Chapter 3
Service Network Approaches

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Abstract This chapter discusses several approaches to design, analyze, describe and compose service networks. We analyze the technical and business-related aspects of these approaches, their evolution, and the trends they will be likely to follow. We further suggest how the two major trends driving these approaches (i.e., business and process orientation) can converge. The chapter concludes with a discussion of future lines of research in this area.

3.1 Introduction

Value Networks consist of relationships that generate tangible and intangible added value between individuals. Along the line of *service-dominant* logic in marketing (as opposed to traditional product-dominant logic), the notion of service is becoming a predominant instrument for actors to apply their specialized competencies (such as knowledge and skills), through deeds, processes, and performances for the benefit of another actor or the actor itself; hence create value [1]. A well-known example of an established value network is Microsoft and its elaborated partner ecosystem that provides various kinds of services around Microsoft products globally.

The Web also brought opportunities to establish short-term value networks without the actors even realizing they interact across boundaries such as time, scale, and geography. E.g., if you initiate the purchase of a second-hand book at Amazon, you are actually initiating the formation of a short-term value network that is medi-

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ated by Amazon between you (in the role of customer), the virtual bookshop, and a packaging and delivery partner that serves at your location.

In short, within a value network it is common to observe three types of relationships: 1) Customer to Customer (C2C), customers exchanging valuable outcomes with each other. 2) Business to Customer (B2C), when service suppliers exchanges valuable outcomes with the final customers, e.g., you and Microsoft. 3) Business to Business (B2B), service suppliers exchanging valuable outcomes with each other, e.g., Microsoft and the packaging and delivery partners [2].

As discussed in Chapter 1, Web services (in the technical sense) should not be confused with commercial services as found on the real-world market place. Web (a.k.a. software-based) services specify interfaces and communication protocols, and by doing so implement a specific computing paradigm. Web services are still much dominated by manual engineering, and predefined top-down composition.

Commercial services are simply not describable in terms of interface specifications, as their conception inherits from marketing and social studies. As explained above, in a value network, services create value. E.g., the composition of an educational commercial service bundle should seek maximum value creation for all stakeholders. Students get value from educational services by achieving certain learning objectives and get evidence (by means of a diploma or certificate) for the acquired competencies. Educational institutes, in return for their services get value usually in the form of money.

Functions of a commercial service might be partly supported by Web services such as, e.g., billing facilities. However, in order for these commercial services to find each other and automatically bundle into economically sustainable value networks, we must model and analyze their valuable outcomes as well. Analogously, customers should be able to express their needs — i.e., the value they expect from commercial services — in human-understandable terms. Examples of value aspects that should be taken into account include pricing, competitive service properties such as discounts or home delivery, agreements on the extent to which services are legally dependent or exclusive, and ratings based on user sentiment analysis.

In this chapter we present a survey of approaches addressing issues such as description, design, analysis, and composition of service networks (SNs). Although these approaches might have some similarities such as the notion of service or the use of standardized tools, each approach has different purpose, which influences and drives the way in which SNs are described. Therefore, in our survey we not only describe these frameworks but we also analyze how they can provide some insights on service value network (SVN) composition.

The chapter is organized as follows. Section 3.2 presents the foundations to understand the concept of SNs as well as the main elements to be considered when modeling such networks. In Section 3.3 we perform an analysis of several approaches to design, analyze and compose SNs. Finally, Section 3.4 provides a discussion.

3.2 Comparison Framework

3.2.1 Definitions

Value network methods and technologies are inspired by two main foundations: value chains and value networks that cooperate. In 1985, Porter introduced the notion of *value chain*, to conceive the combination of value-adding activities within a firm to provide value to customers [3]. These activities can be classified generally as either primary or support activities that all businesses must undertake in some form. The value chain is defined as follows:

Definition 3.1. A *Value Chain* is a directed sequence of activity relationships that generates tangible and intangible added value through bilateral static communication between organizations.

In 2000, Tapscott, introduced the notion of *b-web* [4]. He explains that the advent of the Web provides a new platform for business opportunities. He identifies typical roles stakeholders can play. Depending on how value is being created and the organizational dynamics of the b-web, he distinguishes five archetypes along all b-webs can be categorized. Later, in 2006, he introduced the notion of wikinomics, where he highlights the importance of collaboration/networking [5]. A *value network* is defined as [6]:

Definition 3.2. A *Value Network* is any web of activity relationships that generates tangible and intangible added value through complex dynamic communication between two or more individuals, groups, or organizations.

Within the notion of network marketing, Lovelock and Wirtz define good networkers as entities who are able to put individuals in touch with others who have a mutual interest, e.g., providing services to a market segment [1]. In this matter, a *service network* can be defined as follows:

Definition 3.3. A *Service Network* is a team of individuals who establish relationships among homogeneous peers to provide a specific service.

By homogeneity we mean that individuals have a common business objective, i.e., provide a service solution. Based on ideas from Hamilton [7], Verna Allee [6], Lovelock and Witz [1], and our point of view, a *service value network* is defined as follows:

Definition 3.4. A *Service Value Network* is a flexible and dynamic web of homogeneous enterprises and final customers who reciprocally establish relationships with other peers for delivering an added-value service to a final customer.

3.2.2 Service Network Criteria

In order to provide both expressiveness and usability, the description approaches must cover the following criteria, some of the aspects are proposed by ourselves whereas others are taken from a previous analysis [8].

1) B2C interaction: refers to whether the approach allows interaction between final customers and suppliers (or brokers) to co-create SNs. Since customers are not static participants, they must be provided with some mechanism for expressing not only service requests but also preferences and/or recommendations. In this sense, we determine three possible situations: The customer is involved, the customer is partially involved or the customer is not involved at all during the composition of the SN.

2) B2B relationships: modeling how suppliers relate to each other is a required step within SN composition. Such B2B relationships might be based on business rules, strategic alliances among other requests or constraints. The approaches being analyzed can model this aspect in different ways such as: inter and intra company relationships, inter-company relationships, intra-company relationships.

3) Network Definition: at this point we evaluate whether the approach provides a definition for an SN. It might be a formal or informal definition. A formal definition provides meaningful descriptions not only about the SN itself but also about the components and their relationships within the SN. In contrast, an informal definition only provides descriptions for an SN.

4) Visualization: since internal and external relationships among network participants might bring about hidden structures or patterns, providing a visual of the SN is also relevant [9]. Moreover, this visualization might be also exploited for analysis and synthesis tasks that lead to innovation based on discovered niches.

