VIRTUAL FACTORIES: HOW INNOVATION NETWORKS CAN CHANGE YOUR PRODUCTION CHAIN

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ABSTRACT

Production supply chains are undergoing several paradigm changes, in various vectors such as increasing focus on operating costs reduction, core business specialization, increased level of product customization, shortage of specialized technical workers, the emergence of innovation networking models, among others. So, developing and producing in partnership has been a main issue in new product developing and innovation contexts. Several models have been proposed for the development of these chains, from ones, more focused on internal competencies, to others completely based on external production, using licensing based business models. For organizations that follow a network innovation model there are difficulties and risks that need to be managed, in order to aim the potential benefits expected from a partnership.

In the present paper, the production process of an automatic toll payment machine for Brisa, a Portuguese highway company, is presented. The production process of this product was all based on strong collaborative work between Brisa and its suppliers/partners. The case study shows how innovation networks can be applied to the production phase and reveals some of the difficulties and solutions that appear on a production partnership.

INTRODUCTION

Usually the production of a product involves a long chain of entities consisting of a set of suppliers and vendors, which manufacture components, modules and systems that are then integrated by client companies or OEM (Original Equipment Manufacturer), providing further distribution companies who in turn deliver them to end users.

Often the specifications for the manufacture and / or supply of these components are supplied by the client company as a "closed" concept. Suppliers based on this information produce the components ordered, not having great opportunities to provide inputs for improvement.

The costs, risks and scope of knowledge required for the development of new products are very often so high, especially in areas unrelated to the core business of the company, that even the big companies have difficulties to accommodate those using exclusively internal resources.

A strategy to resolve these difficulties has been a change in relations with their suppliers, using a close and active collaboration with them, integrating them in the early stages of product development [1], [2].

Supplier Involvement in the Production Process

The collaboration between companies, in particular between client companies and their suppliers, targeting the development of new products is not a novelty. In fact, for the competitiveness sustention of industrial organizations innovation is becoming a determinant factor that requires hard and focused work, materialized in the integration of innovation processes as a part of their daily operations.

The establishment of such collaboration networks with suppliers and other partners allows the client companies to solve, in an innovative way, broad systemic problems, difficult to overcome through exclusively in-house solutions. By one side client companies can deal with such problems spreading the developing risks and reducing the required effort through the access of partners competences. By the other side, suppliers, and specially the small and medium sized ones, benefit from their integration in a market-driven innovation processes [3].

This networking with suppliers can take many forms and degrees of presence. In the initial stages of the process of developing new innovative projects is increasingly common the involvement of external factors. Andrew [4] proposes three levels of integration with suppliers:

- Integration: The client organization manages and executes all innovation processes, controlling all aspects
- Orchestration: The organization manages and controls all processes but is not responsible for the execution of all of them
- Licensing: The organization owns the idea and the concept, but has no control over their practical execution, licensing these activities to other parties
- Focus on the second level of integration, several factors can promote an approach like this [4]:
- The organization lack the resources

- Is a new area of knowledge to the organization
- The organization don't want to invest in facilities
- The organization had trust in potential partners
- When the organization want to share the risk

A strategy according this orchestration approach has been involving the suppliers in the early stages of the product development in order to incorporate manufacturing processes knowledge disseminated within the supply chain and materialize it in the product design. This methodology is known as Early Supplier Involvement (ESI) and many authors have underlined its importance [5] notability in the automobile industry [6]. ESI can facilitate the design of innovative solutions, improve the final product quality and, at the same time, reduce the time and the development costs.

We can enumerate short-term advantages for the client company among others, the following:

- Reduction of development time [7];
- Reduced development costs and production [8]
- Improvement of the performance characteristics of products and reduction of quality problems [9]

There are also medium and long term benefits, described by several authors:

- Increased collaborative capabilities of the company with others [10]
- Access to new technologies and knowledge exist internally in the organization [9]

However, these benefits are not immediate and usually require a structured and continuous work to provide positive results, and some drawbacks in the use of ESI could be expected including the potential to extend development time [11].

