Designing Analytical Approaches for Interactive Competitive Intelligence

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Abstract: Since Porter's work on competitive strategies in the 1980s, the concept of competitive intelligence has become part of the management mainstream. Currently, two big shifts are challenging the state of the art. On the one hand there is the rise of the ubiquitous servicification in all industries which makes the existing methods for product-oriented industries outdated. On the other hand there is the rise of big data (volume, velocity, variety). Both shifts are driving the development towards interactive competitive intelligence systems. We introduce a framework for interactive competitive intelligence systems which overcome the sequential water-fall processes which are current CI practice. In the introduced framework we combine the concept of Key Intelligence Topics (KIT) with the concept of (boundary) objects from interaction theory. We demonstrate by examples within our case "IP Industry Base" how interactive CI for service-oriented sectors can be implemented. The resulting vector-based representations of the companies' service profiles allow the user to visualize, compare, retrieve and analyse companies in a constructive and scalable way.

1 Introduction

1.1 Motivation

Competitive intelligence (CI) is turning external, unorganized data about the competitive environment into strategic, useful insights. It is the basis for strategic decisions of a company. While CI is already an established topic in research and industry, within the last years two major shifts have emerged and are challenging the state of the art. First of all there is the rise of smart services and service-orientation in all industries which challenges the CI methods for product-

oriented industries. Secondly there is the rise of big data [Manyika et al. 2011, McKinsey 2012] which opens the way to new dimensions of scalability and speed but also failures. Both shifts are driving the development towards interactive competitive intelligence (iCI) for service industries.

In this paper we demonstrate by examples within our case "IP Industry Base" how interactive CI for service-oriented sectors can be implemented. In the underlying conceptual framework we combine Herrings' concept of Key Intelligence Topics (KIT) [Herring 1999] with the concept of objects known from the interaction theory.

This allows the user to visualize, compare, retrieve and analyse companies based on their service profiles in a constructive and scalable way. These artefacts are used as boundary objects for all stakeholders in continuous, collaborative analyses of the competitive environment.

1.2   Research approach

The aim of the research presented in this paper is designing a conceptual framework for interactive competitive intelligence systems, as well analytical approaches to be implemented in these systems. To achieve this goal we followed the principles of Design Science Research (DSR) [Pfeffers et al. 2007]. The Design Science Research Methodology aims to generate problem-solving artefacts as a result of a well-defined research process. In order to validate the introduced framework for interactive competitive intelligence we demonstrate the implementation of concrete analysis in our case "IP Industry Base".

The remainder of this article provides the following contributions. In chapter 2 the conceptual framework for interactive competitive intelligence systems is introduced, based on an analysis of the shortcoming of current CI practices and systems. Chapter 3 introduces the analytical approach "service profiling" in order to demonstrate the application of the framework. With this example we show, how new methods and approaches for competitive intelligence can be designed and implemented in a structured way, governed by the conceptual framework introduced in the first step. The last chapter provides a short outlook.

2   Towards a conceptual framework for Interactive Competitive Intelligence

In this chapter the general concept of interactive competitive intelligence is introduced. Derived from two enormous trends present in current industry – servicification and the rise of big data – we highlight the major shortcomings of conventional competitive intelligences practices. To enable the design and implementation of practical solutions in this context we introduce a conceptual framework for interactive competitive intelligence. This framework should be used as fundament for the design of systems for interactive competitive intelligence, as well concrete analytical approaches. This conceptual framework combines the concept of Key Intelligence

Topics with objects known from the interaction theory. To proof the practical relevance of the proposed framework, we demonstrate in chapter 3 its usability during in the design and implementation of service profiles as analytical approach.

2.1 Competitive intelligence in service industries

Competitive Intelligence is "the use of external sources of information (news announcements, analysts' reports, patents, company web pages, feedback from clients and suppliers, personality profiling of key individuals) to assess the environment in which a particular organization operates and to predict future political, economic and competitor actions which might affect the organization" [Tsitoura et al. 2012]. Summarized, competitive intelligence is the structured analysis of the company's competitive field by using external, legal sources. Competitive intelligence is not only collecting and analysing data, but also the translation of this information into strategic, actionable and usable knowledge [Rothberg et al. 2004].

