Rethinking of the Value Chain model

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Abstract: Industry 4.0 solutions have fundamentally transformed the value creation processes of business organisations. By enabling IT processes, and thus automated high-precision data collection, the functions performed by business organisations, the way in which various business processes are carried out and the architecture of the calibre and ICT infrastructure used have been fundamentally changed. Thus, in these farming organisations, real economic and IT (partly virtual) processes are integrated and inseparable. Drawing on Porter's value chain, I will examine how these results have induced changes in the life of the business organisations. The result is a modified version of Porter's value chain model that provides a unified assessment of the functioning of business organisations that apply Industry 3.0 and Industry 4.0 technologies.

Keywords: Value Chain model, Industry 4.0, digital tranformation)

1 Introduction

When we consider the impact of the evolution of IT infrastructure services on business organisations, we often make the misconception that we are looking at a radical shift from Industry 3.0 to Industry 4.0 [1]. We do this because comparing the two eras reveals the well-known significant distinct features, so that their impact can be easily examined. (Regretfully, few authors get to the point of identifying the transition period [2].) This has the inconvenience of presenting the process of what is commonly referred to as 'digital transformation' with a simple narrative. As a as a result, it is harder to articulate why the development of the informatics infrastructure has had such an ambivalent impact on the operations and structure of profit-driven organisations.

If we focus on the period from the 1960s to the turn of the millennium, which is marked by the term "Industry 3.0", we can conclude that by the end of the era, the various enterprise management systems were aiming to cover the entire range of corporate activities [30]. In principle, these solutions made it possible to support the IT support of organisational operations, preferably with a single large system. These integrated systems were based on a more financial approach, but for those organisations with significant fixed assets (e.g. production lines), there was a need to operate systems that would optimise the organisation's operations by optimising strategies for the life cycle of fixed assets and the investment and work organisation decisions that were taken instead [4-5]. The proliferation of computer-aided design (CAD) and production management (CAM) solutions has begun to radically transform the enterprise value creation process through automated operations that minimise the need for human intervention [3], but these too can be seen as isolated solutions [6]. Industry 3.0 has focused primarily on automation within plants, substituting machines and computers for human labour to optimise production lines. The aim was to improve both productivity and efficiency

Prior to the turn of the millennium, the spread of TCP/IP-based networks made B2B and B2C transactions more efficient, and the spread of the TCP/IP-based Internet and the http protocol and its web-based technologies allowed the various custom EDI solutions to be replaced by vendor-independent standardised B2B solutions, usually based on XML. This opened up the possibility of integrating the supply chains of different market actors [7] and of automating the purchase transactions. Technological developments since the early 2000s have blurred the sharp boundaries (legal and geographical) between the different business partners, and human intervention is no longer always required to carry out certain transactions. As a result of these developments, companies that follow "classic value creation processes" are increasingly digitising their business processes. At the same time, business models have emerged that have introduced purely online-based products and/or services [8]. The development of communication networks across the spectrum of services - and not just the internet - has made it possible to integrate supply chains within a sector, formed by companies (often in competition with each other) that need to cooperate with each other. Two examples of this are the financial services and civil aviation industries, where integrated and interoperable supply chains had already emerged before the dawn of the Industry 4.0 era discussed in this article [9-10]. Technological advances since the early 2000s have blurred the sharp boundaries (legal and geographical) between the different parties to a transaction, and human intervention is no longer always required to complete certain transactions. As a result of these developments, companies that follow "classic value creation processes" are increasingly digitising their business processes. (This development was also somewhat reversed by the bursting of the dot-com bubble, which can be seen as a failed attempt to transition between the era of Industry 3.0 and Industry 4.0 [11])

Almost all publications agree that the automated, sometimes IT-supported, production process in Industry 3.0 is undergoing a fundamental architectural change in the course of digital transformation. This will enable production to be monitored with much greater frequency and much more accurate sampling, automated decision-making and decision validation through automated control. Production equipment capable of exchanging and receiving IT data and control data can be organised into a single system, but M2M, i.e. peer-to-peer machine-to-machine communication and autonomous decision-making, can make this ICT infrastructure partially or entirely decentralised. It should be stressed that this change is not only affecting formerly technology-intensive industries, but is permeating almost all segments of the economy. When we answer the question of how this transformation is taking place, we are confronted with the fact that it involves a multi-technology group. Without being exhaustive, the technologies related to Industry 4.0 include [12-13]: IoT devices, cloud computing, augmented reality, big data, artificial intelligence (AI), autonomous devices and vehicles [14-15]. If we look at the relevant qualitative research, we can see that indeed, there are significant differences in the uptake of these technologies. In this research, I will examine the issues of whether the Value Chain Model, which is the most common model of the structure and operation of business organisations, can and will reflect these changes, and which changes are required.

