A Framework for Exploring Digital Business Ecosystems

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Abstract

ICT-enabled business solutions have created a possibility for automated business relations and transactions. Digital business ecosystems are becoming an increasingly popular concept for modeling and building distributed systems in heterogeneous, decentralized and open environments. However, traditional economic and computing theories do not focus on digital business ecosystems as a separate form of organization and they do not provide conceptual frameworks that can be used to explore digital business ecosystems. In this paper, we present a framework for exploring digital business ecosystems developed from Zachman's enterprise architecture. This framework serves as a structure for exploring the value network and the enterprise as part of a digital business ecosystem.

1. Introduction

The key to business success is to understand the need of real-time business information of business areas [1]. For example, supply chain collaboration and its information flows have been extensively studied by academics and their relevance has been widely recognized. In integrating business-to-business (B2B) trade processes, the automation of order-to-cash is often considered the first necessary step in electronic supply chain collaboration [2]. Some industries, such as the aerospace, automotive and retail industries, have been able to establish real-time information much further than order-to-cash. Electronic manufacturing has created digital business ecosystems based on collaboration and transparency, for example, the RosettaNet industry standards.

Business information is created, distributed and stored in the supply chain and for various business needs. This information in the business models should be used as a tool to create customer value and to collect revenues by using resources and capabilities effectively in the value network [3,4]. Enterprise architecture is the organizing logic for a business and the IT to design, plan, implement and govern enterprise information [5], whereas business process standards enable a modular design of business integrations.

The industry standards available deal with data models (data elements, code lists and document libraries) and process models (process descriptions, process lists and process integrations), e.g. UBL and RosettaNet. Common business process standards serve as the key enablers in establishing the links between the services and business processes in the value network. The interoperability of information can be established through well-designed business processes and ICT services that channel information over the internet and across the industry.

B2B integration (B2Bi) can be understood as a change from manual to electronic and automated information management, which involves many stakeholders with different needs. Large companies, operating on a multi-continent level, have first integrated business information internally with enterprise resource planning (ERP) systems. The objective of the internal integration of business units is to gain better real-time information to manage their business. After internal integration, the focus is on developing the strategic supply chain. An electronic and automated process should improve their business; it will save transaction costs, reduce waste, speed up the lead time, improve information quality, and give employees time to deal with challenging work instead of spending it on routines. In most businesses this has a direct effect on the company’s competitiveness [6]. Suppliers and customers often have limited resources and knowledge of B2Bi, especially SMEs. IT services have often been outsourced to service providers. Process and document integration is often channeled to specialized intermediates, such as banks or operators. The finance sector has successfully launched several integrated services such as ePayment, eInvoicing and eFactoring. These services are offered over the internet to customers as additional eBanking services. The objective of these investments is to offer better customer value and gain cost savings. eBanking has restructured the entire banking business by reducing the
bank office chain and manual work costs in the value network.

Multisite companies have started to utilized integration of internal business information to help strategic decision making on executive level. Business managers have started external integration with strategic supply chain partners to improve business performance. IT development has designed information models for internal and external processes and information storage and retrieval. In order to facilitate external integrations, several business domains have started business process standardizations. Interoperable business process information is achieved by converting data between different data specifications or standards and channeling this over the internet. This integration of business has recently developed an independent outsourced intermediate service. The ICT sector is developing interoperable software and services based on these needs and wants.

The builders of business ecosystems are seeking the right moment to start external integration with the value net but it is difficult for them to understand the requirements of B2B integration, and therefore there is a need for a simplified model.

In this paper we will further develop the concept of enterprise architecture frameworks to make it more suitable for B2Bi. The challenge is to (i) formulate a framework that can be used to explore the organizational and inter-organizational situation of the digital business ecosystem and (ii) to evaluate this framework.

2. Related research

2.1. Business Ecosystem

A business ecosystem is a dynamic structure that consists of an interconnected population of organizations. These organizations can be small, medium sized and large companies, research institutes, public sector organizations, and other parties that influence the system.

