

Procurement Optimization In I4.0 Environment-A Review

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ABSTRACT

The much-discussed topic, Industry 4.0 receives more and more attention. However, literature mainly focuses on Industry 4.0 in coherence with production and the practical application. Due to the minimal attention in literature for purchasing in connection with the fourth industrial revolution, this research pursues the subject. A multiple case study has been conducted with companies from different industries to explore the status quo of applications regarding Industry 4.0 technologies in procurement. The theoretical framework of the purchasing year cycle was adapted regarding Industry 4.0 and used to analyse the interviews. Qualitative data obtained from nine conducted interviews was analysed and compared with corresponding literature. The analysis revealed that Industry 4.0 in procurement is still in its infancy. Most companies market new technological developments within their firm as Industry 4.0 applications. However, some of the implementations can be considered as advanced technologies of the third industrial revolution and not as Industry 4.0 in procurement. Therefore, companies need to fully adapt the third industrial revolution before being able to successfully carry on with the fourth industrial revolution. It was figured that the companies share similar visions. They aspire to make use of Industry 4.0

applications to lead the firm to more transparency, efficiency, and enable more precise forecasting. It was analysed that interconnected cyber-physical systems can be considered as the organisational antecedents for Industry 4.0 in procurement. Following the adapted framework could help companies to overcome uncertainties that appear due to the novelty of the topic. Hence, the concept of a company-wide interconnected ERP system received special attention in this paper. The ERP system is suggested as a unifying system for the companies encouraging the connection to their suppliers.

INTRODUCTION

Industry 4.0 became a high relevant and frequent discussed topic for companies, universities and research centres. The buzzword Industry 4.0 describes the fourth, currently taking place, industrial revolution which promises huge economical potential as well as provides promising ecological and social opportunities. Moreover, Industry 4.0 and its current concepts (i.e. Smart Factory, Cyber-Physical System (CPS), Internet of Things (IoT) and Internet of Services (IoS)) also cause a paradigm shift in work organization, business models and production technology[7].

This revolution is initiated through forces that can be described as a customer-pull as

well as a technology-push. On one side, shorter development cycles, individualization on demand, flexibility in production, and required resource efficiency pull for this revolution in manufacturing [1]. On the other side, technological developments like increasing automation, digitalization, and networking push customer expectations leading towards the fourth industrial revolution.

The so called ‘Smart Factory’ provides an example for the application of Industry 4.0 concepts, resulting in highly integrated, self-controlled operations. These ‘Smart Factories’ are strongly equipped with sensors and autonomous systems. ‘Cyber-Physical Systems’ merge the physical with the digital level while the ‘Internet of Things’ enables interaction between machines and/or humans. Big Data & Business Intelligence extract valuable knowledge from complex structured, large data sets. Beyond manufacturing changes, new distribution and purchasing systems enable customized product development through connected processes along all channels.

At the same time, the importance of purchasing, the active managing of external resources, for the overall company performance continues to increase. Outsourcing, globalization, and the switch from labour-intensive production to machine-based production can be seen as main reason for the increasing relevance of sound purchasing processes.

INDUSTRY 4.0: BACKGROUND AND OVERVIEW

As a result of the introduction of water- and steam-powered mechanical manufacturing facilities, the first industrial revolution began at the end of the 18th century. Electrically-powered mass production and the division of labour led to the second industrial revolution at the end of the 19th century. From the early 1970s on, the usage of information technology and advanced electronics for the further automation of manufacturing resulted in the third industrial revolution[2]. Today we are in the fourth industrial revolution that was triggered by the development of Information and Communications Technologies (ICT). Its technological basis is smart automation of cyber-physical systems with decentralized control and advanced connectivity (IoT functionalities). The consequence of this new technology for industrial production systems is reorganization of classical hierarchical automation systems to self-organizing cyber physical production system that allows flexible mass custom production and flexibility in production quantity.

