An Approach for Improving Business Process Management in Agile Service Networks

Minor Research Report of
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Abstract

La ricerca nell'ambito della gestione dei processi di business si sta focalizzando nella ricerca di modi efficaci ed efficienti per adattare i processi di business ai rapidi cambiamenti che si verificano a livello di ambiente, di requisiti, di entità con cui si collabora, e di tipi di prodotti/servizi offerti. In un'epoca in cui ormai il costo per memorizzare e trasmettere le informazioni è prossimo allo zero, le aziende moderne, così come ogni individuo comune, possono sfruttare questa caratteristica per incrementare l'opportunità di stabilire con altri collaborazioni in grado di incrementare il loro valore. Sotto questa idea ci si è spostati dal concetto di "catena di valore" a quello più completo e più espressivo di "rete di valore". Quello che si propone in questo lavoro è un metodo per modificare dei pattern strutturali frequenti in questo tipo di reti in modo da poter identificare e utilizzare le informazioni "intangibili" messe a disposizione da ogni entità appartenente a tale rete. Il fine ultimo è quello di trovare delle trasformazioni che, trasferendo la conoscenza in modo più appropriato (ad esempio attraverso un sistema di gestione delle reputazioni), possano aumentare i livelli di fiducia nella rete e ridurre il rischio nelle varie transazioni, determinando perciò un rilevante aumento del valore. In questo modo dopo ogni riconfigurazione della rete, anche tutti i processi aziendali sottostanti sono adattati di conseguenza in modo da mantenere la capacità di perseguire gli obiettivi originali. Il lavoro è stato integrato nell'architettura di un sistema di Business Process Management (SN4BPM) e la metodologia è stata esemplificata attraverso l'analisi di un caso di studio aziendale.

Abstract

Business Process Management research is focusing on finding effective and efficient ways to adapt Business Processes to rapid changing environments, requirements, collaborating entities, and type of offered services. In the Internet era where the cost of storing information and of diffusing it is almost zero, modern companies as well as common individuals may exploit these features to increase the opportunity of establishing new value-creation relationships with others. Under this idea we naturally moved from a vision of a value chain to a more meaningful concept of value network. What we propose in this work is a method for identifying some network patterns for exploiting intangible information provided by participating entities. The final purpose of this network transformation is to bring the whole business system to a situation in which it produces more overall value (in terms of customer satisfaction) with less risk for its participants. This way we obtain a service network whose underlying business processes are adapted in a seamless way while still reflecting the original goals.

1 Introduction

The research in Business Process Management (BPM) has traditionally focused on the study of the interactions among companies in the process of offering a product of a service. All the steps that are required to convert some value from the form of raw materials and/or knowledge to the supply of a final product or a service usually consists of a transformation process that may involve several other companies or different entities within the same company. Each step of this process adds cost to the whole process in terms of time and money. An efficient process should be able not only to fulfill the requirements, but also to minimize these costs.

The traditional model for these processes started from the supply chain model of Porter [22] where he describes a transformation chain from the Supplier to the Customer (through Manufacturer and Dealer) and then evolved to a more general vision in which the former entities where seen as nodes of a network and their collaborations as the links of the network. The common name for these networks has been defined as Value Networks or Service Networks [20].

Research in BPM is thus moving on analyzing all the characteristics on every single interactions to provide an estimation of the value created by the entire service network. To achieve this goal many methodologies have been developed for defining these interactions in a formal way (e.g., Business Process Languages and Service Level Agreements), for example by identifying the nature of the product/service, the contracts for stating its minimal quality characteristics, and information on how to use the service/product in other transformation steps.

After this research, decisions in value networks have been taken by using value network analysis tools such as [4] that are able to give quantitative evaluations on the stability of the network, bottlenecks, the resistance to loss of interacting partners, as well as the amount of created valued by considering not only financial costs and revenues, but also intangible aspects such as knowledge, trust, and competence transfer.

What we focus in this work is to identify some patterns in existing service

networks and exploit them to reorganize the network by adding the capability to rapidly react to dynamic environment conditions and to changes in business requirements. The key technology that we are going to exploit is the informative value that is given by adding a concept of feedback to every interaction, and by adding a reputation managing system to support the whole infrastructure. The final goal is to increase the total value produced in the systems, especially in terms of knowledge and trust that service network participants may use when interacting with unknown entities, thus at the end they will be able to reorganize their processes in a more "agile" and secure way.

We will finally show first how to apply this methodology in the BPM lifecycle described in the SN4BPM [2] model, and second a case study in which we improve the agility of an existing Car Sharing service network.

This report is organized as follows. Chapter 2 introduces the concept of Service Network and gives some information on the state of the art. Chapter 3 describes the problem of the current approaches in BPM in presence of particular situations such as an environment characterized by dynamism and highly variable risk, and presents a possible method for automatically transforming the network for dealing with them. In Chapter 4 we show the methodology applied to the Car Sharing system, and finally Chapter 5 concludes the report.

2 Background Information and Related Work

In this chapter we will introduce the concept of Agile Service Network [1], in particular we will focus on the concept of value, on its meaning, and on existing methods for evaluating it. In the other sections we will recall some notions that will be used in the rest of the report, such as the parallelism between business systems and ecosystems, the concept of trust, and an existing model for managing business processes in service networks called SN4BPM [2].

2.1 Agile Service Networks

An Agile Service Network, also known as an Agile Service Value Network, or simply ASN, is defined as a system of interconnected entities with the following characteristics [20, 19, 11, 21, 8, 7, 17]:

- Each entity may be a company or different roles within the same company that are able to offer one or more services. For example in the service network of a telephone company there may be an administrative center, many local telephone centers, a customer service, a billing department, and so on.
- The connections among the entities define the relationships among the partners. Some of these relationships are defined by "contracts" that state the tangible value exchange between the two entities in terms of payment or other forms of value. Other connections reflect the intangible value that is exchanged as a side effect of contractual relationships. According to some authors the value may be also negative, in such the case it is usually referred as cost.
- The direction of the connections indicates the source of the value and the destination of the value.

