International Journal of Innovation and Scientific Research
ISSN 2351-8014 Vol. 17 No. 1 Aug. 2015, pp. 120-130

http://www.ijisr.issr-journals.org/

Detecting Innovation Signals with Technology-Enhanced Social Media Analysis - Experiences with a hybrid approach in three branches

Robert Eckhoff[1], Jakob Frank[2], Mark Markus[1], Markus Lassnig[1], and Sandra Schön[1]

[1]Innovation Lab,
Salzburg Research Forschungsgesellschaft,
Salzburg, Austria

[2]Internet of Things,
Salzburg Research Forschungsgesellschaft,
Salzburg, Austria

ABSTRACT: Online communities are seen as valuable knowledge source about customers' needs and interests. Innovation research also tries to analyze content from online communities to detect signals for future innovations. Within this contribution the theory of signals for future developments, existing approaches are introduced.
Building upon this introduction, we describe the Austrian research project "Innovation Signals" that aims to develop and implement a technology-enhanced analysis of signals for future developments by analyzing user-generated content from selected online communities. Besides automatic data extraction and statistics the approach tries to make sense through structured content analysis. Therefore, the approach combined so-called qualitative research with quantitative research, as well as automatic monitoring and analysis with manual social research.
Part of this research project was the identification of innovation signals for three companies from different fields/branches (sport, energy, and mobility). Within this contribution we describe and reflect on our experiences within these settings and on additional findings based on the project. These are guidelines for social media mining and a comparison of existing approaches of technology-usages for weak signal detection. The authors also discuss practical implications derived from their experiences, as well as future opportunities for further research.

KEYWORDS: weak signals, innovation, foresight, future, enterprises, social media mining, approach.

1 INTRODUCTION

From the perspective of enterprises as well as from the perspective of innovation research, user generated content within the Social Web can be a valuable source for detecting ideas for future innovations. To arrive at a deeper understanding of customer needs, of their opinions about products or new trends, several theories and approaches have been put forth by now. Nevertheless, the potential of Social Media for strategic innovation purposes is still at its beginnings: The understanding of social media content and its transformation into business opportunities, innovation chances and novel products and services are still in their infancy (cf. [1], [2], [3]). In addition, futurologists do currently not consider content from weblogs and Internet forums as being among the top ten sources for detecting weak signals (see [4]).

The research project "Innovation Signals" at Salzburg Research (Austria) focuses on the idea of detecting weak signals as potential early signs of innovations. In this context, the developed technologies and methods have been combined to provide three enterprises with a full social media analysis and consulting phase. Within this contribution, the state of the art, the project and our specific approach called "innovation signals" as well the respective lessons-learned are described and

discussed critically. The paper builds upon contributions that describe first experiences with this new approach (see [5], [6]) and provide a final summary of the research project and its results.

2 THE THEORY OF (WEAK) SIGNALS FOR FUTURE DEVELOPMENT

According to Ansoff weak signals are "imprecise early indications about impending impactful events" [7]. All that is known, he proceeds, "is that some threats and opportunities will undoubtedly arise, but their shape and nature and source are not yet known" (ibid.). Compared with other levels of knowledge about the future, weak signals are among the vaguest, especially compared with "drivers" or even "trends" (see [8] and Table 1). It is either totally surprising (positively or negatively) or gives you the feeling of change (ibid.).

Table 1. Future signals sense-making framework (see Kuosa [8], p. 45)

The levels of future knowledge	The fundamental nature of information	
	Disrupters / non-linear	**Promoters / linear**
A. Weak Signals	Any observation that is totally surprising, amusing, ridiculous, or annoying to you.	Any observation that tells about change and makes sense to you.
B. Drivers	Your understanding of potential seeds of change.	Your understanding of demands of change.
C. Trends	Your understanding of blockers and change.	Your understanding of inevitable large change processes.

The collection and detection of weak signals could "be a key to anticipating changes in advance and avoid letting them cause surprise" [9]. The challenge in detecting weak signals is that they normally are hidden in the "noise of the daily produced data" [10], see also Figure 1.

