



# A survey of digital B2B platforms and marketplaces for purchasing industrial product service systems: A conceptual framework

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## ABSTRACT

The shift of profit margins from products to services, has transformed traditional production equipment supplier industries to providers of Industrial Product-Service Systems (IPSS). IPSS is a new business model for consistent delivery of industrial products such as production equipment and manufacturing services (Manufacturing as a Service). However, procurement of IPSS between industrial companies (i.e. Business-to-Business - B2B) is more complicated compared to the case of products offered to consumers (i.e. Business-to-Consumer - B2C). The complexity in interaction between the involved B2B stakeholders, the lack of trust and high costs especially for Small Medium Enterprises have hampered the establishment of standardized e-marketplaces in a similar manner as in the business to consumer world. This research work presents an overview on the requirements to support supply-chain processes on a digital B2B platform as well as a discussion of the objectives and the benefits of this multi-sided platform.

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## 1. Introduction

The globalization of economic activity and the advent of the Internet have contributed to the introduction of a new Business-to-Business model (B2B) known as the online B2B market or e-Marketplace which promotes marketing relationships between buyers and sellers (Meier et al., 2010). The global industrial world tends to follow the structural change towards the service paradigm. Additionally, the industry sector has become more complex and dynamically affected by the era of Industry 4.0 (Wee et al., 2015). Following the new manufacturing era, the industries aim to enhance their sustainability and competitiveness through shifting their business models by providing Product Service Systems (PSS) for commercial use extending to Industrial Product Service Systems (IPSS) solely for industrial use along with the simultaneous increase of the values of the products (Meier et al., 2010; Mourtzis, 2019). A comparison of the two systems indicates that the integrated development of the mutually determined product and service is necessary. The distinct separation between product and service is no longer feasible neither at the development phase nor at the delivery phase. Thus, a win-win-situation is created during the product lifecycle, both for the IPSS and the stake-

holders. This new business model ensures tight and long termed service provider-customer relationship by providing a complete package of services and products. The sustainability-driven market guides the manufacturers towards altering their design methodologies for saving resources (material and energy), such as design for long life product, necessity for remanufacture and sustainability (Ziout and Azab, 2015; Archana, 2015). The IPSS contribution to sustainability is based on its ecological motivation to reduce resource consumption by using machinery more efficiently. The simultaneous focus on product and service development causes the integration of product and service engineering. To that end, sustainability impact enables high wage countries to create new job opportunities and employment protection (Meier et al., 2010).

This study aims to present an evaluation of the IPSS, the B2B platforms, the e-Marketplaces and the Supply Chain Management (SCM) that will allow the dynamic evaluation and synthesis potential candidate services and stakeholders towards the development of e-Marketplace solutions. The rest of the paper is structured as follows. A literature review is presented in Section 2, an analysis of Digital B2B Platform and Market Places for IPSS purchasing is done in Section 3. Next, Discussion and Conclusions are summarized in Section 4.

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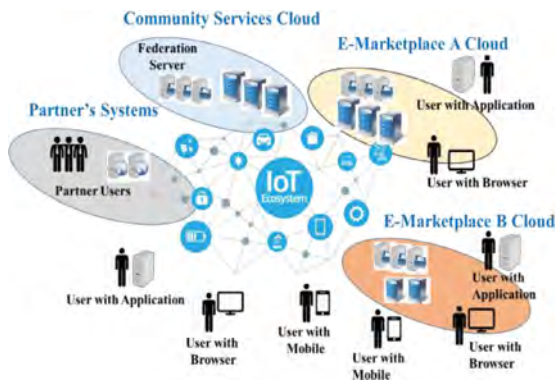


Fig. 1. The vision of a Cloud-Marketplace Ecosystem (Grilo and Jardim-Goncalves, 2013).

