Maturity-Model for the Evaluation of Investments into IIoT

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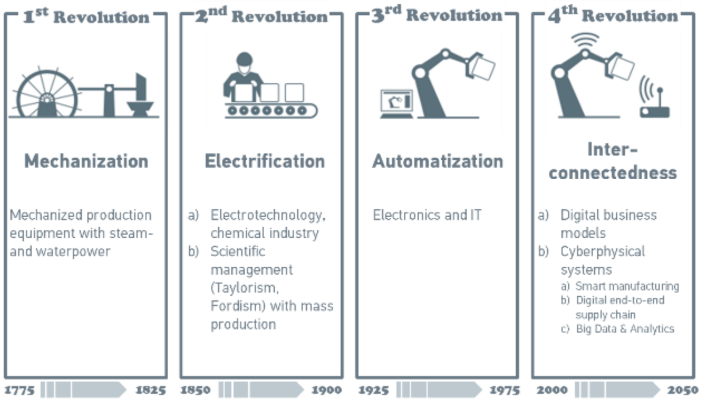
Abstract

The transition from the second industrial revolution (electrification) to the third industrial revolution (automation) was accompanied by a transformation of economy into a science with a powerful mathematic foundation. The methods developed do have some inaccuracies, such as the assumption that logical agents drive the market, an assumption that was realized to be a failure in the models not long ago. The models were developed in a transition phase, while the industrial revolution took place. The models are currently not mature enough to support companies in their investment strategies for the fourth industrial revolution, the age of digitalization and interconnectedness. The purpose of this study is to create a theoretical model for the process of creating a business case for the investment in technologies within the Industrial Internet of Things (IIoT).

Keywords: Maturity-Model for the Evaluation of Investments into IIoT

Introduction

The calculation process for investments into IIoT must be different ones than the one that is applied for established technologies. The uncertainty with IIoT devices is high, reliable information that is not available or based on experiences. The further development of the technologies is vague.



At the end of a calculation process a classic business case will often point in the direction to invest in current and established technologies and not into new technologies, such as IIoT.

While working on the topic we found that the calculation method for the business case is not only dependent from the status of the technology but also from the IIoT-maturity of the company that is going to apply the technology and its product portfolio.

Figure 1 - The industrial revolutions

The challenge is, that the current calculation models for the creation of a business case are limited (e.g. cost-benefit analysis, return on investment calculation) because there are both unknown variables and variables where the impact is unknown. In the industry a business case is often based on past-data, there is obviously no data streaming in from the future.

What is complicating the situation is, that the IIoT technology can have a lower performance than a current technology and will relapse a comparison against a well-established technology.

By this time the public is well aware that a new age of machines is upon us, based on the computing machine...to replace human judgment on all levels...this new replacement will have a profound influence upon our lives, but it is not clear to the man of the street what this influence will be.

Norbert wiener, 1949

In school we learned that the development of mankind is classified into several phases and that stepping from one phase to another is triggered by a transformation in human behavior (e.g. social behavior or change from hunters and gatherers to peasants) or has been triggered by inventions (such as the invention of the fist wedge).

The industrial revolution is also classified in this manner, the textbooks show 3 different industrial revolutions, triggered by natural-scientific discoveries and the inventions that are based on those discoveries.

It is most likely that we are already in a phase that will be described in some years as the beginning (or the center point) of the 4th industrial revolution, the area of *digitalization* and *interconnectedness*.

The aftermath of the digitalization and the interconnectedness get a wide range of attention today, but were recognizable for visionary already long ago, such as the following statement, taken from a letter sent to the president of the United States, Lyndon B. Johnson, on the 22nd of March 1964:

A new era of production has begun. Its principles of organization are as different from those of the industrial era as those of the industrial era were different from the agricultural. The cybernation revolution has been brought about by the combination of the computer and the automated self-regulating machine. This results in a system of almost unlimited productive capacity, which requires progressively less human labor (Pauling 1964).

Every revolution needed its drivers or enablers; for the digitalization there are several enablers, such as the doubling of components on an IC every 12 to 24 months (Moore’s law), the increased bandwidth (Nielsen’s law), the reduced cost for hardware, driven by mass production (economies of scale) or the multicore technology that is able to sextupling Moore’s law in regards of the speed of calculation.

Motivation

The purpose of this study is to create a theoretical model for the process to create a business case for the investment in technologies within the Industrial Internet of Things (IIoT).

The area of digitalization is happening and almost all companies have accepted the challenges that go along with it.

But the investment process for IIoT must be a different one than the one that is applied for established technologies. The uncertainty with IIoT devices are high, reliable information that is based on experience is often not available and the further development of the technologies is vaguely.