- The entities and their connections are allowed to change with a certain level of flexibility: this is often referred as the agility of the service network [24].

There is not a dominant standard yet in the representation of these networks. The graphical formalism is usually the corresponding graph, however different authors choose to represent and differentiate tangible/intangible interactions with dashed lines, as well as coloring each interaction with sequence numbers and cost/benefit differences (for negative and positive values).

2.2 Evaluating Agile Service Networks

The evaluation problem in Agile Service Networks is divided into two subproblems: the first focuses on the calculation of the value actually created by the network and its possible evolution over time, the second focuses on analyzing structural characteristics of the network such as, for example, its stability, its resistance to loss of interconnections, and the identification of strengths and weaknesses.

2.2.1 Value in Agile Service Networks

Since Agile Service Networks are strongly related to the concept of Value Network we need a proper definition of value [10]. Value is defined as the "*benefits of an agent accrued by his participation in the network minus any costs involved in setting up the network links directly or indirectly*". The problem with this definition is that it is really high level since this "amount of benefits" is subjective and involves not only physical transfers of something, but also for other forms of intangible goods that may not be easy to quantify.

The work described in [12] describes a possible formalism for estimating value and value evolution in an agile (always evolving) service network. In this work all the interactions are expressed in terms of offerings and payment flows (offerings and payments occurred per time unit). Then the total revenues for all offerings exported by each participant are computed and used to estimate future revenues. However according to this work the total value is not only a simple subtraction revenues minus costs, but there is another value-contributing component that the authors call *Satisfaction Index*. The satisfaction index measures the perceived preference for a relationship and it is usually related to revenue expectations and other intangible facts such as the brand name, quality expectations, and other factors. The meaning of this index is the capability for the partner to repeat past successes (and thus past revenues). The evaluation of this index in subjective and may be calculated using interviews, market research, questionnaires, polls, etc. One open problem of this work is that the computation of the satisfaction index is not trivial, since it embeds all the value information about intangible transactions.

2.2.2 Other Metrics for Evaluating Agile Service Networks

In [9] there is a possible definition for the notion of complexity of a Service Network that is derived over the Shannon's notion of entropy in information theory [25]. The result is that a typical network may require billions of questions to determine its full status since it reflects the total complexity of its market.

The work from Parolini in [20] describes a methodology called "*Value NET*" for taking strategic decisions on the service network by doing a qualitative analysis over it to identify bottlenecks, dominant relationships, and to predict the effects of possible structure/relationship modifications.

Another work from Allee points out some other metrics that may be directly derived from a network:

- **network stability**, which is the capability of the network to keep on creating value and is expressed by the *ratio of tangible to intangible exchanges* whose best value should be 1 since a network with more tangible interactions has a high level of transparency and good formal structure, but with less trust and less flexibility; while a network with more intangible exchanges is usually characterized by strong personal relationships and flexibility, but with some broken formal processes.

- **network risk**, which is related to the *"centrality"* of network participants: for example, if a role has a great impact on the creation of value and it is the only one in the network, it means that the network is risky because some roles are overburdened with too many inputs and outputs.

Other works from Allee are related to the concept of knowledge value [3] and on an analysis on how to reconfigure the network by considering intangibles [5, 6, 7]. Additional works that try to understand and measure the value of services networks may be found in [28, 8, 11, 26]. It is important to notice that many areas of complex networks science such as social network theory [13] are providing ideas and metrics that may be applied in services networks as well.

2.3 Business as Ecosystems

Service Networks are usually formal representations of whole Business Networks. The interactions among the actors of these networks may be traditionally coordinated in two different ways: using hierarchies and markets.

- Hierarchies are based on a rigid hierarchical organization among the actors of the network, their cost usually grows very fast as the network becomes larger and more complex.

- Markets are based on a self-coordination among the actors that is based on the law of offering and demand. This is less complex and requires less explicit coordination than hierarchies, but is affected by a problem in the possible loss of the "perfect market conditions", such as the hiding of information or the creation of external opportunistic relationships for controlling and damaging the market.

These coordination methods are usually related to aggressive behaviors of companies whose main goal is to try to dominate as many competitors as possible.

In the latest decades another coordination mechanism emerged: the Business Ecosystem [18] in which each firm may still coordinate in the traditional ways, but with the difference that the final goal is not to remove competitors, but to cooperate with them by establishing some value-creating virtuous circles. This last behavior has been called the "keystone behavior" [16]. Examples of keystone companies are eBay and Amazon since their core business is supporting

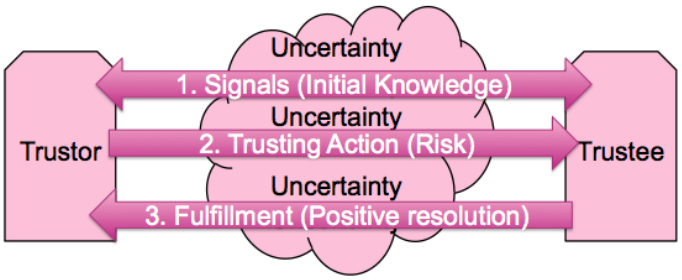

Figure 1: Process of Trust.

the creation of value of other individual/companies. The particularity of Business Ecosystems is that the value is an emergent property of the system that arises not only from existing actors, but, since the Ecosystem is open (unlike traditional Businesses that were used to keep everything secret and proprietary), it may also benefit from the occasional intervention of new incoming entities. In a business ecosystem the strategy, defined as the set of common cooperative and competitive behaviors that are required to obtain an emergent value, is also called the "ecology" of the network [15].

2.4 Trust

The definition of trust proposed in [23] is the following: "an attitude of positive expectation that one's vulnerabilities will not be exploited".

