Professional MBA
Entrepreneurship & Innovation

The shift from closed to open innovation in automotive industry

A Master's Thesis submitted for the degree of
"Master of Business Administration"

supervised by

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Vienna, 28-07-2015

Affidavit

I, **DIMITAR PEIKOV**, hereby declare

1. that I am the sole author of the present Master's Thesis, "THE SHIFT FROM CLOSED TO OPEN INNOVATION IN AUTOMOTIVE INDUSTRY", 33 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and

    2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 28.07.2015

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Signature

Contents

Abstract

Adoption of open innovation in each industry is a long process and implementation of such practices is hardly dependent from industry specifics. In industry like automotive, where number of standards are applying restrictions and at the same time imply strong push for improvements, it's important to measure the level of implemented collaborative practices in various processes of idea gathering, concept build, engineering, design and manufacturing. Thus proposed methodology is trying to capture the established practices, and then the process aspect, then involvement in standardization and community based partnerships, and finally community affiliation in collaborative innovation. Analysis on achieved results is to provide basic interpretation of numbers and how to read trends in process related dependencies. As the scope of the research was limited to automotive electronics suppliers, extending it to other domains and industries shall be easy, and can be used as comparison basis. However, as not all organizations operating in the industry had been interviewed and as the list of people was focused to ones having expertise (more than 10 years) and having at least some management experiences, additional limitation on completeness and possibilities is to miss important aspects or change of some values than currently presented. Finally the results and methodology can be used in individual organizations to measure their affiliated organizations and to understand their motivation for implementing open innovations with them.

1. Introduction

Modern business recognizes growth, sustainability and profitability as result of successful implementation of innovation strategy (e.g. Drucker, 1988; Christensen 1997; Thomke, 2001). During the years, businesses and science identifies number of advanced techniques how to perform innovation processes with improved results, while looking behind operations excellence and achieving better results than traditional development of in-house innovation. In these methodologies, external factors start to play significant role while contributing to collecting, identification and implementation of an innovation. A term describing opening innovation first was coming from Chesbrough (2003-1, and 2003-2) – proposing term Open Innovation, was quickly adopted. His definition on open innovation sounds like:

> *"the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology".*
> (Chesbrough, 2006-2, p.1)

Looking at closed innovation model, where companies rely on full control of the innovation process and having involvement of internal resources as much as possible. Then the Open Innovation concepts heavily impose use of external resources and external force, as their number and power is much less limited compared to in-house ones. Logically each company tend to utilize at maximum its internal capacity for development and innovation, and theoretical explanation of that is related to 'absorptive capacity' (Cohen, Levinthal 1990). In their research work in late 90', Cohen and Levinthal argue companies to invest in the pre-work knowledge investigation especially for R&D, to be aligned with present domain achievements, or with other words to capture available external knowledge at starting phase.

Constructive suggestion (Frans Van den Bosch 1999) on coevolution describes other important factors - namely organizational forms and combinative capabilities, which is related to absorptive capacity. Suggestion addresses distributed utilization of in-house human resources to combine internal and external knowledge for new product development.

Recent work (A. Burcharth, C. Lettl, J. Ulhøi, 2014) add significant role of organization characteristics on experimentation, thus preventing inertia of in-house development. These organization characteristics namely: "(1) slack resources, (2) climate of tolerance for failure, (3) willingness to cannibalize, and (4) external openness", are considered as key factors affecting learning curve and resource utilization. The last one "(4) external openness", reflects directly collaboration willingness of organization and idea capturing trough partnership.

Having these models in mind, for any organization when looking for next organizational structure challenge, one of the key questions are how to capture better ideas and then how to realize best of these ideas into products or services. Research on the field date from decades now, and thus few streams of theories are followed around the managers skills to manage the organization from one side (Lawson and Samson, 2001; Gumusluoglu and Ilsev, 2009), or as another side where structure and capability of the organization are leading requirements for management to foster the innovations. (Hage, 1999). In research for optimal R&D organization (Bjorn Axling at all, 2014) identifies eight imperative directives to be answered by the organization to adjust its innovation strengths. A document UB:10017501 from Bradford University School of Management, 2011 is reviewing what open innovation is and typically applied methodologies and approaches by reporting how organizations are implementing open innovation in their structures.

But when starting to speak about changing the organization, and defining strategies to accommodate open innovation as important shift of mindset, the work of (Keinz, Hienerth, Lettl, 2012) on "Designing the Organization for User Innovation" explaining what are existing approaches, present some instruments and methods for identification where are the needs of organization to re-design, and what are typical design principles to be applied by companies when are going to follow open innovation strategies.

Managing innovation strategies on leading organizations like 3M, General Electric, P&G, Lego, IBM, HP, etc. are described and discussed in many cases and used as subject for many students in their class work. However, industry analyzes on used innovation models may contribute by finding common patterns trough industry players and depict how and where

industry is evolving. And last but not least, how partnerships, consortiums and standardization authorities impact established innovation models.

For each company, the innovation management is essential problem, and answering this question takes strategical position in organization.

1.1.   Problem

Automotive industry is perceived as one that delivers to people products for their daily usage. People living in different countries have various needs and habits to use automotive products, for travel, work, study and living. So passenger and road safety as care for people implies number of regulations and standards to reduce the risk for people. In industry following many strict regulations and standards, and then having a strong competition on the market (between OEM and between suppliers), to what extend innovations inside and outside of the company benefit from industry collaborative initiatives? Or with other words how contribution to shared projects impacts company development? Do the organizations tend to make only in-house development and innovations and thus keeping technology as advantage to their competitors?

Industries like automotive, avionics, yachts, etc., develop products that are of use in daily life of people, and due to risk for human's life injury exposure, number of global and local authorities is imposing hard regulations. Addressing these regulations in turn require individual parts to be certified to certain compliance level, in order end-product to be compatible with these standards. However, general public domain and particular youth generation of people demands to have all new technology available and seamlessly integrated now and immediately, which turns huge pressure to manufacturers and their suppliers to introduce more innovative features in end-user products. And how this is impacting the industry? Are these product features focused in given area or is more general technological problem?

At the same time, understanding that shared development and collaboration within the industry and beyond, results with faster implementation and adoption of regulations required over the years and thus save engineering effort and resources to develop future solutions. These regulations come not only via standards, but also through governmental regulations for environmental, health and safety, security and economical marginal impact. During the past 15 years and even before, inside the industry has been created number of initiatives, projects, consortiums and working groups in order to work on identified problems. These initiatives have been supported not only inside the industry from companies itself, but also from governmental funds and other global organizations. Later, behind these initiatives, supporting working groups and individuals launched open and semi-open projects referencing and licensing working group

partnership (Autosar/Edona/Artop, GENIVI/TIZEN, etc), to continue innovation development in collaborative manner.