At the end of a calculation process a classic business case will often point in the direction to invest in current and established technologies and not into new technologies, such as IIoT.

While working on the topic we found that the calculation method for the business case is not only dependent from the status of the technology but also from the IIoT-maturity of the company that is going to apply the technology and its product portfolio.

The IIoT technologies are part of the disruptive Industry 4.0 and can be considered as disruptive therefore, too.

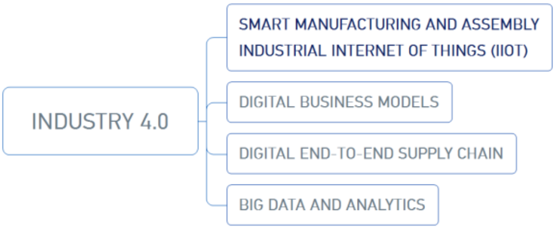


Figure 2 - Smart manufacturing as part of Industry 4.0

IIoT technologies are no stand-alone-technologies, require in most cases identical preconditions (such as a digital network to communicate and to exchange information), are interdependent and superimpose and reinforce one another. This is often underestimated in the creation of business cases because business cases are limited in the way of integrating and representing the complexity of disruptive innovations.

The challenge is, that the current calculation models for the creation of a business case are limited (e.g. cost-benefit analysis, return on investment calculation) because there are both unknown variables and variables where the impact is unknown. In the industry a business case is often based on past-data, there is obviously no data streaming in from the future. Even more due to the disruptive nature of IIoT there is not even data from the past and the numbers are either not available or, what is even worst, are misleading.

What is worsening the situation is, that the IIoT technology can have a lower performance (q.v. sigmoid curve / S-curve) than a current technology and will lose a comparison against a well-established technology.

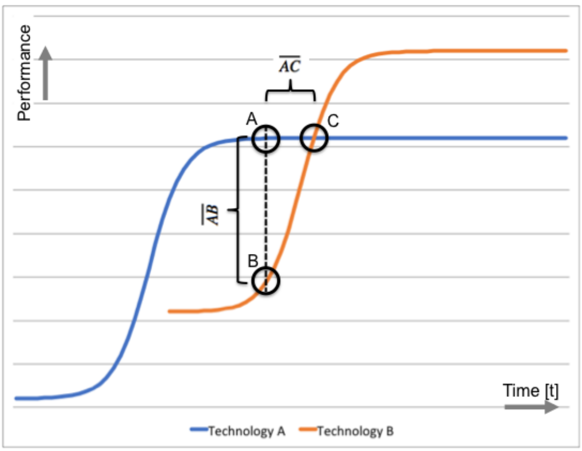


Figure 3 - Delta in the performance of competing technologies

An established technology might have a better performance and the new technology is currently not able to compete with a mainstream technology. But due to the technology development, that does not have to be a linear one, the new technology will draw level with the old technology and outperform it ultimately.

A business case based on those standard calculations, linear calculations and performance indicators from the past will be vague and often lead to wrong decisions.

Therefore, the manager often decides business cases intuitively. But intuition is from a statistical point of view only in half of the cases leading to the right decisions. It is also very likely that a manager has certain biases, driven by his experiences and learning from the past (Thaler, 2000). Such biases can be *Optimism (and wishful thinking)*, *Overconfidence*, *the False Consensus Effect* or the *Curse of Knowledge*.

In the beginning of the 3rd industrial revolution already outstanding minds struggled with imprecise assumptions regarding forecasting and investment decisions, such as John Maynard Keynes:

"Too large a proportion of recent 'mathematical' economics are merely concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols" (Keynes, 1935).

Even though production and its supporting sectors, such as logistic, is an enormously complex system, with a myriad of interdependencies and feedback loops, planning and controlling is possible.

But believing that due to the disruptive nature of I4.0 it is not possible to gain and evaluate the required information for a sustaining business case and to give in, is from my perspective the wrong approach. It is also not recommendable to set up a strategic budget without formal cost controlling, just to be present in the digitalization race and to invest in what is currently in vogue (q.v. the Gardner Hype Cycle) is not a constructive approach.

Investments have to be driven from an economic point of view but when talking about disruptive technologies a company has to take the long-term-perspective into account. The standard motivations for investment decisions for production are (Olfert, 2003):

End of utilization of an equipment
Increase of production cost (e.g. due to an increase of maintenance)
Change in demand (too little or too much capacity)
Technological improvements
New production technologies
New materials
Also the targets that are superior for the company define the investment decisions, such as (Olfert, 2003) (Weber, 2008):

Seeking for profit
Seeking for growth
Seeking for sales
Seeking for security
Seeking for corporate social responsibility and sustainability
Predicting the future performance is challenging and requires taking several variables into consideration and the effect of superposition. The performance of the new technology can end at the lower end of the strategic chasm or it can be driven to achieve the upper end.

