INTERNATIONAL DESIGN CONFERENCE - DESIGN 2016
Dubrovnik - Croatia, May 16 - 19, 2016.

# THINK.MAKE.START. - AN AGILE FRAMEWORK

A. Böhmer, C. Richter, R. Hostettler, P. Schneider, I. Plum, D. Böhler,
U. Lindemann, J. Conradt and A. Knoll

*Keywords: makerspace, prototyping, agile, open innovation ecosystem, makeathon*

## 1. Motivation

Nowadays technology has a very short life cycle due to rapid technological innovation. The challenge of innovation is about getting technology to market more quickly. A company usually operates in a culture driven towards efficiency rather than creativity. The business's long term sustainability is determined by its ability to address a constantly changing market and rapidly changing economic environment.

Until recently developing new products was about specifying the offering, assembling a team, and going into stealth mode for designing, building, and manufacturing. It has been identified that a certain degree of flexibility for the innovation processes is of great advantage. New linear models have been designed, comprising softer overlapping phase transitions. Latest models tend to be more flexible and involve agile frameworks [Link 2014]. According to Vetter [2011], there are two main perspectives regarding the innovation processes: object-specific and context-specific. A pure phase and context consideration within innovation process models is no longer appropriate. The approach shifts from purely linear and sequentially to iterative and collaborative.

Agility is the capability to react, and adopt to expected and unexpected changes within a dynamic environment constantly and quickly; and to use those changes (if possible) as an advantage [Böhmer et al. 2015]. A framework compromises the space in which a project team can act free and continuously improves itself [Brandes et al. 2014]. An agile framework comprises agile values and principles as well as methods, which are commonly coupled through a process.

Morris et al. [2014] replace the word "software" in the Agile Manifesto with "innovation" and thus transfers the agile approach to the development of innovations.

An idea never emerges in isolation, and the rate of innovation is a function of the number of people connected and exchanging ideas [Bakker et al. 2006]. Ecosystems are part of the so-called Open Innovation 2.0. This new paradigm bases on principles of collaboration, co-created value, exponential technologies and a culture of exceptionally fast acceptance [Curley and Salmelin 2013].

An Open Innovation Ecosystem (OIE) comprises aspects of Open Innovation, Lean Innovation, and Innovation Labs [Böhmer and Lindemann 2015]. Main aspect of an OIE is the creative and open-minded community. One exemplary OIE are the Singularity University labs, an open innovation campus where large enterprises, startups and innovators come to use high-tech to create new business solutions [Singularity University 2014]. Another variant are Makerspaces, which may appear as simple public workshops, but have many characteristics of an Open Innovation Ecosystem (see Figure 1).

Makerspaces are community-focused high-tech workshops where innovative people meet, socialize, collaborate, and work on new ideas or do-it-yourself projects. New science and relevant technologies are explored and makers can exchange their experience and ideas within a network of creative people.

It is an an adult playground for thinking and prototyping and boosts the innovation capability of its community. The maker movement is also known as the silent new industrial revolution [Anderson 2012].

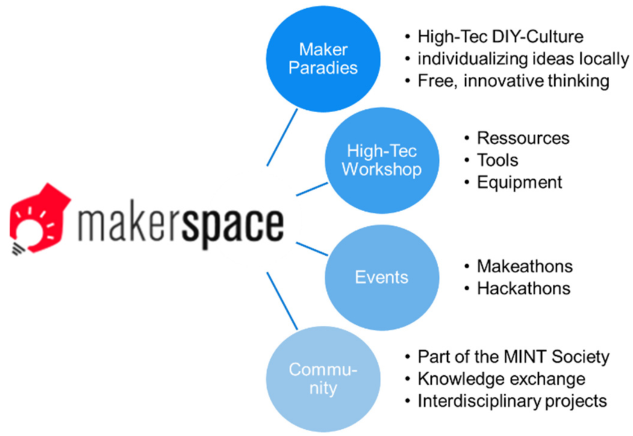


**Figure 1. Characteristics of a Makerspace seen as Open Innovation Ecosystem**

For both, large corporations and small startups the difficulty with most ideas is that they are not sufficient in their initial state. Building prototypes in an extremely quick and inexpensive manner, that accelerates the idea generation phase and increases the amount of ideas being developed. Hardware prototypes have several areas of application. They render abstract ideas tangible in the initial phase of an innovation process and thus provide a basis for discussion and reputations. Promoting ideas means also acquiring resources, gaining attention and facilitating the comprehension.
The objective of this paper is to outline the potential of an agile innovation framework within an OIE for physical product development. Therefore the educational course, Think.Make.Start., is analyzed. The concept is inspired by Makeathons among others and takes place at the MakerSpace of UnternehmerTUM. The course is composed of an interdisciplinary and creative community, as well as the idea to develop products quickly and iteratively. Based on the user feedback, the teams react flexible and adopt their ideas within an agile framework.

