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Open Innovation in the Automotive Industry: A Multiple Case-Study

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1. Introduction

Our chapter aims at exploring the concept of Open Innovation (OI) and evaluating whether, why and how it is adopted in the automotive field. Moreover, the intent is identifying which kinds of potential advantages and risks automotive companies should face when choosing Open Innovation strategies. As regards its basic goal, the study attempts to enrich the existing empirical evidence because few studies about the topic were conducted.

Our research is carried out with a combination of literature analysis (i.e. bibliographic research of journal articles, books, and official companies' press) and face-to-face interviews, conducted with a semi-structured protocol and addressed to three well-known companies operating in the automotive industry (i.e. an Italian automotive company[1], Pininfarina, Bosch).

Figure 1 represents our main research questions:

1. whether and why open approaches can be adopted;
2. how openness can be set-up;
3. what are the obstacles firms face and the advantages companies achieve while adopting an OI approach.

The underlying idea is that firm-specific strategic goals as well as external factors (i.e. environmental/industry features) can affect (i.e. explaining whether and why) the adoption of OI approaches and that openness can lead to some advantages despite some obstacles and risks. Both literature and case studies helped to define the framework and to set it in the automotive industry. Case studies in particular allowed us to grasp in practice these pressures toward OI and to describe in detail how OI is set up (this is possible in many different conceptions as it will be explained later in this chapter: e.g. in terms of prevalent partners; phases of the innovation funnel on which the collaboration is in place; adopted

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[1] Named "Company A" because confidentiality reasons force the authors to hide the real name of the company.

organizational modes, only to give some examples of questions); the obstacles and risks on one side as well as the potential advantages on the other side.

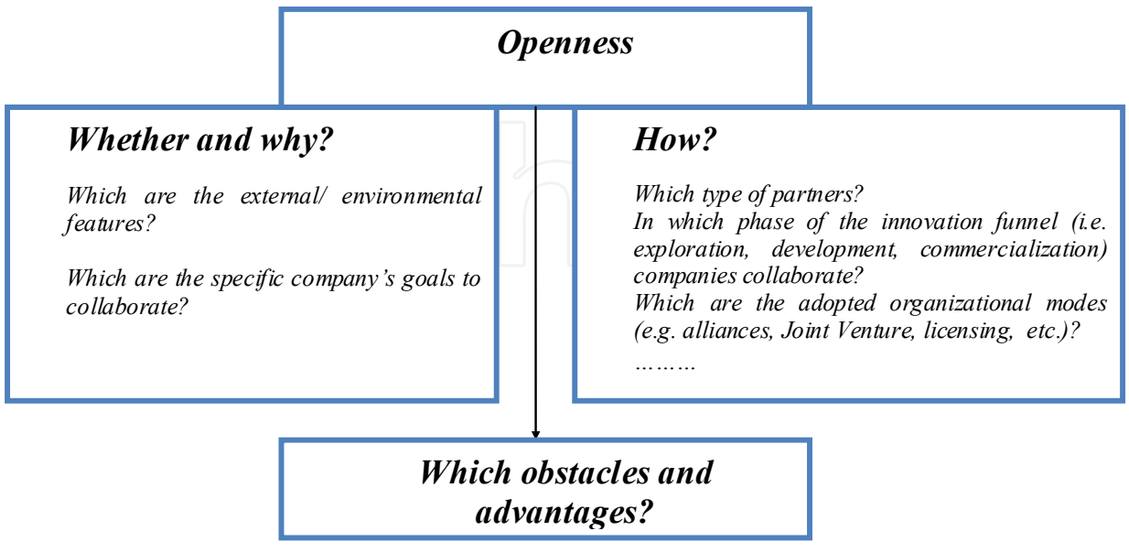

Fig. 1. Research questions

The chapter is divided in four main sections. It begins with the literature analysis in order to identify suggestions by previous studies about our research questions. Methodology section follows, with the description of the investigation protocol. Then, chapter goes on by presenting the results of the three case studies developed through semi-structured interviews. Finally, the chapter ends with conclusions and limitations of our study.

2. Literature review

Literature analysis is aimed at capturing suggestions from previous studies about three main aspects consistent with our research questions:

1. the main general competitive factors leading nowadays to the adoption of the OI approach in the automotive industry (i.e. why);
2. the firm-specific factors or strategic automotive companies' goals leading to the adoption of an OI approach (i.e. why); studies belonging to this stream of contributions usually try to find whether the expected advantages have been achieved and which types of obstacles companies eventually faced;
3. the manner in which openness can be set up (i.e. how), this interpreted in many different conceptions (e.g. prevalent typology of partners; organizational modes to be adopted for cooperation – Joint Venture, R&D contracts, etc., only to give some examples).

Open innovation is a phenomenon that has become important for both practice and theory over the last few years in many industries. One of its most often used definitions is: "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the markets for external use of innovation" (Chesbrough and Crowther., 2006). In 2003, Henry Chesbrough coined the term "open innovation" in order to create a contrast

