Digitalisation technology adoption – A case study on absorptive capacity and B2B relationships

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Abstract

This paper contributes empirical insights into the phenomenon of digitalisation technology adoption in the automotive supplier industry by exploring absorptive capacity (ACAP) and B2B relationships. 20 semi-structured in-depth interviews have been conducted with technology gatekeepers in a globally leading automotive supplier. In potential ACAP, aim is to "identify the truth" about a technology's actual capability. In realised ACAP, operator involvement is important for purposeful exploitation and technology acceptance. Context-related relationships with technology providers are given in all ACAP process, whereas relationships with customers or suppliers are negatively associated due to asymmetric relationship power. A case study illustrates the findings.

Keywords: Digital transformation, technology adoption, absorptive capacity

Introduction

In the era of digitalisation, managers have to cope with novel technologies like 3D printing, which is accompanied by uncertainty and restraint. Digitalisation, in an operations context also referred to as Industry 4.0 (Halse et al., 2017; Klingenberg and do Vale Antunes Jr., 2017), is considered to dramatically change how companies collaborate. Therefore, these technologies are likely to cause a paradigm shift (Campbell et al., 2011; Petrick and Simpson, 2013) in what constitutes and characterises B2B relationships (Johnsen and Ford, 2001). This underpins the socio-technological challenges for managers and emphasises the need for research.

In this paper, digitalisation technology adoption is analysed, which is practically referred to as digital transformation in the automotive supplier industry. Digitalisation technologies are considered as process innovations (Utterback and Abernathy, 1975) such as 3D printing. Technology adoption is analysed from the viewpoint of ACAP (Zahra and George, 2002). B2B relationships and characteristics (Johnsen and Ford, 2001) are integrated into the ACAP process to explore their role during technology adoption.

RQ1. How is digitalisation technology adoption practically carried out in ACAP?
RQ2. Which role do B2B relationships have in the different processes of ACAP?

Methodology

This qualitative research is conducted from a social constructionist perspective, considering data as an interpretivist. Relating to the work of Halse et al. (2017), this paper provides a case-study (Yin, 1994) to furthering technology adoption knowledge by integrating ACAP (Zahra and George, 2002), process innovation (Schumpeter, 1939; Utterback and Abernathy, 1975) and B2B relationships (Johnsen and Ford, 2001) in a research framework, which has been derived by literature review.

Research is carried out from an engaged researcher perspective in cooperation with a globally leading automotive tier one supplier. 20 semi-structured, in-depth interviews have been conducted with technology gatekeepers, which have been identified by opportunistic sampling (Miles and Huberman, 1994; Robinson, 2013), based on the extent to which they act as key respondents (Patton, 1987). To consider multiple realities (Berger and Luckmann, 1967) and to incorporate different viewpoints (Flick, 2006), identified interview participants are positioned at diverse management levels from directors of central functions to project managers in production sites.

An interview guide (Easterby-Smith et al., 2015; Saunders et al., 2016) was used in order ensure that the main topics are covered while remaining flexible and open to also pursue topics that the interviewee brings up (Rossman and Rallis, 2012). Interviews usually lasted between one and two hours and were audio-recorded and transcribed with given consent, followed by an abductive (Dubois and Gibbert, 2010) coding process.

Grounded in the empirical data, this paper presents a case study (Yin, 1994) to address RQ1 and RQ2. The case study is designed according to the ACAP core process sequence, i.e. acquisition, assimilation, transformation and exploitation. In each process multiple viewpoints are integrated to triangulate the findings.

Theoretical foundation

Innovation and process innovation

The term "innovation" is particularly driven by the thoughts of Schumpeter (1939), Freeman (1982) and Damanpour (1991), where Schumpeter defines innovation as "doing things differently in the realm of economic life", including the introduction of new goods, new methods of producing a new good, as well as the opening of new markets, the conquest of new sources of supply and the carrying out of a new organisation of any industry.