## 2. Background

Hackathons and its variants are increasingly emerging in the available literature, both as reported sources of innovation and as the topic of field reports [Lapp et al. 2007]. Innovation with digital technologies continues to emerge, and there are efforts to help nurture such innovation. According to Raatikainen et al. [2013], „a Hackathon is an event where people in small groups participate in an intensive prototyping activity for a limited amount of time."
The term Make-a-thon was used by Design and Innovation consulting firm IDEO describing an event similar to a Hackathon but differing in terms of participants and products [Zhang 2012].
Briscoe and Mulligan [2014] do not exclude hardware development from Hackathons so Hackathons and Makeathons are used synonymously in the following. Hackathons are a fast way to explore ideas with high technical and market uncertainties and decide whether an idea is worth following [Komssi et al. 2014]. Both events are encouraging of experimentation and creativity, and can be challenge orientated.
Komssi et al. [2014] propose a process for Hackathons, starting with the creation of ideas and team building. Ideas can also be gathered before the actual event, to have more time for concept development during the Hackathon itself [Komssi et al. 2014]. Teams are built by letting participants choose which idea they want to follow, based on the participants' interests and skills [Briscoe and Mulligan 2014], [Komssi et al. 2014]. This is followed by a prototype development phase which can take several hours to a few days [Briscoe and Mulligan 2014].
After a set time prototypes are presented to an audience to show the implemented functions, that demonstrate the product's concept and its value [Komssi et al. 2014]. Technical feasibility is assessed

by testing the prototype's functionality. For obtaining information about the market acceptance the audience's reaction to the presentation can be seen as a first acceptance check. Longer Hackathons might include real costumer involvement. Subsequent to the Hackathon it is decided whether the idea is followed up or abandoned [Komssi et al. 2014].
Prototyping is used as a method within agile frameworks for implementation of iterative approaches. Cantone and Marchesi [2014] adjusted the principles of the Agile Manifesto from software development to the development of products that include physical components. Examples for the application of agile frameworks in physical product development is the development of a sports car for the X-Prize competition using Scrum and Kanban [Denning 2012]. Johnson Controls applied Scrum for development of car seats [Schröder 2014]. Another example is the development of a new category of bicycles at IDEO in cooperation with Shimano [Brown 2008].
While iterative prototyping is relatively simple to adopt in software development, producing physical prototypes is more difficult as it requires significantly more resources and planning. However, the possibilities to create physical prototypes have improved through rapid prototyping and development of affordable 3D-printers [Vetter 2011]. At the same time, the number of Makerspaces has increased offering nearly everyone the opportunity to work with professional machines and tools. DiResta et al. [2015] recommend using Makerspaces for prototyping because paying a small monthly fee is more favourable than purchasing the machines. Hatch [2013] calls this development the democratisation of hardware innovation.

## 3. Agile product development

First, it is to find out how agile frameworks and the Makerspace are used for physical product development within the innovation process. Second, the role of prototyping within the innovation process will be examined. Third, the purpose for agile product development principles is analysed.
Agility is the capability to react, and adopt to expected and unexpected changes within a dynamic environment constantly and quickly; and to use those changes (if possible) as an advantage [Böhmer et al. 2015]. Based on this definition, existing agile frameworks were identified [Böhmer et al. 2015]. To combine those agile frameworks a generic stage gate process is used – see Figure 2 [Link 2014]. Based on the formalised application of agile frameworks within the innovation process an integration of the frameworks is examined in practice.

