The Impact of Collaboration with Big Companies on Entrepreneurial Technology Innovation

Eva Maria Grochowski[1], Joachim Warschat[2], Richard Dasher[3]
[1]University of Stuttgart, Graduate School of Excellence Advanced Manufacturing Engineering (GSaME) and Institute of Human Factors and Technology Management (IAT), Stuttgart, Germany
[2]Fraunhofer IAO, Stuttgart, Germany
[3]Stanford University, US-Asia Technology Management Center, Stanford, CA - USA

Abstract--**Startups and small and medium sized companies are an important source for technology innovation. Cooperation with big companies reinforces technological innovation but it can also hamper entrepreneurial undertakings. This research considers the impact of cooperative activities of startups or small and medium sized companies with big companies in regard to technology innovation in the automotive industry. The analysis of 16 cases gives a first overview about the particular characteristics of cooperative activities in an industry that suffers from disruptive innovation and new players. The analysis covers the reasons for cooperation, the desired partner characteristics, and the benefits and sacrifices caused by the cooperative activities. Risk and cost reduction are not seen as critical by big companies regarding the decision for or against the collaboration. Their focus is on knowledge gain and new ideas. Startups or small and medium sized companies on the other hand seek for market entry and public relation. Cooperation is not primarily considered as a source for venture capital. Public funding as a financial source for innovative work is underestimated except for university cooperation. The study bases on eight expert interviews with CEOs, founders and technical directors with wide experience in research and development cooperation.**

I. INTRODUCTION

Two decades ago high-tech companies grew rapidly. Today technology companies have to respond much faster to the challenging market conditions in order to stay competitive. [1] Shortening product life cycles, increasing technical complexity, varieties of new technologies, and disruptive innovations that can even replace existing products force technology companies to seek for new sources of innovation.

Parallel research and development of several ideas is necessary in order to have enough new products and technologies in the pipeline to compete in the market. Small and medium sized companies (SMEs) usually do not have the capacity to develop new technologies simultaneously and bring them to market within the necessary time. [27] Entrepreneurial high-tech startups usually have an innovative idea or technology and need seeding in order to develop their technology. [37] Depending on their product market entry can be a difficult task without a company already in the market. Big technology companies have the resources for research and development (R&D) and are in the market. However, if they only innovate in-house they are likely to lose opportunities and market share.

Cooperation is a way to compensate the weaknesses of the companies and even arise new opportunities. [3] However, small and medium sized companies work more flexible than big companies. Big companies need defined processes for coordination and organization. Decision processes take longer, especially if they contain high risk like in R&D. [47]

Many cooperation fail or do not even start. Reasons therefore for example are different working mentalities, hidden interests, or barriers to communication. This work examines the distinct circumstances in cooperation of startups or small and medium sized companies with big companies. The survey focusses on the automotive industry and the connected chip and software industry as this industry suffers from disruptive trends and the entrance of new players like Google, Tesla or Apple. [48], [12] Automotive companies realized that they need to keep up with trends like digital customer experience, connectivity, big data, or shared mobility and that they can only succeed if they collaborate with companies outside their traditional industry. They need to nurture new ideas inside and especially outside the company. New ideas with a high execution risk and a high market risk are generally realized by startups or SMEs not by big companies. [6] Automobile manufacturers as well as suppliers are not used to such cooperation with startups or SMEs. Therefore, this survey gives current insights about the reasons for cooperation, desired partner characteristics, and the benefits and sacrifices caused by collaboration of big companies with SMEs or startups seeking for entrepreneurial technology innovation.

II. THEORETICAL BACKGROUND

A. Motives for Cooperation in Research and Development

The most important reason for cooperation is the realization of **synergy effects**. In the technology industry this is usually fulfilled by complementary know how of the cooperation partners. [8], [20] R&D demands high financial funding, personal as well as equipment resources. Especially startup and small companies usually lack all of this in order to bring the invention to market. Big companies seek for new ideas in order to stay competitive. Therefor **capacity complement** is a second motive for cooperation. [34] Resources can be allocated for an optimal innovation process. Personal resources also imply knowledge and know how. An agreed knowledge and know how exchange leads to a **gain of knowledge and know how** ideally for all partners. [20], [34] Besides cost and time reduction also the quality of the result can be improved. A pooling of resources, knowledge and know how usually

cause **cost reduction** during the R&D process. [19] Moreover, regarding shortening product life cycles and higher complexity of the products the pooling also helps to **reduce the time to market**. [29], [34] Especially the pooling of resources and sharing knowledge and know how needs a high level of trust among the cooperation partners. Contractual agreements cannot create a trustful collaboration on their own. Especially in an early stage of research it is not possible to predict the future development detailed enough to cover all eventualities. Unpredictable or opportunistic behavior of the partners is one risk factor concerning cooperative activities. In R&D financial risks and product development risks have to be minimized. The above mentioned motives lead to a **risk reduction** if they are applied in a joint success oriented way. [17] In case one of the partners faces feasibility issues that would usually mean the end of the undertaking. By cooperating with other companies these issues might be compensated by complementary capabilities and capacities. The **facilitation of market entry** is the last quoted reason for cooperation. It already leads beyond R&D but still plays a role for it. [8], [20] Especially cross-industry cooperation might open new opportunities for the product by minor adjustments during development. Also relations of partner companies can ease market entry both national and international.

B. Phases of Cooperation

The definition and determination of phases of cooperation differ in the corresponding literature. All models define three to five phases. The following table gives an overview of the established models.

