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TOWARDS GUIDELINES FOR THE EVOLUTION OF E-SERVICE ENVIRONMENTS

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Abstract

Different domains, such as the health care domain, can benefit from an increased use of e-services. However, factors such as vendor lock-in, the lack of standardized infrastructure and quality criteria can slow down the creation and use of e-services in a domain. To encourage the development of e-services there is both a need for simplicity – to enable new actors to use and provide e-services, and a need for regulation – such as defined standards and quality levels. In this paper we present the concept of a service collaboration environment - a sustainable model for e-service evolution that facilitates the maintenance of the balance between simplicity and regulation. We use the theory of competitive market forces to define a set of service collaboration environment guidelines that aims to enable increased use of e-services by stimulating new service consumers and providers to enter the environment. The guidelines can be applied to drive the evolution of e-services in a business domain.

Keywords: e-services, software service, integration, service market

1. Introduction

The use of e-services has started to evolve from limited point-wise use towards large-scale use across enterprise boundaries. From a technology point of view standardized technologies such as SOAP and WSDL [Gudgin, 2003] pave the way for simpler and

thus cheaper integration of systems. Trends such as outsourcing and process based business engineering promote the use of e-services from the business perspective.

Increasing the extent of e-service use and the number of actors involved put emphasis on finding a sustainable model for how e-services should be managed and regulated both on a business and on a technical level. In a controlled environment, such as an organizations intranet, strict rules might be applied for the development and use of e-services. However putting up such restrictions for collaboration with external organizations might hinder new innovative actors from providing e-services. On the other hand, having no rules or regulations on the e-services an organization uses might result in the use of a number of incompatible e-services with varying quality. The innovative use of e-services relies on enough flexibility to allow new actors and at the same time enough regulations and infrastructure to uphold compatibility between the e-services and a required level of quality.

The balance between flexibility and regulation is especially required for domains where the overall quality and sustainability cannot be left to ad-hoc evolution. Examples of such domains are the health care sector and other areas regulated by the government. E-services provisioned in these domains need to work under at least some form of supervision.

An example of an e-services working in a supervised environment is health care e-services supporting treatment, health examinations etc. In the case of Swedish health services these are regulated on the national and county levels. For example, on the technical level the interconnection of e-services in the county of Stockholm is currently undergoing regulation by a new e-service environment named "shared health care data" (in Swedish "Gemensam Vård Dokumentation", GVD). The goal of GVD is to make it possible for all health care units in the county of Stockholm to share necessary administrative and clinical information. GVD defines standard interfaces for the exchange of such information, as well as an infrastructure for exchanging messages with a shared database. Incorporating new e-services into the GVD environment requires that they adhere to technical rules as specified in the GVD infrastructure. However the e-services must also follow business rules as stated by the county council. For example, in order to get reimbursement for expenses the health care providers must account for each patient visit (a business rule). Further, the health care providers must deliver this information in a specific format called "DRG" (which is a technical rule).

A key question for future supervised service environments is how to device technical and business rules that both work for upholding service quality without severely affecting the balance between innovation and regulation. This is an important question: without a structured model for how rules are issued, it becomes difficult to uphold controlled evolution of service environments.

In this paper, we suggest a high-level model of how to handle domains where extensive uses of multi-vendor e-services are anticipated and desired. We use the notion of a *Collaboration environment* to denote a network of interconnected services that work and evolve under a set of guidelines such that the environment gets "balanced". By "balanced" we mean that the environment should stimulate both consumers and providers of e-services to use, respectively supply, new e-services. Thus, neither the consumer side nor the provider side should dictate the overall evolution of the environment. The guidelines are based on the now classical framework for assessing competitive forces and entry barriers by Michael Porter [Porter, 1979]. Presented guidelines are aimed at being applied by the actor regulating

the environment. In the case of the health care in Stockholm, the guidelines would thus be implemented and enforced by the county council.

Our approach targets the high-level design of an environment of e-services and its evolution, rather than the ground-up design and development of single e-services. The research on design of e-services commonly focuses on model-based requirement analysis [Ruiz, 2005; Quartel, 2004; Martin, 2003] and thus forms a ground for the design of individual e-services in a well known environment. Even though some research target the design of e-services that forms processes across business boundaries [Piccinelli 2002; Fremantle, 2002; Papazoglou, 2003; Hull, 2003] there is a lack of analysis of what makes these processes and e-services work and evolve over time. Our contribution is to point out design guidelines that can control the long-run competitive forces exerted between consumers and providers of e-services. This work thus complements prior research on service design by pinpointing the design guidelines that affect the long-run sustainability of e-service collaborations.

