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Secure Information Model for Data Marketplaces enabling Global Distributed Manufacturing

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Abstract

The German term “Industrie 4.0” is distinguished by expanding networking and intelligence of machines, products and services. In this context new business models are developed, many of them is based mainly on digital design and production data. In this paper, a new concept for a technology data marketplace (TDMP) is presented, which allows trading manufacturing process data. Digital data distribution involves various risks by hackers’ attacks, theft or manipulation of data. So, the use of effective security methods and mechanisms is the key to the success of this TDMP. At the same time authority, authenticity, privacy and availability of these machine data are highly required for secure use and confidential identities. The scientific challenge is to develop a secure concept of technology data exchange between market members. Furthermore providing machines with required data automatically from the marketplace is desired. This distribution of data introduces a basic concept to exchange and protect production information. In addition it discusses developing new business models based on existing resources, which create a new value stream in the industry.

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Keywords: Industrie 4.0; business models, networking; digital design data; production data; security methods, data market place

1. Introduction

German industry is the heart of economy in Germany. Worldwide German companies have top positions in several market branches. A recent report from the Federal Ministry of Economics and energy in Germany asked essential questions, which discusses the capabilities and chances of German enterprises in the digital age and its consequences at German industry and also at economy. What are the challenges and chances German industry is facing by digital innovation? How can German companies stay competitive in the world market?

This study illustrates that digitalization opens new successful approaches and leads to developing new enterprise directions. Indeed German industry companies should exchange their traditional strategies with an innovative management vision concerning digital transformation worldwide. Moreover revolutionary business models as well as innovative value-added-chain processes regarding new ICT (information and communication technology) are the key to enhance their existence in the world economy. The study advises German enterprises to analysis digital potentials in production, products and added-value-processes. As a result of realizing these potentials, the new business models will be defined and determined to the digital age of the global industry. Without concerning these recommendations German companies will lose their essential economical role [1].

In order to remain competitive in the global digital competition and tackle the new market challenges, the High-Tech strategy of the German government facilitated the new future ways of connected industry with the term “Industrie 4.0”. Industrie 4.0 is characterized by the next evolution to past industrialization phases (steam machine, assembly line mass production, digitalization with logic controls). Its fundamental idea is to merge the physical with virtual world by extensive use of information and communication technologies. The main goal is improving the added-value-chain over all phases of the product’s lifecycle. Main Condition of administrating this industrial revolution is digitizing, connectivity and interconnection between products, machines and operators overall product lifecycle processes. As a result, the high flexibility, agile adaptation in manufacturing processes will be

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enabled as well as the individuality in development and production [2].

Many German companies recognized this fact and started changing their strategies, thus they are tending to digitalization according to a survey published in 2014, the results are shown in Figure 1. Current results illustrate that 27% of German companies have already implemented a high level of digitizing in their products. 35% of all companies are still working with low and medium digital levels. In five years the digitalization process are forecasted to be strongly increased. About 50% in high level digitalization alone, over the entire product portfolio, according to the company's expectations [3].

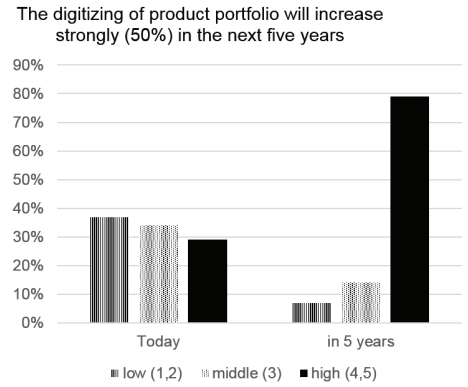

Fig. 1. Digitizing trend in Germany [PwC AG 2014].

In this paper the essential concepts for development an industrial marketplace trading digital technology data will be illustrated. Cloud computing technology, e-commerce concept and its types will be explained. Implementation of such services has hindrances due to protection, hence common security issues and solution approaches are presented. These issues are required over all phases in e-commerce business transactions for safe online trading [4]. To bring the explained technologies together to new business opportunities, a new concept for digital marketing of data under value usage and protection aspects will be introduced.

2. Cloud computing

Cloud computing conception was used for the first time by University of Texas in 1997. In this domain VMware was founded in 1998. It provides cloud and virtualization software and services [5]. According to its features and provided services, cloud computing can be defined as a framework, which provides on demand configurable computing resources through internet, such as networks, servers, storage, applications, and services. These services are available everywhere and can be accessed from different devices [6].

Cloud computing technology provides three different types of services, which serve resources on demand by the user. These services are Software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) and involve different business models.

1. Software as a Service (SaaS): in this model software applications will be provided over the internet to the client.

2. Infrastructure as a Service (IaaS): it uses the cloud infrastructure (software/hardware) as a service on demand enabling users to provision their applications and platforms via virtual machines as well as it provides storage capabilities.

3. Platform as a Service (PaaS): it enables users to run or to develop applications at a provided platform layer resources such as operating system [5, 6].

Cloud computing technology offers effective, flexible and low cost services that give enterprise high chance to increase their revenues. Indeed, these services are the fundament of development new business models in the digital age.

3. E-commerce

E-commerce is defined according to Kalakota and Whinston as following, *"E-commerce is a dynamic set of technologies, applications and business process that links enterprises, consumers and communities through electronic transactions and electronic exchange of goods, services and information"* [7]. E-commerce is carrying on business over computer systems and networks e.g. online (internet) and bulletin board system (BBS). The growth of e-commerce is related to the growth of the financial transaction techniques, and their security techniques. Because most e-commerce activities are online, it is called (Internet commerce, or I-commerce). E-commerce is divided into four types of business models [7]:

1. B2B-business to business: this is done between companies e.g. manufacturers selling to distributers like *Covisint* for automotive industry
2. B2C-business to consumers: companies selling to the general public, e.g. *Amazon*
3. C2B- consumers to business: individuals sell products or services to companies e.g. *Mobshop*
4. C2C- consumers to consumers: consumers selling products or services directly on internet to each other e.g. public sales platforms like *eBay*.

Online marketplaces enable trading goods and services online. First, people register on the web site of this marketplace and then start trading products. *eBay* was the first marketplace enabling an auction service, which was established in 1995 in USA [9]. Nowadays there are several electronic marketplaces with different business models in the World Wide Web.

4. Protection means

In order to implement technical and organizational means for efficient protection of industrial assets, attack vectors and vulnerabilities must be analyzed. Fig. 2 shows a layer-based representation of industrial connected systems as used in Industrie 4.0 scenarios. Exemplary attack vectors are depicted by stars. The system boundary is represented by a dashed box containing networking, software, electronic and physical elements. Outside the system, other machines and humans are entities with which interactions are performed via network connectivity or human machine interfaces (HMI).

Common weak spots in this system representation are as follows:

1. Knowledge theft, social engineering, phishing;
2. Protocol analysis, DDoS, network intrusion;