Moore defines a business ecosystem as “an economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world” [7]. A business ecosystem includes customers, lead producers, competitors and other stakeholders. The basis of a business ecosystem is formed by leadership companies, “the keystone species”, who have a strong influence in the ecosystem [8]. Keystone companies serve as enablers that have a great impact on the whole system. In the same way a business ecosystem is often built on one single company that is highly connected [9]. This definition highlights the interaction within a business ecosystem.

According to Moore, a business ecosystem is an “extended system of mutually supportive organizations; communities of customers, suppliers, lead producers, and other stakeholders, financing, trade associations, standard bodies, labor unions, governmental and quasigovernmental institutions, and other interested parties”. This definition emphasizes decentralized decision-making and self-organization [9].

According to Iansit and Levien [10], there are three critical success factors in a business ecosystem. First, productivity is a very basic factor, the basis of success in any kind of business. Second, any business ecosystem should be robust. This means drawing competitive advantage from many sources and having the ability to transform when the environment changes. Third, a business ecosystem should have the ability to create niches and opportunities for new firms. This requires a change in attitudes from protectionist to cooperative.

Power and Jerjian claim that the ecosystem constitutes an integrated electronic system of businesses, “a system of websites occupying the world wide web, together with those aspects of the real world with which they interact, it is a physical community considered together with the non-living factors of its environment as a unit” [9]. Integrated electronic business creates truly networked business, which has fundamentally changed everything that the companies do [8].

A business ecosystem as an organizational form is enabled by four related ideas. The first one is collaboration, creating complementary capabilities, the second one is finding “space” for business opportunities, the third one is developing business within a space as a specific business ecosystem, and the fourth one is creating a concept for aggressive continuous innovators. The concept of a specific business ecosystem naturally follows from the concept of a space. Within a particular space, there will be a number of critical contributions that need to be linked in order for solutions to be produced and managers must identify these critical contributions, make preliminary distinctions about modularization and in turn define the initial niche contributions and contributors [11].

A digital business ecosystem (DBE) is a concept presented for the first time in the field of business research in the Lisbon Agenda in March 2000, and later the DBE pilot projects were taken up in the EU Framework Programs FP6 and FP7. It will enable SME users to interact with each other more efficiently. A
digital business ecosystem improves the traditional, thoroughly defined collaborative environments, such as centralized models (client-server), distributed models (such as peer-to-peer), and hybrid models (such as web services) and develops them further into its own model. It provides an interactive, self-organized software environment that is distributive in nature but presents a unified view of all the business entities. Some of the anticipated benefits include the cost-effectiveness of services and value-creating activities, which are advantageous to SMEs, employees and consumers [12].

Gossain and Kandiah [13] expand Moore’s concept by recognizing the importance of creating value for customers through the provision of additional information, goods and services. Gossain and Kandiah include only partners and suppliers in the business ecosystem and say that the “connectivity between them is the engine at the heart of the whole system”. They see the eBusiness ecosystem as basically similar to an integrated value chain, with the addition that a business ecosystem emphasizes close symbiotic relationships between organizations, the developing nature of those relationships, and the significance of brands.

2.2. Zachman’s Framework

Researchers have various definitions and explanations of enterprise architecture and they differ in terms of their approach and the level of detail. Some are proposed guidelines, whereas others have specific methodologies and aspects to follow. In the latest developments of cloud computing technologies, software is only one of the components in an information system. Further design is required in diverse areas of requirements modeling, network infrastructure, server configuration and middleware technologies [14]. Tang et al. provides a model for understanding enterprise architecture through analyzing the goals, inputs and outcomes of six Architecture Frameworks (CADM, RM-ODP, 4+1 View Model, TOGAF, DoDAF and the Zachman Framework).

Models should take into account the requirements of different business stakeholders for designers; architecture must be usable by end users, acquirers, the system’s owner and operator, etc. Therefore, the architecture should be able to support technical, cost and programmatic decisions [15]. In literature, there exist very few methods to design and analyze a digital business ecosystem. In this study we have chosen to use the Zachman Enterprise Architecture (ZF) as a basis to design a DBE framework.