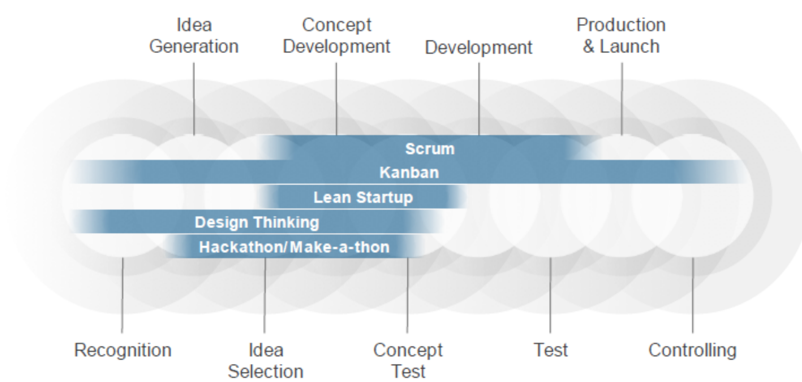


**Figure 2. Agile frameworks within the generic innovation process model [Böhmer et al. 2015]**

The integration of agile frameworks within the Think.Make.Start. course is done by extracting the relevant elements, needed to derive an agile product development process. The approach bases on Conforto et al. [2014], who adapted agile project management practices to other industries than software development, e.g. new product development projects.
Scrum is described as an iterative and incremental framework for projects and product or application development [Sutherland and Schwaber 2012]. The structured development process starts with Sprint Planning for each Sprint, Daily Scrums – brief daily team meetings during which the progress is analysed and the remaining hours of work are recorded –, Sprint Review and Sprint Retrospectives.
Kanban is here considered as an agile framework as suggested by Highsmith [2009]. There are no

predefined processes or roles in Kanban, but it optimizes the current processes by mapping them, limiting work in progress and eliminating waste [Anderson 2010].
Lean Startup follows the Build, Measure, Learn cycle which comprises the following actions according to Ries [2011]: First, hypotheses are defined. Value hypotheses make assumptions about a product's value to the customer, growth hypotheses about the way customers become introduced to the product. Next, a minimum viable product (MVP) is built as fast and as resource-efficient as possible only including features which are needed to test the hypotheses.
Design Thinking contains a process which comprises the phases understand, observe, define point of view, ideate, prototype and test, which are usually not passed linearly [Plattner et al. 2009].
Makeathons focus on iterative prototyping. After a set time the functions demonstrating the product's concept and its value will be presented [Komssi et al. 2014].
In contrast to linear or iterative process models, an agile model passes several process phases at the same time. Main aspect is to give priority to the innovation object within the innovation process. Instead of optimizing the process (e.g. Lean) or rather defining context-based process models (e.g. Open Innovation), the innovation process focuses on the characteristic of the prototype. Starting with just a vision, the minimum feature set is derived to build a prototype. This will lead to the first MVP and a user interaction. A complex product vision is broken down into doable product increments in order to implement it with less resources. Different types of prototypes can be used to test engineering- and business-driven hypotheses.
Prototyping without learning is a waste of effort. In contrast to software development, it is more difficult to produce physical prototypes as it requires significantly more resources and planning. Makerspaces enable individuals to use simple prototyping equipment like 3D printers and laser cutters, as well as working with professional machines and tools. Nevertheless, a certain degree of concept planning is necessary for physical product development. Changing or adding features may be accompanied by a rebuilding of the prototype, which is cost intensive and time consuming.
Having said this, an agile innovation framework needs to be complemented with a systematic approach regarding physical product development. They are used to gather relevant information about the abstract product vision and to manage the level of detail needed. Different types of prototypes may be used for specific feedback. A flexible product development may involve a high degree of modularization to facilitate add-on modules. On this account the happy medium between trial-and-error principles and systematic approaches is to find out (see Figure 3).

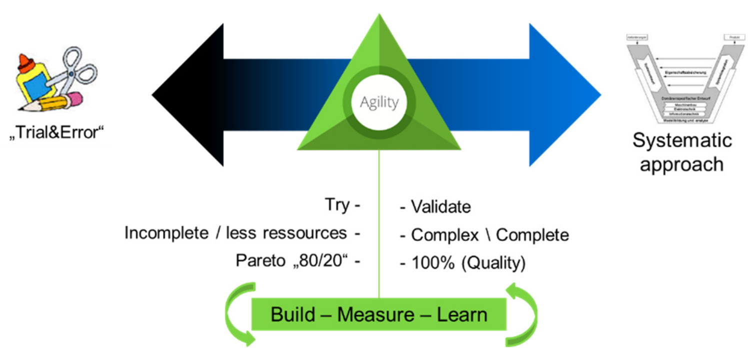


**Figure 3. Agility through prototyping**

The following methodology is a first step to derive an agile mechatronic product development. Systematic approaches, which are incorporated within the Münchner Vorgehens Modell (MVM) by Lindeman [2009], are used to manage the experimental agile product development. Besides a requirements list, a functional model and a building structure, the characteristics and usage of the prototypes will be analysed to study the evolution of the product.