## 2. Literature review

### 2.1. Cloud-Marketplace: vision and components

B2B relationships between Original Equipment Manufacturers (OEM) and suppliers of OEMs can be implemented with many e-marketplaces available online. In most cases, SCM solutions are driven by Enterprise Resource Planning (ERP) software vendors or portals (MARKET 4.0). Many industrial research projects require the development of next generation platforms for e-marketplaces or Cloud-Marketplaces. The developments combine the cloud computing concept and the Service-Oriented Computing (SOC) (Vaquero et al., 2009). Thus, the traditional e-marketplaces are transformed into e-marketplaces and Community Services Clouds, as depicted in Fig. 1.

The performance of the supply chain has been enhanced due to the evolution of the Information and Communication Technologies (ICT). This is a result of the integration in B2B e-commerce and the higher process efficiency. In recent years, e-Procurement and e-Market have multiplied and been applied to an ever-increasing range of domains. An online marketplace is a place for buyers and suppliers to trade more effectively. More businesses face e-marketplace trade and because of its efficiency and effectiveness and most businesses are satisfied with their performance (Rask and Kragh, 2004). Consequently, the firm's procurement and sales activities depend on its e-marketplace. Moreover, trust is another important factor. The lack of personal contact and namelessness create uncertainties that leading to increased risk and privacy issues. Procurement is responsible for identifying customers' needs, turning them into specifications, arranging the delivery of goods and services, and assessing customer satisfaction with goods and services. Another role is to deal with suppliers, including commissioning, pricing, ordering, delivery and pricing. A mean to accelerate and reduce the cost of corporate purchasing activities and is the use of e-procurement. Therefore, market makers use e-procurement as way to create value and to establish relationships with the different stakeholders focusing on the field of Small and Medium-sized Enterprises (SME) (Rai et al., 2006).

### 2.2. Industrial Product Service Systems (IPSS)

Since the era of Industry 4.0 the manufacturing environment is more complex and dynamic following the double staged evolution of information and communication technologies. The long-term goal of the manufacturing firms is to achieve stable competitiveness and sustainability (Chrysolouris, 2006; Wiersema, 2013). The traditional manufacturing equipment suppliers have adopted the IPSS business model as a means to achieving consistent delivery



Fig. 2. Marketplace business objectives for 2019 (Brian Solis).

of products and services. This is an outcome of the shift of the profit margins from products to services (Alexopoulos et al., 2018). IPSS can be defined as an integrated set of products and services offering added value to industrial applications and includes the dynamic adoption of changing customer requirements and supply capabilities. What is more, IPSS offer personalization, customer-oriented product configurations and services that interact with each other due to the integrated development and provision (Meier et al., 2010). Consequently, this comprehensive integration leads to new, customized solutions. The adoption of IPSS by industry has enabled the creation of innovative business models with the main purpose of increasing their competitiveness and profits (Alexopoulos et al., 2017; Matsas et al., 2017). To that end, IPSS can be classified into three main categories, identical to the classification of PSS, as follows: i) *Product-oriented*, ii) *Use-oriented* and iii) *Results-oriented*.

In the study presented in (Mourtzis et al., 2018), it is claimed, that the IPSS requires an example shift towards selling functionality rather than selling products. According to (Meier et al., 2010) an IPSS can be characterized by the following basic stages. First the product integration and the service offering that delivers values in industrial applications. Second the understanding consisting of integrated product and service shares. Third the combination of the integrated and determined planning, development, provision and use. Fourth the capability to adapt to the changing customer demands and the provider abilities. Fifth, the capability to offer services or to substitute the product over its lifecycle. Sixth, new, customer-oriented solutions due to the integrating understanding. Seventh, innovative function-, availability- or result-oriented business models.