5) Orientation: the locus of attention differs from approach to approach. Some have a process-oriented view, others focus on business-oriented issues. By business orientation we mean that the approach takes into account economic relationships rather than work-flow properties. It has been discussed in previous work why business modeling is different from process modeling [10]. Briefly, an important goal in process modeling is to reach a common understanding about how activities should be carried out (e.g., in which order). On the contrary, business models are centered around the notion of *value*, therefore it is relevant to determine who is offering what of *value* to whom and what expects of *value* in return, i.e., economic reciprocity.

6) Tool support: this aspect describes whether the approach, design, analyze or compose SVNs using standard tools. When applicable, we also specify the tools being used.

3.2.3 ICT Support

Moreover, we have also identified six levels of ICT maturity on which all the approaches can be positioned:

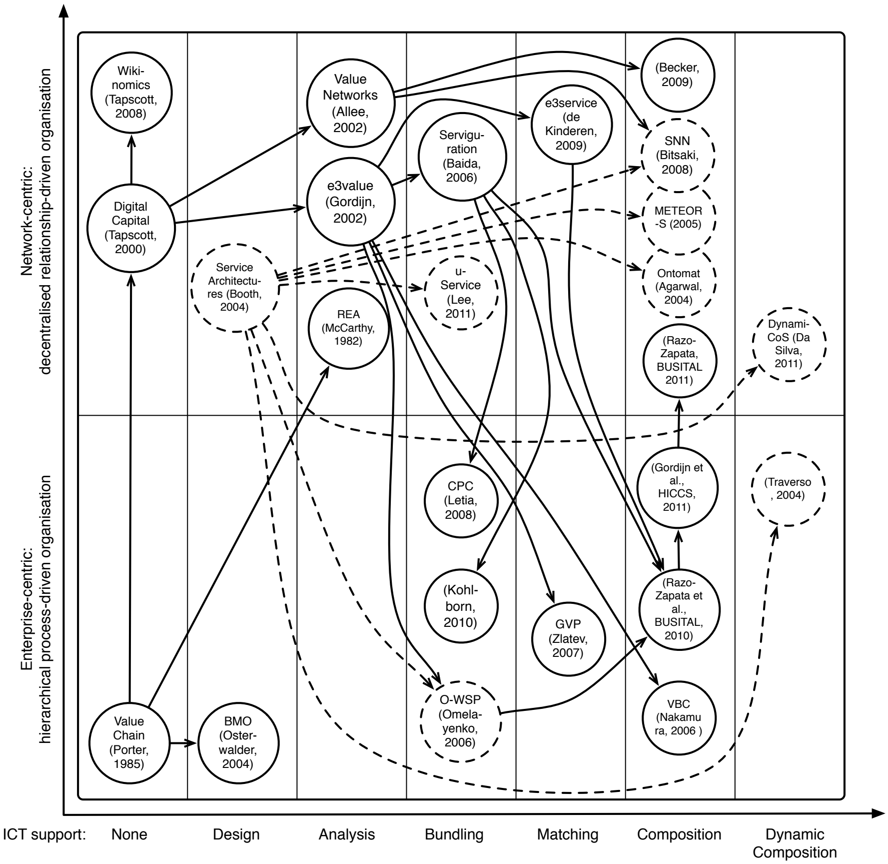

Fig. 3.1: Evolution of Service Network Approaches. Three dimensions: 1) Economic context. 2) ICT maturity. 3) Orientation: solid circles represent business-oriented approaches whereas dotted circles stand for process-oriented approaches. Arrows represent influences among approaches.

a) **Design.** In this level, building SNs is seen as a design task. The network is built by manually selecting enterprises as well as the services they offer or request.
b) **Analysis.** ICT tools allow to evaluate properties of a given SN such as profitability, misalignments with business models or potential risks.
c) **Bundling.** At this level ICT provides tools for combining services into bundles, which are the starting point for generating SNs. The generation of bundles might take into account the properties offered by services, business rules or pre-defined patterns. Indeed, this process mainly looks at the supplier perspective, i.e., what service bundles can be generated to cover more complex customer needs.

d) **Matching.** ICT tools provide support such that: 1) customers provide a formalization of their needs, and 2) the customer needs are matched with the offerings coming from the supplier side, then identifying possible solutions.
e) **Composition.** It combines the previous steps, bundling and matching. Once a customer need has been formalized and matched with a service bundle, the next stage is to solve the bundle's dependencies. For instance, a bundle providing an streaming music service to the customer might require a software-protection service to work safely. Actually, this is the case in the real-life bundle composed of Spotify[1] and Last.fm[2] which depends on the software-protection service provided by Morpher.[3] The customer only interacts with Spotify and Last.fm, nevertheless the complete SN also includes the Morpher service. Fixed templates can achieved this step by providing a clear description of the services to be found.
f) **Dynamic composition.** at this level ICT tools perform *on-the-fly* composition. Therefore, the SNs are composed from scratch based on a given customer need and a pool of service suppliers that can be dynamically combined. The challenge is to achieve *self-organization* among services so they can network themselves to cover a customer need. To address this issue approaches usually explore ideas coming from the Semantic Web area, so services can be described by means of ontologies linked to real-world service descriptions [11].

Fig. 3.1 shows how SN approaches fit within the economic context (vertical axes) and the ICT maturity (horizontal). Moreover, Fig. 3.1 also depicts how these approaches have been influenced by others. For instance, the definition of a Web service as defined by Booth *et al.* has influenced approaches such as OntoMat, METEOR-S among others [12, 13, 14].

1. (vertically) the economic context in which SNs thrive is evolving from an hierarchical process-driven organization to a decentralized and relationship-driven organization. This evolution is enabled by the increasing social and knowledge connectivity on the Web.
2. (horizontally) the support of ICT in the different activities towards finding the right SNs in these organizations.

3.2.4 Illustrative Example

The next section presents different approaches for either designing, analyzing or composing SNs. Furthermore, for each approach, an analysis is given, by means of a table, which explains whether the mentioned approach supports the aspects previously described in Section 3.2.2. Moreover, when applicable, we also provide an example of how the given approach depicts an SN.

[1] http://www.spotify.com/
[2] http://www.last.fm/
[3] http://morpher.com/

Our illustrative modeling example consists of four entities: a buyer, a seller, a tax office and an ad company. The real-world version of this example could be more complex, e.g., including a manufacturer, a company to deliver the good among other entities. However, due to space constrains we only consider these four entities. By making use of the facilities offered by each approach, we tried to model this example describing not only the entities but also the interactions among them.