## 4. Methodology

Think.Make.Start. (TMS) represents the process from idea to prototype; representing the phases from recognition to development or rather test. The agile product development has three main elements: 1)

early development of working soft-/hardware, 2) iterative prototyping and user tests and 3) flexible reaction on early customer feedback. To manage this experimental approach within the limited time frame of 14 days, there are two documentations, the students have to work with: Final Documentation as well as Validation and Progress Board (see Figure 5).
The final documentations are derived from the MVM and represent the product backlog of the Scrum methodology and aspects of MVP. Students need to think of a customer problem, business solution and a proper market. In addition, they start to acquire requirements, functions as well as the building structure of the product vision. These documents are revised during the TMS Makeathon from an abstract idea to a validated and detailed product. The Progress Board helps the students to manage the two weeks and helps not to lose track of the overall vision. It is used similar to the Kanban theory or rather a Scrum board with daily stand ups and reviews in the evening. Assigning tasks for each team member with a specific amount of time limits the work in progress. By mapping the process transparently, the students get a feeling for doable tasks within the limited space of time. The Validation Boards is mainly based on Lean Startup and helps to manage the experimental prototyping approach. For each Validation Board several hypothesises, presumed assumption as well as success criteria are defined. Proofing a hypothesis to be true or wrong is done by building a resource efficient prototype to test the created customer value. A prototype can be a paper prototype, a wizard-of-Oz prototype or rather a landing page. For each prototype the objective is to maximize the learning regarding the concept or value created during the Makeathon. As with Design Thinking, the students observe the user's interaction, empathize with him and restart the ideation. Over the course the final documentations get more concrete by opening up the solution space subsequent to focusing on a prototype.

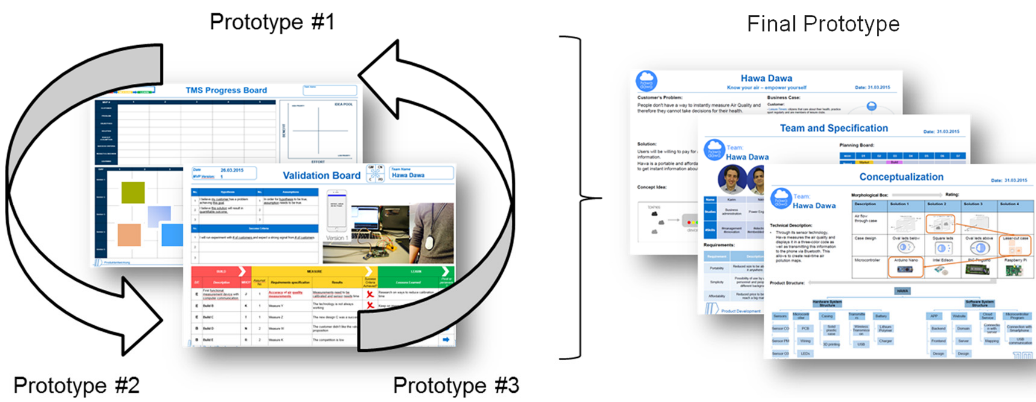


**Figure 4. Progress and validation board (left); final documentation (right)**

## 5. Think.Make.Start.

Think.Make.Start. is an interdisciplinary course for students at Technical University of Munich (TUM). With the course, TUM and UnternehmerTUM join forces in a complementary manner, enabling students to come up with great tech-driven ideas. The course strengthens the students' ability to actually implement their ideas themselves and to create a potential business around it.
The practical course brings together students from different backgrounds, such as Mechanical Engineering, Informatics, Computer and Electrical Engineering, School of Management as well as others (Physics, Communication Management, etc.). The objective of TMS is to realize own ideas and apply academic knowledge hands-on. Besides developing innovative mechatronic products, the students also design their own business. TMS is not focusing on creating new products from scratch, but rather on "hacking" existing products or technologies. The aim is to create new functionalities and find new use cases. Fostering tech-driven ideas is accompanied by a free playground to experience technology.
Each team consists of four to five students, from at least three different faculties. Coaches of the four different faculties support the student teams for the whole time frame. In addition, students get inspirational talks and feedback of industry experts and experienced entrepreneurs.
The course takes place over 14 days at the Entrepreneurship Center of TUM right next to the MakerSpace UnternehmerTUM GmbH. Main aspect of TMS is the role of prototyping or rather

presenting ready-to-use applications with limited resources and within a limited time frame. Students need to show their daily progress by presenting a working product increment. In contrast to business innovation models, TMS fosters tech-driven innovation and promotes an agile approach for physical product development. The business aspect is present but accompanies the development process in a hands-on approach: instead of working out an extensive business case, the students think of the relevant aspect and test their business driven hypothesis immediately with their prototype. Based on the feedback they persevere or pivot.

Think.Make.Start is an agile framework representing the process from idea to prototype by constantly acquiring feedback and iteratively developing product increments. As mentioned above, the agile framework is inspired by elements of the following approaches: Makeathons, Scrum, Kanban, Design Thinking as well as Lean Startup. Central aspect of the agile product development is the the Münchner Vorgehens Modell. It is used to gather relevant information from an abstract to a more detailed level.