### 2.3. e-Marketplaces

An e-marketplace is an online market, usually referring to Business to Business (B2B) in which buyers and sellers create tight relationships and facilitate trade, either goods or services, between them in a more efficient way. In most cases, there is no previous interaction among the partners (buyers, suppliers and e-marketplace provider) (Son et al., 2006). The emergence of Internet-based B2B e-Marketplaces in various industries is claimed to have opened up "real opportunities for online transactions" (Dai and Kauffman, 2002). Most manufacturing firms are satisfied with the performance of the e-Marketplace due to its efficiency and effectiveness. Therefore, these web-based platforms are important to the manufacturing firm's procurement and sale activities (Rask and Kragh, 2004). More specifically, in the manufacturing section the e-Marketplaces combine the search methodology and unique tools (e.g. applications, messaging and collaboration tools, intellectual property protection etc.) to the manufacturing buying cycle. In Fig. 2, the business objectives are presented, as a conclusion from the survey conducted in 2019 (Brian Solis). In general,

the marketplace business objectives for 2019 identified illustrate a well-rounded approach to growth in general, focusing on increased margins, value, geographic expansion and seller acquisition.

The rapid growth of online markets over the last 8 years has been an unprecedented phenomenon. The growth of the market economy driven by sharing economy companies is estimated to double between 2017 and 2022, rising from 19 billion US dollars to 40 billion US dollars. Some of the emerging trends in the marketplace economy can be summarized to (Brian Solis), marketplaces are going hyper-local & hyper vertical, online and offline marketplace models, disruption of traditional middleman businesses, trust factor will be improved by Artificial Intelligence and Machine Learning, Marketplaces as utility. There will be more business services around the marketplaces. Agency-based marketplace models will be disrupted by new peer-to-peer marketplace models. B2B marketplaces will dominate. Block chain use for marketplaces.

#### 2.4. B2B and B2C platforms/business models

Most people think that e-Commerce refers to electronically transactions of goods. However, it also involves delivering services by network communication technology to increase the business collaboration. The term “e-Commerce” has emerged during the recent years with the transformation of Internet into a significant medium to conduct businesses and has prompted the rise of virtual business relationships including business-supplier, business-client, business-to-end consumer and strategic alliance (Speier and Harvey, 1998). The e-Commerce term can be classified either as Business-to-Customer (B2C) or B2B. Comparing the B2B and the B2C market according to the Frost and Sullivan report (Archana, 2015) the gross merchandise value of the B2B market (\$6.7 trillion) will be twice larger than the B2C market (\$3.2 trillion). B2B e-Commerce companies face the big challenge of delivering large amounts of online orders in a quick, safe and cheap way. As a result, the B2B e-Commerce logistics problem involves many parameters such as the logistic setting prices, the determination of transportation, the integration of B2B e-Commerce and logistics trading, the utilization of common protocols and shared logistics assets to improve profitability and market efficiency (Lilien, 2016). In (Leek and Christodoulides, 2011) the markets dichotomization into B2B and B2C is referred as simplistic. As a result, two common business models are described in the above-mentioned study: 1) 'Mixed' applies to companies selling goods to other firms as well as individual consumers (e.g. Amazon has many business customers and suppliers as well as its B2C retail) and 2) 'B2B2C' refers to companies that, while directly earning revenue from corporate customers, manage customer experience (or promotion of products and services) to the client and to the end consumer (Iankova et al., 2019). Marketers, especially for B2C Services companies, still expect to drive growth through market penetration. From a global perspective, domestic expenditure continues to account for the lion's share of global expenditure, with an increase of almost 10 percent since 2012. Western Europe is the largest international sales market, and Western Europe and China have the largest forecast opportunities. Interestingly, since August 2014, Internet sales have dropped to the lowest levels.

