COLLABORATIVE CONTINUOUS SERVICE ENGINEERING

A CASE STUDY IN A FINANCIAL SERVICE ENVIRONMENT

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Abstract

We present a methodology to engineer services in real-time information environments. We evaluate, combine and enrich traditional techniques and methodologies such as New Product Development and Adaptive Software Development in order to support the development and continuous improvement of information services. Our methodology is based upon the financial service environment. It is specific enough to be applicable in the field of finance and general enough to be applied broadly in information services development.

1. Introduction

Services have, and are increasingly becoming an area of intense research. The fields of marketing, management of information systems, computer science and operations management are all, to varying degrees, focusing their attention on the study of services. In this paper we develop a service engineering methodology that specifically aids in the creation of real-time information services. Our theoretically narrow focus is a function of our problem domain and necessity. Our domain, financial trading, requires comprehensive and ubiquitous information in order to function. We use this as the specific case study and generalize our methodology to broader information electronic services. The methodology developed in this paper is in the spirit of Gregory's theory for design and action [2], which states that modern design processes have become too complex so that intuitive methods, e.g. brainstorming, have become inadequate (Cross 2001). Thus, our proposed methodology explain, "how to do" something in designing services [3].

Although still the source of some debate [4] products and services require distinct development processes. Specifically electronic information services can neither be classified, nor developed using a traditional new product development process. The decision to apply an engineering perspective towards service development reflects the nature of services. The development of a service, in contrast to products, is not complete after the product is released to market. Information services are mainly characterized by a need for continuous reengineering and improvement.

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Chesbrough and Spohrer [5] highlight six elements common across service types:

1) Close interaction of supplier and customer (co-production)
2) nature of knowledge created and exchanged (contextual knowledge, collaboration)
3) Simultaneity of production and consumption (co-production)
4) Combination of knowledge into useful systems (collaboration)
5) Exchange as processes and experience points (information flow, collaboration)
6) Exploitation of ICT and transparency.

We develop these 6 common elements into concrete requirements in Chapter 2 that an effective methodology must fulfill. Based on these requirements Chapter 3 gives a detailed insight in theory and explains proposed methodology. As collaboration is a central aspect of this work Chapter 4 focuses on different forms of collaboration and corresponding methods and concepts from related work. Developed methodology is then demonstrated in a case study based on a financial service environment in Chapter 5. Chapter 6 closes with a conclusion and outlook.

2. Motivation and Requirement Analysis

Much effort has been made to define and categorize services. For the purposes of this paper we define services as electronic and further reduce this to information services. Information services have numerous manifestations. Newspapers, stock quotes, and radio are all examples of information services. We, however, focus on electronic, or, ICT-based information services, which still include newspapers, stock quotes and radio, but only in electronic form, and predominantly available over communication networks. Examples of information services in the financial trading domain are, the Wall Street Journal online (WSJ), Dow Jones, Reuters, Bloomberg, and Thompson DataStream.

Stock quotes and news form the basis for trading in financial securities and are critical to the functioning of financial markets. Different information is processed, stored and applied in different manners throughout the information supply chain. Depending on sub-domain, equities, bonds, or commodities trading entirely different types, speed and levels of information are required to operate. Current service providers are presented with problems of scale and scope. They possess mountains of information, so much so that they are unable to offer it all simultaneously. The information providers also lack domain insight, in that, they cannot track or following how their information is being used. The current paradigm is to send the massive amounts of data to customers in streams, and hope that the end users know what to do with the information.

First attempts have been made to further classify and categorize information. Information modeling languages like the eXtensible Mark-up Language (XML) are being used to enrich information artifacts, such as news stories, or quotes. Service providers have also traditionally further segregated their clients in to real-time and delayed-time, usually 15-minutes, information. Since providers couldn't effectively segregate their customers they were forced to offer to simple temporal services and hope that cus-

tomers would pick the right one for their information needs and utility.

What is missing is a methodology to engineer real-time information services, with customers, information providers and information aggregators, in order to improve, the quality of information, the delivery of information, and the use of the information provided.