In preparation for the course there are two pre-events, for getting to know technologies as well as the participants. This enables the students to get started immediately, knowing the participants' interests and skills. The first day of TMS starts with an ideation, where students come up with product visions based on the technology they have available. These include high-tech gadgets, like the Oculus Rift, AR Drones, leap motion, and also research technologies, like Roboy, or eDVS cameras.

Within the given timeframe students pursue a product vision and adapt this vision based on feedback and lessons learned. A notable distinction with respect to common product development approaches is the happy medium between systematically detailed methods and trial-and-error principles.

The characteristics of TMS or rather the agile model is illustrated in Figure 2 on the left. Instead of following on phase by another, agile means going through several steps of the innovation process at the same time. The approach is object-oriented and therefore focuses on several generations of a prototype. The prototyping process can also be seen as an iterative approach, enabled by the MakerSpace and the Maker community (illustrated on the right in Figure 2). The framework of TMS is characterized by time pressure, many ideas and the knowledge exchange of the participants. The accompanied coaches and network and the accessible know-how of the TMS community improves the agile model.

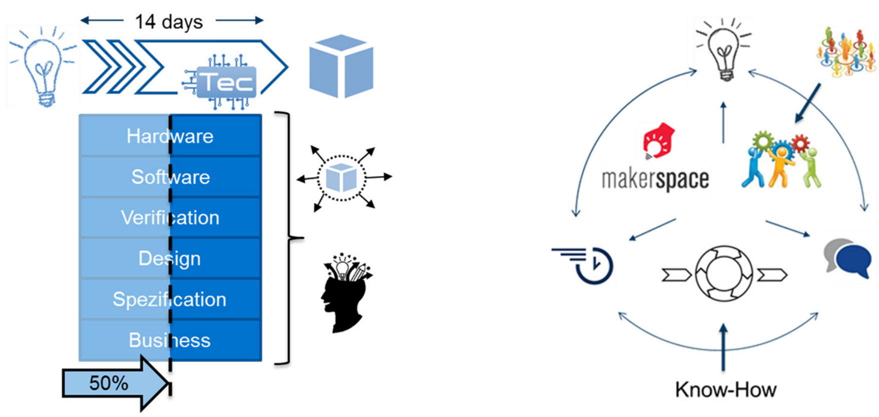


**Figure 5. Agile innovation model (left); characteristics of agile model (right)**

The documents presented above guide the students through this new dynamic, but structured design process. The progress board is used every morning for planning the day, define specific tasks and to present the progress in the evening. The content of the progress presentations can be pitches, prototyping insights, user feedback or project status. Every evening the students get feedback and ideas from the coaches and their fellows. The open knowledge exchange and the curious but critical community is main aspect of TMS. It promotes the mutual support of (un)experienced students with different skills. Physical ideas facilitate a clearer understanding of the ideas within an interdisciplinary setting.

The evaluation boards and the progress board helps to manage the experimental approach. It facilitates the handling of changes to their product vision or business idea. The dynamic product backlog, which leads to the final documents, enables a flexible handling of changes to the original idea. The Scrum methodology also implies giving the power to the team. Instead of implementing predefined tasks, giving by an instructor, the team itself defines the next steps and specifies the tasks to be achieved. The progress board always gives a transparent project status and facilitates the planning of the next days within the limited time frame.

## 6. Findings

The second TMS took place from 29.09. - 12.10.2015; 45 students participated whereof 10 were from School of Management, 6 from Electrical Engineering, 9 from Informatics, 16 Mechanical Engineering and 4 from others (e.g. Physics). Each team wisely made use of the different skills each team member had.

The first pre-event of TMS was a lightweight prototyping workshop to the end that the participants got to know each other. Similar to the principles of Design Thinking, the students also got used to simple forms of prototypes and the sense of making something physical. Traditional methods of product development like MVM helped the students to head towards their vision rather than getting lost within the experimental approach. The use of the Progress Board at TMS was very diverse: it was hard for the students to specify the assigned tasks. The major challenge was to estimate the needed time to fulfil a task. Most teams just assigned one task to each team member every day without a specific time estimation. Scrum principles are challenging to use for newcomers and requires a high level of discipline in order to affect the project progress significant.

In contrast the Build-Measure-Learn approach was accepted very fast and very good. Every team had a first simple prototype from day one of TMS. Dependent on the product complexity each team built up to five prototypes. The development of the prototypes was well supported by the use of MakerSpace. At the beginning of the innovation process the students mostly used simple tools like paper, dough and wood pieces to illustrate their idea. The following days, the use of rapid prototyping as well as laser cutters came in to play. Starting day five also professional equipment, like the lathe was used.