Trust is strictly related to risk, meaning that the act of trusting is always risky. The current research effort on this topic is to try to understand what are the components that contribute to trust/risk and how it is possible to evaluate them [27, 14].

Trust is usually needed when two different entities that we call Trustor and Trustee have to establish a relationship in an environment characterized by uncertainty, meaning that it is not able to provide valuable information for both parties, and it is not able to prevent selfish or malicious behaviors.

The trust process is composed by three phases:

1. *Signaling*: Trustor and Trustee share some information about who they are and about what they need.

2. *Trusting action*: Trustor has to decide either to execute a trusting action with Trustee (and therefore take the risk), or to cancel the establishment of the relationship (no risk, but also no value).

3. *Fulfillment*: the Trustee may either fulfill the Trustor by respecting his contract (positive resolution), or act in a selfish way and create a negative value to the Trustor (negative resolution).

Before taking the risk the Trustor entity has only information about the initial knowledge for estimating the decision, therefore if such information is not enough he would not probably take the risk.

Possible ways for having a better understanding of risk is to either adopt reputation mechanisms to increase the amount of knowledge in the signaling

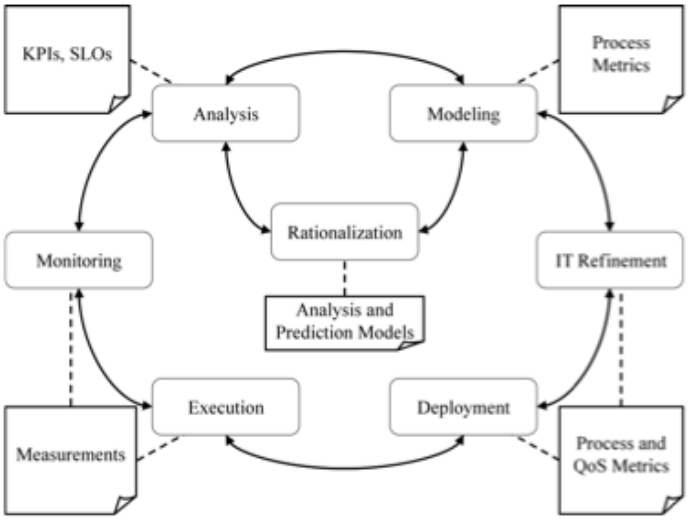

Figure 2: SN4BPM Lifecycle.

phase or to execute the transaction in a controlled environment rather than in a completely uncertain one. An example of extensive use of reputation is seen on the eBay service network, where the environment is completely uncertain. Another example is given by real estate companies where the act of transfer is usually done in a "protected" environment (public notary) therefore the risk of not obtaining what it has been paid for is irrelevant.

Quantitative methods for evaluating trust are several, and often very different since the perception of trust is different for every Trustor. A possible way, as proposed in [12], is to define it as the willingness to pay for not having the risk (insurance), and representing it as a value transfer (offering) from the Trustee to the Trustor.

2.5 SN4BPM

The Service Network for Business Process Management [9] is an architecture that supports the management of Business Processes from the requirements to the deployment. The architecture provides different levels of abstractions in terms of layers: the highest is the service network, followed by the process models, by the service compositions, and finally by the single service. The final goal of the architecture is to manage the lifecycle of the business process that, by analyzing requirements and the Service Network model is able to define high-level business processes that may be then refined and made executable.

The core part of the architecture is the BPM lifecycle depicted in figure 2. It is composed by a set of continuously iterative phases strictly related to each other in both directions (bottom-up and top-down):

- *Analysis phase*: definition of functional and non-functional requirements of the Service Network that may be expressed in terms of Key Performance Indicators (KPIs) and Service Level Objectives (SLOs).
- *Modeling phase*: high-level business process definition, based on the re-

quirements analyzed in the analysis phase and on the characteristics of the Service Network.

- *Rationalization*: Requirements and high-level processes are used to derive the Service Network Notations (which is another formal way for defining Service Networks and interactions among components). These notations can then be analyzed with quantitative techniques to perform corrective actions in the analysis or modeling phases.
- *IT Refinement/Deployment/Execution*: refinement of the abstract processes to executable ones and their deployment/execution in the IT infrastructure.
- *Monitoring*: the metrics used in the analysis phase are monitored and, if there is a change, the whole loop is executed again from the analysis phase. This makes it possible the reorganization of the business processes and therefore contributes to the agility of the service network.

3 Improvement of BPM

In this section we will show how a particular pattern that often appears in service networks may be exploited to create an improved service network that has more value. We will finally show how the rationalization phase of the SN4BPM lifecycle may benefit from this high-level service network model transformation.

3.1 The Problem

We know from the service network theory that all activities and interactions among a set of companies (or roles within the same company) may be always represented as a service network. Current research has focused on finding efficient and intelligent ways for reorganizing such network (and therefore the underlying business processes) in order to maximize its value. In most of the works these decisions are taken by considering some sort of value function based on requirements, expected satisfaction, and collaboration alternatives, therefore each entity looks for an answer to the following questions:

- Why, as a company, should I belong to this service network?
- Why, as a company, should I choose to interact with company X instead of company Y?

The answers to these questions are usually analytically (or intuitively) computed. Traditional networks tend to be conservative and closed, meaning that the role of each participant is fixed. What we want to point out here is to explain why a service network should check whether to start new cooperations and to open itself to new value-creating collaborations (as described in section 2.3).

In the next paragraph we will describe that this is actually a frequent problem and that there are already several successful case studies in which such problem is addressed by doing deep modifications on the service network and on the business processes.

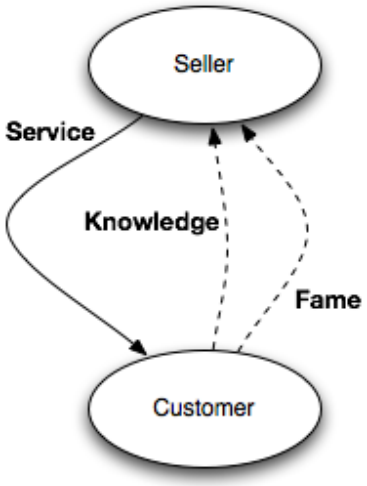

Figure 3: Common pattern in Services Networks.