Over the last decades, diverse innovation typologies have been proposed as the following table summarises:

Table 1: Innovation typology examples – adopted from Geldes et al. (2017)

Author	Innovation typologies
Schumpeter (1934)	New products, new methods of production, new sources of supply, the exploitation of new markets, new ways to organise business
Knight (1967)	Product or service innovation, production-process innovation, organisational structure innovation, people innovation
Utterback and Abernathy (1975)	Product innovation, process innovation
Dewar and Dutton (1986)	Incremental and radical innovations
Freeman and Perez (1988)	Incremental innovation, radical innovation and new technology systems
Christensen (1997)	Sustaining innovation, disruptive innovation
Francis and Bessant (2005)	Product innovation, process innovation, position innovation (commercial or marketing related), paradigm innovation (changes in mental models of organisation)

In this research, digitalisation technologies are considered as process innovations, thus related to the viewpoint of Utterback and Abernathy (1975). From the practical perspective, digitalisation technologies such as 3D printing (3DP) is used to improve production processes, or automated guided vehicles (AGV) are implemented to automate transportation processes. These process innovations are either incremental or radical in nature Freeman and Perez (1988).

Technology adoption and ACAP

The term "technology adoption" can be defined as "the stage of technology diffusion in which an organisation or individual decides to select a technology for use" (Kaldi et al., 2008). The concept is particularly driven by the research of Davis et al. (1989) on the technology acceptance model, Ajzen (1991) on the theory of planned behaviour, and Rogers (1995) on the diffusion of innovations, to mention only a few.

In this research, technology adoption is considered as the willingness (readiness) to and the result of activities to approach and integrate digitalisation technology process innovations. From a practical perspective, transferring digitalisation technologies such as smart glasses from the market into the organisation is accompanied with efforts (e.g. time) and barriers (e.g. costs) on both individual and organisational level.

Following Cohen and Levinthal (1989), (digitalisation) technology adoption is analysed from the viewpoint of ACAP, which is most often defined as "the ability of an organisation to recognise the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990). The concept of ACAP was introduced in 1990 by Cohen and Levinthal, who proposed ACAP as a dynamic capability which consists of three elements of knowledge articulation: recognition of the value of externally generated knowledge, assimilation of this knowledge to the firm's existing knowledge base, and application of the assimilated knowledge to commercial ends (Spithoven et al., 2009).

In this research, the reconceptualised ACAP model from Zahra and George (2002) is selected for the analysis, which is mainly driven by the clear ACAP core process and the practical fit of this particular model.

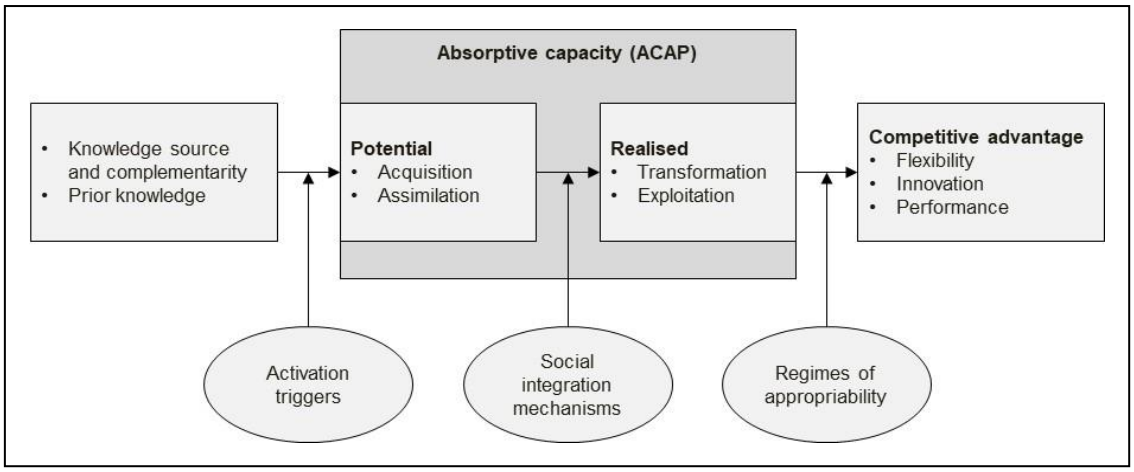

Figure 1: ACAP model by Zahra and George (2002)

ACAP in digitalisation technology context

The development of ACAP along with critical reviews of the community shows still existing, related to both theory and context. Theory-wise, points of discussion are for instance the configuration of the model and construct definitions (Todorova and

Durisin, 2007). Context-wise, points of discussion are for example that ACAP has been predominantly applied to the R&D context by using quantitative methods.

