

14th CIRP Conference on Intelligent Computation in Manufacturing Engineering, CIRP ICME '20

Investigation of the “lean startup” approach in large manufacturing companies towards customer driven product innovation in SMEs

Isabella Jesemann *, Tim Beichter, Carmen Constantinescu,
Klaus Herburger, Marc Rüger

Fraunhofer IAO, Allmandring 35, 70569 Stuttgart, Germany

* Corresponding author. Tel.: +49 711 970 5453. E-mail address: isabella.jesemann@iao.fraunhofer.de

Abstract

The agile product innovation method *Lean Startup Approach* is used by startups to quickly adapt to the fast changing market conditions and customer needs. The authors carried out a preliminary study which showed that global challenges such as digital transformation are urging companies to become more dynamic and flexible, and that this method is already used by large companies to meet the needs. Based on the preliminary study, the authors conducted in-depth interviews with experts to examine the procedure for introducing the Lean Startup Approach in large manufacturing companies, and examined the feasibility of applying the method to SMEs..

© 2021 The Authors. Published by Elsevier B.V.

This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by-nc-nd/4.0>)

Peer-review under responsibility of the scientific committee of the 14th CIRP Conference on Intelligent Computation in Manufacturing Engineering, 15-17 July 2020.

Keywords: Innovation; lean startup; Customer driven production; SMEs

1. Problem statement and overall objective

The world is currently experiencing global changes and challenges in unprecedented speed. Digital Transformation, climate changes or social inclusion have a huge impact on our life and concern all industries. Global competition, rapid market changes and the need for more and faster innovations lead to a new risk situation for companies. Even though challenges like that pose a risk for companies of all sizes, SMEs are especially exposed and vulnerable.

As dynamics increases, the reliability of success forecasts decreases and many of the product design innovations launched on the market fail. This is forcing companies to innovate more and faster. News about bankruptcies of former global players and market leaders make visible that there is a need of change in the way how companies deal with new ideas and how they manage innovations.

Traditional methods such as V- Method or Waterfall-Method are complicated as well as time consuming, expensive and inflexible. [1] Sadly, it is becoming increasingly common for manufacturing companies to find that, despite well-founded market research at the beginning of the process, the customer

does not want or need the new product, because until the product is on the market, the market needs have change. [2]

To reduce the risk of failing customer needs, agile processes and iterative product design are of enormous importance. It is crucial to constantly check whether the products meet the demand of the market and to design the product in a variable way, so that changes can be taken up immediately and learning effects can be implemented. Therefore, companies are forced to use new methods of innovation that allow faster and more customer oriented product development.

One such method is the Lean Startup Approach. This method is based on a constant customer feedback, iterative testing of prototypes and continuous improvement through learning. Originally, it was established as a way of product development for startups, which need a very fast and effective way of product development and are therefore forced to optimise their initial market approach through iterative testing of prototypes and continuous improvement through learning from customer feedback.

In order to deepen this idea and in order to confirm the initial hypothesis that the Lean Startup Approach can be applied to large companies the authors carried out a preliminary study, in which specialist literature was used to demonstrate

that the Lean Startup Approach can also be successfully applied to larger manufacturing companies.

To support this assumption, three global companies (Daimler AG (Germany), General Electrics (USA) and Alibaba (China)), which have already integrated the Lean Startup Approach into their existing product innovation processes, were examined and challenges and opportunities were identified. The investigation showed that all three companies achieved great success using this approach as it enables them to react more flexible to external influences, such as market competition, new technologies or economical shifts, due to a fast and direct reaction to the experiences based on customer dialogue.

2. Approach and research methodology: overview

2.1. Hypothesis and procedure

Upon confirmation that the Lean Startup Approach works both in startups and in large companies the authors established the hypothesis that this innovation method can deliver an important contribution to the product development process in SMEs and thus influence their innovation potential positively. If this transferability is possible, the Lean Startup Approach could be an innovation method applicable to companies of any size.

