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Opening up the R&D process is risky - how far do you have to go in order to beat your competitors?

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Abstract: Looking into the research of the last 20 years, opening up the R&D process seems to help companies to be more successful. Looking for external ideas, based on market demands or external solutions to internal technical problems helps to save time, reduce costs or find entirely new solutions. Having said that, opening up the R&D process also bears risks. If a company is willing to open up their R&D process, to what point should the process be opened? In a quantitative study with 100 German companies, followed by a qualitative study conducting interviews at 20 companies, an approach how to define the value of the ideal openness (IO) was developed. This value of the ideal openness is compared to the value of the real openness (RO) which can be measured directly. Using the difference between the values, recommendations to open companies to an ideal level can be developed.

Keywords: Open Organization, Open Innovation, Integration of external Information, R&D Process, Product Development, Innovation Management, Collaboration

Opening up the R&D Process seems to have a positive impact

Globalization, Diversification, the Digital Revolution, higher productivity, the increasingly brilliant quality of Chinese products – all these create a headache among the top management of globally operating companies, at least in Germany. Managers ask themselves more and more often: To what extent do companies have to change in order to stay successful?

Where money can be made, markets are usually saturated and companies were pushed through cost cutting programs many times. In those markets, a huge marketing budget or the market demand fulfilling product leads to success. Therefore, especially looking at companies, which do not have enormous marketing budgets, the R&D department and its

processes with its ability to provide the right product have become the focus in recent years.

In order to ensure the right products were developed, R&D processes were opened and customers were integrated. To select the right Open Innovation method, methodologies and tools were developed. But did it help? R&D managers were quite successful in keeping the market out (Lang, 2011), as they were offended by external knowledge or ideas, all well described in the theory behind the "not invented here syndrome" (Reichwald, 2009). Studies show that only a small percentage of companies which have executed an Open Innovation R&D project such as a Lead User study, are willing to do a second one. A solution to the dilemma would be a general change in the R&D culture, a change in the organizational behaviours, a transformation of the Closed to an Open Organization in the R&D department.

Looking at the problem from a different angle, many companies in developed countries have increasingly difficulties finding qualified R&D engineers. In closed environments it is also hard to keep the best talents, as they tend to move from one company to the next. One reason for the lack of qualified engineers in larger companies is the fact that startups with their open structures are a magnet for young, well-trained university graduates. For them, working in structures as in the Roman Army in 200 AD, is not an aim they would pursue. Especially looking at the demands of the Generation Y, organizational structures need to be changed in order to succeed in the hunt for the best talents.

Both lines of reasoning lead to an opening of R&D processes, the transformation of the R&D division into an Open Organization. But opening bears risks. How far should a company open up and what measures need to be implemented?

Opening up the R&D process, but how far?

Opening up structures in companies is not new. Many years ago Chesbrough illustrated the collaboration of Xerox with its supplier of the selenium drum of the early copy machines as an example of the opening of the R&D process. In the automotive industry the collaborative R&D process has evolved further in recent years. As a result the average US car is mainly developed and manufactured by the supplying industry, and not the OEM. On the one hand the automotive industry developed a very strong and open relationship with its suppliers and engineering service providers, on the other hand, there are many more collaborative partners in the R&D process involved a company can open up to.

Following the principles of Open Innovation, which are elaborated on in the literature, OI has become one of the key methods for opening up R&D processes. But there a many unsolved issues which prevent companies from using Open Innovation methods as standard recurring R&D tools. Among the problems are the difficult IP situation (Giannopoulou, 2011), the allocation of the OI projects in corporate research groups without the power and willingness to execute an internal change process (Chesbrough, 2013) and above all the lack of guidelines on how to transfer the benefits and results into the companies (Giannopoulou, 2011). Collecting OII (Open Innovation Information) works quite well, while integrating the results into the different R&D process steps within the companies seems to be the bottleneck (Chesbrough, 2013). Therefore, only following

the principles of OI will not lead to a successful transformation of companies from closed to open.

Not only looking at the R&D / Innovation management processes but at the entire company, two major developments in opening-up structures can be identified.

