University of Crete
School of Sciences and Engineering
Computer Science Department

Model Transformations to Leverage Service Networks and Implementation of Value Network Tool

by

GEORGIOS D. KOUTRAS

Master's Thesis

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Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

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A thesis submitted in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE

Author: ____

Geogios D. Koutras, Computer Science Department

Supervisory Committee:

____

Christos N. Nikolaou, Professor, Supervisor

____

Dimitrios Plexousakis, Professor, Member

____

Georgios Georgakopoulos, Associate Professor, Member

Approved by:

____

Panos Trahanias, Professor,
Chairman of the Graduate Studies Committee

Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

Abstract

The evolution of service systems has changed economic structure towards a service-oriented ecosystem combining social science and technology. Service systems form networks in which value is created and captured by their members. The rapid growth and the increased complexity of service systems raise many challenging issues in their design and improvement.

The current master thesis presents the work done to develop and validate a methodology for transforming a service network in abstract business process. It presents the transformation rules through which the transformation is achieved, the proposed transformation methodology and its application on a case study.

Also, it presents the value network tool, which provides a range of graph drawing functionality, visualization and interactions within value networks. This tool is organised into four main modules: the Graphical User Interface Module, the XML module, the Calculations module and the Business Process module.

Supervisor: Christos N. Nikolaou
Professor

Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

Περίληψη

Η εξέλιξη των συστημάτων υπηρεσιών άλλαξε την δομή του οικονομικού συστήματος προς ένα οικονομικό σύστημα προσανατολισμένο στις υπηρεσίες συνδυάζοντάς ανθρωπιστικές και τεχνολογικές επιστήμες. Τα οικονομικά συστήματα πλέον σχηματίζουν δίκτυα στα οποία οι συμμετέχοντες παράγουν και καταναλώνουν αξία. Η ταχεία ανάπτυξη και η αυξανόμενη πολυπλοκότητα τέτοιων συστημάτων εγείρει πολλά ενδιαφέροντα θέματα που αφορούν την σχεδίαση και την βελτίωσή τους.

Στην συγκεκριμένη μεταπτυχιακή εργασία παρουσιάζεται το έργο της ανάπτυξης και επιβεβαίωσης μίας μεθοδολογίας για τον μετασχηματισμό των αξιακών δικτύων σε αφηρημένες επιχειρηματικές διαδικασίες. Παρουσιάζονται λεπτομερώς οι προτεινόμενοι κανόνες μετασχηματισμού, η μεθοδολογία μετασχηματισμού, καθώς και η εφαρμογή αυτής σε ένα παράδειγμα.

Επίσης παρουσιάζεται και ένα εργαλείο που δίνει την δυνατότητα για την σχεδίαση, αναπαράσταση και διάδραση με γράφους τέτοιων δικτύων αξίας. Το εργαλείο αποτελείται από τέσσερα κύρια μέρη: Το μέρος της γραφικής διεπαφής χρήστη, το μέρος των μετασχηματισμών, το μέρος των υπολογισμών αξίας και τέλος το μέρος της διαχείρισης δεδομένων.

Επόπτης: Χρήστος Ν. Νικολάου
Καθηγητής

Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

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Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

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1. Introduction

One of the greatest challenges that the Service Value Networks (SVNs) research area faces today is the exploitation of Information Technology's (IT) facilities in order to understand, model, analyze and transform Service Value Networks. The main goal of these efforts is to explore the nature, flow and growth of value within a Service Value Network and develop appropriate methods for beneficially transforming SVNs and optimizing the produced value.

Since Michael Porter introduced the concept of value chains in [1], the way we think about value and value creation has changed. In the value chain, a product passes through various activities that can be performed by different roles and organizations and gains value. The total value that the chain adds to the product is greater than the sum of the values of each activity in the chain. Traditionally, the value chain was used to analyze the firm and its major competitors and to identify gaps between firm performance and a competitor's performance. Then the strategist could make and implement plans to fill these gaps [2]. On the other hand, the competitiveness among firms, especially Small and Medium Enterprises fighting for their share in the marketplace, created the need for coordination and cooperation among organizations [3]. As a result, the realities of the new 'network economy' require that we reconsider traditional methods for analyzing competitive environments. The old linear models do not take into account the nature of alliances, competitors and other members in business networks. This need for new approaches introduces the concept of Value Networks. According to the value network concept, value is co-created by a combination of players in the network. The healthiness of the network and the individual organizations that constitute it is equally important to each participant's own organization [4].

When it comes to services, there appear difficulties in understanding how value is created in the context of a network and how this value could be discovered and even increased. In the service industry the relations between suppliers, service providers and customers are even stronger indicating that the old models are not suitable for studying service ecosystems. Value Networks seem to be the most suitable solution to describe the appearing exchange of experience, knowledge, capabilities and connections [5]. Service Value Networks present the service as a value proposition and exhibit the interdependences between the involved actors as a flow of value – they comprise a value network whose outcome is a service.

In this work we will focus on the transformation rules that are introduced and how these lead in bridging the gap between SVNs and BPM. The main target is to be able to move from service provisioning to abstract business processes and the implementation of a tool (Value Network Tool) that is used in order to represent analyse and simulate SVNs. Different research groups have their own viewpoints on the subject that more or less indicate the diversity of study and analysis of SVNs.

The remainder of this work is organized as follows: In the next section we present Service Science Management and Engineering (SSME), how it is related to Service Value Networks, the different approaches on Service Value Network definitions and visualization concepts. All the previous are accompanied with the developed methodologies for modeling, analyzing and evaluating SVNs as well as the supporting tools. In the third section we present the transformation rules that are introduced and a methodology of transforming the SVN to a BPM. Also we apply this methodology to an example in order to describe the steps in detail and represent the whole procedure more clearly. In the fourth section we present the Value Network Tool and how it is implemented by describing the different modules that this tool consists of. Finally, in the last section we conclude and discuss the open problems and future challenges.

Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

2. Related Work

2.1 Service Science Management and Engineering (SSME)

Although the service sector is the most rapidly growing part of global economy - it accounts for more than 50 percent of almost all developed countries' economies [6], there is still not much research on services, service delivery and innovation. The need to come up with new systems that facilitate service and business activities in a service-led economy by combining existing knowledge on Information Technology, Social and Management Sciences according to a group of researchers in both academia and industry is leading to a new multidisciplinary Science of Services [6], [8]. Furthermore, Chesbrough and Spohrer observe that the main reasons for founding and studying the field of services based on the Information Technologies (IT) can be: the close interaction between suppliers and customers because of IT; the created and exchanged knowledge; the simultaneity of production and consumption; the combination of knowledge into useful systems; the exchange as processes and experience points; the exploitation of IT and transparency [9].

The term Service Science, Management and Engineering (SSME) was originally introduced by IBM. But the focus on services in academia goes back in the 1970s when business schools were establishing the service operations and service marketing concepts [10] as a distinct discipline. Today SSME is increasingly attracting the attention of academia and the industry due to the dramatic changes that service sector has been through over the past few years.

Information Technology has played a significant role in this transformation since the service sector is the primary user of IT products and services. Organizations have massively adopted Resource planning applications (ERP) in order to monitor and analyze critical operational information. At the same time Customer Relationship Management (CRM) solutions promise to allow businesses to feel the pulse of the market and provide better services to the customers [5]. The emergence of Internet, Web Services and Service Oriented Architectures has come to add much more to the contribution of IT. From a customers' perspective one can be well-informed about the existing products and make the best choice for value according to their needs. On the other hand, from a business' perspective the opportunity for coordination and collaboration among organizations was dramatically changed since the regional constraints seem to wash out and it is of no surprise that these changes have clearly reflected the world economy.

A key concept in the field of Service Science, Management and Engineering is the Service System. The definition of Service Systems as presented in [8], [11], [12], [13] is that 'Service systems are dynamic configurations of resources (people, technology, organizations and shared information) that can create and deliver service while balancing risk-taking and value co-creation. Service Systems are complex adaptive systems that can interact with or even contain other service systems. This interaction is performed via value propositions, which may form stable relationships in extended value chains or networks [8].

Even from this view of Service Systems as networks of resources working together to co-produce value, we can detect a connection between Service Value Networks (SVNs) and SSME. In [12] it is stated that the terms 'Management and Engineering' in SSME stand for the need to understand service systems' improvements or failures to improve and then be able to design service systems that improve. This could be accomplished by applying Value Networks' analysis methodologies in order to model and analyze Service Systems. The white paper on Service Science, Management and Engineering that the University of Cambridge published in 2008 also notes that Service Value Networks are the tool to analyze service systems for robustness, sustainability, and other properties [8].

2.2 DEFINING A VALUE NETWORK

Before we discuss the Value Networks' methodologies that have been developed and applied in several case studies, we need to know exactly what a Value Network is, and how it can be formally defined. Although there exist several definitions of Value Networks and some of them seem to differ significantly, all researchers accept as a common objective for value networks, the optimization or at least improvement of its value. The variances that one can notice in the modelling and analysis approaches presented in the next sections, can be easily accredited to the lack of unanimity in a theoretical level. At this point we will focus on definitions that refer to both Value Networks and Service Value Networks. In addition to the fact that SVNs can be viewed as a subset of Value Networks, a group of researchers bear the claim that the distinction between services and products is not so clear. Everything can be seen a service, in the sense that a product is the vehicle for service delivery [5].

Back in 1993, Normann and Ramirez claimed that in today's environment, the focus should now be on the value-creation system itself [14]. A supplier should not perceive value as what he achieves in his own business, but as what he helps the customer to achieve. The article that introduced this Normann and Ramirez' idea was seminal for the Value Network model to emerge.

In [15], Christensen defines a value network as a set of suppliers, distributors and ancillary providers that support a common business model within an industry. A would-be disruptor that joins an existing Value Network cannot succeed because he must adapt his business model to conform to the value network and therefore he will become co-opted. Such disruptors can though have better chances of success when they form their own value network that differs from the original not necessarily in the target group, but in the strategic partners (suppliers, distributors).

Over the past few years, much work on the Value Net-works area has been done by Verna Allee. Her definition for a Value Network is the following: 'A value network is any web of relationships that generates both tangible and intangible value through complex dynamic exchanges between two or more individuals, groups or organizations. Any organization or group of organizations engaged in both tangible and intangible exchanges can be viewed as a value network, whether private industry, government or public sector' [16]. In this definition, tangible exchanges are those which involve products, services and revenue. Tangible exchanges can include contracts, physical goods, confirmations and even knowledge services that come in exchange with revenues. The intangibles are considered to be exchanges of knowledge and benefits that help build relationships, but are not contractual. These can be an exchange of know-how, collaborative design work, research etc.

An approach by J. Hamilton that refers to Service Value Networks, defines them as 'the flexible, dynamic, delivery of a service, or product, by a business's coordinated value chains (supply chains and demand chains working in harmony), such that a value-adding, specific, service solution is effectively, and efficiently, delivered to the individual customer' [17]. Observe here, that Hamilton in this definition adopts the aforementioned arguments about services and products.

2.3 MODELING A VALUE NETWORK

Sensing the delivery and exchange of service value is an essential step in analyzing and evaluating Service Value Networks. Since we talk about networks there is a need that all participants have a common understanding of how service is delivered. Conceiving a conceptual model of Value Networks is an easy way to achieve this task [18]. There are several conceptual models used to model SVNs.

Verna Allee's approach on the subject is called HoloMapping™ and is based on three basic elements [16]. The Value network is represented by a graph. The nodes of the network represent the participants, which can be individuals or groups of people who carry out specific roles. Participants must be able to make their own decisions about what activities to carry out in the network, so they can only be humans. The second element is the actual transactions or activities the actors are involved in. Each activity is represented by an arrow, which signifies the direction of the activity that takes place between two participants. Note that two-headed arrows are not allowed here, because such arrows only show that there is some kind of relation and do not tell what the activity is, who generates it and who the recipient is. Lastly, deliverables are the resources that are passed through from one participant to another. Deliverables, according to Verna Allee's approach, can either be tangibles or intangibles as described in the previous section.

