

**A NEW METHODOLOGICAL APPROACH FOR DESIGNING THE SOFTWARE
INDUSTRY VALUE CHAIN**

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Abstract

The importance of the software industry today is increasing because of its dispersive effects on the development of other industries. In this context, the software industry value chain analysis is a useful methodological approach that allows better understanding of software industry potentials for achieving increased efficiency and competitiveness. Hence, the main objective of this paper is to offer a new conceptual framework for the software industry value chain that will reflect the contemporary changes in this sector. The new model includes: a) identification of the key activities in the software industry; b) a new approach of sequencing the stages in the value chain; c) systematization of activities within each phase; and d) identification of interrelations and linkages in the chain.

Key words: *software development; software industry; software value chain; value chain.*

JEL Classification: *030,031.*

I. INTRODUCTION

The software industry is one of the key pillars of the digital economy that generates extensive and multiplicative effects on the development of other industries. Namely, productivity and quality improvements from software production may be transmitted to other sectors of the economy through various input-output links. In this sense, software is a central intermediate good in the new digital economy, and it takes up a special role in the process of economic development (Li Gao 2003). Therefore, the perception of the possibilities, potentials and ways for generating a greater value in the software sector receives considerable importance in the contemporary literature. This paper is focused on identifying the main components of the value creation process by using value chain as a reference analytical tool. Hence it offers a model for designing a software industry value chain that incorporates: a) identification of the key activities in software industry; b) a new approach of sequencing the stages in the value chain; c) systematization of activities within each phase; and d) identification of interrelations and linkages in the chain.

The paper covers three conceptually related parts. The first part comprises the general methodological aspects of the value chain. In addition it includes an analysis of the existing models and approaches of the value chain in the software sector. A new approach to conceptualization of the software industry value chain is offered in the second part of the paper. In this regard new components and specific changes are included in the value chain reflecting the complexity of linkages between the actors in value creation process.

Issues related to distinctive characteristics of the software industry value chain and factors that have affected contemporary changes are discussed in the third part. Limitations of the applied analytical framework and potential questions for further research are identified at the end of the paper.

The research is conducted by using secondary sources and comprises a qualitative analysis of the existing literature, surveys, studies, reports and evidence from empirical research carried out in different countries and companies.

II. THEORETICAL BACKGROUND

The issues related to the vertical integration of production have always been a subject of theoretical observations. In this context, the introduction of value chain methodology has provided a significant contribution for analysis of these issues. A first notable input for developing a value chain concept was given by Porter. According to Porter the value chain disaggregates a firm into its strategically relevant activities in order to understand the behavior of costs and the existing and potential sources of competitive differentiation (Porter 1985). In fact, value chain is useful analytical tool that enables systematic monitoring of all activities in the company as a key prerequisite for recognizing the sources of competitive advantage. The value chain is consisting of two groups of activities: a) primary activities that include inbound logistics, operations, outbound logistics, marketing and sales, and b) support activities that comprise infrastructure of the firm, human resource management, technology development and procurement. The classification of the activities is being made on the basis of whether they have a direct or indirect impact on value creation.

This methodological approach is adopted by many authors that have perceived the value chain as functionally related set of activities. Thus, according to Kaplinsky and Morris (2001) simple value chain incorporates the full range of activities which are required to bring a product or service from conception, through the different phases of production, up to the delivery to final consumers, and final disposal after use.

It should be noted that in most of value chain concepts the activities are linearly structured. Linear configuration of the value chain activities creates an impression of their chronological order. However, it must be emphasized that the complex interrelationships and linkages established among activities are iterative and are not always realized with synchronized chronology. Value may in fact be accumulated as layers overlapping one another without distinct separation or clear demarcation among activities (Ensign 2001).