Industry 4.0 is enabled by technologies that integrate the digital and real worlds, such as:

- The Internet of Things (IoT): Connecting more and more systems, devices, sensors, assets and people through networks ranging from wireless, low-power wide-area networks to wired high-capacity networks
- Mobile solutions: Including smartphones, tablets, wearable sensors and smart glasses

- Cloud computing: Including low-cost processing and data storage solutions
- Cyber-physical systems (CPS): Monitoring and controlling physical processes using sensors, actuators and processors, based on digital models of the physical world
- Big data analytics and business intelligence: Turning data into actionable insights, which include early warning algorithms, predictive models, decision support, work flows and dashboards
- Advanced manufacturing technologies: Including robotics and 3D printing

INDUSTRY 4.0 IN PROCUREMENT

Procurement is the process of finding, agreeing terms, and acquiring goods, services, or works from an external source, often via a tendering or competitive bidding process. The new strategy and procurement 4.0 framework helps firms to adapt to the radical changes that are associated with new opportunities of Industry 4.0. The framework substantially focuses on the digital supply chain. Thereby, the changing competitive landscape is recognised as one of the main drivers in today's business environment[6]. Competition and technological developments are included in the framework while Arnold's framework concentrates on the traditional sourcing categories.

The aim of this research is to discover new opportunities for Industry 4.0 in purchasing. Purchasing process is divided into six sub processes, the sub processes are closely related and building up on each other. The next step can only begin once

the previous step is successfully performed. Therefore, careful consideration of requirements and issues for the next steps in the purchasing process is required, as interruptions or repetition of the purchasing process through changes or inadequate planning can lead to additional costs [5].

- The define specification sub-process consists of two elements, the determining of the purchasing requirements and the development of the purchase order specification
- To satisfy the identified need, suitable suppliers need to be identified
- In the negotiation and contract agreement step, the main objective is to come to a final agreement on all specific elements of the purchasing agreement.
- The characteristics of the ordering sub-process differ based on the contract decision that was taken in the previous step. In case of a single purchase, a purchase order will be created including all agreed conditions and send to the supplier. In case of framework agreements, blanket orders are created against which a material call-off is done whenever a requirement comes up
- Order follow-up consists of several small tasks that need to be considered between the placement of an order/material call-off and the final settlement of the delivery.
- After the successful receipt of the order, a supplier evaluation based on the delivery performance should be conducted

METHODOLOGY

METHODOLOGY	CHOICES
Research paradigm	Constructivism
Research strategy	Exploratory, qualitative
Research approach	Deductive with inductive elements
Research design	Multiple case study
Population & sampling	Non-probability (purposive, snow-ball)
Data collection model	Interviews (personal or phone)
Data analysis model	Qualitative content analysis, cross-case analysis
Research quality criteria	Construct validity, external validity, reliability
Ethical remarks	Protection through consent form and anonymity

CASE: A

The first case consists of two parts. The focal point is a German premium car manufacturer. The automotive manufacturer (MA) is located in Germany and produces premium cars. The purchasing organization is split into product areas. Supplier 1 (S1A) is a multinational corporation specialized on certain interior components. This supplier covers a wide range of different products. Supplier 2 (S2A) is a mid-sized automotive supplier specialized on natural interior components. This company covers a wider range of value creation within the

specialized field. For this case, seven interviews were carried out.

The current state of Industry 4.0 implementations at the focal company is assessed to be comparably high. Several isolated solutions and pilot projects are carried out. From the supplier side, supplier 1 claims to already promote highly automated, interlinked self-learning operations. Supplier 2, with a focus on natural resources sees little feasibility for own Industry 4.0 operations.

Beyond production implementations, participants state that infrastructural changes come along with Industry 4.0 implementations, focusing on digitalization, standardization and automations. The relevance of Industry 4.0 for purchasing is assessed to be high and even growing. Implementations of Industry 4.0 aspects in purchasing cannot be found yet, while general digitalization is already strongly addressed.

CASE: B

The company's suppliers are completely integrated in daily processes and specific innovation processes in procurement. However, suppliers are not as much involved in tasks and projects that belong to Industry 4.0.

A supplier selection platform should contribute to the procurement strategy. Company B has an ERP system integrated within the entire company that stores data from the entire course of business. The suppliers are connected to ERP to get more information and instructions about their

assignments. In addition, a warehouse system is implemented in the procurement department that stores data about suppliers and helps to evaluate them. The outcome is forwarded to the supplier in order to help them improve their performance in crucial points. Additionally, a platform that enhances the supplier appraisal stands in line to be tested. The platform aspires to register suppliers and make reclamations. Criteria in terms of supplier selection will be upgraded and touch-points increase. Furthermore, the platform should contribute to procurement strategies, monitors the supplier's development, fosters supplier integration, and optimises the integration between the different departments.

