Issues of Implementation of CMMI in Pakistan Software Industry

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ABSTRACT: Pakistan Software industry despite having potential failed to progress well in order to capture fair amount of international market share. Due to poor quality practices and lack of standardized practices Pakistan software industry ranked as tier-3 among the taxonomy of software exporting nations. Software Process Improvements (SPI) practices can play their part to overcome problem of Pakistan software industry but we also suffer in implementation of these standard practices. The core aim of this study is to identify the main barriers of Software Process Improvement (SPI) best practices in term of CMMI model in Pakistan. Pakistan based software development organizations suffer with implementation of Software process Areas due to many factor.

Keywords: Capability Maturity Model Integration (CMMI), Software Process Improvement (SPI), Project Planning (PP), Supplier Agreement Management (SAM), Process and Product Quality Assurance (PPQA), Requirements Management (REQM), Project Measurement and Analysis (PMA), Configuration Management (CM)

1. BACKGROUND

Software industry of country can play a significant role in a country national income and considered as enabler technology for the developing country to play their part in globalization and improve their economic gesture for well-being of their people. India is one of the prime examples who took the opportunity and is considered as "mini superpower (software). Pakistan software industry is considered sharing many factors of Indian Software Industry but it is rated as tier-3 in taxonomy of software export nations. Pakistan Software industry blessed with an excellent infrastructure, skills and talented labour force along with government protection deserved to be at least tier-2 industry like China and Russia if not tier-1 like India [1].

Pakistan Information technology despite having lot of potential of growth and success in international market failed to get expected status of at least tier-2 among the taxonomy of software exporting nations. Pakistan software industry failed attains desired level of status in the international market place. Among many other reasons one is that industry have paid little attention to quality assurance and improvements activities especially in process areas. Many issues, problems and barriers block the way of organization to the efforts of process improvements and implementation of any standards like CMMI model for this purpose. But due to many reasons, Pakistan software industry failed to progress and achieve the expected portion of international market place. Out of many factors of poor performance, before we start the subject of quality practices issues and quality enforcement standard implementations we would like to have an overview of Pakistan Information Technology industry [2].

Pakistan Information technology industry is one of the fast growing among the international IT market place with about 2.8 billion US dollar market share. Due to its potential, it is the focus of many offshore and outsources firms. Due to great concerns of Government, availability of skilled staff, better infrastructure and competent rates of connectivity make it attractive for Information Technology (IT) vendors an ideal marketplace for investment. It is one of luckiest industry where Government paid heavy attention towards development of infrastructure and capacity building. Government also declared it a tax free industry till 2016 [1]. Pakistan IT industry faces uneven pattern of growth. Though software houses exist since

1970s but Government was not much interested before last decay of twentieth century. During last decade of twentieth century, many concrete steps were taken to promote software developments in order to meet local needs and to earn foreign revenue. Government of Pakistan also took initiative during this period for supporting by providing infrastructure and policy for the industry.

Let have an overview of salient features of Pakistan IT market place. Pakistan Government has taken serious steps and involve in development of many policies and strategies for the betterment of IT industry in Pakistan result into following characteristics of Pakistan software industry [1].

- Pakistan It market place share 2.8 billion US dollar of international IT market place.
- There are about 110,000 IT professionals available to industries that are fluent in English speaking capabilities.
- Out of these available skilled IT professionals 24,000 are also engaged in export, play important role in national income of Pakistan.
- There are seven hundred IT companies operating in Pakistan. Out of these two are listed on Karachi Stock Exchange (KSE), One on Dubai International Financial Exchange (DIFX) and two on National Association of Securities Dealers Automated Quotations (NASDAQ).
- About seven multinational companies have set up their development offices in Pakistan.
- Out of these companies eleven are ISO 9001 certified, twenty three CMMI and eleven ISO 27001 certified.
- Development of IT parks in all the major cities of the country.
- A strong telecommunication infrastructure presents to support development in Information Technology.
  100% profit belongs to software companies in Pakistan with exemption of all kind of Taxes.
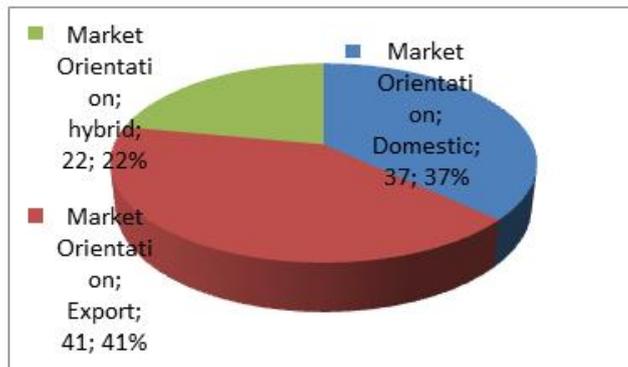

Fig. 1.   Market orientation of Pakistan software industry [1]

In short Pakistan is an ideal place for software and Information Technology developments in term of available infrastructure, capacity and Government privileges and protection of industry.

1.1   INTERNATIONAL TREND

We would like to show the trend of adaptation of CMMI in global IT market place with same statistics. More than two thousand organizations evaluated since 1987 to 2005 for CMMI. In the first we show the nature of organization adopting the CMMI and their percentage out of total organization implementing CMMI.