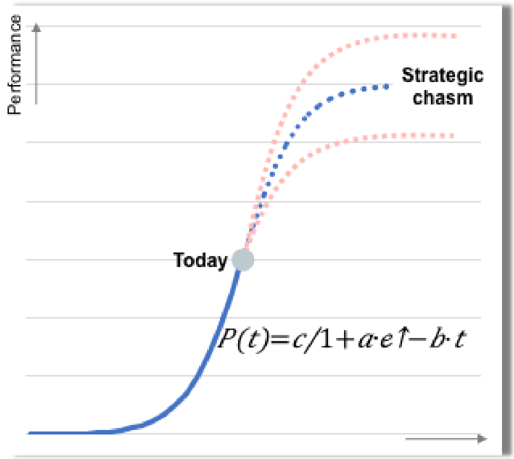


Figure 4 - The strategic chasm

Factors that influence the final performance within a company depend on several factors and can go as far as the product portfolio.

The assumption, that there is time to react before a new technology outperforms the current one (even if it is only a short period), is in some cases wrong. There are cases, where a newly introduced technology outperforms a current technology right from the beginning (Christensen & Bower, 1996).

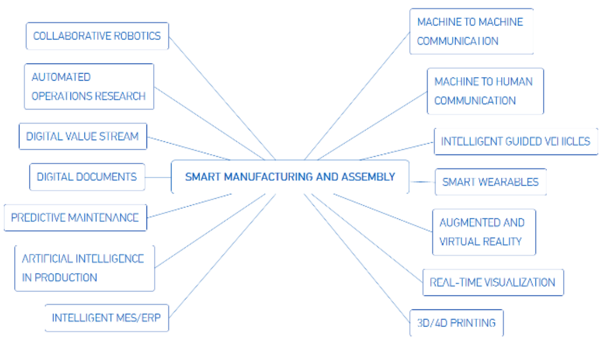


Figure 5 - Example of IIoT technologies

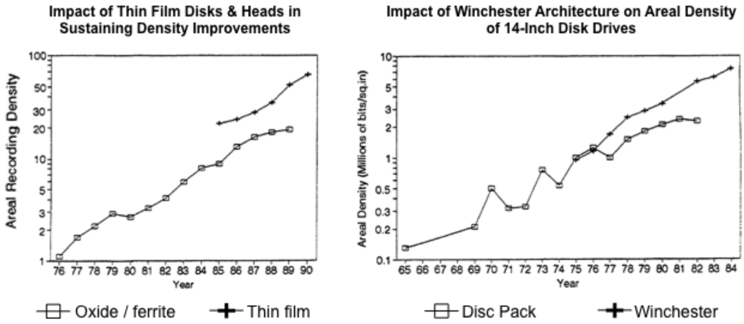


Figure 6: Example of sustaining technological change in componentry (left) and product architecture (right)

It also depends on the point in time, when a prediction is made. The human being tends to think in a linear manner, not in a non-linear

manner. This makes it hard for men to predict correctly the point in time when two technologies reach an equal level of performance. The newer a technology is and the farther the point of inflection is, the more imprecise the prediction is. The closer the gap regarding the performance of the technologies is, the better is the prediction.

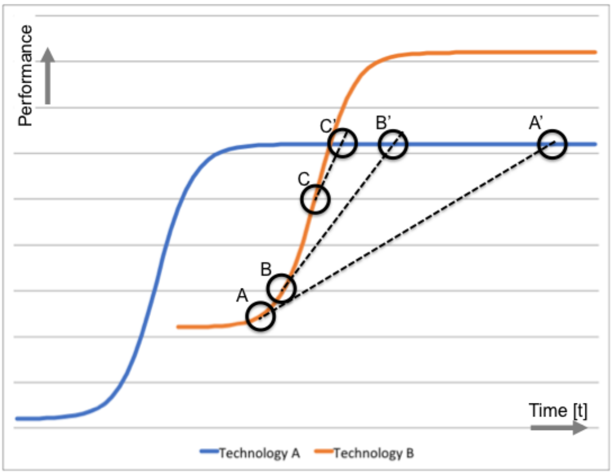


Figure 7 - Accuracy of the prediction of the development of technology-performance

In point A the performance is low, it does not seem to be likely for technology B to be able to compete with technology A in the near future. Point B is not long after point A but the forecast accuracy improved significantly. In point C the accuracy is quite high, due to the small gap between the two technologies.