The authors state that manufacturing companies using the Lean Startup Approach will be able to react flexibly to market situations, as well as to innovate their production process, which can lead to a faster production process.

In order to find out how the Lean Startup Approach can help manufacturing companies become more agile, flexible and faster, and for the sake of gaining the best possible insight of the topic the authors defined a methodology of investigation in four main phases:

- **Phase I:** Preliminary study aiming at definition of the research goal and determination of the research method, furthermore a literature research regarding state of the art of the research topic and identification of challenges, chances and possible benefits.
- **Phase II:** Expert interviews to examine in detail the procedure for introducing the Lean Startup Approach in their company. Description of the Lean Startup Approach in its qualities and possible applications. Transfer of the research results of the preliminary study and the findings from the expert interviews to the needs and circumstances of SMEs.
- **Phase III:** Conception of a method for customization of the Lean Startup Approach to SMEs. Pilot-implementation of the concept with a selected medium-sized company and evaluation.
- **Phase IV:** Final works: Validation, refinement and final conclusion. Publication.

In the following the authors present the results of the second phase of the study consisting of a performed empirical study with field investigation aiming at validating the above stated hypothesis and delivering a concept for the migration of the Lean Startup Approach to SMEs.

2.2. Approach and methodology

The authors chose qualitative expert interviews as primary data gathering method to collect information regarding experiences, convictions and opinions from experts, who have applied the Lean Startup Approach in large manufacturing companies. This method is particularly suitable for gathering background information and tapping into an expert's knowledge of a particular subject.

In accordance with Adams [4] interviews can generally be placed on a continuum of structure, from “unstructured” to highly “structured.”, which represents the amount of “control” the interviewer will have over the interaction. [4] Following the method also described by Harell et al [3] Adams [4] and Ahlin [5] the research group used semi-standardized interviews to identify specific qualitative characteristics of respondents on the same topics and to find out about the different individual experiences with the implementation of the Lean Startup Approach. Conducted in form of a conversation with one respondent at a time, this interview method employs a blend of closed- and open-ended questions, often accompanied by follow-up “why” or “how” questions. The interviewers used an interview guide with topics and questions that had to be covered, and which had been asked of all respondents. Even though the dialogue could meander around the topics on the agenda and delve into totally unforeseen issues, the main questions were always asked and answered.

In order to qualify as an experts the interview partner had to meet three criteria:

- They had to be employees of a large company,
- They had to be occupied in a leading position with the topic “innovation”. And
- The company had to use Lean Startup Approach at least as one of the components in their innovation method portfolio.

For the evaluation, the experts were anonymized. Figure 1 shows a list of all interviewed participants with their assigned identification number, gender, position and time in the organization.

Gender	Time in company	Department/Position	ID
Male	5-10 years	Digital Strategy Development	E1
Male	<5 years	Business Model Design	E2
Female	5-10 years	Strategy Development and Innovation Management	E3
Male	>10 years	Lean Startup/Agile System Development	E4
Male	>10 years	Employee Innovation Programs	E5
Male	<5 years	Digital Service Innovation	E6
Female	5-10 years	New Work	E7
Male	>10 years	Startup accelerator	E8
Male	>10 years	Employee Innovation	E9
Male	>10 years	Global Portfolio and Investment Management	E10
Male	<5 years	Intrapreneurship	E11
Female	5-10 years	Innovation and Portfolio Management, Intrapreneurship	E12
Male	>10 years	Innovation Center	E13
Male	>10 years	Continuous Improvement	E14
Male	<5 years	Innovation Lab	E15

Fig 1. Expert overview

These criteria were important to determine the benefit of the Lean Startup Approach in large companies, in order to determine a possible transferability of the Lean Startup Approach to SMEs.

The experts came from a wide range of industrial sectors. It was important to choose experts from a wide range of industrial sectors in order to find out if the method is applicable to all sectors.

