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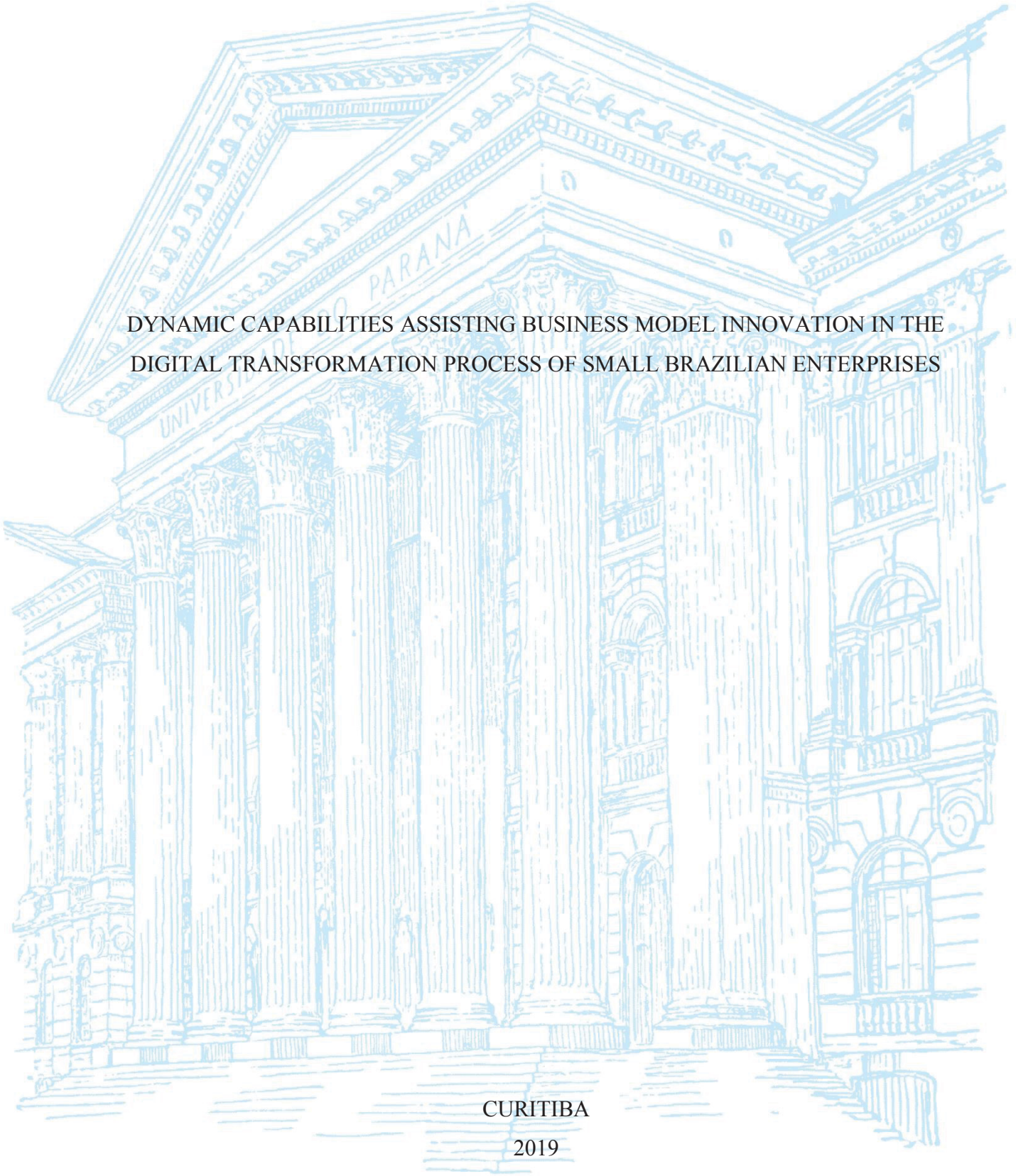

DYNAMIC CAPABILITIES ASSISTING BUSINESS MODEL INNOVATION IN THE DIGITAL TRANSFORMATION PROCESS OF SMALL BRAZILIAN ENTERPRISES

CURITIBA

2019

GIOVANI CRUZARA

DYNAMIC CAPABILITIES ASSISTING BUSINESS MODEL INNOVATION IN THE DIGITAL TRANSFORMATION PROCESS OF SMALL BRAZILIAN ENTERPRISES

Dissertação apresentada ao curso de Pós-Graduação em Administração, do Setor de Ciências Sociais Aplicadas da Universidade Federal do Paraná, como requisito parcial à obtenção do título de Mestre em Administração.

Orientador: Prof. Dr. José Roberto Frega.

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Os membros da Banca Examinadora designada pelo Colegiado do Programa de Pós-Graduação em ADMINISTRAÇÃO da Universidade Federal do Paraná foram convocados para realizar a arguição da Dissertação de Mestrado de **GIOVANI CRUZARA** intitulada: **DYNAMIC CAPABILITIES ASSISTING BUSINESS MODEL INNOVATION IN THE DIGITAL TRANSFORMATION PROCESS OF SMALL BRAZILIAN ENTERPRISES** , após terem inquirido o aluno e realizado a avaliação do trabalho, são de parecer pela sua Aprovação no rito de defesa.

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CURITIBA, 27 de Fevereiro de 2019.

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Dedicada aos meus amigos, colegas e a todos os membros do Programa de Pós-Graduação em Administração da UFPR por terem me auxiliado no decorrer dessa jornada.

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Clichê. Essa é aquela seção clichê que quase ninguém lê. Talvez seja clichê porque quase sempre elas são escritas na correria. Perdemos tempo demais em todos os elementos obrigatórios e deixamos um tempo quase nulo para os opcionais, em especial para os agradecimentos. Assim, quando o escrevemos, fazemos algo rápido apenas para cumprir tabela.

Por isso, decidi fazer diferente. Considerei os agradecimentos um elemento obrigatório em meu trabalho. E, assim sendo, adicionei um tempo em meu cronograma para sua escrita. O objetivo não era fugir do clichê (talvez também fosse um pouco), mas o que eu queria mesmo era poder agradecer de verdade, não escrever algo na correria. O que eu queria era escrever algo de forma calma e muito bem pensada, para poder agradecer com as palavras certas.

A verdade é que, em meio a tantas escritas e reescritas, descobri que é difícil fugir do clichê. Que acabamos sempre agradecendo a Deus, aos familiares, amigos e aos entes queridos que nos ajudaram, e comigo, não foi diferente.

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Portanto, deixo a todos vocês o meu muito obrigado!

"The butterfly counts not months but moments, and has time enough."

Rabindranath Tagore

RESUMO

O termo Industria 4.0, conceito introduzido primeiramente pelo Governo Alemão no ano de 2011, passou a ganhar espaço no decorrer dos últimos anos tanto na esfera acadêmica quanto na esfera da prática organizacional. Diante disso, estudos relacionados a modelos de negócio e a capacidades dinâmicas passaram a ser desenvolvidos com o objetivo de melhor compreender a relação desses construtos com a indústria 4.0 e com a transformação digital. Apesar disso, a maioria desses estudos explora tais construtos de forma isolada, trabalhando assim apenas com a relações entre modelos de negócio e a Indústria 4.0, ou com a relação entre capacidades dinâmicas e indústria 4.0. Além disso, a maior parte dos estudos explora esses construtos no âmbito das grandes empresas, em geral multinacionais. Diante disso, o presente estudo busca analisar como as capacidades dinâmicas se relacionam com os modelos de negócio em pequenas empresas relacionadas à transformação digital. Assim expandindo a literatura que aborda tal cenário em pequenas organizações. A partir da revisão teórica realizada, foi construído um *framework* que serviu de base para a análise de quatro organizações (três provedoras de tecnologia para a indústria 4.0, e uma usuária dessas tecnologias). Os resultados demonstram que o *framework* construído com base na literatura encontra-se alinhado com o cenário identificado nas empresas, onde foi constatado que as empresas classificadas como 'provedoras' desenvolveram capacidades dinâmicas que se relacionam com o modelo de negócio dessa, facilitando a ocorrência de inovações no mesmo. Além disso, também foi identificado que a 'rede de relacionamentos' e o ecossistema onde essas se encontram inseridas tiveram um papel fundamental para o processo de transformação digital e para as mudanças no modelo de negócio, enquanto a cultura organizacional foi apontada como uma das maiores barreiras para o desenvolvimento da Indústria 4.0 no cenário Brasileiro, sendo essa considerada uma barreira maior do que a própria limitação tecnológica.

Palavras-chave: Transformação Digital. Industria 4.0. Capacidades Dinâmicas. Modelos de Negócio. Pequenas Empresas.

ABSTRACT

The term Industry 4.0, officially introduced by the German government in 2011, started to gain space during the last years both at the academic and the practitioners field. Upon that, studies related to business models and dynamic capabilities started to be developed with the objective of better comprehend the relationship between these constructs while at the Industry 4.0 and with the digital transformation. However, most studies explore those constructs in isolation from one another, thus addressing either the relationship between business model and the Industry 4.0, or the relationship between dynamic capabilities and the Industry 4.0. Besides that, most studies explore these constructs considering large organizations, usually multinational ones. Upon that, the present study aims to analyze how the dynamic capabilities relate to business models on small enterprises related to the digital transformation, thus expanding the literature that address this scenario at small organizations. Upon the literature review, a framework was constructed to serve as the base for the analysis of four different organizations (three providers of and one user of technologies related to the industry 4.0). The results demonstrate that our framework is aligned with the scenario identified at the organizations, where we identified that the organizations classified as 'providers' of the Industry 4.0 managed to develop capabilities that relate to their business model, assisting the organization to innovate it. Besides that, it was also identified that the network contacts and the ecosystem where those organizations were inserted presented a fundamental role for both the digital transformation and also for the business model changes. At the same time, organizational culture was pointed as one of the greatest barriers for the development of Industry 4.0 at the Brazilian scenario, being considered a barrier even greater than the technology limitations.

Key-words: Digital Transformation. Industry 4.0. Dynamic Capabilities. Business Model. Small organizations

LIST OF FIGURES

LIST OF PANELS

ABBREVIATIONS AND ACRONYMS

ABII	- Brazilian Association of Industrial Internet
ABINC	- Brazilian Association of Internet of Things
ACATECH	- National Academy of Science and Engineering
AR	- Augmented Reality
B2B	- Business to Business
CEO	- Chief Executive Officer
CFD	- Computational Fluid Dynamics
CIO	- Chief Information Officer
CNI	- National Confederation of Industry
CPS	- Cyber Physical Space
CTO	- Chief Technology Officer
ECSPN	- Extended Colored Stochastic Petri Nets
FAPESP	- São Paulo Research Foundation
FIEP	- Industry Federation of the State of Parana
FIESP	- Industry Federation of the State of São Paulo
GPRS	- General Packet Radio Services
HR	- Human Resources
IIOT	- Industrial Internet of Things
IOT	- Internet of Things
IOTS	- Internet of Things and Services
IT	- Information Technology
MCDM	- Multi-Criteria Decision-Making
MRS	- Mobile Robotic Systems
MSE	- Micro and Small Enterprise
NFC	- Near Field Communication
PFI	- Profiting from Innovation
PROMETHEE	- Preference Ranking Organizations Method for Enrichment Evaluations
PWC	- PricewaterhouseCooper
RBV	- Resource Based View
RDS	- Relational Database Service
RFID	- Radio-Frequency IDentification

R&D	- Research and Development
SaaS	- Software as a Service
SENAI	- Brazilian National Service of Industrial Training
VR	- Virtual Reality
VRIN	- Valuable, Rare, Inimitable and Non-substitutable

CONTENTS

1. INTRODUCTION

The term Industry 4.0, officially introduced by the German Government in 2011, describes an organization where employees and machines interact with one another like on a social network, which results in a level of integration and complexity greater than the ones that we currently have in-place at the organizations (KAGERMAN; WAHLSTER; HELBIG, 2013).

To characterize itself as an 'Industry 4.0', the organization pass through a process that is called 'Digital Transformation Process', which is characterized by the application of technologies such as Internet of Things (IOT), cloud computing, big data and the data analytics, that, when merged together, ultimately result in the creation of the Cyber Physical Space - CPS (KHAITAN; MCCALLEY, 2015), which further represents the inter-connection between the physical and the virtual worlds of the organization (SPATH *et al*., 2013).

That creates a scenario that result in challenges and demand changes for a large number of organizational aspects, such as the governance and regulatory frameworks (WEBER, 2013; DOCHERTY; MARSDEN; ANABLE, 2017), the value creation processes (KIEL, 2017; MÜLLER; VOIGT, 2017), the business models (KAGERMAN; WAHLSTER; HELBIG, 2013; KIEL; ARNOLD; VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2017), and also the organizational capabilities (ORLANDI, 2016; ZENG; SIMPSON; DANG, 2017; TEECE, 2018a, 2018b).

However, despite the fact that all those different aspects are affected by the digital transformation process, the changes that it presents is characterized by a very technical background, mostly due to the fact that this process was originated at the engineering and computer science streams. Thus, most academic studies concentrate on the exploration of its technical challenges (LIAO *et al*., 2017), while the economic and business management perspectives are still underexplored at the academy (KIEL, 2017; KIEL, 2017; MULLER; VOIGT, 2017).

More specifically, once we take a closer look into the business administration perspectives, we note that most studies address the business models and the organizational capabilities in isolation from one another (BURNMEISTER; LUTTGENS; PILLER, 2016; ORLANDI, 2016; KIEL; ARNOLD; VOIGT, 2017, ZENG; SIMPSON; DANG, 2017; MÜLLER; BULIGA; VOIGT, 2018). Furthermore, a number of studies address business models perspectives with the utilization of the *canvas* framework, where the scholars usually

aim to map the business model blocks that were most affected by the digital transformation process (KIEL; ARNOLD; VOIGT, 2017; MÜLLER; VOIGT, 2017).

Nevertheless, Baden-Fuller and Haefliger (2013) state that the *canvas* perspective does not allow one to address the questions posed by Chesbrough (2010), related to 'When a novel technology requires a novel business model', and 'When a novel technology combined with a novel business model indeed result in competitive advantage for an organization'.

Regarding Organizational Capabilities, we can see that most studies also address them in isolation, usually aiming to identify which capabilities an organization need to improve or develop in order to digitally transform itself (ORLANDI, 2016; ZENG; SIMPSON; DANG, 2017).

Besides, the literature also demonstrates that small enterprises are still underdeveloped and unsure about their position at the digital transformation process and the Industry 4.0 (SOMMER, 2015; MÜLLER; VOIGT, 2017), and one of the reasons for that seems to be related to the fact that this type of organizations tends to be overlooked at Industry 4.0 studies (SOMMER, 2015; MÜLLER; BULIGA; VOIGT, 2018).

Considering that, the present study aims to provide an extension to the business models and the dynamic capabilities studies at the context of the digital transformation process, thus encompassing a perspective that aims to explore the relationship of those two constructs at this novel scenario.

At the same time, this is aligned with the position of Kagerman; Wahlster and Helbig (2013) that small enterprises need to be better addressed at the digital transformation process due to the importance of those organizations not just to the Industry 4.0, but also for the country's economy, since those organizations usually represent the largest type of industries that a country has (SEBRAE, 2016). Furthermore, this also classifies the present study as being aligned with the current policies developed by the Brazilian government in order to promote the development of the Industry 4.0 (BRASIL, 2016).

To have the research performed, the present study was built upon three main constructs: (1) Digital Transformation Process (also encompassing the Industry 4.0); (2) Dynamic Capabilities; and (3) Business Models, where upon the literature review a framework was constructed (see Figure 17). Using this framework, we analyzed four different organizations, three of those classified as being 'providers' and a fourth one classified as a 'user' of Industry 4.0 technologies. The results demonstrate that the organizations classified as 'providers' developed capabilities that are related to their business models, assisting it with business model changes.

Apart from that, the results also demonstrate that the network contacts and the ecosystem were the organizations are inserted presented a fundamental role for the organizational development, while the organization culture was pointed as one of the greatest barriers for the development of Industry 4.0 at the Brazilian scenario, being considered a barrier even greater than the technology limitations.

For a better understanding, the present study is organized as follows: The next subsections will expand the present introduction, thus encompassing the theoretical and practical justification and also the research problem with its objectives. After that, section two will encompass the theoretical background of the study, where we aim to present the literature related to the study constructs and also explore the relationships between them. After that, section three encompass our methodology, thus describing the approaches that we use to grant validity and reliability to the study. Later, section four encompass the case studies of our research, thus presenting the individual case analysis and also the cross case analysis. And lastly, section five presents our conclusions, also encompassing the study limitations and future research directions.

1.1. THEORETICAL AND PRACTICAL JUSTIFICATION

Despite the fact that the digital transformation process and the Industry 4.0 are two research streams that receive more academic attention over the past years, these streams are still very recent. Moreover, if we consider the relationship that they have with technology and engineering it's easy to see that these concepts ended up having a very technical background (KAGERMAN; WAHLSTER; HELBIG, 2013). Due to that, it received more academic attention on the areas of engineering and computer science, where studies usually explore its technical challenges (LIAO *et al*., 2017).

At the other hand, the economic and business management perspectives have received less attention from the academy (KIEL, 2017), which resulted in concepts such as business models (RUDTSCH ET. AL., 2014; WAITZINGER; OHLHAUSEN; SPATH, 2015; BURMEISTER; LÜTTGENS; PILLER, 2016), and dynamic capabilities (ORLANDI, 2016; ZENG; SIMPSON; DANG, 2017) to be still overlooked.

That scenario is demonstrated at the study of Liao *et al*. (2017), where the authors perform a bibliographic review of 224 papers, aiming to identify the main research streams, journals and congresses that had published about the subjects 'Industry 4.0' and 'digital transformation process'. Upon that, the authors identify that of the reviewed papers, 41% and

28% were respectively related to computer sciences and engineering streams, while the remaining 31% were shared among other 13 different areas of research.

Moreover, considering journal publications, Liao *et al*. (2017) identify 25 journals that had published papers about the subjects. However, of the 224 papers that were analyzed, only 40 were published at journals and all of them were related to the areas of computer science and engineering.

If we take a closer look to the study of Liao *et al*. (2017) it's also possible to note the prominence of published papers involving institutions located at Germany, since despite the fact that the authors had reviewed only papers published entirely in English, 186 out of the 224 papers had at least one author from a Europe research institution or University, being 128 of them specifically from Germany. Thus, a research gap related to studies that explore the digital transformation process and the Industry 4.0 outside the European perspectives can be identified.

Due to the lack of studies related to the business administration perspectives, Kiel (2017) perform a bibliographic review of 82 papers, aiming to identify the business administration streams that had published studies related to digital transformation process and the Industry 4.0. Upon that review, the author identifies that the main streams at the area of business administration are: human resources management and Industry 4.0 implementation techniques (responding for around 60% of the papers); supply chain management (responding for 24%); business models (with 13%); and law and regulatory aspects (with 3%).

At the study performed by Kiel (2017), we can also note the prominence of publications related to German institutions, since 63 out of 82 papers had at least one author from a Germany institution and of those, 36 were written entirely in the German language.

If we take a closer look to the business models stream, we can note an emphasis of the literature to identify which ‘items’ of the business model most affected due to the digital transformation process (BURNMEISTER; LÜTTGENS; PILLER, 2016; MÜLLER; VOIGT, 2017). At those studies, the business model perspective proposed by Osterwalder (2004), and Osterwalder and Pigneur (2010) named business model *canvas* is widely used as the framework of analysis (ARNOLD; KIEL; VOIGT, 2017; KIEL, 2017; MÜLLER; VOIGT, 2017; KIEL; ARNOLD; VOIGT, 2017).