3.3 Approaches for Modeling Service Networks

3.3.1 BMO

Osterwalder proposes the Business Modeling Ontology (BMO) to model inter-company relationships within business models [15]. Whereas Table 3.1 presents the aspects covered by BMO, Figure 3.2 depicts its main constructs. BMO provides four strategic areas: product, customer interfaces, infrastructure management and financial aspects, which allow to describe the business model of a firm. Briefly, product refers to the value propositions (products) offered to the market. The product area includes one building block: value proposition. The customer interface not only addresses issues about how the firm deliver the products or services to the customers but also how it builds relationships with them. Customer interface includes three building blocks: customer segments, distribution channel and customer relationships.

Table 3.1: BMO analysis.

Aspect	Analysis
B2C interaction	The customer is partially involved
B2B relationships	Inter-company relationships
Network Definition	None
Visualization	Graphical representation
Orientation	Business oriented
Tool support	Standardized tools: XML-based language. Non-standardized: Business Model Canvas

Infrastructure management refers to how the company performs infrastructural or logistical issues, with whom, and as what kind of network enterprise. Infrastructure management also includes three blocks: key resources, key activities and key partners. Finally, the financial aspects describe the revenue model, i.e., the cost structure and the business model's sustainability. Financial aspects includes two blocks: cost structure and revenue streams.

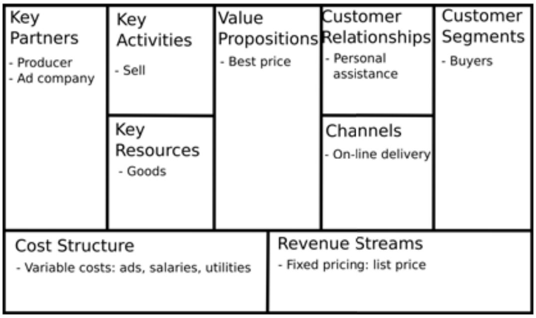

Fig. 3.2: BMO Example.

3.3.2 REA

Initially proposed as a framework for accounting systems, the Resource-Event-Agent (REA) approach has evolved into an enterprise ontology that allows modeling enterprise-wide value chains [16]. Table 3.2 describes the aspects covered by REA, which relies on three economic concepts: resources, events and agents. Shortly, economic agents exchange economic resources by means of economic events. Examples of economic agents are: customers and suppliers. Examples of economic events are: exchanges and processes (Figure 3.3 shows four economic processes: Buy, Sell, Taxing and Advertising). Finally, examples of economic resources are: products and services, which in Figure 3.3 are depicted as Good, Payment, VAT, Legal Compliance and Audience.

Table 3.2: REA analysis.

Aspect	Analysis
B2C interaction	The customer is not involved
B2B relationships	Inter & intra company relationships
Network Definition	None
Visualization	Graphical representation
Orientation	Business oriented
Tool support	Standardized tools: ebXML and UMM meta-models

A central concept within the approach are REA activities which are either exchanges, trading resources between agents; or processes, consuming input resources and producing output resources [17, 18]. REA activities are connected by stock flows, which represent one resource moving from one activity to the next. In this sense, the REA information flow across multiple companies is as follows:

$$Process \rightarrow StockFlow \rightarrow Exchange \rightarrow StockFlow \rightarrow Process \quad (3.1)$$

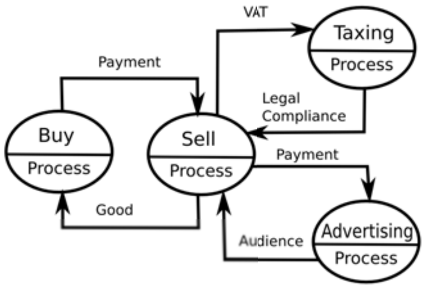

Fig. 3.3: REA Example.

Each event on an REA supply chain knows what other events it is connected to, via the stock flows, which gives also to agents an organizational structure since they know which events they control. The expression in (3.1) shows how REA focuses on supply chain's issues, i.e., how a directed sequence of activities exchange resources. Although Figure 3.3 depicts value exchanges, the expression in (3.1) also denotes a more process-oriented perspective, i.e., sequential steps. Finally, we can also conclude that REA models the supply chain taking into account only the supplier point of view which does not allow interaction with the customer.

3.3.3 Value Network Analysis (VNA)

Verna Allee argues that value networks are like living systems experiencing physical exchanges and interactions [6]. Table 3.3 presents the aspects covered by VNA. Allee proposes a graphical representation to describe these phenomena by means of tangible and intangible deliverables. The main argument for building such representation is that any value interaction is supported by some mechanism that enables it to happen, i.e., exchange of deliverables.

Table 3.3: VNA analysis.

Aspect	Analysis
B2C interaction	The customer is not involved
B2B relationships	Inter & intra company relationships
Network Definition	Formal definition
Visualization	Graphical representation
Orientation	Business oriented
Tool support	No information provided. Although VNA generates visuals in Microsoft PowerPoint and Visio and reports in PDF

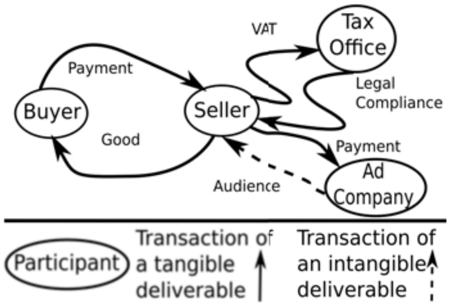

Fig. 3.4: VNA Example.

According to Verna Allee, three constructs are needed for representing value exchanges: participants, transactions and deliverables. Participants, graphically represented as ovals, are described as real people, they are the entities performing roles in the system. Software programs, databases or any other kind of technology are not considered as participants since they rely on people's decisions. In Figure 3.4 the participants are the buyer, the seller, the tax office and the advertiser.

Transactions[4] are depicted by arrows that represent the direction of something that is happening among participants. Deliverables are the real "things" that are exchanged from one participant to another, deliverables can be either tangible or intangible and are represented as labels on top of the arrows (transactions). In Figure 3.4 transactions dealing with tangible deliverables are depicted by solid arrows, whereas intangibles by dotted arrows. This basic representation allows to explore complex behavior inside the value networks such as value creation, cost/risk analysis, patterns of exchange among others [6].

3.3.4 O-WSP

One of the first attempts to achieve automatic service bundling was proposed by Omelayenko [19]. Table 3.4 describes the main aspects of the O-WSP approach. The author applies a Semantic Web approach called Open-World Skeletal Planning (O-WSP). In this way the bundling problem is solved through a planning-based reasoning which uses a skeleton to guide such process. Even though this approach solves a bundling problem, the skeletons are process-oriented templates overseeing value aspects. In this way, the skeletons only describe the services to be performed following a description very similar to a flow diagram. Among all the problems presented in his value models, the most important are the inconsistency with the skeleton and the unnecessary generation of failed plans.