In Gordijn and Akkermans' e3value™, another model of Service Value Networks is presented [19]. The e3value model provides an economic, value-oriented ontology to conceptualize and to visualize a Value Network. The ontology consists of the following concepts: an actor is an independent economic entity that participates in the network and undertakes several activities in order to gain some profit, while a market segment incorporates a set of actors that have common properties. Actors exchange value objects of a certain value through value ports, which are grouped in a value interface. Value exchange is used to represent one or more potential trade of value objects between actors and a set of such exchanges is described by a value offering. Lastly, a value is the actual action an actor performs to gain profit and increase its utility. Apart from the ontology's concepts, the e3value methodology adopts the Use Case Maps (UCM) to visually describe the organizational structure of the Value Network. UCMs are composed of scenario paths, stimuli, segments and connections. A scenario path has one or more segments related by connection elements. The first and the last segments of a scenario path are connected to a start and an end stimulus. The model that e3value proposes has been extensively discussed in [19]. Due to the great detail that the e3value™ model goes into, it is easier for someone to describe rather small Value Networks. An attempt to apply this method in an SVN with a large number of actors, activities and value exchanges could possibly complicate the modeling process. Finally, it is assumed here that every incoming port of an actor should also have its corresponding outgoing port, which is not always the case. As an example consider a travel agency that receives offers from both airline companies and hotels and then provides travel packages to its customers. In order to model this according to e3value™'s proposition, one should add to the network value objects that do not exist in reality only because every incoming port must also have an outgoing.

2.4 ANALYZING A VALUE NETWORK

As the theoretical background and the various Value Network models have been already described we will now discuss the frameworks in the context of which these models are applied. We present three different approaches: ValueNet Works™ - a methodology developed by Verna Allee; e3value™'s approach; the approach proposed by Caswell et al (reference). For each one of these we show how the Value Network analysis and the transformations are performed and also introduce the tools that facilitate the overall process.

2.4.1 ValueNet Works™

As already discussed in Section 4, according to Verna Allee every relationship between two participants of a value network, involves not only contractual, but also informal exchanges of intangible assets such as knowledge and benefits. The first arising question here is whether one can manage to convert these intangible assets into something quantifiable. ValueNet Works™ analysis [21] is a methodology that faces this challenge by analyzing the dynamics of value in value networks at the operational, tactical, and strategic level. In the end the participants of the value network will strengthen their relationships and improve their value-creating linkages with each other.

Mapping both tangible and intangible exchanges is the first step of the approach, which leads to a diagrammatic view of the value network. The HoloMapping ™ technique is used for this purpose as we described in section 4. Participants or Roles, Transactions and Deliverables are the core elements of this technique. The roles are the nodes of the value network, while the transactions indicate which deliverables are exchanged from one role to another. A different color is also used on the transactions to distinguish the tangible from the intangible exchanges.

Since the value network is well identified, one can analyze it based on three basic enquiries. The first one is associated with the patterns of exchange of the whole network, which leads us to exchange analysis. In the second case all value inputs and outputs of each role is taken into consideration, in order to realize the effects they impose on each one of them – Impact Analysis. The last enquiry concentrates on the process of adding and extending value or even converting it – Value Creation Analysis.

During the exchange analysis, several key points that are examined are the logic flow of the value that passes through the network, the healthy number of both tangible and intangible transactions – meaning that none of the two types of exchanges must be more dominant from the other and whether one role is benefiting in the expense of other roles. Much useful information will emerge from the exchange analysis such as network bottlenecks and imbalances (missing links or relationships). Next is the impact analysis that shows whether one role can convert his tangible or intangible inputs into assets that lead to real benefit and success. This is achieved through a set of calculation spreadsheets. Depending on whether the impact will be evaluated for only the role or for how value is passed through the network as a whole, the spreadsheet is created by listing the transactions and the key impact categories. For each transaction an expanded cost benefit analysis is being conducted which detects the overall cost/benefit and several other performance indicators such as to what extend is value being realized from the recipient's viewpoint. Another analysis that is being conducted is value creation analysis, which also takes place in the level of the role. The specific analysis examines the way each role adds value to the network. The background idea of this analysis is that when a role receives some input (deliverable), he must find a way to produce some greater value to the product or service. Compared to impact analysis, value creation analysis is also an expanded cost/benefit analysis but is based on the role's outputs. There are five different dimensions results derived from this analysis. Asset utilization is the first one, which indicates how healthy does one role create each output with the use of tangible and intangible assets. The second dimension is value conversion, showing the way one can convert one type of an input to another one. For example if a participant receives an intangible knowledge deliverable, he may extend the value of the network by making it available to other participants. The third dimension is associated to some value enhancements a participant is capable of creating or adding to a specific deliverable. The fourth one examines the perceived value of a specific output from the recipient's point of view, while the last one -social value- shows the value of the output in the context of society. In the end of the analysis participants should be able to identify high value activities and evaluate them from a cost/benefit perspective.

GenIsis™ [22] is a tool that supports ValueNet Works™ analysis. It is developed for creating visualizations and analyzing internal and external value creating networks. It is also capable of designing, simulating, and evaluating complex interdependent processes and knowledge flows. At this point, GenIsis™ is not in production mode. Verna Allee and her team are currently working on a new tool based on the GenIsis™ concept [23]. Due to the fact that GenIsis™ is a commercial product only a demo version of this tool was available to work on, so there is not a full perception of its full capabilities.

2.4.2 e3value™ approach

This method is originally proposed as a requirements engineering framework for designing e-services. It consists of three concrete viewpoints on the service that are especially designed for the different stakeholders (e.g. CEO, CIO, marketers, operational management, IT department) that participate in the service development process. In this work we discuss the value viewpoint, which aims to facilitate people that explore the service idea and comprises e3value's approach for analyzing and evaluating Service Value Networks. The methodology produces three descriptions of the service: The value hierarchy that identifies the end-consumer need and decomposes it to services of known value to be produced by business actors; the value exchange graph which uses e3value™'s Service Value Networks model (see Section 4) and can be seen as a discussion object; the profitability sheets that quantify the value exchanges for each actor involved [24].

The value hierarchy is a rooted acyclic directed graph whose root represents the service that the end consumer receives. Once a consumer need is known we start to decompose it to value objects that will satisfy this need – the other nodes of the graph – where a value object is defined to be a good or service of economic value to some actor. The edges of the graph represent a "contributes-to" relationship. If all children value objects are needed for the higher-level value object to be produced, we denote this with an AND node. If only one child is needed an OR node should be used. When we know that a certain value object can be produced by some actors against known expenses we do not decompose this value object any further. Such value objects are the leaves of the value hierarchy. We should note that value hierarchies are inspired from goal hierarchies. The main difference is that in value hierarchies the nodes represent value objects whereas in goal hierarchies they represent goals to be achieved.

The value exchange graph indicates which actors are involved in the creation and exchange of value objects and in the context of which activities. Value objects in the value exchange graph match those in the already generated value hierarchy. The model used to describe such an exchange graph is the e3value™ model presented in the previous section. Each value object shown in the value hierarchy is an input or output to a value activity of the model and the "consists-of" relationships indicate a value activity in the exchange graph. The value exchange graph serves not only as a discussion object that represents visually the network but also can be used to facilitate the generation of profit estimations for the involved actors.

These profit estimations are summarized in profitability sheets. To come up with these sheets we need to define a number of value exchanges over a certain period of time, meaning that a scenario-based approach has been adopted. The process starts from the consumer need (start stimulus) and follows all connections that denote value exchanges. When a specific value object is being exchanged, the profitability sheet gets updated. The algorithm proceeds similarly until all end stimuli are visited. In the profitability sheet objects other than fees (goods, services, intangibles etc) are represented in parenthesis because they are not considered in profitability analysis.

Once the so far described analysis is completed, the re-maining task is to examine if the network can be transformed to increase profit of the involved actors. In [25] the authors define some transformation rules –called 'model deconstruction operators'- that can be applied for this goal to be achieved. The business model is being deconstructed and then reconstructed following those rules and new profitability sheets are then calculated. During the evaluation process we examine which model is capable of providing profit or increasing the economic utility of all actors and try to locate the weak and strong points of the models [26]. Finally, the model that is evaluated to be the most suitable is being adopted.

The e3value™ framework provides a supporting tool that can be used in order to model a Value Network, assign its parameters and calculate the profitability sheets in an automatic way. The e3editor [27] provides a convenient graphical user interface in order to design a value model. The user can insert actors, value objects, value exchanges and activities as defined in the e3value™ model and come up with the value exchange graph. Then, several parameters such as occurrences and valuation can be assigned to the activities and the tool can automatically generate the profitability sheets. These are saved in Microsoft™ Excel format. An interesting feature of the tool is that the user is able to describe his model in an RDF file using the e3value™ provided ontology and then import it in the tool. This will generate the visualized network -value exchange graph- on which further analysis can be made.

3. Transforming Service Value Networks into Business Processes

In this chapter we are focusing on the work of defining transformation rules. This set of rules provides us the ability to transform automatically Service Value Networks into Business Processes. This is important for any organisation since it will create a flow of information valuable for the organisation between business analysts and IT departments.

3.1 Transformation approach Exemplified/Explored

This section presents our pattern-based approach for constructing abstract business process models from a SN model. This approach is partly based on related patterns in e-Business, e.g., Service Interaction Patterns (SIPs) [30], web-service technologies, e.g., Message Exchange Patterns (MEPs), and approaches and technologies in Model Driven Architecture (MDA) ([31]).

We present the meta-models of SNs and business processes that uniquely describe the objects, attributes and relationships necessary to represent the concepts of SNs and business processes (see Fig. 4). The meta-model for SN has three main building blocks which are the Service Network, the Participant and the Relation (for more details see Ref. [32]). The meta-model for business processes is adapted to include only those elements that are needed for our methodology. In Fig. 1, we show using the dotted lines connections the correspondence of the elements of the SN meta-model to those of BPMN. In the subsequent sections we introduce the transformation patterns and the methodology that accomplishes this transformation.

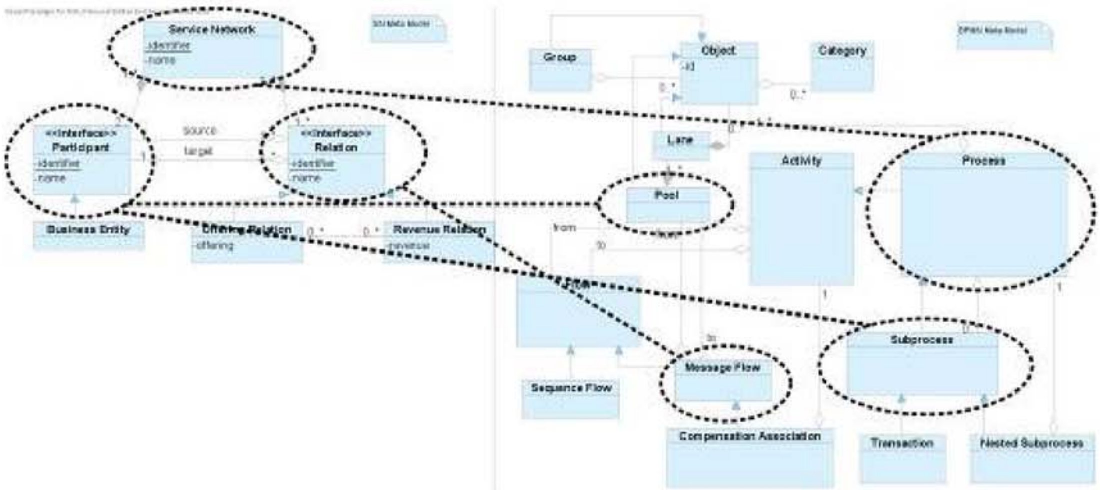

Figure 1: Service Network meta-model to BPMN meta-model

3.1.1 Transformation Patterns

A transformation pattern defines reusable and generic mappings from a service value model to a business process model. These patterns are described just like any other pattern (e.g., design pattern), capturing its goal, summary, motivation, examples, and related patterns. We may discern between two basic types of transformation patterns.

First, the "Service Provider - Client" transformation pattern is defined between two partners in the SN. This transformation pattern maps a unidirectional relationship between two partners in the SN onto abstract message exchange (AMEPs) patterns, and uniquely transforms the partners into two correlated "pools" in the BPMN model. The AMEPs list fundamental message exchange patterns, out of which the most suitable one can be selected and customized by the development team. Predefined AMEPs include the request/reply message exchange pattern, the notification pattern and the optional reply pattern. The Service-Provider-Client transformation function SPC, takes a consumer-provider pair (C,P) as an input, resulting in a customer and provider pool, and a set of abstract message exchange patterns (AMEP), where AMEP={request/response, notification, optional response}.

The process developer may choose from the list of AMEPs, that AMEP that fits best with the desired business practices, after which he may annotate the messages with semantically meaningful business labels. For example, a request message issued by a consumer to a Telco provider may be named "requestTelCoSubscription".