2 Metholdolgy

The constantly evolving range of IT solutions and the ever-intensifying the scientific clarification of the question of how for-profit organisations the role of these solutions in the life of a profit organisation. This analysis is based on the value chain model developed by Michael Porter [16]. Since the author of the model has not changed his model despite technological and economic developments in the meantime [17], I will examine how other authors have adapted the value chain model and, based on my experience, propose a unified model in which both Industry 3.0 and Industry 4.0 technology-systemising business organisations can be interpreted and analysed.

3 The Value Chain model

The original version of the value chain model [16-17], created by Michale Porter, is shown in Figure 1:

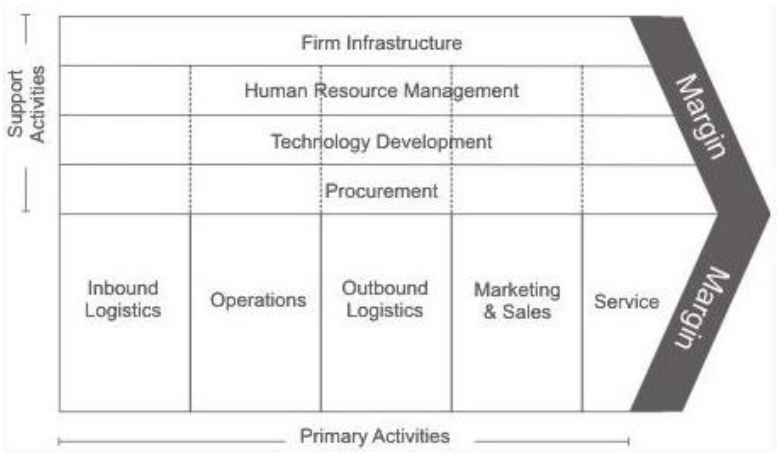

Figure 2.
The Value Chain model (source [16-17]

The following observations can be made with regard to the value chain model and its unchanged form:

- The model only considers the classical value creation process. It does not reflect the digital value creation process mentioned earlier and, as a consequence, it cannot deal with hybrid solutions [18].
- On the one hand, the logic of the model assumes that acquisition takes place in some form, that transformation takes place, but that the buyers are in any case end-users. In practice, this model does not distinguish between B2B and B2C marketing activities, nor is it prepared for the fact that solutions rather than products are sold to end-users: it is difficult to understand the sectoral cooperation. [19]
- The model does not make a distinction between material and information flows. This is worth highlighting because the importance of information sharing in pull supply chains is well known [20].
- It is not made clear at which stage of technological development (Industry 3.0 vs 4.0) each part is. Consequently, neither the automation of the processing of the data generated in the production process nor the automation of the processing of the data generated in the production process can be identified [1].
- The model treats the infrastructure underlying the company's operations as a whole. It ignores the significance of the split between the infrastructure managed by business organisations into classical and IT infrastructure, and the integration of a new actor in the role of the operator into the life of the enterprise with the spread of cloud-based solutions [21].

The model presented in the following chapters aims to address these problematic issues.

4 The proposed model

The procposed modell is presented in Figure 2:

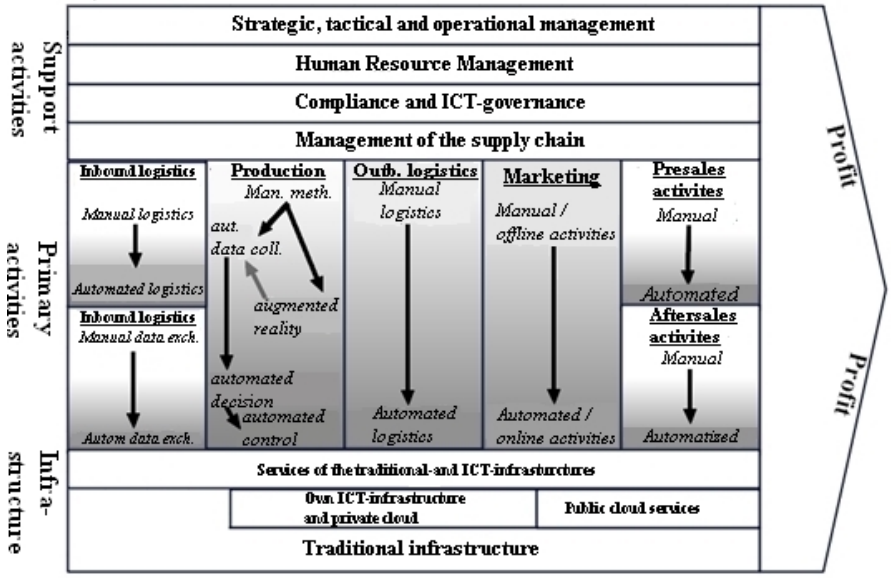

Figure 3.
The prosposed model (Source: [22])

Since Industry 4.0 solutions have first and foremost transformed the value-creating (primary) processes of the farmer organisations, I will first examine the steps of these processes and complement them with the lessons learned from the review of the preparation models, which are complemented by the theory of vertical and horizontal integration that Industry 4.0 has developed [23]. Subsequently, and in light of this, I will examine the different parts of the supporting activites.