Our approach to examining the driving forces behind e-service evolution is to look at what features in an actors *environment* that spur innovation and leads to strategic decisions. This view is in line with economic strategists that focus on companies' abilities to form alliances [Tapscott, 2000] and other means in order to gain market shares and counter external threats [Porter, 1985]. Another approach to analyze strategic decisions is to look at the *internal* resources, or "core competencies" that a company controls [Cheng, 2001; Barney, 1991; Rayport, 2001]. Using such approach, strategies are formulated to maximize the gain from profitable internal resources. We focus our work on guidelines that affects actors through their external environment, not actor internal resources. Through affecting the actors' external environment the target is to achieve a balanced environment that stimulates both consumers and providers of services.

Another important perspective in our approach is to see organizations as part of network of interrelated actors, exchanging resources in order to increase value among these actors [Alter and Hauge, 1993; Osterwalder, 2002; Gordijn, 2003; Pascal, 2004]. In economic literature, networks are seen as a third form for governing organisations, which is not market and not hierarchy [Powell, 1991; Douma, 1998]. Discussion about important institutional and technical factors that can influence the behavior of such network of health care organizations can be found in a several articles (for example [Porter, 2004; Angus, 2004]). Our focus is how management of an e-service environment can influence the overall behaviour of a network of health care organizations.

From a research perspective our study follows a design science approach [Simon, 1969]. Central to design science, and the work presented in this paper, is to design *artifacts* that aid solving real-world problems in a studied domain. According to the classification presented in [March and Smith, 1995] design science research must produce a viable artifact in the form of a construct, model, method or an instantiation. In our study we present a set of design guidelines whose intent is to be used as a method for controlling the level of business regulation in a domain of interrelated e-services. We also provide examples of how the guidelines might be instantiated in the health care sector. The use of the design science approach, particularly its focus on novel artifacts rather than more explanatory research, is in line with the overall goals of the research project that this work is a part of (see Section 2).

We begin this paper with a short case description based on the health care project REMS (Section 2). We use this case throughout the paper to exemplify the guidelines. Section 3 introduces the notion of a "collaboration environment". In Section 4 we

describe guidelines on how to balance the competitive forces that work within an environment. In Section 5 we outline a systematic way in which the guidelines can be applied. Section 6 concludes the paper by a discussion on the future extension of the guidelines.

2. The REMS Case Study

In order to illustrate the guidelines presented in this paper, we report on the work being conducted as part of the REMS project [REMS, 2007]. The main objective of the project is to develop a set of e-services that can be used to create, manage and transfer health care referrals between S:t Erik's eye hospital, primary care units, opticians, and private eye specialists in the county of Stockholm. The project also examines new methods that can be used when analyzing and designing e-services in the healthcare region of Stockholm. As referrals are used as a mean to route a patient from a local physician to the correct level of specialist care, the problem domain is a complex mixture of actors, patient information and health care routines.

Figure 1 shows the main flow of the referrals in the county of Stockholm: Having a problem with the eye(s), the patient first contacts the local primary care unit or an optician, in order to get investigated. If the primary care physician or optician cannot help the patient, the physician or optician may refer the patient to an eye specialist clinic for further investigation or treatments. A referral (today in the form of a paper) is sent to the clinic with information about the patient, including a first diagnosis or description of the symptoms. The clinic will review the referral and prioritize among all received referrals from primary care units and opticians around the county. The patient will then be booked on a certain day according to the prioritization. If there is a lack of physicians related to the number of referrals received, the clinic may pass the referral to a private eye specialist that will carry out the investigation or treatments. When the patient is investigated or/and treated, a referral answer (a paper form) is sent to the primary health care or the optician, informing the primary care physician or optician about the results from investigations and/or treatments.

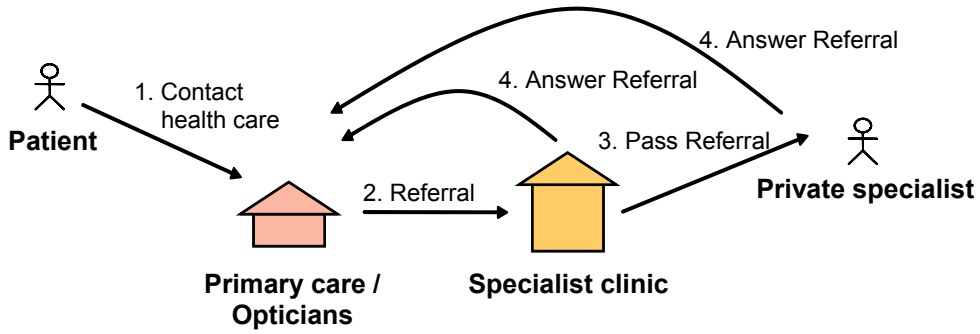

Figure 1. The flow of referrals between primary care units, the specialist clinic and private specialists.