Despite the increasing number of experiences of client/supplier partnerships, a more close examination allows to verify that many of these partnerships are far from being systematic and structuralized, being many times a short term project based on a simple exchange of information and not a long term relation. In fact there are difficulties usually felt in early client/supplier involvement in innovation and product development processes, particularly related to a little emphasis given to how to put ESI into practice and how the available resources and tools can be used for this purpose [12].

In a broader perspective and considering the innovation framework, ESI should be considered within the wider concept of innovation networks (Fig. 1) promoted by client companies, reinforcing the accepted wisdom that suppliers are innovation leaders within such environments.

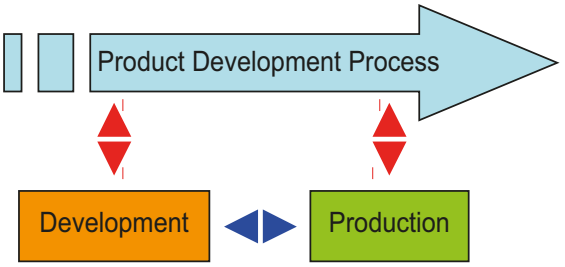

Fig. 1 – *Development and production innovation networks*

Fig. 2 – *E-Toll Machine*

Need for strong planning and management of collaborative projects, which by the nature of innovation networks are prone to landslides resulting in time and cost slipping from the targets. However innovation networks are hardly likely to be managed in a conventional manner, having to look up new ways to induce them to achieve their objectives, balancing control with the creative freedom. In planning the role of the client company is extremely important as centralizing the work planned

One way to manage these complex networks of organizations is through the interface agents that facilitates and promote connection between the Client Company and potential partners. These organizations usually called logistics or supply consulting firms are essential in the passage of the client organization needs and the combination of interests of the parties involved.

In this paper a case study is showed, illustrating collaboration activities between a client company and a net of suppliers, in the production stage of an innovation project and using an interface organization to help them achieve the objectives

BRISA CASE STUDY

In 2008, Brisa, the main Portuguese highway operator, developed an automatic payment machine to install on the manual lanes of the toll plazas in order to operate in periods of lower traffic and also contributing for the increase of the number of lanes available in the toll plazas.

The machine, called E-Toll, Electronic Toll (Fig. 2), uses some of the equipments already operating in the lanes and new ones related with money control and man-machine interface.

This new machine is composed by a metal frame that weighs one ton, which houses a set of equipments. Some of these equipments are standard products available from international suppliers and others are Brisa's products, developed and produced internally.

The development process of E-Toll was based in to main issues:

- Mechanical design and creation of the metal structure
- Electronic and function integration of all equipments

The process design involved several technical skills in numerous areas, such as electronics, mechanics, software and metalworking.

The Development Department of Brisa Inovação e Tecnologia (BIT), a business unit of Brisa Group, responsible for technology innovation, was in charge of all the developments related to electronic, mechanic and software areas. In the development of the mechanical design, BIT used ESI methodology, due to the lack of specialized knowhow, which forced, from the moment of development of the machine, to engage an external expert in the subject.

The company Salemo & Merca, already known by BIT for producing other equipment, emerges in the developing process to create the prototype, contributing with its know-how in the area and closing the gap on features related to mechanical engineering. This scenario of a partnership with BIT had already been established in previous projects.

In this case, the fact of Salemo & Merca participated from the development phase in the process of design the machine, brought positive contributions in the next stage, the production process. The company's experience and their critical look for production aspects, helped to optimize the production process, obtaining benefits with direct impact on the assembly lines. However, the early involvement of Salemo & Merca in the design process obviously raised expectations for the supplier that could not be withdrawn. So the joint product design, led to Salemo & Merca adopted this product as their one.

The production process of this machine had several components (Fig. 3), since the creation of all the metal structure, acquisition and production of equipment, cable mounting, assembly and test.