The idea of worker participation in Europe started in 1880, finally leading to the legislation of representative worker participation in Germany in 1979, which was a large step in opening structures and changing cultures in larger companies. Important decisions had to be discussed with the employees instead of being solely made by owners or the top management. 40 years ago, it was a big issue how well the instruments of worker participation were implemented. Today's graduates ask questions like: Does that mean I can work from Thailand and just show up in my office in Munich twice a year? Currently, the concept of representative worker participation does not have any answers to the demands of Generation Y.

Lastly, attempts to implement modern organizational structures, such as the matrix organization, should be focused on. Companies tried to become more flexible, give employees more space, share responsibilities, open up working processes, also in larger R&D organizations, e.g. at Siemens in 2010. Unfortunately, most of the new organizational structures had to be remigrated to the former stricter, but not as complex structures.

Different approaches to open organizational structures and especially R&D departments have been taken in recent years. But very few of them led to sustainable success in changing the culture of the company into a culture of open organizations.

Another reason for the lack of success in opening R&D structures might be the thread of the companies that opening up also bears risks as there are no clear guidelines on how far the opening should proceed.

Various studies investigated the correlation between the innovation performance and the degree of opening. Laursen and Salter (2006) gathered data about the innovative performance and the search patterns from 2707 British manufacturing firms. Generally, they found that firms, which open up their search strategies, tend to be more successful in their innovative performance. Laursen and Salter (ibid., 2006) classify the search strategies for sources of innovation into two different concepts: the external search breadth as the number of external sources that are used for their innovation activities and the external search depth, which stands for how deeply the sources are performed. In this survey, Laursen and Salter (ibid., 2006) reveal that both breadth and depth of external sources can be directly related to the innovative performance. With an increased opening, the innovative performance increases until a turning point, where the performance decreases afterwards, resulting in an inverted U-shaped pattern. Therefore an "over-search" affects the innovative performance negatively and hinders innovation in a company. Another study by Salter et al. (2014) demonstrates that not only on the corporate level but also the individual level, the openness to external sources of knowledge relates to the ideation performance. Again, an inverted U-shape pattern between openness and ideation performance is found.

These studies show that there is a correlation between the degree of openness and the innovation performance and therefore clearly state that opening up too widely also bears

risks. From a manager's perspective, there is a lack of guidelines on how far this opening should be and how to cope with the risks determined by the collaboration between the different groups within the R&D process.

Research question

Aiming at providing a set of recommendations on how to change the organizational structure of the R&D departments and processes in larger companies a methodology to generate those recommendations had to be developed. Applying the methodology, the following question will be answered. How far should the R&D process in companies be opened and what will the recommendations be in order to control the risks and to benefit from the chances?

A quantitative study followed by a qualitative approach to generate a model to develop measures for opening R&D processes

In order to define the set of recommendations, which will help to open the R&D process in a controlled way a model and a methodology was developed which help to visualise the ideal opening point. The core of the model is the comparison of the real openness (RO) of a R&D process, which can be measured directly, and the ideal openness (IO), which is calculated by measuring risks and chances within the R&D process. The recommendations are based on the deviation between the values of RO and IO.

Research design

In order to measure the real openness, the collaboration of the different internal and external patners within the R&D process was measured. The RO is defined as the spectrum of the openness of the different collaboration groups. 10 groups of collaboration partners were identified. Figure 1 shows the different groups. These range from employees of other project teams to colleagues working in the same department to suppliers and universities, and finally to customers and competitors. The 10 groups were defined in a workshop with representatives of 8 multinational companies based in the Munich area. The different collaboration partners stand side by side and are not built on each other, as different companies would collaborate with a group far to the left and some other partners on the right side, skipping partners in the middle. Therefore it is not a model of stages but a model of columns.

In the first quantitative study 100 companies with 5000+ employees were questioned in an online study about their general collaboration with the 10 groups of different partners of the column model. The three predefined clusters of the collaboration partners – internal, network and peer partner – with similar collaboration patterns were validated using the tools of factor analysis. The group of internal collaboration includes collaboration with other project teams, employees of other business units and other departments. Collaboration with engineering services, suppliers, customers and cross