with closed innovation strategy, supposed its predecessor, where companies generate their own innovation ideas and then develop, build, market, distribute, service, finance and support them on their own (Chesbrough, 2003a). Open innovation deals instead with relying on a firm's capability to carry out internally and externally technology management tasks along the innovation process. In this way, the company interacts and "collaborates" with its environment from different points of view; this leads to external technology acquisition and exploitation, on the one hand, and to share its core competencies with other companies, on the other. Chesbrough (2003b; 2006) goes on with recognizing that an open innovation process involves variegated internal and external technology sources and commercialization channels. By adopting open innovation approaches, the boundaries between a company and its environment, including customers, suppliers and competitors, becomes porous; thus, technological knowledge should be considered as an economic good itself (Chesbrough 2003b). In the recent years, many industries such as computers, semiconductors, telecommunications equipment and biotechnology, are more and more abandoning the closed innovation approach in favour of the open one, as well documented by several studies (Chesbrough et al., 2006; Diaz-Diaz et al., 2006). Conversely, in the literature there are still not many empirical studies regarding the adoption of Open Innovation in the automotive industry. Thus, the question whether an Open Innovation approach could be more adequate in the attempt to achieve a better R&D performance for automotive companies than a closed innovation model is not completely answered. As mentioned above, the first stream of literature contribution tries to study whether the OI model is appropriate also for the automotive industry and which are the main factors leading to this approach. Ili et al. (2010) depict the actual scenario in the automotive industry concerning the way of generating innovations. They consider the automotive industry as trapped by cost and innovation pressure and forecast a revolutionary discontinuity in generating innovations and a change in the way of creating and profiting from innovations themselves. Two of the most important factors leading the change are customers and globalization; customers demand more and more cars for the same old price. As a consequence, their demands and expectations are mirrored on the Original Equipment Manufacturers (OEM) who increase more and more their challenge to innovate. This aspect is also influenced by marginal growth provided by mature markets in industrialized countries, as they are almost saturated. Besides, strict environmental protection guidelines and safety conditions are affecting more and more the way of approaching innovation. Moreover, the pressure for OEMs is increased by the need to build and support the most important brands with innovations that are considered by customers worth of those names. However, adopting strategic approaches aimed at supporting innovations implies significant costs for companies. In 2006, the R&D expense for one innovation added up €70-80 million at Porsche, BMW and VW, and Daimler spent more than €150 million (Bratzel and Tellermann 2007). In the meanwhile, the cost is dramatically reduced by price erosion and shorter product life cycles. Moreover, the technology intensity and fusion (different technologies need to be combined to give the final product, i.e. the car) are crucial factors in the automotive industry. Following Gassmann (2006), Ili et al. (2010) conclude that, because of increasing innovation, cost pressure, globalization, technology intensity and fusion, the automotive industry needs to look outside their own boundaries and OI should be considered a good opportunity even though some obstacles/barriers are still remaining. The

issue of barriers and obstacles to OI adoption is well elucidated by the second line of investigation mentioned above, that primarily aims to identify the automotive companies' goals to collaborate and then tries to evaluate the achievement of such goals (i.e. the expected advantages from collaboration). A relevant contribution is from Dilk et al. (2008) that, through a series of semi-structured interviews with managers from European automobile firms, find the most important goals include "flexible access to technologies", "intensified contact with clients and markets", "long term bonding of suppliers and clients", "access to other competencies (besides technology)", "improving quality of R&D", "reducing R&D costs", "reducing R&D time". The investigated companies report a fairly good performance by declaring that the strategic goals are almost achieved even though several deficits are identified. In fact, collaborations are successful only when the goals, responsibilities and tasks are clearly set among the partners and monitored as it is common practice in project management procedures. Soft and cultural aspects are of crucial importance: authors find that the human resource management of the automobile companies has not yet adapted to the specific challenges that employees are facing during collaborations. In most times, employees do not get adequate training preparing them for working together with external people and incentives to motivate employees to this purpose are also used rarely.

Bartl et al. (2010) investigate the opening of the innovation process when companies' goal is increasing knowledge, creativity and skills by co-creation with users and other stakeholders in new product development. Similarly to Dilk et al. (2008), Bartl et al. (2010), highlight the importance for success of collaboration of adapted innovation processes, organizational routines and cultures in order to change a company's attitude from "not invented here" syndrome to an enthusiasm for ideas and innovations which were found elsewhere. In summary, and also expanding the investigation beyond the automotive sector, literature shares the view that the implementation of Open Innovation is in any case quite difficult, whatever is the prevailing objective. As a matter of fact, recent studies stress the importance of the "right conditions" (in terms of company's strategy, capabilities, organizational factors, managerial tools, etc.) to make any open approach successfully carried out (Chesbrough & Crowther, 2006; Dahlander and Gann, 2010; Pisano and Verganti, 2008; Raasch et al., 2008; Bilgram et al., 2008).

And we finally get to the third line of investigation, which is indeed how Open Innovation is practically setting up. About this, the innovation & technology literature in general is really vast, while that specifically devoted to automotive industry is confirmed still poor. Just to give an idea of this broad set of conceptions, without any claim of completeness, we mention that the way the innovation process can be opened has been studied in innovation & technology literature according to the following main perspectives:

1. the kind or direction of openness (Chesbrough & Crowther, 2006; Gassmann and Henkel, 2004; Lichtenthaler, 2008): inbound (i.e. technological acquisition, where new ideas flow into an organization); outbound (i.e. technological commercialization, where unused technologies can be acquired by external organizations with business models that are better suited to commercialize a given technology); coupled as a combination of the previous two, with the innovation and ideas exchanges at the same time in both directions by establishing cooperation with complementary partners e.g. to co-develop projects;

2. the organisational form of acquisition or commercialization and consequent level of integration and time horizon (i.e. contractual agreements, licensing, alliances, joint ventures, etc: Chiesa and Manzini, 1998; van de Vrande et al., 2006);
3. the number and typologies of partners (von Hippel, 1988; Laursen and Salter, 2004; Pisano and Verganti, 2008; Enkel et al., 2009; Keupp and Gassman 2009);
4. the phases of the innovation process (i.e. exploration, development, commercialization) actually open (Gassmann and Henkel, 2004);
5. the kind of governance of the innovation networks: e.g. hierarchical, in which anyone can offer ideas but only one company defines the problem and chooses the solution; or flat model, in which anyone can generate ideas, and no one has the authority to decide what is or is not a valid innovation (Pisano and Verganti, 2008).

As specifically dedicated to automotive industry, it is important to quote again the contribution of Ili et al. (2010). The authors identify the typology of partners currently being followed by the automotive industry in order to improve idea generation and innovation: customers are considered as the most important sources for innovation; competitors and suppliers follow. Moreover, the study finds that there is high innovation potential from examples of other industries. While the tendency to look outside own boundaries for external sources to increase innovativeness (i.e. inbound openness) is confirmed, authors find that the external paths to outside the current business with own intellectual property is still hard and rare (i.e. outbound openness). In fact, there are many unused patents and companies are not even aware of their potential of external exploitation. As organizational modes of collaboration, reciprocal license agreements, alliances and joint ventures are the most common, while at individual organizational level the human profile defined as gatekeeper has become increasingly important. Learning journeys and trend scouting are promising methods to grasp innovation from different sources. This is the reason why companies such as BMW, Daimler and VW gave birth to the "trend-scouts" in variegated technological areas like Palo Alto, North America and Tokyo. In addition to this, passive web-based methods are adopted; for instance, BMW adopts the so called "Virtual Innovation Agency" and VW uses an online interface allowing engineers from different locations all over the world to provide their contribution with new ideas and innovations.