However, Baden-Fuller e Haefliger (2013) state that the questions posed by Chesbrough (2010) related to ‘when a novel technology requires a novel business model’; and ‘when the combination of a novel business model with a novel technology indeed result in

competitive advantage for an organization', are not possible to be answered by the *canvas* perspective.

That can be observed at studies that use the *canvas* perspective, since most of those seek understand which 'blocks' of that perspective were changed due to the digital transformation process, not addressing what assisted those changes to be made or if those indeed result in competitive advantage for the organization. Apart from that, most studies explore the construct business models by itself, without relating it to a more grounded theoretical background that could provide support for the questions related to modifications and innovations of those models.

On the other side, some studies also seek to explore the dynamic capabilities perspective at the digital transformation process (see HYLVING, 2015; ORLANDI, 2016; ZENG; SIMPSON; DANG, 2017; HELFAT; RAUBITSCHEK, 2018), where the authors usually explore the dynamic capabilities with a more in-depth approach, but without having it related to the business models scenario.

Considering that, this study aims to propose an extension of the previously ones, thus aiming to go beyond the approaches that explore business models (BURNMEISTER; LUTTGENS; PILLER, 2016; KIEL; ARNOLD; VOIGT, 2017, MÜLLER; BULIGA; VOIGT, 2018) and dynamic capabilities (ORLANDI, 2016; ZENG; SIMPSON; DANG, 2017) in isolation from one another, where we propose to explore the dynamic capabilities considering the proposition of Teece (2018), who states that business models are directly related to dynamic capabilities and that business models innovations are possible due to the dynamic capabilities.

Apart from that, an analysis of studies related to the digital transformation process also points to another justification for the present study, which is related to the challenging scenario that it poses for micro and small enterprises (MSEs), as those are more sensitive to changes promoted by technologies (SOMMER, 2015; GANZARAIN; ERRASTI, 2016; MÜLLER; VOIGT, 2017; MÜLLER; BULIGA; VOIGT; 2018). Furthermore, the literature demonstrates that despite this challenging scenario, and also the importance of those organizations for the Industry 4.0 (KAGERMAN; WAHLSTER; HELBIG, 2013), most studies related to the Industry 4.0 and the digital transformation process end up by analyzing only larger organizations, usually multinational ones (SOMMER, 2015; MÜLLER; BULIGA; VOIGT, 2018).

That situation contributes for the fact that small organizations are still underdeveloped when compared to larger ones at the digital transformation process, thus

resulting in a scenario where small companies have difficulties to even define their position at such process (SOMMER, 2015; MÜLLER; VOIGT, 2017).

The study of Müller, Buliga and Voigt (2018) is one of the few exceptions that better explore the relationship between the digital transformation process and the business models at small organizations. At their study, the authors point that a misalignment of information can be noted when one considers the practitioners' perception regarding the impact that Industry 4.0 will cause at their companies. More specifically, the authors point that the literature suggests that the Industry 4.0 will results in large impacts for all organizations and their business models. However, the practitioners of small organizations believe that these modifications will result in only adjustments to their models.

According to the authors, it is still too early to provide a precise information about the impact that digital transformation will cause to the business models and capabilities of MSEs, since only a few studies have been performed at those organizations. Apart from that, the digital transformation process and the Industry 4.0 literature are still on its early days, where there's still a lack of studies that use business administration approach to analyze this scenario.

The lack of studies regarding small organizations is further described by Sommer (2015), where the author performs a detailed review of nine studies that had explore the relationship between small organizaions and the Industry 4.0. Upon that, the author states that there's a directly relationship between the development level of the Industry 4.0 and the size of the organizations.

The study conducted by Sommer (2015) also points that the main concerns of small organizations with the digital transformation process are: (1) Insecurities about new technologies; (2) Incapacity of analyzing the benefits at that scenario; (3) Investment costs that are too expensive; and (4) The internal qualification of workforce.

Nevertheless, those organizations are extremely important for both the Industry 4.0 (KAGERMAN; WAHLSTER; HELBIG, 2013), and also for the country's economy as those usually represent the largest part of organizations that a country has (SEBRAE, 2016).

At the Brazilian scenario for example, there are around 6.4 million of enterprises, and of those, 99% are classified as MSEs, responding for 52% of the formal workforce of the private sector (16,1 million of employments) (SEBRAE, 2018).

Thus, considering the importance of the Industry 4.0, and also the challenges faced by the organizations, the German government (KAGERMAN; WAHLSTER; HELBIG, 2013), and also governments from other countries started to take actions in order to promote

its development. Examples include the American Government (REIF; SHIRLEY; LIVERIS, 2014); the French Government (CONSEIL NATIONAL DE L'INDUSTRIE, 2013); the Chinese Government (LI, 2015); the Japanese Government (CABINET OFFICE, 2015); and also the United Kingdom Government (FORESIGHT, 2013). Apart from that, a research named 2016 Global Industry 4.0 Survey, conducted by the PwC institute demonstrate that countries like Brazil, India and South Africa are also adopting policies to promote and develop the Industry 4.0 concepts (PWC, 2016a).

Specifically at the Brazilian scenario, the National Confederation of Industry (CNI), conducted in April of 2016 a special survey named Industry 4.0: a new challenge for Brazilian industry, with the objective of access the currently development of Brazilian industries towards the Industry 4.0. The results demonstrate that Brazil is still underdeveloped when compared to other countries that are currently investing at the Industry 4.0.

More specifically, the Brazilian organizations that attended to the survey demonstrate that the largest barriers to their development are (1) the lack of qualified workforce; (2) the currently infrastructure of telecommunications, which is still underdeveloped in most regions; (3) the challenges to identify potential technologies and partners; and (4) the lack of appropriate founding for the digital transformation process.

Moreover, the research conducted by CNI demonstrate that 34% of the organizations signaled in at least one question the option "Do not know/No answer", which also sustain the position of by Sommer (2015) and Müller and Voigt (2017) regarding the lack of knowledge, that small enterprises face upon the Industry 4.0, since most organizations of that survey are classified as small ones.

Further, these organizations believe that the government should adopt policies to promote and develop the telecommunications infrastructure, educational models and also training programs regarding the Industry 4.0 and the digital transformation process (CNI, 2016).

Aiming to address that request, the Brazilian Government launched in October of 2017 the ‘Brazilian Agenda for the Industry 4.0’, aiming to promote the development of the Brazilian industry towards the Industry 4.0 (BRASIL, 2017). In December of the same year, the Industry Federation of the State of São Paulo (FIESP) promoted the first Brazilian Congress of Industry 4.0, with the objective to discuss the Industry 4.0 impact at the Brazilian industries (FIESP, 2017).

At the state of Paraná, the Industry Federation of the State of Parana (FIEP) promoted in November of 2017, the International Symposium - Paraná and Baden-

Württemberg, aiming to discuss the concepts of the Industry 4.0 and the opportunities for Brazilian and German companies (FIEP, 2017).

In 2018, FIEP also promoted the event 'Workshop and Mentoring: Industry 4.0', with the objective of access the challenges faced by Brazilian companies with the Industry 4.0 and also trace a roadmap for those companies to assist their development (FIEP, 2018).

Considering those items, this research study has as a theoretical justification the fact that it aims to better explore the relationship between the dynamic capabilities and the business models in a scenario that was still not properly explored (the digital transformation process), thus aiming to expand our understanding about the relationship between business models and dynamic capabilities while at the digital transformation process. By using that approach, the present study also contribute with the literature related to the microfoundations of the dynamic capabilities at environments of rapid change (TEECE, 2007; AMBROSINI; BOWMAN, 2009), with the recent body of literature that address the development of dynamic capabilities at the digital transformation process (HYLVING, 2015; ORLANDI, 2016; ZENG; SIMPSON; DANG, 2017; HELFAT; RAUBITSCHEK, 2018) and also at the body of literature that aims to better comprehend the development of dynamic capabilities at emerging economies (KALE, 2010; DIXON; MEYER; DAY, 2014; WILLIAMSON, 2016), since these economies have an institutional context that is different than other countries (WRIGHT *et al*., 2005).

Besides that, the present study also could also provide a baseline for future studies that want to explore the relationship between the dynamic capabilities (TEECE; PISANO; SHUEN, 1997; TEECE, 2007) and business models at the digital transformation process, since according to Teece (2018a) business models are directly related to dynamic capabilities and their innovations are possible due to those capabilities.

Regarding the practical justification, the present study is justified by the fact that it addresses the scenario of MSEs, thus addressing organizations that tend to be overlooked at the digital transformation process. Thus, the results can further assist not just the organizations that plan to enter the digital transformation process but also the ones that already enter that process, as they could can review their strategies to better address this process.

Apart from that, the present study is also aligned with the governmental policies that aim to promote and develop the digital transformation process and the Industry 4.0 at the Brazilian scenario. Thus, the results of the present study could assist the elaboration of

governmental policies that could promote the organizational development towards the Industry 4.0.

1.2. RESEARCH PROBLEM

Considering the theoretical and practical justifications provided, the present study has a theoretical background that encompass three main constructs: Digital Transformation Process (also encompassing the Industry 4.0); Dynamic Capabilities; and Business Models. Upon that, the research problem for the present study was defined as: **How the dynamic capabilities relate to business models on small enterprises related to the digital transformation?**

1.3. OBJECTIVE

1.3.1. General objective

Considering the research problem, the general objective for this research was defined as: **Analyze how the dynamic capabilities relate to business models on small enterprises related to the digital transformation.** To achieve that objective, the following specific objectives were defined.

1.3.2. Specific objectives

a) Measure the development level of the organizations at the digital transformation process according to the selected maturity model;
b) Describe the organization business model according to the selected perspective;
c) Explore the dynamic capabilities processes of Sense, Seize and Reconfigure;
d) Explore the relationship between dynamic capabilities and the business models;

Considering what was described at this first section, the next section encompasses the theoretical background for the study, further exploring its three main constructs.

2. THEORETICAL BACKGROUND

2.1. THE DIGITAL TRANSFORMATION PROCESS AND INDUSTRY 4.0

This first section provides a summary of the industrial (r)evolutions that happened so far, later addressing in more detail the Industry 4.0 and the digital transformation process. After that, we address some approaches identified over the literature to measure the Industry 4.0 development within the organizations.

2.1.1. The industrial (r)evolutions that happened so far

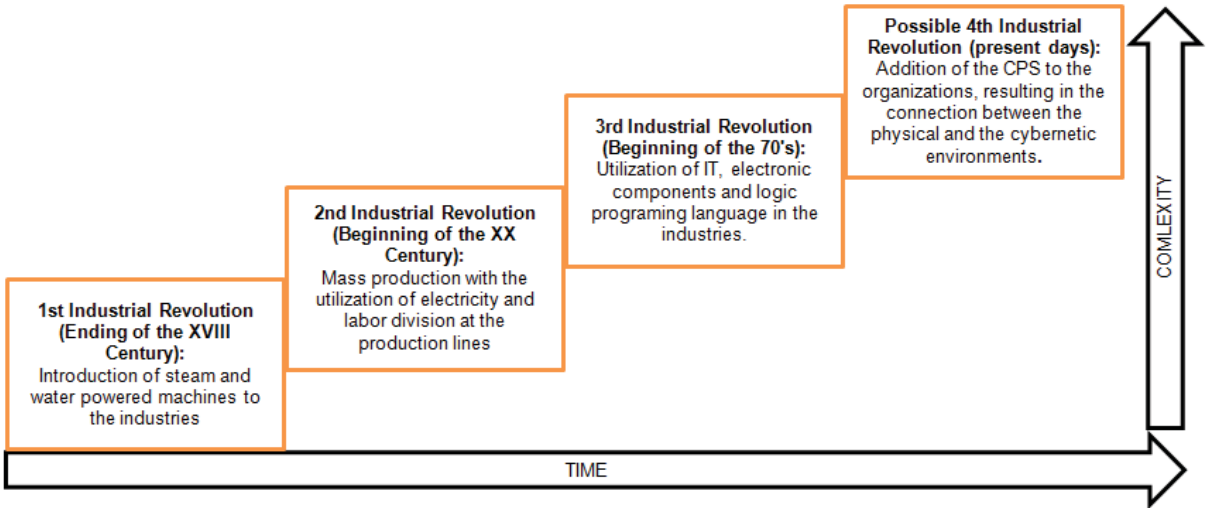
The literature points that up to now three industrial revolutions have occurred (LIAO *et al*., 2017). The first one took place around the end of the XVIII century, and introduced the steam and water powered machines to the industries (like the first mechanical tear, assembled in 1784) (KAGERMAN; WAHLSTER; HELBIG, 2013). The second one, which occurred around at the beginning of the 20th century, have as its main characteristic the use of electricity at the industries (KAGERMAN; WAHLSTER; HELBIG, 2013; DOH; DESCHAMPS; DE LIMA, 2016). And the third one, which occurred around the 1970, added the logical programming languages, the electronic components and the information technology (IT) to the working facilities, which resulted in a higher automation level at the organizations (KAGERMAN; WAHLSTER; HELBIG, 2013; DOH; DESCHAMPS; DE LIMA, 2016).

The Industry 4.0, which was officially introduced by the German government in 2011, represents the ambition that this government had for its manufacturing sector for the next few years (KAGERMAN; WAHLSTER; HELBIG, 2013). At the literature, some authors characterize the Industry 4.0 as the fourth industrial revolution (KAGERMAN; WAHLSTER; HELBIG, 2013; KALVA, 2015; KIRAZLI; HORMANN, 2015; DOH; DESCHAMPS; DE LIMA, 2016).

According to those authors, that revolution is characterized by a close connection between the physical and cybernetic components of an organization, which is achieved by the integration of technologies such as the internet of things (IOT), the cloud computing, the big data and the data analytics (FRANCALANZA; BORG; CONSTANTINESCU, 2016). That integration creates what is called Cyber Physical Space - CPS (KHAITAN; MCCALLEY, 2015), which allow an in-depth integration between the organization components, thus presenting the potential to generate even more disruptions than the other (r)evolutions

previously did (KAGERMAN; WAHLSTER; HELBIG, 2013). In this sense, figure 1 summarizes these four industrial (r)evolutions, correlating their time with their complexity, according to the perspective of Kagerman, Wahlster and Helbig (2013).

FIGURE 1 - THE FOUR INDUSTRIAL (R)EVOLUTIONS



SOURCE: Adapted from KAGERMAN; WAHLSTER; HELBIG (2013).

2.1.2. The Industry 4.0 and the digital transformation process

The Industry 4.0 is not characterized by the creation of new technologies but by an integration of already existing technologies, which thus result in the creation of the CPS (KHAITAN; MCCALLEY, 2015).

That CPS can be defined as being the connection between the physical and the virtual worlds (SPATH *et al*., 2013), in a scenario where IT systems are connected to the mechanical, electronic and human resources of an organization (KIEL *et al*., 2016).

The implementation of the CPS at the organizations occurs through a process that is called **digital transformation process**, which ultimately result in the creation of a Smart Factory (SHROUF; ORDIERES; MIRAGLIOTTA, 2014). This factory can be considered the practical application of the Industry 4.0 concepts, in a scenario where humans, machines and resources are connected to one another like on a social network (KAGERMAN; WAHLSTER; HELBIG, 2013).

Considering that, the present research defines the Industry 4.0 according to the final report of the Industry 4.0 Working Group, where the Industry 4.0 is defined as:

> "The technical integration of the *Cyber Physical Space* (CPS) into the manufacturing and logistics processes, and the use of Internet of Things and

> Services (IOTS) in the industrial processes. Which will have implications for value creation, business models, downstream services and the working organization as a whole." (KAGERMAN; WAHLSTER; HELBIG, 2013, p.14).

However, despite the fact that this definition is the one provided by the *Industry 4.0 Working Group*, which is a member of the National Academy of Science and Engineering from Germany (*Deutsche Akademie der Technikwissenschaften* - *ACATECH*), the complex core that it presents result in a scenario where both the Industry 4.0 and the digital transformation process ended up by having a large amount of definitions (LASI *et al*., 2014; IVANOV *et al*., 2016), and although most of the definitions aim to characterize the application of the CPS to the industrial processes, those definitions ended up presenting inconsistencies when trying to properly define those two concepts (SADEGHI; WACHSMANN; WAIDNER, 2015; KANG *et al*., 2016). Considering that, panel 1 summarizes some definitions that are related to the Industry 4.0, in order to provide a better comprehension of those.

Porter and Heppelmann (2014) also provides a classification for the application of technologies such as IOT to the organizations. According to the authors, we are currently facing the third IT wave. In this sense, while the first wave promoted the automation on industries value chain activities during the 70's and 80's (PORTER; MILLAR, 1985); and while the second one promoted the integration of the individual activities through the internet (PORTER, 2001); the third one is characterized by the addition of IT to the product itself (PORTER; HEPPELMANN, 2014). Due to that, this wave has the potential to promote innovations to products and processes that are even greater than the ones presented by the previous two (PORTER; HEPPELMANN, 2015).

Considering that, the Industry 4.0 is characterized as being inserted in a digital and connected environment (KIEL, 2017; MÜLLER; VOIGT, 2017), which result in changes to the inter-organizational network governance (WEBER; 2013; DOCHERTY; MARSDEN; ANABLE, 2017; TREQUATTRINI *et al*., 2017), to the value chains (KAGERMAN; WAHLSTER; HELBIG, 2013); to the innovation and creation of new business models (RUDTSCH *et al*., 2014; BURNMEISTER; LUTTGENS; PILLER, 2016; ARNOLD; KIEL; VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2018); and also to the development and/or improvement of new dynamic capabilities at organizations (HYLVING, 2015; ORLANDI, 2016; ZENG; SIMPSION; DANG, 2017; HELFAT; RAUBITSCHEK, 2018).

PANEL 1 - DEFINITIONS OF SOME TERMS RELATED TO THE INDUSTRY 4.0

TERM	DEFINITION	AUTHORS
CPS	The integration of technologies such as the IOT, the cloud computing, the big data and the data analytics, resulting in the connection between the physical and the virtual worlds.	SPATH *et al*., 2013; SHROUF; ORDIERES; MIRAGLIOTTA, 2014.
IOT	The application of the internet to home based devices, allowing the capture and analysis of data that can assist in the decision making process and the user experience.	Brazilian Association of Internet of Things (ABINC, 2017).
IIOT	The application of the internet to machines and other industry resources, allowing the computational analysis and the collaborative work, thus resulting in changes and more operational effectiveness to various industry sectors, such as transportation, manufacturing, energy and services goods.	Brazilian Association of Industrial Internet (ABII, 2017).
Smart Factory	Industry where the CPS was implemented through the digital transformation process, thus being characterized as a practical application of the Industry 4.0 concepts.	KAGERMAN; WAHLSTER; HELBIG, 2013.
Cloud Computing	Computational model that allows an on-demand access through the internet to a pool of shared and configurable resources that is scalable according to user demands.	MELL; GRANCE, 2011; KALTENECKER; HESS; HUESIG, 2015.
Big Data	Location where large amounts of data (usually gathered from smart devices connected to the internet) are stored to be later processed and analyzed.	KAGERMAN; WAHLSTER; HELBIG, 2013.
Data Analytics	Software that has the capability to perform data analysis and thus assist with the identification of patterns and relevant information that can generate competitive advantage for organizations.	CHOU; TRIPURAMALLU; CHOU, 2005.
Digital Transformation Process	Process through which the CPS is implemented in an organization in order to have it transformed into a smart one.	KAGERMAN; WAHLSTER; HELBIG, 2013; VEZA; MLADINEO; GJELDUM, 2015

SOURCE: The author (2019).

