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A Platform-Based OEM-Supplier Collaboration Ecosystem Development

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Abstract. Innovative products and services are key success factors for the manufacturing industry. Development of such products and services usually takes place in partnerships in which the original equipment manufacturer (OEM) distributes the development of new products to many locations in several countries across the world. Suppliers, especially first-tier suppliers (FTSs) are involved in the development process as early as possible, because they have knowledge that is strategically important for developing the new product and services. Historically, the OEM-supplier relationship is characterized by a sequential interaction whereby the OEM gives product and production requirements to the supplier and the supplier delivers his product or service to the OEM. However, collaboration between FTS and OEM is essential to fruitfully use the knowledge of the FTS, anticipate potential downstream errors, and reduce costs and risks. The paper presents recent developments in this part of the supply chain with particular attention to the design of a shared platforms, which is part of an OEM-supplier ecosystem. The development process of such an ecosystem can be seen as a transdisciplinary engineering process, because not only IT engineers are needed to build such a platform-base ecosystem but also people with knowledge of supply chain organization and coordination, especially in product development processes.

Keywords. Engineering Collaboration, Supply Chain Collaboration, Ecosystem, Data Exchange, Supplier Integration, PLM.

Introduction

Original Equipment Manufacturers (OEM) are continuously challenged by the market to provide product and service innovations, while reducing their time to market, cutting costs, and improving product quality. Modern industrial products are created and produced through distributed engineering and production approaches using comprehensive PLM systems [1][2]. Thriving to penetrate markets worldwide, OEMs have established globally distributed supplier networks which significantly contribute to their market success [3].

Proper supplier selection, supply chain management and supply chain integration are crucial for an OEM's success. OEMs more and more focus on their core competencies and outsource most of the components, subsystems, and other content

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that are contained in a product. For example, in the automotive industry, strategic core competencies (e.g., car body, engine, and safety) are held in house while the remaining vehicle content is outsourced to one or more suppliers [4] (Figure 1). The first-tier supplier (FTS) is the most important supplier and is often a strategic partner of the OEM. FTSs often state, that they produce almost the entire car as subsystems, while the OEM primarily provides the integration, assembly, and project management [1]. Other industries have adopted this concept likewise.

For the supply chain to function properly, several parties need to play their proper role, while flexibility is a key aspect of the supply chain processes. The complex dynamic system made up by these parties is a supply network, but can also be called an ecosystem, because of the changing flows of information, material, products with ever changing management and coordination needs.

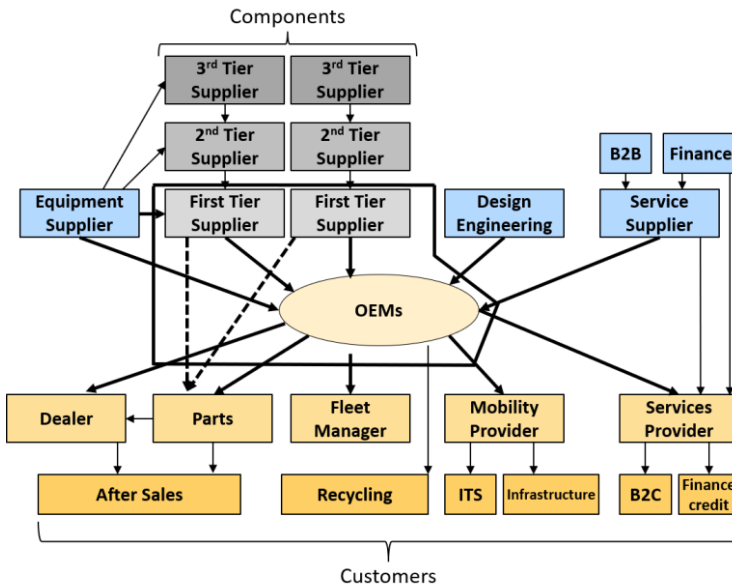


Figure 1. OEM ecosystem in the automotive industry [4].