In this regard, many authors redesign the traditional concept of the value chain including multiple dimensions, relations and actors. According to Normann and Ramirez (2000) the technological development and significant market changes contribute to altering the value-creating system itself within which different economic actors work together to co-produce value. Their key strategic task is the reconfiguration of roles and relationships among the actors in order to mobilize the creation of value in new forms and by new players. Based on compatible insights, Papazoglou et al. (2000) have developed the concept of integrated value system that can be defined as process by which multiple enterprises within a shared market segment collaboratively plan, implement and manage the flow of goods, services and information along the value system in a way that increases customer-perceived value and optimizes the efficiency of the chain.

Recent literature increasingly emphasizes the concept of value networks in which different economic actors participate complementary in the value creation (Holm et al. 1999; Peppard and Rylander 2006). Pil and Holweg, (2006) have developed a model of value grid as opposed to the traditional value chain. The grid approach allows companies to move beyond traditional linear thinking and industry lines. According to Pil and Holweg the increased efficiency of the value grid can be achieved through the establishment of vertical, horizontal and diagonal connections between companies.

The generic framework of the value chain is not fully applicable to all industries. Therefore, it should be adapted depending of the industry that is subject of analysis including specific components and features of each industry. Analogously, the analysis of the software industry value chain requires creation of methodological framework that will reflect these specifics (Schief 2014).

The existing literature identifies several conceptual approaches for designing software industry value chain. These concepts encompass different sequencing of the stages in value chain and different granulation of the activities. Certain concepts include fewer activities while other concepts are characterized by detailed and wider structure of activities. The granularity is up to individual judgment, since activities can be enriched or condensed by aggregation or disaggregation (Schief 2014). The main aspects of the software value chain include: architecture (consulting, analysis, concepts); developing code; testing; implementation, marketing and distribution; maintenance; helpdesk and training and education (European Software Strategy 2009).

The UNCTAD perception of the software industry value chain is through the prism of its role in developed countries and developing countries suggesting that the scope of value creation depends on the nature and market orientation of the production. The offered value chain model is consisted of two components: software services and software products. Software services include all activities associated with the software development, covering specification and analysis, design, implementation, testing and maintenance. The process of software development results in the production of two types of software products - application software and system software (UNCTAD

2012). This configuration of the value chain is a simplified framework in which many relevant actors and activities of the value creation are not included.

Conversely, Pussep et al. (2011) create a very detailed configuration of the value chain. The proposed concept of unified software value chain is consisted of eleven consecutive activities belonging mostly to the primary value chain starting with product research, component procurement, product development, user documentation, production and packaging, marketing activity, implementation, training and certification, maintenance and support, operations and replacement.

Activities in the value chain according to Messerschmitt and Szyperski (2003) can be divided in two global groups, i.e. two value chains: requirements value chain and supply value chain. The requirements value chain includes activities related to: a) analysis of the needs and requirements of users; b) design of specific approaches to their satisfaction; and c) implementation of software (application software and infrastructure software). The supply value chain includes downstream activities and encompasses four primary stages: implementation, provisioning, operation, and use. The implementation phase basically overlaps and connects both value chains.

Boehm and Papaccio, (1988) are using value chain as a method that allows the analysis of costs distribution as a prerequisite for identification of strategies for integrated software productivity and improvement of the software quality. They point out that the value chain is a helpful method for understanding and controlling the costs in various organizations.

According to Tyrväinen (2013) value chain is U-shaped starting from opportunity identification based on a down-stream customer need and going through software development activity to the software release / service platform.

III. MAPPING THE VALUE CHAIN IN SOFTWARE INDUSTRY

Software industry value chain comprises a complex structure that includes several stages whereby each stage can be disaggregated in multiple activities. Interactions and linkages established within each phase and between different stages are the main determinant of the industry effectiveness and success.

In this paper we create a new conceptual sequencing of the stages in the value chain which integrally covers activities from providing inputs, up to the final users. The basic aim is to connect all stages of the value creation in software industry as an essential prerequisite for identifying potentials for achieving more effective articulation of the activities. Namely, value chain methodology enables clear identification of the actors and activities in each segment of the value creation. Hence, it is a helpful analytical tool for recognizing opportunities for functional improvement of the value chain and assessment of its potentials for dynamic adjustment to the market changes. Value chain analysis should be applied in a way that detects all existing bottlenecks and development potentials and help managers and policymakers to deploy a combination of value chain development interventions which only jointly can lead to chain development (UNIDO 2009).