John Zachman published the ZF in 1987 and it is considered to be one of the pioneers in this domain and it is referred to as a reference model. Being aware of the criticism of the ZF, Zachman’s framework was selected as the “initial” framework in this study, because many architecture designs and development environments are still based on the ZF structure. By using the ZF to design a DBE framework, we are able to create a questionnaire and analyze and present results to support practical integration. For further enterprise level design, more detailed enterprise architectures can be linked.

The classical understanding of the Zachman Framework as it also exists today is the realization that “material,” “function”, and “geometry” should have descriptions of WHAT the product was made of, HOW the product worked and WHERE the components were located relative to one another. From that observation, it was obvious that a comprehensive description would have to include descriptions of WHO does what relative to the product, WHEN things happen and WHY various product choices are being made. These questions Zachman calls “abstractions”, which form vertical columns [5,16,17].

Different perspectives, the Scope, Owner, Designer, Builder, Sub-Contractor and End Product form the horizontal rows in the framework. Each column has a simple basic model and each row represents a distinct view, and that is why each cell is unique [17].

In 1999, Zachman wrote criticism of enterprise architecture usage in companies, claiming that because we do not know how to measure enterprise architecture, no one sees it as an asset yet. In Zachman's view, despite all these years, we still do not actually know how to create architecture. The Zachman framework, like many other architecture frameworks, came into existence in an initial incomplete form and has subsequently evolved into a more mature framework [17].

3. Empirical study

The justification to develop a B2B integration framework for a Digital Business Ecosystem rises from the following facts; Business is driven by many stakeholders using different common concepts (business elements) and Enterprise Architecture is mostly a model used by IT experts. However, B2B integration should be used by all stakeholders and this specific knowledge should be included in common business elements. This study outlines the bridge between common business elements and enterprise architecture by introducing the DBE integration framework. By using the DBE integration framework, we can estimate the maturity of a business ecosystem.
We used theoretical sampling in selecting the case organizations. The idea of theoretical sampling is not to get a representative sample of all possible variations (as with probabilistic sampling) but to gain a deeper understanding of the cases analyzed and to develop an analytic framework grounded on the observations. In this case study, the observation has been derived from two global value networks. These value networks overlap within a large population of suppliers in the field of transportation, energy, chemical industries, etc. They use outsourced services in the field of factory maintenance and ICT services. The financing sector operates across industries. The case organizations form business ecosystems with the common objective to integrate business information in their global supply chains. In 2005 this regional value network implemented common electronic invoicing to cover the whole region. As a result, the industry was able to change from a manual invoicing process to an electronic one. During recent years, large industry has invested in ERP systems to integrate internal information globally. There is a solid understanding within the network that the integration will improve information quality, cut costs in manual work and give faster ROI. Based on this experience, the stakeholders understand the need to use common standards and a common collaboration model.

Enterprise architecture frameworks guide towards developing information systems for companies. By using these frameworks, the companies have been able to design point-to-point integration, even on a global scale. However, enterprise architecture frameworks are not fully utilized in the inter-organizational supply chain context.

The research method used in this study is based on a literature review and information collected from specialists (focus group). In this study, the focus group was formed from the representatives of the participating companies in the two case supply networks. The focus group members represented two focal firms, their key maintenance partners and service suppliers: 7 industry partners, 6 industry service partners, 4 financial service partners and 2 ICT service partners, and altogether 18 business managers. All the members had a managerial role in their business and their responsibility was to develop collaboration in a digital business ecosystem and B2B integration in their organizations. The development of the framework was done during the four focus group meetings by utilizing a computer-aided groupware tool and using the Delphi method [19,20,21]. The tool allows the simultaneous participation of several members.

3.1. Research process

The research process had three steps: (i) Description of the initial framework, (ii) Formulation of a questionnaire, (iii) Empirical rating of the framework.