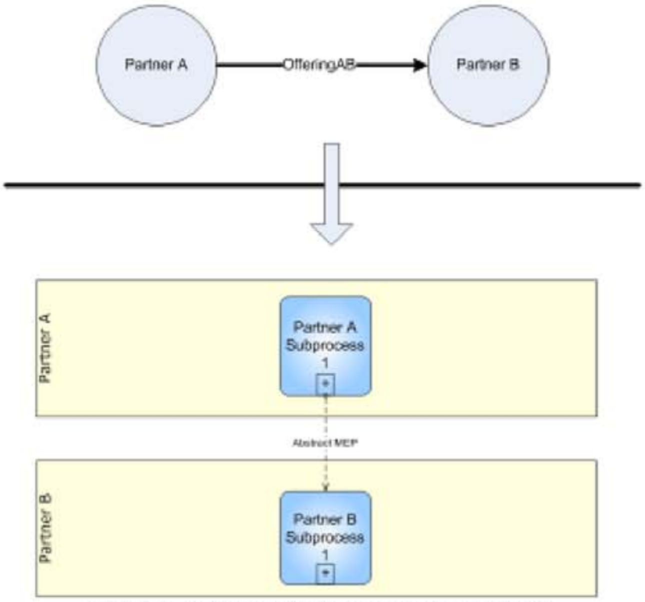

Figure 2: Transformation pattern 1

Second, the "service composition" transformation pattern is defined by a partner who performs processes internally. The partner receives input service offerings, makes the required transformations internally and provides output service offerings. This transformation pattern maps a partner to an orchestration that includes sequencing as shown in Fig 3. The service composition transformation function takes as input an SN node, its input service offerings and its output service offerings and generates an orchestration.

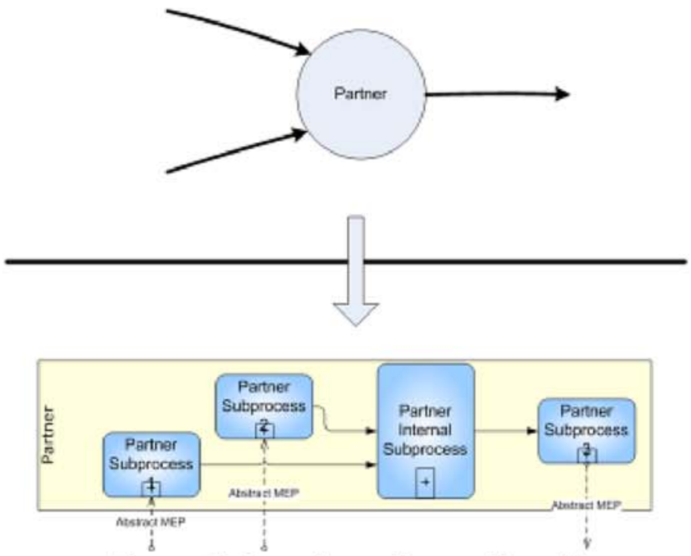

Figure 3: Transformation pattern 2

3.1.2 Transformation Approach

In this section, we propose a methodology to transform a SVN into Abstract Business Process (ABP). In this point, we have to mention that when we are talking about Abstract Business Process we mean Business Process that are formatted with information that does not make them executable and that in order to be executed we need more information. We assume that this methodology is semi-automatic since human interaction is needed to provide information throughout the procedure. For example, the business process engineer provides information about the type of the interaction the two created subprocess have from a library of Abstract Message Exchange Patterns (AMEPs). We also consider a repository of AMEPs which contains AMEPs like Notification and Request/Response.

There may be business cases where the offering of services is being made on behalf of other partners in the SN. Examples of these offerings include the Amazon, Federal Express, and the Call Center, Service Provider cases. In the Amazon example, a customer contacts Amazon in order to purchase a book. Amazon contacts Federal Express to deliver the book to the customer. In this example the Amazon offers a service (book) to the customer, the Federal Express offers a service to the Amazon (book delivery) and a service to the customer on behalf of Amazon.

In the above cases there is a "Service Facilitator" partner SF (in the Amazon example this partner would be the Federal Express) who helps the "main" Service Provider/partner SP (Amazon.com in the Amazon example) to offer the service (S) (delivering a purchased book to the customer's premises) to the customer C (in other words: the Service Facilitator SF interacts with the Customer C "on behalf" of the Service Provider SP). Customer node C is directly connected (in the Amazon example through the service offering "delivery of purchased book") to Service Provider node B in the SN graph, but we observe that in addition there is also interaction between the Service Facilitator node A and the customer C (in the Amazon example the Federal Reserve delivers the book). Therefore when we transform the SN into a BPMN we also have to capture the message exchange pattern of this additional interaction between the Service Facilitator participant and the Customer participant.

In general, the "on behalf of" function defines linked relationships between multiple partners, and is computed as a transitive relation between the beginning SF ("Service Facilitator") and end node C ("Customer") of a cohesive path of nodes. This path of nodes is comprised of a series of directed service offerings that are traversed during the execution of a particular business transaction, e.g., delivery of package (see Fig. 2). The chain is formally grounded on contracts or agreements between partners; for example, an international courier (SF1) could be subcontracting a national courier (SF2) for the local delivery of goods). Formally, we define the "on behalf of" function as follows:

Definition-1: The OnBehalfOf function takes as argument a path of connected nodes starting from a Service Facilitator (SF1), followed by intermediary Service Facilitators (SFi, i = 2, …,K) , followed by a Service Provider (SP) and ending in a Customer (C) (SFK→…→SF2→SF1→SP→C). It returns the OnBehalfOf relationship that connects a pair of nodes. In this pair of nodes the first is the SF1 node and the second is the customer node (SFK→C).

As stated above, the SN describes all business partners and their relationships. Each relationship may be an offering (good or service) or revenue. There are also OnBehalfOf relationships that represent a composition of services through the OnBehalfOf function. For example the relationship of the SF1 and C is an OnBehalfOf relationship that appears because all services through the path SFK→…→SF2→SF1→SP→C are provided. Applying the OnBehalfOf function to a SN, we obtain the enhanced SN (ESN) in which all OnBehalfOf relationships are included. For example, in Fig. 2, OnBehalfOf(SF2, SF1, SP, C) results in (SF2, C). We will use the ESN representation, in order to transform the service network into abstract business processes.

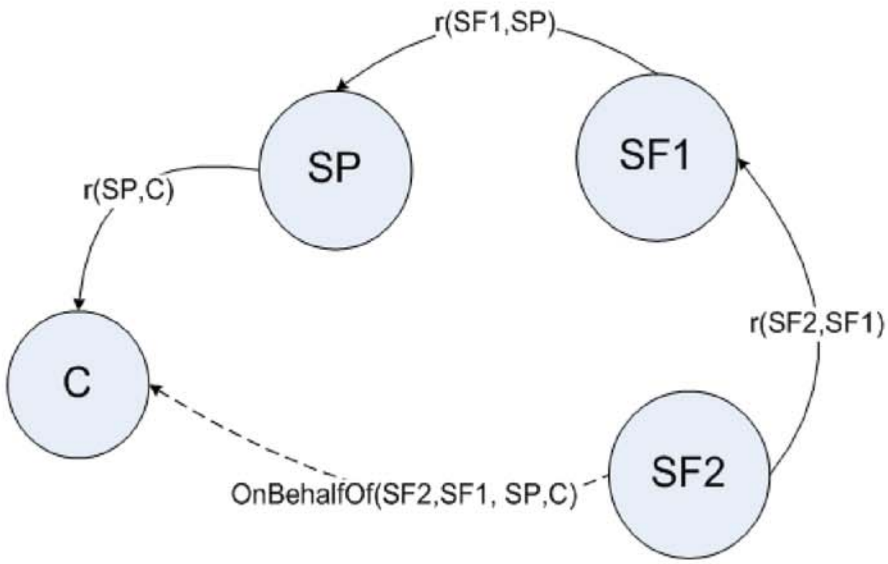

Fig. 3. A part from a SN that shows an OnBehalfOf relation resulted from relations r(SF2,SF1), r(SF1,SP) and r(SP, C).

An abstract business process is a constrained ordering of messages that may trigger activities, which involve two or more actors. Actors can be internal or external to an organization. Activities (also referred to as "sub-processes) in a abstract business process consume inputs and produce outputs, which are usually information entities. Abstract business processes can be defined recursively, and can be composite in nature.

In order to perform the transformation, we need first to include all OnBehalfOf relations and build the ESN. The ESN will then be transformed into ABPM according to the following algorithm.

Step 1: Carve out partners and relationships from an ESN Model.
In this step, the business process engineer carves out fragments of the SN model that are candidates for transformation. Extraction of fragments is based on cohesiveness criteria, including partner-relationship cohesiveness.

Step 2: Choose/Customize pattern
In this step, the business process engineer chooses the appropriate AMEPs from the repository. For example, in Fig. 4 there are two AMEP choices (Request/Response and Notification AMEPs) that the business process engineer can use to connect "Partner Subprocess 1" and "Partner Subprocess 2".

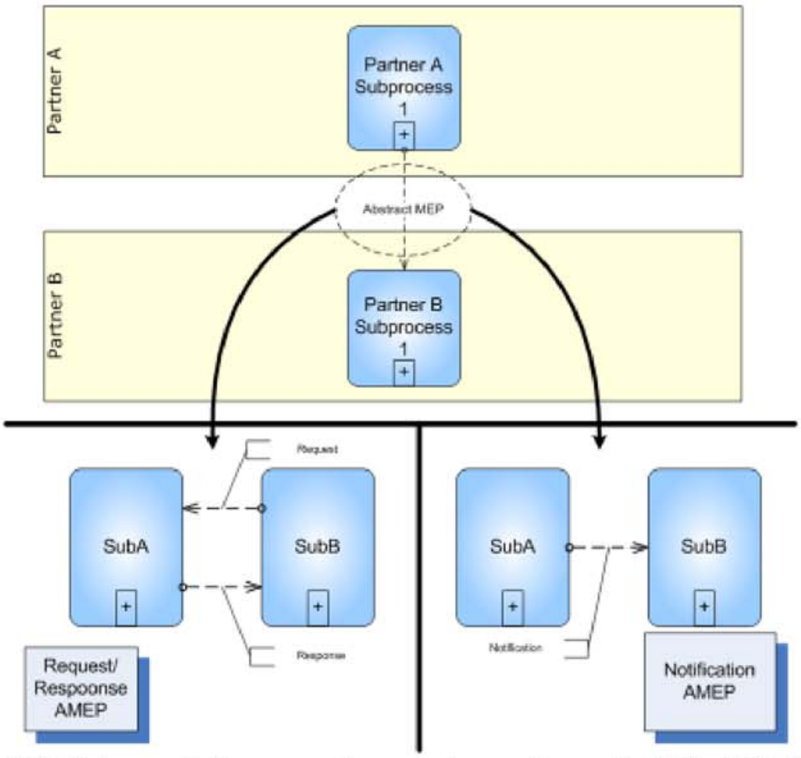

Fig. 4. An AMEP is sent from partner A to partner B. This AMEP is chosen from the repository containing two specific AMEPs.

Step 3: Perform transformation (automatically)
In this step, there is an algorithm that automatically performs the transformation based on the choices that the business process engineer made in step 2.

The following pseudo-code algorithm defines the transformation function “transform”, that takes as input an ESN. It applies the “ transform_pattern1 function” in each relation between two economic entities and the ‘transformation_pattern2” function in each business entity. It results in an ABPM model.

```
transform(eSVN){
        SVNproc=create_new_process();
        while(there is a Relation not transformed){
                transform_pattern1(Business_Entity1,
                Business_Entity2, amep_type, SVNproc);
        }
        while(there is a Business Entity not transformed){
                transform_pattern2(Business_Entity, SVNproc);
        }
```

The “transform_pattern1 function” takes a pair of business entities, the type of the AMEP the business process engineer had chosen in the previous step and the process that was created for this SN as input. When this function is executed it creates a new pool for every Business Entity and two subrocesses each internal to each Busienss Entity. At the end it connects these two sub-processes that belong to different pools with the appropriate message exchanges that are defined for this type of abstract MEP in the repository.

```
  transform_pattern1(Business_Entity1,       Business_Entity2,
  amep_type, SVNproc){
       BE1_sub=create_new_Pool_Subprocess(Business_Entity1
       , SVNproc);
       BE2_sub=create_new_Pool_subprocess(Business_Entity2,
       SVNproc);
       create_new_amep(BE1_sub, BE2_sub, amep_type);
}
```

Note that within a specific pool, all input subprocesses and all output subprocesses can be executed in parallel. Also every time a subprocess is added into a pool, it is added into the input_BE_subs array or output_BE_subs array whether it is an input or output subprocess respectively.