Competitive intelligence has strong relationships to other types of competition-oriented analyses, like business intelligence, market(ing) research and benchmarking [Pfaff 2005]. Business Intelligence is mainly targeted on analysing internal, numerical data (like sales figures or capacity utilisation). Market(ing) research is aimed to investigate the potential markets and target groups of products; hence it has a strong sales oriented perspective. Benchmarking is the comparison of the company with performance indicators of its competitors. Similar to CI, benchmarking and market(ing) research has an external perspective, but both are focused on specific aspects of the competitive field in a more narrow way. Business intelligence, market(ing) research and benchmarking all use historical, mostly statistical data in order to explain the current state of the company. In contrast, Competitive Intelligence aims to use more heterogeneous, factual data in order to assess the mid-term development of the general competitive picture.

Ever since Porter's work on competitive strategies in the 1980s, the concept of competitive intelligence has become part of the management mainstream [Calof et al. 2008]. A recent article review about the CI literature reveals the broad scope of theoretical, empirical and application oriented CI research [Søilen 2013]. However, most academic research and applied management literature are devoted to CI approaches for product-oriented manufacturing industries. "All [of them] thoroughly explore ways to study head-counts, capacity utilization, throughputs, shipments, raw materials [but …] they are not suited for studying how one law firm represents clients in court compared to another, how one recruiter finds the best candidates over another, how one market research firm can recruit better employees than another" [Sawyer 2002].

With the on-going rise of smart services and service-oriented business models the need of CI for service industries increases [Nemutanzhela et al. 2011]. In this paper we demonstrate by giving examples within the case "IP Industry Base" how CI for service-oriented sectors can be implemented.

2.2 Interactive Competitive Intelligence

Beside the ubiquitous servicification of industries, CI is faced with a second big shift. Most executives expect big data and analytics as two main trends in digital business to transform their businesses [McKinsey 2012]. As a natural data-driven business activity, CI will profit as part of this transformation. We expect to see the rise of data-driven approaches to competitive intelligence in the next decade.

We argue that alone the existence of big data will have very little impact on the competitive intelligence practice in the companies. To gain any advantage from big data, its usage and the sense-making processes must be embodied in the CI processes. Bose summarized the existing data-intensives approaches in CI [Bose 2008] and reveals the existing gap between opportunities and reality. Today, as depicted in **Fig. 1**, the CI practice in companies comprises usually four key stages: Planning, Gathering Information, Analysis and Dissemination [Tsitoura et al 2012]. Jaworski et al. (2002) claim that "existing work views the generation of CI as a sequential process of information planning, data collection, and analysis [...] this view may not adequately characterize the less structured, continuous nature of how CI is actually generated within organizations". The sequential, waterfall oriented process, which can be observed as CI practices in the companies nowadays, does not fit to the nature of big data, which is characterized by the three Vs: volume, velocity, and variety. The variability of the real-word which is directly reflected by the incessantly changing data deserves a more agile, continuous practice of CI. The linear push-logic from conventional CI must be replaced by a combination of push-and-pull patterns with flexible feedback loops. Ponis et al. (2013) argue that especially SMEs need more agile and adoptive CI solutions than available today at the market.
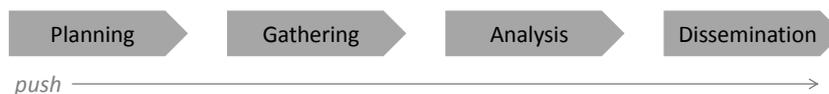

Fig. 1 The sequential process of conventional CI practice

We introduce the concept of interactive Competitive Intelligence. The practice of iCI is a continuous, collaborative sense-making process about the competitive environment by interactively involving all relevant stakeholders. Conventional CI practices implement the logic of final reports to be disseminated to the management. In interactive CI all stakeholders are using a continuously updated system and interactively work on a common understanding of the current status of the competitive environment and the derived implications for the company.