3.2 Description of the framework

The business stakeholder as a horizontal layer in the framework

The design from the ZF to the DBE framework started by changing Zachman’s horizontal IT layers into commonly used business architecture elements and the stakeholder involved. Strategy/Executives and Business Model/Managers layers form the requirements for the design. The Information Model/IT-Experts and Standard/Standardization Experts layers work as design elements. The Integration channel/Intermediates and Service portfolio/End Users layers work as development and service implementation elements.

There exists plenty of literature on common business architecture. In this paper we try to identify the key knowledge in each element from the B2B integration point of view. The business architecture elements and definitions are summarized in the Table 1

Business Strategy is a tool for general managers. It provides the company’s vision, which is a set of goals and objectives comparing the internal strength and weakness of a company and its external threats and opportunities [21, 22], and which positions the company in the market [23,24]. According to Learned [22], strategy acts as a giant and we can only grab onto part of it. Business strategy is a large domain in which little consensus exists and variation can be found between different business domains over time. Strategy emphasizes the overall direction in a firm’s market positioning, interactions across organizational boundaries, growth opportunities, competitive advantage and sustainability.

A Business Model is a tool for business managers. There is an ongoing discussion on the difference between strategy and business models [25]. A generally accepted definition of the term “business model” has not emerged. However, three general categories of definitions exist: strategic, operational and economic, which each consist of a unique set of decision variables. A business unit is about the “material” and workflows, and a business model explains a company’s money earning logic as a set of concepts [4]. At the operational level, the model
represents an architectural configuration. The focus is on internal processes and design of infrastructure, which enable the firm to create value. The decision elements include product or service delivery, administrative processes, resource flows, knowledge management, and logistic streams. A business model describes how an organization (enterprise, business unit) creates, delivers, and captures value. The process of business model construction is part of the business strategy. The business model must be evaluated against the current state of the business ecosystem [21].

An Information Model is a description of the structure of an enterprise, which comprises enterprise components (business entities), the externally visible properties of those components and the relationships between them. The process of designing an information model is a part of the business model.

The Standards of business processes have been under development in several international standardization groups. Standardization allows trading partners of all sizes to connect electronically to process transactions and move information within their extended supply chains (e.g. UBL, RosettaNet) [27,28]. Business process standards have the basic elements of the processes and data definitions with code lists. Each standard uses different definitions and there does not exist a consolidated understanding of these elements. The objective of standardization is to offer error-free information and to share information in the supply chain in real-time [29].

An Integration Channel is based on interoperable business process services or systems. ICT, e-business have made it possible to offer completely new products and services, many of which have an important information component and which are frequently provided in collaboration by multiple companies [25]. The interoperability of services has made it possible to reach customers in new and innovative ways and through a multitude of channels. The internet has made it easier to conduct business on a global basis and theoretically to reach and serve customers in the remotest places. Finally, based on Internet and the Web services, a range of new pricing and revenue mechanisms have found their way into business practice [26,27]. The process of designing interoperable services is a part of implementing standardized business processes.

A Service Portfolio represents a complete list of the services managed by a service provider; some of these services are visible to the customers, while others are not. It contains present contractual commitments, new service development and ongoing service improvement plans. It also includes third-party services, which are an integral part of service offerings to customers. The Service Portfolio is divided into three phases: the Service Pipeline, Service Catalogue, and Retired Services. The process of designing a service portfolio is dependent on the structure of the interoperable service deployment. The service portfolio also includes the testing services for processes and data.

Value creation as a vertical layer in the framework

Customer Value creation is essential for the existence of companies. In short, a company needs to deliver value to customers and understand the business design options, customer needs and technological possibilities [26]. There has to be a deep understanding of how the customer is using the product or services and how this will solve the customer’s problem.

A Data Model addresses the understanding of dealing with business data. Achieving
semantic interoperability is essential for establishing a DBE. The heterogeneity of legacy IT assets, the quick change of business requirements, the lack of information on integration and the chaos of business terms and definitions are considered major hurdles on the path to a common cross-application interpretation of business information [33].