In the following all subsequent expert statements are provided with the corresponding identification number and can thus be assigned directly.

3. Research output: phase II

3.1. Study overview

Over a period of two months, 15 expert interviews were conducted with various companies worldwide. The expert interviews were conducted by telephone in an open exchange. The time frame of the interviews varied between 20 and 60 minutes. The interviews were recorded and subsequently transcribed. An analysis of the interviews was then prepared on the base of the transcripts. Commonalities in content were identified and the respective statements of the interviewees were compared with each other. Existing structures were uncovered and evaluated. The semi-standardized expert interviews were afterwards evaluated with the focus on customer interaction in the Lean Startup Approach.

Since the expert interviews were conducted in an open exchange and many different topics were discussed, the object area was limited to five main topics within the scope of this study. These main topics were:

- Motivation for the introduction of the Lean Startup Approach.
- Presentation of a Minimum Viable Product (MVP).
- Involvement of the customer in the product development process.
- Customer interaction.
- Applicability of the Lean Startup Approach to SMEs.

In addition to the five main question groups, over 60 supplementary questions were formulated and divided into the various sub-themes of the research topic. In this way, it was possible to ask questions that matched the direction in which the conversation with the respective expert had developed.

3.2. Output expert interviews

In the following, the content of the expert interviews will be examined focusing on the importance of the customer in the innovation process. For this reason, the authors carried out a qualitative analysis, that highlights individual positions and examine the corresponding citations.

3.2.1. Motivation for the introduction of the Lean Startup Approach

One of the reasons why companies gave consideration to the Lean Startup Approach was that the methods of product

development used until then have become disappointing and frustrating. Expert 3 commented on this:

“We [...] do have engineers who put in so much detailed work and then develop a really great product and then notice that [...] nobody needs it.” (E3)

Thus, the goal was to find a faster and more reliable way to test as many ideas as possible. Companies needed an approach who to implement ideas at high speed and in high quantity, expert 3 pointed out.

“We needed an approach that would allow us to test very quickly, very many [...] ideas.” (E3)

Expert 15 explained that the traditional innovation methods, like the waterfall-method or the V-method, had become too slow and too rigid for the companies. Therefore, a change in innovation methods had to be made and the Lean Startup Approach was considered.

“[With] waterfall and [...] project management oriented models, [you] realized that it all takes a very long time if you stick with these models.” (E15)

Expert 1 brought out a third argument besides reliability and speed: the costs. He stated that agile innovation methods, especially the Lean Startup Approach, had been introduced in his company to test ideas faster and cheaper. These properties gave agile innovation methods a clear advantage over traditional innovation methods:

“What was hoped for from more agile and lean methods in the field of innovation was that through exploratory approaches, [...] one could easily [innovate] very, very quickly and above all very, very cheaply. [...]” (E1)

Speed pays off for companies in various ways. Since the Lean Startup Approach makes it possible to test a lot of ideas very quickly and very cheaply, companies were able to take advantage of this and place products on the market earlier than their competitors, claimed expert 5.

“Just because it is rapidly, it provides us an opportunity to go and get things in front of the customer or partner or somebody very quickly.” (E5)

Expert 10 ultimately confirmed that the Lean Startup Approach has accelerated the innovative product development process in his company by weeks, often months:

“When we started the new process, development was shortened by months.” (E10)

The authors see all this statements as confirmation that the Lean Startup Approach is of great importance for the innovation process of large companies in terms of reliability, speed and costs.

3.2.2. Presentation of a Minimum Viable Product (MVP)

The MVP is a first unfinished product design, sometimes in a partly primitive stage of development. In the process of the Lean Startup Approach the idea of presentation of a product in a very early stage is of great importance. At the time of presentation to customers, the MVP might still be just a rough visualisation. In the course of the interviews many experts stated, that the companies were highly concerned regarding presentation of a product in such an early state. As employees are usually trained to give the customer the best possible impression about their product and to cover up potential defects, so it proved difficult to present unfinished and *not yet perfect* products.

