What motivates companies for digital innovation?

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Abstract

Aim of the paper is to provide insight into what motivates companies to begin Industry 4.0 developments. The paper investigates why some companies start experimenting with the unknown technology, sometimes taking on significant risk. To find the answer, organizational culture will be studied. The paper is based on four interviews with managers of different manufacturing companies which help revealing how the companies moved towards I40, why they started to innovate and what motivates them to be amongst first movers. Results say that supportive company culture and the self-motivation of firm leaders towards innovation and excellence can be extremely important factors.

Keywords: Industry 4.0, innovation, organizational culture

Introduction

In 2017 summer, Corvinus University of Budapest started a research project on understanding the phenomena and effects of industrial digitalization on companies and their competitiveness. As a part of this, I was entrusted with the task of interviewing manufacturing companies about their interpretation of Industry 4.0 (I40), their attitude towards it and also the steps taken to become a digitally advanced enterprise. During these interviews the managers I was talking with spoke not only about the topics listed before, but they also gave me insight into their unique organizational culture, which seemed to have a great impact on how the interviewed firms turned towards I40. This is why I started to research the interrelation of organizational culture and the emergence of I40 innovation. When I started to review the literature on this, I found that there is still no academic publication available which analyse I40 from this point of view.
In this paper I aim to discover, what motivates companies to begin I40 developments, why some companies start experimenting with the unknown technology, sometimes taking on significant risk, instead of waiting for the others to come up with the best solutions and applying them. To find the answer I approach the topic from an organizational culture perspective.
The research question is, that how organizational culture influences I40 innovations in a company? The question is going to be answered by case studies, introducing diverse solutions.
The paper is organised as the following: first, I give a brief insight into Industry 4.0 and organizational culture literature, collect specific culture-elements which support I40 innovation. In a short chapter I summarize the characteristics of the interviews, then I introduce Cameron and Quinn's (2011) Competing Values Framework (CVF), and

classify the companies I have interviewed. Finally, I draw the conclusions on what organizational culture dimensions are the keys of success in I40 development.

Industry 4.0

According to many professionals and academics, we are in the era of 4th industrial revolution (Monostori, 2014; Geissbauer and Vesdo, 2016; Heynitz et al., 2016). Computers, automation and robotization have appeared in technology many decades ago, but internet revolutionizes their application.
According to Hermann et al. (2016), Industry 4.0, the industrial digitization, is a new, broad concept and covers new methods and technologies to organize the value chain. I40 creates a modularly structured smart factory with a cyber-physical system, which monitors physical processes and translates the physical world into the virtual world, and decentralizes operational decision-making (autonomous machines). The basis of I40 is data. Companies need to pick which data to collect, where to store it and need to build up the competence of analysing them.
Accelerated industrial digitization is trying to respond to rapidly changing customer needs. As a result of even newer product variants expected by customers, product lifecycle is considerably shorter, so working on the innovation of the product and the technology is becoming extremely important and continuously pursued. There is a need for not only to renew the product itself from time to time, but also to create a production technology that can be flexibly altered along changing customer product specifications, allowing customization, and to significantly reduce switching times between products. Due to industrial digitalisation, manufacturing industries can experience significant improvements: substantial inventory, logistics and material handling costs decrease, lead times will be shorter, and shortage will be reduced (Heynitz et al, 2016). I40 challenges companies not only by product and technology improvements, but they also have to build up new competencies e.g. big data analysis, which will be the basis of former two improvements.

Organizational culture

Role of organizational culture in innovation
Organizational culture can be defined as the values, beliefs and hidden assumptions that organizational member has in common (Cameron-Quinn, 2011). Chandler et al. (2000) state that organizational culture is a special mindset, which distinguishes the members of an organization from another. Schein (1992) suggests a rather coordination-oriented approach when defining organizational culture as values and beliefs that provide norms of expected behaviours that employees might follow. Either it is a mindset, or a coordinating tool, organizational culture is an invisible but very powerful force and can be a source of sustainable competitive advantage (Schein, 1992; Hogan, 2014).