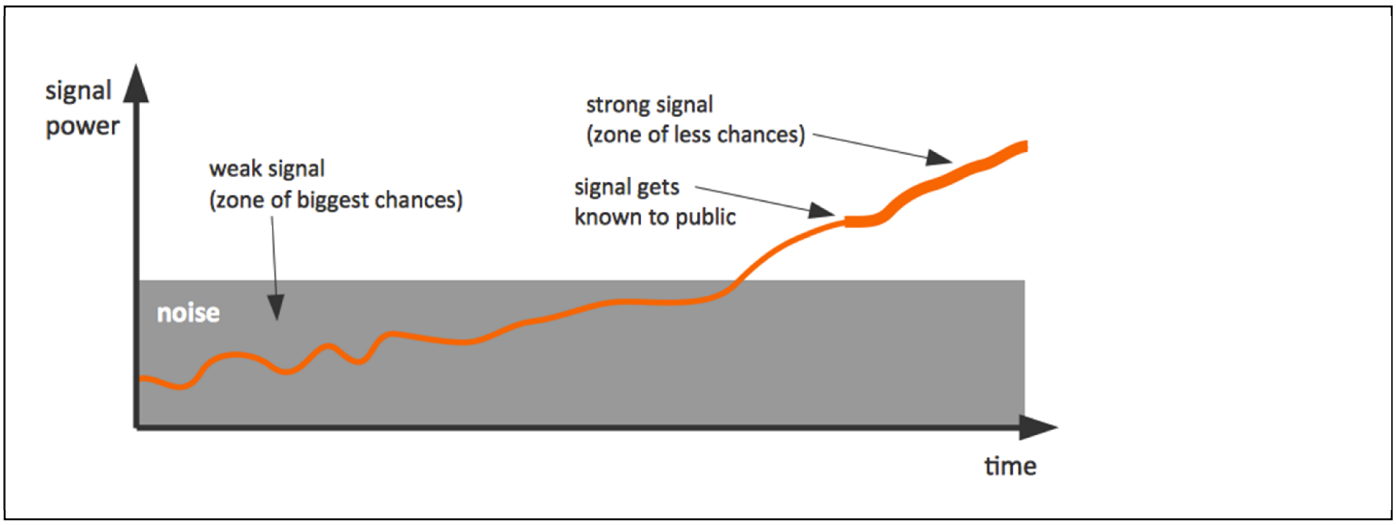

Fig. 1. Evolution of a weak signal, building upon Coffman [11] and Steinmüller [12]

Additionally, it is unclear if weak signals are detectable at any point in time, even if literature sometimes gives the feeling "that they lie 'out there' almost as a commodity" [13, p. 379]. To get a better idea what properties "weak signals" might have or what they can be, it is suggested to use hindsight to detect and identify weak signals for current trends to get better information on how they might be detected in the future [9]. However, it is not only complicated to detect such weak signals inbetween the noise, but it is also a challenge to filter out the "wrong" signals and to keep the "right" ones for further evaluation and discussion. Already Coffman described the issue of "people who 'know'" that scoffed at weak signals [11]. "Cognitive filters" influence the final detection of what is coined as "weak signals" and which weak signals might be overseen. Ansoff [7] named mental filters that influence the realization of weak signals within enterprises: The "surveillance

filter" focuses on specific information in the environment and the "mentality filter" is responsible for the selection that is strongly influenced by a companies' culture. The third filter, the "power filter" might be the influence of managers who neglect or even surpress information. As described and empirically shown in [14] such mental filters can be influenced by contextual factors. Filters can be decreased by "virtual process, open question and anonymity" (ibid., p. 919). Filters can be strengthened through "focused scope, close to the current strategy, strong requirement for plausibility and probability in the social interaction process" and others (ibid., p. 919).

Besides these challenges, weak signal detection continues to attract attention from futurologists as well as enterprises, because this concept provides one of the few frameworks of how future developments might be recognized at a very early stage. Concrete approaches and applications are part of strategic foresight activities in enterprises as well as in research, and are still under development. Of course, technologies play a growing role within such approaches.

3 APPROACHES TO DETECT WEAK SIGNALS

Even if the concept of weak signals might be clear, the variety of approaches to detect them is broad: Sources, detection and evaluation methods vary.

First of all, the variety of sources for weak signals is broad: In a survey experts should rank their favorite sources for detecting weak signals [4]: In some of the branches, for example economics as well as society and culture, (interviews with) futurologists are the preferred source for weak signals detection. In politics, these are politicians; in technology and science, these are scientists/ researchers. Besides individuals, who are always at the first ranks of preferred sources, marginal/underground press (environment) or blogs (society and culture) also belong to the ten most preferred sources.

The variety of detection methods of (potential) weak signals and their evaluation (i.e. if they are weak signals or just noise) is broad. In an earlier study we looked for current usage of technologies for weak signals detection [15]. We collected examples for the usage of technologies for weak signals detection in the literature from the last five years. Our final set of applications of IT within the process of weak signals detection was diverse: To start with, we found a naive application of text mining to identify emerging terms within conference abstracts in the field of technology-enhanced learning [16]. A completely different approach is the application of a tool designed for scouting (collecting data from scouts, edited by an expert round) as part of an integrated insight and response system at Deutsche Telekom Innovation Laboratories [17]. In another application a quantitative model for detecting weak signals (emerging trends) with the help of an inference model and a Bayesian network at a "weak signals tracking board" are part of the "New and Emerging Signals of Trends model", dealing with future sciences and technologies [18]. Finally, in the field of life sciences a set of monitoring and data-mining approaches is integrated to deliver a "technology radar" with the help of a technology watch team [19].

As we will show, our developed approach in the project is yet another variation of how to detect weak signals.

4 PROJECT GOALS AND GUIDING RESEARCH QUESTIONS

Within the research project "Innovation Signals" we set out to develop and implement a new methodology that combines two common analytical approaches: a) using user-generated content for innovation purposes and b) a unique methodological design that utilizes a software tool. The goals of the project are:

- Development of technology for early identification of innovation signals within the Social Web.
- Development of the methodology to combine innovation signals with statistics and trends.
- Tailored reports on innovation signals including ideas, innovation chances and visions for single industry partners.