Another relevant work about the role of partners in the automotive industry is that by Heneric et al., (2005) which depict a clear scenario about the automotive industry evolution and trends. They claim that R&D performance is very important in the automotive industry, as it is an important factor in order to measure technological performance and gain competitive advantage. For this reason, many European companies invested more in research and innovation, carried out both internal and through to external collaborations. The cited study outlines the growing importance of collaboration with suppliers during the product development stages, and not only for the production. Due to the fact that in the last years customers have expected more and more additional improvements from manufacturers, but were not willing to pay higher prices, companies concentrated on core activities and increased efficiency by delegating other activities to partner companies. In this context, the vehicles manufacturers have the special ability to manage the complexity of the production process, which requires to co-ordinate up to 2500 suppliers for the most advanced models (Womack and Jones 1991). The increasing collaboration with suppliers let emerge a pyramid of manufacturers, with first tier suppliers directly involved in production

process of vehicle manufacturers, and second and third tier suppliers with no direct contact with automotive companies (Terporten 1999). Future trends identified by McKinsey & Company (2003) estimate an average decrease of 10% of the value proportion added by the vehicle manufacturers. This decline is mainly explained from the potential spin-offs of tasks for the chassis and engine technology areas to suppliers. Moreover, it is forecasted an increase of strategic alliances in the form of cross-borders developments and components sharing. Roland Berger & Partners (2000) conducted a study on technological innovations for different components of the car (see Figure 2).

It is possible to notice that Information Technology (IT) will take a higher and higher margin in the automotive innovation; it is forecasted that 90% of all future innovations in the automobiles will be driven by IT. McKinsey & Company (2003) claims that vehicle manufacturers are trying to gain important positions in the electronic engine control, but with low success; the growth in this and other IT areas will be so occupied by specialized suppliers, that will gain a higher and higher importance in adding value to the product.

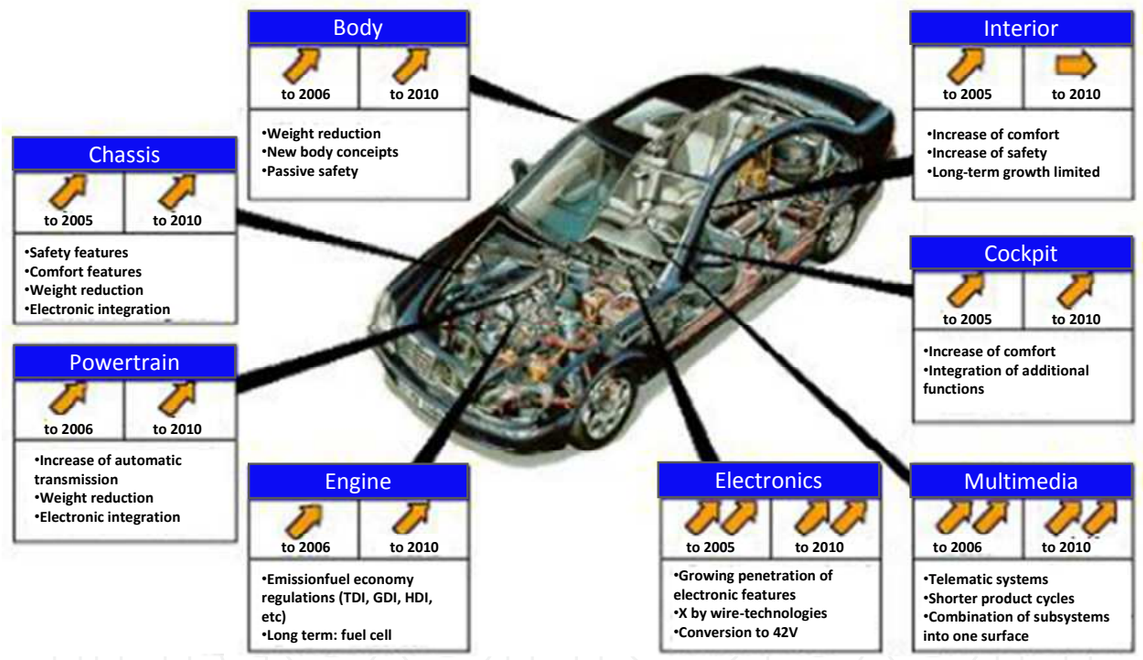

Fig. 2. Technological innovations

In any case, literature is unanimous in believing that a series of factors, i.e. the shorter innovation cycle time, the increasing product complexity, the downward cost pressure combined with increasing demands for performance and quality, deeply increased the number of challenges related to innovation that firms have to face today. In this context the access to new technologies has become crucial. Very interestingly, Gassmann et al., 2004 find that a particular type of partner, i.e. firms operating in other industries, can provide a valuable contribution to this goal. Thus, the choice of external sources is amended by adopting the so called "cross industry innovation (CII)", that is the deliberate combination of the potentials of companies operating in different industries (Gassmann et al., 2004).