Those changes does not occur only due to the digital transformation process inside the organization itself, but also due to the expansion that the CPS has to outside the Smart Factory (KAGERMAN; WAHLSTER; HELBIG, 2013), thus connecting that organization to

other smart concepts that are discussed at this scenario, such as the Smart Mobility (CASSANDRAS, 2017; DOCHERTY; MARSDEN; ANABLE, 2017); Smart Logistics (GREGOR; KRAJCOVIC; WIECEK, 2017; HOFMANN; RUSCH, 2017); Smart Buildings (CARR *et al*., 2017; LILIS; KAYAL, 2017)*;* Smart Products (PORTER; HEPPELMANN, 2014, 2015) and Smart Grids (CARR *et al*., 2017; PARK; KIN; YONG, 2017). To provide a better understanding of those concepts, panel 2 provides a summary of their definitions, and figure 2 provides a conceptualization of their interconnection according to Kagerman, Wahlster and Helbig (2013), where the CPS (orange circle) connects the smart concepts, thus allowing the data that is generated to be stored in a central location (Big Data).

PANEL 2 - DEFINITIONS OF THE SMART CONCEPTS

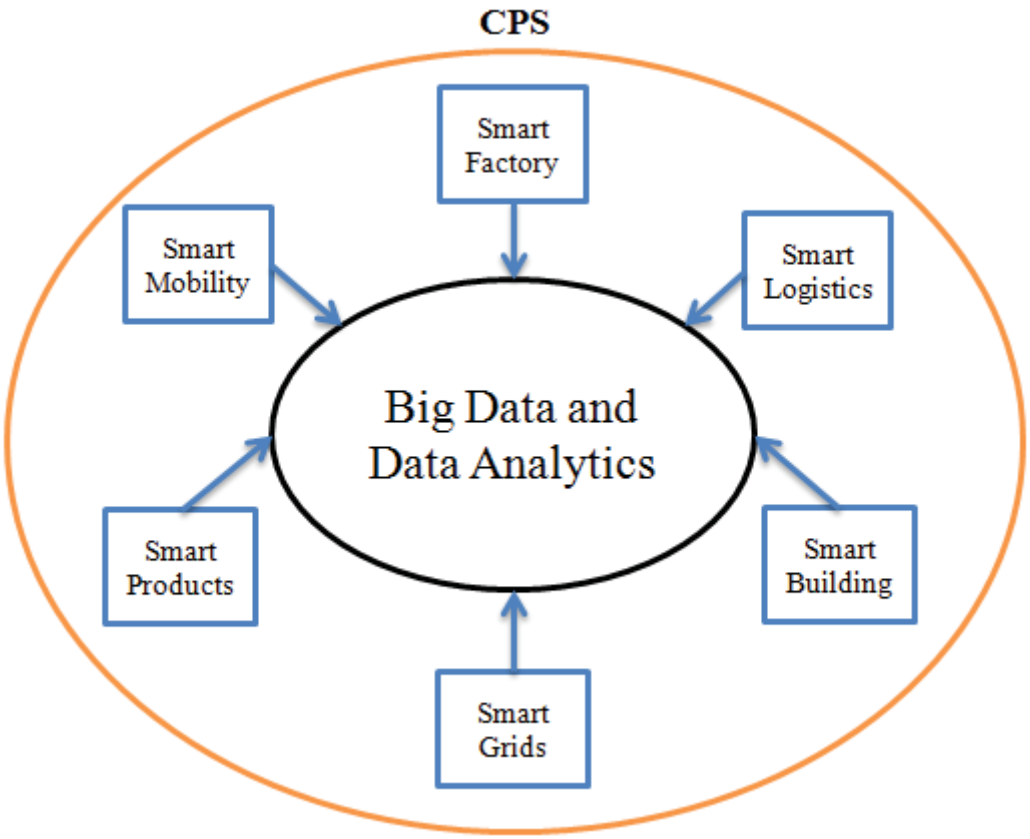
TERM	DEFINITION	AUTHORS
Smart Mobility	The application of technologies and the utilization of sensors and software's on the transport sector and its components, thus generating a more intelligent mobility of persons and things.	DOCHERTY; MASDEN ANABLE, 2017.
Smart Logistics	The utilization of advanced technologies such as Mobile Robotic Systems (MRS); Mobile automated platforms; cloud computing and IOT, to create a scenario where the company logistics can become completely automated and capable to respond to changes to the production systems in a rapidly and efficient way.	GREGOR; KRAJCOVIC; WIECEK, 2017.
Smart Building	The integration of IOT to the information technology and communication systems, allowing buildings to be more autonomous, scalable and adaptable to the user demands, thus becoming more safe and responsive.	LILIS; KAYAL, 2017.
Smart Products	Products that are composed by complex systems that compromise hardware, software, sensors, storage, connectivity and microprocessors, thus being able to recognize the details about how they were assembled and how they will be used, which results in new functionalities and possibilities of utilization.	PORTER; HEPPELMANN, 2014.
Smart Grids	The utilization of IOT and other technologies such as smart meters and artificial intelligence to the electrical and distribution devices, which results in more control on the distribution and consumption of energy.	CARR *et al*., 2017.

SOURCE: The author (2019).

That expansion and interconnection among those smart concepts is also demonstrated by Porter and Heppelmann (2014), where the authors state that before the IOT,

the competition relied on a product functionality, but nowadays the competition encompasses a production system with a broader aspect, where a pool of different products and inter-related and external information are coordinated and optimized, thus resulting in a scenario that virtually expands itself to outside the organization.

FIGURE 2 - THE INTERCONECTION OF SMART CONCEPS THROUGH THE CPS



SOURCE: Adapted from KAGERMAN; WAHLSTER; HELBIG (2013).

2.1.3. The measurement of the digital transformation process

Due to the complexity related to the digital transformation process, and also considering the challenges that this process imposes for organizations, a number of instruments and maturity models were created in order to measure this process (KIRAZLI; HORMANN, 2015).

An example is the maturity model constructed by Schumacher, Erol and Sihn (2016), where the authors create a model based on five other maturity models that were available over the literature (The Connected Enterprise Maturity Model (ROCKWELL AUTOMATIONS, 2014); I 4.0 Reifegradmodell (FH - OBERÖSTERRE, 2015); IMPULS - Industrie 4.0

Readiness (LICHTBLAU *et al*., 2015); Empowered and implementation strategy for Industry 4.0 (LANZA *et al*., 2016); and Industry 4.0 - Digital Operations and Assessment (PWC, 2016b)).

Their maturity model that is composed by 62 variables, which are grouped in nine dimensions (Strategy, Leadership, Customers, Products, Operations, Culture, People, Governance, and Technology), that will measure the organization in five levels, where 1 (one) represents the entry level and 5 (five) represents an organization that has completed the process. In this sense, to be characterized as a Smart Factory, the organization must achieve level 5 in all nine dimensions (SCHUMACHER; EROL; SIHN, 2016).

However, their model also presents some limitations that does not makes it the most suitable option to be used at the present study. The most critical one is the fact that the model provided by Schumacher, Erol and Sihn (2016) used for its foundation other maturity models that are provided by consulting organizations, and those have a lack of literature that better supports the variables used for their creation.

Another model that is being widely used at the practitioner field is the one provided by ACATECH, which encompasses six levels (Computerization, Connectivity, Visibility, Transparency, Predictive Capacity, and Adaptability). According to that model, while the first two levels are characterized by the digitalization of the organization, the other ones are related to a scenario closer to the Industry 4.0, where the last can be considered the Smart Factory. That maturity model encompasses four distinct areas that organization must develop in order to digitally transform itself: (1) Resources; (2) Information Systems; (3) Culture; and (4) Organizational Structure.

However, a more in-depth analysis of that model demonstrate that its applicability might be compromised when one wants to analyze a small organization, since the model is related to larger organizations that already demonstrate a good development level towards the Industry 4.0.

Aiming to provide a model that would be more feasible for other types of organizations, the PricewaterhouseCooper institute (PwC) created a maturity model that can be applied not just to highly developed organizations, but also to newcomers to the digital transformation process (PWC, 2016a). That model measures the organization in 7 areas:

- Business models and access to customers;
- Digitalization of products and services;
- Vertical and horizontal digitalization of the value chain;

- Data analysis as a key capability;
- Agile IT architecture;
- Conformity; security, legal and tributary aspects;
- Organizational aspects, employees, and digital culture.

Each area is measured in 4 levels, where 1 represents an organization that entered the process, and 4 represents an organization that can be classified as a Smart Factory (PWC, 2016a).

Despite that, the model provided by PWC does not have an academic background and also does not properly address the small organizations, since the annual revenue, for example, is measured in a scale that varies from "More than 3 billion Euros, to "Less than 100 million Euros", and thus even the lowest available option is way out of the scope of small organizations.

Despite that, an interesting fact about the PWC model is that it was one of the models used for the creation of the maturity model developed by the Brazilian National Service of Industrial Training (SENAI) which is a model that aims to address the Industry 4.0 at the Brazilian organizations. However, that model restrict the data to be used by only by the SENAI institute, which thus does not make it suitable to be used at the present study.

Upon that and aiming to analyze other available models in order to identify one that would fit the objectives of the present study, the study performed by Leyh, Martin and Schäffer (2017), was reviewed. At their study, the authors review 31 different maturity models related to the digital transformation process and the Industry 4.0.

To have it done, the authors analyze each of those 31 models considering two main groups: (1) their general criteria; and (2) the implementation aspects of the Industry 4.0. Inside each group, specific items were analyzed in a scale varying from of 1 to 5: (1) criteria not explored; (2) criteria only indirectly explored; (3) criteria was mentioned; (4) criteria is partially explored; and (5) criteria is fully explored. Panel 3 summarizes the items analyzed in each of these groups.

Aiming to select a maturity model that would assist us to measure the digital transformation process under the perspective of business models and dynamic capabilities we imposed some restrictions aiming to identify a model that encompassed a holistic scenario, a business application approach, and also an assessment of the Industry 4.0.

Considering that, four models were analyzed to check their applicability to the present study: Juffer *et al*. (2012); Veza, Mladinei and Gjeldum (2015); Long, Zeiler and Bertsche (2016), and Qin, Liu and Grosvenor (2016).

PANEL 3 - ANALYZED ITEMS FROM EACH GROUP

GROUP	ITEM
General Criteria	Manufacturing environment; Holistic Industry 4.0 concept; Software (S) / Hardware (H) consideration; Lean production principle; Business application; Mathematical / statistical aspects; Assessment of Industry 4.0 suitability.
Implementation aspects	Horizontal integration across value networks; Vertical integration; Production life cycle management/consistency of engineering; Employees as a conductor in the value network.

SOURCE: Adapted from LEYH, MARTIN, SCHÄFFER (2017)

From the reviewed models, the one performed by Veza, Mladineo and Gjeldum (2015) was not classified as a suitable one for the scenario being explored at our research. The reason for that is because at their model, the authors aimed to assist organizations to perform a partner selection when considering new value chains. In other words, the authors use a Multi-Criteria Decision-Making (MCDM) process named PROMETHEE (Preference Ranking Organizations Method for Enrichment Evaluations), thus resulting in a scenario where a mathematical model was applied based to the organizations characteristics to analyze the preferable option to create an Innovative Production Network (which according to the authors is a temporary alliance of enterprises that cooperate with the support of computer networks, thus sharing their skills, core competences and resources to better respond to business opportunities (VEZA; MLADINEO; GJELDUM, 2015. p.556).

Thus, their study does not present a "maturity model" that classifies the organization according to its development towards the Industry 4.0, but a model that can assist the organizations to select their partners to better develop themselves towards the Industry 4.0.

Nevertheless, some points regarding the Digital Transformation process and the Industry 4.0 can be observed at study of Veza, Mladineo and Gjeldum, (2015). More specifically, the authors stress the fact that smart organizations need to encompass both specialization and flexibility, due to the fact that those will be inserted in an environment

where “competitors will have similar opportunities and where customers will want personalized product[s].” (VEZA; MLADINEO; GJELDUM, 2015. p.555).

Upon that, the authors state three main features of a smart organization: (1) Production of smart and personalized products; (2) Integration of multiple products and services into a single and extended product; and (3) High level of collaboration through production networks.

A similar situation is demonstrated at the research study of Long, Zeiler and Bertsche (2016). At their study, the authors use the Extended Colored Stochastic Petri Nets (ECSPN) to model a productive system in the Industry 4.0 scenario, which results in a study that has an engineering approach to measure production systems, thus also not making it suitable for the present studies objective.

Nevertheless, the study performed by Long, Zeiler and Bertsche (2016) also presents some business points regarding the Digital Transformation Process, such as the fact that organizations need to have a high degree of variability, flexibility, agility, adaptability, and also a well-developed self-organization process (LONG; ZEILER; BERTSCHE, 2016), which thus involves the networking and the integration of several organizations (KAGERMAN; WAHLSTER; HELBIG, 2013). At the same time, Long, Zeiler and Bertsche (2016), also points the need of a high degree of communication both inside and also outside the organization.

A slightly different scenario is described by Qin, Liu and Grosvenor (2016), where is pointed out that technology reviews alone are not enough to understand the performance of the technology application. At their study the authors describe a categorical framework that is composed by two main dimensions (1) The intelligence level; and (2) The automation level. That results in a scale that varies from 1 to 9 regarding the company development towards the Industry 4.0, and according to the authors, the higher the development level, the higher will be the flexibility, the automation and the intelligence of the measured system (QIN; LIU; GROSVENOR, 2016).

However, as stated by the authors, their scale measures the development of an organization towards the Industry 4.0 considering only items of its production systems. Thus, although their model encompasses some technological capabilities such as single-station automated cells; automated assembly system; flexible manufacturing system; computer-integrated manufacturing system; and reconfigurable manufacturing system, which are necessary technological assets to develop an smart factory, their model is still more related to an engineering approach instead of a business one, mostly due to the fact that the authors set

the background of the study upon the technological gap that nowadays exists between the current manufacturing systems and the Industry 4.0 manufacturing systems.

And lastly, following a similar scenario from the previously ones, the study performed by Juffer *et al*., (2012) address the performance factor of an organization towards the Industry 4.0. At their study, the authors aim to explore the concept of Virtual Factory Framework, which according to the authors is sustained by four main pillars: (1) Development of a holistic data model with a non-deterministic and collaborative procedure; (2) Development of a virtual factory manager; (3) Development of decoupled functional modules; and (4) Development of a knowledge repository and good practices (JUFFER *et al*., 2012. p.44-45). Thus, their study explores a more holistic view of a smart factory. However, their study is still very rooted on the engineering area, as the authors measure the performance of the factory according to production engineering principles, thus encompassing a model that is rooted in three main items: monitoring, optimization, and re-design of engineering processes (JUFFER *et al*., 2012. p.47).

Nevertheless, some business items are also pointed by the authors, where according to them the organizations need to: (1) Have a customer oriented principle; (2) Exploit the potential of the identified technology to achieve higher performance; (3) Increase the efficiency of all available resources; and (4) Exploit the identified human potential and their relative skills and knowledge (JUFFER *et al*., 2012).

Thus, these four studies that were reviewed only slightly address the scenario related to the business administration stream. However, they do provide some very useful information regarding the digital transformation process. More specifically, the information provided assist to differentiate between the what is called 'Organizational Transformation' and the 'Digital Transformation'. Thus, information collected from those studies were taken into consideration when preparing our interview guide and also during the analysis phase, thus allowing a better comprehension and a more valid approach to differentiate between these two types of transformation.

Apart from those models, a very interesting scenario was identified at the model provided by Ganzarain and Errasti (2016), where the authors describe a three stage maturity model for small organizations towards the Industry 4.0. Their model was designed based on the study performed by Erol, Schumacher and Sihn (2016). Considering that, Ganzarain and Errasti (2016) describes a maturity scale composed by five levels:

- 1 - Initial: Where at the organization still does not have any specific Industry 4.0 vision;

- 2 - Managed: Where there is an Industry 4.0 vision present at the organization;
- 3 - Defined: Where customer segments, value proposition and key resources are already defined at the organization;
- 4 - Transform: Where the organization is transforming its strategy into concrete Industry 4.0 projects;
- 5 - Detailed Business Model: Where the organization is performing the transformation of its business model towards the Industry 4.0.

To increase the development level from one to five, the organization can use the three phases model described by the authors, which encompass: (1) Vision of the Industry 4.0; (2) Roadmap for the Industry 4.0; and (3) Projects related to the Industry 4.0 (GANZARAIN; ERRASTI, 2016, p.1124).

Regarding the first phase (Vision), the authors stress the need to perform a capacity and resources analysis, to further develop the organizational understanding and the knowledge related to the Industry 4.0. The second phase (Roadmap) demonstrates the need to identify the requirements for the Industry 4.0, with emphasis to technologies that are related to that scenario. And the third phase (Projects), stress that training and risk management capabilities are necessary for the organization undertake projects that are related to the Industry 4.0.

The scenario described by Ganzarain and Errasti (2016) is thus more aligned with our study objectives, since apart from being related specifically to small organizations, their study (which was built upon the three stage process model described by Erol, Schumacher and Sihn (2016)), results in a model that provide a perspective that consider the digital transformation and the Industry 4.0 not just a matter of technology improvement, but also as something that encompass other organization transformation factors, such as the concepts of co-innovation and strategic road mapping (EROL, SCHUMACHER, SIHN, 2016). Furthermore, their maturity model also considers the business model transformation at the organization, thus being directly related to the scenario here analyzed.

Upon that, the present study used the model provided by Ganzarain and Errasti (2016) as a guide to address the Digital Transformation Process at the organizations. To have this model applied to the organizations, the data collection methods were designed considering the guidelines of the model provided by the authors.

Furthermore, the data collection and the data analysis also took into consideration the information that was provided by the other four studies that were previously reviewed - Juffer *et al*., (2012); Veza, Mladinei and Gjeldum (2015); Long, Zeiler and Bertsche (2016), and

Qin, Liu and Grosvenor (2016) -, since although those studies were more related to the engineering scenario, they also provided very useful information regarding the business application and the technological side of the digital transformation process, thus assisting us to characterize that process and differentiate that from other organizational transformation processes.

2.2. DYNAMIC CAPABILITIES

This section will explore the origins and the conceptualization of the Dynamic Capabilities, its microfoundations, and later its relationship with the business models. Those capabilities are explored according to the literature review, with emphasis to the approach proposed by Teece, Pisano and Shuen (1997); and Teece (2007, 2014), which characterize the dynamic capabilities as an extension of the Resource Based View (RBV) theory.

2.2.1. Origin and conceptualization of the dynamic capabilities

The dynamic capabilities, first approached with this title by Teece and Pisano (1994); and later by Teece, Pisano and Shuen (1997), is considered an extension of the RBV (AMBROSINI; BOWMAN, 2009) that derives from the fundamental question in the field of organizational strategy, which aims to understand "[...] how firms acquire and sustain competitive advantage." (TEECE; PISANO; SHUEN, 1997. p. 509).

The foundation of this perspective refers to the seminal work of Penrose (1959), where its discussed the idea of resource fungibility. According to that idea, the resource nature and its commerciality will affect its diversification (TEECE, 1982). Considering that, Teece points that what was missing for the organizational theory was a “systematic attention to how (entrepreneurial) management can deploy and/or redeploy the non-tradable assets and resources at its disposal.” (TEECE, 2014. p.15).