      This paper is focused on an observation how such advanced innovation techniques are applied in specific industry in particular at electronics suppliers in automotive industry.

1.2. Research questions

Automotive industry is associated with manufacturing vehicles and parts. Effectiveness of the vehicles, their cost and integrity with living environment like entertainment and living style, are from the most discussed achievements and where most of the technological research is focused. Solution of these complex opportunities for organizations working on the subject is not always on their primary domain (automobiles), but also in present days on integration of new technologies. Thus for organization it is hard to be present at all technology domains, and to have leading competence at any point. However integration of technologies implies capabilities to collaborate and jointly develop new products and services with partners, and even with customers.

The research is aimed to look how organizations are collaborating in their innovation development. How the processes for innovation allow and tolerate collaboration with external organizations and individuals. And how the organization use to treat IP protection and related to that what is community affiliation behind innovating and developing future products. Some of the questions applied in research interview are inspired and related to work of (Burcharth, Lettl, Ulhøi, 2014), namely to find measures of organization capabilities and characteristics which helps in organization identification. However the results from the data are not treated using the same methodology and therefore analysis is targeting different aims and results.

Initial direction to observe implemented and used models for innovation handling was silently rejected as confidential for some of the organizations, and was either ignored or skipped from discussions. Under innovation handling I include - idea collection frameworks, and mainstreaming management and control of innovation processes. Information considered that may disclose too much sensitive data. This section was removed from the questionnaire soon after first discussions to conduct interview.

Due to that reason, I decided to capture needed information about used methodology from using indirect questions, which were not disclosing internal details.

Questions in the research were grouped in five groups, namely

- Collaborative innovation

- Involvement of external support in innovation
- Innovation process
- Standardization, consortiums and partnership
- Community affiliation

Questions in 'Collaborative innovation' were selected to present the background of the organization, the approach and preparation of the organization to meet new challenge and to manage innovations with collaboration.

The group of questions addressed in 'Involvement of external support in innovation', were targeting to collect information about involvement of external entities (personnel and organizations) during different phases of collecting ideas, prototyping, design, manufacturing and customization while transforming innovation idea into product or service.

The expectations captured in 'Innovation process' was the process involvement and compliance which follow implementation of innovation management.

Next participation and following standardization organizations and working groups, consortiums or industrial partnerships for technology development, was expected to be captured in 'Standardization, consortiums and partnerships'.

And last but not least, how organization supports, respect and use community values and integrity, was targeted in the last section 'Community affiliation'.

However it is to be noted, that almost all companies has own implementation of idea collection framework using formal or semi-formal process, where some have several different ones.

1.3.   Relevance

The understanding that innovations which happen inside organization are many, but there are far more many innovations outside become as common sense. Learning from this common sense, where organization wants to capture this external innovation capacity or to be associated as the right organization for developing innovative solutions in the domain is not so common. Despite fact that any organization have goal to provide more services or products to their customers, and this more use to come through innovations.

At the same time, automotive OEM's from past decade, launched number of joint-venture initiatives to partner not only on economical shared development, but also on engineering of new vehicle models, new engines, hybrid technologies, and standardization of methodologies for design and development. It's evident that the industry is moving towards open innovation, and then it's relevant to try to find commonalities or to extract patterns.

An important part of the study was to scope of the research. Going for supplier base of electronics components was result from initial identification of the problem and early preparation for the case, where number innovations in automotive industry engineering domains have been rated. This preparation step was essential to select the focus on smaller part of the industry, as observing the complete shall be enormous complex work, which includes not only OEM and their suppliers from different domains (machinery, engines, electronics, textile, plastics, etc), but also complementary ones, after sales and dealership, after-market products, spare parts supply chain, supporting services, rentals, etc. This was enough to conclude to focus on specific part from whole industry.

1.4.   Structure of the thesis

This study is looking on automotive industry particularly at suppliers of electronics parts, how the organizations inside are used to approach innovation challenges and how they collaborate with external organizations and individuals. Important challenge for the case is to understand how innovation processes are formalized, monitored and supervised from management. On that point challenge is to obtain required information from indirect questions as some of the people were biased about sharing sensible information.

Organizations operating in this domain have their understanding how to make innovations and how to secure their manufacturing capacities. The challenge under observation is to find to what extent these organizations are using open innovation as streamline for their development. It is obvious that organizations are evolving over the years and they are not still at the position where they are the only masters, and all is to be developed in-house. Thus over the years of evolution results of adapted innovation management concepts are the processes, practices and expected behavior when they launch or challenge new opportunity. Behind that evolution, it is important to understand what are the most used practices focused, and then to try to understand what can be reasons for these results.

Looking at the work described in case studies from Massis at all, 2012, duplication of such analysis shall additionally confirm the industry specific practices representing open innovation implementation.

Results of the study shall be achieved after analysis of questionnaire of 33 questions grouped in five categories looking for subject, collaboration, process, standardization and community involvement and behavior. All the questions are expecting used practices from organization, or what the organization is actually performing at present days. This notation is essential between organization vision and strategy for deployment and what actually is performing. Also this represents what are currently deployed concepts and how employees have evaluated to meet.

Hypotheses to be confirmed in the following study are that:

- Focus on introducing open innovation methods are more targeted in mid- and long-term industrialization ideas
- Organizations are adopting open innovation but limiting the trust of affiliated organizations and individuals

Answering to these hypotheses shall be found after analysis of interview results, and interpreting dependencies to some of these questions in between them, as a reason from process dependencies.

1.5.   Literature review about related scientific papers

As of presentation from Chesbrough, 20003 introducing the concept of Open Innovation and great work of Baldwin and von Hippel, 2009 on introduction of open innovation as paradigm for collaborative work and innovation, many organizations and people have looked how to challenge and follow their innovation strategies to meet these external collaborative concepts. In each industry there are analyses how are deployed open innovation concepts, trying to identify points for improvements, and also make proposals on research framework for sectoral modes (Beige, 2008). Work continues on that subject from theoreticians and practitioners to propose and proof evidence about applicability and strategies.