The set of e-services developed in the REMS project aims to solve the following problems: the flow of referrals is not efficient because of manual routines, too many referrals has a low quality (i.e., missing information) which make it hard for the clinic

to carry out a appropriate prioritization, referrals may be lost because of manual routines and the use of paper forms, etc.

One of the ideas behind the REMS project is that the created e-services will be part of a future collaboration environment, consisting of a large set of coherent e-services supporting all health care units in the county of Stockholm. Having a set of e-services available from different health care providers would enable healthcare applications to combine e-services from the collaboration environment. As for the e-services that where created in the REMS project, the purpose is to enable them to communicate with the county's shared health care database, i.e. GVD (described in the Introduction). Integration with GVD enables other health care applications and providers to get access to referral information created by the REMS e-services. Thus, GVD and connected e-services will be the fundament for a larger use of health care e-services in the county of Stockholm.

Even thought it is complicated, technical integration is not the only culprit for the continued development of efforts such as GVD. Besides a technical platform, the large-scale creation and use of e-services depends on created incitements for both consumers and providers. For example, the wide-spread use of e-referrals depends on that a critical mass of the health care units' journal systems that are integrated with GVD. To achieve this critical mass, it is crucial for the county council to set standards to enable this integration. The county council of Stockholm must also decide the future business and technical rules for incorporating e-services into GVD.

Before looking into the specific actions needed to create and sustain an environment such as GVD we need to examine the key constituents of a collaboration environment. This is done in the next section.

3. Collaboration Environment – Key Constituents

As stated in the introduction there exist domains where it is important to have at least partial control over the e-services. For this purpose we define a *collaboration environment* as *a set of interconnected and partially regulated e-services that serve actors in a domain*. Companies that are in the forefront of e-service development, such as Sandvik [Henkel, 2004], have already developed a coherent set of e-services together with their sub-suppliers. Taken together these services form a market of services that can be interconnected. The drivers of increased business flexibility and lower cost will drive further evolution of e-services in these markets.

While services in an uncontrolled market can evolve freely and ad-hoc, it is important for e-services in a collaboration environment to follow the regulations as specified in the environment. Our aim is not to invent new technologies that support such an environment but rather discuss the forces that influence how the environments e-services evolve.

For clarity we first discuss the concept of *service* and *e-service* and then classify a set of *roles* involved in the environment. In Section 4 we will then use these concepts to discuss the forces of environment evolution.

A *service* can be defined as an "act or performance offered by one party to another" [Lovelock, 1996]. The notion of *service* has traditionally been used to distinguish service producing businesses from agricultural and manufacturing businesses [Metcalfe, 2001]. Typically, a performed service is contrasted to the manufacturing of goods. In the case of goods manufacturing, the value resides in the produced goods itself (e.g. a car). While in the case of a service its value resides in its ability to change the condition of either something belonging to the customer (e.g. a

carwash) or the customer itself (e.g. a haircut) [Hill, 1977]. Commonly services are performed in an interaction of the customer and the service provider [Sampson, 2001].

A service can be carried out manually or by an IT system. The latter is called an e-service [Piccinelli, 2001], and is the focus of this paper. E-services provided in a collaboration environment are used through e-service interfaces. An e-service interface can either be constructed for direct use by a person or by a system. For example, a service aimed at direct use by a (human) user may be constructed as graphical web interface, while an interface for system to system communication might be constructed following the Web service standards WSDL and SOAP [Gudgin, 2003]. Central to the concept of service is that it is provided by an actor, commonly an economically independent unit. Examples of actors in the health care sector are hospitals and private specialists.

Related to the concept of e-services is the concept of service-oriented architecture, SOA [WSA, 2004]. Commonly a service-oriented architecture involves the roles of *service provider* and *service consumer*. In a collaboration environment we add the role of *environment supervisor* to represent the authority setting the rules for the environment. The roles have the following responsibilities:

The *service provider* is responsible for the run-time availability of the provided e-service, as well as the responsibility for actually performing the service upon request. The provider is an actor working in the domain of the e-service environment. This means that while IT specialists might construct the actual software source code for the service, it is the business related service provider that is responsible for the service in run-time. Likewise, the provider is still responsible for the e-service if the technical provisioning of the e-service is outsourced to a third party, for example a web-hotel in the case of a web application. A driving force behind suppliers of e-services is that consumer usage of the service renders profitable work, or that e-service usage reduces cost or increases quality compared to other manual alternatives.