3.1.1 Problem Statement

Think of a Services Network with the following characteristics (as depicted in figure 3):

- Two roles of the network are a service provider, and a customer who buys services.
- The service provider simply offers a service and the value it receives corresponds to the payment, as well as other intangible benefits such as knowledge about the environment (experience), and fame from the customer.
- The customer offers the payment and the intangible benefits cited above, in change for the execution of the service.

The problem here is that the customer never receives knowledge, therefore its choice whether to participate or not in the network depends only on the price information and the "fame" previously received by the service provider. Since this information is not usually easily accessible by all customers the choice tends to be non-deterministic and does not stimulate any quality improvement from the service provider's side. For example, if a person has recently moved to a new town and wants to whiten the walls of his apartment, he will look-up for the proper service providers in the yellow-pages. However he will have the time to call only a subset of them asking only for the price without knowing anything else about the quality of the job. Looking at this example we have seen that the network is vicious since knowledge means value (in terms of satisfaction) for the customer, but it is not exploited at all. Another thing we can notice is that there is absolutely no way for establishing collaborations among customers or to move additional value from the customers to the service provider. This means that this business ecosystem is closed and has poor chances to increase its value if it stays in such situation.

3.1.2 Existing Case Studies

Some case studies in which this pattern appears are similar to the whitening one explained above. Other possible examples from which we will take inspiration in our methodology are the following:

- A customer (or a company) needs some electronic appliances and goes to a specialized electronic store. The store is offering many services, and tries to provide all the information the customer needs to be sure to sell its goods. However the store has more convenience in selling its goods rather than sending the customer in another store that is going to sell better quality appliances for a lower price. This happens because there is a conflict of interests in the electronic store that, in order to increase its immediate profits, decides not to lose the customer, but with the risk of losing customer satisfaction. To solve this problem nowadays there are many websites (such as ciao.com) that are collecting user feedbacks about every physical and on-line shop in the world as well as about the goods they sell.

- Another typical case study is the travel agency case. Travel agencies usually behave as brokers for selling travel services to customers and providing valuable information. In this case, similarly to the previous one, each travel agency may not have complete information about the market or may not be specialized in all kind of travels, therefore the customer receives a service that may not be the most suitable for his needs, while still paying a high price. This is another typical case in which the risk is very high and the user knowledge very low. Also in this sector there has been a proliferating of on-line and physical meta-travel agencies that is creating networks with a very high value (due to the low cost and to the high user satisfaction) because there is a strong collaboration with many different underlying travel companies.

- Car Sharing case. This case will be explained in detail in Section 4, however it may be summarized as the case in which an individual or a company wants to save the money spent on buying and maintaining a new car by easily relying on hourly car rentals offered by a car sharing company. A possible improvement of the value network of this scenario will be discussed later.

3.2 Ideas

Some possible ideas that come from existing ad-hoc solutions to the service network fragments identified above are shown here. The key features that we want to add to the service network to make it more agile are the reputation (to reduce the uncertainty), the transparency in the operations (to contribute to the increase of knowledge and possibly to a transfer of competences), and finally increase the user (either an individual or a company) involvement in the value creation process.

3.2.1 Reputation in BPM

Reputation in BPM can be defined as the feedback history that an entity participating in a business process has received by other entities on previous instances of the process. This may be seen as either a numeric value or a more detailed written review. The purpose of this information is to add a reputation history to each participant. Participants with a high reputation are considered more trustable, therefore it corresponds to a risk reduction; while participants with no reputation (or a low one) are considered less valuable than the others. Since a higher risk usually corresponds to a lower cost it is up to the other participants whether they should pay in the form of "risk" or in the form of more financial resources. In both situations the decisor has a complete control on the overall risk of the business process, therefore the final decision will be more rational and less non-deterministic than situations dominated by uncertainty.

3.2.2 Transparency and Competence Transfer

In the concept of business ecosystem explained in section 2.3 we have seen that open ecologies (in terms of having the service network open to new contributors) [15] in literature are characterized by a higher capability to adapt to changes and to create new values from new interactions. Business ecosystems are usually characterized by some keystone participants that enable fruitful collaborations among other participants and collect/diffuse large amount of value. In this context an evolution of an existing network into a business ecosystem needs to create processes that are transparent. This way every participant is able to learn information about each phase of the process and especially about how each request is fulfilled by others. The collected information contributes to a feedback loop that may stimulate the individual participants to develop or to export some of their capabilities to help increase the value of those business processes. Think, for example, of two suppliers who produce a particular kind of memory chips that in the next step of the manufacturing process are integrated with another self-produced type of chips. Both suppliers may enhance their production process by specializing on only a type of chip in normal conditions (thus increasing their efficiency and their value), while still being able to produce both types when the other participant fails or has an insufficient production. To achieve this objective the business network should be able to provide the proper flow of information and competences to increase the value of each participant and therefore improve its capability to be flexible when the requirements or the working conditions in which its business processes take place change (for example to prevent the collapse of the whole network if a company fails).