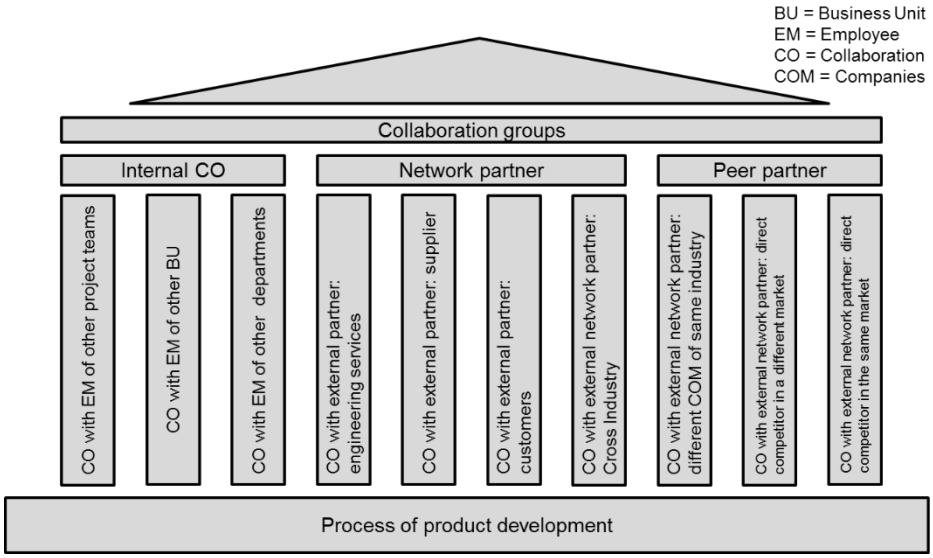

Figure 1: The column model of collaboration

industry partners form the group of network partners. The group of the peers contain companies of the same industry, as well as indirect and direct competitors.

Using the tool of cluster analysis in groups of companies with similar opening patterns common characteristics of the companies were reviled. Using that information, the four clusters shown in figure 2 were developed.