#### 2.5. Social media and mobile marketing

Social media spending falls to levels last seen in August 2017. One reason may be that despite massive financial investments, social media is rated as contributing only moderate value to company performance. Expectations remain strong, however, as social media investment is expected to rise by 73% over the next five years. One explanation may be that social media is viewed as adding only modest benefit to company performance despite massive financial

investments. The use of social media has expanded in important marketing operations, including brand building, customer acquisition, customer retention, product / service launch, and customer service, amid these low participation scores. Organizations favor the use of search engines and other forms of paid digital media over other technology investments. Similar to social media, B2C companies have remained relatively flat with mobile marketing contributions to company performance. Many companies that offer more of their products and services across the internet record mobile's highest performance contributions. Marketing recruiting growth stays strong but slows to 5.1% hiring transition expected for the next year with B2B firms (Product 6.5% and Service 6.1%) outpacing B2C businesses (Product 0.5% and Service 4.4%). Companies expect to employ full-time marketing staff over vendors and recruit promoters from organizations in other fields, followed by recruiting from the same sector rivals (Thompson et al., 2010).

#### 2.6. Supply Chain Management (SCM)

The concept of SCM was introduced in the 1980s. Since then, it has undergone many and significant alterations from its original state. Despite the popularity of SCM in the academic and business environment, the authors in (Wee et al., 2015) it is argued that there is still considerable confusion as to why some writers describe SCM in operational terms, as the flow of raw materials and products, while some consider it as the philosophy of management and some others consider it as a management process or an integrated system. The main purpose of SCM is to manage the flow of information, products and services across a network of customers, enterprises and supply chain partners (Russel and Taylor, 2009). Many authors considered the SCM and the logistics as synonym terms. Although, the SCM consists of logistic management activities, there is a significant difference between the concepts of supply chain management and logistics. Logistics is responsible for materials' movement inside the premises of one organization. On the contrary, SCM encompasses the management and the planning of all activities related with procurement, sourcing, conversion also including all the logistics management activities. The most important feature of the SCM is that includes the coordination and the collaboration with all the partners (suppliers, customers, intermediaries or service providers) (Felea and Albăstroiu, 2013).

### 3. Analysis of digital B2B platform and market places for IPSS purchasing

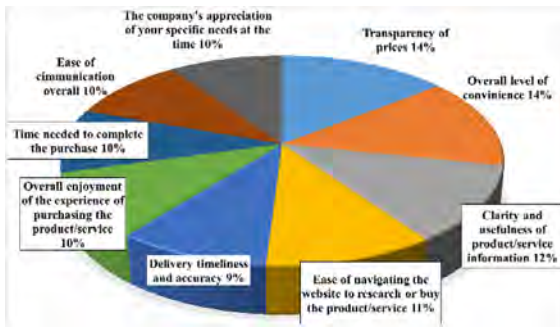
Social media platforms are lauded for facilitating communication, promoting content sharing and creating community (Michaelidou et al., 2011). As a result, consumers and businesses are gradually adopting social networking sites like Facebook, YouTube, LinkedIn, Pinterest and Twitter. Concretely, Twitter is one of Fortune 500 corporations most commonly used social media sites, so about 73 percent of them use it to interact to followers. One way to differentiate between B2B and B2C is to ask a simple question: *is the market for a product or service derived* (driven by some subsequent customers' request – B2B)

*or primary* (driven by the buyer's specific tastes or preferences – B2C)? Below is a list with some B2B challenges for the aspiring B2B academia field (Lilien, 2016).

- Complexity and heterogeneity in the problem domain
- Lack of easy data availability and accessibility
- Lack of domain knowledge by researchers
- Greater need for improved marketing sophistication in B2B versus B2C
- Less academic competition in B2B than in B2C
- The global nature of B2B markets

**Table 1**  
Key differences between B2B and B2C markets (Grewal and Lilien, 2012).

Business-to-Business	Business-to-Consumer
Manufacturing Culture	Marketing culture
Market to value chain	Market to end of chain
Technical proposition	Perceptual proposition
Value in use, quantifiable	Value in brand relationship
Small number of customers	Large customer segments
Large unit transactions	Smaller-unit transactions
Process linkage	Transaction linkage
Complex buying sequences	More direct purchase
Web of decision participants	Consumer decides



**Fig. 3.** Important criteria in decision to buy (% UK consumers who made a purchase in the last three months) (Deloitte Digital 2016).