Omelayenko's skeletons capture a basic representation of an SN [19]. Figure 3.5 shows a basic skeleton in which the activities to be performed are depicted. As can

[4] Also referred as activities by Verna Allee.

Table 3.4: O-WSP analysis.

Aspect	Analysis
B2C interaction	The customer is not involved
B2B relationships	Inter & intra company relationships
Network Definition	Informal definition
Visualization	Graphical representation
Orientation	Process oriented
Tool support	Standardized tools: RDF [20]. Non-standardized tools: UPML-S [21] and e^3*value* [22]

Fig. 3.5: O-WSP Example.

be observed, this kind of skeleton only describes what activities must be sequentially performed missing information about the resources exchanged among participants.

3.3.5 Serviguration

Baida proposes an ontological approach for service bundling called Serviguration [23]. Table 3.5 describes the main aspects of Serviguration. This approach uses three types of ontologies, the first two represent the demand and supply perspectives respectively, as a third ontology performs the composition process. Therefore, by matching the demand and supply perspectives, it is possible to generate a set of service bundles. An additional idea is that interactions among service suppliers can be modeled through a set of *dependencies*, which describe concepts such as enhancing, supporting, exclusion, optionality, bundling among others. In this way, services can be combined by following those dependencies. Since services can be combined in different ways, this approach generates alternative bundles for possibly matching customer needs. Serviguration is actually a guideline for combining services in a multi-supplier environment. One of the main disadvantages of Serviguration is the need for defining all those relationships among suppliers, especially when the number of suppliers grows. In addition, the approach lacks a selection mechanism to prioritize one bundle when more than one is generated.

Table 3.5: Serviguration analysis.

Aspect	Analysis
B2C interaction	The customer is partially involved
B2B relationships	Inter & intra company relationships
Network Definition	Informal definition
Visualization	Graphical representation
Orientation	Business oriented
Tool support	Standardized tools: RDF, e^3*value* ontology

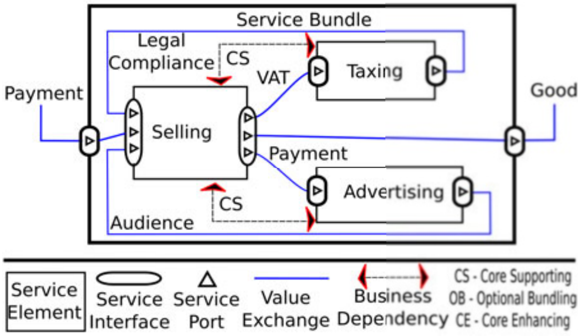

Fig. 3.6: Serviguration Example.

The Serviguration approach provides an idea about how SN participants can interact with each other by means of business dependencies. Besides, it also offers a visual representation of what can be a basic SN. Figure 3.6 depicts a Serviguration bundle where three services are described: selling, taxing and advertising. In this example the customer is supposed to provide a payment in exchange of a good.

3.3.6 The e^{3}family

In this section, we provide a short overview of the e^3*family* of ontologies for building SVNs. Table 3.6 presents the aspects covered by the e^3*family*.

3.3.6.1 e^3*value*

The central ontology of the e^3*family* ontologies is the e^3*value* ontology [22]. The e^3*value* ontology is a design time tool for exploring, analyzing and evaluating value networks. A value network is considered as a number of actors who exchange things of economic nature with each other. The ontology comes with a graphical editor. With the same tool, it is possible to assess economic profitability for all actors involved. The e^3*value* ontology is not aware of the notion of service, although a value object in e^3*value* can be considered as a service outcome, which is valued by a customer.

3.3.6.2 e^3*strategy*

The e^3*strategy* approach is used to analyze the strategic positioning of an actor in a network of enterprises, cf. [24]. In the network suppliers can be active as well as customers and competitors. These may exercise a force on the actor under consideration. Questionnaires are used to determine the exercised forces.

3.3.6.3 e^3*control*

For models constructed with e^3*value* we assume a perfectly honest world; that is no one is cheating and so is behaving honestly. In e^3*control* we relax this constraint of a perfectly honest world; we assume a sub-ideal world in which actors may misbehave. The e^3*control* approach offers constructs and methodologies to find misbehaving actors in a network of enterprises. Additionally, e^3*control* comes with a library of a patterns to address the misbehaving actors. The patterns include solution on the e^3*value* level, but also suggest solutions in terms of changed business processes.

3.3.6.4 e^3*alignment*

While exploring an e-business cases multiple perspectives are considered including the strategy perspective (e^3*strategy*), the value perspective (e^3*value*), the business process perspective and the IT perspective. The e^3*alignment* approach [25] ensures that all these perspectives are aligned, or detects misaligned perspectives.

Table 3.6: e^3*family* analysis.

Aspect	Analysis
B2C interaction	The customer is involved
B2B relationships	Inter & intra company relationships
Network Definition	Formal definition
Visualization	Graphical representation
Orientation	Business oriented
Tool support	Standardized tools: RDF-S [20]

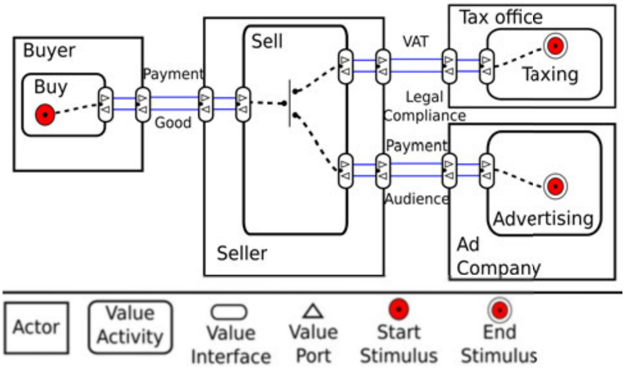

Fig. 3.7: e^3*family* Example.

3.3.6.5 e^3*service*

The e^3*value* ontology is the foundation of the e^3*family* of ontologies with on top of it e^3*service* as an ontology to be used for the composition of SNs, and for relating customer needs to services outcomes as available in the the market. The e^3*service* ontology comprises two separate ontologies for service modeling during design time, as well as configuration of services in *bundles*. Based on needs, a feature solution graph is constructed mapping needs or derived constructs onto services. Then a set of bundles that can potentially covered the given need is retrieved. The *serviguration* ontology, also known as the OBELIX ontology is used off-line for the bundling of services [23]. Although the e^3*service* ontology focuses on deriving a service bundle based on a given need, e^3*service* does not build the complete SVN to provision the service bundle. The second generation of e^3*service*, which is under development [26, 27, 28, 29], will integrate *serviguration* ideas with e^3*service*, such that the resulting ontology is not only compatible with the e^3*value* ontology but also dynamically composes a complete SVN. Figure 3.7 depicts an SVN in which four actors performing different activities can jointly work to provide what the customer needs.