Recently, researchers call for qualitative work on ACAP (Easterby-Smith et al., 2008) in a non-R&D context (Lane et al., 2006), as well as to incorporate innovation types (Duchek, 2013) and thus to provide more guidance to practitioners (Patterson and Ambrosini, 2015). Reviewing ACAP-centred publications of the last 3 years shows that ACAP and digital have already been combined (e.g. Scuotto et al. (2017), Rodriguez and Da Cunha (2018) and Schweisfurth and Raasch (2018)), but also proves, that the combination of ACAP and digitalisation technology adoption is still a contextual gap. This qualitative research, therefore, addresses these gaps with RQ1 and RQ2.

Empirical findings

Acquisition

In order to get to know about new technologies, interview participants commonly explain that they have two different perspectives on what is external: *"I have to differentiate 'external'. There are for me two perspectives on 'external'."* First, the view at the market, i.e. external to the entire company. Second, since the participating company has far over 100.000 employees in hundreds of subsidiaries around the globe, other organisational units such as business units or other production sites are considered as external, i.e. external to the own organisational unit.

In the external perspective at the market, the most important and first step of acquisition is screening the internet: *"Part of the screening is YouTube, Google and competitors – anything. Suppliers as well. Taking that a supplier produces reels for electronic components, then I look for how does the supplier do it. Do they have any automation projects? Sometimes this is really public."* As the response shows, the screening is driven by two intentions. First, the participant wants to know which technologies are developing out there, and second, the participant wants to know whether the technologies are already in use. In particular the latter seems to be carried out to identify technology gaps and competitive disadvantages.

Part of the previously mentioned internet screening is to view YouTube videos that show technologies in operation. Therefore, and often the subsequent step is to visit exhibitions: *"And I personally have been to the LogiMAT exhibition, for instance. Exhibitions are excellent for this. Just get there, have a look and ask questions. You can get a lot of information on what is possible, and what is not yet possible – where no solution is currently available."* Exhibitions enable to deepen the first impressions of a technology gathered via internet in communication with technology providers. Moreover, exhibitions are the transition from acquisition to assimilation, which will be followed in the next sub-chapter.

In the internal perspective at other organisational units, the key activities are screening the intranet or the company-internal social network: *"We scan the internal social network if we have a specific topic or a subject area, which is insufficiently understood so far. We have made very good experiences with the groups […] and that you are able to filter: what is relevant for us?"* This activity is very similar to the internet screening, as it is conducted to identify technology gaps in the own organisational unit.

Comparable to visiting exhibitions in the external screening, benchmarking and visiting other sites is done in the internal screening: *"We do not really survey the market. We benchmark the other locations what they are using."* In this rather extreme response, an external screening is not conducted at all, since it is said to be easier to simply confer what other organisational units are exploiting: *"[…] if we see that our*

company has already experiences with this [technology] than we just simply buy." In general, other responses show that plant benchmarking is either a trigger to initiate an external screening or a subsequent step to identify the right technology provider.

All aforementioned activities are conducted actively. Responses indicate that knowledge acquisition is also conducted passively: *"That is active searching, and on the other hand really the familiar newsletters – 'Automobilwoche', 'Automobil Industrie'. Simply subscribe, read the headlines and read more if something draws your attention."* In this mode, one does not actively search for external developments, but gets passively informed about potentially relevant developments from both internal and external sources, which then initiate the aforementioned activities such as external or internal screening.

Assimilation

Following the exhibition visit to meet technology providers as explained in acquisition, the subsequent step in assimilation is to invite technology providers to identify their actual capabilities: *"And in topics like PDA [Production Data Acquisition] for example, we often approach these topics certainly via internet. We then invite companies and let them explain what they are doing, what expectations they have, and so on. However, in digitalisation and automation, it is often not so easy, as there are many companies at the market. They promise you they can do anything. And now it is the big challenge: do they only promise, or can they really do what they promise?"* A negative notion is the experienced gap between theoretical and practical capability and misleading of technology providers as part of their project acquisition. Another respondent, a Managing Director, underpins the previous statement of an Industrial Engineering Manager: *"We have invited the best 3D scanning company of the exhibition. We gave them some components, set up an appointment and said: 'You are the best company. Please visit us and show us how your 3D scanner scans our components and how your 3D printer prints the scanned components without rework required. If it works, we directly buy your equipment!' It turned out that the 3D print at the exhibition lasted so long, that a hidden employee was able to rework the scans during the printing process."* Even though the given examples are rather extreme, it shows that in assimilation it is important for the participants to understand what a technology is generally capable to do, without a contextual relation to the own company.