Within this paper we will describe the project results as a whole, addressing the following research questions:

- How does the Innovation Signals approach look like?
- How does the approach work within concrete settings with industry partners?
- What are lessons learned for future applications and/or adaptions of the approach?
- What additional insights, results and conclusions can be drawn from the project?

In the following, we will describe the research design of the project.

5 RESEARCH AND PROJECT DESIGN

The project called "Innovation Signals" is a research project funded by the Austrian research program "Research Studios Austria" (Austrian Federal Ministry of Science, Research and Economy, BMWFJ, and The Austrian Research Promotion Agency, FFG). Following the midterm evaluation, further funding depended on the project's ability to find paying customers for the developed service. The project and development builds on academic research and literature and integrates these with concrete requirements from practice. The following illustration (figure 1) gives an overview over the general project plan.

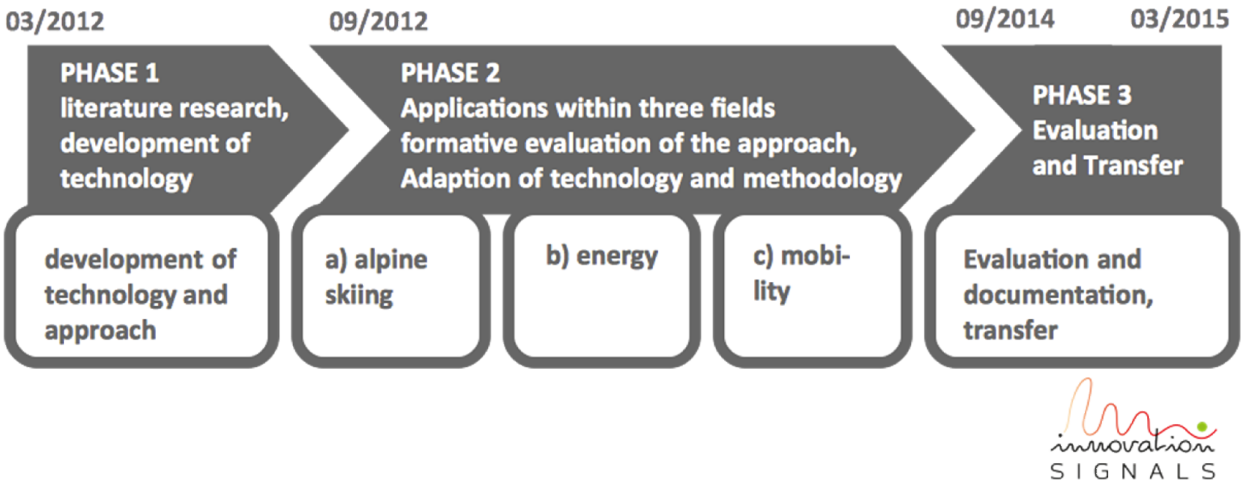

Fig. 1. Innovation Signals project plan

The formative development as well as the evaluation of the innovation signal methodology and the used technologies are the reason that the three examples used are neither identical nor directly comparable.

6 THE "INNOVATION SIGNALS" APPROACH

Our concept called "Innovation Signals" uses a combination of social science methods as well as data mining tools to identify common topics and potential weak signals in a certain field using user-generated content from the Web (esp. from discussion forums). Comparing the findings with the state of the art in the industry and the current product or service portfolio of the client, the researchers focus on and present their data about topics that are currently not or only marginally addressed by the client's portfolio. Additionally, the approach includes the contextualization and translation of information into business opportunities. The subsequent diagram depicts the different phases and the overall structure of the Innovation Signals research process that will be described in more detail below. As you can see in the illustration, the process usually has more than one iteration.

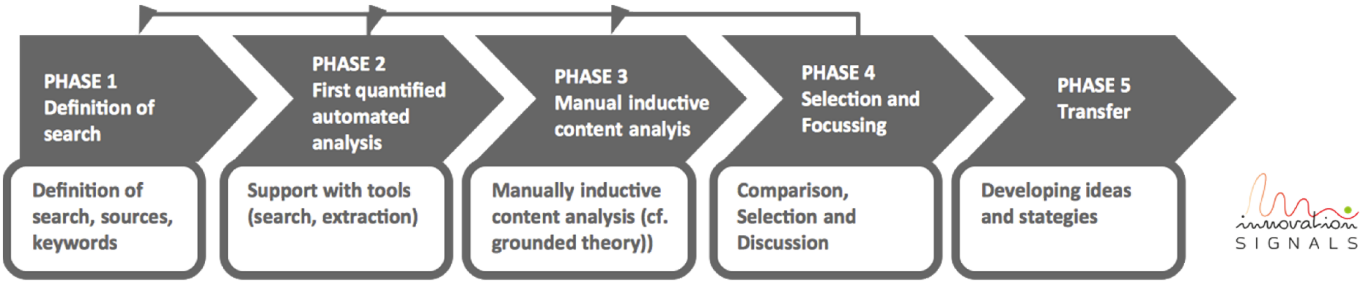

Fig. 2. Innovation Signals research process

Phase 1: Definition of search fields. The main goal of this first phase is to define small and concrete search fields or, even better, hypotheses. An example for such a hypotheses might be, "From the perspective of the consumer, photovoltaics are predominantly an issue of technology and commercial viability, but not so much of ecology". Then a keyword list and a list of forums, websites or discussion lists is collected that fit to the defined search field or hypotheses. We both used our tool or extracted data manually. Within all cases presented, it was easy to find communities discussing the topics of interest, but we developed a list of quality criteria on which communities were selected. Examples of quality criteria are the level of activity in the forum (e.g. the number of new threads per month), the number of members of the community, the number of views on threads, the number of replies in most threads (also that there should not be any posts containing questions that remain unanswered etc.) or a well elaborated structure of contents of the forum (with maybe also sub-forums).