The *environment supervisor* is the initiator of the environment and governs the rules that the e-services must follow. For example, the supervisor might define minimum requirements for security, or define the communication standards that must be used within the environment. The requirements can be represented as for example business rules, concrete standards or as infrastructure e-services that must be used. For example in the case of GVD the county council of Stockholm has defined a set of services that must be used in order to authenticate a user. Such infrastructure services are a way for the supervisor to exert control over the services in the environment. Another example is the use of standardized information structures such as HL7 [HL7, 2003] for the health care domain.

The *service consumer* of the e-services uses the services. For example a hospital might use e-services to refer patients to private specialists in order to shorten the hospitals waiting lists. If the e-service is designed for system-to-system communication the consumer must have its own system to take advantage of the provided e-services.

The growth of an e-service collaboration environment can be measured not only in the amount of services, but also in the number of consumers and providers. A useful service might attract new consumers into the environment, while providers might enter the environment to attract new consumers or lower its costs. However, as will be described in the next section, there might also be hinders in the environment that repels possible new providers and consumers, thereby stalling the evolution of the e-service environment.

4. Forces in the Evolution of a Collaboration Environment

Collaborations among actors in a business environment are driven by, and affected by, a set of forces exerted by the collaborating parties. For example, a new service provider that enters an e-service collaboration environment might compete with existing providers, thereby giving consumers an increased ability to select provider. In this case, the force of *consumer bargaining power* increases. The environment supervisor can also exert the environment to forces, by setting rules. On a high level the collaborating parties in an e-service environment are affected by the rules similar to that of an economic market. We therefore employ Michael E. Porter's theory [Porter, 1979] on competitive markets to analyze these forces. Four main forces are defined in Porters framework; bargaining power of suppliers, bargaining power of consumers, threat of substitutes and the threat of new entrants (Figure 2).

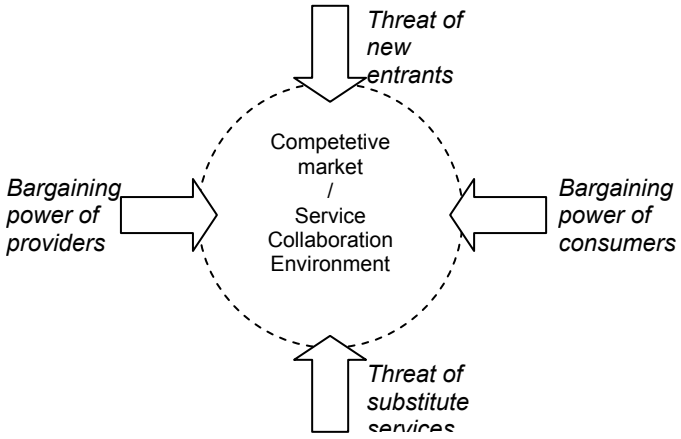

Figure 2. Forces affecting service collaboration (adjusted from [Porter, 1979]).

These four forces influence a market of goods, or services, as in the case of a collaboration environment. Actors active in the environment will take strategic decisions based on the strength of the forces, and change the use or provisioning of services accordingly. These strategic movements in the market are in [Porter, 1979] referred to as the fifth force. A balance of the forces results in what economists call a "perfect market", where there is healthy competition that drives the evolution of the market. However, unbalanced forces might result in monopoly situations, as in the case if powers of suppliers are not matched by either consumer power or threats of new entrants, or both.

An environment supervisor, for example the county council of Stockholm, can balance the forces by setting management and architectural rules. We consider rules set in business terms as being "business" rules, while rules set on the software architecture are considered to be "technical" rules. For example, setting rules on specific contracts that must be used within the environment are a business rule, while specifying that all e-services must use the SOAP protocol is a technical rule. By setting rules the environment supervisor pushes the environment in certain directions

with the aim to support new innovative services and actors. Taking the environment supervisor regulating powers into consideration is in line with extensions to Porters initial work. For example [Carr, 2005] defines a sixth force as being exerted by the government.

In the following, we will use the five forces to identify technical and business guidelines that aid an environment supervisor to steer a collaboration environment. The guidelines are meant as being a basis for formulating rules.