In the era of I40, innovation is essential in some industries, like electronics or automotive. The main question is: can organizational culture affect innovation? The answer is yes, according many researchers (Naranjo-Valencia et al., 2011; Chandler et al., 2000; Claver et al., 1998). Tesluk et al. (1997) differentiate two basic elements of culture: socialization and coordination. Socialization means that organization members know whether e.g. the innovative behaviour is part of business treads or not. Coordination refers to methods, procedures, activities that support innovation. Naranjo-Valencia et al. (2011) prove with their study that organizational culture is strong determinant of innovation strategy.

Innovative culture in an organization is the way of thinking and behaving that creates and develops attitude of raising, accepting and supporting ideas (Claver et al., 1998). Innovative culture incorporates risk-taking, participation, creativity stimulation and shared responsibility. Canalejo (1995; cited by Claver et al., 1998) describes innovative culture with client-orientation, compromise with objectives, challenge and initiative, exemplary behaviour, team work and permanent improvement. Chandler et al. (2000) found that organizational culture, rewarding innovative ideas and resources are determinants of creative behaviour. They also found that managerial attitude towards change and good communication are positively related to innovation. Workload pressure and organizational impediments however might hinder innovative processes.
According to Sarros et al. (2008), individual leadership style is also an important determinant of innovation. There are two approaches on the role of leaders in organizational culture. The functionalists (e.g. Schein, 1992) say that the leader is the architect of culture through his actions made, while anthropologists (e.g. Meek, 1988) state that the leader is part of the culture. Sarros et al.'s research (2008) resulted that leaders can create an innovative culture when they articulate vision, provide individual support and make high performance expectations.
In this paper I am intended to prove through interview-based case studies, that organizational culture and leadership style are equally important when companies are preparing to start innovation project, especially in digitalization, in the sense of I40.

The Competing Values Framework
Cameron and Quinn's (2011) framework intends to classify organizational culture into four culture-types. They suggest adhocracy, clan, market and hierarchy culture-types which they visualize in a two-dimension matrix. The first dimension is that how flexible or stable the organization is when it faces challenges. The second dimension is external or internal focus, which refers to how companies want to adapt to changing market conditions and environment Figure 1.

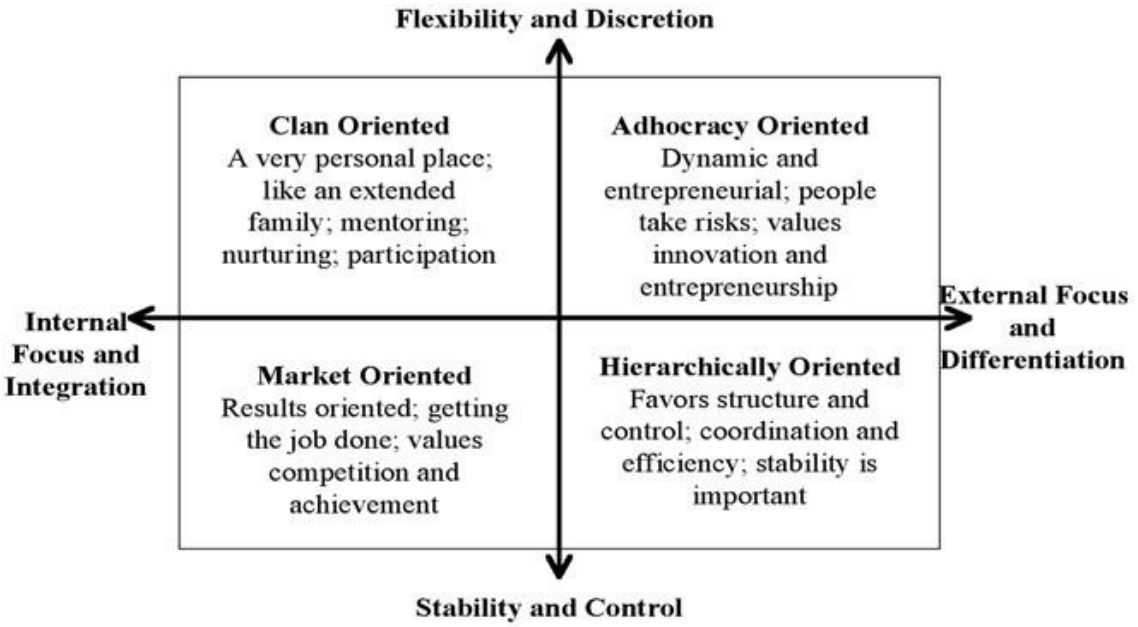

Figure 1. CVF model of Cameron and Quinn (2011)