The transform_pattern2 function has as input the Business_Entity that will be transformed into a pool, and also the SN process (SNproc) that this pool belongs to. Tranform_pattern2 creates a new sub-process in Business_Entity’s pool which has the name BE_int_sub. Function create_new_seq_flow then creates a sequence flow that has the following semantics: control passes to internal subprocesses when at least one of the input subprocesses is ready to pass control. When the internal subprocess finishes its execution it passes the control to at least one output subprocess.

```
transform_pattern2(Business_Entity, SNproc){
        BE_int_sub=create_new_internal_subprocess(Business_
        Entity, SNproc);
        create_new_seq_flow(input_BE_subs[],        BE_int_sub,
        output_BE_subs[]);
`
```

Step 4: Check and enrich transformation ABPM
In this step, the business process engineer checks if the produced AMEPs reflect the real MEPs and enriches these with detailed and accurate information. Actually he names the exact message exchange flows with the appropriate semantic information that shows its functionality.

Step 5: Integration
In this step the business process engineer is integrating the transformed parts and creates the ABPs to form the complete transformation of the original SN.

3.1.3 Application of Transformation patterns

In order to demonstrate the feasibility of the suggested approach, we now introduce a simple motivating example that revolves around a realistic customer order handling process in an international telecom company, entitled IntTelCo (ITC) which delivers high-quality telephone, Internet and broadcasting services and products.

The customer order process not only facilitates subscription of customers to new services (e.g., new wireless or Internet services), but also cancellations and reconfigurations of existing services. As such, this process lies at the heart of customer relationship- and sales processes of ITC, while its operation is contingent on several other processes and systems, in particular the fulfillment of sales orders (e.g. relying on Siebel) and configuration of underlying provisioning (network) systems (e.g., using MetaSolv).

In the following, we will outline the SN model rendering the IntTelCo network of service providers and customers. The order handling process is kicked off after receipt of a customer order request by one of ITC's call centers. Next, the order request is checked for completeness and accuracy, e.g., the address and zip code are verified, and subsequently forwarded to the account manager. In case the customer order request relates to an existing subscriber or order, the accompanying order and subscription information are looked up and validated. In case of a new customer however, customer information is collected and scanned to ascertain he is not on a “black list”, and a new customer account is created. Thereafter, a list of telecom services is generated on the fly, containing only those services that are feasible given the speed of upstream and downstream transmissions of the specified address. The subscriber can then choose a particular (set of) service offering(s) from this dynamically produced product catalogue. Once the choice has been made, two activities are performed in parallel; firstly, the subscriber order is created, and secondly the product or service is billed to the subscriber, which automatically generates a corresponding general ledger posting. The subscriber order process terminates with issuing the order notification and invoice to the subscriber.

In Figure 6, we provide a representation of a part of the service network, showing the relationships created among the subscriber, the call center and the service provider. The economic entities are represented by circles and offering flows are represented through arcs. There are two types of offerings: services and revenues. In the representation of Fig. 6 we omit the revenues arcs for simplicity reasons. We consider a new subscriber that contacts the call centre in order to get information about the available services. There are two possibilities that may take place. Either the subscriber accepts the offering of a new service (for example a digital subscriber line service) or he denies the offering and terminates the communication. In the first case the call centre handles the order and after the procedure is fulfilled, the service provider offers the service to the subscriber. The order handling procedure involves many other partners of the network that are not shown in Fig. 6 since we want to focus on how the transformation of a part of the network to abstract business processes is performed rather than describing in full detail the whole network.

In this example, there is an OnBehalfOf relation between the call centre and the subscriber, The call center performs order handling for the subscriber on behalf of the service provider. This relation is not shown in the graph since it does not create value (the subscriber pays the service provider and the service provider pays the call center). Nevertheless, we need to include this relationship in the SN and create the Enhanced Service Network (ESN) because this is needed in the procedure of transforming the SN to ABPM.

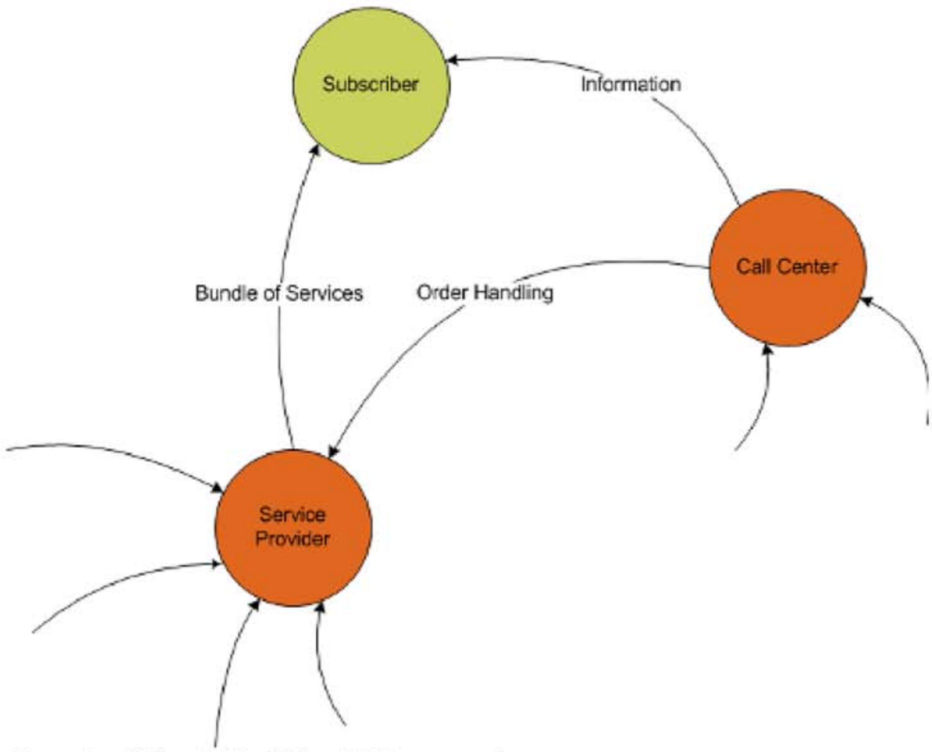

Fig. 5. A part of the SN of the ITC example.

So now, we apply the proposed methodology to the InfoTelCo example.
In the SN of Fig. 3, we add the OnBehalfOf relation between the call center and the subscriber. We use this ESN to perform its transformation to ABPM.

Step 1: We select the offering relations between the service provider and the subscriber (Bundle of Services), the call center and the subscriber (Information), the Call Center and the service provider (Order Handling) and call center and the subscriber (OnBehalfOf).

Step 2: We assign as abstract MEP, for simplicity for all the relations the notification MEP, although in reality these will probably be different MEPs.

Step 3: We apply the algorithm we have described in the previous section and obtain the ABPM model shown in Fig.6. Observe that this figure shows that there are other message exchanges that connect the existing partners with others not included in our simplified scenario.

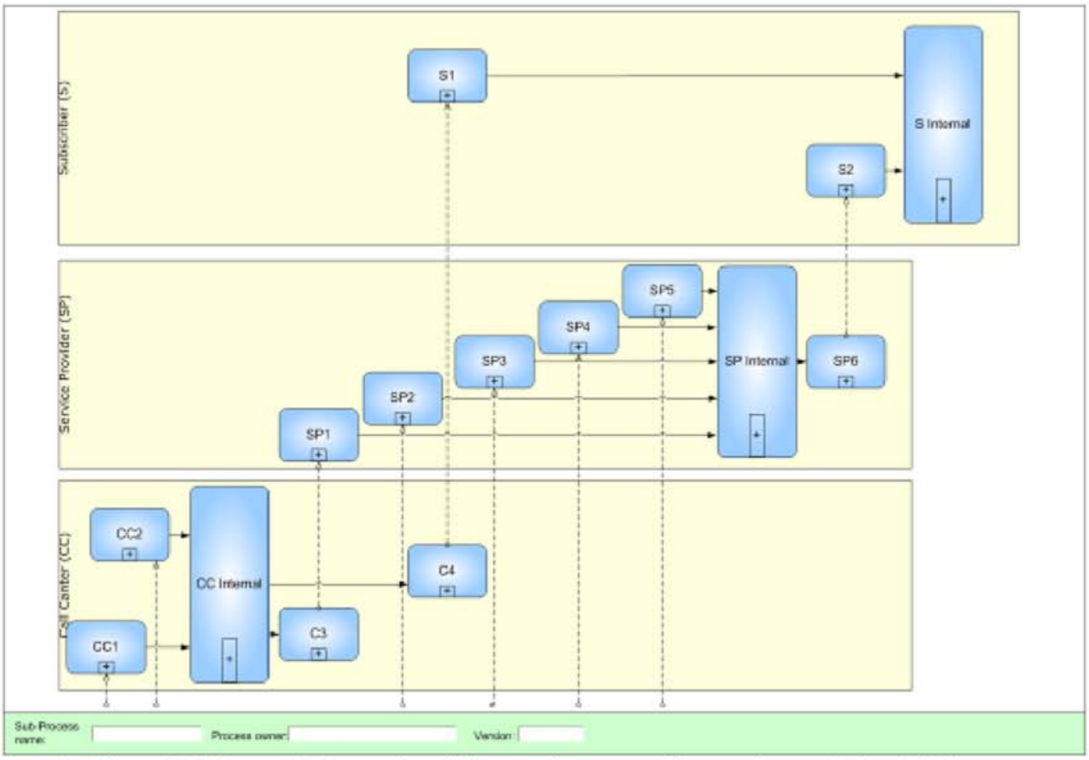

Fig. 6. The ABPM model resulted from the transformation of the ESN.

Step 4: We add on every message the label of "Notification". We assume that all the messages that are exchanged between the sub processes are of notification type, so we label the interactions with Notification.

Step 5: In this example we have taken a part of the complete SN so there is no integration to be done.

4. Value Network Tool

In order to be able to visualize and describe interactions within value networks we implemented the Value Network Tool (VNT), which provides a range of drawing functionalities.

The Value Network Tool provides an approach to calculate value for every participant or the total value of the network. The benefits of understanding value networks are to determine which members are effective or not, how values change, how value networks evolve in the future, how value networks may be replaced by other value networks that are perceived as more competitive, how to quickly react to market changes, how to improve networks competitiveness, how do companies in a value network decide whether or not to accept a newcomer and how a company decides which network to join. These benefits are key questions that strategists, planners and information technology professionals have to answer on a continuous basis today.

The implementation started as four undergraduate theses in Computer Science Department of University of Crete. The author of this work was the coordinator of the whole effort.

4.1 GUI Module

The VNT creates a visual representation of a value network. The VNT uses shapes as circles, rectangles and arrows. Circles represent the business entities, rectangles are introduced in order to support future expansion for nested SVNs and arrows depict business connection between two participants. Also, it supports standard editing functions such as cut, copy, paste and delete, drag and drop operations for drawing components and ordinary zoom functions. The user is able to place and move components inside the editor to have a better positioning, edit the size and the label of each component displayed, undo and redo actions, group and ungroup components and finally save and open value networks.

The tool provides the capability of printing the value network that has been created. The user is free to determine the printer that he wants to use, allowing him at the same time to modify the printed network or part of it in the way he desires. VNT can also export the drawn Value Network in other formats such as pdf, PostScript etc.

The results are exported in a standard xml file, which obeys in specific models and international standards (see 4.2 Section). In this way it can portray value networks that have not been created with VNT. This is very useful, especially in cases of cooperation with different tools. Finally it can export suitably shaped xml, which can be imported in the IBM WebSphere Business Modeler (see 4.3 Section).

The interface consists of a central window with two toolbars (one vertical and one horizontal), one menu bar and one status bar. The vertical toolbar contains buttons for the creation of participants and the connection between them, while the horizontal toolbar contains all the commands available in the tool. The menu bar offers the same operations with the two toolbars, as well as some further operations for the xml export, the tool connection with the IBM WebSphere Business Modeler and for the way the one participant influences the other.