Analyzing the models it can be found that all models contain similar content. The segmentation in three to five phases of the cooperation indicates that the models differ in their level of detail. DAS and TENG or WAHYUNI ET AL. with three phases leave out the decision or strategic planning of the cooperation. The model starts directly with the formation of the cooperation. The formation of the cooperation in a wider view is defined in phase three or even four in the five-phase models.

In this work the focus lies on the impact of collaborative activities in R&D. As SMEs usually do not have defined phases and routines for cooperative activities and structures in big companies differ from each other only three phases will be used for the empirical survey. This broad definition of the phases assures comparability of the results.

Phase 1 involves the time from the decision to cooperate in R&D and the agreement of two or more parties to cooperate. It contains the definition of the desired characteristics of the partners, strategic objectives concerning the cooperation, partner search and selection.

Phase 2 involves the time from the agreement of two or more parties to cooperate until the fulfillment of the common activity. It contains the benefits and sacrifices experienced during the collaborative work.

Phase 3 involves the time after the common activity has ended. It contains the kind of advancement, adjustment or termination of the cooperation and the impact on the company in a retrospective view.

C. Types of cooperation models in technology innovation

Cooperation is defined as an organized economic structure of, according to certain criteria selected, enterprises that are legally independent. Based on a negotiated and defined common purpose subtasks are determined for each party by the involved parties [2].

There are various types of cooperation models. Analyzing numerous scientific sources written by different authors, diverse structures of cooperation can be observed. The following table gives an overview of the most common structures found in cooperation research literature.

TABLE 1: LITERATURE OVERVIEW OF COOPERATION PHASES

Author	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Kanter 1994 [24]	Selection	Negotiation	Creation	Realization	Advancement
Kraege 1997 [28]	Strategic Initiation	Partner selection and evaluation	Decision	Implementation and realization	Advancement or termination
Lei et al. 1997 [32]	Partner selection	Planning and negotiation	Implementation and management		
Gonzales 2001 [16]	Strategy development	Partner selection	Structuring	Management	Re-evaluation
Das and Teng 2002 [7]	Formation	Implementation	Adjustment or termination		
Specht et al. 2002 [42]	Initial decision	Partner selection	Configuration	Implementation	Termination
Storm vans Gravesande 2006 [43]	Initiation	Partner selection	Implementation	Termination	
Wahyuni et al. 2007 [46]	Formation	Operation	Termination		
Howaldt and Ellerkmann 2011 [21]	Idea and initiation	Structuring	Operation	Evaluation	Metamorphose or Termination
Niemann 2013 [36]	Strategy selection	Partner evaluation and selection	Configuration	Realization and evaluation	Adaption or Termination

TABLE 2: OVERVIEW OF COOPERATION MODELS

Source	Cooperation models	Focus
Harzer [18]	Contractual cooperation, cooperative, strategic alliance, joint venture, franchise, incorporated company, value system	Strength of commitment and purpose of the cooperation
Köhne [26]	Virtual company, sub-contracting, agency, licensing, franchise, capital venture, contractual cooperation, civil law association	Cooperation structures of strategic company networks
Morschett [35]	Non-contractual cooperation, contractual cooperation, equity commitment	Formal aspects of cooperation
Stritzel [44]	Licensing, franchise, joint venture, contract manufacture, strategic alliance, minority holding, subsidiary, merger	Market entry strategies
Thommen [45]	Participation, consortia, syndicate, community of interest, joint venture, strategic alliance, group	Strength of commitment of the cooperation
Zillig [49]	Process organization, in-/outsourcing, joint venture, strategic alliance, project organization, network, virtual company	Process oriented and structural organization

TABLE 3: ATTRIBUTES AND CHARACTERISTICS OF COOPERATION [38]

Attribute	**Characteristics**			
Direction	Horizontal	Vertical	Diagonal	
Expansion	Local	Regional	National	Global
Liability	Agreement	Rules	Contract	
Financial integration	No equity participation	Equity participation		
Duration	limited	Unlimited		
Time horizon	Long-term	Medium-term	Short-term	
Target identity	Redistributive	Reciprocal		
Number of partners	2	3-10	> 10	
Company size	Inhomogeneous	Homogeneous		
Substantive limits	Limited	Unlimited		
Function link	Merger	Vote		

It is not possible to explicitly define each cooperation model based on the characteristics described in the literature. Furthermore, the complexity of R&D cooperation for technology innovation forces to consider more than a single structure characteristic. In general they are determined by the attributes and characteristics in the following table.

Cooperation in technology innovation can be defined by the attributes and characteristics. On the other the collaborative activities cannot be directly assumed by the described cooperation models. For this work the focus lies on the enforcement of technological innovation. Therefore, only some of the existing cooperation models will be taken into account and further specified.

The alternatives for R&D cooperation can be separated by the degree of equality of the partners. Several cooperation models leave the decision making power at one partner. They are e.g. contract manufacturing, licensing, sub-contracting, or outsourcing. In technology innovation management external assignment of R&D topics to research institutions or R&D contractors follow these patterns. It is also common to purchase licenses for further in-house development or for implementing the technology in the new product. Another cooperation form is triggered by market demands. R&D is executed in cooperation with lead customers either at the customer´s or at the producer´s premises. Demands and technical possibilities can be matched perfectly and innovation with a lower market risk can be achieved. Equality of the partners is given cooperation or joint ventures with partners either in the same industry or cross-industry. Especially in early stages of new technologies cooperation with R&D institutions or universities is likely. These kinds of agreements are most applicable to cooperation forms like networks, joint venture, strategic alliances, contractual and non-contractual cooperation, or consortia. [34]