The characteristics of the prototypes reached from simple paper prototypes to professional looking design prototypes. Having a prototype as a communication objective was very valuable within the interdisciplinary team. Students also got good feedback from outside the building presenting simple sketches and design prototypes to a potential user. Think.Make.Start. promotes the mind-set to fail early, cheap, and fast. Every prototype can be assigned to the categories: explorative, communication, usability and design, and verification. Every type of prototype was important during each innovation phase, which can be referred to the object-oriented agile model.

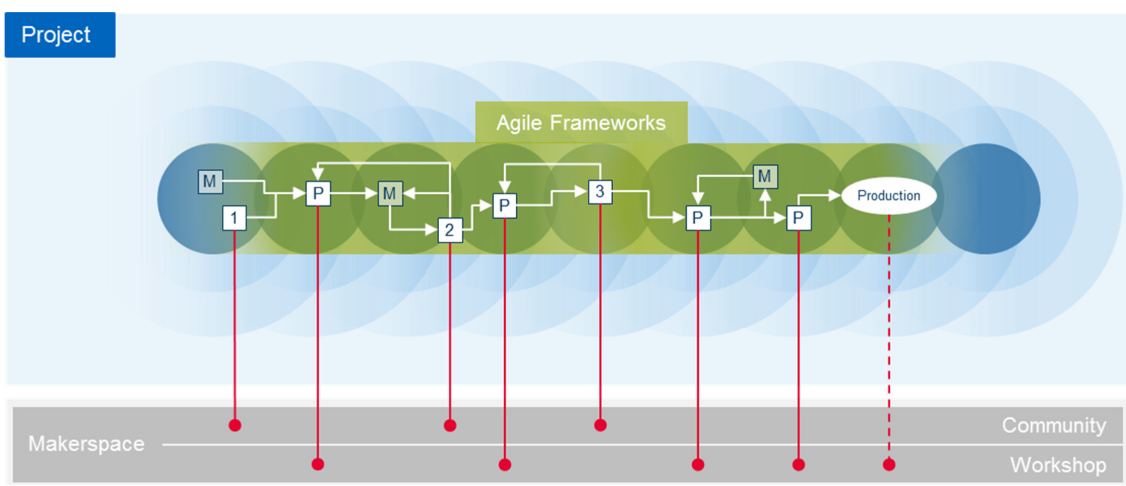


**Figure 6. Makespace within innovation process**

The use of Makerspace within the innovation process is illustrated in Figure 6. Prototyping ("P") can be seen as central method within the innovation process. Additional methods, like Brainstorming are part of the agile framework, but are not supported by the Makerspace. Methods, supported by the Makerspace are numbered and incorporate one or more methods (e.g. interview, observation, brainstorming):

1. The Maker community at Makerspace can be involved, to generate more ideas.
2. Results from the previous methods can be validated with the Makerspace community.
3. The maker community can be involved to user tests. Based on observation and interviews first learnings are gained.

None of the products had more than 8 main hardware elements and most of the teams used existing technologies (e.g. Arduino). All products have a low degree of product complexity which is traceable to the limited 14 days.

Three teams pivoted within the first three days. Open Up! for example started with the vision to track occupants in a parked car, switched to a car key sharing system for existing cars and ended up within the Airbnb market. Most interesting was the team Smartainers, since they were about to implement smart containers for the home application and shifted towards a smart inventory system.

In summary there are some constraints when transferring agile frameworks to a domain of physical product development. Breaking down development tasks, estimating time and resources for development activities is one main challenge. Another one is the delivering of a potentially shippable product increment. Building a physical product requires way more time than coding software. Being ready for changes during the development process is also very difficult. It either implies a highly modular product architecture a priori or requires a rebuild of the prototype. Plug'n'Play solutions like Arduino micro controller support the approach. With increased product complexity more inflexible technologies are needed, leading towards integrated product development.

The purpose for agile product development principles is to flexibly manage the process from an abstract idea to a detailed product increment. The increment can be used for a feasibility test, as well as market acceptance or design test. The biggest challenge within an interdisciplinary team are different perspectives and languages. Agile also means to master the creative chaos by not destroying it through processes or structures. This allows a team to quickly bring a working and presentable product increment to market and explore the interaction with a potential user. Failure is success when one learns from it; so pivoting is recommended when it guides the team towards the right direction.

The main fascination of Think.Make.Start. is to observe 14 days of enthusiastic work, within a free playground, with only a small budget, access to knowledge and the MakerSpace. The agile framework somehow unleashes a tremendous motivation within the TMS community. In the following the three winning teams are presented, giving an insight of the last Think.Make.Start. (see Table 1).