4.1. Bargaining Powers of Providers

The bargaining power of providers represents the control the provider has over the consumers in the environment. A powerful provider might dictate both the business and technical rules for the use of its services. By analyzing the features/problems of an environment that got powerful providers we can identify guidelines that work to balance these powers. The following four force features (extracted from [Porter, 1979]) and corresponding guidelines can be defined for an environment with powerful providers:

Feature: Provider power in form of *unique or highly specialized e-service interfaces*.

Problem: Having unique e-service interfaces means that a consumer is forced to be tightly coupled with the provider. This makes it difficult for the consumer to change provider since it means that the consumer needs to make extensive changes to its systems in order to interact with new providers. This situation is commonly called vendor lock-in, or simply proprietary lock-in.

Guideline: When there is a risk of vendor-lock in the environment, the supervisor must step in and propose standards for e-service interfaces. To plan ahead the environment supervisor should provide a clear development path for e-service interfaces, that is, a path that describe a change from point-to-point interfaces towards highly standardized interfaces that can be implemented by several providers.

Example: In the REMS case, an example of *unique or highly specialized e-service interface*s is if the communication between some private specialist (the providers of e-services) and the clinic (the consumer of the e-services) is done using message-structures based on a specific journal system (for example the MediDoc system). This will mean that the clinic is locked-in with a limited group of private specialists. Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could introduce a standardized interface for receiving referrals. This would be beneficial for the clinic (the consumer) since it would enable the clinic to easily communicate with a larger group of private specialists (the providers).

Feature: Provider power due to *forward integration*.

Problem: Forward integration is when a service provider incorporates a part of the consumers business, and thus provides a larger/more complete set of services. A drawback of forward integration, as seen from the consumer and environment supervisor perspectives, is that it becomes difficult to combine e-services from several vendors.

Guideline: To balance this situation the environment supervisor could *pose requirements for modularized e-services*, thereby allowing consumers to combine e-services from different providers.

Example: In the REMS case, an example of *forward integration* is if the clinic (the provider) would offer the same e-services as provided by the primary health care units (the consumers), for example some basic examinations. The clinic will then enclose a large chain of services – from basic health examinations to specialist eye-surgery. In the extreme this could put patients in the position where they only can select between a few actors for their total healthcare, from primary- to specialist care. Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could force the clinic to modularize its e-services. In this case modularization means that the clinics services need to be documented so that they can be combined with other providers services. This would let the patients to select providers for different treatments and examinations independently.

Feature: Provider power due to that the consumers using the *e-service environment are not vital for the provider*.

Problem: The consumer in the e-service environment might not be vital for a provider simply because the bulk of the providers business is derived from other sources, i.e., they already have enough consumers. In order to carry out its business, the provider is thus not dependent on the existence of the e-service collaboration environment. Thus, since there are little strategic benefits of providing e-services, providers might opt to not join the e-service environment. From an environment evolution perspective this is a drawback.

Guideline: An action that could balance this power is for the environment supervisor to *make a clear statement that future business will be done using e-services* in the collaboration environment. Having this outspoken vision, providers can take strategic (i.e. long run) decisions to provide e-services within the environment.

Example: In the REMS case, an example of that the *e-service environment are not vital for the provider* is if the private specialists (the providers) already have enough patients and thereby may not opt to connect to the environment for receiving referrals from clinics. Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could announce that all future referrals to private specialist would go through the collaboration environment. This would force private specialists to start interact with the e-services in the environment.

Feature: Provider power due to the *domination of a few providers*.

Problem: If there is only a few set of providers in the environment a drawback could be that these few providers might lead to stalled innovation. Furthermore, the few providers may also pose a limiting factor if the need for services increases.

Guideline: To counter the possible problem of having few providers the environment supervisor can make it easy to enter the market for (new) providers, by making the technical specification for e-services easy to understand and use. This will facilitate for (new) providers to develop e-services, increasing the possibility of new entrants. (See also feature *threat of new entrants*, described in Section 4.3).

Example: In the REMS case, an example of *domination of a few providers* is if only the clinic (the provider) provides booking of eye examinations through e-services in the environment, while the private specialists (other providers) do not provide such e-services. Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could make it easier to enter the market for private specialists by making the technical specification for e-services easy to understand and use. An option for the county council is to provide generic, web-based, e-services for the private specialist, enable them to read referrals simply by using a web browser.