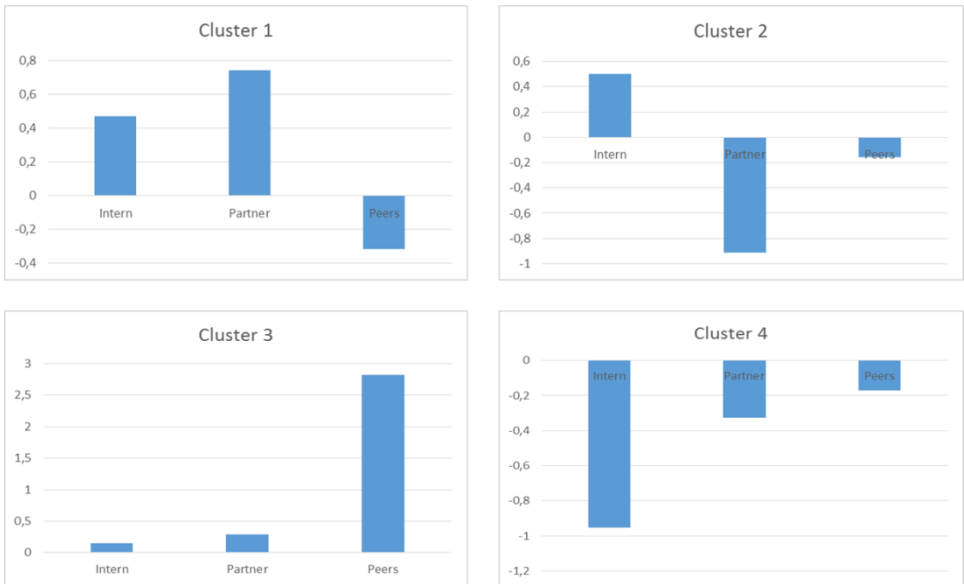

Figure 2: The four clusters of similar opening patterns

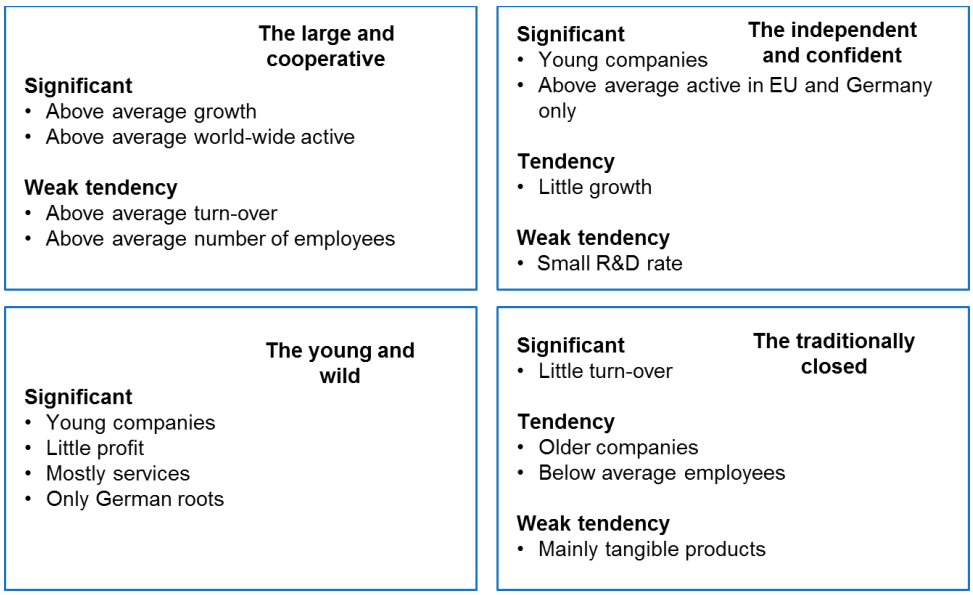

Figure 3: The four clusters with its characteristics

In the cluster called "The large and cooperative" companies are open above average in cooperation with internal groups, well above average with partners and below average with peers. Companies whose growth and worldwide activities are significantly above average and which have a weak tendency for their turn-over and amount of employees to be above average too, belong to that group, which is shown in figure 3.

In the cluster called "The independent and confident" companies are open above average in cooperation with internal groups, well below average with partners and almost at average with peers. Companies, which are significantly younger than the average and which are above average only active in the EU and in Germany, are part of this group. These companies also have a tendency towards little growth and a weak tendency towards small R&D rates.

In the cluster called "The young and wild" companies are open at average in cooperation with internal groups and with partners and extremely above average with peers. Companies which are significantly younger, make little profit, are active mostly in services and have German roots belong to this group.

The last cluster is called "The traditionally closed". The companies are open very much below average internally and also open below average with partners and slightly below average with peers. Those companies are characterised by significantly smaller turn-over than average. They have a tendency to be older companies and the number of employees is below average. They have a weak tendency to be producers of tangible products.

This model consisting of four clusters of similar opening patterns helps companies to perform a first benchmark regarding the cooperation with internal groups, external partners and peers. Due to information which can be obtained easily, like the R&D rate, turnover, number of employees and age, companies can position themselves in one of the

four quadrants. As each quadrant represents a precise opening pattern, companies will get a first hint on how their peer group collaborates with others.

Positive about this approach is the simplicity and the promptness. Companies only have to invest a minimum of effort to get first results. But this approach also has its downside. Even though the validity of the model was reviewed statistically by means of cluster analysis and factor analysis the sample of a total of 100 companies is rather small. Some of the quadrants are represented by less than 20 companies.

In addition to the points above, the nature of benchmarks is to compare ones company with others. Here it is questionable if the average behaviour in regard to collaboration leads to recommendations how to improve. Of course companies, which have been on the market with their products for many years cannot do too many things wrong, but might not be an ideal example how to improve collaboration with others.

Furthermore companies were only asked for collaboration with the different groups of the column model in general – but neither for one particular project nor for a certain process step within the product development process. In order to develop general measures aimed at how to open, each process step in the R&D process needs to be looked at separately, as in each step different measures will be necessary. In order to develop a generalised methodology with general measures which are suitable for different companies a general understanding of the single process steps within the product development process needs to be developed. In a workshop with 15 companies of the 100 that had taken part in the first quantitative study, the product development process of the various companies were visualised and standardized. Figure 4 shows the process all companies have agreed on.