Related to automotive industry, work on case studies from Massis at all, 2012, make excellent overview how industry operates and provided case studies cover to great extent identified area for this research. In their work they provide overview how organizations in the industry have mapped their innovation strategy to open innovation concept, and what risks they may identify while going to implement open innovation. In their review they make broad review of previous work of Heneric et al. 2005 on evolution and trend, Dilk et al. 2008 and Bartl et al. 2010 on opening innovation processes and Ili et al. 2010 on generating innovations, as well as cases around BMW innovations introduced. Detailed cases of Pininfarina, Robert Bosch, and anonymous company A, are presented in details of their innovation structure and how they collaborate with joint ventures, some of their success stories and some failures. Having their work as basis for observation of the established business practices and "trends-scouts" implementation are example for "Virtual Innovation Agency" answer how the industry meets open innovation concepts in practice.

Good example for kicking open innovation at labs is what StelLab and PSA, 2013 have announced, as it "comprises some 100 PSA Peugeot Citroën scientists, 12 OpenLabs and six university chairs in Europe, China and Latin America." to work on opening innovation in reseach.

Internet journals and publications about how open innovation is influencing automotive industry and daily life (IdeaConnection on Local Motors), challenge with introducing end-users in car design and customization – Rally Fighter case. The open innovation and crowdsourcing

approach in implementation is used to design this vehicle, became one of the most cited examples how to implementation in automotive industry.

Analysis on the market and trends of using automotive products from various organizations and agencies, results with prognosis about keeping demand of using automobiles over the world. For example Deloitte, 2014, makes analysis on needs of buy or rent vehicle for GenY generation (mid/late 70-ies). These analyses strongly address mobility and change of life and integrity between technologies, while at the same time push for "more collaborative approaches to transport", as result of urbanization. Pwc, 2015 makes analysis that cost of software from total cost, increased from 20% a decade ago, up to 35% today. While at the same time electronics in automotive industry generates 90% of innovations and new features there. Some of these come even from government regulations to add and improve road safety and environmental features, for example decrease of fuel consumption per mile, reducing CO_2 emissions by 10% for a decade.

A consolidation report from Pwc for 2014, presents facts about M&A and financial results of the automotive industry for 2012 and 2013, and briefs about what happens in industry. Besides the facts, there is forecast about market growth by 2018 in "connected car" market by ~ 3x times from its value in 2012.

At the same time Pwc are providing "The 2014 Global Innovation 1000 & Automotive industry findings" report where findings in automotive industry related to implementing innovations, spending for R&D and innovations, are analyzed over the years and compared with other industries like aerospace, healthcare, software and internet, computing and electronics, etc. One of the outcomes from that report sounds like "Regardless of spending trends, automotive executives think their companies are moving in the right direction when it comes to improving their innovation efforts.", and "The rapid rate of change of technology will keep the auto industry clamoring for the most cutting-edge innovations, spurring on competition for years to come." Barry Jaruzelski, Senior Partner, Strategy&

2. Case study

2.1. Research methodology

2.1.1. Settings

Researching the area, require to conduct series of interviews of different people having experience in the domain, being exposed to many projects in the industry for the last years, and at the same time obtaining leadership position, thus being visible in the field. To find these people, it was needed to follow distant search process, or to ask known experts for screening or for references to find other experts. Finally after looking how to proceed, I selected combined screening and pyramiding direct search process to be used. As the first reference list of people were selected from the list of direct contacts, which in turn, provided references for the people with expected targeted profile.

Research method to collect people's contacts for interviews, was selected to follow directed search methodology using pyramiding approach to identify list of targeted persons to be included in the interview list. References from list of known contacts were limited to second hop to avoid long searches and to void loops. List of references was balanced to capture persons from different kind of organizations, so to avoid bias in results. From list of top 100, list was filtered for people in direct face to face operations in the past one year, to cancel bias from direct relationship.

Questions had to be acceptable by all interviewed persons, and at the same time to allow gathering information indirectly for the analysis goals, which were perceived as sensible information.

2.1.2. Data collection

Data collection was organized in two sets of semi-structured interviews, first to industry experts to refine the scope of the search, and the second one to industry professionals to capture the target of the search. Each of the interviews took one month to collect the data and then up to two weeks' time to process analysis of received answers.

First interview was addressed to 10 persons, all from different companies, having 10+ years of experience in the domain, having leadership position (executive or technical), and operating in automotive industry as OEM or supplier. Exact questions of questionnaire #1 are listed in the first part of appendix.

Second interview set was addressing 77 direct contacts I have built in the past 10 years, from about 40 companies, focused in operations in automotive business as OEM, Tier 1 or 2 suppliers, electronics component manufacturers, technology consultants, recruiters, education and research labs. List of people was carefully selected to have balanced feedback and to avoid biasing of answers due to affiliations or business integrity. By purpose, interview was not addressed to persons who are of direct operative relations with me during past one year. Exact questions of questionnaire #2 are listed in the second part of appendix.

2.1.3. Data analysis

Looking in automotive industry, there are number of domains which integrated results with final product. Of course these domains are not developed with the same rate, and the rate of innovations implemented varies per domain. Thus short focusing interviews with limited industry lead users from various automotive companies, OEM and suppliers, having experience 10+ years and exposed on industry authorities was conducted. This first interview has main goal to identify industry domain advancement rate impact to the industry development growth and this information to be used as filter for the follow-up research. From the top-most impacting domains one shall be taken as focus for secondary interviews.

Answers from questionnaire #1, having values closer to 1 are the most significant values, and least significant values are close to 10.

Thus from results depicted in the graphics representing innovation impact by domain, "Driver information systems", "Electronics" and "Connectivity and networks" are the most close to the center and thus most innovative domains in the industry for the past years.
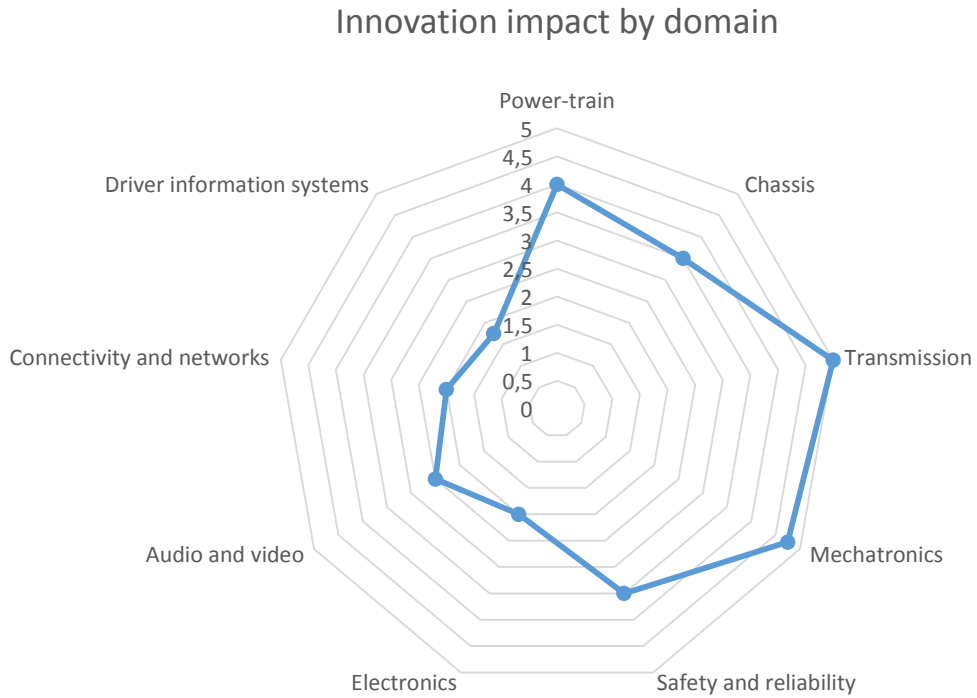
Innovation impact by domain