Phase 2: First quantified and automated content analysis - exploration, mining, analysis: In analyzing the sources, we used both a top-down approach, searching for pre-defined keywords and a bottom-up approach, identifying new topics that are frequently discussed by users in the communities. Therefore, we used a simple search tool as well as our enhanced and adapted data extraction tool to detect relevant content in the Social Web. Our own tool is the innovation signals prototype software, using a framework developed by Salzburg Research as part of several Apache projects (see figure 3). Nevertheless, for each client, we developed our own keyword lists and adaptations to address the special requirements of every search field.

In Figure 3, the Innovation Signals Framework is illustrated. Technically, we used several tools and framework technologies developed in-house or within other Apache projects. For example, the Apache Tomcat Server is in use as application container for the full framework; such as Apache Marmotta and the KiWi triplestore to provide storage backend and Apache Stanbol for content analysis. Additionally, extractors for every case (and search field), transformers, sentiment analysis, upload and search indices were developed or adapted and implemented within the Innovation Signals project.

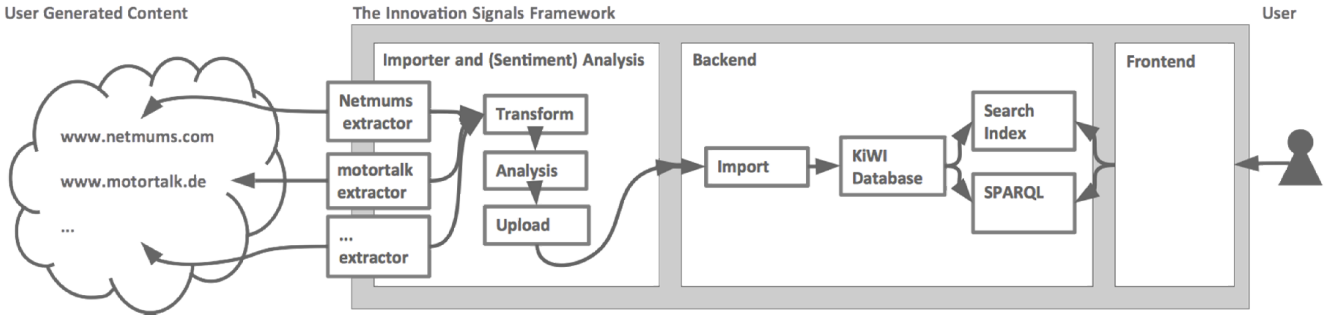

Fig. 3. Innovation Signals Tool Framework

Phase 3 – Manual inductive Content Analysis: The automated analysis of textual content enables an efficient information processing, but the machine-processed information still remains ambiguous. In order to enable effective research, the interactions in the social web must be additionally structured and analyzed with social scientific methods. This means to associate user-generated content with relevant statistics, trends and theories to amplify the meaning of the information and to understand the consumers' conversations better and in a broader context. Therefore postings to one defined (and special) topic had been selected with a criteria list (minimal length, originality of content, not only short statements as "me too"). Using the grounded theory of approach of content analysis and theory development, we developed a coding scheme toward a certain aspect of interest. In a first round and with broader search fields the goals of this analysis was on a more general level, e.g. we analyzed the main topics discussed by users. In second round (after phase 4, selection and focusing), this analysis was normally even more focused. Exemplarily, we looked for other aspect that were aspects of users' argumentation dealing with costs of a special product and service.

Phase 4 – Selection and Focusing: Typically, our list of topics discussed was a very long one and the majority of findings were trivia to any expert in the field: Some aspects of discussion are very well known, already some years old and therefore not an "innovation signal" or a "weak signal". Although we obtained a very good overview over the field, we were (of course) not able to decide which topics are "common" and which could be seen as weak signals. Our way to reduce the amount of relevant topics concerning the search fields in the social web was to research the "state of the art" within the respective field. Within our three approaches we (a) read relevant basic information and standard literature, especially for educational purposes, and (b) we analyzed all services and information material from our client. In addition, verifying the selection with

the client was an important step as well. After confirming the search fields, we started to go into deeper analysis within our selected topics, search fields and hypotheses.

Phase 5 – Transfer: Within the last phase we worked on potential translations of our findings into business opportunities. This phase of the research process utilizes user generated content (in close co-operation with customers/companies) as an additional information source for strategic decision making with regard to the kind of innovation (product, process, business models, strategic innovation fields) to be pursued in order to determine the focus of the product innovation and market strategies and/or to detect new markets and new ideas.