Some respondents also explained that they invite technology providers for the purpose of assimilation to company-internal conventions and pitches: *"We have every year an Engineering Week in the plant and we invite a lot of [technology] suppliers. They show us new technology, the next step for different technologies. And in this Engineering Week a lot of engineers in the plant go to these shows and we take a lot of opportunities in this Engineering Week."* These events can be considered as part of the technology and technology provider selection process. Invitations of multiple technology providers is not only observed at plant-level of the participating organisation, but also on higher management levels where strategies and technology roadmaps are aligned. One of many examples therefore is the "Global Operations Management Conference", where over 100 operations management leaders are invited on annual basis.

Following the plant benchmarking in acquisition, visiting other plants is an important part in the internal perspective: *"Yes, we have a visit, like benchmarks, between plants, that we go to different plants in China, in Europe in America and they come here. It is a shared communication […] to exchange the knowledge. And then we go and see the plants, we have a lot of questions to the experts and we take this information for our*

process." As the response shows, mutually sharing knowledge of technologies is important for the organisation. Experiencing technologies in applied cases in the own organisation does enable talking to the ones who operate the technology, and, importantly, enables to gather unfiltered feedback about the capabilities of both technology and technology provider. This does avoid trapping in the gap between theory and practice, as elaborated above.

Transformation

By conducting the previous ACAP processes, participants are now aware of new technologies and both theoretical and practical capability. In transformation, suitable processes have to be identified, i.e. company-internal routines that can be modified by using the new technology. Alternatively, entirely new processes are designed. Participants commonly state, that prior practical knowledge and shop-floor-level experiences are not only a highly valuable source for transforming external knowledge, but also directly trigger transformation: *"When I was working in a production site: the Gemba walks. The Gemba walks in the morning are predestined, because you see so much. This 'Go and See' – you are right in the production, and then you see something that bothers you. And then you are like 'Ah! This would be a good use case for such a topic [technology]!'"* As the participant stated, transformation particularly happens directly at the shop floor. Similar to the theory and practice gap in the technological capability explained in acquisition, responses highlight that these gaps also exist in the own organisation, i.e. deviations in theoretical process descriptions and practical process execution.

Moreover, being close to the shop floor enables to not only see how processes are executed, but also enables to involve operators and other employees who might have good ideas of what to improve, as they are the ones who execute the processes over and over, every day: *"We have to involve the operators in order to know what we need, because they are doing their job for 5, 10, 15 years. That means, they exactly know where we have problems. If we do not involve them, we will be trying for very long."*

Apart from Gemba walks and involving operators, students are highly advocated for writing bachelor and master theses on the subject of transforming processes: *"I personally have supervised three bachelor theses and one master thesis last year on the topic Industry 4.0: What is possible? Just pick and modify different processes: Bring some ideas."* Participants frequently mention students to have many ideas and out-of-the-box-thinking without being biased and without having organisational blindness. Sometimes, students work in inter-generational teams where the student is acting as a project leader to develop use cases along with process analyses and conceptualisations, motivating the older colleagues.

Lastly, complementary to the previously explained activities, technology providers have also an important role in assimilation of external knowledge: *"On the basis of the provider's requirements catalogue we have recognised that we actually did not really know what we wanted, thus we have collaboratively sharpened our scope."* The response illustrates, that technology providers certainly have the most experience about their own technology. Therefore, technology providers are considered as consultants who can assist in identifying and designing suitable processes to implement the new technology.

Exploitation

After having conducted all prior ACAP processes, participants are now aware of new technologies and both theoretical and practical capability, along with identified and

designed processes. Data shows that two different modes of exploitation are conducted: self-implementation or implementation by technology provider.

Self-implementation is done if the organisational unit expects to be technically capable to do it, as well as if the organisational units intends to gain experiences: *"And cobots we do ourselves. It really makes sense to gain this experience. I think the people love it. They try to do it by themselves."*

Gaining experience by involving employees and particularly operators is frequently argued as to reduce change resistance by the workforce, as well as to reduce anxiety of being replaced by a technology. If operators are given freedom to act, they are likely to accept the new technology. In several examples, operators were officially allowed to propose and vote for giving collaborative robots names such as "Clara". Other examples of humanisation show that operators put smiling faces on AGVs.

