic nature on which they rely on in attaching to the polyester substrate in the first place so, K/S values decrease on increasing dispersing agent concentration.
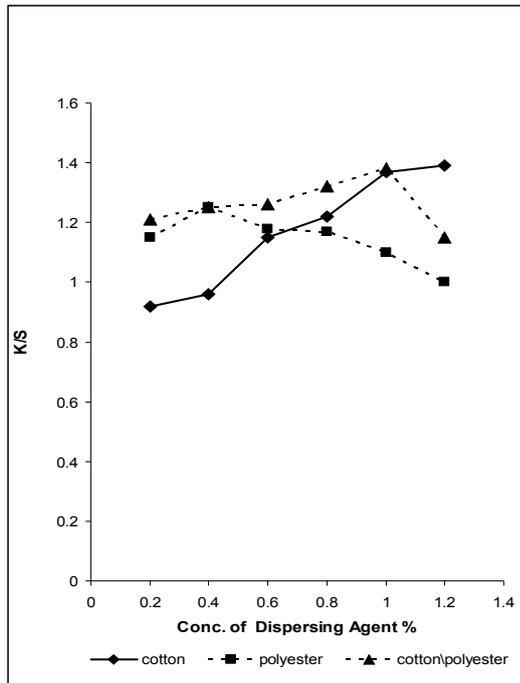
Fig. 3.   Effect of dispersing agent concentration on on the K\S of printed fabrics with the blue ink
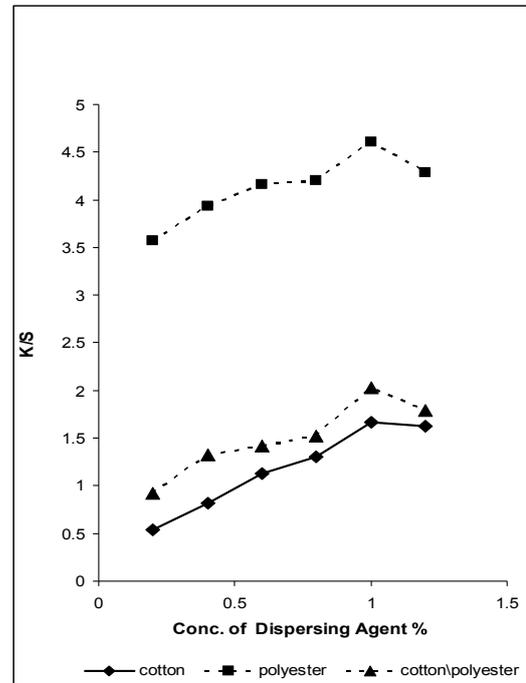
Fig. 4.   Effect of dispersing agent concentration on the K\S of printed fabrics with the yellow ink

3.2.1   EFFECT OF ETHYLENE GLYCOL CONCENTRATION

It is established that, adding ethylene glycol acts as a humectant and adjusts the viscosity and surface tension of the ink and prevents it from drying upon the print head and also helps the ink to penetrate into the substrate quickly. In order to study the influence of the addition of a solvent to ink formula, different concentrations of ethylene glycol were used and the data of are shown in Figs. (5&6).

The results obtained in Fig. (5) imply that, as ethylene glycol concentration increases a marked decrease in the color strength takes place in case of polyester fabrics. The prints have the highest K\S values at concentrations 50, 100 ml\l for cotton and blended fabrics, respectively since it caused enhancements in K/S values by 13 and 12.5% for cotton and cotton/polyester blend, respectively compared with the pretreated samples without the addition of ethylene glycol to their printing recipes. However, 100 ml/l is chosen as the optimum concentration for printing the blended substrate since it caused an increase in the K/S by 11.6% which represents a small difference from the higher concentration. While the highest K\S values for polyester fabrics can be achieved without ethylene glycol with the blue pigment.

Cotton fabrics need high solubility or dispersion of pigment color so high concentrations of ethylene glycol can affect pigment dispersion because of its low solubility in water. So, the dispersing agent has two effects: first, as a dispersing agent which helps to break down the agglomerates to a smaller particle size which disperses pigment particles in the ink and second, as an emulsifying agent which helps to disperse ethylene glycol in water.