4.1.1 Components Description

In this section we will describe each component of the GUI of VNT. In Fig. 7 we can see a screenshot of the GUI that is represented to the user.

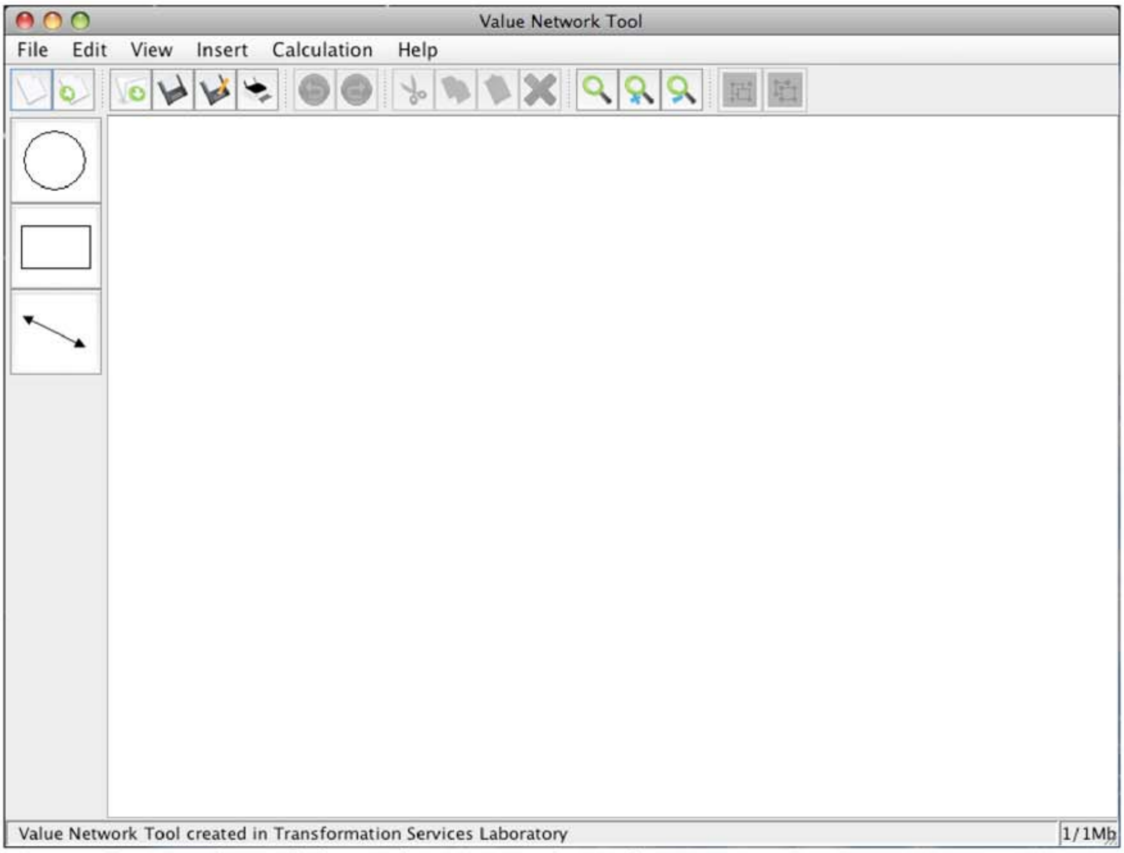

Fig. 7. Screenshot of the Value Network Tool

Horizontal Toolbar Description

The horizontal toolbar contains the elements for the management of the Value Network (see Fig. 8).

Fig. 8. Horizontal Toolbar

 ***New File***. Create a new value network. Click on the new file icon or go to: *File → New File*.

 ***New Instance***. Create new Instance. Click on the new instance icon or go to: *File → New Instance*.

 ***Open***. Open a value network file. Click on the open icon or go to: *File → Open* and choose the name of the value network file to open. Make sure that all previous work is saved before opening a new value network file.

 ***Save***. Save a value network. Click on the particular button or alternatively go to the following path: *File → Save*. Afterwards, make the choice of the name and the file saved destination. After the file is saved, the name of the window automatically changes. If the file has already been saved one time, the previous steps will not be executed.

 ***Save As***. Save a value network in the desired format. Click on the particular button or alternatively go to the following path: *File → Save As*. Afterwards, make the choice of the name and the file saved destination. After the file is saved, the name of the window automatically changes.

 ***Print***. Print a value network. Click on the particular button or alternatively go to the following path: *File → Print*. Afterwards, the user is free to determine the printer that he wants to use, allowing him at the same time to modify it in the way he wants. VNT can also export the drawn Value Network in other formats such as pdf, PostScript etc.

 ***Undo***. Undo the last action(s). Click on the particular button or alternatively go to the following path: *Edit → Undo*.

 ***Redo***. Redo the last action(s). Click on the particular button or alternatively go to the following path: *Edit → Redo*.

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Computer Science Department
University of Crete

Cut. Cut the selected item(s). To cut, select the component(s). To select a component, just click on the component. To select a group of components, drag the mouse to draw a selection square enclosing all the desired components. Selected components will be highlighted. Once the components are selected, click on the copy icon or go to: *Edit → Cut*.

Copy. Copy the selected item(s). To copy, select the component(s). To select a component, just click on the component. To select a group of components, drag the mouse to draw a selection square enclosing all the desired components. Selected components will be highlighted. Once the components are selected, click on the copy icon or go to: *Edit → Copy*.

Paste. Paste a copied or cut component(s). If there are some components previously cut or copied, you can paste them by clicking on paste icon or going to: *Edit → Paste* and they will be copied to the current value network.

Delete. Delete component(s). To delete a component, select the component and click the delete icon or press the delete button of the keyboard or go to: *Edit → Delete*. If a group of components is selected, all the components will be removed.

Actual Size. Return the normal scale of the value network. To return to normal scale click on the actual size icon or go to: *View → Actual Size*.

Zoom In. Zoom in the value network. To zoom in the value network click on the zoom in icon or go to: *View → Zoom In*.

Zoom Out. Zoom out the value network. To zoom out the value network click on the zoom out icon or go to: *View → Zoom Out.*

Group. Grouping is the concept of logically associating components with one another. Grouping involves one or more vertices or edges. Once grouped, the group component may be moved and resized like a stand-alone component. Click on the group icon or go to: *View → Group.*

Ungroup. Ungroup objects that previously have been grouped. Click on the ungroup button or alternatively go to the following path: *View → Ungroup*. When the objects are ungrouped, then they can behave as independent components.

Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

Vertical Toolbar Description

The vertical toolbar contains the elements that are essential for the designing of the value network. These elements contain circles, rectangles, as well as single arrows (see Fig.9).

Circle. The circle represents the participants. To entry the circle, click on the circle icon or go to: Insert → Circle.

Rectangle. The rectangle represents a nested value network. To entry the rectangle, click on the rectangle icon or go to: Insert → Rectangle.

Arrow. The single arrow represents the one way connection between two participants. It is usually used in order to declare that in collaboration between two participants, the source has profit while the destination has cost.

The linking between two participants happens as follows. Provided that the arrow component has been selected, the user can just select the source participant and by keeping pressed the left winger key mouse, he pulls the arrow to the destination participant. When the left winger key mouse is released, the arrow will link the two participants. Simultaneously, this will create the participant's properties that correspond to this linking.

Remark. In the case that the left winger key mouse is released before the linking between source and destination participant has been placed, then the arrow is lost and there is no linking between the two participants.

Menu Bar Description

Menu Bar contains all the previous elements that are used to manage the value network, as well as the calculation of value and the export of data (see Fig. 10).

Fig. 10. Menu Bar

File Menu Description

The File Menu contains the user actions that determine the way data is imported and exported from VNT (see Fig. 11).

Fig. 11. File Menu

New File. Create a new value network file.

New Project. Create a new value network project.

Open. Open a value network file. Choose the name of the value network file to open. Make sure that all previous work is saved before opening a new value network file.

Save. Save a drawn value network. Choose the name of the file and the file saving destination. After the file save, the name of the window automatically changes. If the file has already been saved once, the previous steps will not be executed.

Save As. Save a drawn value network. Choose the name of the file and the file saving destination. After the file is saved, the name of the window automatically changes.

Print. Print the drawn value network. The user is free to determine the printer that he wants to use, and modify the network or part of it. VNT can also export the drawn Value Network in other formats such as pdf, PostScript etc.

Import:

- ***Import from VNT XML***. Import xml files that represent a value network.

- ***Import Selected Items***. Import xml files that represent specific elements chosen from a value network. This feature is useful for the elements imported from a value network to another.

Export:

- ***Export to VNT XML***. Export xml files that represent a value network.

- ***Export to WBI Modeler XML***. Export xml files that represent a value network in a readable form for the IBM WebSphere Business Modeler.

- ***Export Selected Items***. Export xml files that represent specific elements chosen from the drawn value network. This feature is useful for the elements exported from a value network to another.

Exit. Exit from the tool.

Edit Menu Description

Edit Menu contains the attributes that concern the way which the data of the tool are managed (see Fig. 12).

Fig. 12. Edit Menu

Undo. Undo the last actions.

Redo. Redo the last actions.

Cut. Cut the selected item(s). To cut, select the component(s). To select a component, just click on the component. To select a group of components, drag the mouse to draw a selection square enclosing all the desired components. Selected components will be highlighted.

Copy. Copy the selected item(s). To copy, select the component(s). To select a component, just click on the component. To select a group of components, drag the mouse to draw a selection square enclosing all the desired components. Selected components will be highlighted.

Paste. Paste a copied or cut component(s). If there are some components previously cut or copied, you can paste them and they will appear on the value network.

Delete. Delete component(s). If a group of components is selected, all the components will be removed.

View Menu Description

View Menu contains the attributes that concern the way which the data of the tool are portrayed (see Fig. 13).

Fig. 13. View Menu

Actual Size. Return the normal scale of the value network.

Zoom In. Zoom in the value network.

Zoom Out. Zoom out the value network.

Group. Grouping is the concept of logically associating components with one another. Grouping involves one or more vertices or edges. Once grouped, the group component may be moved and resized like a stand-alone component.

Ungroup. Ungrouping the objects that previously have been grouped. When the objects are ungrouped, they can behave independently of one another.

Insert Menu Description

Insert Menu contains the attributes that concern the way which the elements are inserted in the tool (see Fig. 14).

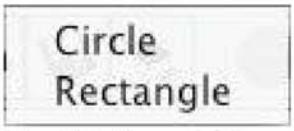

Fig. 14. Insert Menu

Circle. The circle represents the participants.

Rectangle. The rectangle represents a nested value network.

Calculation Menu Description

The Calculation Menu contains the attributes that concern the way which the data are calculated(see Fig. 15).

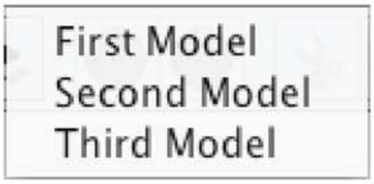

Fig. 15. Calculation Menu

First Model. Model for the data calculation with preconfigured calculation functions.

Second Model. Model for the data calculation with preconfigured calculation functions.

Third Model. Model for the data calculation with preconfigured calculation functions.

Help Menu Description

The Help Menu contains the attributes of help for the user. Moreover it offers some implementation information (see Fig. 16).

Fig. 16. Help Menu

VNT Help. It constitutes a complete menu, with regard to the attributes of the tool. Users could send if they want e–mail to the implementation team, with regard to any queries that concern the tool.

About TSL. It provides information for the Transformation Service Laboratory.

About VNT. It provides general information for the tool.

About VNT Team. It provides information about the developing and scientific team.

Status Menu Description

The Status Bar contains some basic information about the laboratory that the implementation took place. The most important part of the Status Bar is the memory usage monitor. The monitor shows the memory usage (1MB in the figure) and the memory allocated (2MB in the figure) by the application.

Fig. 17. Status Bar

4.1.2 Elements Description

In the current section we provide a description of attributes of each element. The description is similar for the element being a participant or a relation between participants (offering).

Fig. 18**.** Pop–Up Menu.

In order to apply changes in the attributes of some elements of the value network, the element must be first selected and then be clicked by the right key mouse.

Rename. Change the name of an element. As soon as the particular choice is activated, a window appears that asks from the user to place the new name. After the new name is inserted the user clicks on the OK button, to activate the change. In the case that he clicks on the Cancel button, the name remains as it was before. In any case all the other elements are informed about the results of this action.