The term *disruptive innovation* and *industrial revolution* are both misleading, as it seems those refer to certain point in time. But disruption is a process that can take its time, sometimes decades (Christensen, Raynor, McDonald Rory, & McDonald, 2015).

There is a dispute whether the digitalization of the industry is a revolution, started in the eighties of the past millennium or if its origin can be traced back even more in the past. The fundamentals for the digitalization were laid already in the twentieth or thirties of the bygone millennium and todays developments can be understood more as an dramatically advancement that gained speed the last decade.

There is very little dispute that the digitalization and interconnectedness is going to transform the industries, that new business models will appear and that the way we are going to work and live will be a different one.

> No matter what the digitalization and interconnectedness will be seen as, there is very little doubt that many business models will be changed, disappear and new ones will be created.

The change is not only going to affect international companies or companies with a certain scope of application and technologies, it will affect SMEs and their working area overall.

As there is very little dispute about that this change is going to happen, there is uncertainty within companies in what technologies to invest in and when the right time and place is to do so.

There are different strategies observable, based on standard investment calculations, depending on the financial resources and the market pressure that a company experiences.

Due to uncertainties regarding the calculation process, technology experts sometimes recommend a 'Start-Up' mentality. But this approach is neither convincing for the experts in finance and accounting, nor for the experts in controlling. Without having these parties convinced, it is unlikely that a Chief Information Officer, a Chief Technology Officer or a Board of Directors is willing to release a budget.

Creating a business case is taking into consideration the cost and the benefit of an investment, to balance it with the risks and the strategy of the company and to select an option (Brugger, 2009).

This article concentrates on the investments into digitalization in the area of the Industrial Internet of Things (IIoT), a domain within the Industry 4.0, focusing on production and services (smart manufacturing and assembly).

This article suggests a way to reduce the uncertainty when investing into IIoT technologies and to create a transparent and comprehensible approach to develop a business case.

The article can be assigned to the area of *Innovation Management* and can be applied when innovation meets series production and shall be introduced into the market.

Literature Review

The discussion about the disruptive effect of technologies and services is not a new one and does not rest in isolation from historical precedent. Therefore, a historical approach was chosen to examine the available literature and to develop an overview of the state of research.

The literature review is focusing on the creation of business models, the dilemma for the investor and the investment into disruptive technologies, not in disruption in general. The purpose is to place the research in the context with state-of-the-art developments and trying to identify the directions for future investment strategies.

The term of disruptive technology is mainly known due to the work of Josef L. Bower, Clayton M. Christensen and their research fellows (Bower & Christensen, 1995) (Christensen, 1997). They recognized in the middle of the nineties that "Mangers must beware of ignoring new technologies that don't initially meet the needs of their mainstream customers" and wrote a highly observed article about disruptive technologies. Christensen transferred the concept also to different problem statements, such as health (Christensen, Bohmer, & Kenagy, 1992). Together with other authors Christensen worked to apply the concept from a strategic perspective (Christensen, Courtney, Kirkland, & Markides, 1997) and the investors perspective (Christensen & Raynor, 2003).

Even though the articles of Christensen got most attention, there were others who described the concept similarly (Rebecca & Kim, 1990) or to develop a concept to form a competitive strategy, production process capabilities and organizational characteristics (Utterback, 1979).

Innovation management and dealing with disruption was also not only contemplated by firms, but also governments. In Europe there were attempts to apply the concept on the employment rate and the growth of nations and to convert the concept to overcome industrial obstacles (Europe, Community, & Community, 1974) (Böhret & Franz, 1986).

Further concepts were developed, such as the concept of the diffusion of innovation. It is linked to the disruptive nature of technologies and was a widely respected field of research (Robertson, 1967) (Elihu Katz, Levin, & Hamilton, 1963) (E. Katz, 1961).

The management of innovation, the dilemma for investors and taming its disruptive nature is an up-to-date topic since decades and experienced also phases of reconsideration (Danneels, 2004).

Nowadays it is also an area of research and an experimental field and gathers additional adherence due to the digitalization and is still a late-breaking topic with up-to-date publications (Völker & Friesenhahn, 2019).

We also had to intensively work on the field of IIoT applications to develop the basis for the questionnaire. We gathered information from a wide field of literature, such as Big Data, automation, machine to machine (M2M) and machine to human (M2H) communication, manufacturing execution systems, artificial intelligence and mobile devices (Wang et al., 2016) (Industrie, Teichmann, Ullrich, Bender, & Wirtschaftsinformatik, 2018) (Lee & Lee, 2015) (Shah, 2020) (Samie, Bauer, & Henkel, 2016) (Samie, Bauer, & Henkel, 2015) (Danglade, Pernot, Véron, & Fine, 2017).