Combining the different potentials of young and mature firms, the possibility of introducing innovative products using new and/or disruptive technologies is enabled. In 2004, the authors conducted a study over 12 automotive companies and found out that for certain projects companies combined complementary potentials of young and small with large and mature firms of different industries. These collaborations allowed to realize a radical product innovation in a deeply reduced time to market. A relevant example of this opportunity is that of *iDrive* developed and commercialized by BMW. Herrler (2001) depicts the *iDrive* as an innovative control device allowing drivers to access many different functions of their cars in an intuitive and interactive way, with a single hand and using a computer-like screen (*Control Display*). *iDrive* is aimed at simplifying and improving the interaction between the driver and the car, as the number of functionalities in the cockpit of modern cars has increased significantly over the last few years. Besides gear shift, lights, basic air conditioning and radio, CD music, telephone, navigation and advanced climate control systems are now present. The number and complexity of functionalities is in constant increase, as telematics and online applications are already available in several cars. The *iDrive* represents a radical innovation in the man-machine interfaces within the automotive industry, as it radically reduces the complexity and quantity of the control elements in the car's cockpit. This innovation was possible thanks to the integration of a new technology in the automotive environment. BMW involved many companies for the development of the device; a not specifically related to car projects research was initiated and different concepts for systems and concepts for in-car controls were investigated. The aim of the project was the development of a control system inspired by the personal computer's user interface of mouse and screen, and launches it in the new BMW 7 series in the autumn 2001. The BMW Group's technology scouting office in Palo Alto, California, identified *Immersion* company as a potential partner for the development of the project. *Immersion* had never operated in the automotive industry, but developed the proprietary *TouchSense* technology that was mainly applied in joysticks, flights sticks and steering wheels for video games, providing force feedback to the players. *Immersion* started the development of first prototypes very soon, and presented the first of them to BMW, that launched a feasibility study. *Immersion*'s engineers adapted the technology for the automotive industry very quickly, and soon they created a prototype integrated into an experimental car. To demonstrate that the implementation of the collaboration is never easy, it is important to note that the final agreement for collaboration was reached only in the early 2000. Moreover, as the collaboration became closer, several problems became more visible. On the one hand, *Immersion*'s management had difficulties in dealing with a large number of people in BMW. Because of the many BMW's departments involved, they were not able to identify a clear responsibility; on the other hand, BMW's engineers were still sceptical in adopting that technology, as it had never been adopted in the automotive. Once the BMW requirements were fully satisfied, the serial production could be started. However, *Immersion* was not able to become a supplier of complete systems or components, but only a technology supplier; for this reason, other partners' know-how was needed. As a consequence, BMW decided to delegate the *iController*'s serial production to the Japanese electronic group ALPS and purchased the rights for the *TouchSense* application in cars, with the exclusive for a certain period of time. Today, the *iController* can be found in all BMW cars, and Immersion receives royalties for each device built into a BMW's car.

Finally, a last topic studied by literature in the automotive industry concerns the kind of governance of the innovation networks. Dilk et al. (2008) provides interesting evidence: in their sample of European automobile firms, flat configurations, mainly based on trust, seem to dominate. The trust network is based on a collaboration contract, pre-defined assignments or, even if in few cases, oral agreements only. The partners keep their organizations independent among themselves. To work together, they usually set up teams with employees from the involved companies. The network progress is monitored by a committee and budgeting is the instrument that is commonly applied. For conflict resolution, contractual rules build the main basis even though mutual trust between partners is a more important parameter for the network success.

In summary, literature review surely shows a tendency to adopt an open approach, and this appears useful for increasing the firm innovativeness. However, except for the case BMW, examined in detail by Gassmann et al., 2004, other studies investigate groups of companies in order to highlight a set of issues and trends, definitely interesting, but not so in depth. Thus, we believe that the detailed study of three case studies can usefully enrich the empirical evidence on a subject that seems very relevant nowadays in the automotive industry. In particular, "understanding why, how and with what benefits and barriers" open innovation has been adopted in real case studies can provide useful insight for managers operating in automotive industry.

3. Methodology

To carry out our case study investigation, we adopted the triangulation method that is defined as the adoption of different data collection techniques within the same study in order to ensure the truthfulness of the gathered information (Saunders, Lewis and Thornhill 2007). For this reason, we combined both information provided from secondary sources and face-to-face interviews. The need of direct interviews emerged as a consequence of the gap between the literature and the aims of the research, as there were not found any similar studies, and the gap needed to be filled with the direct experience of people working in important automotive companies. In particular, we opted for the adoption of semi-structured interviews. The aim is to combine the advantages of both structured and unstructured interviews. Moreover, the possibility of conducting telephone or mail interviews was excluded; we believed that a direct contact could make the information sharing process easier, as the interviewed people could directly provide potential useful material of the company. Besides, the respondents could lead the discussion to areas that were not previously considered but are significant for understanding. Furthermore, they could feel more confident in providing information in a face-to-face context as they can receive personal assurance about the way the information will be used (Saunders, Lewis and Thornhill 2007).

We developed three case studies respectively about an important Italian automotive company, Pininfarina design and Bosch. The intent was to obtain diverse points of view about the theme from actors operating in different parts of the supply chain. After the initial contact with the human resource offices, we interviewed responsible specialists working in the R&D departments and management of the company.

3.1 Interview structure

The interview is going to be divided in three parts (see Table 1), consistently with our research questions reported in previous Figure 1: whether and why; how; obstacles/advantages.

Interview section	Research questions
Understanding whether and why company searches for collaboration	• Identify whether the company considers the possibility of collaborating with external actors • Identify the goals for technological collaborations with external partners
Understanding how	• Identify the typologies of partners • Identify the phases of the innovation process in which the company collaborated with external partners • Identify the kind of collaboration (i.e. inbound and/or outbound direction) • Identify the organizational modes adopted by the company for the technological collaborations • Identify the kind of governance
Understanding obstacles and advantages	• Identify the main reasons determining the failure of technological collaborations • Evaluate the main benefits achieved with technological collaborations

Table 1. Interview's structure and objectives

4. Findings

After a brief overview of its context and innovation strategy, each case study will be described in detail by trying to answer to the research questions reported in Table 1.

4.1 Case study 1: Automotive company A

For many years, the company's strategy was aimed at being a follower; however, after the change in the management, things evolved in better, and Company A managed to develop and to patent successful technologies that were also licensed to competitors. At the moment, the company retains a leadership position in diesel, LPG and natural gas engines; the lower success of petrol engines is attributed to an investment reduction in their research, as a consequence of the fuel price increase and the customers' tendency to opt for alternative engines such as diesel, LPG and natural gas. Moreover, Company A has been pursuing for many years an international policy aimed at accessing new emerging markets, by locating there the production and introducing products according to their needs. However, in those countries the innovation is not as important as in the European countries and, thus, it is just an adaptation of the existent models (or also past models) to specific needs. The core activity

of innovation is in Europe, where Company A feels more and more the pressure for innovating, as the demand for new product increases and the time to market is dramatically reduced. Nowadays, the economies of scale are a critical success factor for the company. However, their pursuit implies significant investments for every new product. Anyway, the high flexibility levels obtained thanks to the versatility and standardization allow the pursuit of economies of scale and the production of different models on the same production line. Partnership with other automotive companies supports this aim. The expansion strategy focused at reaching economies of scale is often mirrored in the collaboration agreement with local companies. This approach is followed for two main reasons: on the one hand, it is possible to reduce designing, production and investment costs, as local companies already own the plants. On the other, it is possible to overcome some government barriers as many states prohibit foreign companies to produce in their territory unless they do not set a joint venture with a local company.