Inbound logistics: in the original model, this was understood as the purchase of all inputs that the business entity obtains in the process of creating value. This is the point at which suppliers come into contact with the entity and is considered the boundary of the taxonomy unit. This remains the case in the revised model, but it is necessary to go into more detail in several respects. - The strategic importance of customer-supplier relationships is paramount in the era of Industry 4.0, i.e. turnover is slowing down and there is a need to automate operational processes. That is, from

the perspective of a company, the question is whether it can generate data automatically and transfer it to its supplier partner in an automated way [24].

Operation: by definition, this is the area that has been radically transformed by the Industry 4.0 mega-solutions. Regardless of whether we are looking at the production of tangible and/or intangible products/services, there are several aspects to keep in mind: advances in sensor technology and the related mindsets of ICT infrastructure (e.g. data transmission) have made it possible to capture the data generated in value creation processes more frequently and accurately than was previously the case (i.e. manually, with human intervention). Advances in information technology have enabled automated decision making, usually based on artificial intelligence (AI) (even if the use of AI today raises ethical questions.) The fact that decision making can be performed autonomously in the production tool and can take place in the 'centre' of a centralised ICT infrastructure, on servers, makes it difficult to manage AI-based unified models. Finally, a word about control. This can be done manually, semi-manually (decision is made automatically but requires human approval), or automatically (centralised or non-centralised).

Outbond logistics: the key point of outbond logistics is that it integrates the role of another actor, the transport partner, in cases where the transport is outside the responsibility of the entity under consideration. Whether the relationship is B2B or B2C, real-time or at least quasi-real-time data reporting is expected. Therefore, not only the contractual delivery of the product is expected, but also in many cases data on the circumstances of the transport, which is provided by an external partner performing the forwarding tasks.

Marketing and sales: the main question in this section is the ability to integrate external and internal data into marketing activities and to use data mining and artificial intelligence solutions (recommendation systems, chrun analysis, other predictive techniques) for marketing purposes.

Operations: includes activities directly related to the sale of a product (e.g. customer service). The service itself can be broken down into two parts: these are services during delivery and services after delivery. Services during delivery are firstly related to Outbound logistics and Marketing and sales. Post-delivery services are more complex, as they include a range of additional online services, online administration (e.g. in case of warranty), this part can even go back to the "Production" function.

After the overview of the primary activity, the analysis of the supporting activities follows: in my proposed model, the range of supporting activities has undergone a significant change. Corporate infrastructure has been removed from this scope and is a new category, the reasons for which will be discussed later.

Strategic, tactical and operational management: this replaced the former "business infrastructure" activity. This category includes all corporate management functions, i.e. all management activities that do not affect other areas of responsibility covered

by the supporting activity, from the design of the organisational hierarchy to accounting controls. These are mandatory functions and should therefore be included in the revised model.

Human Resources Management: this activity remains autonomous (and not integrated into the previous activity) because, although Industry 4.0 technologies may trigger human work through automation, there may be an increased demand for knowledge from employees, which will probably need to be updated more frequently than in the past [25]. As a result, human resource management will have to deal with more sophisticated, controlling activities than before [26].

Compliance and IT-Governance: the main characteristic of Industry 4.0, as I pointed out in the introduction, is that the physical environment and IT (information) systems are symbiotic entities. This situation is complicated by the fact that with cloud-based solutions, the ICT infrastructure used by the business organisation is (at least partially) outside the control of the business organisation in terms of operation, but the user bears the operational risks. In the proposed model, this category includes all ICT Governance, IT Management and Compliance dimensions [23].

Supply chain management: this activity has replaced procurement. This was necessary because several authors have argued that supply chains are becoming more integrated and it is becoming more common for an entity to pay more attention than before not only to buying/selling but also to working with other market partners [1, 2, 8]

In the version of the value chain model I have revised, infrastructure has become a separate activity, consisting of three parts: own physical infrastructure, own ICT infrastructure and some (partial) ICT infrastructure of the cloud service partner. I have considered it necessary to treat these three elements separately and in a coherent structure because these three elements provide the infrastructure framework for business organisations in the era of Industry 4.0

Conclusion

Two important properties of the model based on the theoretical derivation, summarized in Figure 2, are that the original value chain model can be made asymmetrically equivalent to the new model. Accordingly, each component of the original model can be uniquely assigned to one or more components of the new model. In this way, it has been possible to achieve a model that can be applied to enterprises using Industry 3.0 and Industry 4.0 generation technologies. This model can be interpreted in the same way for integration in classical, digital and hybrid supply chains. In this model, it is not a specific solution that has been identified directly, but the objectives and sub-objectives that could be achieved by applying each solution.

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