Figure 1 Innovation impact by domain

The same scale is used for the second graphics; representing "Innovation impact by demand" where "Competition" and "OEM demand" are the strongest factors driving innovation in the industry.

Innovation impact by demand
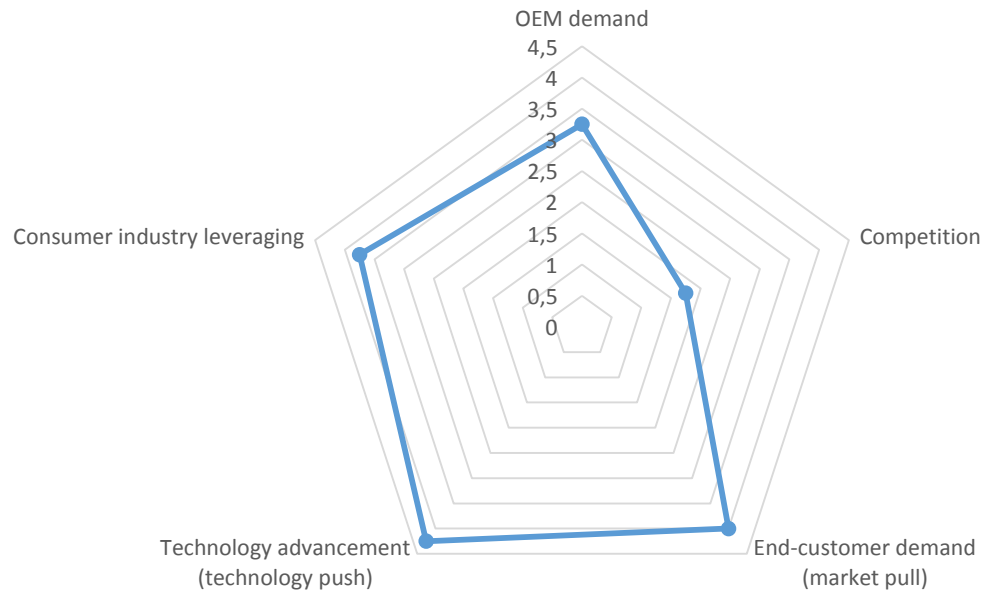
Figure 2 Innovation impact by demand

Conclusion from the results above:

- For the second questionnaire shall be targeted companies operating in the domains of automotive electronics, driver information and connectivity and networking, as well as OEM, and supporting organizations.

Next are the results from the questionnaire #2.

Here results from questionnaire are normalized from the total number of variations answered per question to number of answers. As there are many questions allowing multiple answers total of the normalization may exceed 100%. Also for questions which were not always answered totals are less than 100%.

This second set of questions was more formal from first one, and thus allowing more quantitative analysis of the results.

What nature of organization is described

OEM	18%
Supplier	55%
professional / consultant	14%
research lab	5%
manufacturer	9%
Other	0%

How organization perceives opportunity for new project

Carefully analyze financial constraints and only risk-free projects are pursued	46%
Risk about available existing product undervaluation or loss of market must be closed	59%
It's enough that technical novelty is perceived as promising	27%
start without any consideration for current factors	0%
Other	0%

Is there a separation of innovation project opportunities based on time to market identification

Undetermined scope	10%
Long term	35%
Mid-term	70%
Short term	25%
Immediate	15%
Follow-up / adoption	15%
Other	0%

Does the organization supports / maintains innovation hubs

externally owned	5%
partnered or share owned	19%
externally affiliated	5%
community based	39%
internal	76%
academical	52%
governmental	10%
Other	0%

Involvement of external support in innovation

Does the organization use to involve external support

suppliers	36%
consultants	73%
academic	46%
clients	32%
labs and R&D hubs	27%
competitors	0%
professional events/fairs/conferences	41%
Other	0%

How does the organization use to involve these externals for new product idea generation?

always	0%
frequently	14%
often	55%
rarely	32%
not usual	9%

How does the organization use to involve these externals for new product DESIGN?

always	0%
frequently	14%
often	32%
rarely	50%
not usual	27%

How does the organization use to involve these externals for new product MANUFACTURING?

always	0%
frequently	0%
often	27%
rarely	68%
not usual	14%

If academic collaboration is used, is it:

partnership behind concrete project co-development to 3rd party sponsor?	20%
partnership due to contribution in common organization?	40%
organization leading project co-development	30%
academic research domain interest, where company have expertise	55%
Other	0%

Does the company have enough resources to handle new special projects?

All available resources are blocked on running projects	37%
Organization has backup resources to handle starting of new project	46%
Always can be found people to work on new projects	27%
Organization has enough funds to secure resources for new project	14%
Other	5%

Where does the organization involves external contributors for new product

Idea formation	5%
Idea gathering	11%
Feasibility study	26%
Concept elaboration	37%
Early prototyping	63%
Product development	42%
Product manufacturing	26%
Assembly or dealership customization	11%
Maintenance and after-market support	5%
Market analysis	37%
Strategic development definition	0%
Other	0%

Does the organization participates to public/government funded programs

own projects	79%
partnered	39%
affiliated	39%
Other	0%

Innovation process

Does the number of innovation projects increased compared to 5-10 years

decreased: 1	5%
2	10%
3	57%
4	24%
increased: 5	5%

Does the organization follow formal idea collection process?

yes	36%
partially	60%
no	18%
Other	0%

Does the organization follow formal innovation process?

isolated project based	24%
innovation scorecard (inputs-process-output-control)	38%
stage-gate (go/no-go decisions)	43%
multi-dimensional	19%
no	19%
Other	0%

Does the organization opens involvement to innovation process outside of employees?

yes	10%
only to preferred list	43%
only trough subcontracting	38%
no	19%
Other	0%

Can the organization disclose IP after certain period of time, but before patent protection expire?

yes	21%
through NDA	84%
no	5%
Other	0%

Does the organization holds or has affiliation to open patents?

yes	77%
no	24%
Other	0%

How organization considers the failure of project execution?