The innovation process is different according to the kind of project the company is working at. Efforts are paid to both radical innovations (breakthroughs) and incremental innovations. The company perceives innovation as a new or existent product, process, methodology or service applied at a lower cost, and not necessarily as a new technology application. The innovation might also be a recombination of existing processes and technologies.

The external sources of innovation are various and the company has a specific department to identify them. However, Company A tends to directly and secretly control the so called "perceived distinctive functionalities", considered as belonging to the mosaic that provides value added to the brand. These variables directly affect the customer in the choice of the product[2]. The company has internal and external technology intelligence departments that conduct every day opportunity/risks analysis, as well as technology scouting. Moreover, a market intelligence area explores existing and new market segments in which a new technology might have potential success. Economic incentives often support these analyses, in order to increase productivity and motivate employees. Especially with regard to short-medium projects (3-4 years), directed at improving technologies or carrying on products' restyling, the voice of customer (VOC) has a significant impact. Thanks to the support of appropriate market analyses, the potential customers express their needs providing an external point of view; their ideas are intersected with the technicians and engineers' ability, which are responsible for evaluate whether ideas are realizable in practice and carry on the development. The designing cycle is usually performed in co-design with the suppliers. The objectives are enlarging company's competence base, stimulating creativity and capability of generating new ideas, reducing and sharing risks related to innovation activities and costs of innovation process. In this case, the company decides whether to set a task force dedicated to a project, composed of members of both the company and the supplier, or to name supervisors operating at the suppliers' premises. One of the latest company's innovation is the "Virtual Car", that is a software able to perfectly simulate the dynamic behaviour of

[2] For instance, Company A retains very successful patents in the field of diesel medium-powered engines and therefore keeps a strong control over all the components related to the engine monitoring. Besides, the design is also a strongly controlled variable as it allows to differentiate the components that are visible to the customer.

the car in different driving conditions. It gives the opportunity to perform all the electronic setups preventing potential faults. Until the 2008, Company A was the only one adopting this kind of electronic systems. The importance of the suppliers in providing value added to the product is witnessed by the slogan "global purchasing to the global partnership". Company A adopted a structured collaboration plan with suppliers, offering them three years contracts in order to plan more realistically their growth and development strategies. At the same time, the company developed a co-sourcing strategy, allowing Company A and its suppliers to join each other in the materials purchase, in order to obtain prices that are more competitive. Moreover, Company A's managers carry on training to the suppliers' employees in order to improve the quality of the service.

In addition to this, Company A relies on other external actors such as companies operating in other industries (i.e. from aeronautic sector), universities and research centres. It considers their collaboration very useful, as they are able to provide a significant contribution in the user functions' development. In particular, universities' collaboration concerns the idea generation and testing phases.

As concerns the kind of collaboration (i.e. inbound and/or outbound), Company A declares the adoption of both the approaches by showing its willingness in exchanging innovations and ideas on both directions. Ranking them in order of their use (i.e. less employed to most), contractual agreements, reciprocal license agreements, licensing, patent sales, alliances, and Joint Ventures are the organizational modes employed for opening up innovation process in both directions. The lesser adoption of alliances and Joint Ventures is justified by the fact that they imply a higher resource employment and therefore are chosen for high-relevant long-term projects only. As proof that outbound open innovation is adopted, Company A reports that the number of ideas "on the shelf" is definitely reduced as well as the number of un-used patents.

With regards to the kind of governance, Company A has in general the main function of coordinating all the actors' work in order to respect timescales, by adopting a hierarchical approach. However, the governance approach depends on the importance of the project and the partners' capabilities. In case of relevant projects, the decision making process is shared and the work is carried out in co-development. Moreover, when the company A considers the supplier as able to safely carry out the project on his own, it cooperates with him only in the phase of requirement specifications and final testing in order to verify whether the product is effectively interfaced with the vehicle. In this case, the supplier takes the decisions for the other phases on his own and carries on the development.

Finally, based on its expressed goals, Company A was asked to evaluate its degree of satisfaction in reaching these goals. Company A declares that the initial expectations have been partially achieved even thought some problems emerged. For example, disagreement on prices or misunderstandings related to supplying timescales and payments are very frequent especially with low-importance partners. Furthermore, the non-compliance of the specifics by suppliers is also a much discussed theme. In these cases, it results very difficult identifying the guilty, as responsibilities are not often well distributed. Besides, the high and increasing complexity of the product does not help in solving this issue. However, this phenomenon is not reported for important suppliers, as it is their primary interest to carry on a successful collaboration in order to have high sales: in fact, if Company A reports low

sales, the failure is reflected on the supplier too. Effective times longer than what planned and cultural differences between partners are also reported.

4.2 Case study 2: Pininfarina

Pininfarina is one of the most famous designing companies operating in the automotive industry as well as in other industries. Differently from the other automotive constructors and designers, Pininfarina operates in a diverse reality. Its aim is not directed at involving mass production products, but niche markets that are not attractive from an industrial point of view. Pininfarina always retained a leadership position in its activities. In most of the cases, it tried to behave as first mover, by introducing innovations in terms of design and technology before competitors. Since the seventies, Pininfarina gained a leadership position, as it was one of the first companies adopting personal computers and calculators. In the same period, it built a wind tunnel that is still working and implies a yearly 2 million € investment for research and innovation. The tunnel is on a 1:1 scale, and allows performing virtual simulations, avoiding testing prototypes on the street, as there are many unpredictable hidden risks. Moreover, the company tried to influence the structure and rules of the sector by pursuing the mission of eco-compatibility. This pattern has been followed for about thirty years; among the most important innovations, the Ethos and m^3 in collaboration with the FIAT research centre are worth to be remembered. The radical innovations introduced in the eco-compatibility field were so successful that now it constitutes the company's core business. The company is actually working on the launch in the market of "Nido", one of the first electric cars. Since its origins, Pininfarina dealt with innovation, as it constitutes the core element of the company's mission. Until the 2007, the whole innovation process was sponsored by auto-financing. However, collaboration modalities were set with strategic partners, with whom Pininfarina started co-development projects aimed at building prototypes based on an emerging technology. Furthermore, public financing was also an important sponsor.