4.2. Bargaining Powers of Consumers

The force of bargaining powers of consumers represents the consumer's powers to select services, and to govern the overall evolution of services by having a strong influence on the terms of service use. To some extent these forces are balanced by the bargaining powers of providers. Based on [Porter, 1979] we distinguish three features of this force, and set guidelines that balance these:

Feature: Consumer power due to that *purchasing of services is done in large volumes*.

Problem: Consumers that buy in large quantities can set providers in an all-or-nothing situation, i.e. a provider gets a large order, or nothing at all. Purchasing (the execution of) services in large quantities can be done by setting long contractual times, for example, by buying services that last for a year. A drawback if a few consumers buy large quantities over long contractual times is that consumers and providers cannot adjust to temporally shifts in demands. Further, bulk buys means that smaller providers can not participate – they simply cannot provide the amount of services needed to compete.

Guideline: To counteract this, the environment supervisor can make it possible (and preferable) to make *contracts on service use on shorter time intervals*. The extreme would be the possibility to change provider for each service use (this is referred to as just-in-time binding [Andrade, 2001]), rather than having yearly contracts negotiated.

Example: In the REMS case, an example of *purchasing of services in large volumes* is that the Stockholm county council currently offers potential providers, such as private specialist, yearly contracts stating the amount of examinations that they can get reimbursement for (the cost of examinations is partly paid by the county council). Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could complement the yearly contract with contracts on a shorter time interval. Introducing shorter "contracts" might increase the interest of small providers to step in and provide extra services when the healthcare waiting lists are becoming to long.

Feature: Consumer power due to that the used services are *non-unique e-services*, there simply is no difference between provided e-services, the consumer can therefore switch provider very easily.

Problem: If e-services follow exactly the same specification, there is no possibility for providers to excel and provide a better e-service. From the environment supervisor

perspective this is negative, since there is nothing pushing the providers to improve upon their services.

Guideline: To counter this it is desirable to make it possible for a provider to differentiate their e-services, but still follow the overall e-service standards. An overall goal for the environment supervisor is to *enforce the use of quality criteria's when specifying and selecting e-services*, thereby letting providers differentiate their e-services in quality terms. Furthermore, it should be allowed and encouraged for the e-service providers to extend their e-service description beyond what is regulated as being the minimum requirement as set by the environment supervisor.

Example: In the REMS case, an example of *non-unique services* is if the quality of services is not considered when the clinic chooses e-services among the private eye-specialist, i.e. all services are considered to be equally good. Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could measure the quality of the services, for example, measure the number of complications per treatment and make the result publicly available (although this will be a controversial decision in Sweden).

Feature: Consumer power by *backward integration*.

Problem: Backward integration is the opposite of a provider power, namely forward integration. The power of consumers increases when they overtake their providers' services, thereby becoming more and more self-supplied. This means that consumers by themselves perform the same services as their (potential) providers. The consumers are thus not inclined to use the e-services in the collaboration environment. This situation is not beneficial for the service environments since it makes it more difficult to combine services from several providers.

Guideline: The environment supervisor can counteract this situation by following the same guidelines as for forward integration, by *enforcing modularized services*.

Example: In the REMS case, an example of *backward integration* is if the primary health care units (consumers), or opticians (consumers), start to perform both basic and advanced treatments, which are bundled together, and some of the advanced treatments are also offered by the clinic (the provider). Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could force the primary health care units and the opticians to modularize its e-services, offering advanced treatments as separate services. For a potential consumers (patients in this case) it would be easier to combine services from different health care providers.

4.3. Threat of New Entrants

The force of threat of new entrants constitutes the potential of new providers that enters the collaboration environment and thereby pose the threat of changing the balance – to the consumer advantage. Seen from a positive side new entrants can provide new innovative services. Hinders for new providers are entry barriers. We identify two entry barriers, and corresponding guidelines that can lower them in a collaboration environment:

Feature: Entry barriers due to *advantage of scale* for existing providers.

Problem: Existing providers in the e-service environment can have substantial benefits from having a large customer base. The cost of keeping the e-services running in the form of administrative IT personnel and the need to use proprietary technology can hinder providers from entering the e-service market. Scale advantages of existing providers can enable them to handle complex technologies, while new providers cannot make the investment necessary to put their e-services into the environment.

Guideline: This entry barrier can be amended by making it easier for a provider to enter the environment in a small scale by *setting low initial requirements on required technologies and their complexity*.

Example: In the REMS case, an example of *advantage of scale* is if the clinic (large provider) due to its size can have its own IT staff. Large providers have no problem cooping with advanced technology. For smaller (presumptive) providers, like private eye-specialists, the cost associated with the (technology) required to enter the collaboration environment is an entry barrier. Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could set low initial requirements on required technologies, for example by offering financial and technical support, Note that this example is similar to that of *domination of a few providers*, Section 4.1.