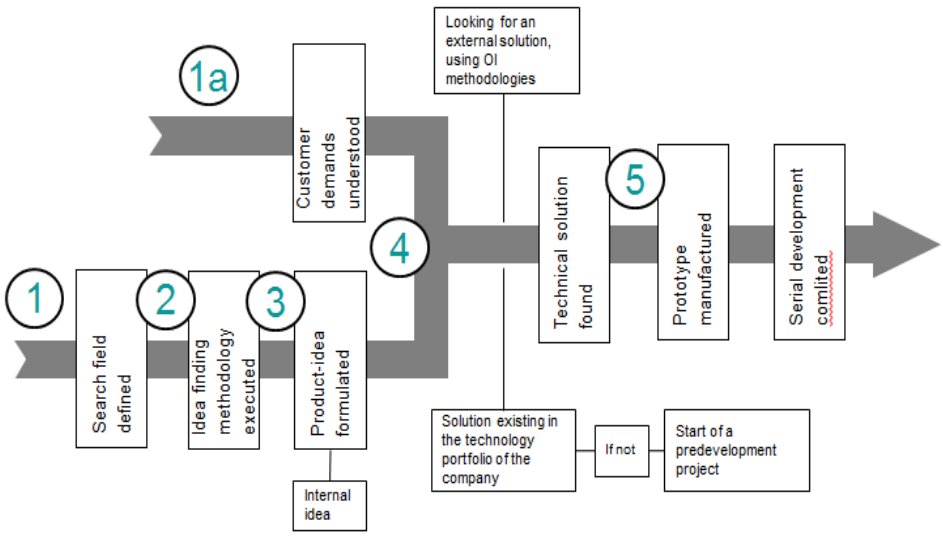

Figure 4: The standardised product development process

The process consists of two starting points and one end point. In order to reduce the large amount of process steps within the product development process, process steps which are governed by one team are summarized in one process step and visualised by the final result of the step executed. The process can be started at 1, where a company defines a search fields and looks for new ideas or at 1a, where the sales organisation channels customer demands towards the R&D department. At stage 4, a technical solution to solve the technical problem will be developed, either using existing technical solutions or looking for new solutions outside the company.

Figure 5: The product development process reduced to the simplest version

Within the interviews of the major study it was possible to interview all companies on the process steps 1a und 4, which reduced the complexity enormously. Figure 5 describes the first step of the process up to the point where the customer's problem is understood, the second process step up to the point where the solution to the customer´s problem is developed.

In order to develop general recommendations interviews in various companies need to be conducted and similarities need to be identified. Doing so, the real openness (RO) was measured by conducting 20 interviews in the manufacturing industry within companies with 5000+ employees in southern Germany in 2016. To a specific project within the product development process, the project leader was asked to describe the collaboration with the 10 defined groups of the column model within each of the two visualised process steps, shown in figure 5. Collaboration was measured by the amount of co-working occasions and the depth of trust in the collaboration-partner.

As described above, the approach to develop recommendations was to compare the values of the Real Openness (RO) with the values of the Ideal Openness (IO). The methodology to measure the values for the RO was explained above. The following paragraphs will describe how to calculate the value of the IO.

When opening up processes in companies various factors will be influenced. In interviews with companies more than 30 factors were identified. In a workshop this long list was shortened to 12 relevant factors, which cover all relevant aspects, i.e. knowledge/ competencies in the department, velocity/ cost/ adaptivity of the process/ performance of the process, sales volume of a future product, image and market position of the company and possible future legal issues. Those factors will be influenced/ altered/ changed by opening up the R&D process, and they will generate risks and chances. The 12 factors are defined as influenced factors and the positive/ negative characteristics of those factors are the risks and chances. Figure 6 illustrates the model by visualising 2 of the 12 sets of influenced factors and its 2 positive (chances) and 2 negative (risks) characteristics.

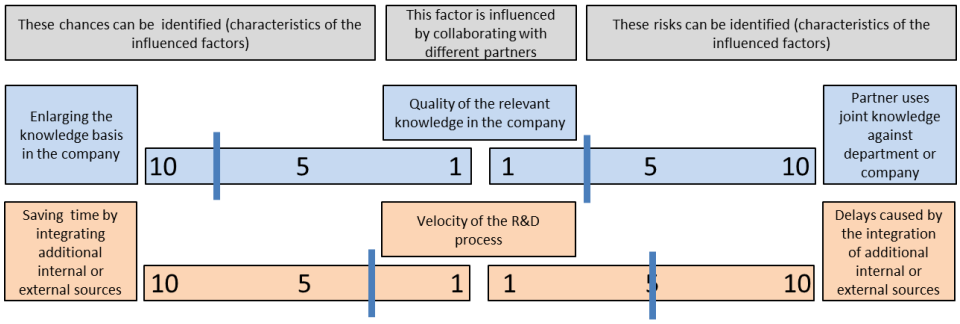

Figure 6: 2 of the 12 influenced factors and its characteristics

In the example shown in figure 6, an automotive supplier, when asked about a development project on an exterior-product, looking at the process step: understanding the customer's problem, and examining the collaboration with another business unit (column 2 of the column model) sees large chances (8) with regard to the quality of the relevant knowledge in the company but also risks (3), but which are much smaller than the chances. Looking at the second influenced factor – the velocity of the process – the interviewed sees a small chance (3) and a slightly bigger risk (5). When rating all 12 factors by the project manager in the companies, a pattern illustrated in figure 7 could develop.