Absolutely unacceptable for people involved	14%
Failure is accepted to certain margin, and unacceptable in general	68%
It's considered as learning opportunity	32%
Other	0%

Management is controlling the process as:

mastering any aspect of project execution	14%
monitoring analysis and decision making	82%
involved in information gathering and supports execution	5%
Other	0%

How the organization handles members/staff roles knowledge transfer

There is formal description of each role and expectation	23%
Number of training materials are delivered for self-education and mentors are assigned to support in starting up	36%
Knowledge is transferred from experienced ones to newly assigned	77%
Other	5%

How does the organization monitor external sources

periodically inspects for new technologies	43%
scans technology trends	67%
monitor industry analyses	48%
maintaining information for top technology in-house	38%
hire agency to provide market trends	19%
Other	0%

Standardization, consortium organizations and partnerships

Does the organization participate or contribute to any standardization organization?

contribute to some organizations	64%
only participation	23%
no	14%
Other	0%

Is this contribution used as foundation to strategic advancement IP towards competitors?

yes	44%
no	50%
Other	6%

Does the organization use to make partnerships for innovative products development?

yes	46%
most likely not	46%
no	14%
Other	0%

Does the organization make / follow partnerships after standardization or consortium participation?

yes	46%
most likely not	41%
no	9%
Other	5%

Community affiliation

Does the organization contribute to community projects (in their business domain)?

yes, without constraints	9%
members/employees may contribute at will	27%
members/employees may contribute with company awareness	46%
members/employees are discouraged to contribute	14%
no	18%
Other	5%

Does the organization maintain community stream around its technology?

Maintain forum for collaboration	44%
Support open source projects and initiatives	22%
Organize and facilitate community events - conferences / hubs	39%
Other	11%

Is the organization used to open framework to public or licensed working group?

yes, conditionally	12%
case by case	29%
after certain lead time	0%
only after NDA in the working group	59%
no	17%
Other	0%

Does the organization respect community through licensing

Separate licensing for community members	20%
Exclusive licensing per customer, having incentives for affiliated communities	0%
Technology feature split based on licensed user / community	20%
Equal licensing policy for any customer	60%
Other	7%

2.2. Findings

One of the findings comparing distribution of external involvement in

- New idea generation
- New product design
- New product manufacturing

is that organization in industry is typically trying to keep in-house all activities which are closer to end-user, or to obtain external opinion / support at as early stage as possible – e.g. idea generation, prototyping. At the same time, involvement of external contributors at early prototyping, product development, concept elaboration and marketing research are the top-most evaluated points for collaboration. It's to be noted that organizations typically use to have enough resources to handle startup of a new project, but still most of the people are used to be blocked and allocated on running projects. Then it's logical to expect external contribution, not only from opening innovation, but also due to resource starvation prospective.

As expected, contribution in partnered or community based projects is almost driven due to specific internal need or technology demand for the company. At the same time, organization is trying to manage the innovation process and to be at close hand to decision making, most likely transferring internal project knowhow and used practices. But speaking for public funds, owned projects are the most preferable application, unless fund requires partnership.

Academic collaboration as expected, is focused on own expertise domain, and nicely affiliated by the interests of common partnership. Collaborations are then expected to be closer where there are common interests and traditions in both academic and industry organizations.

Still there is field for improvement to accept failure and to teach from it, as majority of organizations still try to avoid failures at any cost. However it's to be noted that there is slight perception for increased number of innovation projects compared to a decade ago.

Looking at expected prospective for industrialization of an idea, mid-term opportunities are at the main focus, followed by long term and short-term opportunities. Related to that, the perception of keeping the rate of innovations or slight increase, speaks for increased creativity in order to meet increased complexity and available solutions.

From process view point, formal or semi-formal innovation process is used to be followed, and based on organization evolution, several formalizations might be applied. As organizations in the industry are more or less manufacturing parts and goods, it's likely that most of the prevailing methods for managing innovation process is either stage-gate or innovation scorecard, where both are used more than 80% of times. Then it's not a surprise that more than 90% of organizations are following formal or semi-formal idea collection process.

The strong competition in the industry is one of the reasons why processes are still closed or opened to well known or preferred list of suppliers / contributors, and work is protected by sub-contracting and formally through NDA. IP protections in the domain are related to number of innovations which the organization is developing, and thus achieving strategical advantage to competitors. Here the knowledge transfer is essential and the most used practice to mentor or coaching newcomer is preferred, then capturing this knowledge into formal training programs. At the same time, the number of organizations competing for the same kind of business is not that big compared to most other industries, it's also obvious that almost all competitors are obtaining IP in the same domain. Thus it also interesting that 77% have reported that organizations hold or are affiliating open patents, which helps licensing and shared technological advancement in the industry.

Participation to standardization organizations or consortiums looks to be perceived as recognition and as industry participant and authority, but is not accepted as strong influencer and technology driver in standardization. This used to be so, due to not willing to disclosure IP achievements, technological advancement and know-how governance. That's why 50% do not perceive such participation as foundation for strategic IP advancement, they simply has it already. Thus it's not surprising that more than 50% are not likely pursuing partnerships after standardization or consortium organizations participation, in the same development area. But still partnership is valued option to make new product innovative development.

Interesting moment is building or supporting community around the organization or technology they master. With the same value, maintaining forum based collaboration, as well as facilitating and being present on community events, fears, conferences, hubs, etc. is perceived as normal and thus most of the organizations are supporting such communities. But when it's

related to open source and opening licenses, things are slightly different. Valued community is the one that contributes, or is a client base, or affiliated partners, and this community use to be perceived / treated as client base support. When community becomes public, or is exposed without licensing agreement, organizations become not that open to collaborate. Well, at least internal preferences are always to the customer base and partners. Even separated licensing policies are not that common, reporting 20% are following such practice.

Findings above are confirming the specific interest for organizations in the industry to secure long-term manufacturing and long-term contracts, while at the same time are investing in mid- to long- term innovations more than immediate, thus confirming hypothesis (1). The trust in industry is expected to be governed by special contracts and there is low entry trust for organizations and individuals outside of trusted affiliations and thus confirming hypothesis (2). Its confirmation finding that to gain trust and enter the industry, participation to standardization organizations and industry community projects allows new organization shortly to be accepted.