The remainder of this paper is structured as follows: in section 1 the background of supplier collaboration is described and defines ecosystem and transdisciplinary system. Section 2 highlights a platform-based ecosystem for collaboration. Section 3 deals with IT concepts and implementation for supporting an OEM-supplier ecosystem, followed by an introduction of a running platform for an OEM-supplier collaboration ecosystem in section 4. The paper ends with conclusions and an outlook.

1. OEM-supplier collaboration

Strategic collaboration between an OEM and one or more of its FTSs as well as with their downstream suppliers are deemed crucial for reaping the benefits of new product, service and process development. Setting up a strategic OEM-FTS collaboration requires the involvement of several functions in both organizations, like top management, development and engineering, marketing, purchasing, and support

functions like HRM and the IT department. This process can be considered as a transdisciplinary process, because of the many different disciplines involved, possibly also with input and support from science institutes.

However, despite the high expected benefits and cost savings, many OEMs still have not reached a sufficient level of collaboration, because they lack suitable support for data and knowledge exchange. To prevent that business units from an OEM concurrently use different approaches and tools to collaborate with the same supplier (email, FTP server, portal), an adequate supplier development approach is needed [5]. Supplier development includes, among others, goal setting, supplier evaluation, performance measurement, supplier training, etc.

To maintain, support, and improve an FTS-OEM relationship in a global supply chain, supplier relationship management is essential. This management task involves different skills and knowledge for enhancing the supplier's performance. A good relationship between buyer and supplier is crucial for firms to develop strategic global competitive advantage [5]. Success factors for improving the buyer-supplier relationship and develop the supplier are, amongst others [5]:

- effective communication
- an attitude of partnership
- mutual commitment
- top management support.

These success factors are essential for achieving a beneficial relationship through continuous improvement. A good buyer-supplier relationship prevents missing or wrong data exchange, costly recalls, and warranty [6]. Insufficient OEM – First Tier Supplier (FTS) relationships have been identified as reason for recalls due to weak design solutions [4]. Managing the supply chain is essential involving challenges such as developing trust and collaboration among supply chain partners, identifying best practices that can facilitate supply chain process alignment and integration, and successfully implementing the latest collaborative information systems and internet technologies that drive efficiencies, performance, and quality throughout the supply chain [5].

An OEM-FTS partnerships can be viewed as an ecosystem. The term ecosystem to indicate a business system was first used in 1993 in an article in Harvard Business Review by Moore [7]. With this term he indicated that a firm is embedded in a business environment that has to evolve with other companies, because they are continuously challenged. A firm has to be pro-active and undertake mutually beneficial activities in symbiosis with clients, suppliers and even competitors. An ecosystem as such is an operational system that reacts to disturbances in the environment to maintain and even strengthen their market position. Silicon Valley is an example of a business ecosystem. A definition by the OCDE (Organisation for Economic Cooperation and Development) emphasizes that the ecosystem is a coherent set of entrepreneurial (potential as well as active) players, market parties, institutes (government, universities and watchdogs), and processes formally and informally influencing a local environment [8]. A network of an OEM with its FTSs, other suppliers, and the suppliers of the FTSs can also be viewed as an ecosystem, because it is also always challenged to adapt to changes imposed by competition, law, environment, economics, etc.

A transdisciplinary system is a solution development system. The solution is meant to solve a complex problem with high societal impact. The solution process is performed by people from both science and practice. The essence of the solution

development process is the exchange of knowledge from not only technical but also social-science disciplines [9]. Examples of problems can be found in environmental problems and city development problems. In engineering, such problems can also be found, especially when innovations are expected to have a large impact on the (local) environment. Social science disciplines are needed to investigate the expected environmental impact or manage introduction of a new product or service and its acceptance.

An ecosystem as described above can be a transdisciplinary system when both science and practice are involved as well as social-science and technical disciplines. Especially the problem-solving part of the ecosystem is a candidate for being a transdisciplinary system. However, not all ecosystems are transdisciplinary systems.