The key differences between B2B and B2C markets are divided, as presented in Table 1 (Grewal and Lilien, 2012).

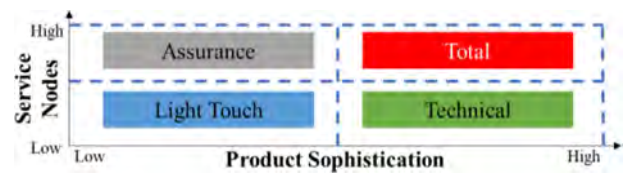
Consumer expectations are constantly evolving, making it more difficult to offer a positive experience. It is becoming increasingly difficult for companies to anticipate what customers want, especially as digital technology advances and the preferences of consumers continue to change. Not only do consumers expect traditional customized products and services, but also, they often welcome different ways to order or experience products and services. More customers now prefer buying products online than in store, according to the report presented in (Deloitte Digital 2016). Moreover, almost half of customers bought a product online 48 percent versus 45 percent who bought it in store. The share of “the experience” is important in the decision to purchase a product or service. When asked what was crucial about their decision to purchase a product or service, more than half of respondents stated the general pleasure of the product or service purchasing experience, as presented in Fig. 3.

With each new business model offering a better product, the demands of customers are increasing, as is the demand on traditional businesses to adapt and change their business models. The steps of the shopping trip are summarized in Fig. 4. It is difficult to decide on the right questions to ask regarding the segmentation of customers based on their service needs. While customer questionnaires typically focus on top-of-mind requirements including price, security, and on-time delivery, these are qualifiers rather than differentiators (Michaelidou et al., 2011).

Nonetheless, second-order requirements typically exist, for example, consumer knowledge, technical support, and a flexible supply chain, which determine who gets the order. Grouping firms on two axes by their needs provides a useful segmentation. In Fig. 5 the vision of how such a system could look with sample explanations for each consumer section is reflected.



**Fig. 4.** Companies need to adapt their operating model (Deloitte Digital 2016).



**Fig. 5.** Needs-based segmentation (Strategy, and Analysis 2013).

	Currently using	In discussion	Planning within the next 2 years	No plans to use this service
CHATBOTS	42%	37%	9%	12%
AR/VR	24%	39%	20%	17%
DRONES	19%	34%	21%	26%

**Fig. 6.** B2B Companies are adopting new technologies (On the Verge 2018).

#### 4. Conclusion and outlook

B2B companies are changing their sales force to become more focused, data-led and advisory on solutions. And they invest heavily in technologies and services that allow this to be achieved. There are new ways of testing and applying Artificial Intelligence (AI). According to the research work presented in (On the Verge 2018), 79 percent of companies use chatbots for customer service uses, while 32 percent use chatbots in the payment process. Similarly, 73 percent of businesses have integrated Digital Reality technologies, such as Augmented Reality (AR) and Virtual Reality (VR) for customer service applications, and 66 percent use them in the sales process as well. The adoption percentage of the above-mentioned technologies is presented in Fig. 6. Approximately one third of companies are aware that adding innovations is an emerging opportunity to use these back-bone technologies, supplemented with new innovations like natural language-based software and semantic data search tools to improve the conventional sales channels and create a better customer experience. As a result, B2B companies are doubling their investment on the integration of new technologies, aiming at investing 21 percent of their marketing and IT budget which currently accounts for approximately 12 percent, to do so over the next two years.

B2C experiences are often correlated with the personalization of consumer products to improve sales and service. Retail, media and transport events are often seen as leading examples. Few B2B companies have implemented personalization in similar fashion,

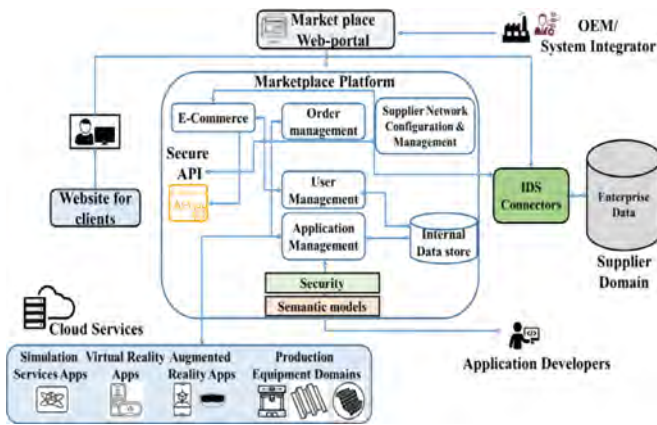


Fig. 7. Proposed marketplace conceptual framework.

despite knowing their customers better than consumer-facing businesses.

Moreover, the top priorities for B2B businesses within the next two years are: 73 percent believe that customer expectations are significantly higher for more relevant goods, services and interactions than they were just a few years ago and 63 percent lean towards an increased implementation of customization. This will become increasingly important as B2B executives broaden the scope of their catalogs. Surprisingly, at the bottom of the priority list, the emphasis was on getting a 360-degree view of the consumer at a rate of 33 percent and using data better for marketing and helping, at a rate of 36 percent (Thompson et al., 2010).

A practical example of one e-marketplace based on the proposed conceptual Framework presented in Fig. 7 is explained below. In a digital multi-sided e-marketplace based on peer-to-peer (P2P) data sharing, to ensure trust, infrastructure for Industry 4.0 multiple participants can be involved. Therefore, Industrial Product Service Systems (IPSS) providers are considered as the Supply Side. Production Equipment Providers (SMEs) and Service and Application Providers are categorized all together with all their attributes. Next, Original Equipment Manufacturers (OEMs) are the customers (demand side). At the first step, the customer (OEM – Metal Processing Manufacturing Company) enters and registers in the marketplace and places his order (e.g. CNC Milling Machine). Furthermore, free access to public information (i.e. data sheets, videos etc.) and services (e.g. VR/AR and simulation services) by the IPSS providers (e.g. Metal Sheet Equipment Supplier) is offered. In case of more customized services (e.g. Thermal analysis in specific parts) access to premium information can be acquired through payment. At the same time, the order requirements have been analyzed and the supply chain is proposed (e.g. Metal Sheet Equipment Supplier, Machine Tool Equipment Supplier, OEM etc.). The demand side (OEMs) using platform-based software are able to scan and browse for the desired equipment or service, check and compare their functionalities with each other. The web-presence of production equipment SMEs will offer advanced services such as simulations, Virtual and Augmented Reality capabilities and a P2P Industrial Data Space (IDS) that offers smart user-services and a secure API to try and test the Digital Twin of the desired production equipment before the final order and assembly of the product. In turn, the app would provide consumers with the option to provide anonymized reviews and feedback both manually and automatically on the purchased equipment.

This paper presented a survey of a representative set of B2B marketplaces to support purchasing of IPSS systems. Moreover, a brief analysis to B2B e-Commerce and SCM has been done assessing their ability to support requirements addressing the

development of website for an e-marketplace in which production equipment and services will be listed together with all their attributes. OEMs using tools provided by the platform should be able to search and browse for the equipment or service, test their functionalities and compare them against each other. The platform will provide a multi-sided ecosystem in which several stakeholders. A proposed architecture of a B2B and B2C marketplace is presented in Fig. 7. Moreover, the platform will provide the capability to the customers for anonymized feedback regarding the purchased equipment both manual and automatically. As far as future challenges, digital customer experience and sales channels will become the main points of differentiation. Brands that adapt to changing perceptions and attitudes will benefit, while those that lack the pattern will risk losing substantial market share and undermining their industry. Investing in B2B trade and customer experience will lay the foundations for developing people, processes and technology needed to compete in the digital age. The current survey can be the basis to continue further and create a marketplace with added services. The developed marketplace could be implemented in a pool of suppliers and customers in order to gain insights and expand its functionalities.

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