The idea generation does not present a fixed pattern. A new idea may come from specific market needs in a certain time or an internal intuition that is proposed to the customers. In general, it may bear internally, as well as be commissioned by the customer. It is very frequent that customers ranging from automotive companies to private entrepreneurs delegate Pininfarina to design a coach according to their particular needs. However, a new idea can be developed also for particular occasions.[3]

Before the creation of industrial prototypes needed to test the serial production, the company creates prototypes for show purposes, that are used for exhibitions and marketing initiatives. In this way, the customer has the possibility to directly evaluate the product according to the previously set requirements and suggest changes or new ideas. This strategy is successful; in fact, the company worked for the most important worldwide automotive companies: customers' collaboration can be witnessed in almost all the phases of the innovation process (Figure 3; Pininfarina 2010a and Pininfarina 2010b).

[3] For instance, in order to celebrate the 80 years of Alfa Romeo, Pininfarina designed an unique prototype.

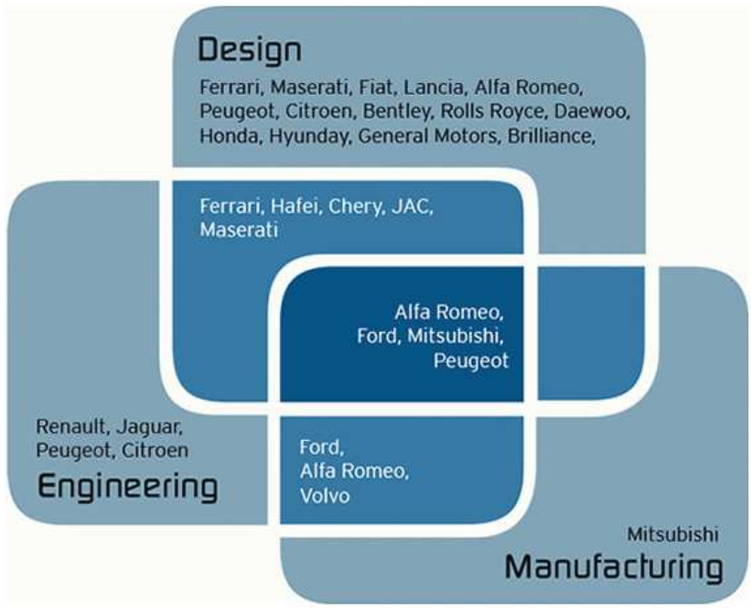

Fig. 3. Pininfarina' s customers for design, engineering and manufacturing

The time needed to complete a project, from the idea generation to the serial production is more and more shortening in the last years. However, the effective time is influenced by the presence of an existing chassis; in this case, the cycle usually lasts 18 months with an average investment of 100 million €. Moreover, the interviewed people report that a completely new project may take up to 36 months to be completed and investments up to 500 million €.

Due to the fact that Pininfarina has always worked as a full service provider to automotive companies (i.e. customers), these are the most common partners. They have the possibility to ask for services ranging from the program management to the full design of a car. In the latter case, the project is often carried on in co-development and the most used organizational mode is the "equal sharing alliance". Key figures are the program manager, that keeps the contacts with customers and deals with timescales and costs, and the engineering manager, who deals with the engineering. To favour co-development, in 2003 Pininfarina built a structure in which it is possible to give hospitality to the partners' employee in order to work together and facilitate the data exchange. The structure is very flexible, in order to best adapt itself to the different projects. However, the opening of innovation process is not always easy, as the company has to learn how to work with the partners' software and vice-versa. Anyway, Pininfarina developed IT interfaces where both the company and the customer can share projects and ideas in a definitely secure way.

The project cycle is usually carried on with external supplier partners; each of them is specialized in a different area and thus provides the necessary technology competencies to the projects. Among the most important partners, it is worth to remember: OSRAM, for the vehicle external and internal lighting; NUVERA that provided fuel cells with a reformer able to produce hydrogen; BI Technology that contributed to the vehicle energetic efficiency improvement; REICOM that developed vehicle to vehicle interfaces technologies. Their

cooperation deeply contributed to the success of many important projects. Obviously, there are also more occasional external suppliers, called upon to satisfy peaks of demand. When Pininfarina is confident that the supplier is able to carry on the work on his own, job order contracts are set. In the opposite case, there is integration on the production platform, in order to ensure the requirement respect and the error reduction. Pininfarina' s purchasing office does not adopt a formal procedure for selecting suppliers, but it relies on the one presenting the best quality/price balance chosen from the supplier checklist developed after direct visits to supplier facilities. On the other hand, when the supplier is considered of strategic importance, stronger organizational modes of collaboration, such as joint ventures, are set up. An important example of joint venture is that with WEBASTO, which saw the creation of a new society (50%-50%), OASIS, for the retractable top realization.

In addition to this, commercial agreements are used to be set. It is worth to name the one with Ansaldo Breda, who bought the right for avoiding that Pininfarina would work for its competitors. Besides, there is a tacit agreement with Ferrari that has been lasting for seventy years about "not working" for competitors such as Porsche or Lamborghini.

The strategy of continuously dealing with external actors has always been pursued with the basic goal of enlarging the company's competence base. The choice of partners is usually influenced by the possibility of acquiring complementary competencies. Besides, CII is an important source of innovation as Pininfarina adapted railway and naval technologies to the automotive.

As concerns the kind of collaboration (i.e. inbound and/or outbound), the co-development is a clear example of coupled type of Open Innovation: through its collaborations, Pininfarina acquires ideas and knowledge, but also it transfers knowledge by making available its patents to benefit cooperation. However, this does not mean that Pininfarina is an active seller of patents to exploit those that are not suitable to its current portfolio. In other words, there is no mindset to actively exploit intellectual property.