2. Platform-based ecosystem for collaboration

In a network of OEM with FTSS, and between FTSS and their suppliers, there are many interfaces for online and offline communication, e.g., for exchanging CAD data and similar documents. In such a complex network, each member needs to exchange and provide frequent updates of complex data structures containing many types of data [10].

To keep data traceable and up to date support by appropriate IT processes, methods and tools is needed, including collaboration tools to manage the collaboration. Such organizational and technical solutions need to recognize the different roles suppliers play, and therefore the different collaboration needs. OEMs tend to develop a comprehensive rule base and provide their own supplier portals. It is a comprehensive solution, mostly implemented as a front end to a backbone PDM system which gives a strict set of rules of game.

However, such a portal fulfils requirements of this one OEM only. In other words, one process or technical solution cannot address the collaboration needs of the entire global supply network which works for several customers. While suppliers need solutions for all of their OEMs there is not yet a standard for such a solution.

In this paper, a proposal for an innovative solution is presented to solve the problem. The proposal is an innovative ecosystem with certified service providers for specific tasks which are part of the OEM-supplier collaboration. Part of the solution is a platform that incorporates new forms of organisational and information coordination to activate OEM-supplier collaboration from the early stages of new product (co-)design, so that the speed and the efficiency of the process can be improved, stock levels dramatically reduced, and on-time deliveries (just-in-time) achieved in assembly activities [4].

The platform is provided by an independent service provider that is independent of the OEMs involved [11]. It needs to maintain connections to all OEMs and provide a standardized interface not even to the FTSS, but to suppliers in all tiers of the collaboration. The success of such an innovative platform depends on how knowledge is organized and managed, on a comprehension of the innovation dynamics and on respecting the balance conditions of the innovation ecosystems between the provider and other members of the system.

As such, in the ecosystem set up by the provider, feedback from all suppliers, not only FTSS, needs to be collected, prioritized and transferred by the provider of the platform to the OEMs. Then, OEMs can take this comprehensive input, align and optimize their rule bases according to the suppliers' feedback. OEMs should keep in

mind that the extent and complexity of his rule base directly impact its acceptance and execution by suppliers. The ecosystem is, hence, a self-adaptive system.

In practice, a huge benefit can be leveraged if collaboration works seamlessly, driven by mutual interest. Well-balanced, proven approaches to facilitate collaboration in a wide supplier network which forms the ecosystem will carry huge time and cost savings in all tiers. Apart from the (very important) ecosystem proposed above for supporting the exchange of information and data, management of the collaboration, especially the relationships with suppliers, is essential.

3. Conceptual approach for a ecosystem

As indicated above, business ecosystems describe the network of firms, which collectively produce a holistic, integrated technological system that creates value for customers [12]. The ecosystem is defined by the alignment of the multilateral set of partners that need to interact for a focal value proposition to materialize [13]. The composition, relationships, and dynamics of an ecosystem can provide valuable information for organizations that are positioned in these networked environments [14]. Important are the roles of ecosystem members, the endogenous and exogenous factors of ecosystem evolution, the dynamics of ecosystem change, and the strategic consideration of firms that participate in business ecosystems [12].

A business ecosystem is a strategic planning concept analogous to an ecological system [15]. It is widely adopted by the ICT industry, a dynamic and innovative industry demanding a forward-looking and coordinated strategy. Business ecosystems are believed to reinvent value, because of the network effect of the huge number and range of stakeholders around a platform, which interact complementarily and competitively [13]. The appearance of ecosystem is fostered by the development of the network, especially manufacturing supply networks in the automotive industry and network-centric architectures in e-commerce business [11]. It is also connected with the development of platforms, so-called platform-based business models, especially in media, broadband, software, video-games etc [13].