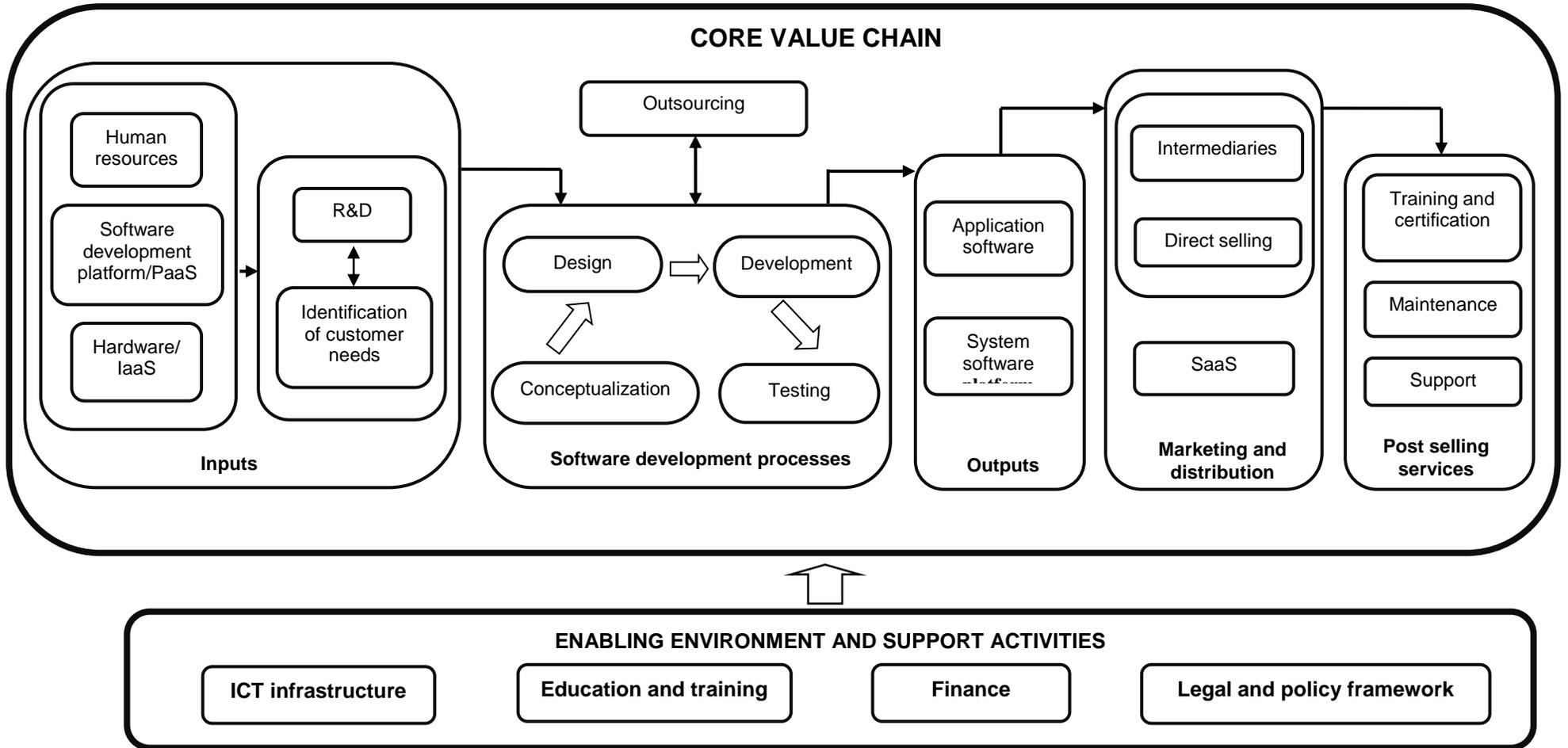


Figure 1 - Software industry value chain

Mapping of the stages and linkages established in value chain is presented in Figure 1. Upstream segment of the value chain includes synergy of inputs employed in software development that can be classified in two groups. The first group is consisted of labor inputs, software tools and hardware tools that integrally constitute the main input platform. It should be noted that in the conditions of expansive growth of the cloud computing technology, software tools and hardware components may also have service character (Platform as a Service - PaaS, and Infrastructure as a service-IaaS), i.e. they can be used by all interested customers on global level. The components belonging to the main input platform can be directly utilized for development of custom or packaged software. Furthermore, a number of input components can be engaged for conducting R & D activities. Based on the identification of customer needs and market data these activities contribute to development of innovative software applications. In fact, a generic process framework for software development encompasses six activities: communication, conceptualization, design, development, testing and deployment (Pressman 2010; Maheshwari and Jain 2012; Kumar et al. 2013). It should be noted that communication activities have very important role in pre-development stage (the stage of identification stakeholders requirements) and are significant factor in conducting R&D activities. After that, the software development process continues with conceptualization, design, development and testing activities. Although there are many different software development methodologies, the intention of this paper is not to deal with the selection of the software development model. The deployment activities are included in post-development phase (delivery of software to customers and receiving feedback from its evaluation) i.e. in the downstream part of the value chain. The dynamic and novel changes that are now taking place in the software industry have contributed for diversification of the downstream segment of the value chain. Namely, the options for distribution of software applications are becoming wider and innovative. In this context, apart from the use of traditional methods (intermediaries and direct sales) the value chain incorporates the option for accessing the software applications over a network (Software as a Service- SaaS). In fact, SaaS is model that allows access to software applications over the Internet, whereby the services from one or multiple providers can be used free or by paying a subscription fee. Activities that refer to training, maintenance and support of the software products can also be implemented by using conventional methods or are included in the SaaS model. The emergence of SaaS contributes significantly to streamlining and simplifying the downstream activities of the value chain.