3.2.3 Final User in Value Creation

Usually service networks focus on interactions among companies and on their business processes. The role of the final user is usually marginal and is not well represented in the network. The idea we propose here is that the user is not only the source of the dominant forms of value (such as financial value, knowledge, and potential satisfaction), but it has also the power to participate actively to the network. This possibility may be explained by the fact that the same entity may have more than a single role in the service network, therefore its experience

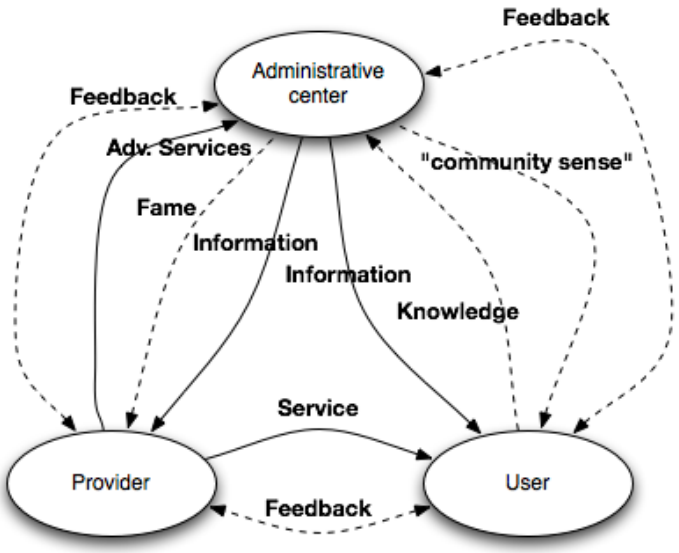

Figure 4: Improved version of the common pattern found in figure 3.

as a user may be shared and used as an experience as a producer. A possible example in which this happens is in the on-line auctions systems: user/companies may either behave as producers and/or consumers, therefore they have in both roles the experience of the other role. This concept of inter-changeable roles will contribute to develop and exploit latent competences and collaboration opportunities that are usually considered not important and hardly converted into value.

3.3 Improving the BPM

This section shows how it is possible to convert the abstract service network fragment described in subsection 3.1.1 to a smarter piece of network that is able to exploit the ideas identified in the previous section.

3.3.1 Improved Service Network Description

Figure 3 shows a possible substitution of the abstract service network fragment depicted in figure 3. The two existing roles (Seller and Customer) are replaced by three roles (who are not necessarily played by distinguished companies/individuals):

- *Administrative Center*: acts as the network keystone; it receives service advertisement requests from all the service providers, and exchanges information/knowledge with them and other potential users; manages feedback between providers and users and gives them tools for leaving and receiving feedback information about previous transactions. The value it obtains is composed of payments and intangible value in the form of information and fame.

- *Provider*: offers information about its services to the administrative center and offers the actual service to the user; it also contributes to the creation of reputation information. The value it obtains is composed of payments, fame, and reputation.
- *User*: offers value (usually in the form of a financial payment) in change of a service from the provider. It also gives information about its requests and its needs to the administrative center that will be able to process them to better predict how to maximize its satisfaction. The value it obtains is composed of the fulfillment of its service request, reputation, and a sense of belonging to a community that may be used to share ideas, experiences, and cooperate with other users/providers to improve in a further way its participation in the next business transactions.

In more formal terms the total value that is created by the old piece of network and the new one is described by general definition of value taken from [12]:

$$V = \sum_{i \in Roles} (R_i - P_i + SAT_i \times \overline{R_i})$$

where R_i, P_i, SAT_i, and $\overline{R}_i$ are respectively the total revenues of participant i, the total payments, the satisfaction index, and its expected revenue in the next instance of the same interaction. From the formula it is clear that satisfaction (usually expressed as a number between 0 and 1) measures the probability that such customer (or other customers with the same information) will participate again in the network, and therefore that he will be able to produce the expected revenue.

3.3.2 Considerations on Value

The final outcome of the service network transformation described in the sections above is to increase the total value of the network, therefore if we want to increase the total value of the network we need to check whether the following relation holds before deciding if the system may benefit from the reconfiguration:

$$\sum_{i \in Roles\ of\ old\ fragment} (R_i - P_i + SAT_i \times \overline{R_i}) < \sum_{i \in Roles\ of\ new\ fragment} (R_i - P_i + SAT_i \times \overline{R_i})$$

However as we have said in the state of the art section, the actual evaluation of the satisfaction perceived by each role as well as other intangibles are subjective, therefore every tentative of an analytical explanation would never be general, but will be based on some assumptions (e.g., the choice to consider an intangible interaction in terms of an abstract revenue/payment rather than using it only in the computation of the satisfaction index). Since until now we have always been in an abstract level we will provide an explanation on why we may expect an increase in value, however this might not be true in all situations and a deep understanding of the problem instance is always required before taking such decisions.

A possible reason for expecting more value in the enhanced network is that, although actual payments/revenues may be less since there is more choice for the users, intangible benefits like the information, lower risk and predictable quality tend to be more dominant. Some other intangible offerings that may

generate additional value are knowledge, reputation, sense of community, chance of collaboration, and so on: all of them may have a great impact on the final satisfaction that is perceived at each role. A high satisfaction is usually related to the quality of the obtained service, its fitness to the actual needs, and other benefits that are not contractually defined, but arise as side effects.

Another possible reason for expecting more value is that internal/functional costs are likely to be less because participants may focus on their core competences and outsource non-profitable activities.

3.4 Integration in SN4BPM

In the context of the SN4BPM architecture (see section 2.5 for more details) the service network model transformation above may be automatically recognized. However not every network may benefit by it. In this section we will show which kind of KPIs may indicate the need of such transformation and how it affects the SN4BPM lifecycle.

3.4.1 Special KPIs

The two Key Performance Indicators that we intend to analyze are: Trust (in terms of reduction of perceived risk) and Satisfaction (in terms of other intangible benefits, such as the chance of collaboration). The formal definition and the numeric value of these KPIs is always problem-dependent, however their general meaning is always the same.

Trust. This indicates the level of trust of the network participant of being involved in a business process within the network. This is meaningful in situations in which the environment in characterized by uncertainty and therefore its base value is low.

Satisfaction. This indicates the potential benefits of the actual participants related to the intangible value of the network.

3.4.2 New BPM lifecycle

With reference to the SN4BPM architecture, the above KPIs may be qualitatively (and quantitatively, although with some very deep understanding of the environment) studied in the Rationalizing part of the life-cycle.

The first additional step of the rationalizing part would be to identify in the current Service Network Notation model the presence of the pattern described in section 3.1.1 and to analyze its value before and after applying the transformation proposed.