Fig. 2 illustrates the differences between conventional and interactive CI practices. Even iCI systems will have data gathering, analysis and dissemination phases. But instead of the sequential process in the conventional CI practice the iCI systems will combine these three phases into a period of continuous interaction. Tasks from all three stages will be realized whenever it is necessary. In example, interactive analysis might require additional and refined data gathering, or feedback on disseminated results will initiate deeper analysis on a specific topic, or new data from the original sources will require new revisions on disseminated results. Interactive CI systems have to support the users by realizing these tasks in a collaborative and non-linear way. This period of continuous interaction is the implementation of combined push-and-pull patterns with flexible feedback loops in collaborative settings.

2.3 The proposal of an Interactive Competitive Intelligence Framework

To act and interact successfully in such collaborative settings the participating stakeholders need guidance. Recent research emphasises the role of objects in "cross-disciplinary" collaboration [Neyer et al 2013]. Here it is distinguished between four different types of objects: material infrastructure, boundary objects, epistemic objects and activity objects. All these objects are reference points for the communication in interactive settings. In this article we want to concentrate on the best known type of objects, the boundary objects. "Objects turn into boundary objects when they act as translation and transformation device across various thought worlds … boundary objects can serve as a means of translation in interaction" [Neyer et al. 2013]. Examples for boundary objects in CI might be "the latest investment project of a competitor" or "the awkward business model of a rising start-up". (Boundary) objects are very important conceptual building blocks for interactive CI practices and systems.
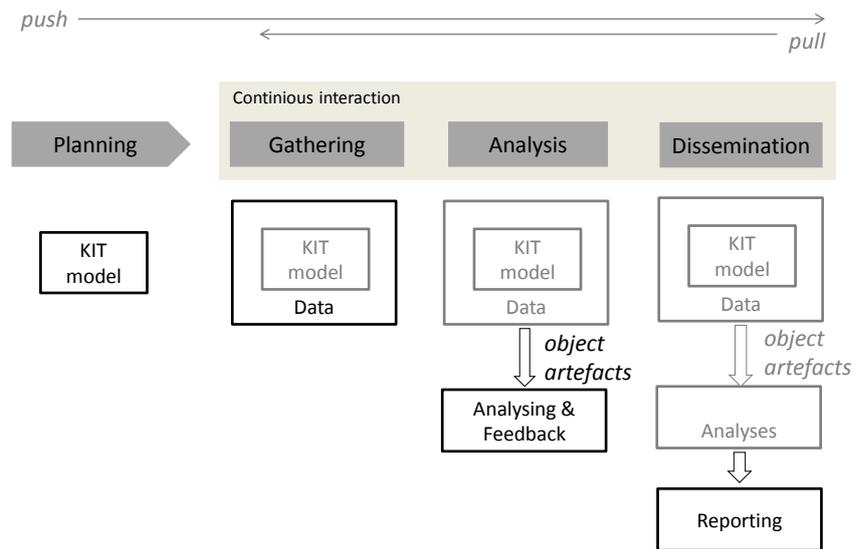

Fig. 2 Interactive Competitive Intelligence Framework

With Key Intelligence Topics (KIT) a similar concept is already introduced in the CI literature. KITs are important and well accepted management and communication tools within the CI processes [Calof et al. 2008]. KITs are mutual agreements between the CI professionals and the company's senior management about the main questions and issues to be addressed by the CI [Herring 1999]. KITs can be understood as requirement definitions against which the CI professionals continuously deliver reports with usable insights. Usually, KITs follow three functional categories: strategic decisions and actions, early-warning topics, or descriptions of key players [Herring 1999]. "The latest investment project of a competitor" as well the "the awkward busi-

ness model of a rising start-up" can act as KITs. By combining the concept of KIT with the concept of objects in interaction we achieve the conceptual framework for interactive Competitive Intelligence.