7 EXPERIENCES IN THE FIELD

The described process is the result of our (learning) experiences from three different client projects. As requirement of the project, applications of the innovations methodology were needed and several potential industrial partners were courted. Finally, we had the chance to support three customers with our analyses and approaches and to take further project effort to work, tuning and adapting the methodology as well as technology. The following field experiences took place in three very diverse settings (alpine skiing, mobility, and energy) and are reported chronically.

7.1 EXPERIENCES WITHIN THE SEARCH FIELD OF ALPINE SKIING

In our first case, a ski manufacturer commissioned us to support their early innovation phase. Part of the mission was to identify possible areas of innovation and new customer needs in the social web. In a kick-off workshop with the company, we identified the relevant search fields, i.e. the areas in which to look for innovative customer needs and solutions. We selected 24 specific ski forums derived from the objectives of the ski manufacturer, from which we extracted a total of 170,000 posts.

From earlier projects with the company, we knew about current innovation projects, the general product portfolio and were aware of the state of the art. Accordingly, we were able to very well define the search field and come up with hypotheses relatively easily.

In total, we selected over 300 authentic user posts that provided valuable ideas and information to specific product improvements and other innovations. We translated these posts into customer need statements (Ulwick, 2005), which we reviewed and prioritized in a customer survey. Among the top ten customer needs were joint-friendly skis, eco-friendly ski manufacturing, more grip on ice and simple handling, etc.

7.2 EXPERIENCES WITHIN THE SEARCH FIELD OF MOBILITY

After the first successful application, we wanted to prove the method in a second field: mobility. Within the first workshops and discussions the industry partner showed a broad interest on “everything from the field”. This had several consequences for our work: As we had 12 different search fields with a relatively long list of subtopics each. As a first step, we searched for forums in which the relevant search fields might be discussed. Astonishingly, interesting statements were not only found in automobility-related forums but in very general ones, for example bravo.de (a Website of a journal for teenagers) und Moms.org (a community platform for mothers). The range of search fields delivered a long list of potential interesting aspects and topics that might be weak signals. To verify if a topic was new or “trending” we also used Google Insights for Search.

In our first presentation of results we presented a large amount of new items, potential signals, interesting things. Nevertheless we had the impression that this was “too much”: Some aspects were not “new”, some were “uninteresting”, some were “overemphasized”. On the other side, this long presentation also made our customer aware, that we had to limit and therefore focus the search fields and questions. Reflecting why our work within the second field was much more difficult as compared with the first one, we found some additional reasons: Of course we also found that this process might be easier if we had a profound knowledge on the topic before we started the development of the keyword lists and first analysis, helping us to define the search fields. Additionally, we did not have a clear idea on how to filter all the potential innovation signals –mainly because filtering means to prioritize some information over others, something that we couldn’t do without knowing what qualified as interesting information and what didn’t. After the presentation we re-defined and sharpened the search fields together with our industry partner, for example we focused on “changing the means of transportation” instead of multi- and intermodal mobility. .

The following work and presentation of results was more focused. A good driver was the decision on “what is relevant from customers’ perspective”. Additionally, we did an analysis of the current working fields of our partner to see where and if

the new topics might be influencers. Nevertheless, the preparation of the presentation itself and the concrete way to present the data took approximately half of our time within the project and was done in close communication with the partner. As a result and sign of approval, the final presentation was presented at a management board meeting (by our industry partner).

Within this second case we frequently utilized sentiment analysis. For example we analyzed the sentiments along our client's product portfolio. Sentiment analysis is an analysis of the affective tone of the posts. For this purpose we use word lists that assign sentiment values to common words in a certain language, which acts as foundation for the sentiment values of a post. This analysis provides e.g. a comparison, representing the number of positive and negative sentiments associated with competing enterprises. In addition, customer associations with a brand, for example with words such as 'fun' or 'performance' can be compared. As a result, the company gains a much broader view over potential innovation fields that are prioritized and put into the context of larger societal trends. We used automated sentiment analysis implementation within our tool and some cases, but did this in combination with a manual analysis. This comparison led us to the decision, that manual analysis produces much higher quality outcomes (we typically had 100 to 1,000 posts for such analyses).

Of course we tried to conduct automatic sentiment analyses with our tool, but as the number of relevant text parts was small (in the described case 288) we also analyzed them manually. This and some other attempts to deal with an automatic sentiment analysis resulted in the conclusion that the manual analysis was much better and was always needed for control.

7.3 Experiences within the Search Field of Renewable Energy

In our third case we worked with an energy provider interested in what users say about renewable energy. In preparation for our first workshop we did a relatively intense analysis of the current state of the art within the field. We wanted to be well prepared and be able to offer recommendations for search fields and possible hypotheses in the first workshop.

Nevertheless, we had similar experiences in our first workshop as in our second case: Building on our experiences from case two we insisted on just five search fields, one of them being renewable energy. This restriction resulted in the client's wish to have very broad search fields. Our client had the impression that focusing on just five narrow search fields might result in missing some interesting weak signals.

Technically, the online discussion of "solar energy" was pretty well covered in five specialized discussion forums that made it worth to develop extractors for these forums. Compared with a simple text search our tool enabled us to search and count the appearances of words including all synonyms in one single step.