A Process Model describes the process of translating the value creation of the business into more detailed definitions of its operations. To really achieve business process interoperability, the process models and their representations must be well defined to enable cross-organizational process coupling [33].

Network Collaboration and the conducting of a business network refer to “the activity of dominating the organization's locations and networks where the business integration is aimed to be established”.

People Capabilities and competence relate to “the activity of involving proper people with knowledge and concepts” - the question is who would be involved.

Network Value Competitiveness has been added as a new column to the framework for several reasons. First, the enterprise architecture literature expresses the importance of including this in the models, and second, all business architecture elements include this as a fundamental criterion for sustainable business.

In the ZF, the time column, “When”, to design systems to optimize the workflow, running time and priorities of process usage, was essential work for system designs in the 80's, but the processor capacity and costs today no longer dominate design choices as such. This is the reason why this column was left out from the DBE framework.

The definition of value activity elements has been explained and summarized in Table 2.

### 3.3 The Basis of the framework

<table>
<thead>
<tr>
<th>Step 1: Formulation of the framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>This study has a multi-stakeholder view on digital business ecosystems. In order to create a better understanding of digital business ecosystems, a framework for exploring them was necessary. Based on the literature review, the research group could not find any suitable framework for exploring B2Bi in the digital business ecosystem. Therefore, the research group began the formulation of a framework by using Zachman’s enterprise architecture framework as the starting point. The B2Bi requirements and the abstraction of the Zachman Framework were included in the questionnaire.</td>
</tr>
</tbody>
</table>

The framework is based on six horizontal layers (rows) and five vertical layers (columns). The horizontal layers describe the different business architecture elements used by the stakeholders involved. The vertical layers describe the value activities to optimize the value delivery.

<table>
<thead>
<tr>
<th>Step 2: Formulation of the framework questionnaire</th>
</tr>
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<tbody>
<tr>
<td>Based on this framework setup, the researchers developed a questionnaire to measure the shells in the matrix. The matrix with the measures is presented in Table 3. Based on the literature, the interview of experts and earlier observations, each question represented a description of the importance of this element in building a digital business ecosystem with B2Bi. The rating was given by the focus group. The questions were asked using a 7-point Likert scale.</td>
</tr>
</tbody>
</table>

The questionnaire was tested by using the Delphi method in several iterative loops in the focus group meeting by using a groupware tool. The final rating was done by using a web-based survey tool. The answers were given by all 18 organizations in the focus group.

<table>
<thead>
<tr>
<th>According to the Zachman EA</th>
<th>Why</th>
<th>What</th>
<th>How</th>
<th>Where</th>
<th>Who</th>
<th>When</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA Framework</td>
<td>Motivation</td>
<td>Data</td>
<td>Function</td>
<td>Network</td>
<td>People</td>
<td>Time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>According to the Information Value</th>
<th>Description of vertical elements and activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBE integration framework</td>
<td>Customer Value</td>
</tr>
<tr>
<td>The column describes how information enables to add value for products and services.</td>
<td>The column describes what information is needed and how it is designed.</td>
</tr>
</tbody>
</table>
Step 3: The Questionnaire used in the rating

The key motivation to explore the situation in the existing digital business ecosystems was to understand the readiness and knowledge caps in the digital business ecosystem. Each shell contained the argument that describes the situation. The responses were rated from 1 to 7 on a Likert scale (1 = the work not started, 7 = completely executed). The respondents were executive level managers, business unit level managers, and ICT service providers in the role of a buyer or seller.

4. Results

The results of the evaluation are presented in Table 4, which summarizes the adoption of B2B integration in different layers according to the integration framework developed. The results are based on a focus group of 18 companies and their valuation. The sample consisted of banks, intermediate companies, ICT service providers, forest industry companies and strategic product and service suppliers. They represented a digital business ecosystem, and the results reflect a wider understanding of a heterogeneous business environment than we previously had available.