3.3.7 VBC

Nakamura *et.al.* present the Value-Based Composition (VBC) approach [30]. Table 3.7 summarizes the aspects offered by VBC which is composed of three elements. 1) value models, 2) a value meta-model, and 3) a service broker. The idea is to achieve composition by allowing customers to interact with a service broker who has knowledge of service suppliers that can match customer requests. Besides, the broker is composed of nine components. The broker has two repositories, one for value models and one for process models. Both of them store templates, nevertheless the authors only give examples of the first one. The value templates are represented through value models and their Value-based Service Description Language (VSDL) representation. At this point it is very important to mention that the concept of value model is different from the one specified by the e^3*value* ontology. They conceive a value model as a hierarchical structure in which the value of a service is described at different levels. The broker can traverse this structure to evaluate whether the service matches the expected values requested by the customer.

Table 3.7: VBC analysis.

Aspect	Analysis
B2C interaction	The customer is involved
B2B relationships	None
Network Definition	None
Visualization	None
Orientation	Business oriented
Tool support	Standardized tools: Oracle BPEL [31]

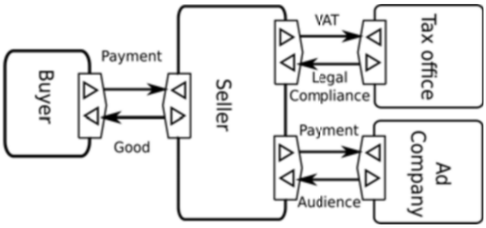

Fig. 3.8: VBC Example

They also present an interesting idea about composing services through a process of iteratively matching suppliers' interfaces. Regarding the rest of the elements within the broker, the authors do not present any example but just a description of what is supposed to occur at each step. Moreover, the output of their prototype shows an example where the performance of the whole process is only specified. Therefore, it seems to be a work in progress. In this sense, from our point of view, VBC shows two contributions: 1) the idea of a broker composed of a set of elements for matching customer requests with services, and 2) the iterative process for composing services. Although VBC does not provide insights on SN modeling, it provides an automatic approach for achieving composition [30]. Moreover, VBC also offers meta-models for describing B2C interaction. Finally, Figure 3.8 depicts how an SVN might look like under the VBC's approach.

3.3.8 GVP

Zlatev proposes the concept of patterns to reuse knowledge and perform a semi-automatic matching of needs, GVP [32]. Table 3.8 depicts the aspects covered by GVP which considers a pattern as a recurrent design fragment that solves a problem in a particular context. In this sense, Zlatev's work focuses on designing a library of patterns, these patterns are represented with value, process and goal models. In this way, before starting the matching, a goal model must be defined. This model represents what goals must be covered. Later on, parts of this goal model are matched with the goal-model representation of the patterns, which at the same time are linked to the value and process model representation.

Table 3.8: GVP analysis.

Aspect	Analysis
B2C interaction	The customer is partially involved
B2B relationships	Inter &. intra company relationships
Network Definition	None
Visualization	None
Orientation	Business oriented
Tool support	Non-standardized tools: e^3*value* ontology

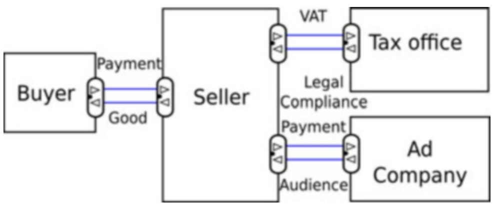

Fig. 3.9: GVP Example.

The whole process relies on four steps. Starting with the design of a goal model, following with the selection of patterns that match with the goal model, continuing with an evaluation where possible solutions are determined, and finalizing with a synthesis step. Even though this methodology looks like a good solution, the process requires a lot of human intervention, so there is neither automation nor implementation of this process. In the end, GVP presents a manual approach for service composition [32]. The main contributions of the approach are: 1) Business orientation, and 2) the matching of customer desires by means of goal models. Figure 3.9 depicts an GVP model, as can be observed, GVP makes use of e^3*value* models to represent an SVN. Nevertheless, GVP only describes the actors involved within the SVN omitting information about the internal activities performed by those actors.

3.3.9 Becker

Becker *et.al.* present a modeling language for bundling products and services [33]. Table 3.9 summarizes the aspects covered by Becker's approach that takes into account four main requirements (supplier's point of view, customer's point of view, bundle's functionality & structure and bundle's economic consequences) which are addressed by a meta-model that allows to specify three elements: the solution space, customer-specific instances from the solution space and the economic consequences for the customer (cf. also Chapter 2).

Table 3.9: Becker analysis.

Aspect	Analysis
B2C interaction	The customer is involved
B2B relationships	Inter & intra company relationships
Network Definition	Informal definition
Visualization	Textual representation
Orientation	Business oriented
Tool support	No information provided

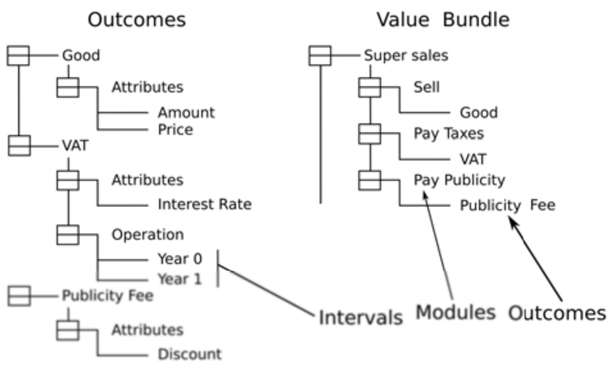

Fig. 3.10: Becker Example.

The generation of value bundles is performed based on the the three elements previously described. In this sense, three steps are required to generate a value bundle. First, modeling value bundle types. It involves modeling possible configurations of generic value bundles. Figure 3.10 illustrates how the bundles, their internal modules (services or products) and outcomes are defined. Second, customers configure individual value instances. The process requires to indicate preferences about parameters such as price, availability, delivery time among others. Once the preferences are indicated, the configurator can make recommendations about modules (services or products) to generate a bundle or automatically generate the bundle. Finally, the computation of the economic consequences for each bundle is performed. Based on this information, the most adequate value bundle can be selected.