Properties. A window appears with all the static attributes of each element. There are two different cases depending on the element. If the element is a participant, the user cannot change the participant attributes. He only can observe the transactions that this participant has with the other participants, as well as total income, expenses and profits of each participant. If the element is an offering, the user can change the data. He can determine the prices that participants take. In any case all the other elements are informed about the results of this action.

Extra Info. A window appears with the additional dynamic attributes that an element can have. It is similar for the case of participants or offerings.

Priority. This choice is appeared only in the case of participants. A window appears where the user inserts the priority of the participants. This is very useful especially in the case where the connection between the VNT and the IBM WebSphere Business Integration Modeler is actually used.

4.1.3 More GUI Features

When the user selects a vertex, he will notice small handles (rectangles that you can grip for sizing) in the vertex's corners and along its sides. Similarly, the selection of an edge results in handles at the source and target of that edge. These handles make it possible to resize the vertex or edge. We accomplish that task by using the mouse to select and drag a handle. The vertex or edge resizes in that direction. For example, resize the vertex by selecting that vertex, gripping the handle in the lower-right corner, and dragging the handle downward and to the right.

The user can select a combination of vertices and edges by holding down Shift during the selection process. If he accidentally selects a vertex or edge that he does not want to be included, he releases Shift and presses Ctrl to deselect that vertex or edge.

The presence of groups within a graph affects the selection process. When selecting a vertex or edge within a group, the first mouse click on the vertex or edge selects the group; the second mouse click selects the vertex or the edge. If groups are nested within other groups, it can take multiple clicks on the vertex or edge before that vertex or edge is selected.

You can select multiple groups, vertices, and edges by pressing Shift and clicking each entity. If these entities exist within a rectangular area, an easier way to accomplish this task involves marquee selection. Marquee selection is a selection mechanism in which the user moves the mouse pointer to any location in the graph and presses a mouse button. As he drags the mouse pointer, he observes a rectangle – known as a marquee – that expands or contracts, based on the direction of movement. When he releases the mouse button, the marquee disappears; all groups, vertices, and edges completely within the marquee are selected. Sometimes, he will want to place a vertex, an edge, or a group more accurately, during a drag operation by constraining the drag to horizontal and vertical movement. In other words, he does not want to drag diagonally. That operation requires from him to hold down Shift while dragging the mouse.

The clone selection feature is the duplication of a vertex, an edge label, or a group by holding down the Ctrl key while dragging the mouse.

4.2 DATA - XML Schema module

In this section we describe the data and xml schema that we used in order to save data that describe a SVN. We created an XML schema that describes our data and it is based on the SVN meta-model with some more technical details. So every time we want to save a Service Network with its attributes or load a saved one, we have to save and load an XML file that is described by the following XML schema (Fig. 19).

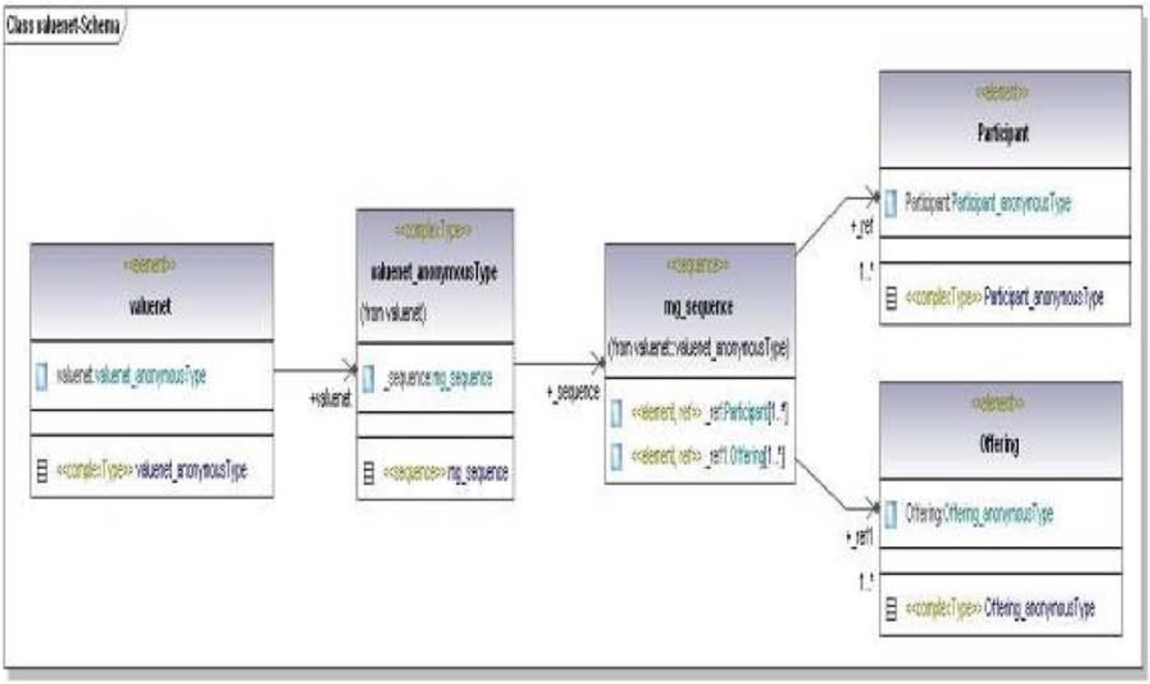

Fig. 19: XML Schema

As you can see from figure 19 there are two main classes in this schema, the Participant and the Offering. In the following figures 20 and 21 you can see in more details the attributes that they have.

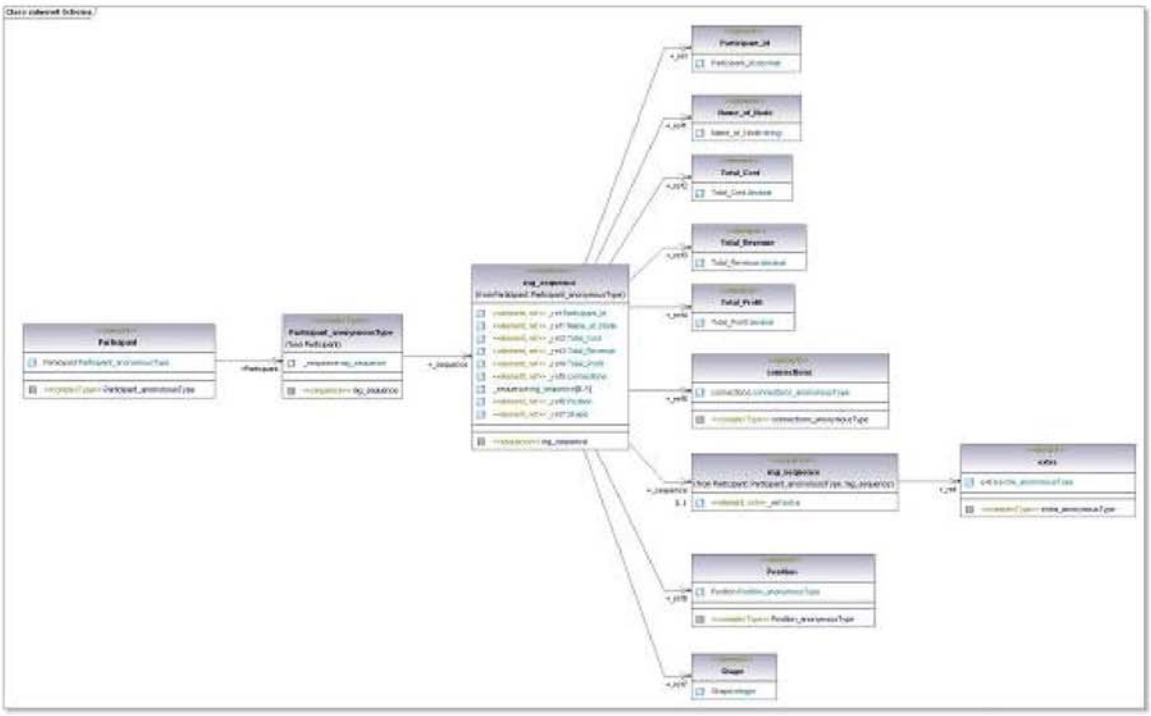

Fig. 20: Participant Schema

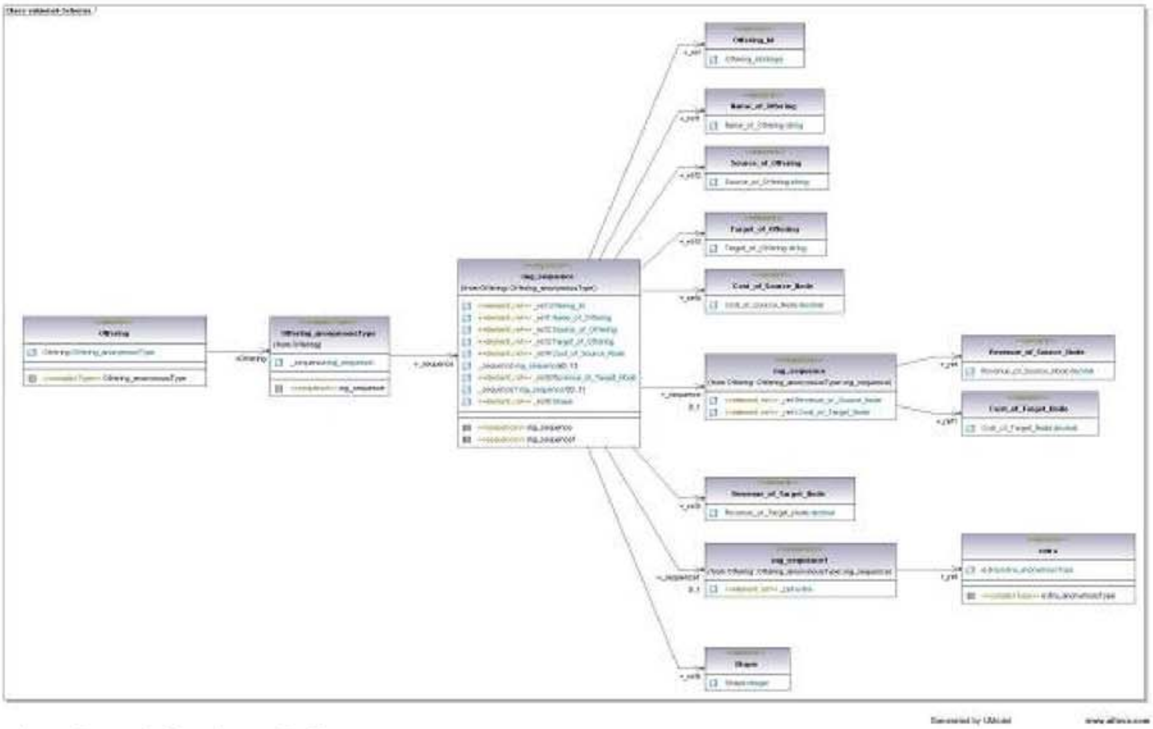

Fig. 21: Offering Schema

Also you can find the full XSD schema file, with the relevant detailed information in the following xml:

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://vnt.tsl.gr/schemas/"
xmlns="http://vnt.tsl.gr/schemas/"
elementFormDefault="qualified">
<xs:element name="valuenet">
<xs:complexType>
<xs:sequence>
<xs:element maxOccurs="unbounded" ref="Participant"/>
<xs:element maxOccurs="unbounded" ref="Offering"/>
</xs:sequence>
</xs:complexType>
</xs:element>
<xs:element name="Participant">
<xs:complexType>
<xs:sequence>
<xs:element ref="Participant_Id"/>
<xs:element ref="Name_of_Node"/>
<xs:element ref="Total_Cost"/>
<xs:element ref="Total_Revenue"/>
<xs:element ref="Total_Profit"/>
<xs:element ref="connections"/>
<xs:sequence minOccurs="0">
<xs:element ref="extra"/>
</xs:sequence>
<xs:sequence minOccurs="0">
<xs:element ref="Priority"/>
</xs:sequence>
<xs:element ref="Position"/>
```

```
<xs:element ref="Shape"/>
</xs:sequence>
</xs:complexType>
</xs:element>
<xs:element name="Name_of_Node" type="xs:string"/>
<xs:element name="Total_Cost" type="xs:decimal"/>
<xs:element name="Total_Revenue" type="xs:decimal"/>
<xs:element name="Total_Profit" type="xs:decimal"/>
<xs:element name="Participant_Id" type="xs:decimal"/>
<xs:element name="connections">
<xs:complexType>
<xs:choice maxOccurs="unbounded">
<xs:element ref="name"/>
<xs:element ref="value"/>
</xs:choice>
</xs:complexType>
</xs:element>
<xs:element name="Priority">
<xs:complexType>
<xs:choice maxOccurs="unbounded">
<xs:element ref="name"/>
<xs:element ref="value"/>
</xs:choice>
```

14