Collaboration is a process by which various parties work together, towards a common goal. Collaborative efforts include a feedback loop, a recursive interaction of knowledge. In a business setting, collaboration should be used where the gains from collaboration outweigh the costs. Certain steps in the service engineering process and various points in the information flow are ideal candidates for collaborative activities. The goal of this paper is to identify these and provide a framework and methodology to capture the value inherent in the process.

Collaborative Service engineering is different from traditional product development and engineering. Typically the Collaboration occurs at finite and predefined points in the development process. Staging and gating in the innovation and development process although good from a product development financing perspective, do not apply in the information world of zero variable cost.

The analysis of the service development and improvement process leads to following requirements for our collaborative continuous service engineering methodology:

R1 Customer participates in the production process proactively (prosumer)
R2 Continuous elicitation of contextual knowledge
R3 Feedback flow of knowledge into systems
R4 Provision of tailored information services fulfilling users needs

3. Methodology/Theory

We have divided collaboration into two categories, direct and indirect collaboration. Ways to collaborate directly: in-person (focus groups, interviews, case-studies), electronically (surveys, feedback from websites). Indirect collaboration: logs, usage stats, service selection (version, package, pricing).

Each form of collaboration has distinct advantages over the other. Depending on the environment only certain collaboration techniques are available. High-touch low information services, insurance for instance, likely require more direct collaboration and less indirect collaboration.
Direct collaboration has the advantage that feedback is generally rich, direct, open and comprehensive. The disadvantages are cost, time, participation (representative) and discontinuous.

Indirect collaboration has the advantage of timeliness, it is inexpensive, measures what customers actually do and not what they say, and is instantaneous. The disadvantages are lack of comprehensiveness (after a certain point we don't know what a customer is doing with the information) and richness of feedback. A more detailed analysis of collaboration is provided in Chapter 4.

Using our methodology we can effectively capture tacit expert knowledge from users. By capturing the usage, statistics, feedback and bug reports from domain experts the knowledge gained during the 'indirect' collaboration can be used and transferred to less adept users. The transfer benefits not only the service provider and less-adept users, but also the expert user. Even the most talented domain experts will be able to benefit from the knowledge gained and combined from other users.

random. Only by applying techniques to gather and analyze the artifacts generated during collaboration can the randomness be harnessed and provided to other users. By applying the Adaptive Software Development methodology to service engineering we add short development cycles, customer proximity and agile development techniques to our methodology.

From the literature we have derived three types of collaboration applicable to information services engineering, intra-

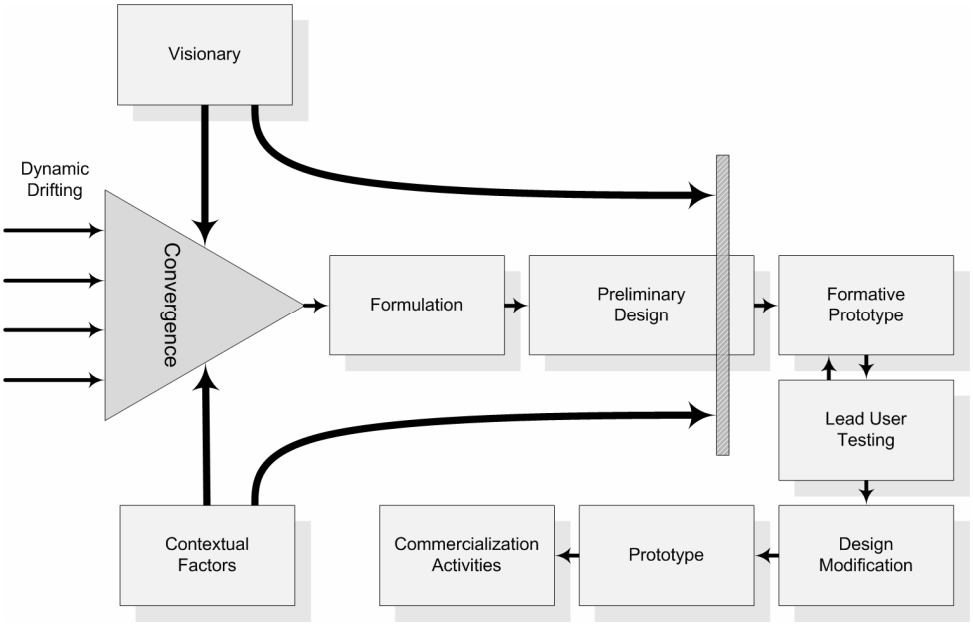

Figure 1 Discontinuous Innovation and the New Product Development Process [1]

By adopting a CSE approach service providers introduce the effects of randomness in their service engineering process. By providing users with tools to develop extend, combine and produce content and interfaces the results can present novel ideas, solutions and services. The direction these take is, for the most part, unforeseeable and therefore

firm, inter-firm and between a customer and firm.