To perform this value analysis trust and satisfaction need to be expressed in some way. In this context we propose a general idea on how it is possible to express them and to predict their impact on the business processes, however each individual problem needs to be addressed in a different way, therefore this is not a task that can be completely automated.

Evaluating Trust. We have seen from the State of the Art that this parameter may be expressed in the form of an insurance value, however according to our experience this is more related to a reduction in risk, where the risk, may be expressed as the probability of not receiving value from the transaction. We call this probability function $risk_{ij}(t)$ that resembles the risk perceived by participant i in his interactions with j at time t. Since a high value means higher chances of not receiving value, it may be used as a damping parameter for the obtained value (and not the offered one), meaning that it becomes a factor of the revenue function of partner i and to the offerings function of partner j. For keeping the expressions as simple as possible we may still embed this value as an additional cost (insurance) that is proportional to the revenue, however the meaning and its contribution to the final value is always the same. In it important to note that all the partners involved in the process may have a different $risk_{ij}(t)$ function, therefore it is not possible to accurately predict opportunistic behaviors. This lack of possibility to predict is desirable since it avoids the occurrence of situations in which opportunistic behaviors are encouraged, and therefore it avoids the transformation of value-creating virtual circles to value-depleting vicious ones.

Evaluating Satisfaction. Satisfaction is an indicator that encloses all the potential value given from intangible interactions that are allowed by the environment, but that do not appear in the original network fragments. A possible, but not complete, list of value parameters is: the openness of the network to new value-creating collaborations (i.e., How easy is it for a new business partner to join the network? Do all the partners benefit from its contribution?); the increase in freedom for each partner (i.e., new entities are able to diversify the number of exported services); reputation and information flow (i.e., turning an unpredictable environment to a transparent environment). All these parameters may not be easily expressed as a number, therefore a qualitative study should be possible.

4 Case Study: A Car Sharing Company

This section shows how the transformation methodology proposed in section 3 may be applied to improve the service network of a Car Sharing Company. This section starts with an overview description of the car sharing system, its existing implementation in Milan and finally a possible idea on a network reconfiguration that is expected to increase the total value. The analysis has been performed using an existing value network analysis tool [4].

4.1 Car Sharing Overview

As the name suggests, the car sharing system is a system for motorized personal mobility that is alternative to traditional public/private transportation. The system is similar to a car rental system, with the difference that it is more affordable, has more pick-up/drop-off locations, sessions may have an arbitrary duration (from half a hour to several days), and the access to the service is completely automatic (no need of personal interactions or to fill paperwork before/after each session).

The expected goals and benefits are summarized as follows:

- Reduction in the number of cars in circulation (less traffic, less pollution, more parking slots);
- Reduction in the cost for occasional drivers;
- Remove the need for having a second car.

The typical way in which a traditional car sharing system works is based on three payments from the customers: an annual subscription fee, a cost per kilometer, and a cost per hour; what the customer obtains is the complete use of the car for the specified amount of time, kasko insurance, vehicle maintenance, and unlimited fuel.

4.2 Milan's Car Sharing Company as a Service Network

The car sharing network of Milan is composed of the following nodes:

- (many) *Customers*: the final users of the car sharing system and we often refer to them as the payers.
- (one) *Administrative center*: owns and coordinates the activities of the car sharing company.
- (many) *Maintenance centers*: provide maintenance to car sharing vehicles.
- (many) *Suppliers*: provide vehicles to the car sharing company.
- (many) *Reservation centers*: manage bookings (on-line and by phone).
- (many) *Garages*: provide pick-up and drop-off locations.
- (many) *Insurance centers*: provide insurances for car sharing vehicles.
- (one) *Public Administration*: supports the whole network providing financial eco-incentives.

Figure 5 and Table 1 show how the various nodes interact the one with the other in terms of objects to be transferred (called deliverables using Allee terminology). Each interaction involves two partners at the time, it is ordered in time, and its nature may be either tangible or intangible. We remind that tangible offerings are usually a contractually defined transfer of objects that produces some revenue, while an intangible offering reflects its value in the computation of the satisfaction index of the network.

4.2.1 Service Network Analysis

The network analysis using the ValueNetwork.com application [4] has pointed out that the ratio of tangible/intangible interactions is very biased toward tangible interactions, there is a weak tie stability of 0.25, and an average degree of separation of 0.14 for intangible interactions and 1.75 for tangible interactions.

The general meaning of these results is that the service network is able to create value almost only from tangible well-defined interactions. This may be a symptom of lack of trust among participants, so every interaction needs to be contractually defined.

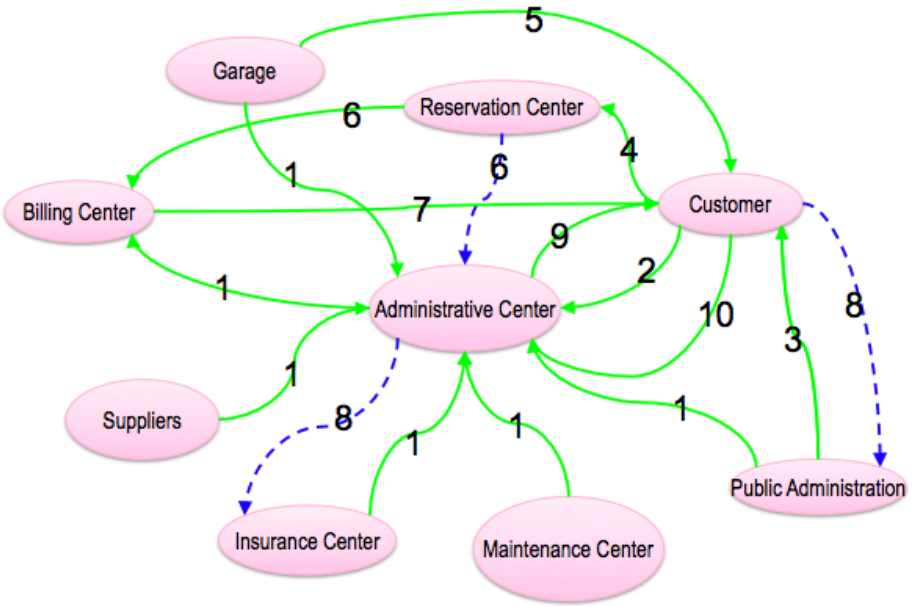

Figure 5: Service Network of Milan's Car Sharing System. Look at Table 1 for a detailed description of each interaction.