Aiming to fulfill that gap, the studies of Wernerfelt (1984) and Barney (1991) explored the scenario where the best utilization of available resources resulted in the growth and development of an organization. However, those works only addressed resources that were already available at the organization, thus not encompassing how those resources could be renewed or how new ones could be created (TEECE; PISANO; SHUEN, 1997).

Considering that, the dynamic capabilities aimed to be an extension of the RBV in the sense that it explores the resources renewal of an organization. That perspective was

created upon three main theories: The Porter Five Forces (PORTER, 1980); the Strategic Conflict (SHAPIRO, 1989); and the RBV (PENROSE, 1959; NELSON; WINTER, 1982; TEECE, 1984; BARNEY, 1991) and while the first two theories share the idea that the competitive advantage of an organization is obtained from privileged products and positions in a specific market, the third one stress that the resources and capabilities existing within the organization, and also the ability that the organization has to isolate those capabilities from competitors are the main factors to establish the competitive advantage (TEECE; PISANO; SHUEN, 1997).

In other words, Porter Five Forces and the Strategic Conflicts are theories that address issues ‘between the organizations’, thus aligning those theories with a background related to the ‘Game Theories’. However, if there are huge asymmetries in the competitive advantage between the involved organizations, the results of those theories are easily predictable, since those does not intend to address the entrepreneurial side of the strategy (like how new resources are created and protected) (TEECE; PISANO; SHUEN, 1997; TEECE, 2007).

With a different perspective, and also giving more emphasis to the exploitation of the market to build the competitive advantage, the RBV focus on the internal efficiency of an organization. Thus, an organization does not acquire competitive advantage by engaging in strategic investments, but by having lower costs or by offering products with higher quality or performance (BARNEY, 1991).

Considering that, an organization should have resources that are considered valuable, rare, inimitable and non-substitutable - 'VRIN Resources' (BARNEY, 1991), and to acquire competitive advantage, the organization should implement strategies of value creation that are difficult to be copied by its competitors (EISENHARDT; MARTIN, 2000).

In this sense, the Dynamic Capabilities are considered an extension of the RBV theory since it aims to explore how an organization could renew its resource base (AMBROSINI; BOWMAN, 2009). This approach is sustained by the idea that an organization will be more competitive in the market by providing rapid and flexible answers to products innovation, while also being capable of coordinate, manage and redeploy internal and external competences (TEECE; PISANO; SHUEN, 1997).

Upon that, the Dynamic Capabilities can be defined as "The ability that the company has to integrate, built and reconfigure internal and external competences in order to address rapidly changing markets." (TEECE; PISANO; SHUEN, 1997. p. 516).

According to that definition, the dynamic capabilities are characterized as a perspective that encompass the resources renewal, allowing the organization to perform changes along the way (TEECE, 2007), which thus result in a perspective that provides a valuable focus to address changes at the organizations (AMBROSINI; BOWMAN, 2009).

Furthermore, and aiming to better address the dynamic capabilities, Teece, Pisano and Shuen (1997) provide a differentiation between two types of capabilities that an organization may have: the 'Ordinary Capabilities' and the 'Dynamic Capabilities'. In this sense, the ordinary capabilities (also called operational capabilities) are the ones related to 'do the things right' (TEECE, 2014), while the dynamic capabilities are the ones related to 'do the right things' (TEECE, 2014).

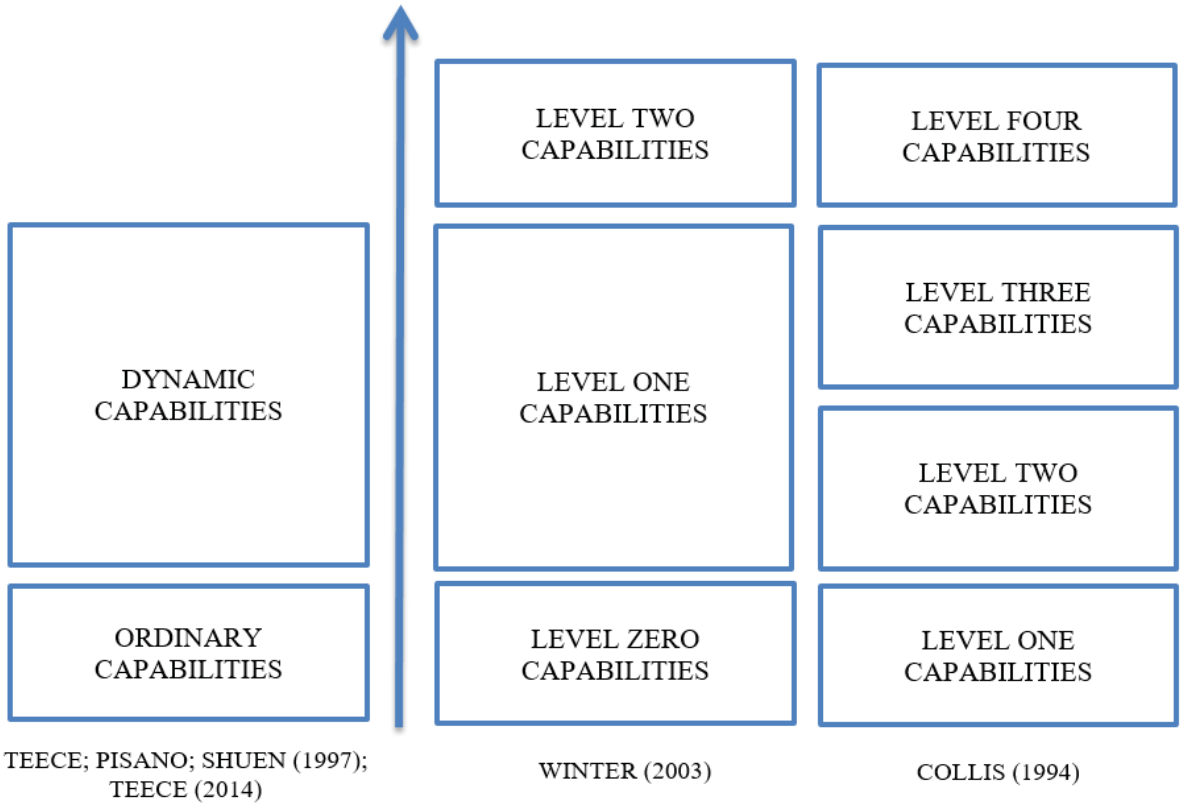
That differentiation was also explored by Collis (1994), where the author provides a differentiation between four types of capabilities. According to the author, the first level of capabilities are the ones that reflect "[...] an ability to perform the basic functional activities of the firm." (COLLIS, 1994, p. 145); the second level capabilities are related to improvements of the dynamic activities of an organization; the third level capabilities represent the ability that the organization has to "[...]recognize the intrinsic value of other resources or to develop novel strategies before competitors." (COLLIS, 1994, p.145); and lastly the fourth level capabilities are related to the concept of meta-capabilities (also called high order capabilities), which are related to the ability that an organization has to 'learn to learn a capability' (COLLIS, 1994).

Considering that perspective, Ambrosini and Bowman (2009) point out that the first level capabilities presented by Collis (1994) can be considered 'Ordinary Capabilities', while the second and third levels can be considered the 'dynamic capabilities'. The fourth level were considered the capabilities that an organization can use to renew its dynamic capabilities.

Winter (2003) also provide a classification for the capabilities that an organization may have, thus pointing to three different types of capabilities: the level zero capabilities (also called operational or ordinary capabilities); the level one capabilities (which are responsible to perform changes at the level zero capabilities, thus characterizing those as being the dynamic capabilities); and the level two capabilities (which will act upon the level one capabilities, thus characterizing those as being the high-order or meta-capabilities).

Figure 3 compares the classification provided by Teece, Pisano and Shuen (1997); and Teece (2014), with the classifications provided by Winter (2003) and Collis (1994).

FIGURE 3 - COMPARASION BETWEEN DIFFERENT TYPES OF CAPABILITIES ACCORDING TO THE REVIEWED LITERATURE



SOURCE: The Author (2019), adapted from COLLIS (1994), TEECE; PISANO; SHUEN (1997), WINTER (2003), TEECE (2014).

Considering that, we can see that both Collis (1994) and Winter (2003) end up by expanding the capabilities perspective provided by Teece, since they add to their perspective high order capabilities that are will act upon the dynamic capabilities (AMBROSINI; BOWMAN, 2009). Furthermore, at panel 4, we´ve summarized the main characteristics of each capability level previously described.

Thus, ordinary capabilities are related to the technical fitness (do the things right); while the dynamic capabilities are related to evolutionary fitness (do the right things) (TEECE, 2014). While technical fitness is related to the performance of a specific capability (AMBROSINI; BOWMAN, 2009), the evolutionary fitness is related to at the concept of at which level a capability can modify or extend the company resource base, thus providing competitive advantage for the long run (TEECE; PISANO; SHUEN, 1997). According to Teece, Pisano and Shuen (1997), the technical and evolutionary fitness are a method to measure how a capability perform its intended function.

PANEL 4 - MAIN CHARACTERISTICS OF EACH CAPABILITY LEVEL ACCORDING TO THE REVIEWED LITERATURE

CAPABILITY LEVEL	MAIN CHARACTERISTICS
Ordinary Capabilities	Can be operational, administrative or related to governance aspects; Only allows a product or service that already exist to be built and/or sold; Related to Non-VRIN resources and organizational practices (including best practices); Cannot support competitive advantage on the long run; Related to 'do the things right'; Supports the Technical Fitness.
Dynamic Capabilities	Emphasizes the questions related to replicability and imitability of organizational processes and positions; Aims to provide competitive advantage on the long run; Related to VRIN resources and signature practices of an organization; Supports the evolutionary fitness; Internal to an organization, thus being impossible to be purchased in the market.
Meta-Capabilities	High order capabilities; Related to the concept of 'capabilities to learn a capability'; Due to its complexity they are extremely difficult to be identified; Tend to go to *'ad infinutum'*, where it's expected that an infinite number of capability levels may exist, as described in the words of Collis (1994, p.148) "it's the capability to develop the capability to develop the capability that innovate faster (or better) and so on."

SOURCE: The Author (2019), Adapted from COLLIS (1994), TEECE; PISANO; SHUEN (1997); WINTER (2003), TEECE (2014).

Ambrosini and Bowman (2009) demonstrate that the technical fitness does not necessarily lead to the evolutionary fitness, and due to that the dynamic capabilities cannot be directly related to the acquisition of competitive advantage.

Considering that, the authors state that the dynamic capabilities will result in competitive advantage on the long run only if "[...]the resulting resource base is not imitated by for a long time, while the rents are sustained." (AMBROSINI; BOWMAN, 2009. p.38). However, if that´s not the case, the result will be only competitive advantage on the short run (RINDOVA; KOTHA, 2001).

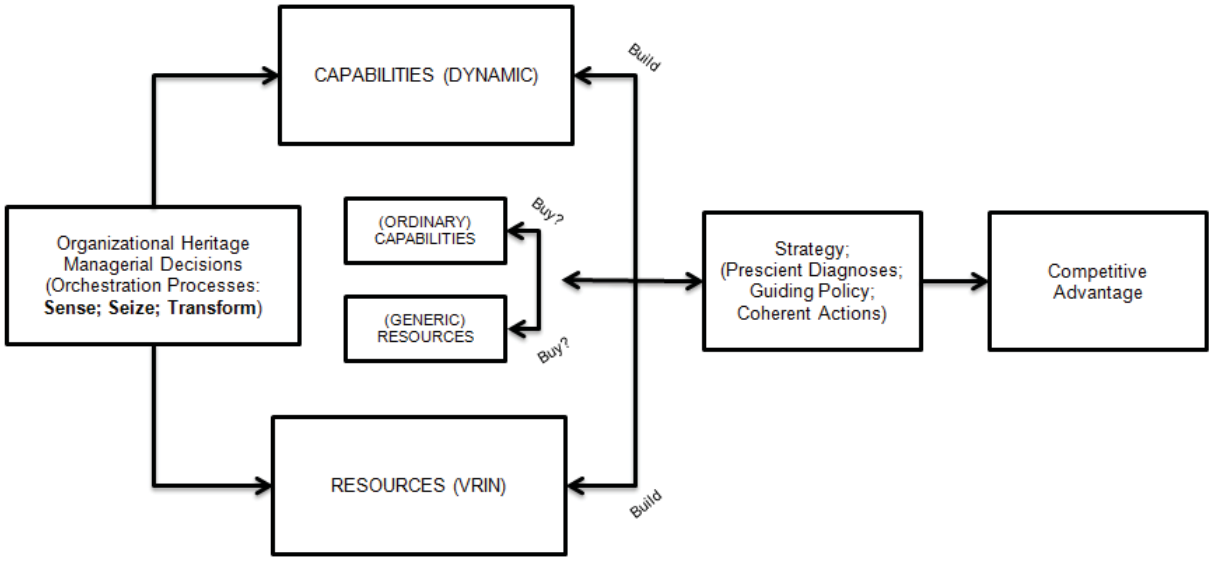
In both cases however, it's important to note that the dynamic capabilities cannot allow the acquisition of competitive advantage by themselves. As stated by Teece (2007), those capabilities can modify the organization resource base, but that modification aligned

with strategies that will prevent the imitation will be the source of competitive advantage for the organization.

The relationship between dynamic capabilities and competitive advantage is also expanded by the study of Teece (2014), where the author address other elements that affect the competitive advantage. With that perspective, one can thus see that the acquisition of competitive advantage goes beyond the dynamic capabilities themselves. However, those capabilities have a fundamental role to allow the competitive advantage to take place at the organization.

At figure 4 we can also note that the Dynamic Capabilities are related to three main processes named **Sense**, **Seize** and **Transform**. Those three processes were explored according to the concept of 'Microfoundations of the Dynamic Capabilities' which was explored in more details at the work of Teece (2007).

FIGURE 4 - RELATIONSHIP BETWEN DYNAMIC CAPABILITIES AND OTHER ELEMENTS IN THE CREATION OF COMPETITIVE ADVANTAGE



SOURCE: TEECE (2014).

2.2.2. The microfoundations of the dynamic capabilities and their approaches in organizational researches

In order to explore the process of Sense, Seize and Transform and their respective microfoundations, we first need to understand the structure of the dynamic capabilities. Considering that, Teece, Pisano and Shuen (1997), and Teece (2007) described a scenario

composed by three main items that sustain the dynamic capabilities: (1) Processes; (2) Positions; and (3) Paths of an organization.

In this sense, processes are related to how things are done at an organization, or in other words they are the organization routines (TEECE, 2007), which characterize them as the mechanisms through which dynamic capabilities are put into practice (AMBROSINI; BOWMAN, 2009). Those include the organizational and management processes; the coordination and integration; the learning; and also the reconfiguration and transformation (TEECE; PISANO; SHUEN, 1997). Due to that, the dynamic capabilities reside, at least somehow, within the management, entrepreneurial and leadership skills that an organization has. Upon that, organizations with stronger capabilities learn not just to better adjust themselves to the environment (TEECE; PISANO; SHUEN, 1997; TEECE, 2007), but also to change the environment where they are located (EISENHARDT; MARTIN, 2000; TEECE, 2014).

Positions, according to Ambrosini and Bowman (2009), can be related to two things. First, Teece, Pisano e Shuen (1997) state that the positions could refer to an **internal position** of the organization, thus representing the resources that this organization has. Those resources can be technological, complementary, financial, reputational, structural, and institutional (TEECE; PISANO; SHUEN, 1997), and according to Teece (2014) those will provide a better position if they are characterized as VRIN resources (as pointed by Teece (2000), a resource is more likely to be classified as VRIN if it is related to intellectual capital, technologies that are specific for the organization, and also know-how). Second Teece, Pisano and Shuen (1997) points to an **external position** of the organization, which represents the relationship that this organization has with the environment where its located. In this sense, the authors point that the organization positions are also influenced by the organizational boundaries (AMBROSINI; BOWMAN, 2009).

Lastly, the paths refer, as the name suggests, to the paths that an organization went through its history. That occurs due to the fact that for the dynamic capabilities, the current position of an organization is largely the result of the paths that this organization went through its history (TEECE, 2007; AMBROSINI; BOWMAN, 2009). In other words, the organizational history maters (TEECE, PISANO, SHUEN, 1997). Upon that, the paths also include the technological opportunities that the organization encountered along the way (TEECE; PISANO; SHUEN, 1997).

Considering that, there´s a consensus over the literature that characterizes the dynamic capabilities as being processes that are shaped by the positions and by the paths of an

organization (TEECE; PISANO; SHUEN, 1997; EISENHARDT; MARTIN, 2000; ZOLLO; WINTER, 2002; TEECE, 2007; AMBROSINI; BOWMAN, 2009; TEECE, 2014; 2018a), and due to that, those capabilities are internal to the organizations, (TEECE; PISANO; SHUEN, 1997, TEECE, 2007, PISANO, 2015), which does not allow them to be acquired on the market, ultimately requesting those to be built by the organization (EISENHARD; MARTIN, 2000; AMBROSINI; BOWMAN, 2009).

Here it's also important to place a difference between the use of the term 'capability' for the dynamic capabilities and for the RBV theory: At the RBV theory, a 'capability' is seen as a **resource** that the organization has, while at the dynamic capabilities, the term 'capability' is not seen as a resource, but as a **process** that is related to the **renewal of a resource base** (EISENHARDT; MARTIN, 2000; TEECE, 2007; AMBROSINI; BOWMAN, 2009; TEECE, 2014), which thus result that the adjective ‘dynamic’ is related to the **modification of the resource base**, and not with the dynamicity of the environment where the organization is located (AMBROSINI; BOWMAN, 2009). However, although the adjective ‘dynamic’ is not directly related to the dynamicity of the environment, that dynamicity also affects ‘how’ the dynamic capabilities are developed and explored by the organizations.