3.3.10 Traverso

Traverso and Pistore propose an approach for automatically composing Semantic Web Services (cf. also Chapters 6 and 7), which can subsequently be transformed into executable processes [34]. Table 3.10 describes the aspects covered by this approach which relies on several components: OWL-S process models for each service, a composition goal and a Model Based Planner (MBP). The first step requires translating OWL-S process models into state transition systems (STSs) that describe the dynamic interactions within services.

Table 3.10: Traverso analysis.

Aspect	Analysis
B2C interaction	The customer is involved
B2B relationships	Inter-company relationships
Network Definition	Informal description
Visualization	None
Orientation	Process oriented
Tool support	Standardized tools: OWL-S

In the second step, a composition goal is defined. Afterwards, in the third step the BMP generates a plan that interacts with services in such a way that the composition goal is satisfied. Finally, the last step translates the plan to BPEL4WS executable code. Although, the approach performs an automating generation of plans that are supposed to deal with a specific goal, it does not say anything about the interactions among customers and service suppliers. Finally, the approach lacks a visual representation that allows analyzing structural properties of the composite service.

3.3.11 OntoMat-Service

Agarwal *et al.* present an approach to annotate, compose and execute Semantic Web Services [13]. The approach provides both a software piece and a four-step framework in which suppliers and users interact to generate execution plans where the active elements are Web services. Table 3.11 summarizes the aspects provided by OntoMat.

Table 3.11: OntoMat-Service analysis.

Aspect	Analysis
B2C interaction	The customer is involved
B2B relationships	Inter & intra company relationships
Network Definition	Informal definition
Visualization	Graphical representation
Orientation	Process oriented
Tool support	Standardized tools: WSDL

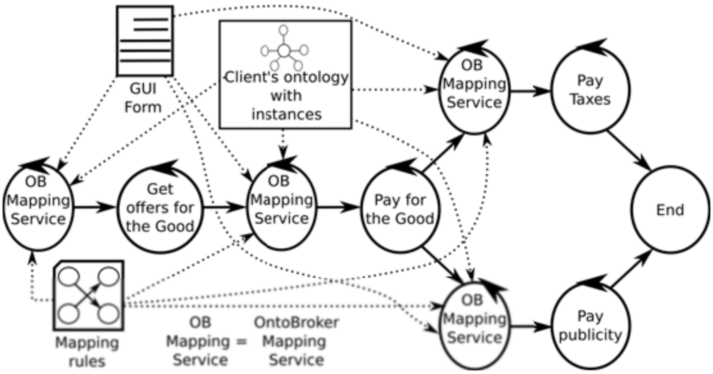

Fig. 3.11: Onto-Mat Example.

In the first step suppliers advertise their Web services by means of WSDL descriptions. The second step, which is called deep annotation, is performed by a user and it requires a mapping of rules between the WSDL-based advertised services and concepts in a client ontology. Later on, the user interconnects the desired Web services based on either data-flow or control-flow driven planning techniques. Finally, a software engine takes the plan and calls the Web services in the proper order. Figure 3.11 depicts an example of such service flow. As can be observed, the customer is all the time involved in the composition of this flow. The customer interact with the GUI form through which s/he has to do the mapping of rules.

Even though this framework allows basic interaction between suppliers and users, the composition process lies on the user side, which implies that the user must have a good understanding of what s/he is building up. According to Agarwal *et al.*, OntoMat-Service does not aim at completely automating the discovery, composition and invocation of Web services. Instead, the idea is to support users' intelligence and guides them to add semantic information such that only few valid paths remain to be chosen from by the user.

3.3.12 METEOR-S

Sivashanmugam et al. [14] provide the METEOR-S framework for Web service composition, which is composed of four components: the Process Builder, the Discovery Infrastructure, XML repositories and the Process Execution Engine. Table 3.12 describes the aspects supported by METEOR-S.

Table 3.12: METEOR-S analysis.

Aspect	Analysis
B2C interaction	The customer is not involved
B2B relationships	None
Network Definition	Informal definition
Visualization	None
Orientation	Process oriented
Tool support	Standardized tools: WSDL

The whole idea relies on designing Semantic Process Templates (SPTs). This is achieved by the Process Builder. Such templates are collections of activities that can be linked by using control flow constructs. The Discovery Infrastructure allows suppliers to advertise their services by means of a registries ontology which maintains a categorization of services according to their domains.[5] XML repositories are mainly used for managing (storing, searching, sharing) ontologies, SPTs and WSDL service interfaces. Afterwards, once a SPT is designed or selected from the repositories, the required services are discovered and added to the data flow according to the required activities. Later on, an executable process is generated based on the process template and the WSDL files of the participating services. Finally, the process is validated, deployed and it is ready for invocation on the Process Execution Engine. Since all the idea is around STPs, Sivashanmugam et al. actually aim at a framework for semantic web process composition in which a skilled designer or a domain expert creates templates for composite services that might be called later on.

3.3.13 Service Network Notation (SNN)

Bitsaki *et al.,* [35, 36] present an approach for modeling SNs focusing on relationships and exchanges of software services among the involved parties. The authors offer a formalism to model SNs by making use of graph theory and visual modeling constructs. The main concepts are: service offering, service description, service request, service providing, contract, service providing dependency and par-

[5] The authors claim that this categorization helps for finding the right services.

ticipant internal dependency. Table 3.13 summarizes the aspects that are covered by SNN. Figure 3.12 depicts an SVN based on SNN constructs. Although the approach models resource exchanges it focuses on temporal dependencies among services and does not provide the notion of economic reciprocity which is important for a business-oriented approach.

Table 3.13: SNN analysis.

Aspect	Analysis
B2C interaction	The customer is not involved
B2B relationships	Inter & intra company relationships
Network Definition	Formal definition
Visualization	Graphical representation
Orientation	Process oriented
Tool support	Standardized tools: BPMN [37]. Non-standardized tools: SN4BPM

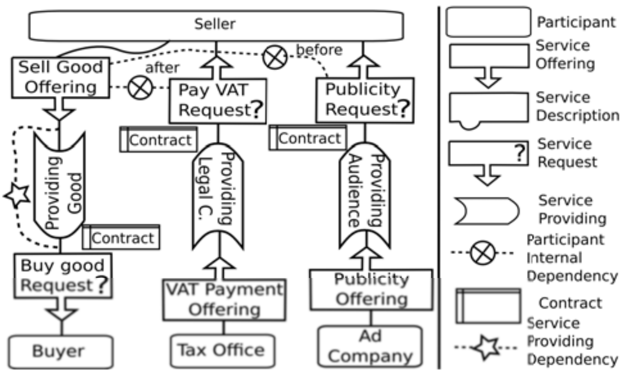

Fig. 3.12: SNN Example.