The authors also analyse firms along six characteristics (dominant dimensions, leadership, management of employees, organizational glue, strategic emphases and

criteria of success) and then classify them into one of the four culture-type. I briefly summarize what different characteristics cover with help of Cameron and Quinn (2011) and Igo and Skitmore (2006). *Dominant dimensions* refer to the level of teamwork, the space left for creativity and the dynamism of the firm. *Leadership* covers the leaders spirit, how he or she turns towards people, manages them. The model uses the following types which are also used in OCAI review process (Organizational Culture Assessment Instrument): mentor, facilitator, innovator, broker, producer, director, coordinator, monitor. *Management of employees* contains aspect of working environment, how workers are treated, the level of consultation and participation. *Organizational glue* refers to the bonding mechanisms that keep the organization together, like goals, loyalty, rules and policies. *Strategic emphases* cover the company's strategic drivers, long term development, goals, innovation. Finally, *criteria of success* means how success is defined at the organization and how it is rewarded. Success can be the sensitivity to customers, market share, development of new products and services.

Along the above characteristics, CVF model classifies companies' culture type. A *Clan culture* company focuses on its internal environment, there is a great emphasis on people and employees, it is like a big family. In this kind of culture leaders are more like mentors, the company is held together by loyalty and tradition.
Hierarchical organizational culture also focuses on internal environment and strive for stability. The tasks are clearly set, and there are strict rules. Relationships are rather formal.
Adhocracy-type organizational culture is rather an extrovert one, the flexibility and individuality is very important. This kind of company is open for new ideas, experimentation and rewards it. Leaders are innovative and supportive.
Market culture companies work for clearly set rational goals, strive for productivity and efficiency. They are result oriented, focusing on customers and suppliers, to outperform competitors.
In the following section I introduce the manufacturing companies I interviewed during the summer of 2017, use the above characteristics and try to define their organizational culture-type.

Methodology

The qualitative research - that is the basis of this paper - was carried out during the summer of 2017. Four manufacturing firms (who requested anonymity) were interviewed with the aim of getting insight into the level of digitalization of companies whether they started any development projects or not, how developed they are and what motivates them to improve. All analysed companies are operating in Hungary, but their ownership structure varies. Details about the companies can be seen in Table 1.

Table 1. Information about the interviews carried out

Interviewed company	*Ownership structure of firm*	*Industry*	*Position of interviewee*	*Revenue/ # of workers (2016)*
C1	Hungarian private	electronics	CEO	4 M € 75 people
C2	US private	automotive	Lean & 6σ manager	176,5 M € 1500 people

C3	German private	automotive	operations manager, vice-plant director	113 M € 900 people
C4	German private	automotive	team leader	1,65 B € 5300 people

The interview method was semi-structured interview and each of them took approximately one and a half hour long. The talk was recorded with the permission of the interviewees and was replayed for making the CVF analysis.

Analysis

All of the interviewed companies have already started some kind of I40 projects, three of them (C2, C3, C4) already run pilot projects or implemented new I40 solutions.
In their interpretation on I40 is:
C1: "The revolution of information in the industry." (C1 interview, 2017)
C2: "Use the enormous amount of data that is being generated, interpret them, predict from them into the future. That is the key." (C2 interview, 2017)
C3: "Industry 4.0 is data and behaviour. Everyone gets relevant information, but how and on what to react and decide, that makes difference." (C3 interview, 2017)
C4: "Connecting an even more intelligent industry into network." (C4 interview, 2017)
Since the interviewed companies operate in industries the most affected by I40, and they are already developing and using I40 solutions, it seemed appropriate to analyse their company culture and see how it affects innovativeness.