Within our third case we developed a new idea on how the results might be presented: The "customer journey" illustration. Building on our analysis of the existing offers and services of our partner, we developed a plan of the typical steps or customer journey, from the first idea of purchase to recycling. Each step in the survey was supported by a (manual) sentiment analysis, resulting in values showing whether customers overall experienced this phase as positive or not.

As a result, we could pinpoint all the current touchpoints that were described as negative by customers. In turn, we could describe and sketch a complete new business model for our client that would allow customers to only experience the positive steps in the customer journey and thereby changing the entire experience from mainly negative to mainly positive.

7.4 Overview of the three settings

In the following we give an overview about facts and figures as well as experiences from the three settings.

Languages were always English and German

Table 2. Overview over the three settings

	Sports (Leisure)	Mobility	Energy
Field Description	Potential trends and ideas for alpine skiing	New emerging customer needs with regards to mobility	Alternative energy from customers' perspective
Definition of Search Fields and Questions	One clearly defined search field	12 search fields (to many)	Five fields (but too broad)
Usage of Tools	Building own Extractor, Analysis with own Tools	Google Insights for Trends, Usage of sentiment analysis with own tool	Building own Extractor, analysis with own tool
Description of Sources	(Very) specialized discussion forums of alpine skiers and alpine winter sports.	Customers' needs were found in very general forums.	Specialized forums of providers and end-consumers.
Presentation of Results	Presentation was not only, but also a long list of ideas from skiers.	Presentation builds on long discussion with client to match their existing categorization; focus on customers' needs.	We developed a "customer journey" illustration to reveal points for improvement.

8 REFLECTIONS OF THE EXPERIENCES IN THE FIELD

Reflecting all experiences with the innovation signals methodology and looking forward on future adaptions of our approach, we considered four aspects as relevant lessons-learned: (a) researchers should be well prepared in the field, (b) defining the search is crucial and requires a set of helpful methods, (c) the potential of technological support depends on search fields, (d) the potential of surprise is small, and (e) the presentation of data is the key.

8.1 RESEARCHERS AS FIELD EXPERTS AND COMMUNICATION IS IMPORTANT

In order to use social media mining to the benefit of third parties, e.g. clients, an excellent knowledge of the field decreases the time needed to define search fields and derive plausible hypotheses. This is not always the case for consulting in innovation management. However, within our innovation signals approach we experienced that certain level of expertise can help set boundaries early and facilitate the generation of own ideas to develop good (focused) search fields or even small research questions or hypotheses within the workshops with the client. For future work, we would suggest to e.g. deal with the service description of the customer to understand them and to read and analyze basic literature from the field. One of the authors of this paper describes this as "our key competence in this project is to become experts in an entirely new field in beeline".

8.2 NEED TO DEVELOP METHODS FOR THE DEVELOPMENT OF SEARCH FIELDS, QUESTIONS AND HYPOTHESES

One of the difficulties we encountered was that in the first phase of defining the search fields it was not easy to arrive at clear and "small" foci? We identified the following reasons: Potentially our client got the impression of losing certain aspects by focusing. Another aspect is that the approach itself, at least the approach description, leads to the impression that it delivers data without input, i.e. "the data speaks itself". Another challenge we confronted was the fact that clients' often perceived our findings as being trivial, even though they would address main challenges in the field. An example is that discussion on global oil supplies and trade were seen as irrelevant – or at least well known - to our mobility client. After our three projects, we are pretty aware, that there is a need to design the first phase more effectively, to increase communication and narrower search field definitions. The challenge is finding a good balance between defining the search fields and the consequent search concepts in a way sufficiently focused to avoid fuzzy results and providing a definition broad enough to include important yet silent innovation signals – with the support of the client. Thus, one conclusion here is that "data doesn't talk". We have to come up with relevant hypotheses that we can test and therefore support or reject with the help of the data. Focusing the search is the way to get a better understanding of the data.

8.3 THE POTENTIAL OF TECHNOLOGICAL SUPPORT DEPENDS ON SEARCH FIELDS

The role of technology in any project was central for the start phase, but within our projects we more and more see, at least within part of the cases, that the "manual work" for collection, indexing and also analysis itself was often faster, better

and more efficient than the automated analysis (and the additional work needed). The analysis of sentiment for instance was far more reliable and efficient when done manually, especially considering that our typical set of user posts amounted to some hundred text parts. Writing an extractor is worthwhile writing when the material comes from specialized and focused discussion forums such as forums on solar energy. Of course the tools might be helpful in social media mining, for example monitoring user feedback. For usage in analyzing posts in order to find weak signals with relatively few relevant posts, manual analysis proved to be superior to the automatic analysis currently available.

8.4 POTENTIAL TO SURPRISE IS SMALL (IF ANY)

The general feedback in all three settings was that our customers said that the results do not surprise them, but rather support their hypotheses. This is a little bit concerning, as such hypothesis were not clearly described within the first contacts and workshops with our partners. For instance, the social media mining project for a large mobility provider showed that drivers are increasingly dissatisfied with the costs of mobility. However, this observation did not qualify as groundbreaking news to our client. The analysis in the energy sector could after major contextualization deliver at least some food for thought as we could show that the customer journey towards a solar panel on the roof was paved with negative experiences for which an energy provider could possible offer a remedy for. Finally, the analysis conducted in the realm of the skiing industry was able to identify some features that users would look for when reviewing new skiing products. However, even though this last analysis was by far the most specific, the results failed to surprise our client. Building on the impression, that no big surprises were developed for our customers, we tried to validate these experiences. Therefore we discussed the role of surprise within weak signals theory and similar experiences within the extant literature. The paper [20] may be seen as a first discussion of the topic, which should be a first step to validate researchers' experiences and to initiate future discussion.

8.5 PRESENTATION OF THE DATA IS THE KEY

Even if our clients asked us (more or less literally) to "let the data talk", the presentation of this data in meaningful and digestible form is possibly the most challenging part of each project. We developed and used several approaches to "fill" the data with meaning and tried to avoid presenting a long list of findings. One example is the sorting by services provided to our mobility client, another was the development of a (typical) "customer journey" and what might influence or innovate it. Another lesson concerning the presentation of results can be summarized as follows: Finding out and showing unknown innovation potentials are key, while the presentation of previously known facts should be kept to a minimum. A careful researcher should not only be aware of a senseful presentation and good story for his/her issues, but should additionally address future potentials of change within the partner's enterprise.

9 ADDITIONAL INSIGHTS AND RESULTS OF THE PROJECT

Whereas the key project work was the development of new technologies, the implementation and adaption of the approach and the work with our three clients, additional work was necessary. As described within the introduction of this article, we looked for and analyzed existing experiences and approaches of technology usages for weak signals detection [15]. And as referred to in the reflection part, we wrote a short paper on our impressions concerning the limited surprise potential of weak signals detection [20].

Additionally, we discussed and reflected our experiences within this and similar projects related to a first set of guidelines concerning social media mining for innovation purposes in general [21]. Social media in general and user-generated content are seen as potential sources for trend detection and innovation. Nevertheless, there are quite a variety of approaches and experiences. Within this contribution, we wanted to collect and discuss existing recommendations from the literature and our own experience. Building on lessons-learned from the literature and an expert discussion, we present guidelines for social media mining for innovation purposes. These guidelines especially build on experiences with an approach called innovation signals, which combines social media mining technology with an interpretative methodology. We explain guidelines, as "No tool will do your work automatically" or "Narrow your search", and discuss our methodology of guidelines' development as well as the results critically.

10 DISCUSSION

Technology was the basis of our project idea. However, we were always aware that social science methods and consulting competences will play an important role. Looking back, we gained a lot of experience with the possibilities of social media

mining technologies, but also with the effort this implies: Developing one extractor translates into the need of one good developer from our research institution for at least one day – and usually, 4-6 extractors for one topic are needed. This is not affordable in a non-co-funded working situation. Additionally, the results leads to a smoother way to obtain results, but especially the quality of the sentiment analysis did not convince us.

Interestingly, our experiences seem to be shared within research institutions and consultant agencies in our field, but the experiences are seldom shared openly. Perhaps this is also related to potential customers and funding agencies that focus on technologies and a certain magic that might occur with its help. From our perspective in the field of innovation signals, technology of course plays a major role, but current tools are already help enough to support our social science analysis and consulting services for the detection and communication of innovation signals.

Nevertheless our report shows that the approach itself, even if successful, i.e. satisfying our clients, has potential for optimization and adaption.

11 OUTLOOK

After finishing the "innovation signals" project, an important future project is called "Innovation Lens". Within our projects we saw that internal innovation processes in firms are crucial for the realization of innovation. Therefore, many companies have introduced dedicated structures how to decide about innovation processes internally. This may be advantageous, e.g. regarding the focus on markets or product categories. At the same time, the increasing dynamics of most markets require not only incremental, but also disruptive innovations. Yet, traditional patterns of innovation are an impeding factor, in this respect. The new project "Innovation Lens" tries to develop and pilot an innovative technology-enabled methodology to detect blind spots in a company's innovation management at a very early stage. Companies shall question and analyze their traditional patterns of thinking, in order not to miss changes in the company's environment and in customer needs. The new methodology shall be based on IT-supported aggregation of a company's internal and external sources of data, visualized in the form of so-called innovation concept maps.

ACKNOWLEDGMENT

We thank Kathrin Parson, Sandra Obermann, Jovanna Urosevic and Laurenz Giger for their support in the project.

REFERENCES

[1] CFO Innovation Asia (2010). Social Media's Potential to Impact Bottom Line Largely Untapped, http://www.cfoinnovation.com/content/social-medias-potential-impact-bottom-line-largely-untapped

[2] D. Eich, *Rapid Innovation: The Potential to Utilize Social Media and User Generated Content to Create Strategic Competitive Advantage, Differentiation and Elite Brand Experiences*, 2009. [Online] Available: http://www.brainreactions.com/rapid-innovation-the-potential-to-utilize-social-media-and-user-generatedcontent-to-create-strategic-competitive-advantage-differentiation-and-elite-brand-experiences.html (2015-01-30)

[3] HBR, Harvard Business Review Analytic Services (2010). The New Conversation: Taking Social Media from Talk to Action, [Online] Available: http://www.sas.com/resources/whitepaper/wp_23348.pdf (2015-01-30)

[4] E. Hiltunen „Good Sources of Weak Signals: A Global Study of Where Futurists Look For Weak Signals", Journal of Future Studies. [Online] Available: http://www.jfs.tku.edu.tw/12-4/A03.pdf (2015-01-30)

[5] M. Markus, R. Eckhoff, and M. Lassnig, Innovation Signals in Online-Communitys – ein komplementärer analytischer Ansatz. In: M. Blattner, and A. Meier, Eds., Web Monitoring. *HMD - Praxis der Wirtschaftsinformatik*, 293, 10/2013, pp. 13-21.