Methodology

We started with a literature research and identified articles and documents to recognize the current state of research.

We found extensive literature in the field of disruptive technologies and innovations, business model calculation and integration of disruption into a business strategy.

But for the area of our specific field of research and application we found no coherent proceeding.

We also decided to conduct some unstructured interviews with experts from the banking sector, such as Commerzbank, Sparkasse and Deutsche Bank to understand the investment strategies more in detail.

We also read extensively literature from the IIoT applications to ask for real-life applications in the questionnaire.

In a second step we conducted a survey in the area where our research is applicable, in the automotive industry. We have chosen a Tier 1 that is working for every relevant OEM and is one of the Top 100 automotive suppliers worldwide. The company has 40.000 employees, is present in every relevant growth market and reached more than €7.1 billion in its last fiscal year.

The size of the panel is 269 managers, the return rate of the questionnaire is 63%.

To prepare the dimensions of the questionnaire we took the analyzed literature and carved out the focus topics of our research. At the end we had a set of 45 IIoT technologies and 6 identical questions for each technology.

There are several I4.0 and IIoT maturity models available to access the maturity status of a company (Kese 2017) (Goericke & Dr. Lichtblau, 2018) (Bsquare, 2017) (Hocken, 2017) (Anderl & Fleischer, 2015). But the models are either superficial and deliver only a very facial insight into the IIoT maturity status or consume a huge number of man-hours to be conducted (e.g. with team meetings, expert interviews or brain-storming-sessions). In some cases, they also require an external moderator.

We have chosen to build up our own maturity model. This is giving us the following three advantages:

We can consider the product portfolio and the production processes of the probed company; this allows us to exclude some of the IIoT measures and doing so reduced the effort for the respondent

The maturity model is considering the economic perspective. Other maturity models often imply that "the higher the maturity, the better it is for the company". This is not true from our point of view and can be avoided with an adapted model

An external consultant or moderator is not necessary to conduct the survey; the effort to create and conduct the survey is reduced

Out of sixteen different maturity models an own model was created; the main contribution for the maturity model is coming from the "*Leitfaden Industrie 4.0*" (Anderl 2017) and the "*Industrie 4.0 Maturity Index*" (Schuh 2017).

Leitfaden Industrie 4.0[1]

The VDMA[2] developed a guideline to give SMEs orientation regarding the implementation of I4.0 and IIoT.

The guideline from the VDMA was chosen even though it focuses on SMEs. But due to the size of the investigated company and its divers structure we believed that it was applicable for the survey.

The guideline is built upon a chronological structure and provides a toolbox that is subdivided in *products* and *production*.

The VDMA guideline takes 4 different structural areas into account, such as:

Resources
Information systems
Culture
Organizational structure

The VDMA guideline is sub-divided into a five-step-process, requires a strong contribution of the employees of the analyzed company and can be installed to generate ideas and to structure the development-process while working out a strategy for I4.0.

The Industrie 4.0 Maturity Index (acatech) [3]

The acatech model's approach is based upon a succession of maturity stages, i.e. value-based development levels that help navigate through the transformation process, starting with the basic requirements for I4.0 to its full implementation.

Computerization

Connectivity

Visibility *("Seeing" – What is happening)*

Transparency *("Understanding" – Why is it happening?)*

[1] Developed by Reiner Anderl (TU Darmstadt) and Jürgen Fleischer (wbk Institut für Produktionstechnik)
[2] Verband Deutscher Maschinen- und Anlagenbau
[3] Developed by Deutsche Akademie der Technikwissenschaften (acatech)

Predictive capacity *("Being prepared" – What will happen?)*

Adaptability *("Self-optimizing" – How can an autonomous response be achieved?)*

It is not about reaching always the maximum level. A company's desired target state will depend on its business strategy and about the best balance between costs, capabilities and benefits for its own individual circumstances (Schuh 2017).

Therefore, the acatech model is a more holistic one that is taking also basic requirements and support functions into account.

Questionnaire

We have chosen to reach out to the future applicants of an IIoT device directly and to use a structured questionnaire. We have chosen to do so to collect information from a wide range of individuals. Our panel for this survey is the middle and top managers of a tier-1 supplier in the automotive industry. The company has 40.000 employees, is present in every relevant growth market and reached more than €7.1 billion in its last fiscal year. The size of the panel is 269 managers, the return rate is 63%.