The numbers are based on a survey for the focus group and they represent the average rating by the respondents on a 7-point Likert scale. The questionnaire contained a statement in each shell. This statement described the best practice for B2B integration. Value 7 on the Likert scale denoted that this statement is completely executed. Value 1 on the Likert scale denoted that they have not started the actions. The other given values described the maturity for each statement.

Table 3: Questionnaire for rating DBE integration model

<table>
<thead>
<tr>
<th>DBE integration model</th>
<th>Customer Value</th>
<th>Data Model</th>
<th>Process Model</th>
<th>Network Collaboration</th>
<th>People Capabilities</th>
<th>Network Value Competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy Executives</td>
<td>Our B2B integration plan will support the company's strategic goals and enable the emergence of new strategies</td>
<td>Our executives have real-time information of our business units and supply chain to support decision making</td>
<td>Our executives have defined what standards are used for the integration of business process information</td>
<td>Our executives have defined and prioritized the business units where integration is implemented</td>
<td>Our executives are aware of B2Bi benefits and are therefore committed to using common standards across the value network</td>
<td></td>
</tr>
<tr>
<td>Business Model Managers</td>
<td>Our B2B integration plan supports business units in achieving their objectives and goals</td>
<td>Managers are collecting and sharing real-time business information to increase efficiency and cut non-value work</td>
<td>Management has prioritized business processes where integration has been sped up with the use of standards</td>
<td>Management has prioritized customers and suppliers where integration will be executed</td>
<td>Management have actively participated in B2B integration planning and they have nominated the process owner to all major processes</td>
<td>Management measures supply chain performance against the company's performance measures such as delivery accuracy, error-free</td>
</tr>
<tr>
<td>Information Model IT Experts</td>
<td>We have a compact graphical drawing of the IT structure of our enterprise to help discussions and development</td>
<td>The IT structure tells where the information is located, where it is collected and where it is distributed</td>
<td>The IT structure tells in which business locations the process integrations will be implemented</td>
<td>The IT structure describes the core user groups internally and within the network</td>
<td>The IT structure includes the key responsible persons for each module</td>
<td>Our company's IT budget can be presented according to the IT structure</td>
</tr>
<tr>
<td>Process Standards St. Experts</td>
<td>The usage of standards has made rapid integration and scalability possible</td>
<td>The usage of standard documents has improved information by being real-time, error-free and reliable</td>
<td>The usage of industry standards has made it possible to integrate the supply chain</td>
<td>The usage of industry standards has made it possible to integrate supply chain</td>
<td>We have utilized experts who know how to use standards</td>
<td>We have agreed to usage of standards in our integrations and we have reached our target benefits faster</td>
</tr>
<tr>
<td>Integration Channel Intermediates</td>
<td>Interoperable systems support real time B2B collaboration in the business network</td>
<td>Information is exchanged as standardized electronic documents between IT systems</td>
<td>Shared, standard processes allow IT systems to process and exchange business documents at a desired level of automation</td>
<td>Guidelines and supporting services aid in B2Bi process implementation in the network</td>
<td>The roles and responsibilities of the B2Bi experts in organizations are clearly defined and communicated to partners</td>
<td>Organizations are able to carry out the targeted B2Bi and at the intended level of automation by dispensing the manual processes</td>
</tr>
<tr>
<td>Service Portfolio Users</td>
<td>We know which services of our customers and suppliers are ready for integration</td>
<td>We have test methods available for information integration</td>
<td>We have test methods available for process integration</td>
<td>We have an information repository available to our B2Bi in the business ecosystem</td>
<td>We have experts available for implementing</td>
<td>Open information sharing has sped up integrations and brought us the targeted benefits</td>
</tr>
</tbody>
</table>
The total sum of the given values explains the overall maturity of the B2B integration. The companies were ranked by these criteria within the DBE. The sum values of the rows or columns explain how the maturity varies by stakeholders or activities.

The Average scores of the shells give the possibility to observe the detailed maturity of the B2B integration. The statement in the framework (see Table 3) defines the scope of the B2B integration maturity. A detailed evaluation of the maturity can be done in a company, the network or the DBE level. These results outline the maturity in two dimensions, the value activities in columns and the stakeholder in rows.