Information services and services in general, lend themselves to mass-customization [7] and economies of scope. In contrast, products thrive in environment of mass production and economies of scale. It follows logically

that a processes to developed products, or goods, do not lend themselves well to the service engineering process.

Google offers an excellent example in terms of using permanent, or long-term, beta tests. By offering a product that is neither technically ready, nor commercially ready for release, forms the basis for collaboration. New clients offer insight into how a product may be improved technically, and usage patterns can be analyzed to improve the commercial acceptance of the product.

Figure 2 provides an overview of the continuous collaborative development process. Information service providers use indirect forms of collaboration to develop and improve their services. As users use existing services and provide feedback they participate actively in the service production process. By combining existing services and using the underlying information in different scenarios they provide insight into the end-product of the information. By capturing this contextual information and providing it as input into the emergence or development process we fulfill our first two requirements.

Taking the information collected via the indirect collaboration process and formalizing it in the form of new services and systems, depicted as a service cloud in Figure 2, fulfills requirement 3. By efficiently capturing and formalizing the

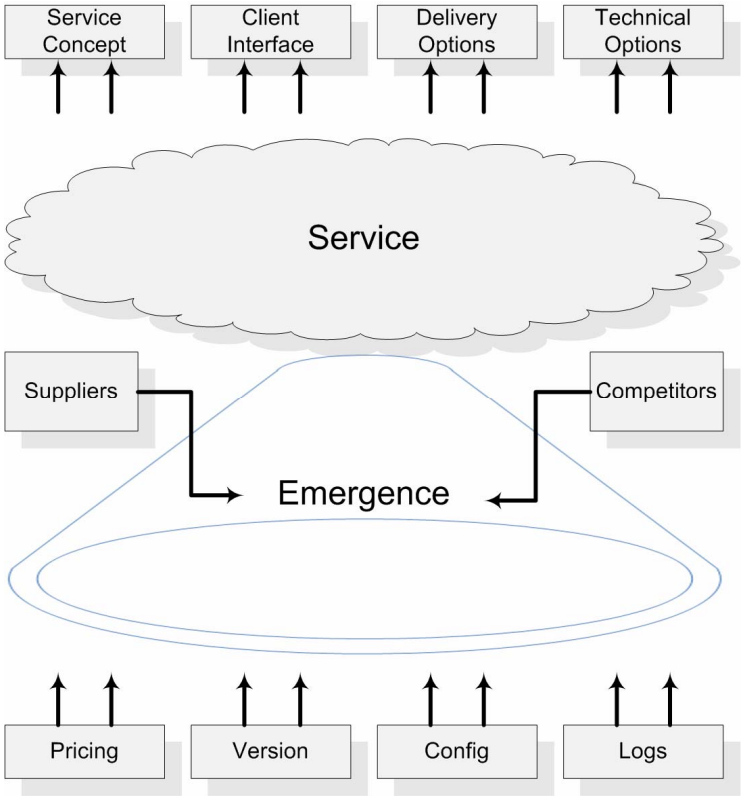

Figure 2 Discontinuous Innovation and the New Service Development Process [1]

knowledge gained we have a continuously improving service, service offering and new service development process.

The top methodology layer captures the delivery of a service to the consumers, or prosumers of the services. By offering numerous configurations, delivery options and by providing an infrastructure to independently combine services we allow prosumers complete control over the service. Services not available from a specific provider can be acquired from other providers or created, by combining existing services, by prosumers in order to meet their individual needs. This feature fulfills our final requirement.