Pigment particles are held together by attraction forces of various physical chemical natures including Van Der Waals' forces which affect their dispersion stability within the ink formulation that consequently blocks the nozzles of the inkjet print heads and decreases the color strength [13].

The results obtained from Fig. (6) imply that, as ethylene glycol concentration increases, a marked increase in the color yield takes place. The prints have optimum K\S values at ethylene glycol concentrations of 200, 250 and 200 ml\l for cotton, polyester and blended fabrics, respectively on printing with the yellow pigment since enhancements in K/S values by 18.4, 13.8 and 16% for cotton, polyester and blended fabrics, respectively are observed.
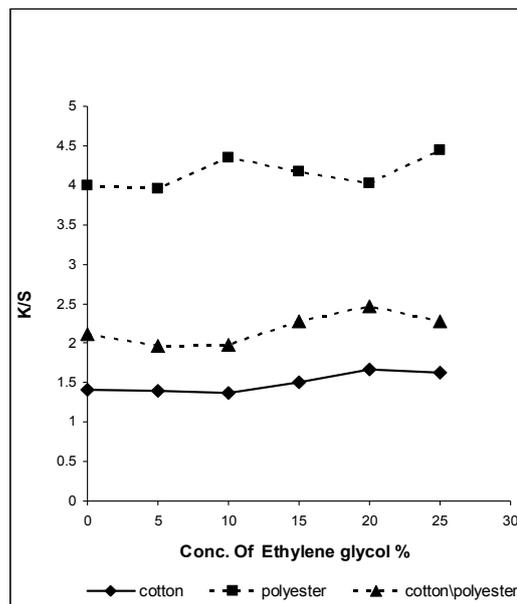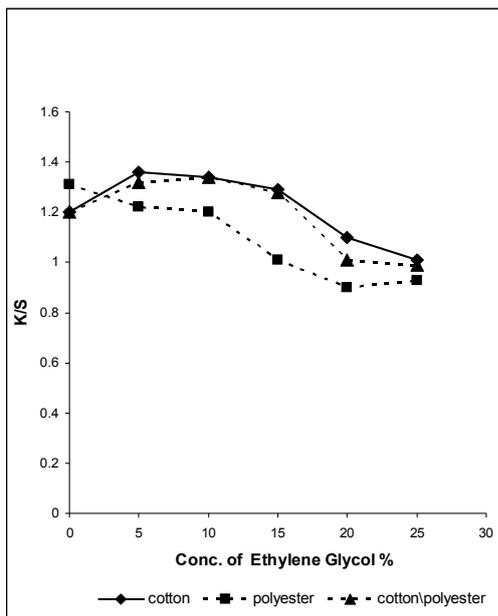
Fig. 5. *Effect of ethylene glycol concentration on the K\S of printed fabrics with the blue ink*

Fig. 6. *Effect of ethylene glycol concentration on the K\S of printed fabrics with the yellow ink*

3.2.2 EFFECT OF DIAMMONIUM PHOSPHATE CONCENTRATION

Condensation reactions of the used binder in the present study (N-methylol compounds) require an acid medium and the pigment print paste will have therefore an added weak acid such as diammonium phosphate [13]. This compound causes reduction of the pH of the print paste film during curing, promoting crosslinking. To investigate the role of diammonium phosphate on the color yield of the printed fabrics, different concentrations of diammonium phosphate are added to printing recipes, and the results are illustrated in Fig. (7) &(8).