D. Silicon Valley as a System of Open Innovation

Silicon Valley is an entrepreneurial region which is not determined by governmental borders. [25] Silicon Valley is distinguished by unique competencies in production, product engineering and management which make entrepreneurial success in a rapidly growing environment possible. [31] Stanford University as leading institution for higher education in this area fosters entrepreneurial activities as well. [39] Geographically it was considered to be the southern part of the San Francisco Bay area. According to the development of San Francisco and Oakland concerning innovation and venture capital investment they can be seen as part of Silicon Valley today. [23]

More than 14 percent of the generated patents in the United States are created in the Silicon Valley. This is one part of the evidence of a highly innovative ecosystem. At the moment 13.5 percent of firms without employees in California are situated in the Silicon Valley. Thereof almost one third is in Professional, Scientific, and Technical Services. This suits the fact that the value added per employee is more than 30 percent higher than in the rest of the United States, even though it declined in Silicon Valley from 2013 to 2014. [23] If we look at the new business formations per person on the other hand we face North American average. This is because entrepreneurs in this area do not stop after building one com-

pany. They usually exit at a certain point and start a new business. Until 1997 more initial public offers (IPO) were observed as mergers and acquisitions (M&A). Today mergers and acquisitions clearly outweigh IPOs. [22]

For this work innovation is defined as a process that leads from the creation of a new idea (invention) to its real-world deployment (often by commercialization). New ideas can appear at any time during the innovation process and be implemented in the product. But only few ideas from research will be developed and finally brought to market. They have to fit the overall company strategy and have a high probability of success. However, in order to stay competitive companies need to have a broad range of new ideas from which they can chose. Otherwise they cannot bring competitive products to the market respectively have a higher failure risk. Small or medium sized companies do not have the internal research capacity of a big company. This is one reason why big companies are more competitive on a long-term view. About 60 percent of startup companies fail. This is about the failure rate of ideas within a big company.

Traditionally big companies followed a primarily closed innovation strategy. They stayed competitive because they are able to support a broad innovation pipeline through high investments in their internal R&D. The following figure shows the internal innovation pipeline with several ideas. Only a small portion of ideas reach the target market. Company external ideas and businesses are not included in the innovation pipeline.

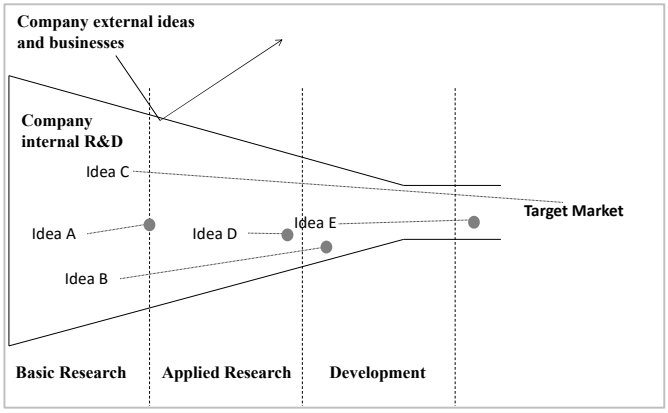

Figure 1: Closed Innovation [5]

Even though big companies have sufficient resources for the development of innovative technologies they are limited to company internal ideas. The motivations for inbound open innovation are to fill the innovation pipeline with new ideas that are outside the boundaries of the company. [5]

Opening up the innovation process brings new opportunities for the company. [13] Even if the idea does not fit into the core business they can still generate income by licensing or even creating a new company as a spin-out. [14]

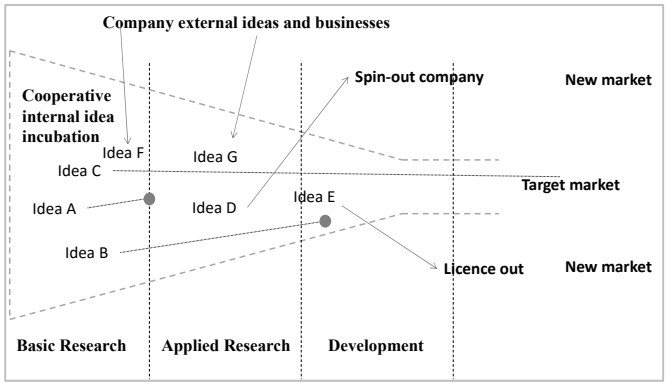

Figure 2: Open Innovation [5]

III. METHODOLOGY

A. Sample Structure

In order to receive an overview of cooperative R&D activities between small and medium sized companies and big companies the experts are spread around the automotive, chip and software industry. Companies reach from suppliers to manufacturer. As insurance companies increasingly appear in startup platforms looking for cooperation opportunities with companies that develop new technologies, they were also taken into account. Every expert reported about two or more cooperative activities enforcing technology innovation. Therefore, the survey covers more than 16 cooperative activities in R&D. The following table shows the distribution of the interviewees.

TABLE 4: SAMPLE DISTRIBUTION

	Number of interviewees
Automobile manufacturers	2
Automobile suppliers	2
Chip and software developers	2
Innovation platform managers	2
Insurance industry	1
Sum	**8**

There were two strategies for specifying the sample. Firstly, companies were searched for, which fulfill the following criteria:

- The company has to have a R&D site in the Silicon Valley area
- It has to be in a technology oriented industry with focus on automotive
- It has to cooperate with companies of significantly smaller resp. bigger size for the purpose of technological innovation
- The cooperation can be past or still running

Secondly experts were searched for, who fulfill the following criteria:

- They have to have experience in cooperative R&D in the Silicon Valley area for at least five years

- Experts have/had to be involved in at least two cooperative activities with companies of significantly smaller resp. bigger size for the purpose of technological innovation
- They have/had to be in touch with the startup scenery in the Silicon Valley e.g. startup platforms

The personal criteria overrule the company criteria as the knowledge of the interviewee is more important than the company one works for at the moment of the survey. Nevertheless most of the experts were found by contacting the companies. As an information source public lists like AngelList, member lists of startup platforms, company lists and contacts provided by the US-Asia Technology Management Center of Stanford University were used.