Organizational culture characteristics at interviewed companies

C1 company is subsidiary a big Hungarian holding, manufacturing various electronic and machine products. The firm manufactures high-tech manufacturing machines by unique design for other firms. The holding has several service companies too, so the portfolio is very wide. Even though C1 is affected by I40 since it manufactures machines, which have to be conformed with I40 expectations, the company is still aloof from I40. They prefer stability, not to risk what works well, they can still satisfy customer needs with their existing systems, although some kind of development is about to start. The CEO is rather coordinating and optimizing the current structure, emphasizing stability and try to achieve efficiency. Since this is an old Hungarian company, workers appreciate its reputation and are loyal. Also because of its relatively long history, the organization is too formal.
C2 company is subsidiary of a global American group. It manufactures plastic parts and components for automotive manufacturers, playing a Tier 2 supplier role in automotive supply chain. The Hungarian subsidiary has an exceptional role within the group, this is one of three pilot factories in the world, which have the ability to develop I40 tools and solutions, test them and – in case of success – introduce them in the other subsidiaries. Being a pilot factory is the achievement of the Hungarian management, which was agile, creative and brave enough to invest money in new ideas. Later, when the results came, the parent company admitted it and granted with this special position – and also – gave funds for further developments. The management is open for new ideas – coming from either white collars or blue collars -, and helps the idea to be realized. To realize it, all the relevant people are involved and professionals add their knowledge, working on the

realization together. When a new solution is implemented in the factory, the workers are explained why this is implemented and how it will make the work easier. They are also opened for the feedback. Companies within the group also discuss the most current projects and learn from each other. Maybe the very low volume of fluctuation refers to that employees appreciate the creative environment, the management being opened to their ideas. The company tries to be a market pioneer by being the most innovative and creative within its industry.

C3 company manufactures metal machine parts, also in the automotive industry. C3 is a subsidiary of a global German group, playing a Tier 2 and recently also Tier 1 supplier role in automotive supply chain. The company faces fierce competition on the market which they want to win with innovation. Within the group they also achieved pilot factory status, developing projects, and in case of success implementing them in other factories. The plant managers are creative, feel the changes and challenges of the industry and trying to go ahead. The management is open for new ideas of white and blue collars either, and discuss the possibilities with all the relevant people who could influence or can be affected by the new I40 tool or solution. In this company, education of workers did not work. Although they explained the advantages of implementing a new digital tool or solution to the workers, they did not cooperate: they damaged the tools, tried to mislead it. For this reason, they use regulation and dismiss the workers who do not want to adapt to the new technology. Despite this rule, fluctuation did not grow.

C4 company is one of the nine Hungarian subsidiaries of a global German group. It operates in various industries, from household appliances, technical equipments, to automotive. The group is well known of its innovativeness, high-tech solutions and engagement to excellence. C4 is the largest automotive plant within the group, also assigned with not only manufacturing but also research and development tasks. In this case, not the Hungarian leaders are the ones, who create the atmosphere to be creative, but the parent company expects it, and ensures the conditions. By being a creative workplace and spending a lot on R&D the company attracts good employees who are committed to the firm. Since it is a giant German company, they have to take a leading role in I40 developments, outpacing the competitors. They run plenty of I40 projects and pilots, working in teams to elaborate the ideas, discussing them within the group with the best experts. In case of success, tools and solution are implemented in other subsidiaries. As it can be seen in the analysis, the approach of companies to I40 are quite different. Maybe the international ownership ensures more funds for being innovative, but pilots have already started at each firm. The role of the leaders is also exceptional in case of C2 and C3, and it will be highlighted later.

Discussion: Placing the companies into Competing Values Framework

The interviews discovered examples for both organizational culture interpretations (Tesluk et al: socialization vs. coordination): C2 and C4 realizes organization cultures which socialize employees into an innovative environment, who are open to broadcast their ideas and cooperate in realization. C1 and C3 have coordinating organizational culture, because management decided to be committed to I40 and to start different levels of innovation and they motivate their employees to take place in these.

Canalejo's innovative culture attributes can be also captured in the case studies. In C1's innovative culture the goal is to find compromise with firm objectives. The organizational culture that supports innovation at C2 is client orientation as well as challenge and

initiative. C3 and C4 are very client oriented which drives the innovation, while C4 also committed to permanent improvement and known of its exemplary behaviour.