IV. DISCUSSION

Based on the proposed model of the value chain the discussion is focused on a few more relevant aspects that come from the recent features and trends in the software industry and impose a need for reviewing the existing value chain models.

The process of software development is a skill-intensive and knowledge-intensive because the labor with appropriate knowledge and skills is a crucial input, or as Hoch (1999) notes software production is consisted of "nothing but knowledge in codified form". The required capital investment, including hardware and software development tools are comparatively low and do not constitute an entry barrier as in other areas of information technologies (notably hardware and telecommunications) (GIZ 2011). Having in mind this it comes out that the competitive advantage of software industry cannot be built on economy of scale but primary on developing innovation capabilities and product differentiation.

The vertical structure of relations between actors in the proposed value chain model is complemented with certain horizontal interactions and links. Namely, the trend of value chain fragmentation where external parties are included in the software development is more evident in practice. Nowadays, globalization opens up numerous opportunities for utilization of location and cost advantages of the countries that has significantly changed the traditional concept of software industry value chain. Thus, the linear structure of the chain is transformed into a more complex network structure. Namely, the high modularity of the software development process allows fragmentation in multiple sub-components where different components of value chain are allocated in countries where activities can be carried out more efficiently and cost effectively. According to Aspray et al, (2006) the following software development activities are usually subject of the offshore outsourcing: (1) programming, software testing, and software maintenance; (2) IT research and development; (3) high-end jobs such as software architecture, product design, project management, IT consulting, and business strategy. This trend describes the increasing differentiation and specialization within the software development value chain in terms of providers and technologies (GIZ 2011). In this context, cost savings, increased flexibility and innovation as a result of the capitalization of external knowledge are often mentioned motives for software development outsourcing (Heeks et al. 2001; Hätönen 2008). It should be noted that today, the outsourcing strategies in software firms shift from outsourcing core activities for cost-cutting reasons towards outsourcing value-adding and customer-specific activities in order to achieve a better business focus and operational flexibility (Hätönen 2008). Additional benefits also come from having operations in other time zones which can speed up production by facilitating round-the-clock production (Aspray et al. 2006).