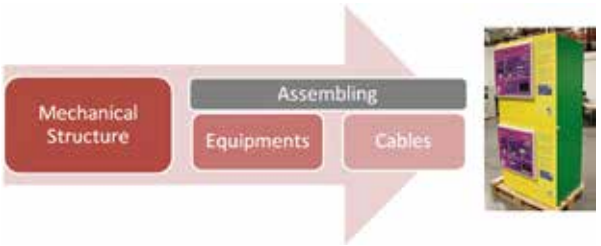

Fig. 3 – E-Toll Production Process

The production of the E-Toll forced BIT to establish a set of partnerships and to manage a set of external entities to achieve that, adapting a model of virtual factory. The fact that BIT didn't have any production structure has led to hire externally all production process, from management to the creation of their own assembly lines.

A company, G3P, arises in that context. With control and production management skills, G3P led the production process of the machines, where BIT took the role of supervising and controlling the scene from a highest level. In this case, G3P was an essential interface between development and production departments, becoming a company with a key input in the internal structure of BIT. The lack of internal resources specialist with experience and total dedication to production, and confidence in G3P, allowed it to assume a prominent place in the whole process. The risk inherent to this "controlled freedom" could be transformed in the loss of process control and loss of knowledge by BIT on their production process. In some moments, trust led to the information asynchronism between internal departments.

Based on the client's needs, G3P generated the MRP (Material Requirement Planning) for the production. All the partners and suppliers (Fig. 4) involved in the production process, suppliers of cables, cards and electronic cash equipment, were conducted by G3P, representing BIT, in negotiation processes and deliveries plans. Because Brisa is a reputable company with a highlight position in Portuguese market it brought better trading conditions and partnership trust on the negotiation with all suppliers.

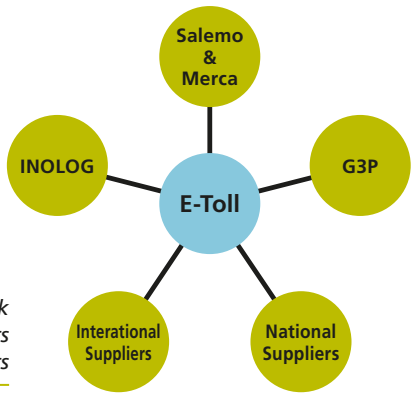

Fig. 4 – *Network partners and suppliers*

The interest of BIT in using national partnerships was maintained throughout this process. At some moments there was a need to consult international suppliers seeking to obtain the best conditions among national suppliers and making them more competitive.

E-Toll virtual production was accomplished at INOLOG. This company was the integrator of all the equipments that compose the machine. As happen with Salemo & Merca, the partnership with this company has already established in previous projects.

With G3P support, INOLOG was responsible for:

- Managing the purchases and delivery's plan among all suppliers;
- Equipment integration;
- Final machine testing

In resume, manage the entire production process, although the production consisted of a virtual internal process of BIT.

Using a network of partners, BIT could mass-produce the equipment E-Toll applying all the concepts of Virtual Factory. The adoption of the model Virtual Factory allowed transferring some risk to each partner, although the greatest risk would always be in BIT, as responsible for managing the entire process. This risk allocation allowed, in a proactively way, to involve of all companies, accountability them and sharing a common objective, which would meet the production timings.

CONCLUSIONS

The concept and potential benefits of innovation networks are easy to perceive but, as we saw in the brief description of our case study, its application in real work situations is complex, requiring a set of best practices that ensure the best transformation of these experiences into real earnings for all entities involved.

The use of partnership interface entities helps to systemize the obligations of the parties involved, without causing excessive rigidity in the process, reducing the risk of potential future failures.

This project foresees the construction of an innovation chain that focuses on BIT. In fact, unanswered requirements, materializing its market needs, are the engine of innovation itself, promoting and fostering the development of new skills and new solutions in other partners. These partners in turn will similarly influence the other entities and organizations with which they interact.

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