The framework depicted in **Fig. 2** provides guidance for the implementation of interactive CI systems. Here the "KIT models" become the masterpieces of these CI solutions. We define KIT models as shared and agreed data models, based on the KITs to be investigated in the CI processes. If, for example, key personals of the competitors should be analysed, the analysts need to know what kind of information is important to look for and they need tools to store information properly. Not only the data gathering tools but also the analytical tools should be implemented against the KIT models.

For the collaborative, continuous interaction object artefacts have to be generated based on the KIT models. These object artefacts have to invite the stakeholders to collaboratively analyse the competitive environment – based on the defined KIT in the planning phase. Once the collaborative, analytical phase has reached a saturation point, the systems should support the generation of reports (snap-shots) in order to disseminate the findings to loosely coupled stakeholders.

3 Service profiling: Demonstration of the practicability of the interactive competitive intelligence framework

In the previous chapter we have introduced a proposal of a framework for interactive competitive intelligence systems. In this chapter we will demonstrate the practical usage of the framework by introducing the analytical approach "service profiling". This method aims to make service companies comparable. Hence, the contribution of this chapter is two-fold. On the one hand it introduces the service profiling approach. On the other hand, it demonstrates how the introduced iCI framework supports the design process of this approach by providing a theoretical ceiling.

3.1 Competitive intelligence along the value chain of the IP industry

In the subsequent sections we demonstrate the service profiling approach by our case of the "IP Industry Base" (IPIB)[1]. Within this section we briefly introduce this case.

The IPIB is intended to be an analytical database about the main international market actors within the Intellectual Property (IP) industry. These are not only patent attorneys, but for example also strategic consultants, insurance companies, database providers, matchmakers, or financial entities.

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[1] Access to the IPIB is free: http://s.fhg.de/IPIB

The societal impact of the IPIB can be drawn from its role in improving technology transfer processes (which is the value chain from the idea to the product). IP rights and related services have an essential role in employing and transferring technologies under the current law scheme. Improving this technology transfer is urgently required, especially in the field of adaptive and mitigating clean technologies [Nanda et al. 2009].

In the last two decades the IP industry has matured and IP market intermediaries have emerged in order to facilitate more efficient market transactions of technologies, technical knowledge, intellectual property and particularly, patents by developing new models (e.g., patent auctions and patent portfolio funds). However, the current role of these market intermediaries is quite diverse [U St. Gallen 2011]. It is not apparent which intellectual property-related services do exist and how extensively they are used. The IPIB has been developed by the authors in order to investigate the role of IP market intermediaries, and to serve in parallel as an interactive CI tool for the market players [Neyer et al. 2013]. Shown in **fig. 3** is a screenshot of the IPIB depicting the current company profile of the company "Ascenion".

3.2 Reverse service engineering

One of the main challenges within the development of the IPIB was making the service providers retrievable, comparable and visually readable. When investigating service-oriented competitors, one of the main key aspects is the portfolio of provided services. KITs like "Which companies in Brazil are engaged in similar services as we are?" require a KIT model which allows the user to compare different companies based on the quality and quantity of their service profiles. In order to provide an interactive system, the stakeholders should be enabled to easily analyse the provided data from different perspectives.

For the specification of service profiles (and the underlying KIT models) current developments in the field of service engineering can be used. For example [Böttcher 2009] provides a review of existing approaches to service engineering and summarizes them in a comprehensive architectural model of services. Although this is necessary preliminary work, for the analysis of different companies, new ways of quantitative reverse service engineering have to be investigated.

The general concept of reverse engineering is a well adopted method in CI for product markets [Chikofsky et al. 1990, Crane 2004]. Reverse engineering in general "is the process of analysing a subject system to identify the system's components and their interrelationships and create representations of the system in another form or at a higher level of abstraction." [Chikofsky et al. 1990]. Reverse engineering is deconstructing a product in order to understand the basic functionality. But how should the products of a service company be deconstructed?

In our case of reverse service engineering the subject system is the observable artefacts of the competitors' service portfolios (like the service portfolio described in the info brochures). These observations have to be transformed into one unified layer of abstractions which allows comparison, analysis, retrieval and visualization of the service portfolios with algorithmic means.