For the analysis the sample is divided into "SMEs or startups" and "big companies". Cooperation literature provides evidence that according to the degree of equality of the partners the circumstances of the partners differ. SMEs or start-ups are usually in a weaker position than big companies due to their financial power. For this survey SMEs were defined by their employee number at the beginning of the observed cooperative activity. There is no universal definition of SMEs even within the US government. Nevertheless they are mostly defined by up to 500 employees. [10], [11], [41]. They are also mentioned as an important source of innovation and entrepreneurial skills. [41]

Startups are defined by their need for capital, fast growth rate, high degree of innovation and young age. [4], [30] The most important characteristic is the high growth rate. They are even called "gazelles" in the present literature. [40] As SMEs and startups are usually in the same position in cooperation with big companies they are evaluated together.

TABLE 5: DISTRIBUTION OF OBSERVED COOPERATION BY POINT OF VIEW

	SMEs or startups	Big companies
Automobile manufacturers		4
Automobile suppliers	1	3
Chip and software developers	2	
Innovation platform managers	5	
Insurance industry		1
Sum	**8**	**8**

For the interpretation of the results, it has to be taken into account that no SMEs or startup companies were interviewed that do not exist anymore. The former CEOs and/or CTOs were contacted but were not willing to participate in the survey.

B. Interview Structure

The interview guideline contains qualitative as well as quantitative parts. Every interview starts with personal questions about the interviewees background and company data of the considered cooperation partner. In the second part at least three cooperative activities are picked in which the interviewee was directly involved. Every cooperation is examined in three steps: Prior to the cooperation, during the cooperation and after the cooperation.

Prior to the cooperation contains information about the original mission and strategic objectives of the company and the stated aims of possible cooperation. Based on this information the desired characteristics of cooperation partners and the selection process are determined. Finally the interviewees rank characteristics stated in the literature from 1 = most important to 5 = less important.

In the part "during the cooperation" the focus lies on benefits and sacrifices caused by the cooperation. Benefits and sacrifices are structured by knowledge gain or loss, cost reduction or increase, possibility of public funding, risk reduction or increase, intellectual property agreements, and decision power concerning cooperative topics. All topics are also evaluated with a 4-point Likert scale, 4 = very important to 1 = not at all important.

The part "after the cooperation" shows the retrospective view of the expert about the cooperation. Why or why not the cooperation was a success for the company and how the business plan changed because of the cooperation. In order to prevent biased information the personal development of the interviewee through the cooperation is captured.

C. Data Analysis

The interviews are recorded, paraphrased, and analyzed by a qualitative content analysis. [15] As an analysis tool MAXQDA is used. [33] Quantitative data is analyzed by descriptive statistics. [9] Due to the small sample an explorative analysis would not achieve reliable results. All information is cited in order to assure that the interviewee cannot be identified by the content according to the declaration of consent.

IV. THE IMPACT OF COOPERATION ON ENTREPRENEURIAL TECHNOLOGY INNOVATION

A. Incentives for Cooperation in entrepreneurial Technology Innovation

The analysis of the incentives for cooperation shows differences caused by the desired level of innovation and time to market. They also differ between big companies and SMEs or startups.

Big companies who focus on radical innovation are looking for a dramatic increase in performance that can also replace an existing product. They scout for new ideas or technologies in their industry and also in other industries. Normally the companies face R&D durations from five to ten years in this case. The cooperation described with the aim for radical innovation start in more than 50 % of the observed cases with university cooperation. The students might even found a startup company during their university studies. In one case the university cooperation became a spin-off company of the big company.

The specifications resp. the description of the final tech-

nology or product are defined rather vague if the aim is radical innovation. Formulations like "better results, higher performance, faster, saves space, or cleaner device" are regularly found in the descriptions for the idea or technology hunt.

Big companies with focus on the market demand usually seek for incremental innovation. Radical innovation in this case was only accepted in one of the observed cooperation. They are market focused and therefore motivated to cooperate with SMEs or startups that already have a use case. Incremental innovation is also more likely to be accepted by the customers what helps to bind existing customers and to attract new customers. In more than 80 % of the observed cooperation the incentive for cooperation was pulled by identified customer needs. Looking at the R&D durations two years were stated as the maximum. The formulations of the specification are accurate as the innovation is pulled by the market and not pushed by technology.

SMEs or especially startups are the new ideas or technologies by itself. One incentive for all SMEs or startups is market entry. Venture capital was also mentioned but not directly connected to the cooperation. All successful cooperation, meaning the technology or product was developed to market readiness, ended in all observed cases with the SME or former startup as the supplier and the big company as the customer.

Companies in the insurance industry are not interested in cooperation focusing on technological innovation. They realized a shift of risk caused by new technologies and products. Risks disappear but new risks especially because of the digitalization of the world arise, one example is autonomous driving. They also identify new technologies that might help to improve their risk assessment. Especially data analytics managing big data are from interest.