3. Synthesis

Organizations in the industry have realized that they are not alone and need to collaborate to achieve faster progress and better results in their operations. Operations and manufacturing as key production elements drive for high technological advancement and high level of integrity with different technologies and products. Complexity and cost to meet all this in-house, increased each day and understanding for shared collaborative business is realized. So it's important to know where we are, and are we ready for next step, and last but not least - which is the next step? Here I try to find and answer - where we are.

Even that the complexity of the technology and the entry barrier level to enter the market are high enough, development and innovations in the industry domain are not solely in-house development of the organizations. Collaborations and industry standardization speaks for understanding that common problems can be solved with shared development and is not necessary each individual to gain knowledge from ground. Still technological expertise advancement in domain and IP protection are strong in the industry and further development and innovations are requirements to meet customer expectations. This can be used as explanation about individual and community affiliations are strongly business oriented, e.g. oriented to answer business relations first.

From received results, I can conclude that shift to open innovation is in progress and still there are opportunities for organizations to open its collaboration. Understanding is there that all development in-house is first economically not efficient, second time to market is slow, and last technological challenges and completeness might be limited. Therefore settlement of standardization organizations and consortiums are firstly addressing collaboration in that aspect for the industry, but still at organizational level, collaboration level might be extended. Even there is still ice to break, for example involvement from concurrent organizations in some of the collaborations is close to zero.

Explanation for the observed status can be found in strong competition and operations performance, the strong focus on execution dominates management style to have more control and predictability at any process. Tolerance and failure acceptance are direct implication of the first dependency, which put business expectations and results from any project at primary focus.

At the same time relationship and trust are confirmation about predictability in collaborations between organizations.

Finding that mid-term innovations are dominant, can be understand as mature and settled business environment, long term contracts and not sharp dynamic development, but still dynamic is there. This can be explained to some extent with high entry barrier to enter the market, establishment of trust and long term relationships. On other hand, results for sustainable rate of innovations speak for increased push on creativity and challenging the teams.

4. Discussion

4.1. Implications for research

Questions in the research are focused on observing organization capabilities having indirect answers to used behavior and possibilities to foster open innovation imperatives. One reason for that is matter of secrecy and discussing tangible subject, and from other side possibilities for wrong understanding what the questions meant. During the first questions it was noticeable that perceptions of the questions from people not introduced to terminology of open innovation were literally translated to industry specifics, which may be slight different.

Methodology was selected from list of typically applied methodologies to find external collaboration with domain experts and thus obtaining fast enough process to select right people for interviewing. Before to run for the exact method, I experienced simple test inside group of people near me to see how it works outside of book explanation and to be prepared for potential challenge when running through.

One big help for the research was experience and public exposure in past years, so that people were keen to answer my questions and respecting to discuss where some of the questions were not properly formulated for their understanding. This feedback was essential to adjust the question statements so to achieve maximum acceptance and understanding. And last but not least encouragement and support from rising related questions following what-if methodologies and 5-why to clarify exactness of what they shall answer.

4.2. Implications for managers

Having data in 2.1.3. Data analysis section, make own analysis how your organization is distant from these results and find your strategy to follow. Depending on organization directions, some factors might require to be increased other to be suppressed.

Questions were selected to be independent from particular domain and particular activity, so to allow to be reused for sub-sub-domain if needed. You may apply the same set of questions to your direct suppliers and network, even internally between organizational units, to better understand their position more concrete and understand their level of openness. Of course, analyses from achieved results have to be explained and understood why and what is behind.

4.3. Limitations of the method

Research is focused only on part of the industry, and cannot be generalized in general for the whole one. Different domains might face additional opportunities and problems, and therefore to be distant from results.

Operations in various geographical regions might have different contexts and therefore to be distant from obtained results.

As each process, or methodology, obtaining quality input data is important to find good foundation for analysis and to expect good results at the end. When looking for such limitation in finding right time to reach right people providing feedback – immediately face two negative drawbacks. First is not able to obtain feedback and second obtaining feedback indirectly from expert / targeted person, from his representative or offline via questionnaire. Not obtaining feedback limits you with lost opportunities, however obtaining answer indirectly increases the chance for receiving answers to slightly different questions.

As the directed search methodology imposes to search for experts and then based on collected list of people to conduct interviews with these people. The limitation here is to select the right number of "experts" and to normalize the expertise, so to rate them fear and to focus on those who might provide valuable feedback.

The list of questions sometimes is perceived as trade secret, and willingness to disclose details or to talk at all on tangible subject is particular challenge.

4.4. Outlook for future research

Analysis of the results if possible to be compared in time offset from 5 to 10 years, shall allow better to understand how organizations in the industry have decided to develop. It shall also compare their motivation to use open innovation concepts and to open collaboration with external for their structure people and organizations, if this is still open stream for sustainable innovation development.

Research can be extended so to contribute existing work, looking at innovations management and how organizations are structured towards handling innovations.

Used methodology is stable enough, however adding another methodology to compare and merge results may end with more solid explanation about industry position and its development.

Looking with more detailed focus on particular region (e.g. Germany/Munich, France/Paris, US/Detroit, China/Shanghai, India/Bangalore, etc) may became source for culture, economic and business comparison study. Each market has their specific customer base, and even that expectations may vary, similarities and common problems might be identified and faced as opportunity.

Comparison with other domains in the industry can be also good source for analysis how to transfer knowledge base cross domain boundaries and to benefit from common targets and goals.

Another possibility for extension is analysis on the results and providing recommendations to the organizations how to read the results and how to use the methodology for their future needs, like internal research or measuring their network.

Interesting subject for analysis would be the impact of merge and acquisitions (M&A) on the innovation strategies and how management could benefit from careful monitoring on the

rates. Is there a relation before and after the M&A to the rate of innovations? Or how to understand organization development changes based on fluctuations in rate of innovations?

Bibliography

Referenced works

[1] Alfredo De Massis, Valentina Lazzarotti, Emanuele Pizzurno, Enrico Salzillo, 2012, Open Innovation in the Automotive Industry: A Multiple Case-Study, http://cdn.intechopen.com/pdfs-wm/33289.pdf www.intech**open**.com/download/pdf/33289 - retrieved on: July 1, 2015

[2] Ana Luiza Lara de Araújo Burcharth, Christopher Lettl, John Parm Ulhøi. 2014. "Extending organizational antecedents of absorptive capacity: Organizational characteristics that encourage experimentation"

[3] Bartl, M.; Jawecki, G. & Wiegandt, P. (2010). Co-Creation in New Product Development: Conceptual Framework and Application in the Automotive Industry. Conference Proceedings R&D, Manchester, 30 June – 2 July.