Existing brands and a reputation built up over the years often make it difficult to use a method in which a product is presented to the customer that, due to its type of prototype, does not come close to the classic standards of the company. Experts 9 and 11 claimed, that the concern to damage the reputation of a brand already built up was the main issue for the employees. They feared that customers could misinterpret the MVP for a real product, which could ultimately have a negative impact on the company's image.

“It is always a topic that companies are afraid of approaching customers [...] with half-finished products, because [...] a corporate has a completely different brand risk than a startup.” (E11)

“There is a lot of issue behind our brands and you do not risk brands that have taken in some cases a hundred years to develop.” (E9)

However, experts 4 and 3 stated, that through open and honest communication in which they explained that the product actually is in an early stage as the goal of the method is learning from customer feedback as well as iterating and improving the product based on that feedback, the understanding of the customers grew considerably.

“When you go to the customer and say we want to listen to you first, we want to learn from you [...] the door is wide open and it is always incredible how much the customers talk.” (E3)

“They are already prepared [...] for the fact that it is not really about the finished product, but that it is more about learning from the customers.” (E2)

Therefore, to the authors it seems advisable to be well prepared for the presentation of the MVP and undergo special training before doing so as well as preparing the customer.

If concerns of damaging the brand are still severe, expert 9 suggested to carry out the presentation of the MVP anonymously, so that no damage to the company would be done.

“They will not necessarily know if it is a [corporate name] product they are [testing] or not.” (9)

3.2.3. Involvement of customers in the product development process.

Expert 6 observed that the ever-recurring emphasis on the practical aspect of the Lean Startup Approach was very close to the experts' hearts. Since customer contact is very important in the Lean Startup Approach, to get the necessary opinions from customers and to react to them, employees need experience in dealing with customers which they only can gain in practice:

„Lean startup has a lot to do with experience, because you get out of the comfort zone pretty quickly. As opposed to sitting behind the computer and building slides forever, you have to get out and get feedback at some point. So it's an experience.“ (E6)

Statements by experts 11 or 15 show that the involvement of the customer may contribute to strengthen the relation between company and customer.

“The customers react great, of course. [...] Especially because people like to share their opinion.” (E11)

“[Customers] usually [react] positively, so most of them find this very pleasant, because [...] we have [...] topics that are very new [...] and in this way they were involved very early on.” (E15)

Most experts suggested that customers reacted positively on being involved into product development, were happy to contribute and felt honoured for being consulted.

An open communication with the customer creates understanding and solidarity which only can be beneficial in the future.

Nevertheless, some experts (like expert 7) also experience negative customer reactions.

“We also have had very different experiences with customers. We had a workshop where the customers also said, “Say, what am I actually doing here when I develop my product together with you?” (E7)

According to expert 2, it is also much easier if the customer already knows the method and uses it himself.

“The fear [...] is not there to test a minimal viable product on a customer, because [...] our customers also start [...] lean startup [...] so [it] is much easier for them to understand.” (E10)

Well-trained and prepared employees seem to be especially important to approach customers differently and clarify their role in the process, without raising false or too high expectations. Therefore, the authors suggest that a part of the preparation for the customer presentations should be dedicated to training for such situations.

3.2.4. Customer interaction

Many experts emphasized that the customer interaction was extremely important. According to the experts, companies should find the courage to send their employees out and let them interact with customers as often as possible. To guarantee the customer contact, some companies have defined how many customers the respective teams have to talk to. This was up to 100 customers in eight weeks, as reported by expert 3.

“The teams must conduct at least 100 customer interviews in [...] eight weeks.” (E3)

Such statements make it obvious how time consuming a procedure that is which requires appropriate resources. The employees and teams need sufficient working time to maintain this customer contact. Expert E13 suggested the employees being freed from their daily routine tasks, allowing them to focus on the new task connected with the Lean Startup Approach relevant customer interaction.