Table 1: Objects transferred between roles in Milan's Car Sharing Service Network.

Sequence	From Role	To Role	Deliverable	Nature of Deliverable
1	Administrative Center	Billing Center	Rates and Rules	Tangible
1	Garage	Administrative Center	Slots	Tangible
1	Insurance Center	Administrative Center	Insurance	Tangible
1	Maintenance Center	Administrative Center	Maintenance	Tangible
1	Public Administration	Administrative Center	Economic Incentives	Tangible
1	Suppliers	Administrative Center	Supplies	Tangible
2	Customer	Administrative Center	Subscription	Tangible
3	Public Administration	Customer	Economic Incentives	Tangible
3	Public Administration	Customer	Free Parking	Tangible
4	Customer	Reservation Center	Reservation	Tangible
5	Garage	Customer	Pickup/Dropdown	Tangible
6	Reservation Center	Administrative Center	Usage Knowledge	Intangible
6	Reservation Center	Billing Center	Reservation Information	Tangible
7	Billing Center	Customer	Invoice	Tangible
8	Administrative Center	Insurance Center	User Behavior Knowledge	Intangible
8	Customer	Public Administration	Ecologic Advantages	Intangible
9	Administrative Center	Customer	Controversy Management	Tangible
10	Customer	Administrative Center	Unsubscription	Tangible

4.2.2 Limitations of this Network

Milan's car sharing system is not taking over the transportation market, especially private transportation, because the customers simply do not have the feeling of being in their own car:

- Last minute reservations cannot be usually honored. This means that if a user has some unpredictable need, he may simply not get the car (it lowers satisfaction).
- Garages are a very limited resource, therefore many potential customers may not find a garage close by.
- Default insurance is always the most "secure" for the car sharing company, because it does not trust its customers, however not all the customers represent the same risk, making it possible to have a differentiated insurance offering.
- The "hourly+kilometer" cost system may not reflect the actual costs: it may be more convenient for occasional users, but very expensive for habitual users.

In addition to these problems, in order for a customer to take advantage of car sharing benefits, he is forced to sell his (second) car. A possible key for addressing these issues it to increase flexibility and put more realistic costs. Moreover customers may play an active role in the network by sharing their own cars at their conditions (instead of selling it and being forced to comply with the car sharing company conditions).

4.3 Adding Agility: Agile Car Sharing

A possible method to overcome the issues of the actual Milan's car sharing system is to perform the following changes to the network:

- Add a new type of users that acts as a car sharing provider (they simply share their own car).
- Remove from the administrative center the responsibility of finding suppliers, sharing cars, choosing garages, providing maintenance, insurances and so on: these responsibilities are transferred to the providers.
- Solve the uncertainty problem of the environment by adding a reputation management mechanism for all transactions that occur in the system: this will enable a knowledge transfer and an easier evaluation of risk.
- Administrative center becomes a pure coordinator (matchmaker) that provides subscription service, unsubscriptions, conflict-resolution, and possibly manages certifications and payments.

The final outcome of all of this is to have an offer that is more differentiated, in fact the final cost is likely to be proportional to the quality/risk ratio, the final user may have some cash back by sharing his second car, and private companies that have many unused vehicles may cooperate with other companies who need them. Another important characteristic is that not only the satisfaction indexes

of the customers increase, but also the new openness of the network enables the opportunity for easily replacing the coordinator (Car Sharing company), increases the chance of having roaming agreements among different companies, creates the possibily to have the service also in places that are not covered by local coordinators (since a coordinator may not have physical interactions with the customer, a coordinator may act globally), and finally - as soon as a critical mass of car sharing vehicles has been reached - it adds much more flexibility in choosing pick-up/drop-off time.

Nodes in the modified network will be:

- (many) *Car Providers*: customers who share a car.
- (many) *Car Users*: customers who use a shared car.
- (many) *Garages*: entities that provide parking slots to providers and users.
- (many) *Insurance centers*: provide personalized insurances to providers and users.
- (one) *Administrative center*: acts as broker between providers and users.
- (one) *Reputation center*: manages feedbacks and the flow of intangible information.
- (one) *Billing center*: manages invoices and payments.
- (many) *Reservation centers*: manage reservations (by phone or by email).
- (one) *Public Administration*: gives money to the administrative centers or to the user as eco-incentives.

As we have previously done previously figure 6 and table 2 show the various interactions among the entities of the network as well as their sequence order and their nature (tangible/intangible). What is first evident in the network diagram is that we have more roles, and a lower average of interactions for each role, meaning that complexity (and therefore the expected costs) at local level is lower. Another important thing is the heavy use of intangible offerings that is expected to overcome the low-satisfaction issues of the previous network.

The data produced by the ValueNetwork.com application shows a ratio of intangible/tangible interactions of 0.54:1 that is much close to 1 than the one of the previous network (0.19:1), moreover we have a higher weak tie stability (0.62) and an average degree of separation of intangibles increased to 1.11 (instead of 0.14 of the previous network). The considerations that come from these results are the following: coordination in the network is encouraged since it has more intangible value transfers (that means more trust) and there are more entities that can join the network and increase the variety of offered services; in addition, the presence of so much reputation information makes it possible to increase the flexibility (agility) of the network since each entity has more variables for taking decisions whether to stay or not in the network, so also the whole underlying business processes may be adapted and optimized according to them.