With regard to the kind of governance, it depends on the type of partner, i.e. supplier or automotive customer, with which Pininfarina is collaborating. As concerns suppliers, Pininfarina usually holds the ranks of the projects, even if the granted delegation is strong when it comes to highly competent actors. In the case of automotive customer partner, as it could be for example Company A, Pininfarina has to submit to customer' s governance conception although, in turn, its distinctive competencies favour the adoption of participative approaches.

When we asked about the benefits of collaborations, Pininfarina never reported significant failures in agreements, as it tries to build partner loyalty by establishing long collaborations[4] and following a common pattern.

However, an unsuccessful cooperation with GM (General Motors) can be cited as example. GM commissioned to Pininfarina the development and production of a car to be partially assembled in the Pininfarina Italian plants and completed in Detroit with the engine assembling. The shipping costs had a too high impact to GM, which did not manage to forecast the costs well, and implied the failure.

[4] 70 years with Ferrari, 30 with Ansaldo Breda, 80 with Peugeot.

Moreover, Autoblog (2010) reports the failure in the collaboration between Pininfarina and Mitsubishi for the production of the Colt CZC. The latter complained with Pininfarina about delays in production and quality issues, demanding a 43,4 million € refund. Pininfarina replied with a 100 million € damages refund for the investments performed. The international Paris law-court accepted both damages requests, establishing a 19,2 million € refund in favour of the Italian company. Finally, the interviewed people explain that in the past the company invested in collaborations aimed at producing models that were not successful. However, they also claim that the failure was exclusively linked to a Pininfarina's mistake, rather than a partner fault.

4.3 Case study 3: Robert Bosch S. p. A.

Robert Bosch S.p.A. is a company operating worldwide that supplies the most important automotive companies. It deals with many industries, and the automotive field constitutes one of its main businesses. Bosch supports automotive companies by researching and developing 360° innovative solutions for the cars of the future and supplying standard components in a large scale.

As observed before, the recent financial crisis has led to a significant increase in the cost of technology development, as customers are demanding more and more reliable and sophisticated products but, at the same time, they do not accept any increase in the price. Therefore, companies supplying commodities in big quantity and high precision tend to perform investments in order to reach economies of scale and lower costs for the new released products.

The interviewed people report that, for the automotive division, Bosch aims to be a leader for each product. Its constant engagement in innovation makes that automotive companies rely in greater and greater part to Bosch's components: reported data show that in every car the Bosch's components contribute to the product value creation for at least the 15%. However, while the constant research allows keeping a leadership position for the innovations, there is a higher risk of imitation for the standard components. As the competition increases, especially from eastern countries, Bosch is trying to acquire new markets and penetrate them as first mover.

The innovative ideas do not come from a research "with an end in itself", but they can be originated in different ways. In the most of the cases, they come from a specific need of the customer; moreover, the company has a specific office that analyses market trends and press releases, from which it draws to suggest potential ideas to develop.

The Bosch innovation process presents a series of innovation steps at the end of which the idea development is approved. However, the interviewed preferred not to go in depth to these steps for confidentiality reasons.

At the end of these steps, the company looks for customers with who would carry on the idea development and would make an initial application of it. The high know-how of the company allows always finding a customer; obviously, in case the idea is generated from a customer need, the search for customers is not needed.

Before the designing phase, a business plan is developed. This phase is carried out in cooperation with the customer, as the success of the product depends on how many cars the customer manages to sell. Partners evaluate together ideas, Bosch's products and innovations as well as information about both Bosch and the customer competitors.

The project cycle follows different patterns according to the source of the idea. In case the idea is developed according to a customer need, the project cycle is carried on in cooperation with the customer. The company usually opts for co-development contracts or joint ventures according to the importance of the project. In this case, the idea is specifically developed for the customer and it does not need to be adapted to its product. In case the idea is proposed to the customer, the project cycle deals with adapting it to its vehicles.

The testing cycle presents two different phases. First of all, the component is tested internally in order to verify whether the technical specifications provided by the customer are respected, and the objective quality level has been reached. Bosch has also an internal society (ETAS) that develops and tests simulation systems and the software needed for the electronic components. After that, the component is assembled on the vehicle and technicians verify whether it well interfaces with the other components. It is very important to cooperate with the customer technicians, as they are the only ones who can express better the needs for a certain product. This phase presents a high degree of complexity, especially for components with a relevant percentage of electronic parts. When all the tests provide positive results, it is possible to plan the production cycle. This is internal or performed by an external actor depending on the production is completely carried out by Bosch or outsourced to an external supplier.

The innovation process time-horizon depends on the time to market of the car. When working in co-development with a specific customer, it usually lasts 14-15 months. However, when Bosch establishes joint ventures, there is not always a specified time horizon, as there is the hopefulness to collaborate as long as possible.

Bosch cooperates with a large range of partners for its innovations. In many countries, it constitutes the main supplier for the local automotive companies; for instance, in Italy it is the most important among FIAT suppliers.

As mentioned above, it sets different kinds of contracts and organizational modes for collaboration according to the importance of the project. The company does not adopt a formal procedure for the risk evaluation, but it depends from case to case. If the product specifications are clear, Bosch usually prefers a co-development agreement. Instead, for longer collaborations, the joint venture is the favourite form. In all these collaborations, Bosch keeps the control or at the last the 50% of the share by confirming, similarly to Pininfarina, a more hierarchical style of governance with suppliers (especially with those whose competencies are not so distinctive) and more participative with (automotive) customers. Among the most successful joint ventures, it is worth to remember the one with Samsung, for the development of lithium-ion batteries, lasting ten years, and the one with ZF Lenksysteme (ZFLS), in 1999. The latter provided its knowledge in steering systems and Bosch offered its ability in dealing with the management of electric components. Besides, in 2008, as reported on the website (Bosch Press 2010) the company established a fifty-fifty

joint venture with MAHLE GmbH to develop, manufacture and commercialize exhaust gas turbochargers for gasoline and diesel engines.

For all its joint ventures, Bosch sets the objective to gain complementary knowledge; thanks to the acquired knowledge it will have a stronger contractual power in the future. Moreover, it usually adopts the policy of employing people of different nationalities within the same project, in order to stimulate creativity and integrate different kind of knowledge, improving the ability to respond to market requirements.