Feature: Entry barriers due to missing (or costly) *access to distribution channels.*

Problem: In the case of e-services the distribution channel is the technologies that transfers messages to the receiving e-services, for example message middleware servers. By using proprietary protocols and authentication mechanisms existing service providers can lock out new providers from entering the environment. Even if the potential new providers have the skills and other resources to provide e-services they thus might get hindered by not having the legal access to other e-services via the distribution channel.

Guideline: A step that can be taken to limit this barrier is to *make the distribution channel available to all providers*, following available protocols. If necessary, the environment supervisor can host necessary middleware servers for message routing and translation, thereby avoiding provider control off the communication means.

Example: In the REMS case, an example of *missing (or costly) access to distribution channels* is if the clinic (the provider) using proprietary protocols and authentication mechanisms which lock out private specialists (potential providers) from interacting with consumers, such as primary care units and opticians. Instead, following the suggested guideline, the county council of Stockholm (the environment supervisor) could introduce a common, shared communication channel. The county council of Stockholm has in fact already introduced such communication channel in the form of the GVD platform. In GVD open message standards such as HL7 are used to ensure that access can be granted to actors that wish to integrate their patient journal systems with GVD.

4.4. Threat of Substitute Services

If it is possible to substitute a service for another without affecting the consumer, new e-service implementations can be introduced. We define a single feature for the threat of substitute services:

Feature: A service might easily be *substituted* for another service if it is fulfilling the same consumer need.

Problem: A substitute service is a service that has the ability to replace an existing service, using the same interface, but with a different "content". Porter [1979] takes the example of cheap corn syrup replacing traditional sugar in the food industry. From the consumer side, the substitution can be positive, since the new service might be of lower cost, or provide other advantages. Thus, for the environment supervisor it is advantageous to encourage the development of substitute e-services.

Guideline: A guideline for the design of services interfaces is that they should, as far as possible, *be independent on how the service is performed*. E-service interfaces should focus on the required input and on the result. Following this guideline will make it easier for consumers to change provider.

Example: In the context of the REMS case, it could be the case that new ways of doing eye examinations replaces older methods. From the overall development of the environment this is positive – it can lead to higher quality or decreased costs. In this example applying the guideline would be to avoid e-service parameters coupled to a special way of doing eye-examinations. This means that once the provider is selected the in and output from the providers of eye-examinations should be the same, regardless of the method the provider uses for the examination.

The guidelines presented above can be categorized as working on two different levels, technical and business levels. We consider guidelines set in business terms as being "business" guidelines, while guidelines related to the software architecture are considered to be "technical" guidelines. For example, a guideline proposing rules on the contracts that must be used within the environment are a business guideline, while specifying that all service must use the SOAP protocol is a technical guideline. The application of the guidelines will be manifested as either a constraint in the technical requirements or a business constraints exerted by the environment supervisor. In the following table we classify and summarize the described guidelines:

Category	***Force***	***Force feature***	***Guideline***
Technical	Provider power	Unique or highly specialized e-service interfaces	*Provide a clear development path for service interfaces, from point-to-point to standardized interfaces*
	Provider power	Forward integration	*Pose requirements for modularized services*
	Consumer power	Backward integration	*Pose requirements for modularized services*
	New entrants	Advantage of scale	*Set low initial requirement on required technologies and their complexity.*
	New entrants	Access to distribution channels	*Make the distribution channel available to all providers*
	Substitutes	Service substitution	*Service interfaces should be independent on how the service is performed*
Business	Provider Power	Environment are not vital for the	*Make clear statement that future business will be done using e-*

		provider	*services*
	Consumer power	Purchasing of services done in large volumes	*Make contracts on service use on shorter time intervals.*
	Consumer power	Non-unique e-services	*Enforce the use of quality criteria's when selecting services*

Table 1. Summary of the presented guidelines.

The success of applying the guideless depends both in the ability for the environment supervisor to detect unbalanced forces and to implement the technical and business guidelines.

5. Applying the Guidelines

The presented guidelines can, as mentioned before, work as an instrument to balance provider and consumer forces in the environment. However, the guidelines need to be used in a structured manner in order to avoid over-regulation of the environment. A structured approach to applying the guidelines will be presented in this section, together with examples based on the REMS project.

The approach consists of five steps: symptom identification, force and feature identification, guideline specialization, risk mitigation, and guideline implementation.