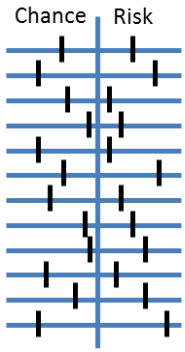

Figure 7: Typical pattern of chances and risks of the 12 influenced factors.

Calculations and Findings

As explained above, in order to formulate recommendations on how far to open the R&D process, and what measures to take, first the IO has to be calculated using the data collected shown in figure 7. Comparing the calculated IO with the measured RO will show differences. Those differences finally lead to the recommendations looked for.

All data collected in the interview with a German automotive supplier when looking at the process step "problem of the customer understood" are illustrated in figure 8. In this particular process step the project team collaborated with 5 of the 10 groups defined in the column model – shown in the first row. The values for the RO were directly measured

in the interview, when asking about the amount of occasions and the amount of trust within the collaboration. The R&D manager interviewed stated values between 25 and 100%, shown in the second row. Within each group of collaboration the risks and chances of each influenced factors were also measured and by adding the values and dividing the sum by the amount of factors, the ideal openness (IO) was calculated. In this calculation risks counted negative and the sum with the value 0 was equal to 50% IO. The values calculated for the ideal opening are shown in the second last row. Comparing the IO and RO, the deviations are stated in the last row.

	Form of collaboration/ column of the column model/ cooperation between	Different departments		Different business units		Different entities in the same group of companies		Supplier		Direct customer	
	Real openness (RO)	75%		75%		25%		50%		100%	
		Chances	Risks	Chances	Risks	Chances	Risks	Chances	Risks	Chances	Risks
Influenced factors	Quality of the knowledge	5	0	8	3	3	5	8	8	10	10
	Quantity of the knowledge	5	3	8	3	3	3	5	5	8	8
	Benefit of the internal knowledge	8	3	8	5	3	0	8	3	8	8
	Velocity of the R&D process	8	0	3	5	②	3	10	8	8	10
	Adaptation of the R&D process	10	0	5	5	0	5	8	5	10	8
	Performance of the R&D process	8	3	3	8	①	5	8	8	10	8
	User Experience	5	3	3	3	0	0	5	3	8	3
	Sales volume of a possible product	3	0	0	0	3	0	0	0	8	3
	Overall project cost	8	8	5	8	①	5	3	5	3	8
	Image of the company	8	0	5	0	5	5	5	8	8	8
	Market position of the company	8	2	0	0	2	0	3	3	2	3
	Legal issues	5	0	2	2	0	0	3	8	2	10
	sum	5		1		0		0		0	
	Ideal Openess (IO)	75%		55%		50%		50%		50%	
	Deviation	perfect		20% closer		25% more open		perfect		50% closer	

Figure 8: Typical pattern of chances and risks of the 12 influenced factors.

In order to develop a generalized set of recommendations for all 20 companies, workshops to develop those recommendations have to be performed. But also without the set of generalized recommendations, workshops help to identify first specific hints of how far to open and what measures to implement.

Confronting the company with the results of figure 8 in a workshop, these recommendations could be given and measures were developed. The RO and IO of the collaboration with the other internal departments and with the suppliers do not show any deviation and therefore do not need to be looked at more closely. The collaboration with different business units seems to be a little too open, the collaboration with different entities too close and within the direct customer much too open. Those 3 types of collaboration were looked at during the workshop. Generally one should always look at the collaboration with the groups with the largest deviations between RO and IO and within those collaborations one should examine the influenced factors with the largest span between chances and risks. In this example the collaboration with the different business units mainly stands for the collaboration with the plant in Shenzhen, China. The value of the RO is 75, but they see a lot of risks, which lowers the value of the IO to 55%. Looking at that result, the company has two options, either they reduce the openness in this project step and in the collaboration with their colleagues in Shenzhen in particular or

they look for measures to reduce the risk. In the workshop with the company, they chose the second option and developed the measures visualized in figure 9.