By converting the values from 1 to 7 on the Likert scale to color codes based on Table 4, we get a graphic presentation for easier observation. The colors in the table can be used for visualization. The colors visualize the results in an easily comprehensible form and the subconscious judgment will be done much faster than by comparing numeric information. The numeric scale and the color scale summarize the maturity of the value network for B2B integration.

The results offer a view to understanding knowledge gaps in the different levels in an ecosystem (company, network or ecosystem). These gaps build an obstacle to starting B2B integration. Efforts are needed to fill these knowledge gaps in order to be able to build end-to-end integrations in a digital business ecosystem.

By analyzing horizontal level (rows) B2B integration maturity, we are able to identify responsible business stakeholders in this particular business area. By analyzing vertical level activities (columns), we get the understanding of information value and how it is delivered in DBE. Detailed information and reasoning can be monitored by analyzing unified shells. The vertical layers can be adjusted into a proper order to visualize better the extreme results. Based on the testing by the focus group, the following case specific results can be summarized. These results provide an example of the applicability of the DBE integration model in a case ecosystem.

**Strategy:** Analysis of the horizontal levels reveals that the executives at the strategic level understand the value of real-time information but they have not chosen the companies for the integration. An intangible asset (Collaboration and Capabilities) as well as tangible assets (Competitiveness) need to be defined and communicated better with companies.

**Business Model:** Managers understand the importance of real-time information, but since the other scores in value activities remain low, they have to improve the overall knowledge to arrange the information value delivery. The B2B integration performance is not measured and communicated.

**Information Model** received the highest scores, explaining that the IT experts have been able to design an integration plan. The detailed practical implementation on the Service Portfolio level is under development, however.

**Process Standards** are not yet in wide use and there is a big gap in the understanding of common standards. The low score in competitiveness value activity explains that the usage of standards is not understood to speed up integration.

**Integration Channel:** The lowest scores were observed in Data Model and Capabilities. In other words, the business is not able to tell what the exact data is that they want to exchange between partners. This work has to be outsourced to intermediate services, which increases the business in this sector. There seems to be little understanding of tangible assets (Competitiveness) to business on this level.

**Service Portfolio:** The lowest scores explain that real integration has not been planned. We lack the list of interoperable services and there are also many testing services that have to be built for data and process testing. Users lack the understanding of intangible and tangible assets.

**Customer Value:** Further analyzing continues on the vertical level, the results explain that there exists quite a good understanding of the value of real-time information for the customer among all stakeholders.

The **Data Model** is understood better by executives, IT experts and standardization experts but a real improvement has to be done in management and on the implementation level.

<table>
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</thead>
<tbody>
<tr>
<td>Strategy</td>
<td>4.3</td>
<td>4.4</td>
<td>4.1</td>
<td>3.8</td>
<td>4.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Executives</td>
<td>4.1</td>
<td>3.8</td>
<td>4.2</td>
<td>3.8</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>Business Model Managers</td>
<td>4.5</td>
<td>4.2</td>
<td>4.6</td>
<td>4.5</td>
<td>4.4</td>
<td>3.7</td>
</tr>
<tr>
<td>Information Model IT Experts</td>
<td>4.1</td>
<td>3.7</td>
<td>4.3</td>
<td>4.3</td>
<td>4.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Process Standards No Experts</td>
<td>4.3</td>
<td>3.5</td>
<td>3.5</td>
<td>3.3</td>
<td>3.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Integration Client Intermediates</td>
<td>4.3</td>
<td>3.8</td>
<td>3.5</td>
<td>3.3</td>
<td>3.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Service Portfolio Data</td>
<td>4.3</td>
<td>3.8</td>
<td>3.5</td>
<td>3.3</td>
<td>3.4</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Table 4: Example of the summary rating results and the interface of the DBE integration model
The Process Model is well understood by IT experts but practical testing needs to be developed. New innovations and services have to be built for testing data and processes.