“But in order to have this [...] team [...] you need to be able to release them from their daily job to allocate time on applying the lean startup and discussing with customers [...].” (E13)

The experts have come to this conclusion through their innovation work, as customer contact proved too valuable. If companies do not maintain close customer contact, this can lead to the failure of an idea. Expert 15 stressed that if an apparently innovative idea does not manage to enter into a customer dialogue, the idea will usually not evolve.

“So the ideas that went really badly, even if the ideas were good, [...] were those due to a lack of customer focus. [If] the idea does not manage to talk to a customer in [...] 6 months [...], be it an internal customer or an external customer, then it won't be successful in general.” (E15)

Companies must therefore be prepared to provide employees with sufficient working time for customer contact.

All the same expert 12 warned against overstretching the Lean Startup Approach. The company must be careful not to flood the customer with too much information and only assign him doable and meaningful tasks. Therefore, companies should be careful not to overburden the individual customer and make everyone feel part of the development process:

„You don't do [lean startup] too inflationary and too spam, it is [a great] form of customer retention, if you give them the feeling of being cocreative. [...]“ (E12)

3.2.5. Applicability of the Lean Startup Approach to SMEs.

The experts confirmed that Lean Startup Approach intended for startups worked well also in large companies. Thus it was of great interest to the authors whether the experts believed in the success of the Lean Startup Approach being transferred to SMEs. As SMEs have fewer human and financial resources

than large companies the question arose if that could be an obstacle.

The experts did not see a disadvantage regarding the size of a company while implementing the Lean Startup Approach. Some experts like expert10 and expert14 believed that the SMEs could benefit from the smaller size, in terms of shorter way of communication and less distinctive bureaucratic processes.

“I think [the Lean Startup Approach] would work much better for SMEs than for a large corporation [...].” (E10)

“Lean startup fits SMEs incredibly well and even better than large companies.” (E14)

Expert 10 was confident that the transferability of the Lean Startup Approach to SMEs would not only succeed, but would work even better for SMEs than for large companies because in his opinion strict administrative processes make it difficult for large companies to use an innovation method such as Lean Startup Approach effectively.

“A corporation is already very, very complex and the decision-making processes can be very complicated. And the most important thing about lean startup [...] is that the people who have to work on the project have the authority to make decisions, not wait for [a decision from] the 120th floor.” (E10)

According to expert 11 some of the companies have already started Lean Startup Approaches with SMEs of different sizes, and the practical results were positive:

“We have several SMEs with us. Starting with one SME with 100 people, up to 1000 people. And it works, it works great!” (E11)

From this, the authors interpret that the application of the Lean Startup Approach is possible for SMEs.

4. Study results

In conclusion, the Lean Startup Approach offers many possibilities to companies. In that, it contains some answers to the urgent issues of the time, not only to large companies or startups but also to SMEs. For one the Lean Startup Approach does accelerate product development, while it makes innovation processes cheaper, more flexible and more reliable.

Through testing and validating the product in a very early stage of development, products that will not work on the market can be spotted much earlier than with traditional innovation methods and excluded from further development. Because of that, the risk of developing costly and time-consuming products can be reduced, making the Lean Startup Approach a safer innovation method than most previously used methods.

Another positive aspect is the possibility to apply the Lean Startup Approach in any industry. While many companies and startups use the Lean Startup Approach for software development, our investigation of experts from many different industries suggests that it can be successfully used in traditional

production, too. However, in order to implement Lean Startup Approach companies need to be ready to change their corporate philosophy as well as their structures to allow for more flexibility.

Because customer involvement is crucial for applying the Lean Startup Approach, there is great need for training employees regarding engaging, communicating and interacting with the customers. The authors have also learned, that a solid preparation for the presentation of an MVP to the customer is crucial for succeeding. A well-informed customer can make the difference between getting much needed customer feedback or failing to do so.