```
</xs:complexType>
</xs:element>
<xs:element name="Position">
<xs:complexType>
<xs:sequence>
<xs:element ref="X"/>
<xs:element ref="Y"/>
</xs:sequence>
</xs:complexType>
</xs:element>
<xs:element name="X" type="xs:integer"/>
<xs:element name="Y" type="xs:integer"/>
<xs:element name="Offering">
<xs:complexType>
<xs:sequence>
<xs:element ref="Offering_Id"/>
<xs:element ref="Name_of_Offering"/>
<xs:element ref="Source_of_Offering"/>
<xs:element ref="Target_of_Offering"/>
<xs:element ref="Cost_of_Source_Node"/>
<xs:sequence minOccurs="0">
<xs:element ref="Revenue_of_Source_Node"/>
<xs:element ref="Cost_of_Target_Node"/>
</xs:sequence>
<xs:element ref="Revenue_of_Target_Node"/>
<xs:sequence minOccurs="0">
<xs:element ref="extra"/>
</xs:sequence>
<xs:element ref="Shape"/>
</xs:sequence>
</xs:complexType>
</xs:element>
<xs:element name="Name_of_Offering" type="xs:string"/>
<xs:element name="Source_of_Offering" type="xs:string"/>
<xs:element name="Target_of_Offering" type="xs:string"/>
<xs:element name="Cost_of_Source_Node" type="xs:decimal"/>
```