There are three key roles in a typical ecosystem: the keystone organization or platform leader, the members of the ecosystem, the dominator among these members, and the niche players. The keystone organization is the firm that has the ability to provide platforms that serve other members in developing their products [12]. The keystone organization regulates the whole ecosystem, including itself, influence the actions and the development of all members and creates the ecosystem's architectural design. Such a firm has the ability to provide a platform that serves all members and ensures their market survival. Although they represent a small part of the ecosystem, they account for a larger share of profit [12].

The direct rival of the keystone organization, also referred to as "wannabe", is a member that competes for the governance of the ecosystem. If the "wannabe" tries to replace the keystone organization via vertical and horizontal integration with a perspective to govern the ecosystem, it is called a "dominator". Finally, niche players bring a larger share of innovation into the ecosystem through their specialized functions and thus they act as complementors. By focusing on the niche, they usually outsource functions to other members, utilising the platform of the keystone and products of their complementors [12].

Evolution of the ecosystem depends on exogenous and endogenous factors. The most important endogenous factor is the co-evolution process among firms around an innovation to support a new product for the customers [13]. It is the degree in which the members support and service each other in the co-evolution process, regardless of their relationship, which may be competitive or cooperative. Ecosystems that reflect a high degree of independence between sub-systems, also referred to as modularity, have a greater possibility to accelerate the evolution, while, at the same time, with lower expenses, because there is no need for coordination and understanding of inner processes between modules in (part of) an ecosystem [12]. However, independence is hardly possible between and OEM and its FTSs. An OEM-FTS relationship requires a high degree of coordination and collaboration.

Some authors emphasize the competitive character of relationships between members of an ecosystem, determined by three key properties and trends: ecosystem dynamics, embeddedness and internationalization [13]. Nurturing strategies along lifecycle stages of an ecosystem to involve more stakeholders into core business process can make a structure too complicated. The focus should therefore shift from structure to dynamics [13]. Embedded resources are proposed to foster network effects and give more opportunities to connect and co-create value. These resources could consist of different institutions, social networks, government associations, local communities, and all kinds of interested parties [13]. A lack of embeddedness may cause the firm to go international, without building a local ecosystem, and may cause failure. Governments have a role to play in building successful ecosystems.

Exogenous factors that influence the evolution of the system consist of environmental and contextual factors: changes in social, economic, cultural and technological environments push evolution and govern its direction [12]. The location of a bottleneck presents a constraint to successful product delivery. Complementary bottlenecks could lead to failure of the whole system, because they could prevent the focal firm from showing its performance to the customer [12]. For the success of an ecosystem, timing in development of component and complementary technology is crucial. In the domain of TV manufactureres an example is the delay of more than 25 years in producing and selling HDTV technology on the market [12].

The emergence of an ecosystem is facilitated by the development of supplier networks [11] and has a close relationship with platform development. A platform of any kind —whether it is a technology or just a venue for meeting (virtually or in person) — is essential for business ecosystems [13]. These relationships are illustrated in Figure 2.

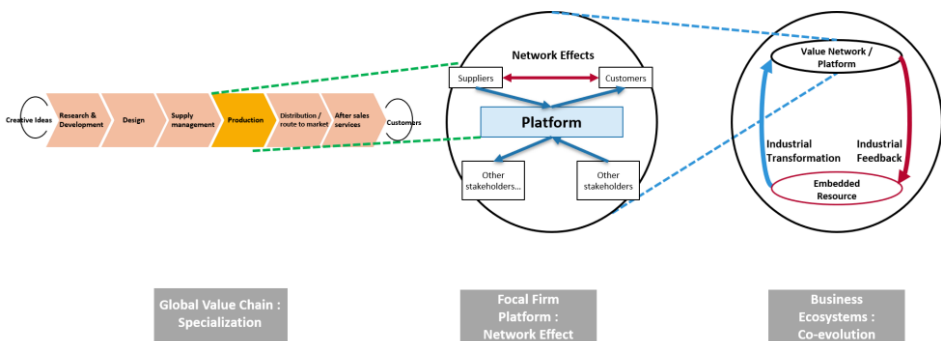


Figure 2. The evolutionary path of business competition [13].