B. Partner Selection

The most important feature of desired partners stated by the interviewees is complementary capacity or knowledge. According to the results about the incentives the views of big companies differ from the views of SMEs or startup companies. The following table shows their average ranking of five features.

Both sides rank "cooperation experience" and "high R&D investment" equal on positions in the middle and "complementary capacity or knowledge" on the top positions. The biggest differences appear for "presence in target market" and "adapts to your company´s processes".

Presence in the target market is not important for big companies. They are already present in the target market and do not implement new products that do not match their core market. An exception is when they look for differentiation in their product portfolio.

SMEs and especially startup companies are not present in the target market. They might even not know their target market at the beginning of their undertakings. Their focus is on technological research and development at first and secondly the market ready product or application possibilities in market ready products or products already established in the market. Another reason is that the placement of a new product in the market is usually expensive. In all cooperation observed the big company brought the final product to market or became the major customer.

Concerning the adaption to the company´s processes the interviewees stated that SMEs and especially startup companies do not have implemented stiff processes and can easily be integrated in the collaborative work with the in-house engineers.

The rankings in the table above are average rankings. Except for "adapts to your company´s processes" there were no significant differences in the answers. The interviewees who are engineers and worked in R&D ranked "process adaption" on the top two positions. They stated that collaborative work is easier when all partners use the same engineering standards and processes. They see this feature as a key success factor of the cooperation.

One feature not included in the ranking table was mentioned by all startup companies as very important. The public relation improvement of the SME or start up caused by a cooperation with a well-known big company is regarded as a major asset. Besides the public relation for their company basically for free they also have experienced follow-up cooperation with other big companies which became major customers.

Finding the right partner and technology is the biggest challenge before the cooperation. Some big companies have scouts who search for new ideas and partners full-time. They follow strategic topics decided by the top management. Within these topics they can negotiate and set the terms without close reports to the top management. They can also push cooperation that are interesting for the company e.g. cross-industry ideas after consulting with the management. Their hunting grounds are startup platforms like PlugandPlayTech Center and events that bring small and big companies together. SMEs and startup companies also use these events and platforms to present their ideas and new technologies.

TABLE 6: RANKING OF PARTNER FEATURES

SMEs or start ups	
Partner features	***Rank***
Cooperation experience	4 (=)
High R&D investment	3 (=)
Complementary capacity or knowledge	2 (↓)
Presence in target market	1 (↑↑↑↑)
Adapts to your company´s processes	5 (↓↓↓)

Big companies	
Partner features	***Rank***
Cooperation experience	4 (=)
High R&D investment	3 (=)
Complementary capacity or knowledge	1 (↑)
Presence in target market	5 (↓↓↓↓)
Adapts to your company´s processes	2 (↑↑↑)

1 = most important to 5 = least important

While one interviewee stated that startups contact the company directly for cooperation possibilities, another stated that it is hard to get the startup companies to cooperate with them. A possible reason discussed in the interviews is the branding and popularity of the company. This possible reason aligns with the desired partner feature "well-known" mentioned above.

All interviewees agreed that the partner company should also seek for a win-win situation and collaboration. Two of them said that they mentioned a good team as the key success factor of a cooperation.

C. Benefits and Sacrifices caused by Cooperation in Entrepreneurial Technology Innovation

The motives for cooperation in R&D are used to categorize the benefits and sacrifices caused by cooperation in entrepreneurial technology innovation.

In all observed cooperation the partners gained complementary capacity and knowledge. In most cases it was either knowledge in computer science or in hardware development. Three interviewees pointed out that additional knowledge for radical innovation came from university cooperation. According to their ranking of the desired characteristics for cooperation partners they evaluated the knowledge gain as very important for any collaborative activity. One interviewee compared the gained knowledge to additional costs which would rise from building in-house capacity or knowledge. In all three cases presented by the interviewee the costs would have been higher to build in-house expertise.

The following question addresses cost reduction during the cooperative R&D compared to in-house R&D. Big companies could not give a concrete answer to this question. They look at the whole process from the idea to the market. As they might reduce costs by sourcing out parts of their R&D work they said that the cost for placing the product in the market are higher than usual due to the novelty of the product or because it is not in their actual core business. Engaging in active scouting for potential partners for cooperation also causes additional costs compared to in-house R&D. So far no calculations were made throughout the whole innovation process in order to compare cost of in-house R&D to collaborative R&D.

The evaluation of the R&D process excluding marketing expenses all interviewees agreed that cost can be reduced. For example there are no purchase costs for the needed complementary capacity and no additional human resources which still produce costs even if the idea fails. Another cost reduction possibility can be found in university cooperation as students cost less than in-house engineers. The importance of cost reduction compared to the benefit of idea generation is important but does not have priority in the cooperation decision. In this context two interviewees already lead to the next topic – public funding.

New technologies that are likely to be researched and developed in university cooperation are often eligible for public funding. It is possible for many new technologies also for all companies if there is a call available. Seven cooperation included public funding. In most cases it was the universities and the SMEs that applied for the call. Two interviewees stated that public funding is not a topic as their innovative work is more attached to new products than new technologies. There are rarely calls for public funding in product innovation. In all cases public funding was regarded as nice to have but the "technology, strategy, terms and feeling" are more important for the decision for the cooperation or against it.

Risk reduction, financially as well as in the R&D process, is seen as important by all interviewees. Nevertheless they do not see the cooperation as the critical factor. As already mentioned above in the context of cost reduction the only aspect that aligns to the cooperation is the possible reduction of sunk costs for additional capacity which might be reduced by a cooperation. Three of the interviewees said that R&D is always risky and cooperation cannot change this fact.