All departments have the same extent of knowledge regarding Industry 4.0. Company B's vision is to optimise networking, forecasting, and reactions in case of potential risks. Analysing data becomes easier with the help of Industry 4.0 technologies and integration between different departments is expedited. All departments are at the same level. They exchange knowledge about digitalization to optimise integration. The entire company is asked to participate when it comes to Industry 4.0 and every department has an equal role within the firm.

CASE: C

Mr V explained that suppliers are integrated into regular innovation processes in procurement in order to systematically improve and implement new ideas. The Company and its suppliers already adapted processes that are based

on Industry 4.0 technologies such as an extensive logistics system. The Company owns lorries and invests in additional vehicles to get along with the extensive transportations within the holding and to their clients. All lorries are provided with a tablet PC that is connected to a company-wide system. The drivers constantly communicate with the company in order to make transportation more efficiently and to plan sufficiently. Employees within the commissioning, for example, know exactly when the next lorry is coming and wait prepared to load the vehicle. Company's purchasing department has implemented a web-based business intelligence tool that is connected to the firm's suppliers. All goods at the Company are transported with standardised loading devices. During the summer, Easter, and the festive seasons more devices are needed than during the rest of the year. A web-based business intelligence tool automatically informs suppliers about the current inventory and sets an alarm when they have to deliver loading-devices. Another pilot project stands in line to be tested. It is based on cloud computing in order to make more accurate analysis by using public data, data from social media, customer's information as well as the company's data. The results are analysed and can be used in the company's different departments. The predictive analytics tool enables the holding to increase the degree of automation and digitalisation. The purchasing department has a leading position within the company in Industry 4.0. The respondent expects that Industry 4.0 increases the overall transparency and efficiency in the company with tools such as predictive analytics. The company's vision is to build a network in order to use capacity efficiently by, for example,

cooperating with competitors to bail out the capacity of the storage room of a lorry. At the Company, the different departments are at similar levels of Industry 4.0 integration. However, the supply chain and the purchasing department have a leading position within the company regarding Industry 4.0.

GRADUAL SHIFT FROM 3.0 TO 4.0 IS HAPPENING

When analysing the interviews it turns out that companies majorly test different Industry 4.0 applications. But have not yet fully arrived in the fourth industrial revolution. Even though technologies already exist, it usually takes between five and ten years until a technology is implemented in major companies. However, it is not expected that a big bang appears but rather that Industry 4.0 is implemented in small evolutionary steps [3]. So far, literature has mainly focused on Industry 4.0 in production and not on procurement aspects. Therefore, not much evidence is allocatable about the status quo of the fourth Industrial revolution in purchasing. This is reflected in the amount companies spend on research projects in Industry 4.0. Leading research projects are in the production while projects in procurement lag far behind.

CONCLUSION

The overall focus, so far, is to optimise processes and not to radically innovate them. New steps are steadily implemented and can be described as advancements of technologies of the third industrial revolution and not as a fully applied fourth industrial revolution. Companies market

this development as Industry 4.0; yet, implementation of Industry 4.0 cannot be considered as an accomplished fact across the different German industries. Companies need to timely adapt technologies that belong to Industry 4.0 in order to keep up with global competition and achieve a competitive advantage.

The work provides a starting point to manage better the transition from the old to the new paradigm: the adoption of innovation policies is essential to obtain an improvement in manufacturing performance [4]. The new paradigm is characterized by the ability to connect objects, guaranteeing control and traceability through sensors, applied directly to machines.

Industry 4.0 will change the entire manufacturing system, from the architecture and organizational structure to products, services and business models. The development and deployment of these solutions will be incremental and part of a long-term trend, but the opportunity is already here today.

Companies that fail to educate themselves on these new technologies and invest in pilot projects will lose their competitive advantage and miss the opportunity to lead the transformation that is currently sweeping across the manufacturing industry.

If you have not yet begun on this journey, you must start today.

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