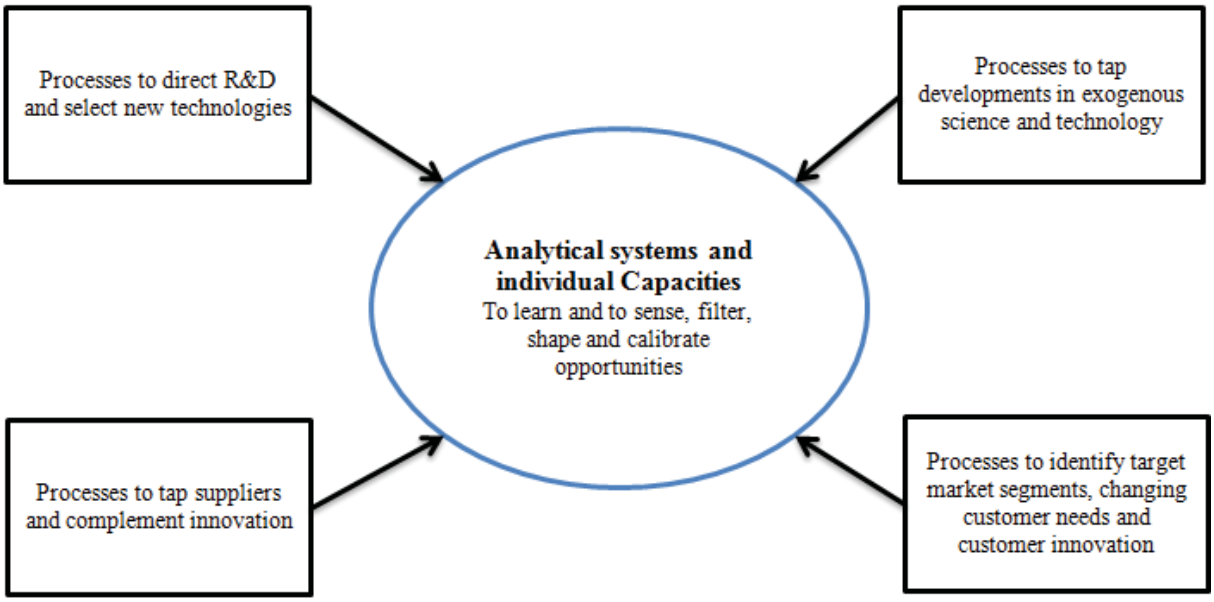
Considering that, the study of Eisenhardt and Martin (2000) expand the dynamic capabilities perspective related to rapidly changing environments proposed by Teece at his seminal paper in 1997. At their paper, Eisenhardt and Martin identify that at markets that present a moderate level of change the dynamic capabilities tend to be more like a set of routines (NELSON; WINTER, 1982), thus being more complex, detailed and built upon an already existing knowledge of linear execution, which results in more predictable outcomes (EISENHARDT; MARTIN, 2000). On the other hand, at markets that present a rapidly change pace (especially high technological environments) (TEECE; PISANO; SHUEN, 1997; TEECE, 2007), the dynamic capabilities tend to be simple and experimental, usually occurring through unstable processes that are sustained by newly created and interactive knowledge, thus requesting modifications at the process that will usually results in unpredictable outcomes (EISENHARDT; MARTIN, 2000; TEECE, 2007, TEECE, 2014).

In both scenarios however, Teece (2007) points that the organizations need to **Sense** the available opportunities and threats of the environment; **Seize** the identified opportunities; and then **Reconfigure (Transform)** its resource base considering what was previously done (TEECE, 2007, 2014). Those three highlighted process are, as Teece (2014) states, the operationalization of the dynamic capabilities, thus allowing those to be built, identified and also explored at the organizations.

Aiming to better explore those processes, Teece (2007) described in his paper the microfoundations of the dynamic capabilities, which is an approach that sustain the operationalization of those capabilities.

According to the author, the first item (**Sense**), refers to the process through which the organization senses the environment where it is located in order to identify threats and opportunities. To have it done, some specific microfoundations assist the organization, which according to Teece (2007) are: (1) The cognitive and creative aspects of the managers and the research and development (R&D) processes developed by an organization; (2) The identification of potential new clients, markets and their needs; (3) The processes related to the development of science and technologies exogenous to the organization; and (4) The processes that aim to explore the supply chain and thus compliment innovations (TEECE, 2007). Figure 5 summarizes the microfoundations related to the process of Sense.

FIGURE 5 - MICROFOUNDATIONS RELATED TO SENSING

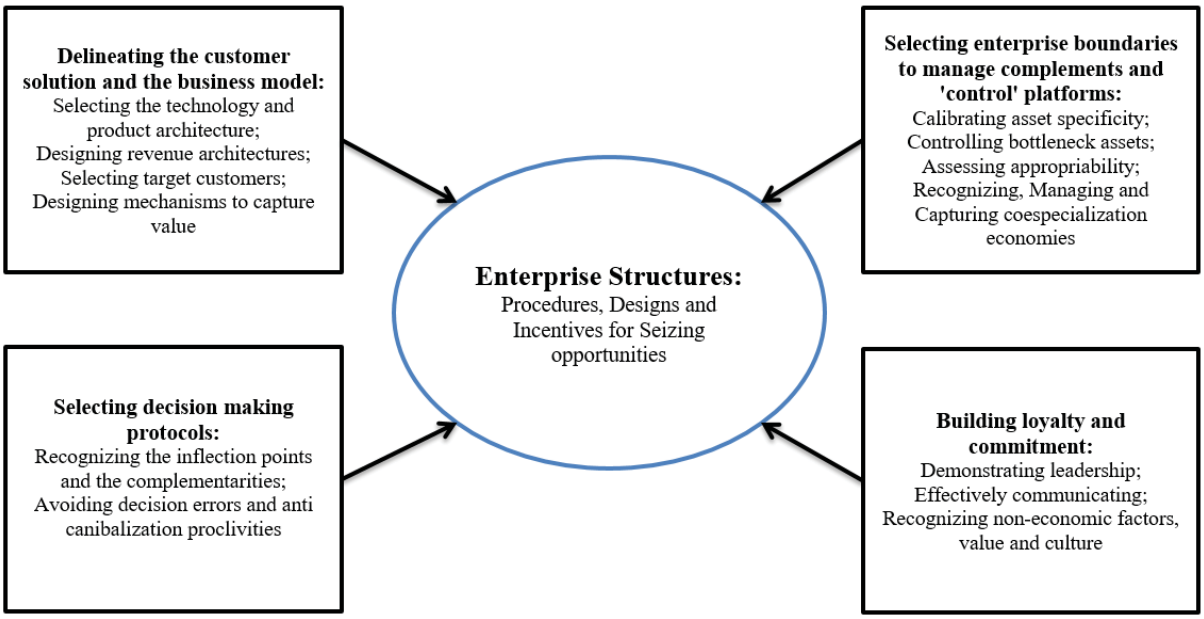


SOURCE: TEECE (2007)

After the identification of a technological or market opportunity, the organization need to explore that opportunity through new products, processes or services (TEECE, 2007). To have it done, the technical and the complementary resources of an organization must be improved. Considering that, the process of **Seize** includes as their microfoundations: (1) The selection of products architecture and business models, as those should demonstrate how the organization will deliver value to its customer and how those customers will pay for the value delivered; (2) The organizational boundaries, since in rapidly changing environments an

organization with boundaries that are properly defined will more easily build and change its business model; (3) The management of the complements and the platforms, as those will emphasize the role of complimentary assets and assets co-specialization; and (4) The processes that aim to avoid the bias, illusion, disappointment and arrogance within the organization, since due to the cognitive aspects of the decision making (NELSON; WINTER, 2002), those can lead to errors that in rapidly changing environments tend to be even more critical due to the small time available to take action and correct the issue (TEECE, 2007). In this sense figure 6 summarizes the microfoundations related to the process of Seize.

FIGURE 6 - MICROFOUNDATIONS RELATED TO SEIZING



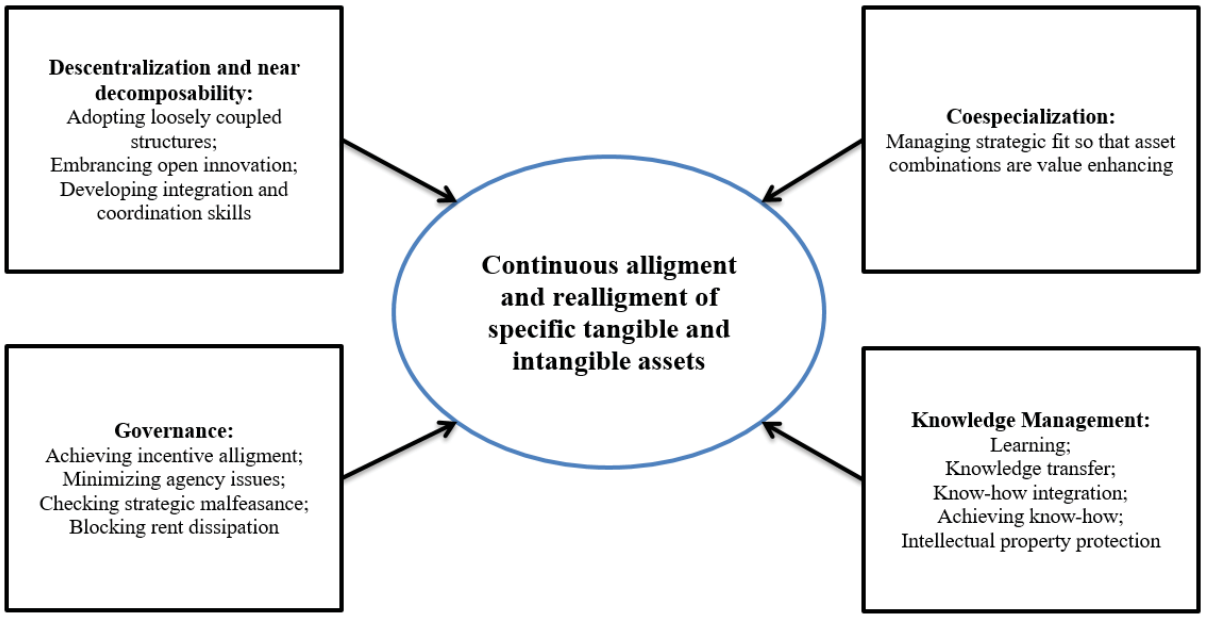
SOURCE: TEECE (2007).

And Lastly, the process of **Reconfigure** (TEECE, 2007), also called **Transform** by Teece (2014) is related to the ability that the organization has to continue the transformation of its resources upon the organization growth and the changes imposed by market and new technologies.

According to Teece (2007), the reconfiguration process have as its microfoundations: (1) The decentralization to a point near to the decomposability, as the organization will hardly remain responsive to customers and to new technologies if it does not demonstrate a high level of decentralization; (2) The co-specialization management, where a co-specialized resource is characterized as a complimentary resource that needs other resources to be used; (3) The knowledge management, which also encompass the learning, and the knowledge

transfer; and (4) The governance, as a structure that support the dynamic capabilities is necessary for them to occur. In this sense, figure 7 summarizes the microfoundations related to the process of reconfiguration.

FIGURE 7 - MICROFOUNDATIONS RELATED TO RECONFIGUING



SOURCE: TEECE (2007).

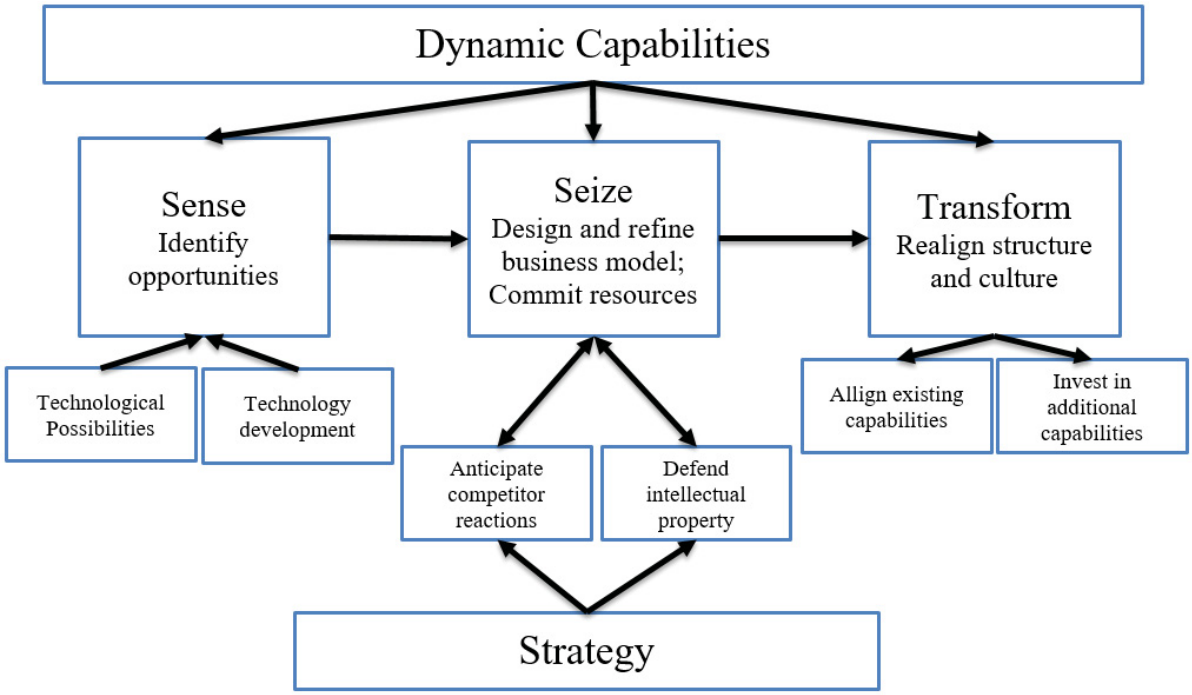
2.2.3. Dynamic Capabilities and Business Models

With the operationalization of the dynamic capabilities through these three processes, some relationship between its microfoundations and the organization business model can be identified. Teece (2007) for example, establishes a relationship between one of the microfoundation of the Seize process and the organization business model, stating that "The capacity an enterprise has to create, adjust, hone, and, if necessary, replace [a] business models is foundational to Dynamic Capabilities." (TEECE, 2007. p.1330). That relationship is also demonstrated at other microfoundations, more specifically with the one related to the organizational boundaries, since according to Teece (2007) an organization with boundaries that are properly defined will better adjust its business model.

That relationship is further expanded at the work of Teece (2018a), where the author points that "Business models are enabled by dynamic capabilities in the sense that a dynamically capable organization will be able to more promptly implement, test and refine new and revised business models." (TEECE, 2018a. p.46).

Considering that, figure 8 demonstrate the framework described at the work of Teece (2018a), where the dynamic capabilities (with the processes of Sense, Seize and Reconfigure/Transform), and the strategy, will be responsible for the creation and revision of organizational business models (TEECE, 2018a). According to the author, the addition of strategy is necessary since it will influence the organization ability to anticipate competitor reactions and also to better defend their intellectual property (TEECE, 2018a).

FIGURE 8 - SIMPLIFIED SCHEMA OF DYNAMIC CAPABILITIES, BUSINESS MODELS AND STRATEGY



SOURCE: TEECE (2018A)

In this sense, the author points that organizations that present ‘weak dynamic capabilities’ tend to adopt business models based on previously investments and already existing organizational processes, while companies with ‘strong dynamic capabilities’ tend to have more freedom to adopt models that involve radical changes to the organization resources and activities (TEECE, 2018a).

Furthermore, Helfat and Martin (2015) perform a bibliographic review related to dynamic managerial capabilities, thus establishing a relationship between these type of capabilities and innovations that might occur at the organizations, where indirectly, some business model related activities can be identified as being affected by the capabilities that an organization develop.

That scenario is further demonstrated at the study of Vicente, Ferasso and May (2018), where the authors analyze the relationship between the dynamic capabilities and the business model innovation on four organizations, thus pointing how the processes of Sense, Seize and Reconfigure influenced the Business Models innovation at the organizations. Upon that study, the authors conclude that the development of dynamic capabilities depends on how knowledge and information are managed and acquired by the organizations, and that the greater is the set of elements present at the business model of the organization, the greater the organization developed its dynamic capabilities.

At their study, Vicente, Ferasso and May (2018) analyze organizations from the IT sector, which presents a rapid change and innovation pace (EISENHARDT; MARTIN, 2000; TEECE, 2007; 2018a), which is also aligned with the digital transformation scenario (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017).

A similar scenario is also demonstrated by Teece (2018a), where the author points out that IOT as a technology that will result in a new wave of innovations for business models, in a scenario where the dynamic capabilities will become even more important for the renewal of resources and for the business models innovation (TEECE, 2018a).

Expanding that perception, Teece and Linden (2017) explore the context of business models and value creation at the digital organization, thus being aligned with the literature related to Industry 4.0 and the digital transformation process (KAGERMAN; WAHLSTER; HELBIG, 2013; RUDTSCH *et al*., 2014; BURNMEISTER; LUTTGENS; PILLER, 2016; ARNOLD; KIEL; VOIGT, 2017; KIEL, 2017; KIEL; ARNOLD; VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2018), where its noticed that more and more elements of the physical world will become sources of data for the organizations (with the utilization of sensors and other technologies related to the IOT) (TEECE; LINDEN, 2017).

Helfat and Raubitschek (2018) also explores the relationship between the dynamic capabilities and business models, stating that at the digital platform based ecosystems, business models rarely emerge fully formed, and due to that the dynamic capabilities play a pivotal role in allowing business models innovations to take place at organizations that are members of the ecosystem.

This further demonstrate that the digitalization process has contributed for the generation of new organization processes and business models (TEECE, 2018a; TEECE; LINDEN, 2017); new dynamic capabilities (HYLVING, 2015; TEECE; LINDEN, 2017; ZENG; SIMPSON; DANG, 2017; HELFAT; RAUBITSCHEK, 2018; TEECE, 2018b), in a scenario where it's expected that organizations with strong dynamic capabilities will manage

to develop business models that will be more suitable for the digital world (TEECE; LINDEN, 2017; TEECE, 2018a).

Considering that, at the next section we explore the construct business model, addressing its definitions, its approaches at the digital transformation and also the literature related to business model innovations.

2.3. BUSINESS MODELS

This section encompasses construct business model, thus addressing the aspects related to the existing perspectives over the literature, its approaches for organizational studies and for the digital transformation process; and also the aspects related to changes and innovations of those models.

2.3.1. The concept and perspectives of business models

Since the 'dot.com boom', which happened around the year of 2000, the research stream of business models started to gain more and more prominence over the years (AMIT; ZOTT, 2001; DOGANOVA; EYQUEM-RENAULT, 2009; WIRTZ *et al*., 2016). Despite that, the problem of having a general and acceptable definition for the term, which roamed this stream on its early days (CHESBROUGH; ROSENBLOOM, 2002), seems to remain till nowadays (LAMBERT AND DAVIDSON, 2013), which created a scenario where the term business model received a large amount of definitions, none of them being considered ‘the most correct one’ (MASSA; TUCCI; AFUAH, 2017).

Considering that large amount of definitions and also aiming to better comprehend why there's a lack of a general and acceptable definition at the academy, Massa, Tucci and Afuah (2017) perform a study analyzing the last ten years of literature related to business models. Upon that, the authors identify three research streams related to business models: (1) Business models as a real attribute of a firm; (2) Business models as cognitive/linguistic schemas; and (3) Business models as formal conceptual representations of how an organization does business (MASSA; TUCCI; AFUAH, 2017. p.76).

While the first stream considers the business models to be an empirical phenomenon (a real attribute of an organization), the second stream considers that managers only hold a ‘picture’ of the organization business models, resulting that those models are severely shaped by the manager cognitive aspects. And the third stream is characterized as an anchor between

the first and the second streams, where the model have a real representation, but that representation is constructed based on the cognitive aspects of the managers. In other words, the model is cognitively constructed by the managers (Second research stream) but is used in an explicit way to represent the organization business (first research stream) (MASSA; TUCCI; AFUAH, 2017).

Moreover, apart from the identification of those three streams, the study of Massa, Tucci and Afuah (2017) also address another question related to the business models, which is the relationship between the construct business models and the construct strategy. According to the authors, two research streams can be identified: A first one considers that the construct business models is "old wine in a new bottle" (MASSA; TUCCI; AFUAH, 2017. p.89), thus encompassing authors that consider that the items discussed at the business models literature were already discussed at the strategy literature, which thus adds very little for the knowledge related to business management (e.g. PORTER, 2001). And a second one, which consider that the constructs business models and strategy are two different things (e.g. CHESBROUGH; ROSENBLOOM, 2002; TEECE, 2010), thus pointing that those two constructs deal with different aspects inside the organizations.