It is clear in Fig. (7) that, there is an increase in color yield on adding diammonium phosphate and the K\S values of the prints give their maximum values at concentrations of 30, 40 and 20 gm\l for cotton, polyester and their blend, respectively using the blue pigment since these concentrations increase the K/S values by 77.5, 40.7 and 9.5% for the three substrates, respectively compared with the printed samples on adding 10 ml/l diammonium phosphate.
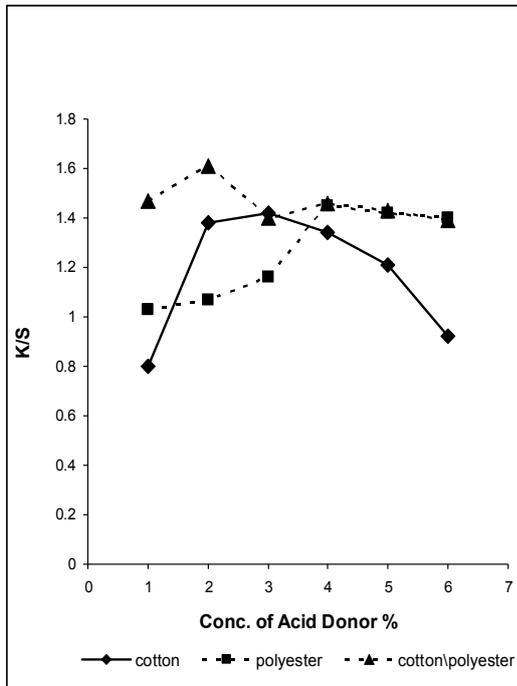
Fig. 7.   Effect of diammonium phosphate concentration on on the K\S of printed fabrics with the blue ink

Fig. 8.   Effect of diammonium phosphate concentration on the K\S of printed fabrics with the yellow ink

From Fig. (8) it is clear that, the maximum color strength values can be obtained on adding 40g\l diammonium phosphate to the printing pastes used on cotton fabrics and 60g\l for both polyester and blended fabrics using the yellow pigment. The results also indicate that, during the fixation process the medium of the ink is converted into acidic medium which helps to fix pigment particles that enhances the K/S values. On the other hand, high concentrations of diammonium phosphate affect the dispersion of pigment particles which results in the formation of pigment agglomerates that precipitate and block the nozzles in the ink jet print head.

3.3   THERMOFIXATION CONDITIONS

During curing, the active groups along the polymer chains undergo intermolecular polymerization reactions producing a number of crosslinks [13]. The crosslinks are, however, reasonably stable to hydrolysis during mild washing and are not present in sufficient number to produce a rigid film. They ensure good film stability, little swelling of the film in dry cleaning solvents and improve the adhesion to the fiber surface. To investigate the best temperature and sufficient time for fixing pigment prints, using printing recipes that include the optimum ingredients' concentrations as previously mentioned, different temperatures as well as periods of time are used and the resulted K/S values of the printed samples are given in Table (1).

Table 1. Effect of thermo-fixation temperature and time on the K/S of printed fabrics

Substrate	Time (minutes)	K\S Values									
		M.D. Blue 15:3 pigment.					Daicofast Yellow 1225 pigment				
		110°c	130°c	150°c	170°c	190°c	110°c	130°c	150°c	170°c	190°c
Cotton	1	1.40	1.51	1.46	1.55	1.52	1.94	1.66	2.09	2.27	2.09
	3	1.39	1.57	1.54	1.55	1.46	2.07	1.65	1.86	2.30	2.18
	5	1.48	**1.62**	1.47	1.57	1.47	2.01	1.63	1.73	**2.39**	2.11
	7	1.53	1.55	1.46	1.24	1.45	2.10	1.71	1.78	2.25	2.14
	9	1.56	1.48	1.50	1.14	1.31	2.23	1.81	1.92	2.24	2.21
Polyester	1	1.30	1.43	1.43	1.44	1.51	3.85	4.34	3.74	4.53	4.79
	3	1.38	1.53	1.46	1.47	1.55	4.12	4.45	4.01	4.79	**5.42**
	5	1.40	1.52	**1.55**	1.51	1.49	4.07	4.06	4.23	4.67	5.13
	7	1.47	1.51	1.44	1.48	1.48	4.21	4.00	4.34	4.07	5.26
	9	1.46	1.50	1.46	1.48	1.50	4.24	3.83	3.97	4.93	5.02
Cotton\polyester	1	1.67	1.61	1.86	2.08	1.96	2.08	2.30	2.36	2.32	2.29
	3	1.83	1.67	2.01	**2.13**	1.98	2.17	2.14	2.23	2.37	2.52
	5	1.84	1.65	1.98	2.00	1.91	2.27	2.21	2.29	2.40	2.39
	7	1.86	1.77	2.01	2.04	1.93	2.34	2.17	2.32	2.32	2.56
	9	1.72	1.76	1.92	1.98	1.76	2.23	2.25	2.16	2.24	**2.69**