Network Collaboration is understood better by most stakeholders but not by the real users. The users lack the knowledge of where or with whom they are able to establish B2B integration. This is a potential area to build new services for user groups.

People Capabilities: Maturity is on the proper level the only with IT experts but coordination of capabilities has to be improved. Combining these two columns, we get an intangible asset. The question is who is going to conduct the collaboration in the DBE.

In Network Value Competitiveness, tangible assets (cost/risk and benefits) are understood at the executive level but the further we go to real implementation, the less understanding we can identify. The results explain that this is one of the important issues in a DBE. Financial aspects are the key to making investment decisions.

Looking at the detailed results (shells), we find that the lowest score in Table 4 (2.9) (Integration Channel/People Capabilities) is probably the biggest obstacle to starting B2B integration. It is stated in the questionnaire that “The roles and responsibilities of the B2Bi experts in organizations are clearly defined and communicated to partners”. These experts are mostly needed in testing and in forming intangible and tangible assets.

By evaluating the DBE integration model, we have noticed that (i) this model can be used to explore the organizational and inter-organizational situation of the digital business ecosystem and that (ii) the evaluation of this framework improves the understanding of B2B integration.

5. Discussion and conclusion

The paper describes how the Digital Business Ecosystem framework was designed by using Zachman's enterprise architecture [13]. We refined Zachman’s framework in this study by adding the business elements with the responsible stakeholder and value activities to the framework. The Zachman framework's column “when” was replaced by the “Network Value - Competitiveness” column. This DBE integration model explains why information builds better customer value and how and by whom information is delivered in DBE. It considers different stakeholder views on B2B integration in the value network. This framework builds a bridge between common business elements and enterprise architecture. It explains what the maturity of real-time information involvement is in business and system development.

The framework serves as a logical structure for detecting, inspecting, and exploring the enterprise as part of a digital business ecosystem. The results offer a network view of understanding the knowledge gaps in the ecosystem. Furthermore, it points out the integration areas where more effort is needed. These knowledge gaps form potential for new innovations.

The focus group represented a digital business ecosystem and the results reflect a wider understanding of a heterogeneous business environment. By using a focused sample and one ecosystem as a research unit, it was possible to test the functionality of the framework also from the practical perspective and to get in-depth understanding of the phenomena. The results were evaluated by an academic research group together with the practical implementers in the case organizations.

We recommend stakeholders to use appropriate business elements or enterprise architecture such as TOGAF, DoDAF or FEA. By this DBE integration framework, we were able to outline common business elements and enterprise architecture. The power of this DBE integration model is the ability to illustrate the maturity of B2B integration throughout the organizations and stakeholders within the DBE. The results are easier to understand and communicate throughout the organization. The obstacles can be identified and development actions designed. Best Practices can be identified in multiple dimensions and used by the leadership to speed up development in networks. The DBE integration model can serve as a tool for better understanding of B2B integration requirements. B2B integration aims to build better competitiveness for companies and networks. Therefore, there exists a common understanding to invest in interoperable B2B infrastructure.

The questionnaire was designed by studying literature and testing it in focus group sessions. It is obvious that this work will continue. Testing the framework explored in the case environment gave us interesting results by enabling us to find knowledge gaps in this digital business ecosystem. These gaps build an obstacle to starting B2B integration. Further research is needed to fill these knowledge gaps in order to be able to build end-to-end integrations in a digital business ecosystem. The scope of this study was to build and test the framework. The sample size and the focus being limited to only one industry domain limits the generalization of the research results.

In further research, the sample size will be expanded, and thus the applicability of the developed framework can be generalized. The development of the DBE integration model will continue by extending the research deep into the roots of the business ecosystem. However, we were able to observe that this DBE
integration model serves well in a multi-stakeholder environment. We tested this in a heterogeneous B2B business environment, but it would be interesting to run the test between government and business service integration.

Further surveys will be done by using quantitative methods and expanding the population and involving new business domains. This extension will open new interesting perspectives for a better understanding of this phenomenon.

6. References