Finally, also collaboration with universities has been set-up. However, the people interviewed claim that "the general tendency of universities to provide general and sometimes useless knowledge" leads Bosch to set this kind of cooperation only if there is a specific project with detailed requirements.

Again similarly to Pininfarina, the co-development proves the coupled type of open innovation: through its collaborations, Bosch acquires ideas and knowledge, but also it transfers knowledge by making available its knowledge to benefit cooperation. However, Bosch perceives a very high risk of imitation and therefore it has a careful management of its highly innovative intellectual property (IP): detailed agreements for IP protection are subjected to all the partners from the Bosch's headquarter in Germany and any project will not start if the agreement is not signed by the participants. In 2009, Bosch applied for 3872 patents. People interviewed reinforce this concept by saying that "without our IP policy all the investments would have no sense". As next step, however still not done today, a more active exploitation of IP is expected by licensing products and ideas as opportunity for further revenues.

Despite the lack of a formal procedure for evaluating partners, Bosch reports that the highest part of cooperation agreement was successful. The management-training program for dealing with foreign cultures and international teams are the key of success for good cultural exchanges. As negative aspects, sometimes management makes mistakes in costs evaluation and the company does not obtain the forecasted margins. Besides, in spite of accurate specifications of technical requirements, Bosch experiences collaborations with partners who do not provide the expected quality performance. In addition to this, supplier delays cause effective times higher than the planned ones; the interviewed people said that in these cases the risk of image damages is very relevant.

5. Conclusions and limitations

Except for some relevant studies analyzed in the literature review, there is general consensus on the need to produce more empirical evidence about the automotive industry and its propensity to adopt Open Innovation approaches, how they are implemented and with what results (Ili et al., 2010). With the aim of developing this evidence, we studied the experience of three well-known companies operating at different levels in the value chain of the automotive industry: a final car-producer on one hand; two suppliers (i.e. a designer and a supplier of components) on the other.

First paper goal was to identify whether companies operating in the automotive industry consider the possibility to collaborate with external actors and with which main goals. In this regard, respondents confirm literature suggestions: the automotive industry is reported as being trapped by cost and innovation pressure by customers. As a matter of fact, factors such as globalization, technology fusion (i.e. the need of integrating different technologies in

the final product - the car) and technology intensity seem to force companies to search for external sources of knowledge. Main declared goals for collaboration by the respondents are the enlargement of company's competence base, the stimulation of creativity and capability of generating new ideas, the reduction and sharing of risks related to innovation activities and costs of innovation process.

The second paper objective was understanding how Open Innovation approaches could be set-up. In this regard, the typology of partners has been firstly investigated. As result, the partner variety is considerable high. Company A probably presents the highest openness degree by collaborating with the highest number of different partners. In particular, the company relies on the collaborations with a lot of suppliers, customers, firms operating in other industries (cross industry innovation, i.e. CII) and universities' research centres.

With regard to the other respondents, they cooperate with a minor number of partners. As suppliers of automotive companies, Pininfarina and Bosch keep the main objective of satisfying the customer that, in this case, is represented by the automotive company itself. For this reason, they establish the highest number of agreements with them. However, Pininfarina deeply relies on CII, as its prototypes are aimed at showing the highest concentration of technology in order to impress automotive companies and induce them in introducing those innovations in their vehicles. In particular, Pininfarina retains that collaborating with partners from other industries is a daily activity, rather than a rare experience. To be noted is the almost total absence of competitors among the possible partners identified by the respondents. This is in contrast with the cited findings of Ili et al. (2010), who show competitors as the second source of ideas (after customers) for automotive companies. Probably the respondents have not yet overcome the strong aversion to collaborate with competitors as they perceive a very high risk of imitation.

However, the management of intellectual property is rapidly getting better and, although an active exploitation of IP (i.e. outbound open innovation) is not yet adopted, it is perhaps only a matter of time. With adequate protection mechanisms of IP, also collaborations with competitors will not seem so risky.

As concerns the openness of the innovation process phases, all the respondents agree with the fact that all the stages can be opened according to the project and the kind of agreement among partners. In general, the phase of idea generation always takes information from external sources, ranging from the analysis of customer needs to the adaptation of solutions from other industries. The other phases can be conducted internally, as well as in cooperation with other partners: for example, Company A specifies that it tends to exclude partners when phase activities are dealing with perceived distinctive functionalities.

Also the adopted organizational modes are various: they range from contractual agreements to more integrated forms as alliances and joint ventures, these chosen only for high-relevant long-term projects because of the high amount of required resources.

Finally, both hierarchical and participative kinds of governance are used by the respondents, with the tendency towards stronger delegation when partner competencies are highly distinctive, not standardized and therefore difficult to be replaced.

Lastly, despite the identification of some obstacles, partnerships are described as successful by proving Open Innovation is an appropriate approach to be adopted in the automotive industry.

Our work obviously has severe limitations because it is focus on a limited set of companies. The fact that the investigated companies have different roles in the same value chain allowed at least to provide a broader view on the industry. However, future researches could deal with validating these findings by interviewing other actors of the same dimension of the respondents. In this way, it would be possible to provide more significant evidence on the industry. Moreover, similar analysis could be conducted on small-medium companies operating in the automotive industry, as well as on emerging automotive companies in the Eastern countries. More extended investigations, i.e. surveys, with the use of quantitative tools of data analysis should be also recommended.

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It is widely accepted that technology is one of the forces driving economic growth. Although more and more new technologies have emerged, various evidence shows that their performances were not as high as expected. In both academia and practice, there are still many questions about what technologies to adopt and how to manage these technologies. The 15 articles in this book aim to look into these questions. There are quite many features in this book. Firstly, the articles are from both developed countries and developing countries in Asia, Africa and South and Middle America. Secondly, the articles cover a wide range of industries including telecommunication, sanitation, healthcare, entertainment, education, manufacturing, and financial. Thirdly, the analytical approaches are multi-disciplinary, ranging from mathematical, economic, analytical, empirical and strategic. Finally, the articles study both public and private organizations, including the service industry, manufacturing industry, and governmental organizations. Given its wide coverage and multi-disciplines, the book may be useful for both academic research and practical management.

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