Chesbrough e Rosenbloom (2002) for example, state that according to their perspective, business models are different than strategy in at least three factors. (1) Business Models start to address the value creation according to the organization customers, thus giving, at least in a first moment, less emphasis to the process of value capture. While strategy address both the value creation and the value capture since the beginning of the process; (2) The concepts of value creation have different interpretation when considering strategy and business models streams; and (3) Business models assumes that knowledge is cognitively limited by the practitioners and their previously experiences acquired within the organization, while strategy assumes that there's a large amount of information available, which should then be processes through analytical processes for the decision making to occur (That does not mean that the cognitive limitations are not present within the strategy. They are, but according to Chesbrough and Rosenbloom (2002), those are smaller when compared to the cognitive limitations that are present at the business model stream.)

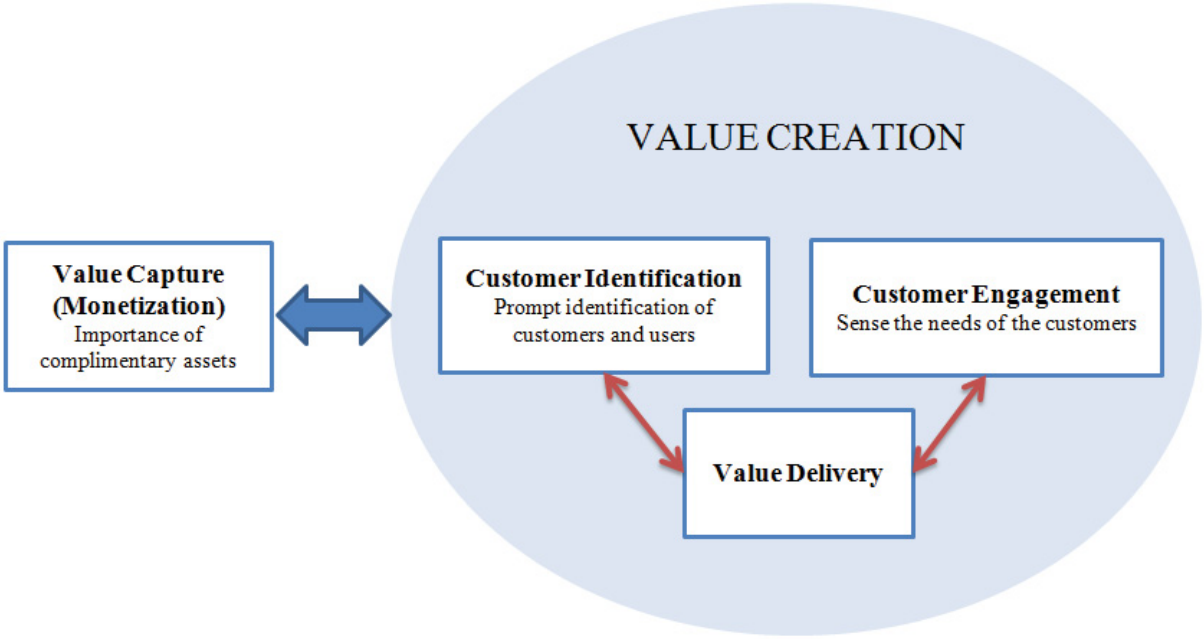
Exploring a different scenario, the work of Baden-Fuller and Haefliger (2013) address the relationship between the constructs business models and technology. Considering that, the authors points that two interpretation lines can be identified over the literature. A first one considers that business models are intertwined with technology, where it's usually discussed questions related to novel and efficient models (BADEN-FULLER; HAEFLIGER,

2013), thus resulting in a closer relationship to the concept of strategy (such as the model proposed by Osterwalder (2004), named '*business model canvas*'). And a second interpretation line, which consider business models as a separate construct from technology, which encompass the definitions provided by Chesbrough and Rosenbloom (2002), Teece (2010), and the authors themselves (Baden-Fuller and Haefliger (2013)). According to the authors, since that line treats business models and technology separately, the questions posed by Chesbrough (2010) ("when do a novel technology does require a novel business model?" and "when do novel technology combined with a novel business model will indeed result in advantage for the company?") can be explored.

Considering that second line, Baden-Fuller and Haefliger (2013) constructed a business model perspective that encompass four main dimensions: Customer Identification; Customer Engagement; Value Delivery; and Monetization). While the **first dimension - Customer Identification** stress that with novel technologies organizations need to promptly identify who will be their customers and users, thus allowing the organization to establish who will pay for the product or service being delivered, the **second dimension - Customer Engagement** stress the need to properly sense the customer/user needs and thus establish the value proposition for them. The **third dimension - Value Delivery** on the other hand, represents the linkage between the identification of customer and users (**first dimension**) with the correct sense of their needs (**second dimension**), ultimately connecting it to the monetization (**fourth dimension**). At that fourth dimension, the authors stress the importance of the complimentary assets (TEECE; PISANO; SHUEN, 1997) for the organization, since those can leverage the monetization especially with 'razor-blade' business models (BADEN-FULLER; HAEFLIGER, 2013). In this sense, figure 9 provides a summary of that model with its four dimensions. Upon that it's further stated that the value creation process encompasses the first three dimensions of Baden-Fuller and Haefliger (2013) perspective (Identification of Customers and Users; Customer Engagement; and Value Delivery).

Moreover, according to that perspective, Baden-Fuller and Haefliger (2013) points that the relationship between business models and technology is two-way and complex, since the business model will influence how the technology is monetized at the organization, and due to that its profitability, while at the same time the 'picture' that the practitioners hold of the model will affect how technology will be developed inside the organization (BADEN-FULLER; HAEFLIGER, 2013).

FIGURE 9 - BUSINESS MODEL PERSPECTIVE OF BADEN-FULLER AND HAEFLIGER (2013) ACCORDING TO THE AUTHOR PERSPECTIVE



SOURCE: The Author (2019), Adapted from BADEN-FULLER; HAEFLIGER (2013)

Upon that, the construct business model was here defined as "A system that solves the problem of identifying who is (or are) the customer(s), engaging with their needs, delivering satisfaction, and monetizing the value." (BADEN-FULLER; HAEFLIGER, 2013. p.419).

Considering that, this present definition is different from the *canvas* perspective (OSTERWALDER, 2004; OSTERWALDER; PIGNEUR, 2010), which is one of the most used definitions among business model studies at the digital transformation process. According to Wirtz *et al*. (2016), the *'business model canvas'* perspective, is an example of definition that encompass a modern technology orientation (where the model is characterized as being more abstract and thus providing a broader representation of the organization).

Furthermore, the *canvas* perspective is composed by four main pillars (Product, Customer interface, Infrastructure management and Financial aspects), and inside those pillars there are nine building blocks that represent the *'canvas framework*' itself. Panel 5 provides a summary of those nine building blocks within the respective pillars, while at figure 10 we demonstrate the relationship between those building blocks, which thus result in the *canvas* framework.

The reason for this exploration of the *canvas* perspective at the present study was the fact that this perspective is been widely used on studies that explore the relationship between

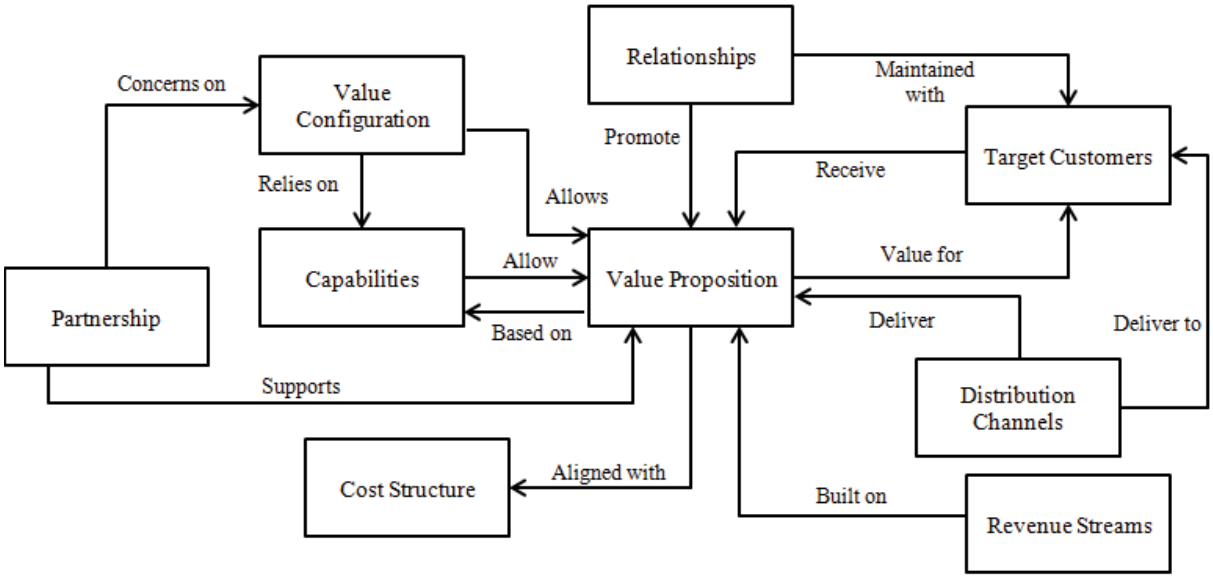
business models and the digital transformation process (KIEL *et al*., 2016; KIEL; ARNOLD; VOIGT, 2017; MÜLLER; VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2018), thus requesting us to understand at least the foundations of the framework, to properly review those studies, which is performed on the next sub-section.

PANEL 5 - THE FOUR PILLARS AND THE BUILDING BLOCKS OF THE CANVAS PERSPECTIVE

PILLAR	BUILDING BLOCK
Product	Value Proposition
Customer interface	Customer Segment
	Channels
	Customer Relationship
Infrastructure management	Value Configuration
	Capabilities
	Partnerships
Financial aspects	Cost Structure
	Revenue Streams

SOURCE: The author (2019), adapted from OSTERWALDER (2004)

FIGURE 10 - THE RELATIONSHIP BETWEEN THE BUILDING BLOCKS OF THE CANVAS FRAMEWORK



SOURCE: Adapted from OSTERWALDER (2004); ARNOLD; KIEL; VOIGT (2017)

2.3.2. Business models and the digital transformation process

Kagerman; Wahstler and Helbig (2013) state that the Digital Transformation process result in changes at the organizations business models, which will occur mostly due to the fact

that the CPS allows the creation of new value chains that are built upon technology elements. Considering that, a recent body of literature aimed to explore questions related to the business models at the digital transformation process (ARNOLD; KIEL; VOIGT, 2017). More specifically, the studies that explored that relationship started to gain more prominence around the years of 2014 and 2015 (KIEL, 2017), one year after the publication of the final report of the Industry 4.0 Working Group.

Nevertheless, most of those studies use the *canvas* perspective as the framework to analyze the organization business models and one of the main reason for that seems to be related to the fact that this perspective is widely used among practitioners, thus resulting in a scenario where a large amount of organizations, consulting institutes, and marketing agencies use that perspective to analyze the organization business model (OSTERWALDER; PIGNEUR, 2010). Summing that to the fact that most of the studies related to the Industry 4.0 have researches that are members of those institutions, the *canvas* perspective is nowadays sustained as one of the most used frameworks to analyze the business models at digital transformation process and the Industry 4.0.

At those studies, the authors usually perform a mapping of the organization business models before and after the digital transformation process, thus identifying which 'blocks' of that perspective changed due to that process.

An example is the study conducted by Kiel, Arnold and Voigt (2017), where the authors use the *canvas* perspective to analyze the model of 76 organizations, thus demonstrating which blocks of the *canvas* perspective were most affect due by the digital transformation process. At their study, the authors identify that the Value Proposition; the Capabilities; and the Partnership, were the most affected blocks, while the less affected one was Customer Segment.

However, those results are different than the ones provided at the study of Müller and Voigt (2017), where the authors use the same perspective to analyze the business models of 68 organizations, thus demonstrating that the Customer Segment was the most affected block.

One of the reasons for that might be the fact that the study conducted by Kiel, Arnold and Voigt (2017) have more than 80% of the sample characterized as large organizations (more than 1000 employees), while the study of Müller and Voigt (2017) has a focus on small organizations, with 44% of the sample represented by organizations that had between 20 and 99 employees, 22% of organizations with less than 19 employees and the remaining 33% by organizations that had between 100 and 500 employees.

Müller and Voigt (2017) also demonstrate that most organizations of their sample tend to classify themselves as ‘users of the Industry 4.0’ (50% of the sample classified themselves as ‘users’, 14% as ‘providers’ and the remaining 36% could not evaluate their position), which demonstrates that MSEs still lack the knowledge related to the digital transformation process, which result that those organizations might not properly address the opportunities that this process promote, leading them to classify themselves only as ‘users’ instead of providers.

This lack of knowledge is pointed as one of the main reasons for the creation of business models that are inefficient for the Industry 4.0 (KAGERMAN; WAHLSTER; HELBIG, 2013), which thus result in small organizations requesting external assistance to this process (MÜLLER; BULIGA; VOIGT, 2018, p.5).

To better the relationship between the digital transformation and the business models Burmeister, Luttgens and Piller (2016) perform a study aiming to identify how organizations innovate their models at the digital transformation process. To have it done, the authors perform 14 interviews with key resources of organizations that had undergone that process. The results demonstrate that the Value Proposition was (just like the study of Kiel, Arnold and Voigt (2017)), the most affected building block.

Again this situation seems to be related to the size of the organizations, since at the study of Burmeister, Luttgens and Piller (2016) none of the organizations had less than 10 thousand employees and an annual turnover of less than 1 billion Euros.

Following a similar analysis line, Müller, Buliga and Voigt (2018) also address the relationship between business models innovation and the digital transformation process. However, here the authors explore that relationship at small organizations.

At their study, the authors identify three main pillars that according to their reviewed literature are related to business models (Value Creation; Value Proposition; and Value Capture). Upon that, the authors analyze organizations that were attending to the digital transformation process, point the items of each pillar that were most affected on the organizations. By using that approach, Müller, Buliga and Voigt (2018) were able to further explore the relationship between business models and dynamic capabilities, pointing the main items of each block that have been affected at the organizations. Figure 11 contain those items at each of the three pillars that were identified by the authors.

FIGURE 11 - ITENS THAT WERE MOST AFFECTED BY THE DIGITAL TRANSFORMATION PROCESS

VALUE CREATION	VALUE PROPOSITION	VALUE CAPTURE
Production Equipment: Increase on productivity; Energy savings and load balance; Higher fault resistence; Fast access to manufacturing data; Machine health monitoring; Increase in-house production; Lower stocks; Easier production maintenance; **Workforce:** Higher employee integration; New types of jobs and workplaces; Technology-based training; Support in failure recognition; **Partners and Suppliers** Higher inter-company connectivity; Co-desing of the value offer; Joint data analysis; Innovative partnership; Higher trasparency and reliability; Increased virtual contact and standardization;	**Products:** Larger product spectrum; Less maintenance required; Versatile and flexible products; Higher quality and output of the production machines; Incorporation of manufacturing data in products and in production management systems; Products tailored to customer demands; Human-machine interfaces; **Services:** Machine retrofitting services; Real time monitoring; Remote maintenance; Digitalization services for customers; Data analytics services; Manufacturing and product simulations; Virtual product development; Engineering and product configuration services;	**Customer Groups:** New customer groups (B2B) Intensification of risks and opportunities for customer retention; **Customer Interaction:** Customer contacted via digital platforms; Easier interaction throught digital communication; Co-desing and Co-engineering with customers; Higher cost transparency; Joint decision making; Value chain integration with customers; Suppliers become more transparent to customers; **Payment Methods:** Digital accounting and automated invoices; Increased payment reliability; Process simplification; Increase in subscription models like pay-per-use and pay-per-feature.

SOURCE: MÜLLER; BULIGA; VOIGT (2018)

Furthermore, the authors were also able to identify that in order to be aligned with the digital transformation process, the organizations should develop business models that aim to:

- **Prioritize the partnerships**, due to the high connectivity between the organizations through the CPS (KAGERMAN; WAHLSTER; HELBIG, 2013; BURMEISTER; LUTTGENS; PILLER, 2016);
- **Be service oriented**, in a process called business model servitization (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017);
- **Provide a greater emphasis on customers**, due to the new relationship channels that are established upon the digital transformation process (KAGERMAN; WAHLSTER; HELBIG, 2013; KIEL; ARNOLD; VOIGT, 2017; MÜLLER; VOIGT, 2017).

These modifications at the business models occur mainly due to the high level of digitalization process and also due to the interconnection of resources both inside and outside the organization, which thus encompasses customers, suppliers and other resources of the value chain (KAGERMAN; WAHLSTER; HELBIG, 2013; LIAO *et al.*, 2017; MÜLLER; BULIGA; VOIGT, 2018).

Another interesting study is the one performed by Arnold, Kiel and Voigt (2017), where the authors perform a review of 13 papers that had studied business model innovations at the digital transformation process. Upon that, the authors identify three possible 'models' related to the Industry 4.0: (1) Service oriented business models; (2) Cloud oriented business models; and (3) Process oriented business models. However, their study also uses the *canvas* framework to create those 'models', where the authors point at each building block the items that were more frequently mentioned on the reviewed studies.

Moreover, the study performed by Arnold, Kiel and Voigt (2017) does not address how those models where changed due to the digital transformation process, and once one take a closer look to the process oriented model, the authors stated that for the blocks Key Partners, Relationship and Channels, the reviewed literature could not point to any indications about a possible configuration.

Considering that, the present study proposes a different perspective of analysis, aiming to explore the relationship between business models and dynamic capabilities at the digital transformation process, since as pointed by Teece (2018a) Business Models and Dynamic Capabilities are directly related to one another, but most studies that explore the digital transformation process end up by analyzing them in isolation.

2.3.3. Business model changes and business models innovations

Once we address the questions related to business model changes and business model innovations, a directly relationship with the literature that consider the model to be a dynamic entity is established (WIRTZ *et al*., 2016).

More specific, upon a literature review, Wirtz *et al*. (2016) states that two different streams that deals with the dynamicity of business models can be identified. A first one considers the model to be a static entity, while a second one consider it to be a dynamic entity (WIRTZ *et al*., 2016).

According to the authors, while most studies had adopted a perspective that consider the model to have a static entity, a recent body of literature (e.g. CAVALCANTE; KESTING; ULHOI, 2011; PUTTEN; SCHIEF, 2012), started to address the dynamicity of business models, and one of the main reasons for that is related to the fact once one address changes and innovation at business models it become extremely difficult to not adopt a dynamic perspective (CAVALCANTE; KESTING; ULHOI, 2011; WIRTZ *et al*., 2016).

Considering that dynamic perspective, Voelpel, Leibold e Teike (2004) state that a distinction between 'business models changes' and 'business models reinventions' is necessary. According to the authors, 'changes' are merely improvements of an already established business model, while 'reinventions' are more in-depth modifications that result in innovations or in the creation of entirely new business models, usually being connected to disruptive technologies or concepts such as 'change the game rules' (HAMEL, 2000).

Cavalcante, Kesting and Ulhoi (2011) go a step further and explore a more in-depth approach related to business models dynamics and innovation, stating that only modifications that affect the core of an organization will reflect in changes to their business model. At their study, the authors use a process perspective to describe four types of business model modifications that can occur at an organization: (1) Creation; (2) Extension; (3) Revision; and (4) Termination. At Panel 6 we´ve summarized their main characteristics.