4. Forms of Collaboration

The term *collaboration* is broadly used in many different research areas and industries (e.g. e-Learning, knowledge management, product development). This paper focuses on forms of collaboration which make a contribution to a process of continuous service re-engineering and improvement. We stress that service innovation is a cyclic and collaborative process involving many external factors including the service provider himself. This scenario forms a main difference to the process of new product development treating innovation as a closed internal activity [8]. It is not only the intrinsic motivation of customers which makes them autonomously enrich an innovation process through service consumption (directly or indirectly), it is more an innovation dialog between the service provider and the service consumer. We state that it is a matter of service design in order to extract valuable customers feedback information in a target-oriented manner, meaning that service providers have to organize the process of service innovation proactively [9].

We distinguish collaboration in two elementary forms, direct and indirect collaboration depending on consumers' awareness of their contribution to the service innovation process.

4.1. Direct Collaboration

Direct collaboration involves the service consumer proactively in the service innovation process. The customer is fully aware of the fact that he explicitly reveals his valuation, needs, requirements and preferences with respect to the consumed service.

Designing quality services is always a trade-off between standardization for the back-end processes and individualization to meet the customers' needs and expectations. The concept of direct collaboration involves the service consumer in the design and innovation process of service development proactively.

Mass customization as a customer-centric strategy provides a standardized base service which can be tailored and configured in order to offer individuality. This bridges the gap of value-added service provisioning and mass efficiency [10] and generates valuable costumers information about his needs, requirements and preferences through a direct collaboration process.

Web service technology enables new forms of mass customization for information services. A core information service for example can be offered to potential service consumers including open interfaces for configuration, customization and extension of the base functionality.

Experienced innovative users copiously utilize these opportunities to form an information service in order to fulfill their needs and preferences which express valuable information on how they tend to innovate. The most valuable feedback comes from a (small) set of users called *leads*. Lead users distinguish themselves from other customers through a high tendency to face needs much earlier than average consumers and significantly benefit from a solution to these issues [11; 12]. They are highly capable of adopting new services earlier and tend to strongly communicate their experiences and issues within their social network. Keeping this in mind it is inevitable to identify these user groups in order to benefit from their feedback.

In literature there are mainly three methods for lead user identification:
The *screening* method identifies lead users within a group of users by analyzing certain characteristics. *Pyramiding* identifies innovative users by asking them for suitable other leads. The concept of *self-selection* implements incentive schemas for lead users to expose their existence to the service provider and reveal their abilities to innovate.

4.2. Indirect Collaboration

This form of collaboration involves the service consumers' feedback without being aware of their contribution. Through the process of service consumption and usage customers implicitly reveal feedback which measures service quality. Keeping this in mind it is possible to get valuable costumers data without investing in expensive marketing activities. This unknowingly provided valuation of the consumed service is available in many different forms involving a broad variety of feedback information which has to be collected and extracted by the service provider. Successful service development and improvement is based on acquiring customers information about their needs and preferences [13; 14; 15].

4.2.1. Pricing

Price differentiation is an important concept especially in electronic commerce. Service providers are capable of charging different prices depending on customer characteristics and behavior. Information technology in this context allows a detailed observation and analysis of nearly every step of customers' behavior. With regard to the degree of price individualization we distinguish three levels of pricing:

First-degree price discrimination: First-degree price discrimination is the most individualized pricing strategy. A highly personalized service is offered at a highly personalized price (e.g. mass customization).

Second-degree price discrimination: This concept describes a scenario where all service consumers face the same menu of personalized services including their fixed price (e.g. versioning).

Third-degree price discrimination: Third-degree price discrimination refers to a situation where certain services are sold to different user groups at different prices.

Proposed pricing strategies incentivize service consumers to reveal their willingness to pay for a certain degree of service quality without being aware of

the fact that they are part of an innovation process. Depending on the service and strategy design, service providers are able to isolate dedicated effects and proactively lead indirect user collaboration with respect to their interests.

4.2.2. Versioning

The concept of *versioning* or *second-degree price discrimination* [16] provides a possibility to incentivize the service consumers to reveal their valuation for the service quality without knowing it.
The idea is to offer a menu of different versions of a service to the customers and to observe which one they choose. This principle is called *self-selection*. It is not important to evaluate the customers' valuation for certain versions of the service in advance. Service consumers reveal this information by choosing the version providing the highest individual utility [17].
Online news papers for example offer subscriptions in different versions as information services. A cheaper version, providing access to a limited set of online articles and a more expensive version providing full access to all present and archived articles. This example reveals the effect of economies of scope which is fundamental for the concept of versioning. Due to the characteristics of information goods and new information technologies [18], reducing a high-quality service in order to offer a low-quality version does not produce any extra costs but enables the possibility to sell the same information to customers with different levels of willingness to pay [19].