The final critical topic in cooperation discussed in the interviews is the handling of intellectual property. Three scenarios were described by all interviewees. The first scenario is joint R&D. In this case they would also have joined intellectual property. In the second scenario the R&D work is mostly done by one partner, whereas the other partner supports with additional capacity. In this case the intellectual property will be owned by the party that executed the R&D. In the third scenario one of the partners is not interested in the intellectual property for diverse reasons. In this case the other partner might have exclusive using rights or keeps equity of the other company. Two interviewees only answered that this matter is evaluated case by case. Taken the diverse answers given for each observed case into account the format of this survey cannot give a clear answer to the question of intellectual property.

V. CONCLUSION

The automotive industry reacted to the disruptive trends and new players that rush into the market by building R&D centers in the Silicon Valley as the home of innovation. The big players in the automotive industry differ a lot from the mentality and flexible organization of the young and innovative companies. Nevertheless they realized that collaboration with startups or SMEs is essential in order to fill the idea pipeline for the purpose of staying competitive.

The reason for cooperation aligns with the desired partner characteristics. Big companies look for fresh ideas or almost market ready products that match their customer´s needs, whereas SMEs or startups look for market entry possibilities and Public relation. Venture capital is not directly connected to cooperation as there are other possibilities than to cooperate with a big company. Both sides agree that complementary capacity and/or knowledge is the most important partner asset.

These facts also cover the results about the most important benefit of any cooperation which is knowledge or knowhow

gain. Surprisingly cost or risk reduction is not seen as important as R&D is considered risky anyway. It does influence the decision for or against the cooperation but is not the main reason. Public funding has high potential but is not seen as such by the collaborators. Universities as partners use this kind of funding more often even though startups or technology companies could apply for calls too. The handling of the generated IP could not be answered as it seems to be decided case by case.

The purpose of this survey is to give a first overview about the peculiarities of the automotive industry´s cooperative activities in the Silicon Valley. Even though the sample was small several interesting topics that need further research were identified.

Some answers did not only correlate with the position of the company in the value change but also with the profession of the interviewee. "Process adaption" as a desired feature of the partner e. g. is seen more important by big companies but also by engineers. It should be tested if the answers are caused by the profession or by the position of the company in the value chain.

The handling of IP in such cooperation need further research, especially what circumstances lead to the IP decision and how the collaborators think about it. This topic should be aligned with power distribution amongst the partners what also might influence other decisions. Another variable to be tested is the place where the collaborative action takes place. Some hints were found in this survey that this also influences the development of the cooperation.

It was not possible to poll interviewees with experience in cooperation were the SME or startup does not exist anymore for different reasons. These reasons might lead to significant improvement possibilities for all collaborators in this industry in the Silicon Valley.

REFERENCES

[1] Aytac, B. and Wu, S. D., "Characterization of demand for short life-cycle technology products," *Ann Oper Res*, vol. 203, no. 1, pp. 255–277, 2013.

[2] Baum, H., *Morphologie der Kooperation als Grundlage für das Konzept der Zwei-Ebenen-Kooperation,* 1. Aufl. Wiesbaden: Gabler Verlag / Springer Fachmedien Wiesbaden GmbH, Wiesbaden, 2011.

[3] Bernhart, W. and Schlick, T., "Automotive Engineering 2025," 2011.

[4] Blank, S. G. and Dorf, B., *The startup owner's manual: The step-by-step guide for building a great company,* 1. ed. Pescadero, Calif. K&S Ranch Press, 2012.

[5] Chesbrough, H. W., *Open innovation: The new imperative for creating and profiting from technology.* Boston, Mass. Harvard Business School Press, 2003.

[6] Christensen, C. M., *The innovator's dilemma: When new technologies cause great firms to fail.* The management of innovation and change series. Boston, Mass. Harvard Business School Press, 1997.

[7] Das, T. K. and Teng, B.-S., "The Dynamics of Alliance Conditions in the Alliance Development Process," *J Management Studs*, vol. 39, no. 5, pp. 725–746, 2002.

[8] Decker, B., "Unternehmenskooperationen im Bereich Forschung und Entwicklung," Seminar, Universität Oldenburg, 2002.

[9] Eckey, H.-F., Kosfeld, R., and Türck, M., *Deskriptive Statistik: Grundlagen, Methoden, Beispiele ; [achelor geeignet!],* 5., überarb. Aufl. Lehrbuch. Wiesbaden: Gabler, 2008.

[10] *Entrepreneurship at a Glance 2015:* OECD Publishing, 2015.

[11] *Financing SMEs and Entrepreneurs 2015:* OECD Publishing, 2015.

[12] Freitag, M., *Apple, Google und Tesla werden zur Gefahr für Audi, BMW und Mercedes*, 2014. http://www.manager-magazin.de/magazin/artikel/apple-google-und-tesla-werden-zur-gefahr-fuer-audi-bmw-und-mercedes-a-1007528.html.

[13] Gassmann, O. and Enkel, E., "Open Innovation: Die Öffnung des Innovationsprozesses erhöht das Innovationspotenzial," *Zeitschrift Führung + Organisation: ZfO*, vol. 75, no. 3, pp. 132–138, 2006.

[14] Gassmann, O., Escher, J.-P., and Luggen, M., "Technologieverwertung durch Spin-off," *Wissenschaftsmanagement*, no. 5, pp. 24–30, 2003.

[15] Gläser, J. and Laudel, G., *Experteninterviews und qualitative Inhaltsanalyse: Als Instrumente rekonstruierender Untersuchungen,* 4. Aufl. Lehrbuch. Wiesbaden: VS Verlag für Sozialwiss, 2010.