I classified the interviewed companies along the six characteristics of CVF analysis, and their organizational culture type were defined.
According to the analysis, the companies can be described as it can be seen in Table 2.

Table 2. Analysis of organizational culture at interviewed companies with CVF

Company **CVF aspect**	**C1**	**C2**	**C3**	**C4**
Dominant dimensions	reliance on system	creativity and dynamism	focus on goals and competition	creativity and dynamism
Leadership	coordinator	mentor	innovator	innovator
Management of employees	stability	consultation and participation, risk taking, freedom	consultation and participation	team work, consultation and participation
Organizational glue	loyalty, smooth running organization, formal rules	loyalty, mutual trust, being cutting edge	commitment to organization, formal rules	loyalty, being cutting edge
Strategic emphases	Efficiency, control	creating new challenges, trust, openness	attaining targets, creating new challenges	creating new challenges, trust, openness
Criteria of success	efficiency	concern for people, innovation	outpacing competition	innovation, outpacing competition
Company culture type	HIERARCHY	ADHOCRACY - CLAN	MARKET-ADHOCRACY	ADHOCRACY

The result of the CVF analysis is the classification of company cultures at different companies interviewed. As it was suggested by Naranjo-Valencia et al. (2011) and Igo and Skitmore (2006), there is no single solution when classifying firms, the organizational culture usually have a dominant type, but a second one might have influence, too. C1 is clearly having a hierarchical organizational culture, the goals are set by the management, an innovation goes the direction the management wishes to, and employees are assigned with the tasks. C4 is also a clear adhocracy company culture, decentralizing innovation, teams are working on their ideas, the company environment helps creativity, the entire group is engaged to innovative thinking. In culture of C2 clan and adhocracy are mixed. C2 offers a creative and innovative environment, giving space for individual ideas, but also, great emphasis is on people, and leaders are more like mentors. C3 mixes market and adhocracy organizational cultures. The culture is primarily influences by client orientation and winning the competition that is why they strive for I40 innovation. The

innovation is supported by creative and opened environment, and employees are motivated to produce ideas.
Based on the analysis of the four companies' organizational cultures, I discovered two exceptional factors. First is *socialization*. Maybe this can be an effect of being parts of international groups, in C2, C3 and C4 they feel the need to be innovative and to be active and determinative part of the group. Second is the *personality of the leader*. In case of C4 socialization was enough to be world leaders in – not only – I40 innovations. But in case of C2 and C3 the agile Hungarian management fray out that the Hungarian subsidiaries became pilot plants within their group and now they have funds to make a creative and inspiring environment for their employees. According to Sarros et al.'s (2008), the role of the leader at C2 is an anthropologist one, while at C3 he plays a rather functionalist role. Their successes speak for themselves.

Conclusion

In the era of fourth industrial revolution, many papers deal with companies improving their production processes and achieving even higher efficiency, productivity and customer satisfaction. My aim in this paper was to see the other side of the coin: why some companies start to innovate and develop systems and solutions helping them to reach the former results, what environment they create to support innovative ideas, how they motivate people? To answer the question, I used organizational culture theory.
After reviewing the literature on I40 and organizational culture briefly, I introduced Competing Values Framework of Cameron and Quinn. I used four company interviews, which were made at manufacturing firms during 2017 with the aim of getting insight into their I40 developments, and from organizational culture point of view I analysed them. CVF provided an appropriate framework and through its diverse aspects, helped me to show how different ways companies can support their employees to become creative and make the firm master in innovation.
I identified two exceptional influencing factors: socialization and the personality of the leader. This means that having funds for innovation is not always enough for having good ideas, it mainly depends on how inspiring environment the employees are working in, and how their leaders motivate them to be creative and produce ideas.
The research can continue with further interviews, especially with Hungarian-owned firms to get insight why they are not so successful in this process, and it would also be useful for them to formulate recommendations for them, how to transform and develop organizational culture to be more innovative. If Hungarian firms do not realize this on time, they will not be competitive in the fourth industrial revolution.

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