[4] Bjorn Axling, Gustaf Ahlenius, Daniel Roos, Rick Eagar, 2014, Creating the Optimal R&D Organization, http://www.innovationmanagement.se/2014/11/25/creating-the-optimal-rd-organization/ - retrieved on: July 1, 2015

[5] BlackDuck, http://osdelivers.blackducksoftware.com/2014/07/28/how-open-innovation-is-revolutionizing-the-auto-industry/ - retrieved on: July 1, 2015

[6] Chesbrough, H. W. 2003-1. The era of open innovation. MIT Sloan Management Review, 44(3): 35-41.

[7] Chesbrough, H. W. 2003-2. Open innovation: the new imperative for creating and profiting from technology. Boston, MA: Harvard Business School Press.

[8] Chesbrough, H. W. 2006-1. Open Innovation: A new paradigm for understanding industrial innovation. In H. W. Chesbrough & W. Vanhaverbeke & J. West (Eds.), Open innovation: Researching a new paradigm: 1-12. Oxford: Oxford University Press.

[9] Chesbrough, H. W. 2006-2. New puzzles and new findings. In H. W. Chesbrough & W. Vanhaverbeke & J. West (Eds.), Open innovation: Researching a new paradigm: 15-33. Oxford: Oxford University Press.

[10] Christensen, C.M. 1997. The innovator's dilemma, Harvard Business Review Press, Boston, US.

[11] Christoph Hienerth, Peter Keinz and Christopher Lettl, 2011, Exploring the Nature and Implementation Process of User-Centric Business Models

[12] Deloitte, 2014, http://www2.deloitte.com/global/en/pages/manufacturing/articles/2014-global-automotive-consumer-study-exploring-european-consumer-mobility-choices.html - retrieved on: July 1, 2015

[13] Deloitte, 2014, http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Manufacturing/gx-mfg-geny-automotive-consumer.pdf - retrieved on: July 1, 2015

[14] Dilk, C.; Gleich, R.; Wald, A. & Motwani, J. (2008). State and development of innovation networks. Evidence from the European vehicle sector. Management Decision, Vol. 46, No. 5, pp. 691-701.

[15] Drucker, P.F. 1988. The Coming of the New Organization, Harvard Business Review, 66(1):45-53.

[16] Frans A.J. Van den Bosch, Henk W. Volberda, Michael de Boer. 1999. Coevolution of firm absorptive capacity and knowledge environment: organizational forms and combinative capabilities, Organ. Sci. 10, 551–568.

[17] Gumusluoglu, L. Ilsev, A. 2009.Transformational leadership, creativity, and organizational innovation, Journal of Business Research , 62: 461–473.

[18] Hage, J. T. 1999. Organizational Innovation and Organizational Change.Annu. Rev. Sociol. 25:597-622.

[19] Heneric, O.; Licht, G. & Sofka, W. (2005). Europe's Automotive Industry on the Move Competitiveness in a Changing world. Mannheim, Germany: Physica-Verlag Heidelberg.

[20] Ili, S., Alberts, A. and Miller, S. (2010). Open Innovation in the automotive industry. R&D Management, 40(3), pp. 246-255.

[21] Lawson, B. and Samson, D. 2001. Developing Innovation Capability In Organisations: A Dynamic Capabilities Approach, International Journal of Innovation Management, 5 (3): 377–400.

[22] Paul Beije, Koen Dittrich, 2008, DEVELOPING A RESEARCH FRAMEWORK FOR SECTORAL MODES OF OPEN INNOVATION, https://www.tem.fi/files/25712/Developing_A_Research_Framework_for_Sectoral_Models_of_Open_Innovation.pdf - retrieved on: July 1, 2015

[23] P. Kale, H. Singh. 2000. Permutter, learning and protection of proprietary assets in strategic alliances: building relational capital, Strateg. Manag. J. 21, 7–20.

[24] Pininfarina (2010a). I Clienti, Auto. Cambiano, Italy: Pininfarina. Available from: http://www.pininfarina.it/index/servizi/clienti/clientiAuto - retrieved on: July 1, 2015

[25] Pininfarina (2010b). Magazine. Cambiano, Italy: Pininfarina. Available from: http://sintesi.pininfarina.com/docs/magazine.pdf. - retrieved on: July 1, 2015

[26] Pwc, 2015, http://www.strategyand.pwc.com/perspectives/2015-auto-trends - retrieved on: July 1, 2015

[27] Pwc, 2015, http://www.strategyand.pwc.com/media/file/Automotive-perspective-2015.pdf - retrieved on: July 1, 2015

[28] Pwc, 2015, http://www.strategyand.pwc.com/media/file/Global-Innovation-1000_Automotive-industry-finding.pdf - retrieved on: July 1, 2015

[29] Pwc, 2014, https://www.pwc.se/sv_SE/se/fordon/assets/consolidation-in-the-global-automotive-supply-industry-2014.pdf - retrieved on: July 1, 2015

[30] Thomke, S. 2001. Enlightened experimentation – the new imperative for innovation, Harvard Business Review, 79(2):66-75.

[31] UB:10017501, Bradford University School of Management, 2011, OI LDN3.pdf - www.bic-innovation.com/knowledge/download/253/ - retrieved on: July 1, 2015

[32] W.M. Cohen, D.A. Levinthal. 1989. Innovation and learning: the two faces of R & D, Econ. J. 99, 569–596.

[33] W.M. Cohen, D.A. Levinthal. 1990. Absorptive capacity: a new perspective on learning and innovation, Admin. Sci. Q. 35, 128–152.

[34] http://www.ideaconnection.com/open-innovation-success/Open-Innovation-Revs-Up-the-Car-Industry-00274.html, Open Innovation Revs Up the Car Industry, - retrieved on: July 1, 2015

Referenced organizations

[35] AutoSAR http://www.autosar.org/ - retrieved on: July 1, 2015

[36] TIZEN https://www.tizen.org - retrieved on: July 1, 2015

[37] GENIVI http://genivi.org/ - retrieved on: July 1, 2015

[38] Artop https://www.artop.org/ - retrieved on: July 1, 2015

[39] EDONA http://www.edona.fr/ - retrieved on: July 1, 2015

[40] Local Motors, https://localmotors.com/ - retrieved on: July 1, 2015

[41] PSA and StelLab, 2013, http://www.psa-peugeot-citroen.com/en/automotive-innovation/car-tomorrow/open-innovation - retrieved on: July 1, 2015

Table of figures

Appendix

Questionnaire to industry specialists

Industry specialists focusing questionnaire

The purpose of this questionnaire is to detail the focus of research on motives and factors, which triggered suppliers in automotive industry to change their innovation processes.