Table 1.   Distribution of CMMI certified organization with respect to their types [3]

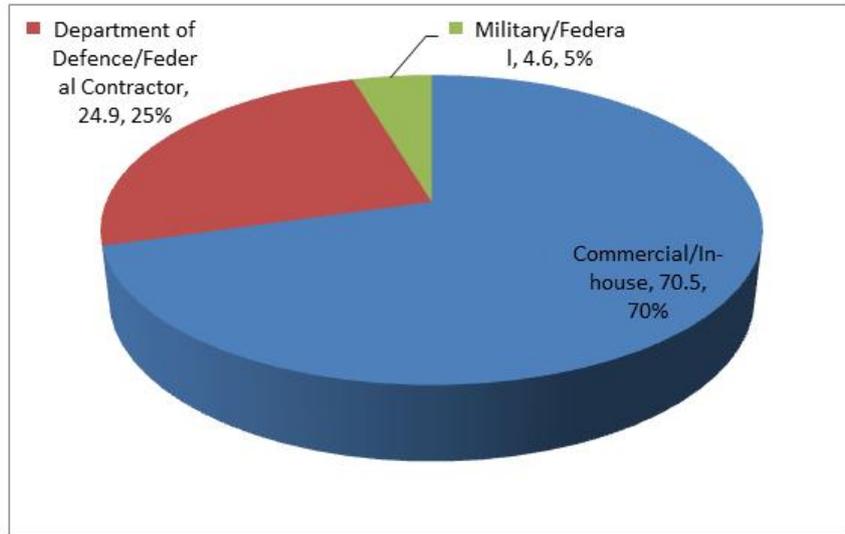| Sr	Type of organization	Percentage
1	Commercial/ In house	70.5
2	Defense department/Federal contractors	24.9
3	Military/Federal	4.6

Fig. 2.   Distribution of CMMI certified organization in world [3]

Table 2.   Distribution with respect to size of organization for CMMI certifies organization worldwide [3]

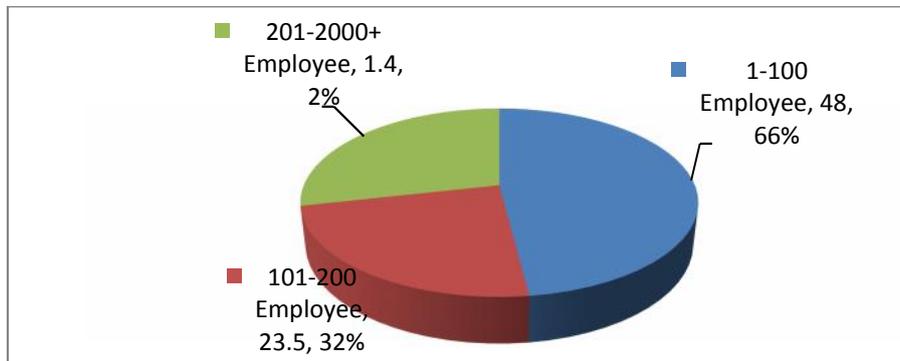| Sr	Size of organization	Percentage
1	1-100 Employee	48%
2	101-200 Employee	23.5%
3	201-2000 and more	28.5%

Fig. 3.   Distribution of CMMI certified organization with respect to size [3]

What these analyses suggest? It is clear from the analysis that most of the CMMI certified organizations are medium to small. And from the next analysis it would be clear that most of the organizations are at Level 3 and level 2.

Table 3.   Distribution with respect to level of CMMI [3]

Sr	Type of organization	Percentage
1	Optimizing Level 5	6.8%
2	Managed Level 4	7.3%
3	Defined Level 3	23.4%
4	Repeatable Level 2	43.4%
5	Initial Level 1	19.3%

Level 1, 19.3, 19%
Level 5, 6.8, 7%
Level 4, 7.3, 7%
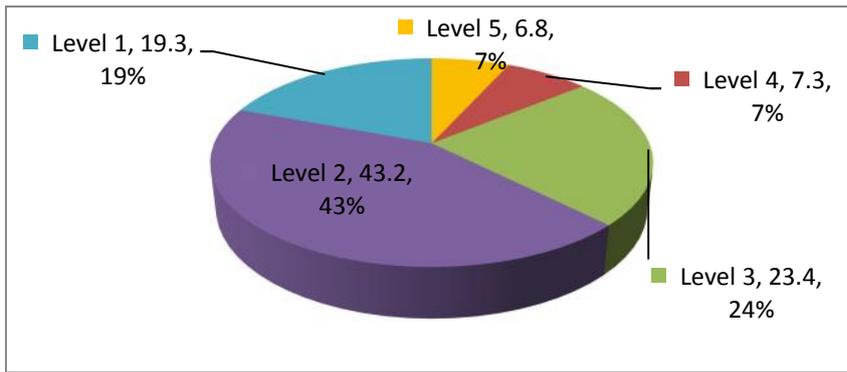Level 2, 43.2, 43%
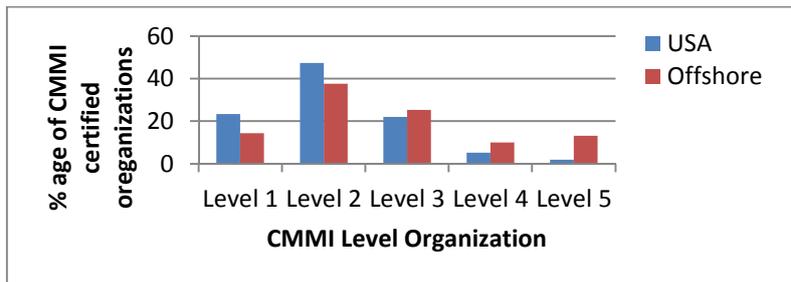Level 3, 23.4, 24%

Fig. 4.   Distribution with respect to CMMI level [3]

Fig. 5.   Comparison of USA and offshore CMMI certified organization since 1998 [3]

Table 4. Countries from where data taken [3]

Argentina	Venezuela	Republic of Korea	Singapore
Australia	Finland	Malaysia	South Africa
Austria	France	Mexico	Spain
Barbados	Germany	Netherlands	Sweden
Belgium	Greece	New Zealand	Switzerland
Brazil	Hong Kong	Pakistan	Taiwan
Canada	Hungary	Philippines	Thailand
Chile	India	Poland	Turkey
China	Ireland	Portugal	United Kingdom
Colombia	Israel	Puerto Rico	United States
Denmark	Italy	Russia	Uruguay
Egypt	Japan	Saudi Arabia	Vietnam

Thanks to NetSol, due to which Pakistan name is also in the list. There is still increasing trends of adaptation to the CMMI worldwide. What all this data and analysis depict. There is change in IT vendors and clients from the last two decades. From the last few decades concern of quality products and services increased to significant amount. Organizations around the globe want to be more efficient and productive in term of their product quality.