Designing service versions in order to utilize economies of scope and induce self-selection is based on the different dimensions of an information good [17].

Actuality: The value of an information service is mainly determined by its actuality respectively its delay of provisioning. Offering an information service in different versions which differ in their actuality is a commonly used strategy especially in finance information provisioning. The willingness to pay for stock quote information for example decreases exponentially the later the information is provided to the service consumer. With respect to their level of experience customers reveal their preferences by choosing a suitable version of an information service.

Interface: Another important dimension of information goods is how easy and efficient the information can be found, retrieved and used. Access to an information service is mostly provided by a user interface. Offering interfaces which differ in aspects like search capabilities; ease of use and efficiency is another powerful way to version and information services divide the market segment of potential service consumers with respect to their willingness to pay which exposes valuable information on how an information service is demanded and consumed.

Capabilities and Features: Information services can also be versioned by reducing capabilities and features from a high quality service. For example the level of granularity of provided stock quote information lowers the value of a finance information service and reduces the willingness to pay from a customers' perspective. The way the service consumers choose from a collection of information services with different levels of capability generates valuable customer data and

ty generates valuable customer data and helps improving a service product.

Comprehensiveness: Comprehensiveness or information completeness is another crucial dimension of an information service. The value of a finance service for stock quotes for example strongly depends on how complete the quote information is (e.g. how long is the timeline? Are values missing?). This fact allows versioning of information services with respect to the completeness of the provided information which generates feedback from service consumers and their need for comprehensive information.

5. Case study

In the previous sections we develop and motivate a new service development methodology. We evaluate the methodology in the provision of information services in the financial services industry.

Information drives the trading process. Financial information services like Bloomberg, Reuters, Thompson and other smaller providers deliver information services directly to the desktops of financial professionals. Equity traders of certain products are naturally interested in different news and information services than are fixed income and foreign exchange traders. Information service providers have segmented, delayed, versioned, and have developed multiple interfaces all to access their information. These service providers have realised what other must learn in order to succeed.

Financial information services providers provide innovative output changing and modifying (1) the service concept, (2) client interface, (3) delivery systems and (4) technological options.

Using Reuters financial information services as an example we have developed the methodology depicted in Figure 2. Service providers share one common problem, determining what customers want, how they want it and when. Using the forms of collaboration highlighted in Chapter 5, service providers can determine what customers currently use, how they use and the preferred methods of accessing information. As an example Reuters provides, at least, three methods to consume stock quotes. Quotes can be accessed in one of Reuters' proprietary information interfaces (Xtra 3000, Bridge Station), directly in Microsoft Excel (API) or quotes can be used directly in front-office systems via a proprietary link provided by Reuters (Front Arena, Murex). Each of these three separate access methods pre-suppose a completely different usage scenario, value to the customer and therefore service offering, despite the fact that the information provided remains exactly the same regardless of method of access. By providing various methods to access the information Reuters can infer the usage and therefore the value to a specific customer. Service provides also use this information to infer how existing services are used together. This usage information can be further used to provide innovative bundled services. The newly developed services can be inferred from expert users or lead-users and provided to more basic users. This allows, Reuters and their less advanced customers to profit from the experience of their lead users. We call the process of gathering and analyzing all possible combinations, including those of competitors and sup-

pliers and turning these into new service offerings, emergence. After a potential new service offering has emerged a more typical engineering approach may be applied. Decision as to how a service will be delivered, interface decision and other technical considerations are analyzed.

6. Conclusion

In this paper we developed a service engineering methodology supporting the development and continuous improvement of information services. Especially information services can neither be classified nor developed using a traditional product development concept such as NPD[1]. Hence, we created a theoretical concept for service development and continuous engineering based on a financial trading case study which involves ubiquitous information. Starting from this case study we broadened and adapted the methodology to the wide field of general information electronic services.

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