The main part of the questionnaire consists of closed-ended questions (90%) where we have given a list of predetermined responses from which the answer had to be chosen. The other 10% consist of of open-ended questions in which we asked the survey respondents to answer questions in their own words. The questionnaire's structure and its design is based on a set of recommendations from survey experts, such as *Research Connections* ("Research Connections," n.d.) and *The Survey System* ("The Survey System," 2019) and follows recommendations of survey specialists (Frary, 2002).

Additionally, there were also questions in the frame of a polarity profiles, such as the following example:

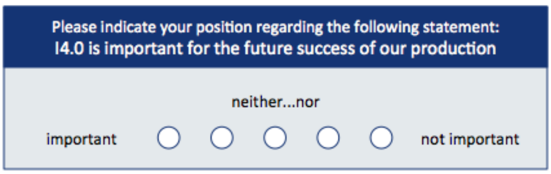


Figure 8 - Example for design of questions

The tool, which was used for the survey, is called Opinio. ObjectPlanet, Inc., an independent software vendor, provided the tool. The company develops software for surveys and polls, data collection, customer satisfaction surveys and employee satisfaction surveys. The company is in Oslo, Norway and has more than 5,000 customers in 100 countries worldwide ("ObjectPlanet," n.d.).

The questionnaire consists of 3 sections.

The first part is about the ***maturity of the evaluated companies section within the Industrial Internet of Things***, determining where it is positioned from the interviewees perspective, finding out what the current state is.

The maturity will be evaluated in the framework of a self-check, based on the "*Leitfaden Industrie 4.0*" and the "*Industry 4.0 Maturity Index*". The "*Leitfaden*" is focusing on technological aspects and the "*Maturity Index*" orientates on the complete value chain (Kese and Terstegen, 2017).

The second part of the questionnaire focuses on the ***evaluation of reasonable IIoT measures.*** This is done to identify where investments have the biggest positive impact on the company and where additional capabilities shall be built up.

This is done by providing an overview of measures from the area of hardware (such as smart glasses) but also measures to make the hardware usable in the first place, such as the transfer of information.

The third part of the questionnaire zooms in onto the ***evaluation of further investments or disinvestments*** to ensure that the measures taken will provide a substantial outcome for the business unit and is supporting our economic success.

The structure of the questionnaire

The intention of the questionnaire is not to cover the full technological range of I4.0, the complete process house resp. production system or the complete value chain of a company. The questionnaire zooms in on I4.0 and focuses on:

Shop floor and office floor at production locations

Integration of suppliers of means of production

By zooming in the focus of the survey is getting narrower and delimitable, looking at the Industrial Internet of Things in a sense. Doing so it becomes more applicable to work out a strategy resp. a roadmap for Operations.

There are more applications and there are interlinks between the different technologies; there is also reinforcement between the technologies and they can amplify each other.

Furthermore, the sustainability can be taken into consideration for the business case, depending on the awareness of the company. To create a systematic business case requires adequate information management and accounting approaches (Schaltegger, 2008).

Distinct maturity model

The model that was created is a three-dimensional one.

The three dimensions of maturity are the following ones:

Maturity level

Field of application
Culture & Organization
Each dimension is subdivided into dignified levels to provide a better understanding and to allow the creation of recommendations that are based on the survey.

The *maturity levels* are arranged in the vertical axis, the ordinate; we have chosen the following denominations (progressive ranking):

Inexperienced
Tentative
Advanced
Dynamic
Outstanding
The *field of application* will be the horizontal axis, the abscissa. Here we requested the feedback for each single IIoT application. The main clusters are:

Resources/processes
Asset utilization
Labor
Quality
The *Culture & Organization* will be the third dimension, it will allow us to ensure the IIoT readiness from a cultural, training and knowledge-based point of view.

Process flow

The flow of the activities in the process of creating and conducting the survey and to work out recommendations for the company is the following one.