Another reason for involving workforce to self-implement technologies is that the participating company awards technology-related competence centres which have to have in-depth experiences on how to transform and exploit the particular technology: *"For 3D printing, we are competence centre. We have to be capable and we have to gain all the experience we can to print from different directions or whatever. Try different materials, try different printing of different parts, stress it and as well evaluate it. And then we are able to be better than others. Cobots the same. If we want to be successful, we have to implement more and more, year by year."*

Implementation by technology provider is often done, when resources or time are not available. Externalisation of exploitation is sometimes done collaboratively, as the following examples about the unique selling proposition shows: *"We have regular exchange with the developers of the supplier [technology provider]. We are the most complex customer with regard to the internal map, the navigation of the AGV, according to the supplier. Therefore, the supplier has actually developed functions exclusively for us, which we have initiated."*

Interestingly, examples for collaborative exploitation of new technologies with suppliers or customers was not found in the interviews. At plant-level of the participating organisation, interviewees stated to have insufficient power to convince the own suppliers to collaborate: *"You always try to implement solutions which are compulsory for everybody. And I think that this is often an obstacle where everybody thinks 'we better leave it'."* Customers, on the other hand, are stated to have a lot of power, thus setting objectives rather the collaboratively exploit new technologies: *"From my perspective, customers state what they would like to have. So, it is more like an objective. I do not know any collaborative digitalisation project with customers."* In case own processes are transformed and new technologies are exploited, customers are further stated to give approval for that. This is grounded in the tight relationships with high expectations on delivery performance and product quality in the automotive industry.

Conclusion

The empirical findings in this paper illustrate how is digitalisation technology adoption carried out in practice (RQ1) and which role B2B relations have in the different phases of ACAP (RQ2).

First, RQ1 can be answered with the following table, which summarises the key activities of the participating company in each ACAP process. The table can be valued as a managerial implication in the shape of a checklist for how to approach new technologies.

Table 2: Activities and intention per ACAP process

ACAP process		Activity	Intention
Potential ACAP	Acquisition	External screening via internet Visit exhibitions	Actively or passively screen developments at the market
		Internal screening via intranet/social network Benchmark other production sites	Actively or passively screen developments at other organisational units
	Assimilation	Invite technology providers Visit other production sites	Differentiate theoretical and practical capability ("identify the truth")
Realised ACAP	Transformation	Gemba walks/Go and See Involve students Engage technology providers	Analyse and design processes to integrate the new technology
	Exploitation	Self-implementation Involve employees (operators) Engage technology providers	Implement technology and involve employees

Interestingly, due to the size of the company with hundreds of subsidiaries worldwide and far over 100.000 employees, participants have commonly two views on the term "external": the market and other organisational units like production sites. What stands out is that aim of potential ACAP is to "identify the truth" about the actual capability of the respective technology. Furthermore, operations workforce and particularly operators are important to be involved in realised ACAP, mainly for two reasons. First, operators execute the processes and thus know what could or should be improved. Second, operators are showing resistance to digital transformation, amongst others as they are having anxiety to be replaced by the technology. Involvement and freedom to act reduces resistance and increases technology acceptance.

Second, RQ2 can be answered with the subsequent table, which summarises the B2B interactions that have been identified in each ACAP process. B2B relationships are differentiated into technology providers, suppliers and customers.

Table 3: B2B interaction per ACAP process

ACAP process		Technology provider	Suppliers	Customers
Potential ACAP	Acquisition	Meet at exhibitions to see technologies in operation	Not identified	Not identified
	Assimilation	Invite to present technological capability		
Realised ACAP	Transformation	Engage to identify, analyse and conceptually transform processes		
	Exploitation	Engage to implement technology		Requirement or approval

As the above table shows, technology providers play an important role in all ACAP processes. Interestingly, examples for collaborative exploitation of new technologies with suppliers or customers was not found in the interviews, even though B2B relationships in the automotive industry are considered as tight and open innovation crucial in the product innovation process. Interview responses show that at plant-level of the organisation, participants see customers to dictate technologies that must be implement, and at the same time having insufficient power to convince suppliers to

collaboratively exploit new technologies. These findings underpin the asymmetric B2B relationship characteristics such as power and dependence.

Limitation and outlook

This research has two particular limitations. First, richness of responses is highly dependent on the participant, along with the daily mood and openness. Second, data has been collected from a tier one automotive supplier, mainly in Germany. Conducting the same interviews with other participants in the participating organisation might lead to different responses, even though saturation was clearly observed.

Future research should investigate whether the identified activities per ACAP process are similar in other industries (RQ1). Further, researchers should analyse if the surprising absence of supplier and customer collaboration is also visible in other automotive suppliers, as well as in industries (RQ2).

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