From the above table it is obvious that, curing the prints at 150° C for 5 min. can be chosen as optimum thermofixation conditions regardless of the kind of substrate or pigment used. This conclusion may be due to obtaining appropriate K/S values as well as satisfactory fastness levels (as will be illustrated later) using these conditions without affecting tensile strength or substrate color negatively.

3.4 PHYSICAL PROPERTIES OF INK FORMULATION

In continuous ink jet printing, surface tension helps to control the meniscus at the nozzle. Inks for ink jet printing should have a very low viscosity in the range of two to ten centipoises [14]. Table (2) illustrates the measurements of density, viscosity and surface tension of both prepared inks.

Table 2. Physical properties of both prepared inks

Substrate type	Pigment based ink	Density (g\cm^3)	Viscosity (Pa.s)	Surface tension (Dyn/cm)
Cotton	M.D. Blue 15:3 pigment.	1.0434	1.3	54.3
Polyester		1.0424	1.2	54.75
Cotton\Polyester		1.0503	1.5	55.6
Cotton	Daicofast Yellow 1225	1.0762	2.1	35.3
Polyester		1.0766	1.9	35.9
Cotton\Polyester		1.0886	2.2	34.68

It is clear from the table that, the surface tension values at 25 °C ranged between 35 and 55 Dyn/cm while the values of viscosity at the same temperature ranged between 1.2 and 2.2 Pa.s.

3.5 COLOR FASTNESS PROPERTIES

The results of fastness properties of the printed fabrics are listed in Table (3). The results show good fastness to washing, from good to very good in case of perspiration fastness. The results of rubbing fastness indicate that the prints have from fair

to good fastness to dry and wet rubbing and from good to very good fastness to light. These results are considered good since they are similar to those obtained from regular pigment printing.

Table 3. Fastness properties of printed fabrics with both pigment based inks

Pigment based ink	Substrate	Rubbing fastness		Washing fastness			Perspiration fastness						Light fastness
							Acidic			Alkaline			
		Dry	Wet	Alt.	St.*	St.**	Alt.	St.*	St.**	Alt.	St.*	St.**	
M.D. Blue 15:3	Cotton	3	2	4	4	4	4	4-5	4-5	4	4-5	4	6
	Polyester	2	2	4	4-5	4	4-5	4-5	4-5	4	4-5	4-5	6-7
	Blend	2-3	2-3	4	4	4-5	4-5	4-5	4-5	4	4-5	4-5	6
Daicofast Yellow 1225	Cotton	3	3	4	4	4	4	4	4	4	4-5	4	6-7
	Polyester	3	2-3	4	4	4-5	4	4-5	4-5	4	4-5	4-5	4-5
	Blend	3	3	4	4	4	4	4-5	4-5	4-5	4-5	4-5	5
Alt. = Alteration				St.* = Staining on cotton				St. ** = Staining on wool					

4 CONCLUSION

Inkjet printing on textiles can give fine, delicate images on fabrics using a high resolution device and printing system. Although there are specialized inkjet printing machines for textiles, printing on textile is still a challenge. In this work, three different substrates: cotton, polyester and their blend are pretreated with a specific concentration of binder (according to fabric type) and are printed with two pigment-based inks (blue and yellow) via inkjet technique. In order to maintain good ink stability and satisfactory fastness levels, ink formulations include a dispersing agent, ethylene glycol, a defoamer and diammonium phosphate, with concentrations depending on substrate type and ink color. Thermofixation of the prints is carried out in constant conditions to fix the binder which helps to form a film that encloses pigment particles and adheres them to the fibers. The results obtained revealed good fastness properties of the prints as well as good physical properties of both inks.

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