4. Implementation and operation of an ecosystem

As already indicated above, global companies have adapted their strategy and structure to react to turbulences in the past [15]. Driven by the increasing complexity of products and processes, as well as the ever-increasing dynamism imposed by market and society, companies are increasingly focusing on their core competencies, resulting in much greater flexibility [16]. The additional demand for goods and services as a consequence of outsourcing is covered by a supplier pool. Together with customers and other partners, this creates a dynamic, flexible network as a new form of corporate culture, sometimes called ecosystem as introduced above.

Even innovations that are considered to be the biggest drivers of economic development are increasingly emerging in network structures, not only because this type of cooperation enjoys large political support in most countries [8]. Usually, in such structures the synergy outweighs the disadvantages such as conflict of interest and the like [17]. As a result, the innovation process includes the capture and use of existing knowledge, machinery, equipment, infrastructure, training, marketing, design, and software development. An innovation process, to perform it right, requires the involvement of people from practice and science with both technical and social-science disciplines as indicated in section 1. Such an innovation process thus requires a transdisciplinary approach [18].

The increasing importance of services in many areas of economic and public life further underscores this development [19]. In well-running ecosystems synergies are much easier to raise, because the tailoring of labour among individual members is part of the network identity [20]. An ecosystem provides a first-class means of first establishing innovations, and then marketing them on a long-term and sustainable basis. For an outsider, a well-running ecosystem is an indicator that the vendor has achieved a good balance between market dynamics, its range of services, and risk sharing [21].

Ecosystems are particularly widespread in the IT industry. They usually combine (a) a disruptive technological development in a field that is very attractive to customers, (b) added value created by applying new software or service to existing products and processes, (c) a broad range of potential users in different fields, and (d) a stable customer base through market knowledge and long-term customer relationships.

A central component of an ecosystem is often a platform that is built for an economic purpose and depicts complex socio-technical processes. Figure 3 shows the platform OpenDESC.com with its stakeholders in its own ecosystem, which serves as a hub for data communication in the global automotive industry. Arrows show different types of mutual relationships [22]. The relationships represent requirements, rules, data, standards, provision of software, payment, and feedback. They are subject to continuous change and evolution due to the dynamics in the ecosystem, resulting from changing trends in the market, organization, methods and technology. The ecosystem is thus a self-adapting, dynamic system which is primarily driven by demand at the suppliers' site. In times of crisis as in the automotive industry, the demand at many suppliers drops subsequently. Fortunately, new technological trends (e.g., electro mobility) ensure new type of customers for OpenDESC.com. Referring to Figure 1, OpenDESC.com covers the needs in the upper half, the OEM-supplier network, related to the product emergence process.

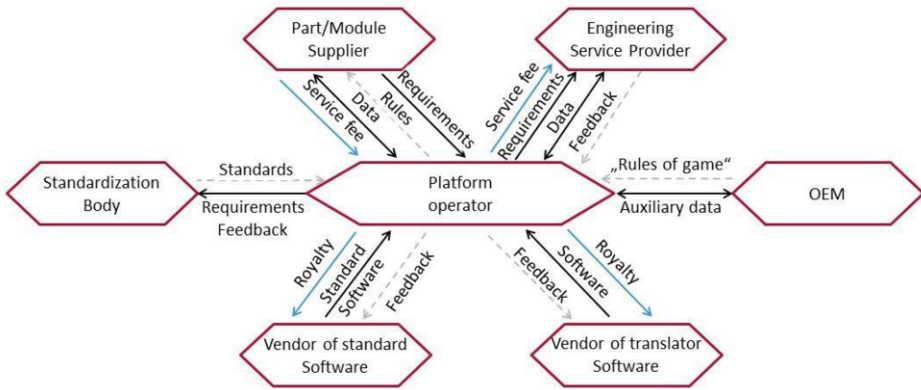


Figure 3. Ecosystem of OpenDESC.com.