Summarized in our context, reverse service engineering means investigating a company in order to categorize the provided services into a standardized taxonomy. In result, the service profile of each company is a set of well-defined terms which can be used for retrieval ("Finding all companies doing a specific service"), for comparison ("Deciding whether two companies have the same assigned services") and for visualization ("Illustrating companies according to the defined services they provide"). The representations of these service profiles are artefacts of (boundary) objects in interactive competitive intelligence. As uniform and comparable representations of the companies they do ease the communication between the involved stakeholders.

3.3 IP Services Taxonomy for service profiles

In the last section we discussed the need of a standardized service taxonomy for reverse service engineering. In this section we demonstrate in more detail how reverse service engineering is implemented to achieve service profiles in the IPIB.

The starting point is the most important KIT-model within the IPIB, which is the company profile. Generally, the KIT-model for companies comprises data about the following sub-topics:

- people and their roles within the company,
- headquarters and office of the company,
- the services provided by the company (service profile),
- the markets served by the company, and
- the companies belonging to the same corporate group.

In order to analyse long term changes, for the most factual data further metadata has to be stored, like date of the beginning and the end of the validity as well a link to the source of the information.

As already described, the service profiles of the companies rely on a standardized taxonomy, which comprises such diverse service providers like patent law firms on the one hand and start-ups for IP management software on the other hand. To our best knowledge such taxonomy does not exist. The authors have developed the "Intellectual Property Services Classification" (IPSC) (see [Maicher et al. 2012] for the full taxonomy). Currently the IPST consists of 6 top categories of services, which are further broken down into 81 sub-categories:

1. *IP-related Finance Services* – which are defined as services involving IP related resource allocation (resource management, acquisition and investment with respect to intellectual property).
2. *Matchmaking & Trading* – which is defined as services that ensure that IP development needs meet the available resources (trading related services include IP brokerage, IP scouting, as well as IP auctions and exchanges)
3. *IP Portfolio Processing* – which is defined as operational services involving IP portfolio management, - aggregation and - augmentation of patents owned (or controlled) by a single entity (or group of entities).

4. *Legal Services* – which is defined as services involving legal or law related matters like issue of patents. It includes IP protection, - contracting and - litigation.
5. *IP Consultancy* – which is defined as advisory services related to intellectual property. It includes IP portfolio analysis, strategy development, IP driven M&A support, fighting infringements, counterfeiting & piracy as well as internationalization support.
6. Media & People - which is defined as publications, journals, blogs and education programs focused on IP related topics. It also includes IP software, databases as well as IP-centric human resource services.

In the example of "Ascenion" (see Fig. **3**) the service profile is defined by the following services "Onsite Matchmaking Services", "Online Matchmaking Platforms", "IP Scouting", "Purchase and Sale of IP", and "Licensing IP". The IPSC is validated through desktop research, expert interviews and its usage for the categorization of already more than 900 companies worldwide.

As any taxonomy the IPST is a hierarchy of terms [Garshol et al. 2004]. Formally, the data-structure behind the IPSC is an ordered directed tree. Consequently, each service has a (potentially empty) set of direct and indirect ancestors, as well as a (potentially empty) set of direct and indirect successors. In the IPIB the service profile of a company consists of all directly assigned services and all indirectly assigned services. The indirectly assigned services are the set of all ancestors and successors, both direct and indirect.

Based on this formalisation, a service profile of a company can be transformed into an n-dimensional vector by depth-first traversal of the taxonomy tree. Each dimension represents one service. The value of the dimension is d if the service is directly assigned to the company. The value is i if it is indirectly assigned, and 0 for no assignment. For example, the values for the first 37 dimensions of the service profile for "Ascenion" (see Fig. **3**) are:

$$(0,0,0,0,0,0,0,0,0,0,0,0,0,i,i,d,d,0,d,0,0,0,0,i,0,0,0,0,0,0,0,0,d,d,i,i,0, …)$$

For each company in the IPIB such a vector is generated through manually analysing the observable artefacts of the services provided by the companies. These uniform vector representations are the result of reverse service engineering.