Under innovation processes look for:

– How improvements in development and new technologies are adopted into industry. More specifically how suppliers evolved and what were/are the trends.

To what extent the sub-system evolution trigger change of innovation processes [1 (most) – 10 (least)]

- Power-train
- Chassis
- Transmission
- Mechatronics
- Safety and reliability
- Electronics
- Audio and video
- Connectivity and networks
- Driver information systems

What were most significant triggers for the innovation process change? [1 (most) – 10 (least)]

- OEM demand
- Competition
- End-customer demand (market pull)
- Technology advancement (technology push)

- Consumer industry leveraging

Timing and factors

1. Time frame where innovation processes at suppliers chain started to change?

    a. Up to 5 years

    b. 5 to 10 years

    c. 10 to 15 years

    d. 15+ years

    e. Other

What was the most significant changing factor? (Select up to 5)

a. Communication

b. Creativity

c. Technology

d. Specialization

e. Manufacturing

f. Competence

g. Integrity

h. Quality

i. Safety

j. Other

Evaluations (free text answers)

How do you evaluate the cost of innovation process evolved during that frame?

How do you evaluate change in complexity of the innovations?

How the number of OEM and number of suppliers relate to innovation processes adjustments?

How OEM synergies impacted innovation (rate, process ...)?

How globalization impacts innovations (rate, process …)?

How global strategies to decrease development cadence influences innovations?

Role of the standardization development organizations like SAE, ISO, HIS, VDA, FAT, AUTOSAR, JasPar, OnStar, GENIVI, etc.?

How particular company management does influences innovations?

Questions used during interview

Collaborative innovation

What nature of organization is described?

- OEM
- supplier
- professional / consultant
- research lab
- manufacturer
- Other:

How organization perceives opportunity for new project

- Carefully analyze financial constraints and only risk-free projects are pursued
- Risk about available existing product undervaluation or loss of market must be closed
- It's enough that technical novelty is perceived as promising
- start without any consideration for current factors
- Other:

Is there a separation of innovation project opportunities based on time to market identification?

- Undetermined scope
- Long term
- Mid-term
- Short term
- Immediate
- Follow-up / adoption
- Other:

Does the organization supports / maintains innovation hubs

- externally owned
- partnered or share owned
- externally affiliated
- community based
- internal
- academical
- governmental
- Other:

Involvement of external support in innovation

Does the organization use to involve external support?

- suppliers
- consultants
- academic
- clients
- labs and R&D hubs
- competitors
- professional events/fairs/conferences
- Other:

How does the organization use to involve these externals for new product idea generation?

- always
- frequently
- often
- rarely
- not usual

How does the organization use to involve these externals for new product DESIGN?

- always
- frequently
- often

- rarely
- not usual

How does the organization use to involve these externals for new product MANUFACTURING?

- always
- frequently
- often
- rarely
- not usual

If academic collaboration is used, is it:

- partnership behind concrete project co-development to 3rd party sponsor?
- partnership due to contribution in common organization?
- organization leading project co-development
- academic research domain interest, where company have expertise
- Other:

Does the company have enough resources to handle new special projects?

- All available resources are blocked on running projects
- Organization has backup resources to handle starting of new project
- Always can be found people to work on new projects
- Organization has enough funds to secure resources for new project
- Other:

Where the organization does involves external contributors for new product

- Idea formation

- Idea gathering

- Feasibility study

- Concept elaboration

- Early prototyping

- Product development

- Product manufacturing

- Assembly or dealership customization

- Maintenance and after-market support

- Market analysis

- Strategic development definition

- Other:

Does the organization participates to public/government funded programs

- own projects
- partnered
- affiliated
- Other:

Innovation process

Does the number of innovation projects increased compared to 5-10 years

decreased   1-2-3-4-5   increased

Does the organization follow formal idea collection process?

- yes
- partially
- no
- Other:

Does the organization follow formal innovation process?

- isolated project based
- innovation scorecard (inputs-process-output-control)
- stage-gate (go/no-go decisions)
- multi-dimensional
- no
- Other:

Does the organization opens involvement to innovation process outside of employees?

- yes
- only to preferred list
- only trough subcontracting

- no

- Other:

Can the organization disclose IP after certain period of time, but before patent protection expire?

- yes

- through NDA

- no

- Other:

Does the organization holds or has affiliation to open patents?

- yes

- no

- Other:

How organization considers the failure of project execution?

- Absolutely unacceptable for people involved

- Failure is accepted to certain margin and unacceptable in general

- It's considered as learning opportunity

- Other:

Management is controlling the process as:

- mastering any aspect of project execution

- monitoring analysis and decision making

- involved in information gathering and supports execution

- Other:

How the organization handles members/staff roles knowledge transfer

- There is formal description of each role and expectation

- Number of training materials are delivered for self-education and mentors are assigned to support in starting up

- Knowledge is transferred from experienced ones to newly assigned

- Other:

How does the organization monitor external sources?

- periodically inspects for new technologies

- scans technology trends

- monitor industry analyses

- maintaining information for top technology in-house

- hire agency to provide market trends

- Other:

Standardization, consortium organizations and partnerships

Does the organization participate or contribute to any standardization organization?

- contribute to some organizations

- only participation

- no

- Other:

Is this contribution used as foundation to strategic advancement IP towards competitors?

- yes

- no

- Other:

Does the organization use to make partnerships for innovative products development?

- yes

- most likely not

- no

- Other:

Does the organization make / follow partnerships after standardization or consortium participation?

- yes
- most likely not
- no
- Other:

Community affiliation

Does the organization contribute to community projects (in their business domain)?

- yes, without constraints
- members/employees may contribute at will
- members/employees may contribute with company awareness
- members/employees are discouraged to contribute
- no
- Other:

Does the organization maintain community stream around its technology?

- Maintain forum for collaboration
- Support open source projects and initiatives
- Organize and facilitate community events - conferences / hubs
- Other:

Is the organization used to open framework to public or licensed working group?

- yes, conditionally
- case by case
- after certain lead time
- only after NDA in the working group no
- Other:

Does the organization respect community through licensing

- Separate licensing for community members

- Exclusive licensing per customer, having incentives for affiliated communities

- Technology feature split based on licensed user / community

- Equal licensing policy for any customer

- Other: