Business Model Development for a Dynamic Production Network Platform

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Abstract. Fully dynamic cross-company production networks that adapt to individual customer orders are a core vision in Industry 4.0. For different reasons, like failure of machines of a supplier or a sudden increase of demand, additional production capacities might be required at short notice. However, there are barriers to finding and integrating suppliers with free capacities into existing ordering and logistics processes. A Dynamic Production Network Broker (DPNB), which is an online marketplace that actively connects suppliers and consumers of production resources to dynamic, cross-company production networks, might bridge this gap. New generic service-based business models are required for operation and usage of the DPNB platform. In this paper, such a business model is drafted.

Keywords: Production Network, Business Model, Platform Economy, Industry 4.0.

1 Introduction and Problem

Fully dynamic cross-company production networks that adapt to individual customer orders are a core vision in Industry 4.0 [1]. Due to failures in own or suppliers machines, other delivery failures or increased demand, production capacities are regularly required at very short notice, e.g. in the area of drawing and special parts. The European Tool & Die making industry is a highly fragmented market. In Germany, the share of SMEs in the manufacturing sector is around 98% [2]. This results in a high effort for a buyer to find a manufacturer being able to deliver on time with acceptable quality and price, and to integrate this supplier into existing ordering and logistics processes.

The existing business model of contract manufacturing implies that all costs are covered by the cash flow of the customers [3]. With such a business model, the machines cannot be utilized to capacity, and the idle times of the machines must be included in the price of production [4]. Therefore, much effort has been put on developing concepts

and tools that allow to share resources for matching of demands and supply [5], i.e. by offering underutilized capacity on platforms, also providing access to new customer groups [6]. A higher utilization of the machines through data analysis to identify suitable productions demands leads to cost benefits for producers and customers [7].

Accordingly, the aim is to develop business models and analyse market and customer segments for the platform, identifying suitable compensation models as well as promise a good value proposition for the participants [8]. In this paper, a concept for a service-based business model of a production platform based on the use case of a "Dynamic Production Network Broker" (DPNB) is presented. The intention is to support the dynamic formation of production networks by means of a modular service system. This includes (i) the matching of supply and demand for short-term availability of production capacities while at the same time ensuring the necessary transport capacities, (ii) the short-term onboarding of suppliers, and (iii) the possibility of making complex assembly activities compatible for outsourcing. The crucial use cases for designing an appropriate business model are elaborated and on this basis, a generic business model is developed in the Business Model Canvas [9].

The paper is structured as follows: The next section explains the research approach and methodology, followed by an overview of the state-of-the art in the field of production platforms. Section 4 presents the DPNB platform, whereas section 5 illustrates the resulting canvas for the identified business model for the platform. Finally, in section 6 next steps and future work are discussed.

2 Methodology

A mixed method approach has been applied for research: a literature review on platforms in the manufacturing sector, in combination with a use case analysis for a dynamic production network platform, based on which a business model has been drafted for the DPNB platform. In order to formalize the required functionalities and to shed some light on suitable business models, three use cases for such a platform have been modeled according to the method described by Jacobson et al. [10]. Furthermore, the actual business model was developed using a user centric and participatory approach in a workshop, based on the St. Gallen Business Model Navigator by Gassmann [11] and the Business Model Canvas [12]. Participants from the manufacturing industry, transport service industry and research institutes have been involved to combine different requirements and perspectives. This approach supports the analysis of the value proposition, value creation and revenue model, in order to get an overview of all relevant aspects of the platform business model.

3 State-of-the-Art

In order to make it easier to find and integrate a reliable business partner, certain conditions have to be established. It must be possible to have an overview of the offers on the market and the participants must commit themselves to the rules of the market and execute the contracts properly. Today, many business-2-consumer (B2C) markets have

adopted a form of Internet-based platforms (e.g. Amazon or eBay). These platforms provide benefits by creating a link between customers and suppliers [6].

In order to establish a link between customers and the highly fragmented market of production companies in the manufacturing sector in Europe, a platform would ideally allow a customer to find a supplier, who can provide capacities according to the demand (e.g. dimensions, quantity and material). If the platform allows the selection between the offers of different suppliers, it also allows competition on quality, costs and delivery times, making product transactions more efficient [13]. Such business-2-business (B2B) marketplaces and eCommerce order portals for production capacities are currently being developed, mainly driven by start-ups. Their business models are based on offering brokering services and collaboration support [14].

Production platforms like KREATIZE [15], established 2015 and Shift from 2017 provide basic marketplace services for manufacturers and customers, however they do not offer instant pricing and require manual entry and acceptance of orders through a web portal. Instant pricing is offered by other platforms for production capacities, like Xometry [16], fictive [17] and 3D Hubs [18], all of which have been established in 2013, as well as Laserhub [19] founded in 2017. Xometry for example offers a large number of available technologies, a large production network capacity (over 2,500 producers) and quality guarantee. All of them still require manual entry and acceptance of orders through a web portal.

One of the more advanced production capacity platforms today is fabrikado [20], established in 2016. It is an example of a supplier-independent portal that anonymously matches production orders with contract manufacturers and itself appears as a "contract manufacturer without a machine". Fabrikado offers a wide range of production technologies, such as 3D printing, cutting and machining. The special value of fabrikado is the possibility to install an information management system that reports free production capacities to the platform, which makes it the only permanent interface between customer and contract manufacturer. The fabrikado platform also offers instant price calculation, from which a 10-15% commission is charged for successful order placement. The quality assurance is based on a certification by fabrikado.

In addition to this concept, further models are being developed like V-INDUSTRY [21] that started 2018 and provides UMTS retrofits to connect machine tools directly to the platform and also offers instant pricing. All these platforms can be differentiated by whether the suppliers appear anonymously or publicly and whether they are portals (marketplaces) open to suppliers or webshops of a supplier. The billing models also differ.

Although these platforms are good enablers for sharing production capacities, they are not yet sufficiently equipped to provide automatically capacities in highly dynamic environments. The existing platforms are not able to commission supplier networks, if no single supplier can satisfy a demand on its own. This could improve resilience and make better use of the prevailing SME capacities in the manufacturing sector. For this purpose, the necessary ad-hoc transport relationships have to be included by logistics service providers. In addition, services are required that go beyond the placement of orders and the exchange of production-relevant data to allow rapid onboarding of production and logistics processes. For this, large amounts of background knowledge (e.g.

production plans, assembly instructions) would have to be linked with real-time data, e.g. from machines.

4 Dynamic Production Network Broker Platform

The use case analysis is centered on a production platform developed in the DPNB project with the objective of closing the gap mentioned in the previous section [22]. It is established as a two-sided market, in which the platform automatically matches the demand of customers to the capacity of suppliers, as depicted in **Fig. 1**:

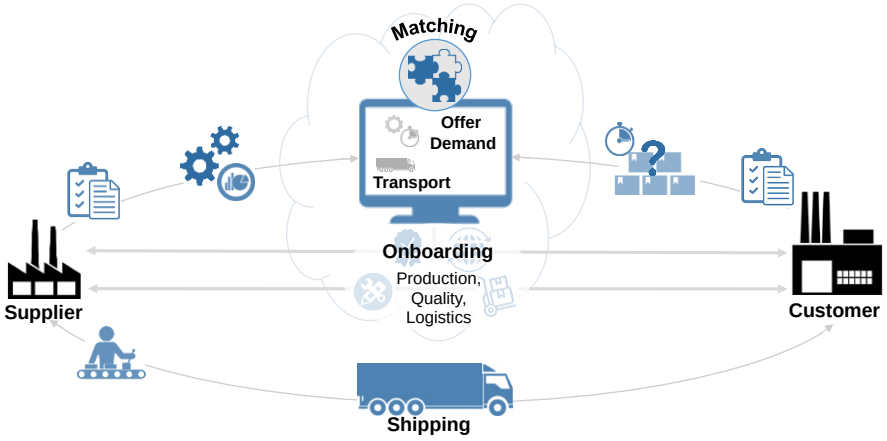

Fig. 1. DPNB Platform Process Overview, according to [22]

A centralized architecture that allows providers of production resources to participate in the market without their own revenue management system is implemented. Customers can directly access the providers' resources without having to rely on services from third parties. Thus, the platform targets a larger potential user group than established systems, as the barriers to entry are relatively low for both suppliers and customers.

The overall vision of the DPNB platform has been divided into three use cases that have been further detailed: The onboarding of participants, order planning and the execution of production orders. The different use cases are described below.

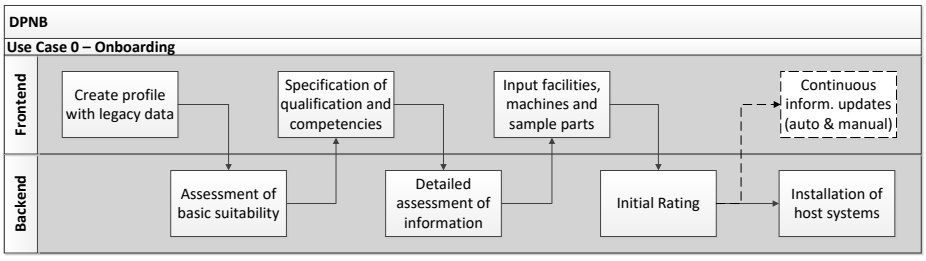

Fig. 2. DPNB Use Case 0 – Supplier and Customer Onboarding

Fig. 2 illustrates the initial use case for DPNB, describing the onboarding of participants to the platform. Suppliers and customers are able to register themselves through a web frontend. Once the legacy data, like name and address, is provided, their basic suitability for DPNB is assessed, i.e. by checking the credit rating. When approved, suppliers are able to specify their manufacturing qualifications (e.g. ISO certifications) and competencies, which are validated by the platform. After that, they describe their facilities and machine capabilities and optionally send a physical sample to the platform operator for verification. An initial participant rating is automatically generated from all the information provided, which can be continuously updated by the participant. It is optional for the suppliers to install a host system, which provides a direct interface between the platform and the enterprise information systems, such as ERP.

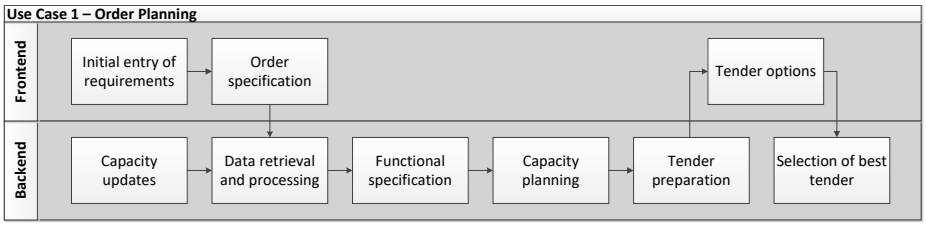

Fig. 3. DPNB Use Case 1 – Order Planning and Tender Selection

Once participants have registered, manufacturing orders can be placed, as shown in **Fig. 3**. The customer is able to enter the required product through the frontend and further specify the order. This is processed against the production capacities reported by the suppliers and a functional specification containing possible manufacturing steps is created by the platform. Suitable production capacities are tentatively blocked for planning. A matching algorithm combines supplier and order information to prepare different tender options, which can be filtered and selected in the frontend. The selected tender is used to block the required production capacities finally and will be executed.

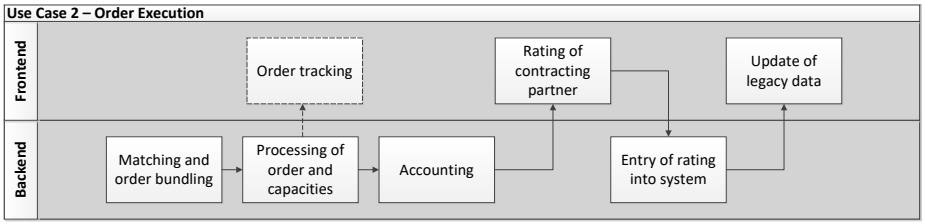

Fig. 4. DPNB Use Case 2 – Order Execution and Partner Rating

For execution, as presented in **Fig. 4**, matching orders are bundled to achieve an optimal capacity usage through the platform. The order is the processed on the reserved capacities, while the customer is able to track the progress in the web frontend. Accounting takes care of invoicing the customer and tracking the payment of the order. Once the manufactured parts are delivered, customer and supplier can rate each other in several aspects. This input is used to update the participant rating on the platform, which is displayed in the legacy data.

5 Business Model Development Results

The DPNB business model was developed during a one-day workshop with participants from two research institutes, two manufacturing companies and one transport service provider. The main goal was to create a Business Model Canvas for the platform, utilizing the use cases for DPNB as an input. After introducing different business model frameworks, the participants reviewed their own organizations' business models through the lens of the St. Gallen Business Model Navigator [11]. The different perspectives and background of the partners proved to be valuable to gain a holistic understanding of the business model. Next, the DPNB Business Model Canvas was modeled, taking into account the instructions by Osterwalder [9]. The result is illustrated in **Fig. 5**.