The interviews have shown, that beside the obvious benefits of getting customer feedback, successfully conducted customer involvement can also lead to a rise in sympathy towards the company and improve customer relations. A large preexisting customer is advantageous but is not crucial for applying the Lean Startup Approach, as during the process, new customers can be gained. As a result, a time-intensive and profound customer contact must be established, continuously cultivated and maintained. This absorbs capabilities what may be a challenge especially for smaller companies.

Nevertheless, the experts agreed that the Lean Startup Approach can be successfully implemented in companies of any size and provide some concept suggestions on how SMEs could establish the method.

The Lean Startup Approach fulfils necessary criteria such as customer feedback which should be integrated in any modern innovation process as a essential part of it. If a flexible and iterative approach is supported, these necessary criteria can be obtained and additionally the full potential of the existing customer base can be exploited.

5. Conclusions and next steps

Due to various global challenges, companies are forced to keep up with rapid market changes and reliably establish a product or service on the market that is both wanted and needed by customers. As dynamics increases, the reliability of success forecasts decreases, and many product design innovations fail.

An innovation that has failed on the market can threaten the existence of companies in particular SMEs, since they can usually spend only limited resources – in financial, human and material terms – on the development of new products.

In order to strengthen the innovation potential of SMEs, this research work considers the Lean Startup Approach, which intends to accelerate the agile innovation process and produce a safe product through fine-meshed customer feedback, as a promising chance.

To verify the hypotheses, that the Lean Startup Approach can be migrated to manufacturing SMEs and influence their innovation potential positively, the authors collected

information about procedures, beliefs and opinions from 15 experts, who applied this approach in large manufacturing companies worldwide. The following is a summary of the most important outcomes that occurred during the establishment of the Lean Startup Approach in large companies:

- In many cases the product development process was shortened by months and a sustainable connection between customer and company was established. The product was more likely to be accepted on the market and the development costs went down.
- A time-intensive and profound customer contact, had to be maintained, what absorbed great capacities and which is considered as potential challenge in smaller companies.
- Involving the customer in the development process, helped immensely to save time, work and costs.
- Many experts believe, that the Lean Startup Approach can work well for SMEs despite the smaller resources than for large companies. The smaller size can even be an advantage due to less bureaucratic hassle and shorter communication channels.
- The Lean Startup Approach can be applied to companies of all size and in any sector.

After this theoretical customization, the research team is now moving to phase 3 which will consist of the elaboration of a conception to migrate the lean-startup-approach to a SME.

This conception will form a guideline for a pilot phase consisting of implementation of the conception in a selected middle-size company. A subsequent evaluation of the outcome will provide the conclusion of the large scale study on the impact of Lean Startup Approach to increase innovation in SMEs

Questions to be answered is, if the Lean Startup Approach is relevant for the process of increasing innovation potential and simultaneously cutting the duration of the innovation process? And to which extend can it be considered?

In the last phase a validation, refinement, and final conclusions as well as a publication are planned.

References

- [1] Eckert R., Lean-startup in Konzernen und Mittelstandsunternehmen Ergebnisse einer Expertenbefragung und Handlungsempfehlungen; 2017. p. 1-3.
- [2] Lehnen J., Hoch J., Scholz V. Mit schlanken Strukturen so agil und kreativ wie Startups arbeiten https://www.projektmagazin.de/artikel/mit-schlanken-strukturen-so-agil-und-kreativ-wiestartups-arbeiten_1129994#paywall-cut-off; 2019.
- [3] Harrell M., Bradley M. Data Collection Methods - Semi-Structured Interviews and Focus Groups; 2009.
- [4] Adams W., Conducting Semi-Structured Interviews; 2015.
- [5] Ahlin E., Semi-Structured Interviews With Expert Practitioners: Their Validity and Significant Contribution to Translational Research; 201