Thus, if we consider the perspective provided by Cavalcante, Kesting and Ulhoi (2011), we can note that during the business model creation, the subjective and cognitive aspects (the ones based on previous experiences of the entrepreneur) will provide more influence for the business model. However, as times passes by, the authors state that the organizational inertia (HANNAN; FREEMAN, 1984); the path dependency (NELSON; WINTER, 1982); the cognitive manifestations (ISABELLA, 1990); and the questions related to power and politics (EISENHARDT; BOURGEOIS, 1988) will start to appear, thus causing the organizations to face more difficulties to change and innovate their models. (CAVALCANTE; KESTING; ULHOI, 2011).

That result in a scenario where the business model tends to face a influence from the individual capability of the entrepreneur, since this person must identify the need for the change and promptly act to promote it within the organization (LINDER; CANTRELL, 2002; CAVALCANTE; KESTING; ULHOI, 2011; TEECE, 2018a). Besides that, we can note a relationship between the business models modifications and the 'age' of that organization, since already established organizations tend to reinforce what they currently are, aiming to maintain their *status quo* (FLIGSTEIN, 1996).

Considering that, as times passes by the rigidity of the organization tend to increase, which thus results that already established organizations tend to adopt entirely new business models instead of revising already established ones (CAVALCANTE; KESTING; ULHOI, 2011; KIM; MIN, 2015). An example of that situation is demonstrated at the study of Chesbrough and Rosenbloom (2002), where the authors demonstrate that the Xerox company

was able to innovate its models with the addition of new business models through spin-off organizations.

PANEL 6 - THE FOUR TYPES OF BUSINESS MODEL MODIFICATIONS

BUSINESS MODEL MODIFICATION	CHARACTERISTICS
Creation	Transition from ideas to the concretization of the business model; Initial idea present at the subjectivity of the entrepreneur; Large amount of modifications before put in practice .
Extension	Addition of new activities or extension of already existing processes; Exploitation of commercial opportunities considered a key process; Firm must have already defined its key processes; Involves the area related to organizational practices;
Revision	Intervention of already existing processes; Removal of something that results in changes for the already established business model, thus also requesting process to be adapted or created; Involves the change of already established organizations practices; Can occur due to the inefficiency of an already established business models, actions taken by the competitors, and newcomer companies that pose a threat for the already established business model.
Termination	Abandon or removal of process that ultimately result in the finalization of the business model; Can happen with an specific area of business or with a business unit, as long as it has its own business model.

SOURCE: The author (2019), adapted from CAVALCANTE; KESTING; ULHOI (2011)

However, Kim and Min (2015) demonstrate that not all organization perform better after adding an entirely new Business Model, which can also be related to the questions posed by Chesbrough (2010), since those organizations might not properly access the business model addition. Nevertheless, the literature points that business models modifications are

unavoidable nowadays if the organization wants to maintain its competitive advantage (CAVALCANTE; KESTING; ULHOI, 2011; TEECE, 2018a).

2.4. A PROPOSAL FOR A JOINT ANALYSIS OF THE STUDY CONSTRUCTS

The connection between business models and dynamic capabilities is not recent, as already mentioned at the section 2.2.3, Teece (2007) demonstrated the relationship between the microfoundations of the dynamic capabilities and the organization business model, which was later expanded by Teece (2014, 2018a) pointing that business models innovations are possible due to the dynamic capabilities, where the processes of **sense**, **seize**, and **reconfigure** influence how an organization will implement, test, refine and review its business models.

Previously reviewed studies such as the one performed by Vicente Ferasso and May (2018), Teece (2014, 2018a) and Teece and Linder (2017) already explored that relationship, pointing to a directly relationship between the dynamic capabilities and business model innovations

On the other hand, the relationship between dynamic capabilities and the digital transformation process is more recent, where studies usually aim to explore which dynamic capabilities an organization need to improve and/or develop in order to digitally transform itself.

An example of study that address this relationship is the one performed by Zeng, Simpson and Dang (2017), where the authors perform a case study of two Chinese manufacturing organizations, aiming to identify which capabilities assisted the digital transformation process of those organizations. Considering that, the authors identify three main phases that the organizations went through in order to digitally transform themselves: (1) The establishment of a new focus; (2) The focus on the resource transformation; and (3) The co-evolution with the system. At each phases, the authors point specific capabilities that were more important to assist the digital transformation. Panel 7 summarizes these capabilities with their respective phases.

However, although Zeng, Simpson and Dang (2017) address the dynamic capabilities scenario, the authors does not address the business model literature, thus focusing only on the identification of relevant capabilities for the digital transformation process.

Another study that address that relationship is the one performed by Hylving (2015), where the author performs a case study and explored the competing values in the digitalization era. More specifically, the author points to results similar to the ones described

by Zeng, Simpson and Dang (2017), thus stating that new organization structures had to be established to support the dynamic capabilities at the fast changing world.

PANEL 7 - CAPABILITIES THAT INFLUENCED THE DIGITAL TRANSFORMATION PROCESS

PHASE	IDENTIFIED CAPABILITIES
1. Establishment of a new focus	'Unlearning from past experiences; Investment in new resource bases; Construction of a new culture that encompass collective learning.
2. Focus on resource transformation	Experimentation; Development of the already existing resource base; Construction of the extended network.
3. Co-evolution with the system	Institutionalization of flexible routines; Improvement of the organization resources; Coordination of the extended network.

SOURCE: Adapted from ZENG; SIMPSON, DANG (2017)

Furthermore, the author point to three enablers of dynamic capabilities that could assist organizations to have dynamic capabilities developed during the digital transformation process: (1) Persistence, which is related to the continuous work to have an idea developed; (2) Contacts, which emphasizes the importance of having connections with the right people in order to assist the organization to break through the current practices; and (3) Timing, which states that the right timing to take managerial and innovation decisions will reflect upon the output of the organization and its projects.

Helfat and Raubitschek (2018) also explores the dynamic capabilities at the digital era. But when we consider the relationship between organizational capabilities and the digital transformation, we can see that the authors point to three types of dynamic capabilities that demonstrate to be critical for the digital transformation: (1) Innovation Capabilities, which are the ones related to the development of new product and services; (2) Environment scanning and sensing capabilities, which states that the scenario analysis can further assist the organizations to detect and make sense of the necessary changes; and (3) Integrative Capabilities, thus representing the capability of having a reliable, repeatable and coordinated

activity for the introduction of new products and services (which also encompasses other organizations of the ecosystem).

According to Helfat and Raubitschek (2018), while the first two types of capabilities are related to the individual level of the organization, the integrative capabilities expands to outside the organization, thus also being related to other organizations that compose the ecosystem. Furthermore, the authors states that the integrative capabilities are more likely to be the ones that will influence the business model innovations within the system and the platform leader.

Also addressing the ecosystem related to the digital transformation, Teece (2018b) expand the Profiting from Innovation (PFI) Framework (see Teece, 1986) stating that "as companies converge around powerful digital platforms, the development, ownership, and/or control of complimentary assets will/technologies will be central to competitive outcomes" (TEECE, 2018b, p.1385).

Furthermore, the author states that (1) General purpose technologies (the ones that have a wide use; are capable of an ongoing technical improvement; and are capable to enable complementary innovation in application sectors (see Bresnahan and Trajtenberg, 1995 for more details)); (2) Enabling technologies (the ones that are capable of drive technological changes at industries); and (3) The appropriability challenge (which is the scenario where the contribution of the technology is high but pioneers are only able to extract a tiny fraction of the value they create (which are usually present at enabling technologies)), are three items that must take into consideration to expand that framework. As a consequence, value capture of the ecosystem where the digital organizations are located will be affected, and while inside the ecosystem the value capture by individual firms will depend upon the level of its dynamic capabilities and its business model design.

Upon that, complimentary assets will become more important since resources might be scarce in the ecosystem requesting the available ones to complement one another, creating a scenario where co-specialized resources will become a huge source of competitive advantage (BADEN-FULLER; HAEFLIGER, 2013; TEECE, 2018b). In other words, the organization must be to co-evolve with the system (as demonstrated at the study of Zeng, Simpson and Dang (2017)).

If we turn to the relationship between business models and the digital transformation process, we can also see that it started to be recently explored by the literature (see KIEL; ARNOLD; VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2018). At those studies, the authors usually address the topic of how the digital transformation caused business models to be

modified and/or innovated. However, that literature some limitations that were previously described, which thus end up restricting our understanding about how the digital transformation affects the business model changes.

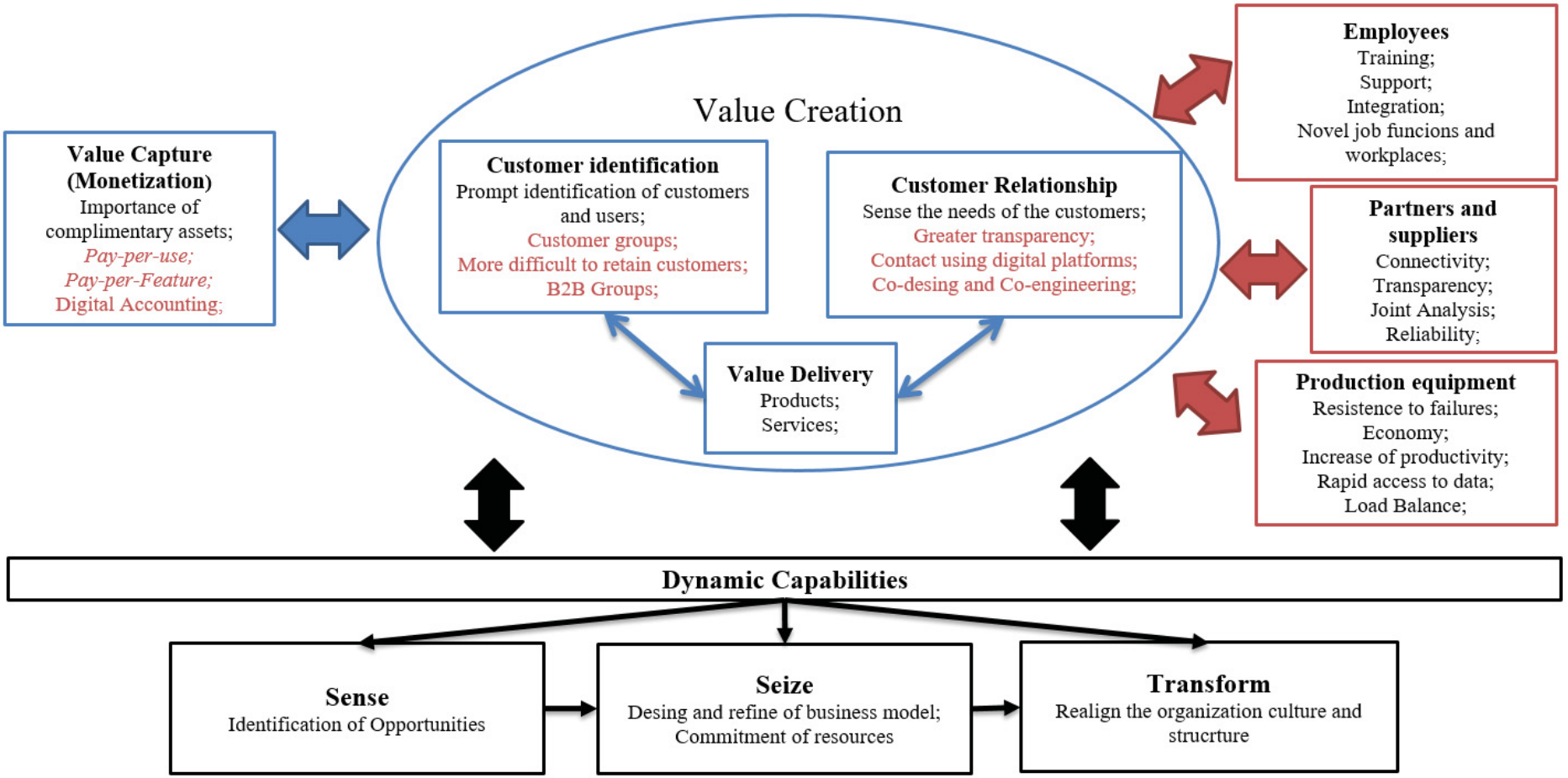
Considering that, the present study aims to provide an extension of the literature related to business models and dynamic capabilities. Upon that, figure 12 represents the theoretical framework for the analysis of our organizational scenario, which was constructed according to the literature review that was performed.

One can thus see that figure 12 is composed mainly by combination of the business model perspective of Baden-Fuller and Haefliger (2013), and the perspective of Müller, Buliga and Voigt (2018), were we added the main items that according to Müller, Buliga and Voigt (2018) will influence the value creation, the value proposition and the value capture of the business model while at the digital transformation process. Furthermore, the proposition of by Baden-Fuller and Haefliger (2013) allows one to address the questions related to novel business models and novel technologies (see Chesbrough, 2010), which are directly related to the digital transformation process. At the same time, the perspective proposed by Müller, Buliga and Voigt (2018) provides a more in-depth approach to the exploration of the digital transformation process at our framework, since it contributes with specific items that according to the authors will influence the business models of mall enterprises at the digital transformation.

Going further with the proposed framework, the dynamic capabilities were added to the model considering the perspectives of Teece (2007; 2014, 2018a), where its stated that the dynamic capabilities will influence the way that business model are innovated, and also Hylving (2015), Orlandi (2016), Zeng, Simpson Dang (2017), Helfat and Raubitschek (2018), and Teece (2018b) where its stated that the dynamic capabilities will influence the digital transformation process. Thus, the processes of **sense**, **seize** and **reconfigure**, which according to Teece (2007, 2014) allows the operationalization of the dynamic capabilities, serve as the base to explore those at the scenario related to the digital transformation process, where according to the microfoundations of each process, the relationship between the dynamic capabilities and the other constructs is explored.

Thus, this scenario is characterized as being a two-way process, since the dynamic capabilities influence both the business model (TEECE, 2007; 2014, 2018a) and the digital transformation process through its items that were added to the framework (ZENG; SIMPSON; DANG, 2017; HELFAT; RAUBITSCHEK, 2018; MÜLLER; BULIGA; VOIGT, 2018).

FIGURE 12 - THEORETICAL FRAMEWORK PROPOSED FOR THE PRESENT RESEARCH



SOURCE: The Author (2019)

3. METHODOLOGICAL PROCEDURES

This section contains the methodological procedures that were used for the present study, presenting the research questions, the constitutive and operational definitions of the constructs, the procedures used for data collection and data analysis, and also the justifications and limitations of the selected method.

3.1. RESEARCH QUESTIONS

The following research questions were elaborate upon the specific objectives of the study in order to better address the operationalization of those objectives (BOAVENTURA, 2004).

a) What's the development of the organizations towards the digital transformation process according to the maturity model selected?
b) What's the organizations business model according to the selected perspective?
c) Which capabilities can be identified upon the processes of Sense, Seize and Reconfigure?
d) What’s the relationship between dynamic capabilities and business models?

3.2. CONSTITUTIVE AND OPERATIONAL DEFINITIONS

The constitutive and operational definitions of the constructs aim to provide a better understanding of their theoretical elements and also explain how these constructs will be operationalized at the study (MARTINS; THEÓPHILO, 2009).

3.2.1. Digital Transformation Process

Constitutive Definition: This constructed was defined considering its relationship with the Industry 4.0, thus encompassing the integration of the cyber physical space (CPS) to the organizational processes, and the use of technologies such as the IOT and the cloud computing at the organizations (KAGERMAN; WAHLSTER; HELBIG, 2013). Upon that, this construct was defined as "The process through which an organization implements the CPS and change its structure, thus aiming to direct itself to the Industry 4.0 and become a

'Smart Organization' (KAGERMAN; WAHLSTER; HELBIG, 2013; VEZA; MLADINEO; GJELDUM, 2015).

Operational Definition: The operationalization of this construct was done upon the maturity model proposed by Ganzarain and Errasti (2016), which maps the development level of the analyzed organization in a scale from 1 to 5 (for instance: 1 - Initial; 2 - Managed; 3 - Defined; 4 - Transform; 5 - Detailed BM). To collect the information and identify this development, specific questions related to each of the levels and also to the three stage development model proposed by Erol, Schumacher and Sihn (2016) and Ganzarain and Errasti (2016) - (for instance: Envision of Industry 4.0; Enablement of Industry 4.0 and Enactment of Industry 4.0) were added to the semi structured interviews that were conducted. Apart from that, items related to the other reviewed maturity models (JUFER *et al*., 2012; VEZA; MLADINEO; GJELDUM, 2015; LONG; ZEILER; BERTSCHE, 2016; QIN; LIU; GROSVENOR, 2016; SCHUMACHER; EROL; SIHN, 2016) were also added to the interviews, thus assisting with the identification of the digital transformation at the organizations. As information was also collected from other sources (non-participatory observation and documental analysis), the information related to the maturity models were also taken into consideration when collecting and analyzing these other sources of information.

3.2.2. Dynamic Capabilities

Constitutive Definition: This construct was defined at the present study as “The process that is shaped by the organization paths and positions, where internal and external abilities, resources and competences are adapted, integrated and reconfigured according to the needs of the market, which thus generate the resource renewal” (TEECE; PISANO; SHUEN, 1997; TEECE; 2007; AMBROSINI; BOWMAN, 2009).

Operational Definition: The operationalization of the dynamic capabilities occurred according to the perspectives of Teece, Pisano and Shuen (1997) and Teece (2007, 2014), thus being built upon the processes of **sense**, **seize**, and **reconfigure** and their microfoundations. Considering that, the operationalization was performed considering what was demonstrated at the figures 5, 6, 7 and 8. In order to collect the necessary information for the

operationalization, semi-structured interviews were conducted with key resources at the organizations and also through the secondary data sources that were used.

3.2.3. Business Model

Constitutive Definition: This construct was defined at the present study as "A system that solves the problem of identifying how is (or are) the customer(s), engaging and satisfying their needs, thus monetizing the value created." (BADEN-FULLER; HAEFLIGER, 2013. p.419).

Operational Definition: The operationalization of the business model construct was performed upon the perspectives of Baden-Fuller and Haefliger (2013), and Müller, Buliga and Voigt (2018), as demonstrated at the figure 9 and at figure 12. Just like the other two constructs, the data was collected with the utilization of semi-structured interviews that were conducted with key resources at the organizations and also from the secondary data that was collected.

3.3. RESEARCH STRATEGY

In order to answer the proposed research problem, the qualitative approach on case study scenario was selected. More specifically, this approach is classified as being multiple and exploratory, with a cross-sectional perspective merged with a longitudinal approximation.

The selected approach is aligned with the perspectives of Eisenhardt (1989) and Yin (2014), since this study aims to answer a research question that is based on 'how something happens at a specific scenario', where the researcher has little or no control over the variables, which thus justify the case study method as being the more suitable one for the described scenario.

The exploratory classification is consistent with the scenario of the Industry 4.0 and the digital transformation process, since this stream is still very little explored, and due to that other studies that also aimed to explore that scenario have used exploratory researches as their method (see KIEL; ARNOL; VOIGT, 2017; ZENG; SIMPSON; DANG, 2017; MÜLLER; BULIGA; VOIGT, 2018). Thus, the present study explores something new, something that was still not fully explored and comprehend, which justify the exploratory method the most suitable one (BENBASAT; GOLDSTEIN; MEAD, 1987; YIN, 2014).

And last but not least, this research is characterized by a cross-sectional approach, which is the default approach for a master's degree research (YIN, 2014). However, we merged that with a longitudinal approximation, which occur upon the interviewees perspective of situations that already take place, and also upon the documental review. The use of the longitudinal approximation aims to assist the verification of changes that occurred at the organizations, thus granting more validity to the observed scenario and for research itself (YIN, 2014).