OpenDESC.com works at the engineering communication interface between OEMs and the global supplier network, especially FTSS. It comprises the process, methods and technology levels to seamlessly integrate the OEMs with the supplier network in the area of the product data integration. To provide an optimal support for a supplier and fulfill the requirements of the OEMs, OpenDESC.com closely cooperates with further stakeholders such as software vendors and standardization bodies. In such a way, OpenDESC.com provides a scalable offering for the cascade of suppliers during their product lifecycle.

OpenDESC.com has been subject of continuous change. The development directions comprise the subject/content of the exchange, the underlying technology, the addressed customer base and, finally, its global offering and presence. Prior to the internet era, it has started as a service for data translation, in particular directed to CATIA V4, which has been the main system in the automotive industry. In this period, OpenDESC.com was the solution to resolve the most difficult CAD translation problems which have occurred frequently. With the rise of internet, OpenDESC.com has incorporated in its offering a portal for collaboration over internet which provides the exchange and translation of data [22]. At the very beginning, the prime customers have been the FTSS in the automotive industry. Later on, customers from other industries (machinery, aerospace, shipbuilding) have recognized the benefits of using OpenDESC.com, sometimes for singular projects (e.g. CAD migration). While most automotive suppliers act globally with many subsidiaries and development centers worldwide, it was necessary to extend the offering (service times, rules) to the customers from all the leading industry nations. Modern methods of knowledge management have also been incorporated in the operation of OpenDESC.com.

Each stakeholder in the platform-based ecosystem guards his own benefits. An OEM can achieve an ordered supply network which follows his rules on data creation and exchange. An FTS gets a simple and cheap interface to multiple OEMs and also his own suppliers. The suppliers in the second and third tier are being released of the tedious task of data adaptation and establishing many point-to-point connections. Software vendors can implement new, easily scalable, business models based on royalties instead of a license fee. Finally, the standardization bodies and agencies get an important and fruitful input for their future activities. The operation is provided under strict security rules and restrictions to mitigate the risk of data loss, both on the member [23], process [24], and system level [25].

It is important to realize, however, that much knowledge from the supply chain and network management domain is needed to properly organize an ecosystem, especially for creating and maintaining the required flexibility, while guaranteeing the quality desired by the customer. Flexibility and strict quality management regimes often require conflicting arrangements [17]. A trade-off between flexibility, network procedures, contracts, and the degree of interdependence between parties is needed [24]. Proper arrangements are important to make the ecosystem function well, also in a global context [26]. Market penetration has been achieved incrementally, because it is global marketing actions are not feasible nor possible.

Development of a platform-based OEM-supplier ecosystem definitely requires a transdisciplinary engineering approach involving people with various different backgrounds, both from academia and practice.

5. Conclusion and outlook

In this paper, we have described OEM-supplier networks as a business ecosystem. Such an ecosystem, when managed well can achieve large benefits for itself and for the (local) environment in which it is operating. Because there are many interfaces between the ecosystem members, IT support is needed to manage and guide data and information exchange. To this end, a platform is proposed as part of an ecosystem of OEM, service provider, suppliers and other parties. The platform allows suppliers to use one system with different interfaces for each of their clients.

The described platform has proven its usefulness and benefits in practice, providing services for almost 400 customers in 29 industry nations, including business transformations like mergers and carve-outs.

A proper strategy is the basis for all business models, but since the inevitable emergence of ecosystems, it is not sufficient to develop a strategy for the own company. The strategic view needs to be expanded to the surrounding ecosystem and the position of the focal firm in it [27].

The development of a buyer-supplier ecosystem with the including platform requires an approach in which not only the parties involved are participating, but also academia. The impact of the ecosystem on the (local) environment needs to be taken into account as well as the self-regulating and evolving character of the ecosystem. The complex behaviour of enterprises in a collaborative manufacturing network has been and still is subject of research [28].

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