The need for restructuring the value chain also is induced by dramatic growth of cloud computing technology that enables development of more effective business models. With the introduction of cloud computing, the value proposition of software has been significantly improved as well as the way for delivering and selling the products (Fois and Lysonick 2012). The emergence of cloud computing implied a significant modification of the value chain. In fact, it comes to virtualization of value creation process in the software sector that can be presented by independent cloud value chain. In order to depict these relations in value creation, Leimeister et al. have developed the e3-value methodology that provides suitable modeling concepts for showing complex interactions between different actors in cloud computing value network. This methodology has two main characteristics. First, it is a methodology, which recognizes the importance of economic value. Consequently, e3-value analyses the creation, exchange and consumption of economically valuable objects in a multi-actor network. Second, e3-value is founded on principles of multi-viewpoint requirements engineering and semi-formal conceptual modeling (Leimeister et al. 2010).

In addition, the broad range of cloud activities has imposed a need for consolidation and better connection of cloud services. This has resulted in development of "cloud broker" model, which can be applied at various stages of the cloud value chain. Cloud brokerage enables efficient connection of buyers and sellers of cloud services. Having in mind the high level of activity in this space, it is expected that cloud brokerages will dramatically change the IT sales channel landscape (Belmans and Lambrette 2012). However, given that cloud computing is just an extension of possibilities for value creation we consider that it has to be incorporated as an integral part of the basic software industry value chain. The IaaS and PaaS components of the cloud computing enable customers to build applications without making considerable investments on infrastructure while SaaS allows distribution of software products on-line with a relatively lower cost. By adopting SaaS applications are accessible from various client devices whereby the consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities (Mell and Grance 2011). Because the software is hosted remotely, users do not care about installation, set-up, licenses, training and maintenance. Hence, SaaS model implies much lower complexity of the supply chain because it does not use complex distribution networks. The vendors charge fees for SaaS applications that at the same time include monitoring, maintenance and upgrades of the applications as well as training and support of the end-users (SIIA 2006). In this way the value chain is simplified because downstream activities and costs are significantly reduced. On the other hand the payment is linked to the real scale of software applications usage, which is not the case with traditional licensed software i.e. there is no possibility of such metrics. Moreover, the development of IT enables significant expansion of the software market because it allows access to software applications through the use of mobile devices.

New insights promote a holistic approach in value creation pointing towards that the software is advancing along five dimensions: collaboration, comprehension, connectivity, cloud, and convergence. These dimensions, coupled with the underlying complexity and scale, demand new software solutions based on new computing paradigms and infrastructure. Such software-driven solutions can create nontraditional market entry points and consequently entirely new mechanisms to address a single customer with time- and location-specific services (Ebert et al. 2015). These insights open up significant room for prospective modification of software industry value chain.

V. CONCLUSIONS, LIMITATIONS AND FURTHER WORK

The software industry provides a strong impetus to the development of other industries. This paper gives an overview of the different methodological approaches for designing software industry value chain as an analytical platform on which we have created a new model for value chain configuration.

Here, we have developed a new methodological framework that reflects the dynamic changes in the software sector and incorporates new activities and modes of value creation in this sector.

The proposed model also comprises external factors (policies and legislation) and support activities as important determinants of value chain success. In this sense the following factors are included in the chain: IT infrastructure, educational institutions, and sources of funding, legislation and policy. However, it should be mentioned that we have not conducted a comprehensive analytical observation for assessment of their impacts. Consequently, it is necessary further research and in-depth analysis to be carried out.

In addition, the expansive usage of open source software has significantly changed the competitive environment in the software industry and opened up new aspects for prospective research. These changes will also imply a need for conceptual modification and upgrading of the value chain in the software industry.

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