Table 5. Concentration of high level organization in different countries [3]

Sr.	Country	Level 4 Organization	Level 5 Organization
1	USA	39	19
2	India	28	46
3	Australia	2	0
4	Ireland	1	0
5	Israel	1	0
6	Singapore	1	0
7	Russia	0	1
8	China	0	2
9	Canada	0	1

From the above table, it is clear that most of the high maturity organizations are concentrated in America and India.
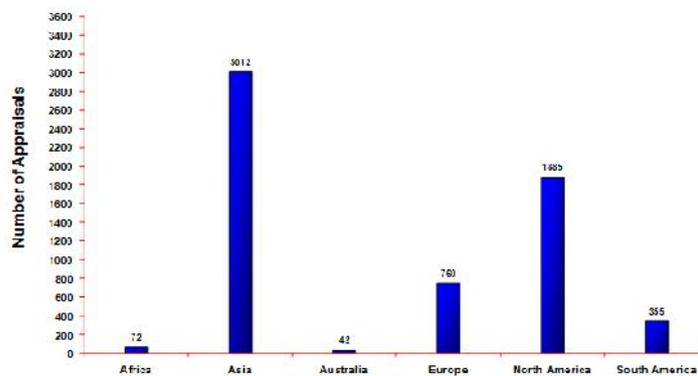

Fig. 6.   Number of appraisals [4]

This might be the reason India is the leading country of software development and IT related services. It is very necessary to promote implementation of CMMI in Pakistan industry in order to compete and get their share in global market place.

1.2   CAPABILITY MATURITY MODEL INTEGRATION (CMMI) STATUS IN PAKISTAN

Pakistan software industry was in right direction in the last decade and many organizations were moving towards acquisition of CMMI certification by year 2002 but due to some unavoidable circumstances Pakistan software industry suffered. The most noticeable among these are the economic recession in international market place, security conditions in Pakistan and most importantly the war against terrorism in the regions hit most of the Pakistan industries including the IT industry in 2003-2004. Due to this changing scenarios most of the organizations changed their policies and strategies in different aspects including their determination to be CMMI certified.

But at the same time NetSol break the shackles for Pakistan with introduction of CMMI practices in their organizations in 2002 and become the pioneer among the Pakistan organization for CMMI certification. During this stage NetSol was assessed as at Level 2 due to CMM based appraisal for internal process improvements [5].

Pakistan software industry faces many problems regarding implementation of CMMI in Pakistan. In order to promote Pakistan software industry and improve its product and standards PSEB play significant role in different time of history. In 2004, PSEB launched the first phase of plan to implement CMMI in Pakistan software industry with at least level 3. In this phase five Software development organizations were selected that are [2];

- NetSol Technologies (Pvt.) Ltd.
- Xavor Pakistan (Pvt.) Ltd.
- Systems (Pvt.) Ltd.
- KalSoft (Pvt.) Ltd.
- Digital Processing Systems

PSEB selected the following companies for training and consultancy in implementation of CMMI practices in above selected organization [2];

- Moody's International/Quality Assurance Institute, Middle East, Africa
- Pakistan NetSol Consulting Services (Pvt.) Ltd.

Keeping in view of importance of quality and its role in success of organization many IT organization in Pakistan also strive to implement quality enhancement practices and policies. With this motive in mind many companies are moving towards different quality implementations standards including CMMI with the support of PSEB and other policy making organization like PASHA etc. Let we have status of CMMI implementation in Pakistan.

CMMI LEVEL 1 & LEVEL 2

Initially all the organizations are at level 1 by default. About sixteen companies in Pakistan planning to achieve level 2. These sixteen companies are registered with PSEB. These organizations also successfully cleared class C appraisal but not class A appraisal to be qualified at level 2 of CMMI model. In Pakistan there are about seven hundred software development companies and only 25 striving for CMMI implantation in their organization. Since 2007 out of these twenty five companies in Pakistan only 2 are successful in reaching at level 5, two at level 3 and 2 at level 2. [6]

Masinfosoft Pvt. (Ltd.) ended their efforts even without class C appraisal for CMMI Level 2 Organization

CMMI LEVEL 3

According to PSEB and published result of SEI-CMU two organizations in Pakistan achieved level 3[6].

CMMI LEVEL 4

There is no organization in Pakistan at CMMI-Level 4.

CMMI LEVEL 5

According to PSEB and published result of SEI-CMU only two organizations in Pakistan named as "NetSol Technologies Pvt (Ltd) and NCR Pakistan Pvt (Ltd.) achieved level 5.

2   MATERIAL AND METHOD

Despite the tremendous start and blooming growth in last decade there are some bottlenecks that hinder the Pakistan software industry to be a source of large income from international market like our neighbor India. Pakistan Industry fails to develop vision, commitment and infrastructure for being a global resource. Where we go wrong and what are the circumstances that lead to change in our direction. Identification of these barriers is the main objective of this study.

Pakistan software industry has fallen into a ghost cycle of quality and resources. Pakistan slowly and steadily losing their international market shares due to quality issues of products and services from industry. Most of these bad quality issues are due to bad practices in industry [1]. Due to lose of market share organizations failed to generate revenue and income. With the reduced income organization resources also tend to decline result in less efforts for improvements in quality and practices across the industry.

2.1   DATA COLLECTION METHOD

We want to use following methods of data collection

- Literature review
- Survey
- Interview
- Case study

Extensive background on literature review is covered in previous chapter that help use to identify the major areas of problem and categorize them as shown in list;

- Organizational
- Project related
- Personal

2.2 ANALYSIS METHOD

As we divide the organization into four groups for data collection and findings to have a mix of all. This mix is based on;

- Organization those are extremely successful in implementation of CMMI in Pakistan like NetSol Pvt. Ltd.
- Organization that are level 3
- Organization that are at level 2
- Organization that take initiative but abandoned
- Organization that do not take initiative or at level 1

For our discussion we categorize these organizations into following categories:-

Table 6.   Category design for organization with CMMI level in Pakistan

Category	Characteristics
A	Organization that are successful in implementation of CMMI level 2 and above like CMMI-5 and CMMI-3
B	Organization that are striving for level 2 and completed appraisal C and B
C	Organization at level 1 and do not striving for CMMI implementation

As from analysis out of the seven hundred registered organizations only twenty two opt for CMMI and out of these twenty two organizations sixteen are at level two. This reveals those major problems are at level 2 for Pakistan industry. Out of twenty two process areas of CMMI model we would like to focus only on seven process areas of CMMI level 2 [7]. These are;

- Project Planning (PP)
- Supplier Agreement Management (SAM)
- Process and Product Quality Assurance (PPQA)
- Requirements Management (REQM)
- Project Measurement and Analysis (PMA)
- Configuration Management (CM)
- Project Monitoring & Control (PMC)

We want to determine to what extent the practices of seven process areas of level 2 are practiced in organization. We rate the implementation of process areas as listed below to determine how strongly organizations in Pakistan implementing these practices of process area improvements in Pakistan or to assess the capability level of process in Pakistan industry organization.

Table 7.   Process area implementation rate design [7]

Ranking	% age practices implemented of process area
Fully Implemented	100%
Mostly implemented	81-99%
Largely implemented	50-70%
Partially implemented	21-49%
Not implemented	0-20%

We also rate the organization according to the presence of above mentioned seven process areas and performance in term of their parentage of presence of these practices in any organization

These are many recognized challenges across the world while implementation of Software Process Improvements especially. But in context of Pakistan where industry struggle at CMMI level 2 we selected only twenty challenging factors or barriers that are more crucial in context of Pakistan industry. With the identification of these factors and their impacts we would be in better position to identify the practices that best suits to Pakistan industry for process improvements [8].

Through literature review we were able to extract out twenty factors that are crucial for the successful implementation of above mentioned seven process areas as we set target area of our research [9]. These twenty successful factors that are crucial for seven process areas identified above in Pakistan industry context are:

- Organizational culture
- Organization's goals
- Lack of infrastructure
- Lack of motivation
- People related factors
- Technical staffing issues
- Lack of knowledge & skills
- Lack of new tools & technology
- Lack of trainings
- Reluctant to investment
- Inadequate budgets & schedules
- Lack of management support
- Lack of commitments
- Documentation issues
- Improper data management
- Lack of stakeholder involvement
- Improper communication
- Lack of internal audits & reviews

In additional we also want to collect data about organization as size, status, profile, market access, practices, politics and culture of the organization. We also want to get some information about respondents in term of their education, skills, experience, job level and affiliation with the organization.

3 RESULTS AND DISCUSSIONS

We want to discuss our findings both in term of process areas and challenges. We start our findings with the process areas.

3.1 PROCESS AREA WISE RESULTS AND DISCUSSIONS

PROJECT PLANNING (PP)

a. Survey result reveals that 100% of category A organization implement fully implementation of Project Planning (PP) process area of CMMI level
b. There is a mix trend of implementation of practices of PP process area and 50% of these organizations implementing with most of full and largely implementation.

There are many reasons behind this performance of the Pakistan based organization some of these are listed below;

a. No proper planning for issues with conflicts
b. No planning for early identification of problems and threats
c. No document management
d. Lack of stakeholder involvement in planning
e. Organization not involved in making agreements

SUPPLIER AGREEMENT MANAGEMENT (SAM)

a. For category A all the companies with level 5 and 3 show 100% full implementation of best practices of SAM process area while level 2 are also performing these practices at satisfied level.

b.   For category B results are not satisfactory with only 9% full implementation.

The main reasons of poor performance for this process area are;

a.   No agreements settlements with supplier
b.   No standard method for supplier selection
c.   Supplier not involved in management and technical practices

PROCESS AND PRODUCT QUALITY ASSURANCE (PPQA)

a.   In case of category A there is 95% of implantation of best practices of PPQA process area.
b.   In case of category B implantation rate change from organization to organization. 14% organization show full implementation, 50% largely, 29% partially and 7% with no implementation of best practices of this process area.

The main reasons behind this poor performance in this process area are;

a.   There is not define method for product and services quality assurance
b.   There is no method for evaluation of product and services quality assurance
c.   Stakeholders are communicated about discrepancies
d.   Stakeholder are not involved and results are seldom communicated

REQUIREMENTS MANAGEMENT (RM)

a.   In case of category A all organization of CMMI level 5 and 3 show full implementation with 100% practices of RM process area. Both CMMI level 2 organization also full implemented practices of RM but with implementation rate of 92%. Whatever the case this category of organization still rated as excellent in term of implementation of practices of RM process area of CMMI level 2.
b.   In case of category B implementation rate varies from organization to organization with 7% of fully implementation and 21% non-implementation. For this process area we can rate category B as average.

When we analyze our finding from different sources we came to know the different reasons of poor performance of requirement management performance as listed below;

a.   Organization usually not recognize important of requirement management
b.   Failed to maintain a consistent record of requirement management and requirement change history
c.   Do not assess the validity of requirements and requirement management
d.   Analyze requirements only in term of schedule and cost.

PROJECT MEASUREMENT AND ANALYSIS (PMA)

a.   In category 1, it can be rated as excellent in term of implementation rate of best practices of PMA
b.   In category 2 it is 0% fully implemented, 41%largely implemented, 43% partially implemented and 17% not implanted

Most of organization of all categories in Pakistan struggle to get higher rating of project measurement and analysis (PMA) process area due to following reasons;

a.   Objectives are nor cleared and refined
b.   No process of feedback
c.   Occasional objective review
d.   No training and guidelines

CONFIGURATION MANAGEMENT (CM)

a.   In case of category A level 5 rate as excellent with 1005 full implementation of practices of CM process area. But organization with level 3 rated as good and level 2 as average against the implementation of practices of CM process area.
b.   In case of category 2 result reveals average implementation of CM practices with 14% fully implementation, 36% largely implementation, 29 % partial and 21% non-implementation of practices of CM process area of CMMI level 2.

Out of many reasons following are considered important for poor performance in context of configuration management process area;

a.   Configuration Management not properly defined and managed
b.   Not updated properly and on continuous basis
c.   Lake of methods of backup and access
d.   Change is not properly analyzed
e.   Lack of standards practices of CM

PROJECT MONITORING CONTROL (PMC)

a.   Category A organization rated as excellent for implementation of practices of Project Monitoring and Control (PMC) process area. Survey reveals 100% full implementation of practices of PMC process area in category A organization.
b.   For category B they vary from poor to average and not satisfactory at all. For category B there is 0% full implementation, 57% largely implementation and 43% of partially implementation of practices of PMC process area.
c.   In case of category C the practices implementation rate is from 0% for full implementation.

There may be many reasons but some important are;

a.   Organization do not fallow plan for work
b.   Never measure actual cost and schedule against the planed
c.   In case of change there are no review for proper analysis and documentation

3.2   FACTOR WISE ANALYSIS

ORGANIZATIONAL CULTURE
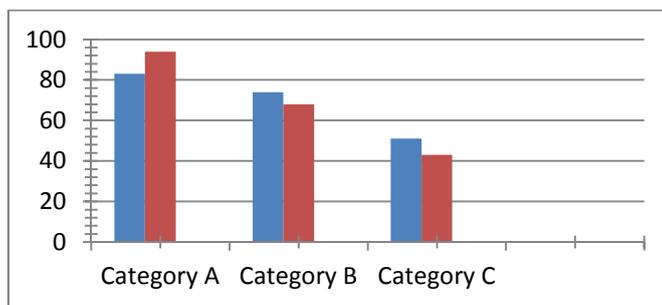
Fig. 7.   Organization culture practices response and implementation rate

From analysis we conclude that culture of organization with category A is supportive while organizations in categories B and C failed to establish culture that is supportive for the implementation of best practices of certain process areas. We got 83% response rate that culture of the industry organization is not supportive for CMMI from category A, 74% from category B and 51% from category C. After close observation we came to know that implementation rate in these organization are 94, 59 and 41% respectively.

ORGANIZATION'S GOALS

Organization in category A are more goal oriented as compared to organization in category B. 93% of category A organization believes that goals are crucial while 61% of category B and 43% of category C. Through case studies we determine the implementation rate for practices to overcome this problem in Pakistan industry are 93% for category A, 58% for category B and 39 5 for category C. Both these statistics are shown in simulation.
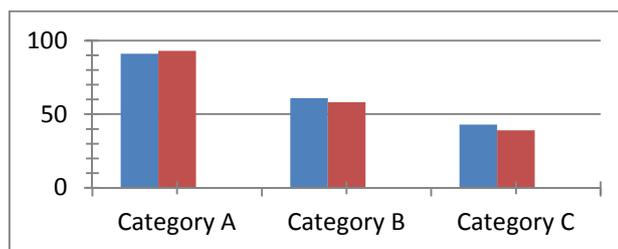

Fig. 8.   Goal setting practices response and implementation rate

LACK OF INFRASTRUCTURE

All the organization from all categories agrees that infrastructure is very necessary for implementation of best practices of SPI in Pakistan industry.

Without proper infrastructure it would be difficult for the organization to take initiative for SPI practices implementation. Category 'A' organization response rate in favor of this factor are 89%, category B 71% and category c with 75%. Implementation rate of best practices to overcome this factors are 95% in category A, 71% category b and 41% category C as shown in next figure
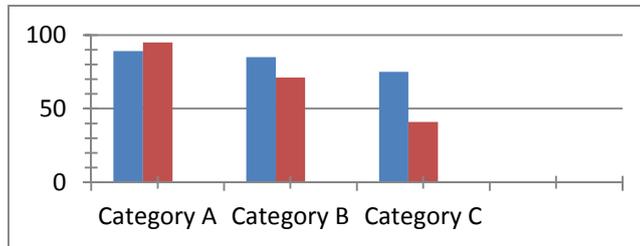
Fig. 9.   Lack of infrastructure practices response and implementation rate

LACK OF MOTIVATION
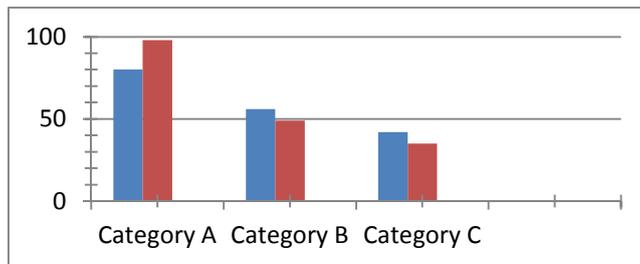
Fig. 10.   Lack of motivation practices response and implementation rate

Management and employee motivation factor is very important in successful implementation of process improvements practices. 80% of responses of employee of organization from category A are in favor of motivation factor while only 56% from category B and 42% from category C believes that motivation is a crucial factor for implementation of best practices. While implementation rate for this factors are 98%, 71% and 41% in category A, B and c respectively.

PEOPLE FACTOR

Employee motivation, empowerment, responsibility delegation, and encouragement are the factors that play important role in inclination of organization for SPI best practices implementation. 87% responses from category A , 65% from category B and 58% from category C consider these factors are important for process improvements in Pakistan industry. While implementation rate of best practices for improvement in people factor are 96%, 42% and 31% for category A, B and c respectively.
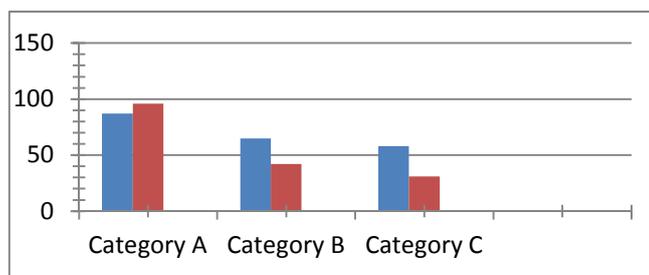

Fig. 11.   Lack of people factor practices response and implementation rate

TECHNICAL STAFFING ISSUES

Staffing issues relate to organization approach of hiring people for SPI implementation. organization from category A is about 93% for need and hiring of specialized task for SPI improvements and only 33% from organization of category B and C.
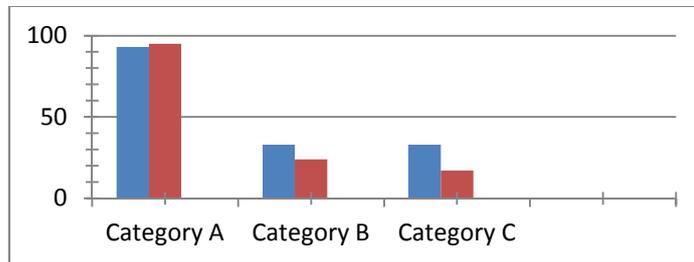

Fig. 12.   Practices response and implementation rate regarding people factor

While implementation rate of best practices for to improve the technical and staffing issue are 96%, 24% and 17% for category A, B and C respectively.

LACK OF KNOWLEDGE & SKILLS
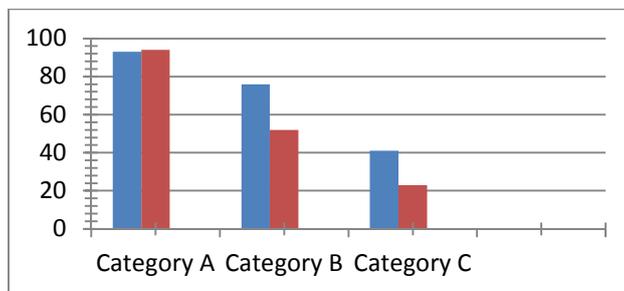
Fig. 13.   practices response and implementation rate about knowledge and skills

Knowledge, skill and expertise and experience of employee also contribute positively towards the implementation practices if improvements. From category A we got 933% responses in favor of the factors while 76% from category B and 41% from category C organizations. While implementation rate of best practices for to improve the knowledge and skills are 94%, 52% and 23% for category A, B and C respectively.

LACK OF NEW TOOLS & TECHNOLOGY

Inclination of staff for adaptation to new tools and techniques is also considered important for adaptation of practices of SPI. employee of organization from category A are more motivated and ready for adaptation to new technologies, tools as compared to employee of organization of category B and category C. After detailed analysis we determine that 91% from category A, 65% from category b and 54% from category C are in favor of new tools and technologies for SPI practices. While implementation rate of best practices for to improve the tools, technology and techniques are 94%, 41% and 23% for category A,B and c respectively.
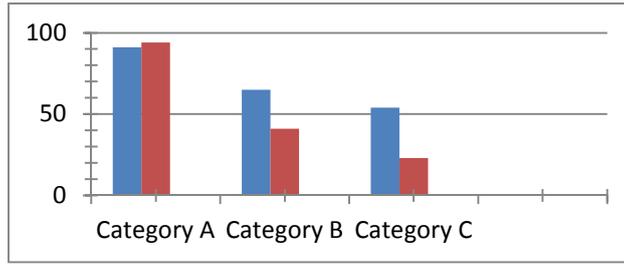
Fig. 14.   practices response and implementation rate about new tools and technology

LACK OF TRAININGS

Trainings are very essentials for capacity building and to be ready for new trends and improvements patterns. Without training it would be difficult for the organization to withstand with emerging needs of the clients.. It is found that organization who are successful in reaching to higher levels of CMMI are frequently involve their employee in different types of trainings as compared to organization of category B and C. Category A positive response rate are 92%, category B with 71% and category C with 45%. While implementation rate of best practices for training the people are 93%, 55% and 19% for category A, B and C respectively.
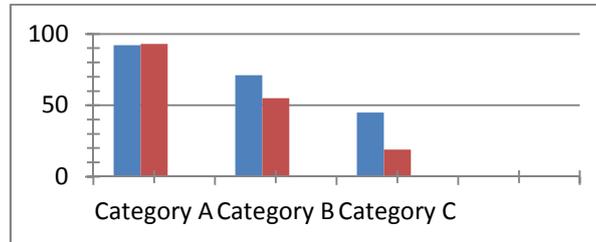
Fig. 15.   practices response and implementation rate about lack of training

RELUCTANT TO INVESTMENT

Organizations are reluctant to invest and afraid of high conversion cost for improvements in process. Though these practices help the organization to cut cost in long run but most of the organization focus is on short term objectives especially in Pakistan. From our study we revels that there are 88% positive response from category A, 65% from category B and 44% from category C to invest for SPI practices. While implementation rate of category A are 92%, category B are 43% and category C are 29%.
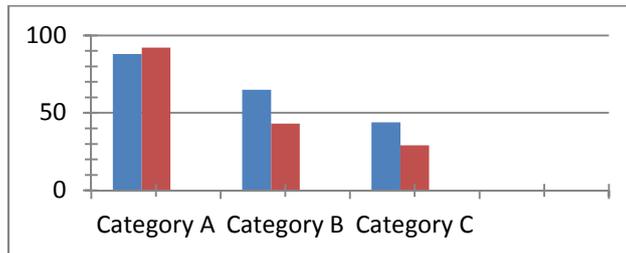

Fig. 16.   practices response and implementation rate about investment

INADEQUATE BUDGETS & SCHEDULES

From different source we reveal that organization always want to cut costs across the projects in order to maximize the profit. Profit margin can be improved through SPI but most of the organization focus on short term goals rather than think big and in long run. Inadequate budget and schedule over project can affect quality practice implementation. Our data reveals that category A organization response rate are 89% towards importance of his issue while category B and C are 76

and 65% respectively. The implementation of best practices to overcome this barrier is 92% in category A, 45% in category b and 32% in category C organizations of Pakistan.
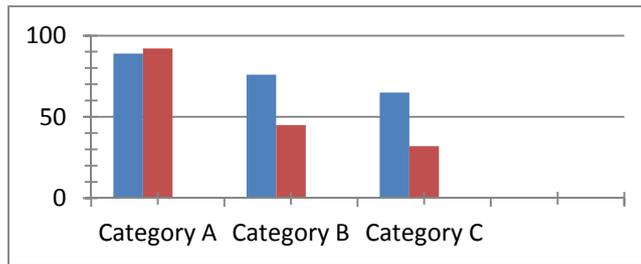

Fig. 17.   practices response and implementation rate about budget and schedules

LACK OF MANAGEMENT SUPPORT

Management usually focuses on short goals and wants to improve their reports, competencies and financial savings. Most of the today managers think narrowly towards project rather than organization. Management are also not ready to delegate powers, responsibilities and to their employee. 87% responses from category A , 61% from category B and 43% from category C consider these factors are important for process improvements in Pakistan industry. While implementation rate of best practices for improvement in enhancements of management support are are 91%, 41% and 16% for category A, B and C respectively.
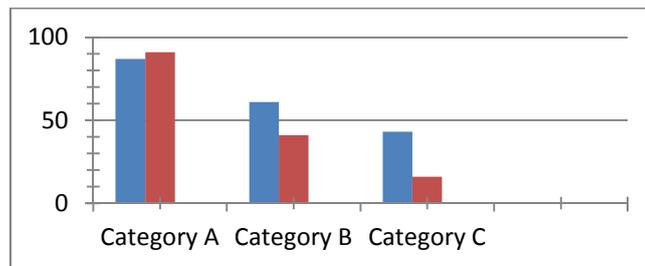

Fig. 18.   practices response and implementation rate about management support

LACK OF COMMITMENTS

All the organization including top management and workforce in the industry not committed to organization, project and quality improvements practices. Our data reveals that category A organization response rate are 87% towards importance of his issue while category B and C are 67% and 41% respectively. The implementation of best practices to overcome this barrier is 91% in category A, 55% in category b and 27% in category C organizations of Pakistan.
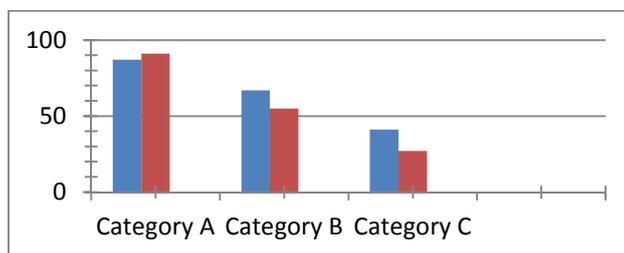

Fig. 19.   practices response and implementation rate about commitment

DOCUMENTATION ISSUES

Documents are crucial for the organization operation and survival but in Pakistan most of agreement and deals are taken verbally. Data collected through different resources show that 93% responses from category A, 67% from category B and 33% from category C consider document management is important for process improvements in Pakistan industry. While implementation rate of best practices for improvement in document management are 94%, 35% and 14% for category A, B and C respectively.
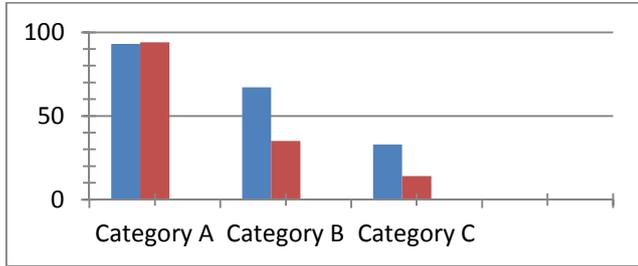

Fig. 20.   practices response and implementation rate about document management

IMPROPER DATA MANAGEMENT

Data is important source of decision making that is the core of management. But in Pakistan most of the organization suffers with adequate data management practices. From survey and other resource we came to know that category A organization response rate are 91% towards importance of his issue while category B and C are 76 and 35% respectively. The implementation of best practices to overcome this barrier is 94% in category A, 47% in category b and 18% in category organizations of Pakistan.
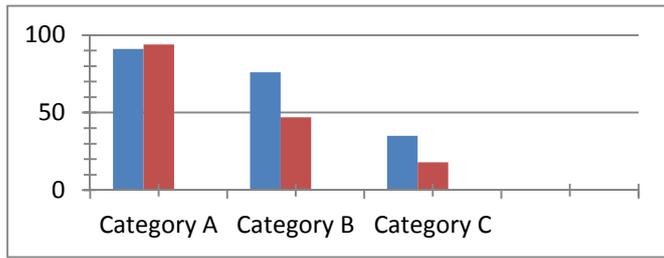

Fig. 21.   practices response and implementation rate about data management

LACK OF STAKEHOLDER INVOLVEMENT

It is necessary that stakeholders are identified and involved in the project as early as possible from the initial stage of project to improve the credibility of the work and project. But in Pakistan software industry we lack this trend. From our study we found 86% responses from category A, 69 % from category B and 43% from category C consider these factors are important for process improvements in Pakistan industry. While implementation rate of best practices for improvement in stakeholder involvement are 91%, 51% and 23% for category A, B and C respectively.
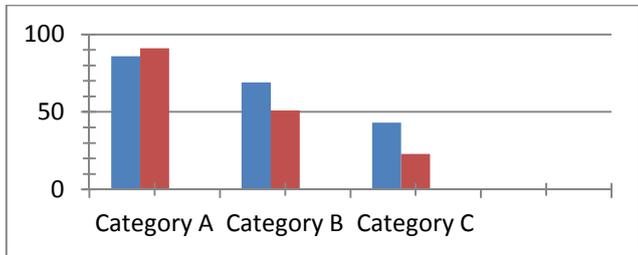

Fig. 22.   practices response and implementation rate

IMPROPER COMMUNICATION

Our data reveals that category A organization response rate are 94% towards importance of his issue while category B and C are 65 and 34% respectively. The implementation of best practices to overcome this barrier is 94% in category A, 56% in category b and 17% in category C organizations of Pakistan.
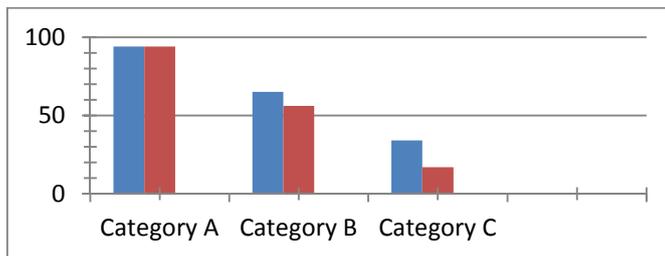

Fig. 23.   practices response and implementation rate about data management

LACK OF INTERNAL AUDITS & REVIEWS

In Pakistan most of the organization believes that audit is not vital but they face problem in term of lack of resources, weak control and loss of revenue. From our analysis and research we found that 87% responses from category A, 67% from category B and 32% from category C consider these factors are important for process improvements in Pakistan industry. While implementation rate of best practices for improvement in internal audits reviews are 92%, 39% and 11% for category A, B and C respectively.
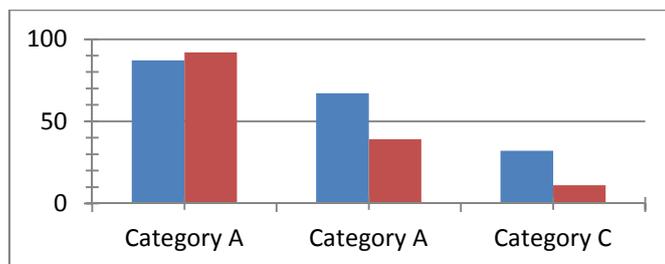

Fig. 24.   Response and implementation rate of audit and review

4   RECOMMENDATIONS

We suggest a very simple framework that can be used by any organization to take initiative for the implementation of any SPI model like CMMI in Pakistan. It based on five core areas to address as access, analyze, set objectives, streamline with business objectives and evaluate as shown in the figure.
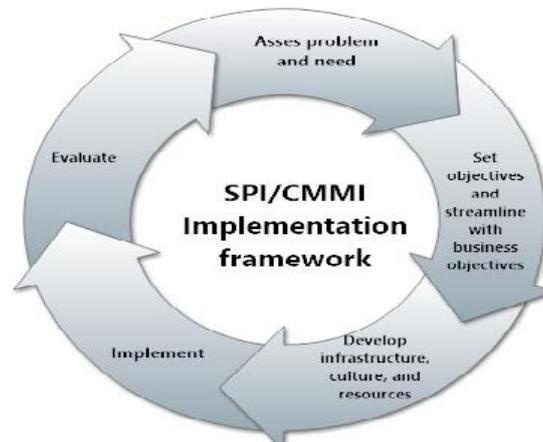
Fig. 25.   Response and implementation rate of audit and review

Let describe each one of the following;

- Before going to any SPI effort or CMMI implantation it is necessary to assess the problem, need for improvements and potential problems. Carefully analyze the situation in term of problems and solutions, possibilities, cost, resource allocation, infrastructure, culture and people.
- Set realistic goals and objectives of improvements. These goals and objectives must be streamlined with the business objectives in for attracting market, going for more market share, competitive advantage and quality enhancement.
- Build infrastructure, culture and resources for SPI or CMMI implementation. There is immense need to create awareness of importance of quality and role of software process improvements for quality. This awareness of importance of quality practices and SPI should focus at all levels and in all departments of organization. Awareness program should start with high level management and span to the all levels in organizations. Another important consideration is the arrangement of resources for SPI like process engineers, assessors and consultants. This capacity and resource building is only possible if organization is committed to introduce the culture of learning and training of its employee. But such trainings are difficult to find and may prove to be very costly if available outside the Pakistan.
- Evaluate the outcomes against the set objectives of improvements. This Evolution should be in term of cause and effect of each process area.

5   CONCLUSION

Pakistan software industry fails to compete in international market place for export. The main reason for poor quality in software industry of Pakistan is related with process area deficiencies. A few organizations take initiative in international standards implementation. Many factors identified that block the way of organization for any standard implementation in Pakistan industry. Out of fifteen hundred organizations in industry only twenty two take initiative for CMMI. It is only 0.15 % of total organizations in industry who inclined towards adaptation of CMMI model. Out of these twenty two organizations that opt for CMMI implementation only two achieve status of level 5, three status of level 3 and two status of level 2. Let we consider them successful in term of implementation of CMMI practices and requirements. Than out of seven hundred organizations only five are successful in implementation of CMMI this is about 0.01% of CMMI success rate in Pakistan industry and success rate is only 0.28% for organization who opt for CMMI implementation.

Out of the twenty two about sixteen organizations are striving for Level-2 achievements. It indicates that most of organization have problem with process areas. It is also identified the reasons of the problem for improvements in these seven specific process areas where Pakistan industry suffer. We also suggest a framework for going to CMMI model that best suits with the requirements of Pakistan industry for going with CMMI implementation.

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