[16] Gonzales, M., "Strategic alliances: the right way to complete in the 21st century," *Ivey Business Journal*, vol. 66, no. 1, p. 47, 2001.

[17] Hagenhoff, S., "Kooperationsformen: Grundtypen und spezielle Ausprägungen," Arbeitsbericht Nr. 4/2004, Georg-August Universität.

[18] Harzer, K., *Wie Sie Gewinn bringend Kooperationen schmieden,* 1. Aufl. Berlin: Cornelsen, 2006.

[19] Heinz, U., "Führung und Kooperation als Erfolgsfaktoren in innovativen F&E-Projekten auf elektronischen Plattformen," Dissertation, Technische Universität, 2005.

[20] Helmcke, M., *Handbuch für Netzwerk- und Kooperationsmanagement.* Theorie, Praxiswissen, Praxisbeispiele, Tools. Bielefeld: Kleine, 2008.

[21] Howaldt, J. and Ellerkmann, F., "Entwicklungsphasen von Netzwerken und Unternehmenskooperationen," 2011. In *Netzwerkmanagement: Mit Kooperation zum Unternehmenserfolg*, ed. Thomas Becker, Ingo Dammer, Jürgen Howaldt, and Achim Loose, 23–35. Berlin, Heidelberg: Springer-Verlag Berlin Heidelberg.

[22] IPO Activity for Venture-Backed Companies Picks up Steam in Second Quarter, 2016. http://nvca.org/pressreleases/ipo-activity-for-venture-backed-companies-picks-up-steam-in-second-quarter/ (accessed January 26, 2016).

[23] Joint Venture Silicon Valley and Silicon Valley Institute for Regional Studies, "2015 Silicon Valley Index," 2015. https://www.jointventure.org/images/stories/pdf/index2015.pdf (accessed January 25, 2016).

[24] Kanter, R. M., "Collaborative Advantage: The Art of Alliances," *Harvard Business Review*, vol. 72, no. 4, p. 96, 1994.

[25] Kenney, M., *Understanding Silicon Valley: The anatomy of an entrepreneurial region.* Stanford, Calif. Stanford University Press, 2000.

[26] Köhne, T., *Marketing im strategischen Unternehmensnetzwerk: Erklärungsmodell und praktische Anwendung in der Versicherungswirtschaft,* 1. Aufl. Neue betriebswirtschaftliche Forschung 348. Wiesbaden: Dt. Univ.-Verl, 2006.

[27] Komorek, C., *Integrierte Produktentwicklung: Der Entwicklungsprozess in mittelständischen Unternehmen der metallverarbeitenden Serienfertigung.* Duisburger betriebswirtschaftliche Schriften Bd. 18. Berlin: S + W Steuer- und Wirtschaftsverlag, 1998.

[28] Kraege, R., "Controlling strategischer Unternehmenskooperationen. Aufgaben, Instrumente und Gestaltungsempfehlungen," *Management Review*, vol. 8, no. 4, pp. 249–251, 1997.

[29] Kropeit, G., "Erfolgsfaktoren für die Gestaltung von FuE-Kooperationen," 2013. In *Innovationsmanagement*, ed. Claus Tintelnot, Dirk Meißner, and Ina Steinmeier, 271–82. Innovations- und Technologiemanagement. Berlin: Springer Berlin.

[30] Kühnapfel, J. B., *Prognosen für Start-up-Unternehmen.* [Place of publication not identified], [Germany]: Springer Science and Business Media; Springer Gabler, 2015.

[31] Lécuyer, C., *Making Silicon Valley: Innovation and the growth of high tech, 1930-1970.* Inside technology. Cambridge, Mass. MIT Press, 2006.

[32] Lei, D., Slocum, J. W., and Pitts, R. A., "Building cooperative advantage: Managing strategic alliances to promote organizational learning," *Journal of World Business*, vol. 32, no. 3, pp. 203–223, 1997.

[33] *MAXQDA, Software für qualitative Datenanalyse.* Berlin, Deutschland: VERBI Software. Consult. Sozialforschung GmbH, 1989 – 2016.