**Table 1.**

| Prototype | Customer Problem | Solution |
|---|---|---|
|  **Team 1 Open Up!** | Key sharing is often needed but only possible with a lot of effort. Especially in cases when you want to share the access to your apartment with other people, a key sharing device is needed. | Open Up is a lock box which can be opened with an app. Thus other people are enabled to get access to keys or other items stored in it. One use case could be the handing over of keys in context of Airbnb. |
|  **Team 2 Sign to Speech** | Hearing impaired persons have difficulties to communicate and express themselves in various situations during daily life. They are not able to listen and speak, therefore they use sign language, which cannot be understood by a normal person. | Sign to Speech provides a communication solution to hearing impaired or mute people. It empowers them to navigate every day social environments by translating gestures to speech. Thus it will give them a voice. |
|  **Team 3 Solemove** | Elderly are afraid to be on their own when going outside since they cannot be sure that somebody is around in case they fall. We identified independency and security as the customer's core needs. | Solemove inlay sole has an intelligent falling detection and emergency calling. All sensors are arranged inside the sole and therefore invisible. With its wireless charging system Solemove is an all-day companion on your journeys. |

## 7. Discussion and outlook

The use of Makerspaces facilitates the iterative prototyping within the innovation process of physical products. Based on a classification by Hallgrimsson [2012] the prototypes objectives were segmented into four main categories: explorative, communication, usability and design, and verification. Explorative prototyping aims at making ideas come alive, act as a proof of concept for ideas and give unexpected insights about an idea. The purpose of prototyping for communication is demonstrating the product to customers, investors, or using it as a model for product photos; for this appearance is given priority. Usability and design prototyping focuses on receiving feedback from users through analysing interactions with the prototype. Verification prototyping aims at verifying product specifications such as the functionality and ability to manufacture and assemble the product. Prototyping is a point of integration or rather consent during the whole innovation process and is an integral part of an open-minded process.

Prototyping can be used in nearly every phase of the innovation process, which makes it a determining element for the application of agile frameworks for the development of physical products. Iterative prototyping can be seen as core element of agile frameworks, and is supported by a Makerspace. A Makerspace is here characterised as a publicly accessible workshop which provides members with machines and tools and offers access to a creative community. This community can be divided into generalists and specialists regarding the members' knowledge. Generalists have a broad knowledge covering several disciplines, specialists have gained in-depth expertise in a single discipline. The community of a Makerspace can support several methods within agile frameworks. Members could attend brainstorming sessions, give interviews or can be included in user tests.

Further research will investigate the use of traditional product development approaches within the agile innovation framework. This will help to characterize the happy medium between the systematic approaches and a trial-and-error approach in detail. Staying innovative implies the capability to becoming agile. How to stay agile within a mechatronic development process is not been explored in detail, yet. Aspects like prototyping and coaching will be analysed in detail in cooperation with Stanford Design Education Lab. A deep analysis of the ME203 course will help to elaborate the factors within Think.Make.Start. framework.

This paper does not want to challenge or rather differ from other intensive programs that are being delivered globally. The objective is to present an approach for agile product development within a creative atmosphere.

### Acknowledgments

Great acknowledgments to Jan Behrenbeck, Ines Plum, Philip Schneider, Alexander Waldmann and Dominik Böhler from UnternehmerTUM for their support and enthusiasm. Furthermore, I would like to thank Christoph Richter and Rafael Hostettler of Technical University of Munich for their great and proficient support during TMS. We are thankful for the opportunities Helmut Schönenberger (UnternehmerTUM) gave us and the feedback of Sheri Sheppard (Stanford University) and the hard-working students, who joined her lab for research.

Besides Technical University of Munich, the Vector foundation, and the Zeidler research foundation funded TMS. In conclusion, a big thank you to Phill Handy and his MakerSpace team, who enables us to prototype quickly and access the maker community.

### References

*Anderson, C., "Makers: The New Industrial Revolution", Random House, 2012.*

*Bakker, H., Boersma, K., Oreel, S., "Creativity (ideas) Management in Industrial R&D Organizations: A Crea-political Process Model and an empirical illustration of Corus RD&T", Creativity and Innovation Management, Vol.15, No.3, 2006, pp. 296-309.*

*Böhmer, A. I., Beckmann, A., Lindemann, U., "Open Innovation Ecosystem: Makerspaces within an Agile Innovation Process", In: Proceedings of the ISPIM Innovation Summit, Brisbane, 2015.*

*Böhmer, A. I., Lindemann, U., "Open Innovation Ecosystem: Towards collaborative innovation", In: Proceedings of the 20th International Conference on Engineering Design (ICED15), 2015, pp. 1-10.*

*Brandes, U., Gemmer, P., Koschek, H., Schültken, L., "Management Y: Agile, Scrum, Design Thinking & Co.: So gelingt der Wandel zur attraktiven und zukunftsfähigen Organisation", Campus Verlag, Frankfurt am Main, 2014.*