1. ***Symptom identification***. An unbalanced force in the environment can manifest itself as one or several symptoms in the e-service environment. In this step the focus is to find symptoms that are caused by unbalanced forces. The symptoms can be identified by using traditional approaches such as business process modeling and monitoring. A promising approach is also to use value models [Henkel, 2006].

   Example: In the REMS case, it is evident that clinics such as S:t Eriks eye hospital periodically is overloaded, which leads to long waiting lists (symptom). Further, by using process and value modeling, we found out that some investigations were redundantly carried out (symptom) by both opticians and the clinics, for example retina photos and refractor tests.

2. ***Force and feature identification***. The symptoms found during the symptom identification are the basis for finding the forces and features that might cause the identified symptoms. An approach to match symptoms and features is to take each symptom and test it against each of the features of the four forces. Symptoms that can be partially or totally explained by an unbalanced force need to be singled out and related to specific features and forces.

   Example: In the REMS case, both of the identified symptoms (long waiting lists and redundant examinations) can partially be explained by the feature of *forward integration* and thus the force of strong providers. The clinic simply performs tasks that can be done by its service consumers (i.e. opticians and primary care). This means that valuable (and expensive) clinic time could be saved if opticians and/or the primary health care physicians could perform some of the examinations.

3. ***Guideline specialization***. When one or several features have been identified the associated guidelines need to be analyzed and specialized in order to fit into the domain at hand.

   Example: In the REMS case, based on the identified feature of *forward integration*, the guideline to *modularize the e-services* must be analyzed in the context of the current health care situation (state of affairs) and the concrete services that the clinics, opticians and primary health care (actors) provide. The question here is how can we modularize the clinics services so that other actors can perform some part of the work? A simple example of a service that can be seen as a "module" is refractor test, i.e. testing the patients ability to see objects at various distances. Applying the guideline in this context would mean that e-services for storing and communicating refractor test results should be standardized. This allows the clinic to take advantage of refractor tests performed by other health care units.

4. ***Risk mitigation***. During this step possible drawbacks of applying the guideline are analyzed. Risks to consider are overregulation and side effects in the form of (inadvertently) affected forces.

   Example: In the REMS case, *modularizing* and standardizing e-services might inadvertently lead to the feature of *non-unique services,* strengthening the force of the consumers' bargaining power. For example, (over-)standardization of an e-service *handling retina photos* might lead providers of this e-service (opticians and specialists) to stop developing higher quality retina photo services. Some older retina photo equipment requires eye-drops that dilatates the patient's pupils, impairing the patient vision for a short duration after the examination. Before standardizing e-services supporting retina photos it is thus necessary to make sure that consumers are able to base their selection of e-services based on the quality of the retina photo examination (including short term side effects on the patient).

5 ***Guideline implementation***. The implementation of the guidelines relies on that the environment supervisor can gather the required resources to deploy the specialized guidelines. On one side the supervisor might have legislative power (in the case of governmental control), and can thus enforce rules. Another, smoother, way is to gather the actors consensus around the needed changes.

   Example: In the REMS case the symptoms, and possible remedies, were discussed in a group with representatives from each health care unit. During the meetings the representatives got insight of the problems from the different actors' perspectives, and consensus could be formed around how the e-services should be designed. In this case consensus could be formed because there where little economic competition among the actors.

The above sequential steps just outline and exemplify an approach how to apply force analysis and the guidelines presented here. The above steps need to be constantly iterated to amend new symptoms and keep the environment balanced.

6. Conclusion

In this paper we have identified a set of business and technical service design guidelines that influences competitive forces among actors using e-services. Some of the identified guidelines are well known in e-service oriented design, such as the use of standardized interfaces. The novelty of the approach is rather the use of competitive forces to derive the design guidelines. A clear connection between the competitive forces and guidelines enables the selection of actions that affect the desired competitive force.

The main use of the guidelines is as a control mechanism for controlling a domain of interrelated e-services. Controlling such an environment is a delicate matter, over regulation will stall the development of new services, while less regulation might hamper the overall quality of the services. By using the guidelines it is possible to issue rules and actions to specifically counteract a single force (for example overly powerful suppliers), thereby avoiding over-regulation.

This work can be extended in several ways. First of all the relationship between business and technical guidelines could be analyzed. For example, posing requirement on modularized e-services on a technical level might also pose corresponding requirement for a modularized business. Another area of extension is to further detail the instruments needed to identify unbalanced forces in a domain. A promising foundation of performing such an analysis is the use of value models [Wieringa, 2005].

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