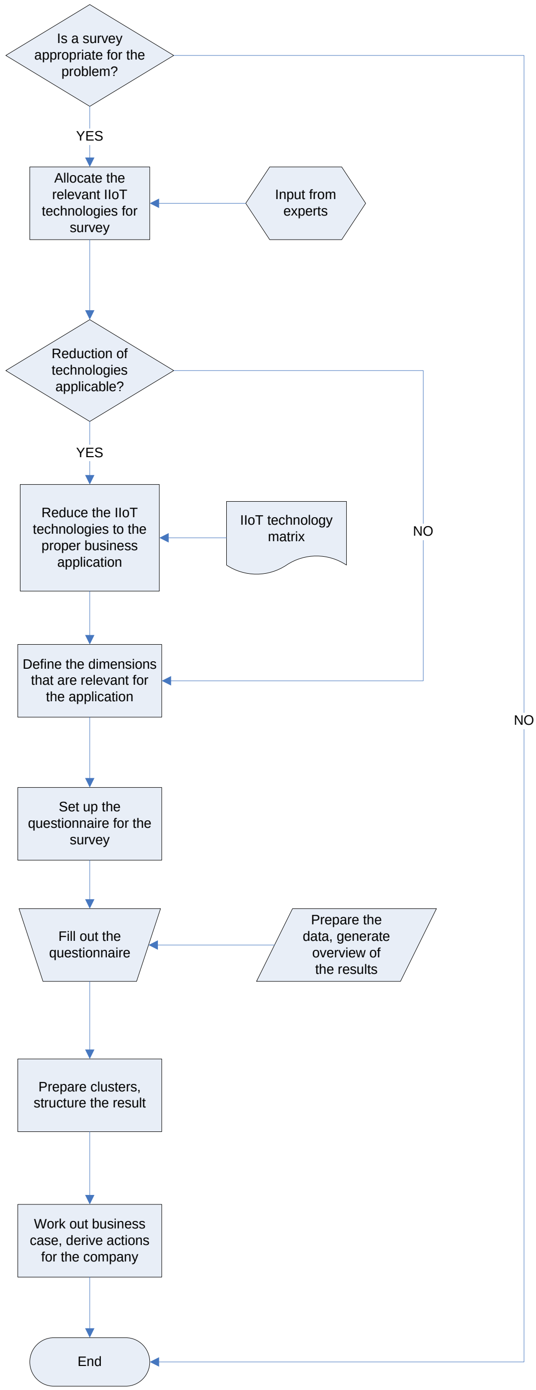


Figure 9 - Process flow of activities

Structural results

Becoming a digital champion requires a successful investment strategy. If an investment strategy is successful, cannot be said in the beginning of an investment.

The agenda of transformation requires at least a vision, a roadmap, a strong will for implementation and a capable team. Implementing IIoT is coming with a lot of risk, new technologies can become obsolete and instead of wining the digital race a company can start falling behind (Schaeffer, 2017).

Based on the literature review and the review of available assessment-tools resp. questionnaires we found that those are often very generic and support an IIoT strategy insignificantly. Those IIoT questionnaires only touch the surface of the problem and don't allow to choose from specific technologies that fit best to the company and its challenges or allows the construction of a convincing business case.

The free-of-charge assessment tools for the IIoT maturity are a good access-point to start with but cannot provide stringent proposals because the incorporated dimensions are not sufficient. The questionnaires either focus on the value chain, the IIoT readiness or ask questions that are imprecise and leave too much room for interpretation.

The dimensions, those are necessary for the kind of companies we focused on, are the following:

Current maturity of the organization

Complexity of implementation

Prioritization

Relevance

Organizational readiness

Those dimensions need to be answered to distinguish the relevant from the not relevant technologies and to create a comprehensible business case.

The dimensions must be taken into consideration when creating the questionnaire. At the end of our literature review the number of IIoT technologies summed up to 32 different technologies.

For each IIoT technology a single page with a short explanation and the set of questions was created:

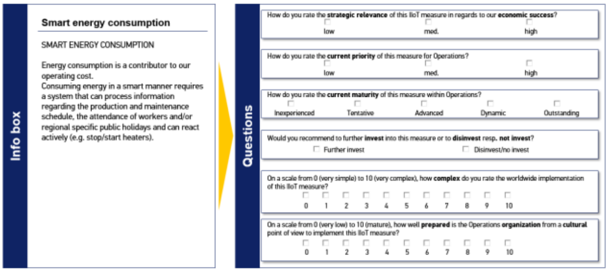


Figure 10 - Example of a full set of questions for one IIoT technology

At the end of the survey we received an overview that allowed us to relate the IIoT technologies in different dimensions, such as the following one:

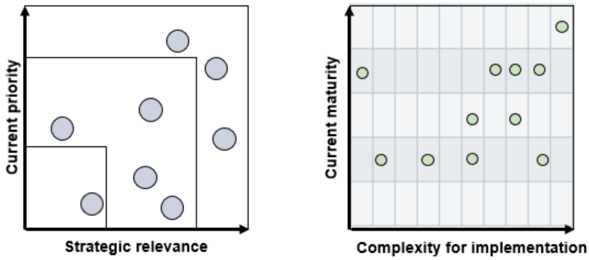


Figure 11 - Example of clustering the results of the survey

The result can be displayed in matrixes that allow an assignment and mapping of the technologies according to the needs of the company.