The authors also argue that the technology stack for enacting SNs consists of four elements: SN models, business processes, service compositions and services. Consequently, they propose a modification to the Business Process Management (BPM) life-cycle. In short, the traditional life-cycle involves six steps: analysis, modeling, IT refinement, deployment, execution and monitoring. In this sense, the authors propose to add an extra step called rationalization which deals with the modeling and analysis of SNNs models. As a matter of fact, the idea is to create a bond between the SNNs models and the abstract process models.

Once the SN is created, they map such representation to Business Process Modeling Notation (BPMN). The resultant BPMN process specifies the operational details to be carried on within the SN. Although the authors offer a novel approach for modeling SNs, they do not say anything about how such SN can be influenced by customers. Moreover, the transformation to BPMN is made by hand which constraint the possibility for developing an automatic process. Finally, since the design of SNs is also performed by hand, the approach is not suitable for automatically composing such networks.

3.3.14 DynamiCoS

Da Silva et al., [38] describe the DynamiCoS framework for runtime discovery, selection and composition of semantic services. The framework provides a service registry where services are semantically described by means of ontologies. Briefly a service is represented as a tuple $s =< ID, I, O, P, E, G, NF >$, where ID is the service identifier, I and O stand for input and output respectively, E are the service effects, G the goals that can be achieved by the service, and NF is the set of non-functional properties and constraint values. Table 3.14 summarizes the aspects covered by this approach.

Table 3.14: DynamiCoS analysis.

Aspect	Analysis
B2C interaction	The customer is involved
B2B relationships	None
Network Definition	None
Visualization	None
Orientation	Process oriented
Tool support	Standardized tools: OWL

Service developers publish services into the service registry following the s representation, an end-user also sends requests following the s representation.[6] Once an end-user defines a service request, DynamiCoS discovers the services that semantically match such request. Later on, a graph-based algorithm compose services to fulfill the service request. Overall DynamiCoS offers a runtime approach for composing semantic services matching user requests, nevertheless the authors does not say anything about how a user can select one composite service among the alternative options. Moreover, they also assume that a user is completely aware of the services he requires to satisfy his need, which is not always the case with users lacking of technical background. Finally, they also claim that whenever a user request cannot be matched with the services in the service registry, they can request the user to refine the details of his request, nevertheless along the paper there is no explanation about how they perform such action.

[6] The authors do not mention whether ID is also part of the final request, but we assume that is not the case.

3.3.15 u-service

Lee *et al.,* [39], describe a service bundling method which uses service complementary indexes. The idea is to bundle services according to a similarity measure. The approach relies on a Case Based Reasoning (CBR) algorithm to determine whether user satisfaction is met or not. Whenever user satisfaction is below a given threshold, several strategies can be followed. 1) If any individual single service can meet the requirements, according to the current context, select the individual service with the highest similarity. If not, 2) given the user context find a bundled service with the highest similarity and provide it to the user. 3) If there is not an existing bundled service, then the already provided service must be bundled with other service. The aspects covered by this approach are described in Table 3.15.

Table 3.15: u-service analysis.

Aspect	Analysis
B2C interaction	The customer is involved
B2B relationships	Inter company relationships
Network Definition	None
Visualization	None
Orientation	Process oriented
Tool support	Not mentioned

This bundling requires both services have high complementary indexes. In addition, once a new bundle is generated, it is added as a new case for the current user context. To sum up, Lee et al. propose an algorithm for bundling services based on user context and service complementary indexes.

3.3.16 CPC

In the field of service bundling, Letia *et.al.* propose the idea of allowing Client-Provider Collaboration (CPC) for achieving co-creation of service bundles [40]. Table 3.16 describes the aspects covered by CPS, which relies on a dialogue between the client and the supplier, such a dialogue takes the form of a persuasion whose dynamic object is the current best composition. In order to achieve this persuasion process, client and supplier use a common ontology for describing needs, where quality plays an important role. According to the authors, a need has some quality requirements that can be represented by using two sub-ontologies, one for properties and one for sacrifices. In this way in order to cover a need, a supplier should match some quality properties while a client should sacrifice something for getting the required quality.

Table 3.16: CPC analysis.

Aspect	Analysis
B2C interaction	The customer is involved
B2B relationships	None
Network Definition	None
Visualization	None
Orientation	Business oriented
Tool support	None

Therefore under CPC, the best bundle is the one providing a good trade-off between properties and sacrifices. The overall CPC process works as follows: once the client submits a request, the supplier generates a possible bundle for covering such request, giving at the same time a set of arguments supporting the proposed bundle. Later on, the client provides either pro or counter arguments for the given proposal. The supplier takes those arguments to either only counter argument or provide other proposal and then counter argument. In fact there are only two ways for finishing the dialogue, (1) the client cannot counter argument and then accepts the proposal, or (2) the supplier cannot counter attack or improve its proposal, therefore there is no acceptable bundle. Although CPC seems to be a good approach, the idea lacks a real test case. Therefore, as with VBC, the main contribution is only the idea of allowing client-supplier collaboration for bundling services. In addition, since all the interaction is between one client and one supplier, it is not clear if the approach will also work in an environment where more than one supplier compete for covering client needs.

3.3.17 Kohlborn

Kohlborn *et.al.* [41] propose a set of relationships for bundling services. The aspects covered by this approach are described in Table 3.17. In this approach, relationships are considered as connections among services. In addition, relationships can play two roles (or even both) as *enabler* and/or *constraint*. Furthermore, their approach distinguishes between two types of relationships, *generic* and *specific*. In this sense a relationship is influenced by two dimensions, the role it can play and its type. The main idea about defining roles is to allow strategic reasoning when bundling services.

In this way when a relationship plays the role of enabler, it can help to find services targeting the same type of needs. In contrast, as constraint a relationship can discard among services. On the other hand, the idea behind defining two types of relationships aims to constrain the solution space. Indeed, the authors claim that the process of building bundles should move through four stages. The first stage, called *Possible Bundles*, includes all the possible combinations among services regarding

Table 3.17: Kohlborn analysis.

Aspect	Analysis
B2C interaction	The customer is not involved
B2B relationships	Inter & intra company relationships
Network Definition	None
Visualization	None
Orientation	Business oriented
Tool support	None

validity or feasibility. The second stage, *Generic Bundles*, contains the set of bundles that can fulfill the requirements of generic relationships. In the same direction, the next stage, *Specific Bundles*, includes the bundles that can cover the requirements of specific relationships, such relationships are supposed to take into account a specific environment. Finally, the last stage, *Feasible Bundles*, applies domain specific knowledge to extract the set of bundles that can meet internal and external requirements. Internal requirements are features as quality, risk assessment, service level among others. External requirements deal with aspects such as customer demand, market saturation or legislation. Although Kohlborn *et.al.* present an interesting approach for bundling services, their work lacks from both case studies and applications, therefore the applicability of such approach remains more theoretical than practical.