```
<xs:element name="Revenue_of_Source_Node" type="xs:decimal"/>
<xs:element name="Cost_of_Target_Node" type="xs:decimal"/>
<xs:element name="Revenue_of_Target_Node" type="xs:decimal"/>
<xs:element name="Offering_Id" type="xs:integer"/>
<xs:element name="name" type="xs:string"/>
<xs:element name="value" type="xs:decimal"/>
<xs:element name="extra">
<xs:complexType>
<xs:choice maxOccurs="unbounded">
<xs:element ref="name"/>
<xs:element ref="value"/>
</xs:choice>
</xs:complexType>
</xs:element>
<xs:element name="Shape" type="xs:integer"/>
</xs:schema>
```

4.3 Calculation module

In this section we will describe briefly the example we used in order to implement the calculations of value in Service Networks. We used an example from the car repair industry.

The conventional service system is briefly as follows (for a more extensive description, see Ref [20]): car owners, owning Original Equipment Manufacturer (OEM) brand name cars, arrive for repairs at the dealerships of this OEM. Technicians diagnose the problem, order parts and perform the necessary repairs. However, ordering parts is a complex process since it involves identifying the faulty part from failure symptoms, asking for advice from expert technicians available from the OEM, including information about warranty covered parts, new parts, etc, and then ordering the appropriate (possibly upgraded) parts replacements. Ordering of parts is performed by the dealer's part manager, who has to first access the parts catalogue, check local, OEMs and supplier's inventories, and eventually perform parts orders. The part manager can buy parts either from third-party suppliers (TPSs) or, through the OEM, from the certified supply-chain suppliers (SCSs). The OEM pays the repair service and the new parts if service and parts are covered by the warranty or by the car owner if they are not. The OEM offers advice to dealers' technicians for free.

In this example we apply three different models and we are calculating the different values for the participants in the Service Network and the overall network value. We are using the functions described in the example and we take the following steps:

Step 1:
We assign the available roles to the participants (see Fig. 22)

Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

Fig. 22: Assignment of roles to participants

Step 2:
We map the data that are already available as attributes of the network to the parameters that are essential for the value calculations (see Fig. 23).

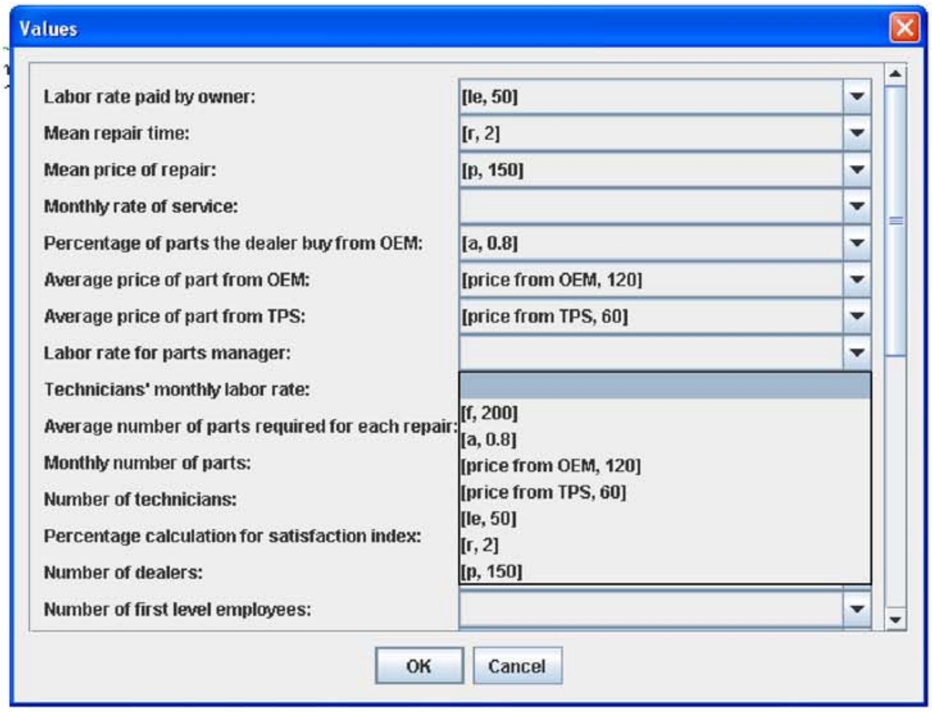

Fig. 23: Assignment of available data to the essential parameters

Step 3:
We get the results of the calculations for the specific period of time (see Fig. 24).

Month	Dealers	OEM	SCS	TPS	Value
1	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
2	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
3	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
4	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
5	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
6	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
7	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
8	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
9	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
10	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
11	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
12	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
13	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
14	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
15	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
16	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
17	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
18	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
19	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
20	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
21	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
22	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
23	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
24	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9
25	5.19E8	2.0451E8	2.304E8	4.7999999...	1.38791E9

Fig. 24: Results of Calculations

Through these three simple steps we can calculate the values of the participants in the given example. We have to mention that the values and the functions depend on the example so it is not possible to create generic functions in order to calculate the value of any given Service Network.

4.4 IBM WBI Modeler connection Module

In this section we describe another simple example and show how a value network is transformed into a business process model using the VNT.

Figure 25 shows the network of Carpenter created by VNT. The network consists of a Wood Merchant, a Carpenter, a Technician and a Customer. The Customer contacts the Carpenter in order to buy a bookshelf. The Carpenter buys raw material from the Wood Merchant. The Technician produces the bookshelf for the Carpenter. Fig, 25 shows the relationships among the participants and the offerings (services, products, money) that are exchanged.

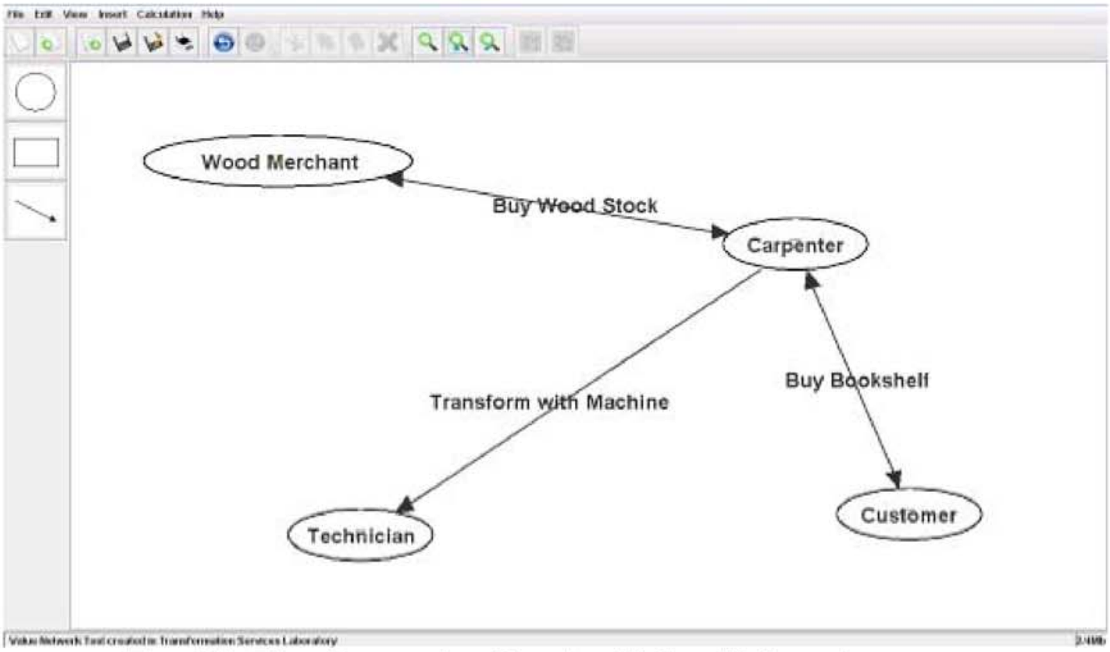

Fig. 25: The Carpenter Service Value Network.

Notice that each participant may have his own equipment and human resources that are combined with input offerings in order to produce output offerings. We insert properties for each participant using the menu extra properties of VNT. In this example we define the resources and costs represented in Fig. 26. We define for the participant Wood Merchant two types of individual resources, Woodcutter and Officer, and two types of bulk resources, Axe and Saw. We also define costs for each resource. For the Woodcutter we define both *One Time Cost* and *Per Time Cost* while for the Officer we define only *One Time Cost.* For the Axe we define *One Time Cost, Per Quantity Cost and Cost per Time and Quantity* while for the Saw we define only *One Time Cost.*

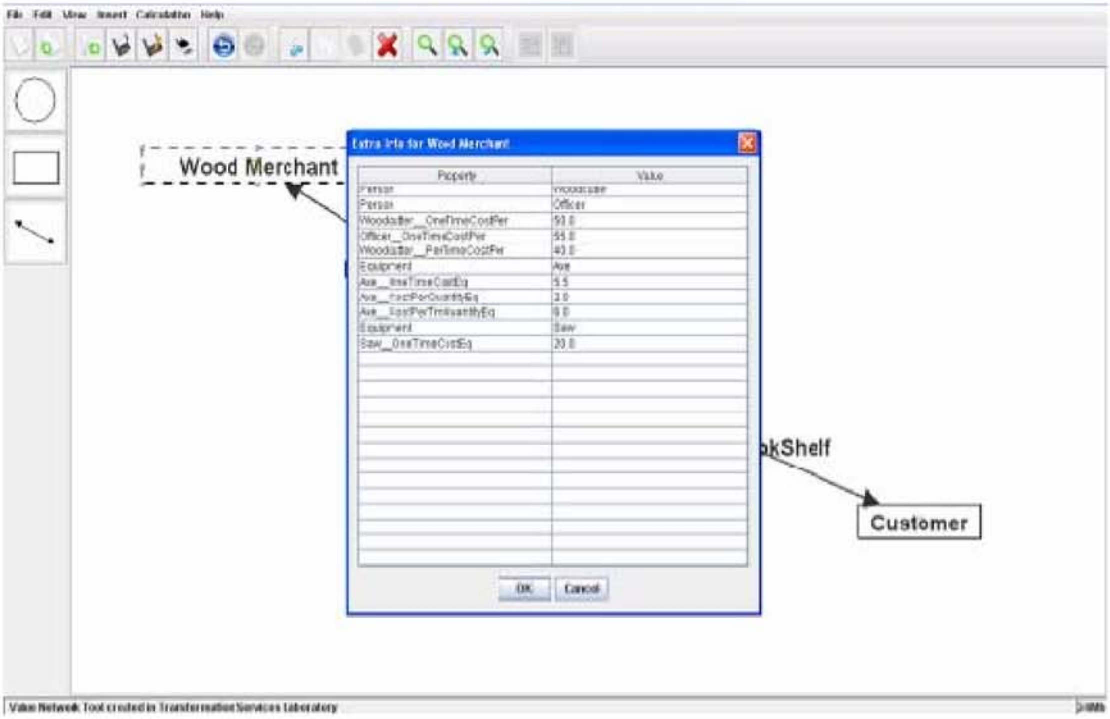

Fig. 26: Definition of resources and their costs.

The next step for the transformation of this value network into a business process model is to use the Export for WBI Modeler function of VNT to create the xml file. We choose a name for the xml file and save it. Then, a JDialogWindow is opened asking if there are any resources to import. Those resources are the resources we defined in the extra properties column. Selecting yes, will provide us the menu shown in Fig. 27. In that menu, we have to select the equivalent definition of each type we defined in each extra property column. We have to use the same definition-mark for every similar type of property in each extra column of a participant. In case we did not define something, we can leave the definition empty.

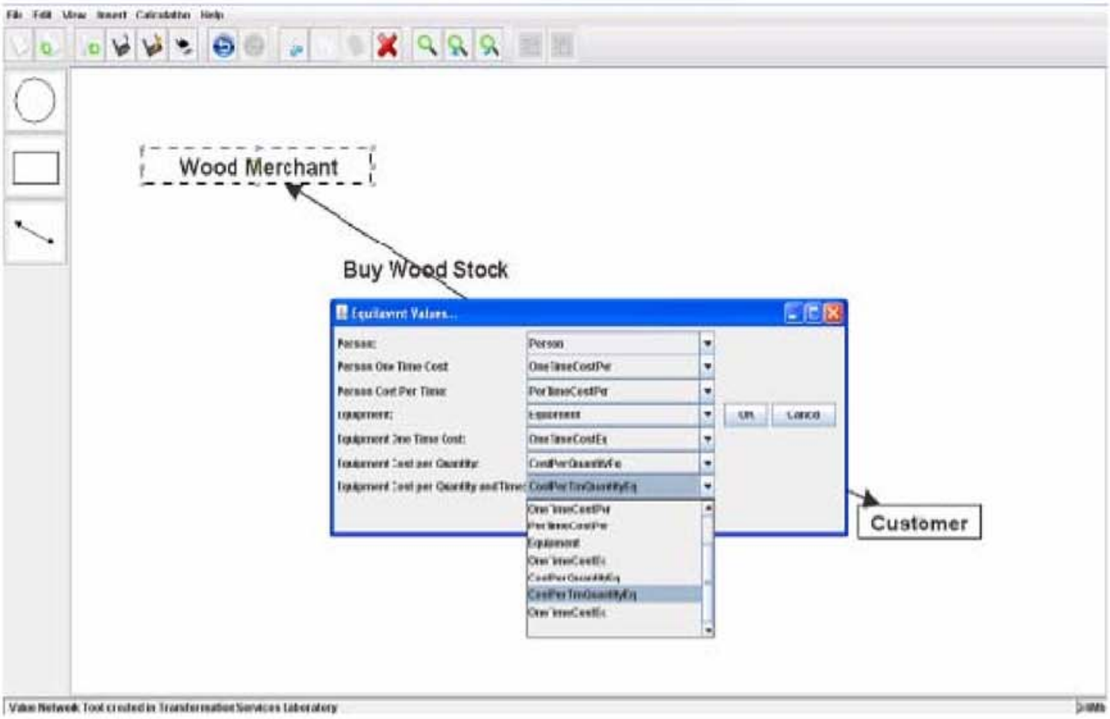

Fig. 27: Defining equivalent definitions of individual and bulk resources.

Then, we import manually the created XML file to a project of WBI Modeler. When the import is finished, we will be able to see the transformation of the value network into business processes. For each path a new process is created. In Fig. 28, the transformation of the relation between the Wood Merchant, the Carpenter and the Customer can be seen. The created sub processes represent all the procedures described above. The business items represent the goods or money that are sent from a participant to another participant. Each sub process belongs to an organization as we can see in the bottom of the screenshot (Fig. 28). In Fig. 29, we can also see the transformation of the second path of the Value Network.

In Fig. 30, the created resources and their costs are shown. In the menu resources in the left hand side, we see the Axe, the Saw, the Woodcutter and the Officer definition. In the right hand side we see all the costs defined for the bulk resource Axe.

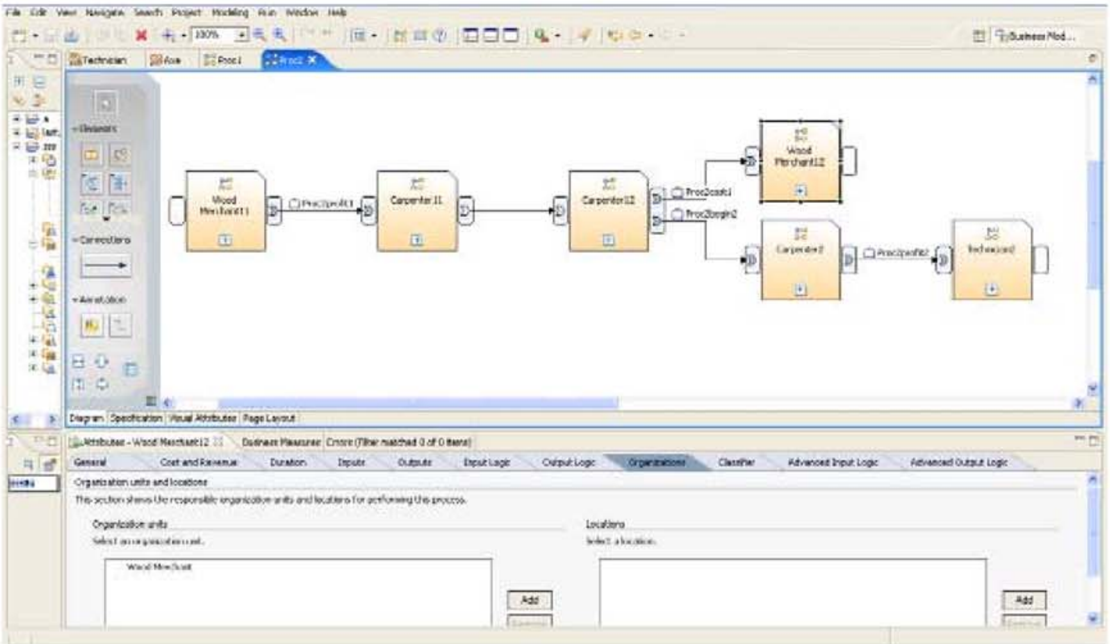

Fig. 28: Modelling the first path of an exchange between participants.

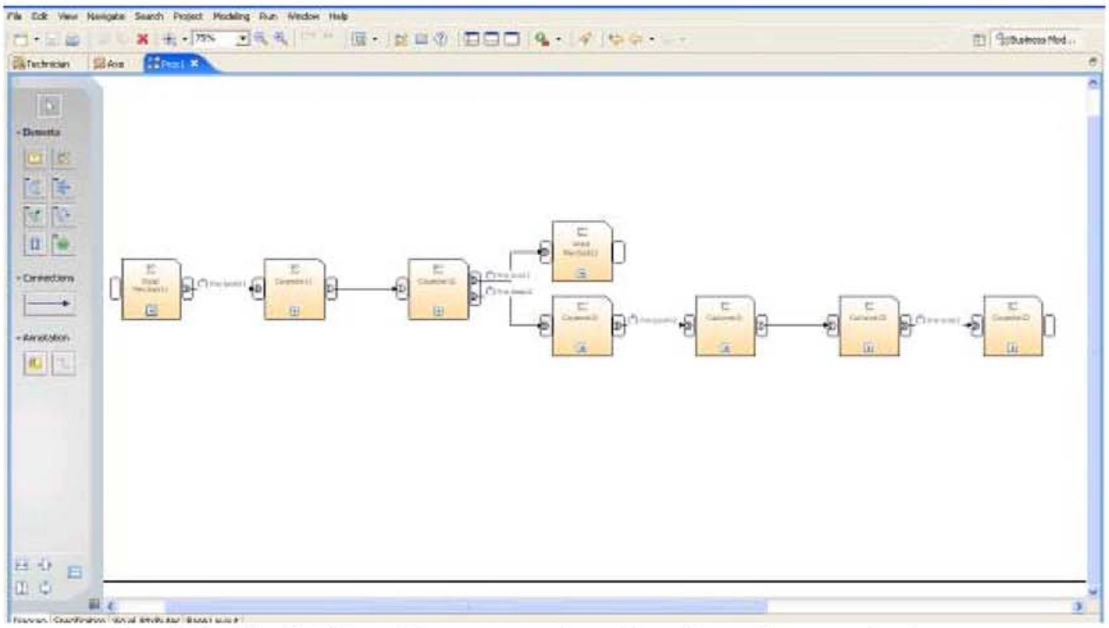

Fig. 29: Modelling the second path of exchange between participants.

Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

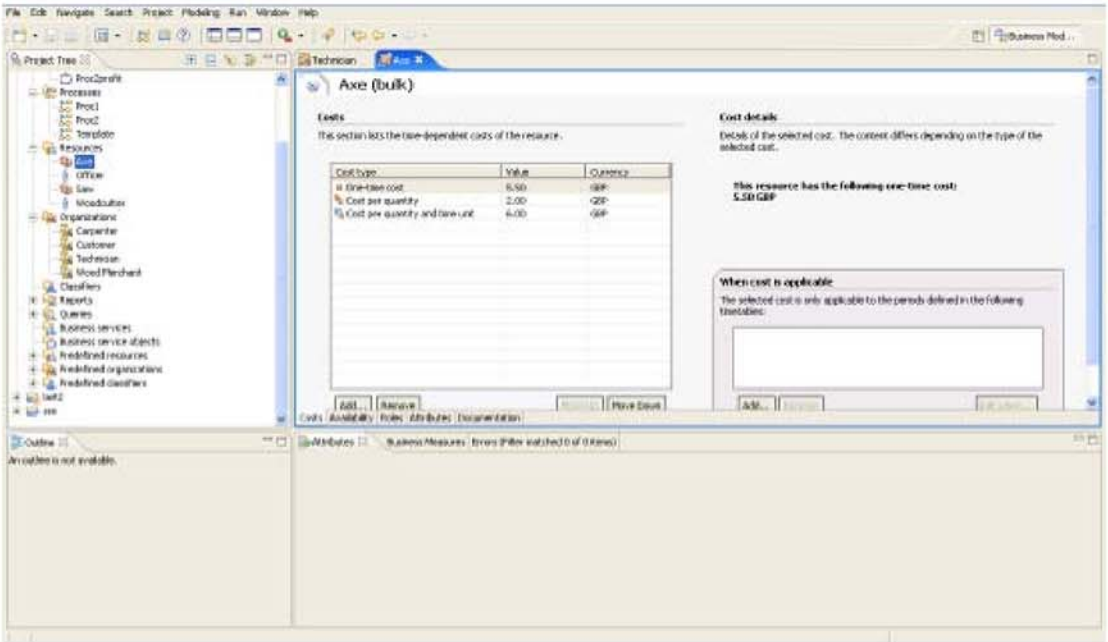

Fig. 30: Imported costs from a Service Value Network.

5. Conclusions and Future Work

Through this work we created a framework for designing, analyzing and calculating value in Service Value Networks.

We managed to bridge the worlds of SVN and BPM by providing a semi-automatic transformation of representation of SVNs to Business Processes based on specific well-defined transformation rules. We should mention that the whole methodology is semi-automatic and not full automated since the user input is extremely essential.

Current research should focus on the transformation from BPM to SVN and the definition of the nested SVNs, which are extremely interesting since they show up in all complex SVNs.

Also there is a field of research in the aspects of defining an adequate ontology in order to describe the value networks as "topologies" and their data. In this effort a valuable help can be the definition of the SVN meta-model.

Furthermore, we should mention that the VNT is implemented as a desktop application. This should change to a web application in order to help the ease of use and the spread of usage around the globe. Also, it can provide services and data to other tools of the same category (like e3editor and value networks analysis tool) or to other category tools (like BPEL4CHOR web editor).

Finally we should implement a generic way of calculating the value of the participants and the whole network value. This could be achieved by providing a framework for defining new functions for calculation in order the VNT to be flexible in future examples.

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Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete

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Georgios D. Koutras
Transformation Services Laboratory
Computer Science Department
University of Crete