A single IIoT technology can be displayed and, for example, can be set in a relation to the strategic relevance for the company.

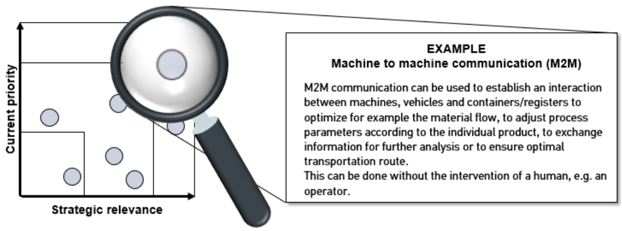


Figure 12 - An IIoT technology from the cluster

In the paragraph *Motivation* we stated that not only the maturity of the IIoT technology but also the maturity of the company, its IIoT readiness from a technology point of view (e.g. connectivity) and its cultural perspective are important.

The process flow explains generically the inputs, the activities and the outputs to work out the feasible IIoT technologies for a company.

Following the flow will support an applicant in working out the proper strategy that will guide a company in the creation-process for the investment into IIoT.

Conclusion

Investing into IIoT technologies can be crucial for the long-term success and safeguarding the existence of the company and is based on analysis done for the company and its environment(Hubert, 2019). It will change the way in which products are manufactured, how services are provided and designed. We have tried to show that the current calculation processes do not take into consideration the further development of the performance of disruptive technologies adequately.

The process that we have introduced ensures that a company invests into the right technologies and enables the best return on investment for the company. The process assists in gaining a much better free cash flow than the state-of-the-art calculation models and supports the overall company's strategy. In the article we recommend involving the know-how of the organization and to utilize the experts as a source of input. This will ensure that the knowledge and awareness of the organization is embedded in the process, that early indicators are included and that the needs of the organization are taken into consideration when investing into IIoT.

Doing so will create further awareness for IIoT and will ensure that the investments are done more selectively and with more focus on the purpose, enabling the organization to have the correct IIoT technologies for the product portfolio and the strategy. To visualize this process, a funnel can be drawn as an explanation. Without the funnel there is no focus, the IIoT technologies are applied without being challenged against each other and their contribution to the company's success is not questioned in any way.

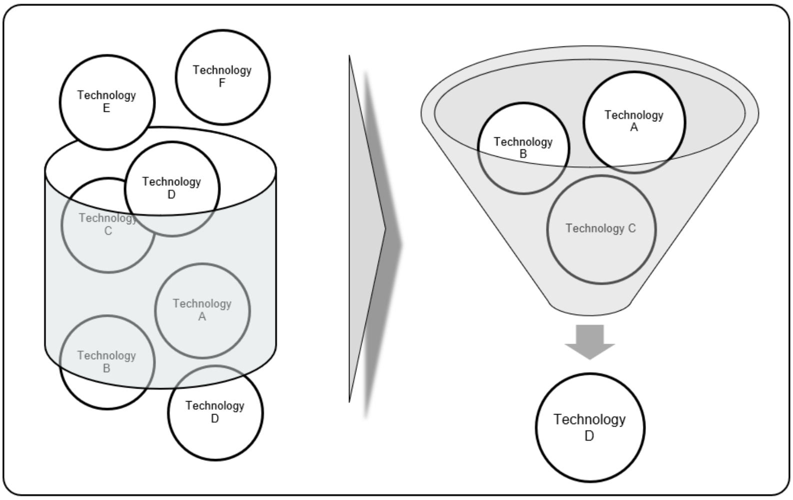


Figure 13 - The funnel for the IIoT technologies

The process (funnel) supports the IIoT technologies to be planned more in detail, communicated in a more transparent way and allows the company and its stakeholders to focus on the development and the introduction of IIoT into the company. Also, the scarce resources that are necessary to develop and implement an IIoT technology are focus and don't have to take care on several technologies but on less technologies but chosen ones.

The investments will be done purposeful and focused on some vital technologies, not on several that were chosen by chance or in the interest of some.

Critics

The presented approach is not a technical break-through, no disruptive change of the calculation of investments. It is a combination of techniques and procedures that are already at-hand but combined in a way to apply it on IIoT technologies.

The approach does not provide full transparency about the development of the performance of an IIoT technology, it is giving indications and is making assumptions.

The input from the experts depends on the involvement of those experts in the development of IIoT and the experts can only give a sufficient feedback on the technologies they work with or are interested due to other reasons. The feedback will be biased and for sure will rank known technologies higher than unknown technologies and this won't be balanced overall, no matter how great the number of interviewees is.

The approach does not provide a solution for this bias and Therefore, cannot be fully precise.

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