3.4 Discussion

In this chapter we have analyzed approaches to design, analyze or compose SNs. Even though each approach models SNs for different purposes, they also share some aspects which are described in Section 3.2.2. Moreover, we have also provide an illustrative example for each approach to visualize how these approaches model SNs. However, there were approaches which we could not provide a visualization of the way SNs are modeled — either because of the lack of tools for modeling (CPC and Kohlborn) or the complexity to represent the SN (Becker, Traverso and u-service). Table 3.18 summarizes the aspects covered by each approach. As can be observed it is only VNA and SNN that provide a formal definition about networks. VNA provides a definition for value networks while SNN provides a definition for SNs, however VNA focuses on analyzing value networks and SNN on composition of SNs (cf. Figure 3.1).

We provide also tables to analyze business and implementation aspects for each approach (Table 3.19 and Table 3.20). Since half of the approaches consider the notion of value and economic reciprocity, in Section 3.2.1 we have provided a definition for SVNs that focuses on these aspects. In many approaches, value aspects of services are ignored simply because this information is usually implicit or not rep-

Table 3.18: Required Aspects. ✓ fully supported, ≈ partially supported.

	B2C interaction	B2B relationships	Network Definition	Visualization	Business Oriented	Tool Support
BMO [15]	✓	✓		✓	✓	✓
REA [16]		✓		✓	≈	✓
Allee [6]		✓	✓	✓	✓	≈
O-WSP [19]		✓	≈	✓		✓
Serviguration [23]		✓	≈	✓	✓	✓
e[3]*family* [22]	✓	✓	≈	✓	✓	✓
VBC [30]	✓			≈	✓	✓
GVP [32]	≈	≈	≈	✓	✓	
Becker [33]	✓	✓		✓	✓	✓
Traverso [34]		≈	≈			✓
OntoMat-Service [13]	✓	✓	≈	✓		✓
METEOR-S [14]			≈			✓
SNN [35, 36]		✓	✓	✓	≈	✓
DynamiCoS [38]	✓	≈	≈	≈		✓
u-service [39]	✓	≈				
CPC [40]	✓				✓	
Kohlborn [41]		✓			✓	

resentative enough. Yet, both the Social Web and the Semantic Web have liberated critical amounts of linked data about people, needs, and services that provide an actionable foundation for a Service Web to emerge from dynamic communication within and between customer and supplier communities.

Table 3.19: Business aspects.

	B2C interaction		**B2B relationships**		**Business Oriented**	
	Customer Need	Dialogue	Inter-company	Intra-company	Value Perspective	Economic Reciprocity
BMO [15]	✓		✓		✓	✓
REA [16]			✓	✓	✓	✓
Allee [6]			✓	✓	✓	✓
O-WSP [19]			✓	✓		
Serviguration [23]	✓		✓	✓	✓	✓
e[3]*family* [22]	✓	✓	✓	✓	✓	✓
VBC [30]		✓			✓	✓
GVP [32]	✓		✓	✓	✓	✓
Becker [33]	✓	✓	✓	✓	✓	✓
Traverso [34]			✓			
OntoMat-Service [13]	✓	✓	✓	✓		
METEOR-S [14]						
SNN [35, 36]			✓	✓	✓	
DynamiCoS [38]		✓				
u-service [39]		✓	✓			
CPC [40]	✓	✓			✓	✓
Kohlborn [41]			✓	✓	✓	✓

Indeed, currently services (such as iPhone apps) are too much pushed by suppliers; anticipating mainstream needs [42]. Yet as more and more customers can express and discuss their needs freely, niches will rather pull profitable service mar-

Table 3.20: Implementation aspects.

	Network Definition		**Visualization**		**Tool Support**		
	Informal	Formal	Textual	Graphical	Manual Composition	Meta-model Composition	Dynamic Composition
BMO [15]			✓		✓		
REA [16]				✓	✓		
Allee [6]		✓		✓	✓		
O-WSP [19]	✓			✓		✓	
Servigurarion [23]	✓			✓		✓	
e^3*family* [22]	✓			✓		✓	
VBC [30]				✓	✓		
GVP [32]				✓	✓		
Becker [33]			✓			✓	
Traverso [34]	✓						✓
OntoMat-Service [13]	✓			✓		✓	
METEOR-S [14]						✓	
SNN [35, 36]		✓		✓	✓		
DynamiCoS [38]							✓
u-service [39]						✓	
CPC [40]							
Kohlborn [41]							

kets to thrive. As an example, consider a community of interest that can use collaborative tools to express, discuss, and detail their needs and value expectations, and finally publish a request for proposals to the self-organizing service market. Service suppliers can participate in proposing a reasonable offer to these needs, on which communities in turn can critique. Therefore, a dynamic interaction between customers and suppliers is a key aspect as depicted in Section 3.2.2. Nevertheless, as can be observed in Table 3.20, there are still several approaches that perform a manual or meta-model based composition for SNs, i.e., they follow a given template to perform the composition. Future efforts must focus also on providing a framework to allow dynamic composition for SNs.

Approaches such as customer interaction- or user sentiment-analysis can source now from big enough customer communities in order to give a representable image on how SNs can anticipate and evolve towards new expectations. Although the Wikinomics bubble in the top-left corner in Figure 3.1 is still isolated from the state of the art, Tapscott's work may inspire future SN composition approaches [4, 5]. Along this line, Pedrinaci *et al.* introduce the notion of Linked Services that tap from Linked Data initiatives to drive their composition [11]. Maamar *et al.* describe how service engineers can capitalize on Web services' interactions, namely, collaboration, substitution, and competition, to build social networks for service discovery [43].

The highly variable customer needs emerging from the social Web stretch the long tail of the market call; hence call for multi-supplier service bundles that cannot be offered by single parties. One example specifically for book reselling is Amazon, that also relies on many third-party book shops globally to have such a wide offering and quick delivery to its customer. This configuration problem can be partly automated, but will still involve a considerable amount of human-driven dialogue.

Key here is to model, analyze, and match divergent perspectives on the notion of value, including needs and services, by customers and suppliers, respectively [29]. In order to express this knowledge unambiguously, communities agree on common semantics of vocabularies and rules [44]. Though detailed enough to prevent misinterpretation, these standards should be as generative as possible to allow mass-scale adoption. Apart from FOAF and SIOC — which are standards to link social data — one recent successful example is GoodRelations,[7] a global initiative to leverage SMEs by publishing e-commerce data in a standardized fashion.

3.5 Acknowledgements

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