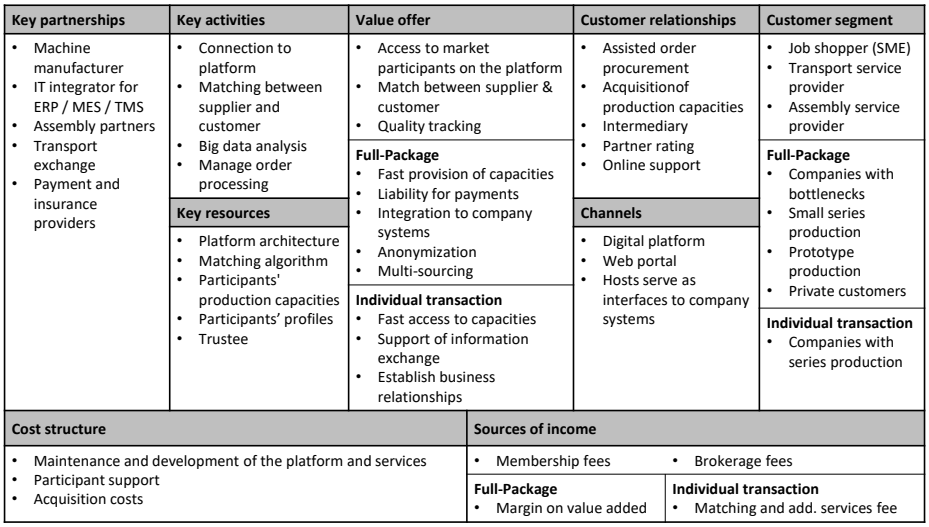

Fig. 5. DPNB Business Model Canvas

Below, the findings of the workshop will be explained in more detail. The main **value** of the platform is to create a dynamic and more or less automated marketplace for production capacities among the participants. Matching algorithms provide suggestions for optimal value chains for a certain product, while quality can be tracked throughout the manufacturing process. It contains a *full-package* service option, where the platform is the contracting party for the participants and takes care of all organizational issues, such as payment or insurance. Anonymous ordering and multi-sourcing from different suppliers are also possible. In contrast, for *individual transactions* the platform can only be used to find suitable production capacities and exchange legacy data between the participants. Organization of order processing and payment has to be arranged directly between customer and supplier.

Main **customer segments** for the platform from the supplier side include job shoppers (mainly but not exclusively SMEs), transport and assembly service providers. From the customer side, the *full package* is intended for a fast provision of missing

capacities to companies with a bottleneck, or for small series and prototypes, potentially also for private customers. The *individual transaction* is rather intended to support establishing long-term business relationships for series production.

Sources of **income** for the platform also differ between the two options. While different fees for membership and brokerage are discussed in general, the *full package* will retain a margin of the value added, while for the *individual transaction* matching and all additional services will have to be paid separately. Associated platform **costs** include the maintenance and further development of DPNB, support of existing participants and acquisition of new participants.

In order to set up the platform and enable the derived business model, several **key partners** are needed. First, it is crucial to involve major manufacturers of production equipment, in order to automate capability and capacity reporting as much as possible. The same applies to IT companies, providing the interfaces between the platform and the enterprise information systems. Assembly and transport exchanges take care of the finalization and delivery of the products, while payment and insurance providers support the financial aspects.

6 Conclusions and Future Work

The research objective of this paper to draft a business model for sharing production capacities in dynamic environments has been achieved by developing a Business Model Canvas for the DPNB platform. The value offer includes services closing the gap identified in the existing production platforms, i.e. the ad-hoc onboarding and implementation of production networks with manufacturing SMEs, logistics and assembly providers. Suitable compensation models that can generate sufficient revenue for the operators as well as promise a good value proposition for the participants have been identified.

Because the DPNB platform is still in development, the business model has not yet been implemented in a real case. Therefore, validation of its practicability is still to be carried out. A number of research issues are thus still to be analyzed more closely, such as the value of different data types or suitable pricing models, which will be accepted by the market. Possible competitive advantages and key resources for "order-driven production" have to be investigated in more detail to refine "Industry as a Service" business models. Furthermore, the service building blocks in the business model will be further expanded. The business models developed for the DPNB project could provide the basis for further expansion of the platform economy in production. Furthermore, aspects like matching algorithms are applicable for multi-sided B2B platforms in other sectors. The necessary alignments form an additional field of research.

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