*Briscoe, G., Mulligan, C., "Digital Innovation: The Hackathon Phenomenon", CreativeWorks London Working Paper, 2014.*
*Brown, T., "Design thinking", Harvard business review, Vol.86, June 2008, 2008.*
*Cantone, G., Marchesi, M., "Agile Processes in Software Engineering and Extreme Programming", Proceedings of the 15th International Conference - XP 2014, Rome, Italy, May 26-30, 2014, Springer Int. Publishing, 2014.*
*Conforto, E. C., Salum, F., Amaral, D. C., da Silva, S. L., de Almeida, L. F. M., "Can Agile Project Management Be Adopted by Industries Other than Software Development?", Project Management Journal, Vol.45, No.3, 2014, pp. 21-34.*
*Curley, M., Salmelin, B., "Open Innovation 2.0: A New Paradigm", 2013.*
*Denning, S., "How Agile can transform manufacturing: the case of Wikispeed", Strategy & Leadership, Vol.40, No.6, 2012, pp. 22-28. doi: 10.1108/10878571211278859.*
*DiResta, R., Forrest, B., Vinyard, R., "The Hardware Startup: Building Your Product, Business, and Brand", O'Reilly Media, Sebastopol, 2015.*
*Hallgrimsson, B., "Prototyping and Modelmaking for Product Design", Laurence King Publishing, 2012.*
*Hatch, M., "The Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers", McGraw-Hill Education, ISBN: 978-0-07182113-1, 2013.*
*Highsmith, J., "Agile Project Management: Creating Innovative Products", Second Edition, Addison-Wesley Professional, 2009.*
*Komssi, M., Pichlis, D., Raatikainen, M., Kindström, K., Järvinen, J., "What are hackathons for?", Software, IEEE, PP(99), 2014.*
*Lapp, H., Bala, S., Balho, J. P., Bouck, A., Goto, N., Holder, M., Holland, R., Holloway, A., et al., "The 2006 nescent phyloinformatics hackathon: a field report", Evolutionary Bioinformatics Online, Vol.3, No.287, 2007.*
*Lindemann, U., "Methodische Entwicklung technischer Produkte: Methoden flexibel und situationsgerecht anwenden", Springer Berlin, 2009.*
*Link, P., "Agile Methoden im Produkt-Lifecycle-Prozess - Mit agilen Methoden die Komplexität im Innovationsprozess handhaben", In: Schoeneberg, K. P., (ed.), Komplexitätsmanagement in Unternehmen, Springer Fachmedien, Wiesbaden, 2014, pp. 65-92.*
*Morris, L., Ma, M., Wu, P. C., "Agile Innovation: The Revolutionary Approach to Accelerate Success, Inspire Engagement, and Ignite Creativity", Wiley, 2014.*
*Plattner, H., Meinel, C., Weinberg, U., "Design Thinking: Innovation lernen – Ideenwelten öffnen", mi-Wirtschaftsbuch, München, 2009.*
*Raatikainen, M., Komssi, M., Dal Bianco, V., Kindstom, K., Jarvinen, J., "Industrial Experiences of Organizing a Hackathon to Assess a Device-centric Cloud Ecosystem", in: 2013 IEEE 37th Annual Computer Software and Applications Conference (COMPSAC), 2013, pp. 790-799.*
*Ries, E., "The Lean Startup", Crown Business, September 2011, 2011.*
*Schröder, A., "Scrum Like It Hot!", In: Der F&E Manger (01/2014), available at <http://2015.agile-pep.we-conect.com/de/media-center/>, retrieved 26.07.2015.*
*Singularity University, "An Overview for the Kansas City Chamber of Commerce", [online], 2014, available at <http://www.kcchamber.com/KCChamber/media/Media/PDFs/2014LeadershipExchange/SingularityUniverstiy-ExponentialLearning.pdf>, 2014, [Accessed 01.12.14].*
*Sutherland, J., Schwaber, K., "The Scrum Papers: Nut, Bolts, and Origins of an Agile Framework", Scruminc, 2012.*
*Vetter, M., "Praktiken des Prototyping im Innovationsprozess von Start-up-Unternehmen", Gabler, 2011.*
*Zhang, H., "Prototyping an IDEO Make-a-thon", 2012, available at <https://labs.ideo.com/2012/04/02/ideomake/>, 2012, [Accessed 22.07.15].*

Annette Boehmer, Dipl.-Ing.
Technical University Munich, Insitute of Product Development
Boltzmannstr. 15, 85748 Garching, Germany
Email: annette.boehmer@pe.mw.tum.de