[34] Michel, L. M., *Management von Kooperationen im Bereich Forschung*

und Entwicklung: Eine empirische Studie, 1. Aufl. Konstanzer Managementschriften Bd. 7. Konstanz: Hochsch. Konstanz, Technik, Wirtschaft und Gestaltung, 2009.
[35] Morschett, D., "Formen von Kooperationen, Allianzen und Netzwerken," 2005. In *Kooperationen, Allianzen und Netzwerke: Grundlagen - Ansätze - Perspektiven*, ed. Joachim Zentes, 377–404. 2., überarb. und erw. Aufl. Wiesbaden: Gabler.
[36] Niemann, B., *Analyse und Messung des Zusammenhangs von Vertrauen und Performance in F et E-Kooperationen.* Research. Wiesbaden: Springer Fachmedien Wiesbaden, 2013.
[37] Park, J. S., "Opportunity recognition and product innovation in entrepreneurial hi-tech start-ups: A new perspective and supporting case study," *Technovation*, vol. 25, no. 7, pp. 739–752, 2005.
[38] Porter, M. E., *Wettbewerbsvorteile: Spitzenleistungen erreichen und behaupten = (Competitive advantage),* 7. Aufl. Campus Strategie. Frankfurt, M., New York, NY: Campus-Verl., 2010.
[39] Sá, C. M. and Kretz, A. J., *The entrepreneurship movement and the university,* First edition. Palgrave pivot. New York: Palgrave Macmillan, 2015.
[40] Saßmannshausen, S. P. and Volkmann, C., „Gazellen" – schnell wachsende Jungunternehmen: Definitionen, Forschungsrichtungen und Implikationen," *ZfKE – Zeitschrift für KMU und Entrepreneurship*, vol. 60, no. 2, pp. 163–177, 2012.
[41] *Small and Medium-Sized Enterprises: Characteristics and Performance*, 2010. https://www.usitc.gov/publications/332/pub4189.pdf.
[42] Specht, G., Beckmann, C., and Amelingmeyer, J., *F- & -E-Management: Kompetenz im Innovationsmanagement,* 2., überarb. und erw. Aufl. UTB für Wissenschaft. Stuttgart: Schäffer-Poeschel, 2002.
[43] Storm van's Gravesande, B., *Internetbasierte Anwendungen in der FuE-Kooperation: Eine empirische Analyse basierend auf der adaptive structuration theory,* 1. Aufl. Gabler Edition Wissenschaft: Marktorientierte Unternehmensführung und Internetmanagement. Wiesbaden: Dt. Univ.-Verl., 2006.
[44] Strietzel, M., *Unternehmenswachstum durch Internationalisierung in Emerging Markets: Eine neo-kontingenztheoretische Analyse.* Schriften zum europäischen Management. Wiesbaden: Deutscher Universitätsverlag, 2005.
[45] Thommen, J.-P., *Betriebswirtschaftslehre,* 4. Aufl. Zürich: Versus, 1996.
[46] Wahyuni, S., Ghauri, P., and Karsten, L., "Managing international strategic alliance relationships," *Thunderbird Int'l Bus Rev*, vol. 49, no. 6, pp. 671–687, 2007.
[47] Welsch, C., *Organisationale Trägheit und ihre Wirkung auf die strategische Früherkennung von Unternehmenskrisen,* 1. Aufl. Gabler Research. Wiesbaden: Gabler, 2010.
[48] Wendt, T. F., Shirokinskiy, K., and Behl, J., *Embracing the Silicon Valley Challenge.* Palo Alto, 2016. http://www.rolandberger.de/media/pdf/Roland_Berger_US_Supplier_Study_Q1_2016_final_20160106.pdf.
[49] Zillig, T., "Neue Organisationsformen - Theoretische Grundlagen - Entwicklungstendenzen - Forschungszentren - Experteninterviews," 2003.

INTERVIEW GUIDELINE

1. Introduction
- 1.1. Declaration of Consent
- 1.2. Description of research project

2. Character of SME/start-up
- 2.1. Basic company information (Foundation date, No. of employees, equity distribution…)
- 2.2. Who are the major shareholders?

3. Interviewee´s relation to the SME/start-up
- 3.1. When did you join this company?
- 3.2. Why did you decide to found/work for this company?
- 3.3. What is your current job title in this company?
- 3.4. Are you a founder of the company?
- 3.5. Do you own shares of the company?
- 3.6. What do you like about being part of this company?

4. Collaborative activities of the SME/start-up
- 4.1. Tell me briefly about collaborative activities between your company and other companies.
- 4.2. How many of these collaborative activities were in R&D?
- 4.3. Please tell me briefly in how many collaborative R&D activities have you been personally involved and how?

5. Information about the observed cooperation
- 5.1. Please select one specific instance of collaborative R&D of your company, preferable in which you have been involved.
- 5.2. Please tell me briefly about it. (Start, end, partners, goal)
- 5.3. Was the cooperation successful?
- 5.4. Did the cooperation happen mostly at your company, the partner´s company or a neutral area?

6. Prior to the cooperation
- 6.1. Would you please state the mission and strategic objective of your company before the cooperation?
- 6.2. How did you expect this cooperation will help to achieve your company goals?
- 6.3. Did your company intentionally pick this partner after comparing to other possible candidates?
- 6.4. If no, why do you think they entered into this cooperation?
- 6.5. For what partner characteristics was your company looking for?
  Please rank from 1 = most important to 5 less important.
  (Cooperation experienced, high R&D investments, complementary capacity or knowledge, presence in target market,

adapts to your company´s processes)

7. Benefits from the cooperation

7.1. Did your company gain **knowledge** during the project? What kind of knowledge or know-how?

7.2. How important was the knowledge gain for your company? Why?

Very important	Important	Less important	Not at all important	No answer
4	3	2	1	

7.3. Would you say your company reduced **costs** during the cooperative R&D compared to in-house R&D projects? Where especially?

7.4. How important was cost reduction for your company?

Very important	Important	Less important	Not at all important	No answer
4	3	2	1	

7.5. Did the cooperation lead you to reduce **the risk of product development**? How?

7.6. Did the cooperation lead you to reduce **financial risks**? How?

7.7. How important was risk reduction for your company?

Very important	Important	Less important	Not at all important	No answer
4	3	2	1	

7.8. Did the cooperation allow your company to receive **public funding**?

7.9. Did every partner pay their own costs or were funds for this project transferred?

7.10. If yes, can you provide information about what your partner supported during the cooperation?

7.11. How was the **allocation of resources** decided? (Money and people time)

7.12. Did you receive **licenses** from your cooperation partner and or did you give your partner licenses as part of the cooperation?

7.13. Who received the **ownership of IP** created within the cooperation?

8. Retrospective view

8.1. Was the cooperation a good thing for your company? Why?

8.2. Did your company´s business plan change through the cooperation? How?

8.3. Had this cooperation any impact on your plans for exit?

8.4. How did your job change during the cooperation?