They can be used for further analysis, for example by calculating cosine distances between these vectors to find companies with similar service profiles. A huge variety of methods from data-mining and information retrieval are based on distance-measures for vectors and thus are applicable here.

3.4   Application the service profiles in the IPIB

In this section we demonstrate how the service profiles are currently used in the IPIB as analytical tools for interactive competitive intelligence. **Fig. 3** below depicts the company profile for the Ascenion GmbH in the IPIB.
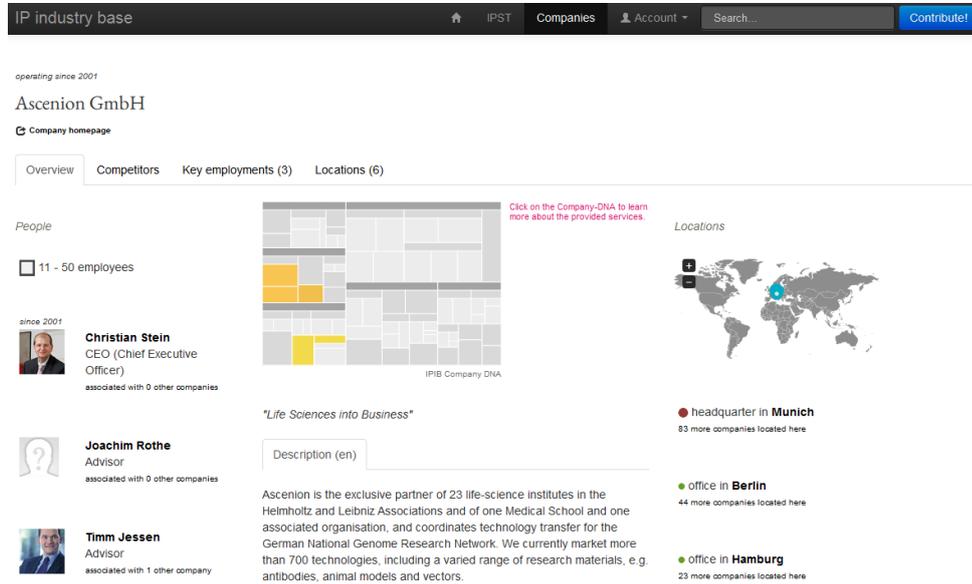
Fig. 3 Screenshot of the company profile for "Ascenion" in the IPIB

The service profiles are used for visualization of the companies. In the IPIB coloured treemaps [Vliegen et al. 2006] are used for visualization purposes. A treemap uses nested rectangles for the visualisation of hierarchical structures. Two dimensions can be visualised by using different colours and sizes for the rectangles. The automatic layout of the nested rectangles is based on the hierarchy. In the IPIB example colour is used to distinguish the different service categories. Each of the six top categories has a different colour. If a service is directly assigned, the according shape is filled in this colour. Additionally all successors and ancestors of the assigned are filled in a lighter shade of this colour. The second dimension - the size of each rectangle – is used to visualise the importance of a service. The more companies provide a specific service, the larger the rectangle for this service is in the visualisation.

From the perspective of interactive competitive intelligence, this visualisation is one of the main boundary objects in the IPIB. The users need to understand the basic business model of the company just at one glance. The users directly see and understand the strengths and the weaknesses of the company in their service portfolio.
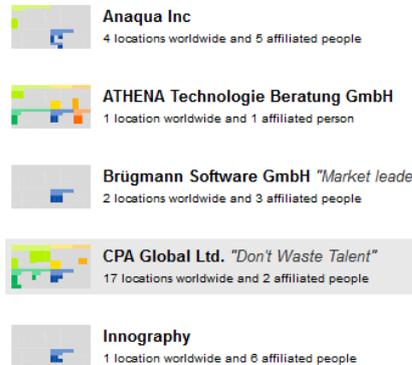
Fig. 4 List of companies providing the service „621 IP Portfolio Management Software"