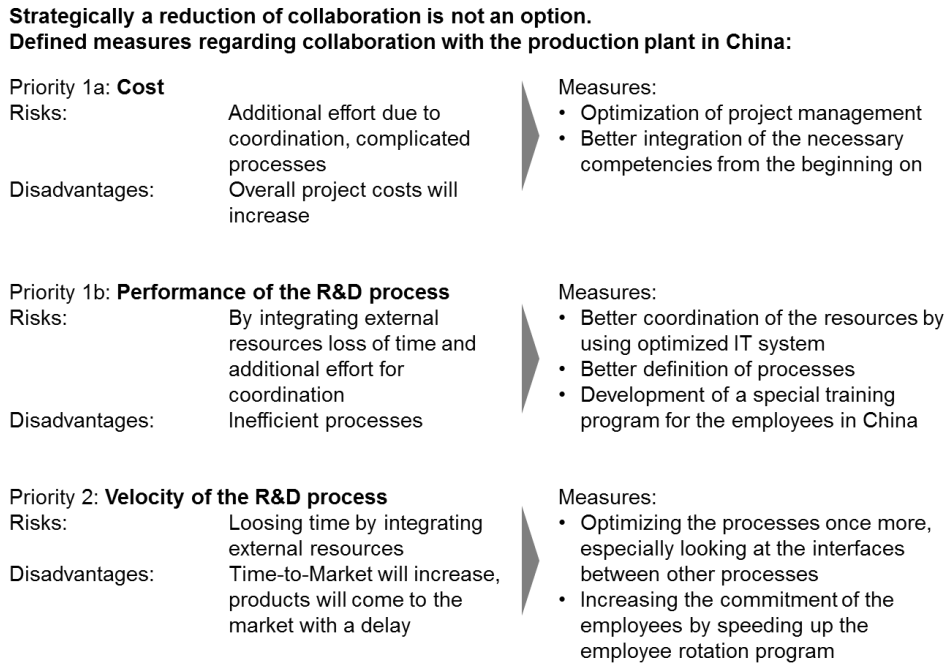

Figure 9: Measure defined in a workshop with an automotive supplier

Next steps

After conducting the workshops at the 20 companies, a set of recommendations will be available. By analyzing the sets of recommendations similarities will be identified and clusters of analog recommendations will be developed. Looking into the companies´ characteristics of the companies which developed similar recommendations will result in a general framework. This framework will allow companies to use the model to detect their biggest deviations between RO and IO and to use the clusters of recommendations, depending on the companies` characteristics for a first hint to reduce the risk and benefit from the chances.

The results of the workshops will also help to validate the calculation methodology of the value of the IO. The workshops will always start to present the results of figure 8, which calculates the value for the IO by adding the values of the chances and the negative value of the risks. Besides this result also a variety of alternative calculations of the IO will be presented. The use of different, more complex, algorithms will generate different values for the IO and consequently different sets of recommendations. By estimating the set of recommendations, the companies will help to identify the algorithm, which produces the most suitable value for the IO.

Summary

By going through the interview R&D managers, for the first time, start to think about opening up the R&D process, not only to the direct customer, but to different partners. They reflect on the existing situation and evaluate risks and possible chances. When confronted with our first estimates on the recommendations in the subsequent workshop, eye opening reactions were witnessed.

As the defined recommendations are adjacent to individual partners and process steps, R&D managers, who are usually very sceptical of opening their processes, realize, they are in control of risks and therefore the possibility of implementing the recommended measurements is much higher.

The developed methodology presents a solution to the problem of integrating the results of Open Innovation projects in well-established, long-existing, conservative companies by developing recommendations on how to work collaboratively with different partners in the R&D process, especially answering the question of how open the R&D process should be.

Companies using the developed methodology to generate recommendations to open up their R&D process, while controlling the risks of the opening process, will be on a road of changing their innovation culture and the possibility to absorb external information. By developing and implementing the recommendations, companies will develop a foundation on which possible collaborations with the 10 defined partners of the column model will reach a different level.

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