[6] M. Lassnig, M. Markus, R. Eckhoff, and K. Wrussnig, Prospects of technology-enhanced Social Media Analysis for Open Innovation in the Leisure Industries. In: R. Egger, I. Gula, and D. Walcher, Eds., Open Tourism – Open Innovation, Crowdsourcing and Collaborative Consumption challenging the Tourism Industry. Salzburg, 2013.

[7] I.H. Ansoff, Implanting Strategic Management, Prentice/Hall International Inc, 1984.

[8] T. Kuosa, "Futures signals sense-making framework (FSSF): A start-up tool to analyse and categorise weak signals, wild cards, drivers, trends and other types of information", in Futures, Volume 42, Issue 1, February 2010, pp. 42–48.

[9] E. Hiltunen, Weak Signals in Organisational Futures", Aalto University School of Economics, Aalto, 2010.

[10] K. Welz, L. Brecht, J. Kauffeldt, and D. Schallmo, “Weak signals detection: Criteria for social media monitoring tools”, in Proceedings of the 5th ISPIM Innovation Symposium: "Stimulating Innovation: Challenges for Management, Science & Technology", 09-12 December, 2012; Seoul, Korea.

[11] B. Coffman, “Weak Signal Research”, 1997,
Online available http://www.mgtaylor.com/mgtaylor/jotm/winter97/wsrintro.htm, (2014-08-2014)

[12] K. Steinmüller, “Wild Cards, Schwache Signale und Web-Seismografen. Vom Umgang der Zukunftsforschung mit dem Unvorhersagbaren”, in W. J. Koschnick (eds.), FOCUS-Jahrbuch 2012. Prognosen, Trend- und Zukunftsforschung, Focus Verlag München, 2012, pp. 215–240.

[13] P. Rossel, “Beyond the obvious: Examining ways of consolidating early detection schemes”, in Technological Forecasting and Social Change, Volume 78, Issue 3, March 2011, pp. 375–385.

[14] L. Ilmola and O. Kuusi, “Filters of weak signals hinder foresight: Monitoring weak signals efficiently in corporate decision-making”, in Futures In Organisational Foresight, Organisational Foresight, Vol. 38, No. 8. (October 2006), pp. 908–924.

[15] R. Eckhoff, M. Markus, M. Lassnig, and S. Schön, “Detecting Weak Signals with Technologies. Overview of current technology-enhanced approaches for the detection of weak signals“ in: International Journal of Trends in Economics Management & Technology (IJTEMT), volume III issue V, October 2014,
URL: http://www.ijtemt.org/vol3issue5/1_Detecting_Weak_Signals_with_Technologies_Vol_III_Issue_V.php

[16] A. Cooper, C. Voigt, E. Unterfrauner, M. Kravcik, J. Pawlowski, and H. Pirkkalainen, “D4.1 Report on Weak signals collection”, TEL Map - European Commission Seventh Framework Project (IST-257822), 2011. Online available: http://telmap.org/sites/default/files/TEL-Map_D4.1.pdf (2014-08-15)

[17] R. Rohrbeck, N. Thom, and H. Arnold, “IT tools for foresight: The integrated insight and response system of Deutsche Telekom Innovation Laboratories”, in Technological Forecasting and Social Change, in press.

[18] S. Kim, Y. Kim, K. Bae, Su.Choi, J. Park, Y. Koo, Y. Park, H. Choi, H. Kang, and S. Hong, “NEST: A quantitative model for detecting emerging trends using a global monitoring expert network and Bayesian network”, in Futures, Volume 52, August 2013, pp. 59–73.

[19] M. Veugelers, J. Bury, and S. Viaene, “Linking technology intelligence to open innovation”, in Technological Forecasting and Social Change, Volume 77, Issue 2, February 2010, pp. 335–343.

[20] R. Eckhoff, M. Markus, M. Lassnig, and S. Schön “No outstanding surprises when using Social Media as source for weak signals? First attempt to discuss the impact of social media sources to detect surprising weak signals“ in: Proceedings of The Ninth International Conference on Digital Society (ICDS) in Lisbon, Portugal. [Paper accepted]

[21] R. Eckhoff, M. Markus, M. Lassnig, and S. Schön “Guidelines for social media mining for innovation purposes. Experiences and recommendations from literature and practice” in: Proceedings of eKNOW 2015, The Seventh International Conference on Information, Process, and Knowledge Management, February 22 - 27, 2015 - Lisbon, Portugal. [Paper accepted]