Table 2: Objects transferred between roles in the improved Agile Car Sharing Service Network.

Sequence	From Role	To Role	Deliverable	Nature of Deliverable
1	Administration Center	Insurance Center	Risk Information	Intangible
2	Car Provider	Administration Center	Subscribe	Tangible
3	Garage	Car Provider	Slot	Tangible
3	Insurance Center	Car Provider	Insurance	Tangible
3	Maintenance Center	Car Provider	Initial Equipment	Tangible
4	Car Provider	Administration Center	Car Information and rates	Tangible
5	Administration Center	Billing Center	Rate Information	Tangible
5	Administration Center	Car Provider	Certification	Intangible
5	Administration Center	Reservation Center	Car Information	Tangible
6	Car Provider	Reservation Center	Availability	Tangible
7	Car User	Administration Center	Subscribe	Tangible
8	Public Administration	Car User	Economic Incentives	Tangible
8	Public Administration	Car User	Free Parking	Tangible
9	Reputation Center	Car Provider	Reputation Information	Intangible
9	Reputation Center	Car User	Reputation Information	Intangible
10	Car User	Reservation Center	Car Request	Tangible
10	Reservation Center	Car Provider	Car Request	Tangible
11	Car Provider	Car User	Car	Tangible
11	Reservation Center	Billing Center	Reservation Information	Tangible
12	Car Provider	Car User	Reputation	Intangible
12	Car Provider	Reputation Center	Register Reputation	Tangible
12	Car User	Car Provider	Reputation	Intangible
12	Car User	Public Administration	Pollution Reduction	Intangible
12	Car User	Reputation Center	Register Reputation	Tangible
13	Car Provider	Car User	Collaboration	Intangible
13	Car User	Car Provider	Collaboration	Intangible
14	Billing Center	Car Provider	Invoice	Tangible
14	Billing Center	Car User	Invoice	Tangible
15	Maintenance Center	Car Provider	Equipment Maintenance	Tangible
16	Car Provider	Administration Center	Controversy Management	Tangible
16	Car User	Administration Center	Controversy Management	Tangible
17	Administration Center	Car Provider	Trust	Intangible
17	Billing Center	Administration Center	Billing Information	Tangible
17	Car Provider	Garage	Reputation	Intangible
17	Car Provider	Insurance Center	Reputation	Intangible
17	Car Provider	Maintenance Center	Reputation	Intangible
17	Reputation Center	Administration Center	Reputation Analysis	Intangible
18	Car Provider	Administration Center	Unsubscribe	Tangible
18	Car User	Administration Center	Unsubscribe	Tangible

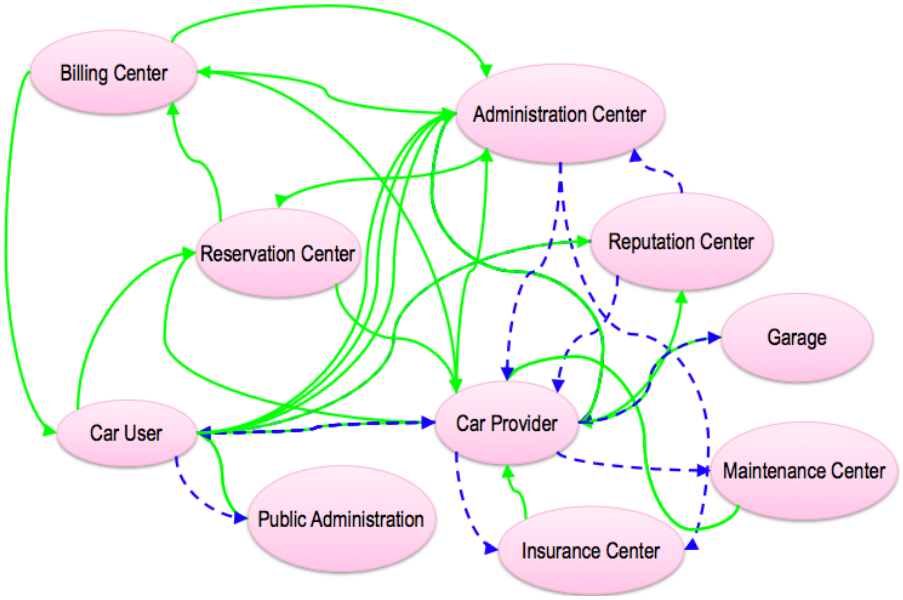

Figure 6: Service Network of improved Agile Car Sharing System. Look at Table 2 for a detailed description of each interaction.

5 Conclusions and Future Work

5.1 Conclusions

In this work we have provided an overview on the state of the art in Service Networks and particularly to Agile Service Networks. Based on this study we identified some characteristics that are commonly found in terms of network graph patterns. We have finally seen that such patterns may be directly transformed into new patterns with the aim of reducing the cost of the network, and to spread the dominance across other entities that may be also the customer themselves. This allows the creation of more information among the network and has obvious benefits in terms of competence transfer, trust, and overall satisfaction, which may be a dominant value outcome.

Last but not least we have proposed to integrate such methodology in the rationalization part of the SN4BPM architecture in order to take into account the reconfigurations we propose in the analysis phase and in the model generation phase of the BPM lifecycle. The approach we proposed has then been exemplified using a traditional car sharing scenario as a case study.

What we have learned from this experience is that increasing the knowledge flow of the service network using either the proposed methodology or also in different ways, helps the whole business system move to a more flexible and organized ecosystem-like system.

5.2 Future Work

Some possible follow-up work that may be based upon this research is to find additional patterns and examples for taking advantage of intangible service net-

work characteristics. Another important aspect that worths investigating is to identify new models for taking the decision whether to reconfigure the service network or not. Possible models offered by existing literature include Game Theory models as well as emergent social network analysis techniques. One of the other possible outcomes that may complete this work is to provide real measured results of the actual application of such technique in a real company.

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