The visualization is used in various parts of the IPIB in order to support the effect of a uniform and comparable profile of each company. For example, the screenshot **fig. 4** depicts a list of different companies which all provide the service "621 IP Portfolio Management Software" (visualised as dark blue rectangles in the treemaps). The visualisation of the service profile allows the users to detect similarities and differences between companies in a fast and efficient way. The companies in the list have different levels of specializations. It is obvious that "Innography" and "Brügmann" are specialized as software vendors. On the other hand "ATHENA" and "CPA" provide a broad set of services. In between "Anaqua" bundles some specific legal service with the software packages they sell.
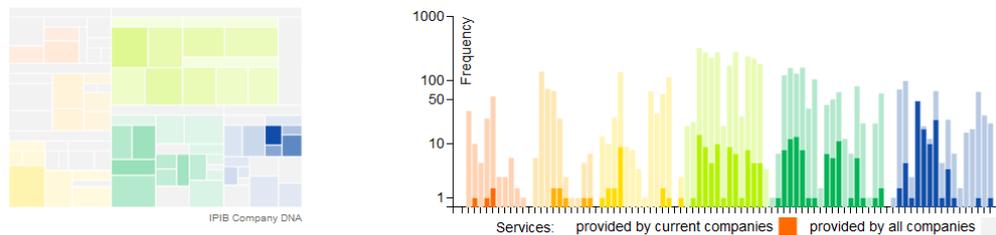

Fig. 5 The market of IP Portfolio Management Software compared to the whole IP service market

The same service profiles (and the underlying KIT models) can be used for other analysis. **Fig. 5** illustrates the difference of the sub-market for IP Portfolio Management Software compared to the whole IP service market. (The y-axis in the frequency histogram is log-scaled). It becomes immediately obvious that a significant part of these companies also provide legal services, but there is only a very limited number of companies providing financial services as well. This view on the data can be used to detect market niches. From the perspective of the framework for interactive competitive intelligence introduced above it is important to emphasise, that using the data from the same KIT-model different analytical tools are implemented, which induce different communication paths and feedback loops within the iCI system.

Summarized, the service profiling supports the users of the IPIB to generate actionable knowledge. It does that by categorizing the service portfolios of the competitors according to a

standardized service taxonomy and by the visualisation of the service profiles The analysts can directly see whether the companies' profiles complement or compete with their own service portfolios.

4 Conclusion, Contribution and Outlook

Competitive intelligence is a good basis for strategic decision making for a company. With the ever increasing importance of the service industries the means and methods of CI have to adapt from product-oriented markets to competition in service-centric industries. In parallel we foresee a shift towards interactive competitive intelligence as response to the permanent availability of big data (variety, velocity and volume). As consequence we introduced the framework for interactive competitive intelligence systems, where we combine the Herring's concept of KITs with the concept of objects known from the interaction theory.

The combination of the above mentioned shifts requires the advent of reverse service engineering. In this paper we demonstrate an example of the service profile in the IPIB. We show how this reverse service engineering can function in the service-oriented industry along the IP value chain. We have demonstrated how a unified layer of abstraction – the vector representations of service profiles - allows retrieval, comparison and visualization of the service portfolios with algorithmic means. Regarding this, in future it will be necessary to consider what happens to established company service portfolio vectors when changes to the categories and subcategories of IPST are made. It is obvious, that interactive CI will induce combined and mutually approved changes to the service profiles – and will require dissemination of these changes to all object artefacts based on this data.

In our future work we will examine how the implemented service profiling supports the day-by-day work of the professionals. We will achieve this by user tests and user interviews. Future improvements of the KIT models and the user interfaces will be driven by the insights gathered from these user studies.

Furthermore we will investigate how the vector representations of the service profiles can be used to further support the users by recommendations or automatic assessments. In example these can be similarity calculations based on the service profiles. Alternatively companies which complement each other into a specific value chain can automatically be detected in order to orchestrate suppliers and purchaser within a sector and a regional focus. While working on all these further improvements we will focus on empowering more continuous interaction within the CI processes.

Acknowledgements

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