3.4. CASE STUDY PROTOCOL

According to Yin (2014), the development of a case study protocol is extremely important since it includes (besides the method), the procedures and the rules to be followed during the research. Considering that, the present study followed the protocol panel 8, thus aiming to grant more validity and reliability for the study performed. That protocol was created according to Yin (2014) methodology, and comprehend the following groups: Objectives, Initial procedures, Data collection procedures, Data analysis procedures, and Report writing procedures.

Data was collected primarily with semi-structured interviews, which were conducted with key resources at the organizations. These interviews include a mixture of open-ended and specific questions, thus serving as a script for the interviewer that allow the collection of not just the information foreseen, but also unexpected types of information that could be relevant for the study (SEAMAN, 1999). That type of interview allows both the interviewer and the interviewee to have more freedom, while at the same time the script can be accessed during the interview to make sure that the relevant items are being addressed and that the interview is not drifting away from its main objective (CORBETTA, 2003).

At the present study, its considered key resources the actors located in key management positions for the organization and for the digital transformation process, such as the Chief Executive Officer - CEO and other high level managers; the Chief Information Officer - CIO; the Chief Technology Officer - CTO; and also Engineers, Analysts and Developers that work with technology at the organizations.

The choice of those job functions as key resources is also aligned with other studies that have explored the dynamic capabilities scenario both at the digital transformation process (see ZENG; SIMPSON; DANG, 2017), and also outside it (see DANNEELS, 2010), and also the business models both inside the digital transformation process (see ARNOLD; KIEL;

VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2018) and also outside it (see DOGANOVA; EYQYEM-RENAULT, 2009).

PANEL 8 - CASE STUDY PROTOCOL DEVELOPED FOR THE RESEARCH

GROUP	ITEMS	DETAILS
Objectives	Objectives description	**General Objective:** Analyze how the dynamic capabilities relate to business models on small enterprises related to the digital transformation. **Specific Objectives:** a) Measure the development level of the organizations at the digital transformation process according to the selected maturity model; b) Describe the organization business model according to the selected perspective; c) Explore the dynamic capabilities processes of Sense, Seize and Reconfigure; d) Explore the relationship between dynamic capabilities and the business models;
Initial Procedures	Initial visit to the organizations	Procedures where its aimed to verify if the selected organization was relevant for the study being performed and if the access to the data could be granted.
	Review of preliminary information	
	Verification of necessary access to the organizations	
	Verification of special documents needed for the access	
	Selection of interviewees and other information sources available	
Data collection and data analysis procedures	Definition and Justification of the methods employed	Procedures that aim to standardize the data collection and data analysis procedures, in order to avoid biases and thus grant more validity to the study performed.
	Construction of the database for the study	
	Characterization of the individual case studies	
	Data analysis between the cases	
Report writing procedures	Draft of the report	Procedures that aim to standardize the report writing, thus assisting to have the details and the relevant information from the cases reflected upon the theoretical background.
	Descriptive information of the individual cases	
	Cross-case report	
	Referral to the case study protocol and to the theoretical background	

SOURCE: The Author (2019), based on YIN (2014).

All the interviews were recorded in audio upon the consent of the interviewee. Later, those records were transcribed using the software Express Scribe in order to avoid information to be lost or not utilized. Additional notes were also taken during the interviews in order to collect as much information was possible to increase the validity.

Non-participatory observation was also used if the interviewee gave the consent to do so. According to Breakwell *et al*. (2010) that technique is characterized by the integration of the researcher to the observed group, but with the explicitly intent to observe only. That technique allows the researcher to have access to more material that could be useful for the research (BREAKWELL *et al*., 2010), while at the same time it allows one to capture the perception from the practical point of view of someone that is effectively inside the case being observed (YIN, 2014). Additional notes were also taken during the non-participatory observations in order to increase the amount of data collected and allow a more precise data triangulation.

The utilization of non-participatory observations aimed to collect information that could be omitted by the interviews and also to get a closer look to 'how things were done at the organization', which thus allowed us to more precisely identify practices and processes that could influence what we were analyzing at our study.

Additional data was also collected from documents and archives from the organizations, since according to Yin (2014) these sources of information are relevant for the study as they might contain information that could be omitted by the interviewees.

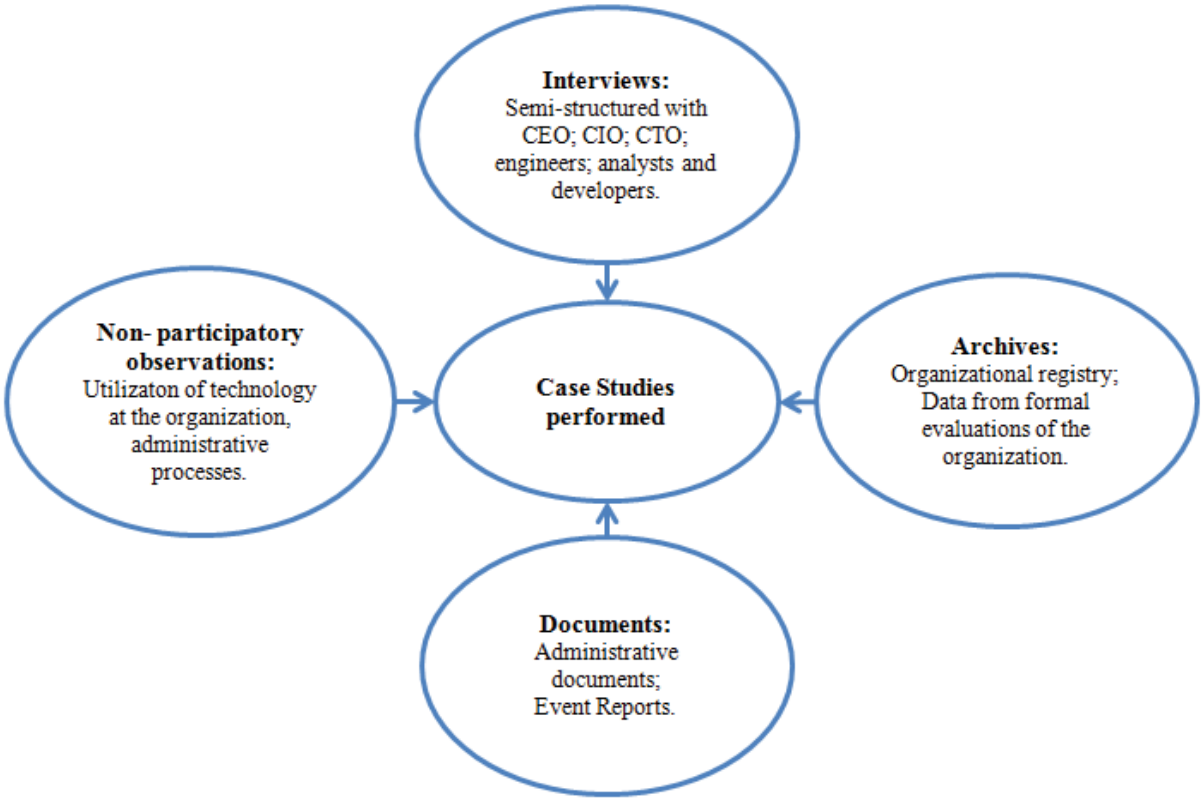
Considering these sources of information, figure 13 summarizes the triangulation procedure that was used for the present study, built upon Yin (2014) methodology.

As stated at the case study protocol, a database was also built for the research. To have it done, all data related to the research was stored in a folder located at a cloud provider infrastructure (Google Drive). A copy of that data was stored in another provider infrastructure (One Drive), in order to avoid a potential data loss that might occur. The objective with this approach was also to create the evidence's chain and connect these evidences to the study conclusions, thus following the three principles of Yin (2014) for case studies: (1) The principle of multiple information sources; (2) The principle of having a database created for the study; and (3) The principle of having the evidence's chain created.

Content analysis procedure was used to explore the data collected (MILES; HUBERMAN, 1994), to which we used the software ATLAS.ti version 7. Upon that, codes were created to analyze the collected material, thus allowing it to be broken and reorganized

into different ways, allowing inference to take place. The table containing the codes that were used for the present study were added at the appendix section (see APENDIX B).

FIGURE 13 - MODEL OF DATA TRIANGULATION USED FOR THE PRESENT RESEARCH



SOURCE: The Author (2019), based on YIN (2014)

Following the case study protocol, the cases were first analyzed individually pointing the interesting findings about each of them to which individual reports were written for each organization in order to provide a more in-depth perspective about the three constructs that were explored. After that, the cases and their individual reports were analyzed together, thus following Yin (2014) prescription about cross-case analysis to have patters and differences identified.

Moreover, Stake (1995) and Miles, Huberman and Saldana (2014) points that the report should be written considering its main public segment. Thus, the reports of the preset study were written using the analytical linear approach, which according to Yin (2014) is the standard choice when the study is related to a master or doctoral degree.

3.5. CASES SELECTION

The selected cases comprehend Brazilian MSEs that were related to the digital transformation process. To classify the organizations as MSE, the definition provided by SEBRAE was used, which thus classifies the organizations according to the following criteria:

- Micro Enterprise: Number of employees (being less than 9 for organizations that provides services and less than 19 for industries), and annual turnover being less than R$ 360.000,00.
- Small Enterprise: Number of employees (being between 10-49 for organizations that provides services, and between 20-99 for industries), and annual turnover between R$ 360.000,00 - R$ 3.600.000,00.

3.6. DATA COLLECTED AND DATA ANALYSIS CRITERIA

To select potential cases for the present study, we got in contact with the Industries Federation of the Paraná State (FIEP) and explained our study objective, providing an executive summary of it. Upon that, a list containing 23 micro and small organizations were sent to us. Of those, we selected 12 organizations that were working with Industry 4.0, digital transformation or with technologies related to those concepts (such as cloud computing, real time monitoring, automation, 3D printing, robotics, virtual reality (VR), augmented reality (AR), big data, IOT, and machine learning).

Apart from that, we also received the list of organizations that had participate in the TECNOVA program at the state of Paraná (for more information about the program see FUNDAÇÃO ARAUCARIA, 2017). That list contained 56 organizations and the respective projects developed by them during the program. Of those, we selected 8 organizations that met the criteria for our study.

To increase the number of organizations, we also got in contact with the Jupter initiative (which is an innovation ecosystem located in Curitiba that provide assistance for startups and organization with innovative ideas). Jupter was selected due to its involvement with Universities, students and also due to the support that it provides to researches.

It was thus sent to us a list of 37 organizations that had participate of their ecosystem. Of those, we selected 5 other organizations to participate in our study. Apart from that, two other organizations were contacted by indication of a friend of the researcher.

In total, from 118 organizations that were provided on the lists and through informal contacts, 27 were selected to be contacted. To contact those organizations, we sent emails to the CEO or other person that would be responsible for managerial decisions at the organizations (if that contact was provided). If that was not the case, the email was sent to the contact provided at the organization website. Apart from that, some CEOs and managers were also contacted via WhatsApp, since some organizations provided that option.

From the 27 organizations that were contacted, 8 have replied to our initial email stating that they were interested in participating at the study. Of those, one organization refused to participate due to time constraints, and three other stopped responding our emails. Considering that, we remained with four organizations to be analyzed at the present study.

After the initial contact and the explanation of the study, we proceed with the signature of the necessary documents, where both the researcher and the interviewees provided their signatures (the signed documents were added to the appendixes of the present research).

To collect the data, the interviews were (whenever possible) conducted face to face with the interviewees. However, due to time and resources constraints, some interviews were conducted using Skype calls. In both cases however, the interviews were recorded and later transcribed using the Express Scribe software. The transcript files were later reviewed in order to check for typo errors that could lead to misinterpretation of the software used for analysis.

In total around 8.7 hours of interview were generated. Panel 9 summarizes the interviews that were conducted with the participant organizations. Apart from that, we also performed three non-participatory observations (which were performed at organizations that we managed to conduct interviews face to face (goEPIK and Organization D). Panel 10 summarizes the non-participatory observations that were performed at the organizations. To further enhance the data collection, we also collected data also from portfolios, folders and other documents available at the organization websites, their social medias and also on their facilities. Panel 11 summarizes the secondary data that was collected for our research.

To further enhance the data analysis, the software Atlas.ti was used, thus aiming to assist with the categorization process to allow patterns and differences to be identified more easily among the organizations.

PANEL 9 - DETAILS OF INTERVIEWS CONDUCTED AT THE PRESENT STUDY

ORGANIZATION NAME	INTERVIEWEE	NUMBER OF INTERVIEWS	TOTAL LENGHT OF INTERVIEWS	METHOD
PackID	CTO	1	55 minutes	Skype Call
	CEO	1	40 minutes	Skype Call
	Developer	1	42 minutes	Skype Call
TauFlow	Executive Director	2	86 minutes	Skype Call
	Engineering Director	1	43 minutes	Skype Call
	Commercial Director	1	48 minutes	Skype Call
GoEPIK	Operations Director	1	60 minutes	Face to Face
	Developer/ Business partner	1	43 minutes	Skype Call
Organization D	HR Manager	1	32 minutes	Face to Face
	Industrial Manager	1	25 minutes	Face to Face
	External Consulting analyst	1	40 minutes	Face to Face

SOURCE: The Author (2019)

PANEL 10 - DETAILS OF THE NON-PARTICIPATORY OBSERVATIONS

ORGANIZATION NAME	OBSERVATION DESCRIPTION	NUMBER OF OBSERVATIONS	TOTAL LENGHT OF OBSERVATIONS
goEPIK	Organization facility in general	1	40 minutes
Organization D	Management team	1	90 minutes
	Production line	1	60 minutes

SOURCE: The Author (2019)

3.7. LIMITATION OF THE SELECTED APPROACH

Despite the fact that the present research was properly conducted, following the guidelines of the case study protocol to have it performed and thus meeting the three principles that according to Yin (2014) are necessary to grant more validity for the study, the selected methodology still have its limitations. First, Yin (2014) states that case studies severe limits the generalization. However, as stated by Stake (1995), generalizations are not the main objective of case studies, as they seek to better understand a specific phenomenon that occurs at a specific environment. Thus, although a multiple case study approach was selected, generalizations should be performed with caution as there are many variables that are very specific to the analyzed organizations.

PANEL 11 - DETAILS OF THE SECONDARY DATA COLLECTED

ORGANIZATION NAME	SECONDARY DATA SOURCES
PackID	Organization website, Linkedin, Facebook, ACATE, Jupter Portfolio, ACE Portfolio
TauFlow	Organization website, Linkedin, Youtube channel, IELPR, FIEP Institute, SAENSE, FIEP Portfolio
goEPIK	Organization Website, Linkedin, Youtube Channel Facebook, IELPR, FIEP Portfolio
Organization D	Organization website, Facebook, Local documents available at the facility

SOURCE: The Author (2019)

Apart from that, the present study also presents limitations related to the data collection and data analysis. Regarding the first one, although multiple sources were used for data collection, that process is usually limited to some pre-established concepts and also from time and resource constraints. Regarding the last one, the analysis will always be limited to the cognitive aspects of the researcher (STAKE, 1995; YIN, 2014). However, the case study protocol was designed to avoid that type of bias, thus including multiple sources of information as well as individual and cross-case analysis (YIN, 2014).

3.8. THEORETICAL MATRIX

In order to correlate the theoretical background with the methodological approach of the present study, the panel 12 and panel 13 contains the theoretical matrix, thus allowing one to visualize the relationship between the research problem and the study objectives with the theoretical background and the methodology used at the research.

Considering the present methodology, the next section will encompass our case studies, where we describe each analyzed organization using both the single case and the cross case analysis.

PANEL 12 - THEORETICAL MATRIX - PART 1

RESEARCH PROBLEM	GENERAL OBJECTIVE	SPECIFIC OBJECTIVES	RESEARCH QUESTIONS	THEORETICAL BACKGROUND
How the dynamic capabilities relate to business models on small enterprises related to the digital transformation?	Analyze how the dynamic capabilities relate to business models on small enterprises related to the digital transformation.	a) Measure the development level of the organizations at the digital transformation process according to the selected maturity model;	What's the development of the organizations towards the digital transformation process according to the maturity model selected?	**DIGITAL TRANSFORMATION PROCES** CHOU; TRIPURAMALLU; CHOU, 2005; MELL; GRANCE, 2011; KAGERMAN; WAHLSTER; HELBIG, 2013; SPATH *et al.*, 2013; LASI *et al*., 2014; PORTER; HEPPELMANN, 2014, 2015; ROCKWELL AUTOMATIONS, 2014; SHROUF; ORDIERES; MIRAGLIOTTA, 2014; KALTENECKER; HESS; HUESIG, 2015; KALVA, 2015; KHAITAN, MCCALLEY, 2015; KIRAZLI; HORMANN, 2015; LICHTBLAU *et al*., 2015; SADEGHI; WACHSMANN; WAIDNER, 2015; KIEL *et al*., 2016; LANZA *et al*., 2016; SCHUMACHER; EROL; SIHN, 2016; DOH; DESCHAMPS; DE LIMA, 2016; GANZARAIN; ERRASTI, 2016; IVANOV *et al*., 2016; KANG ET AL., 2016; PWC, 2016; ABINC, 2017; ABII, 2017; LIAO *et al*., 2017. **DYNAMIC CAPABILITIES** PENROSE, 1959; PORTER, 1980; NELSON; WINTER, 1982, TEECE, 1982, 1984, 1986; SHAPIRO, 1989; TEECE, 1984; WERNERFELT, 1984; BARNEY, 1991; TEECE; PISANO, 1994; COLLIS, 1994; TEECE; PISANO; SHUEN, 1997; EISENHARDT; MARTIN, 2000; TEECE, 2000; WINTER, 2003; TEECE, 2007; AMBROSINI; BOWMAN, 2009; KALE, 2010; DIXON; MEYER; DAY, 2014; TEECE, 2014; HYLVING, 2015; PISANO, 2015; ORLANDI, 2016; WILLIAMSON, 2016; TEECE, LINDEN, 2017; ZENG; SIMPSON; DANG 2017; HELFAT; RAUBITSCHEK, 2018; TEECE, 2018a, 2018b. **BUSINESS MODEL** AMIT; ZOTT, 2001; CHESBROUGHT; ROSENBLOOM, 2002; OSTERWALDER, 2004; VOEPEL; LIEBOLD; TEIKE, 2004; DOGANOVA; EYQUEM-RENAULT, 2009; GAMBARDELLA; MACGAHAN, 2010; TEECE, 2010; CHESBROUGH, 2010; OSTERWALDER; PIGNEUR, 2010; ZOTT; AMIT, 2010; CAVALCANTE; KESTING; ULHOI, 2011; PUTTEN; SCHIEF, 2012; BADEN-FULLER; HAEFLIGER, 2013; LAMBERT; DAVIDSON, 2013; VELU; STILES, 2013; RUDTSCH *et al*., 2014; KIM; MIN, 2015; MARTINS; RINDOVA; GREENBAUM, 2015; BURSMEISTER; LUTTGENS; PILLER, 2016; WIRTZ *et al*., 2016; ARNOLD; KIEL; VOIGT, 2017; KIEL, 2017; KIEL; ARNOLD; VOIGT, 2017; MASSA; TUCCI; AFUAH, 2017; MULLER; BULIGA, 2017; MULLER; BULIGA; VOIGT, 2018.
		b) Describe the organization business model according to the selected perspective	What's the organizations business model according to the selected perspective?	
		c) Explore the dynamic capabilities processes of Sense, Seize and Reconfigure;	Which capabilities can be identified upon the processes of Sense, Seize and Reconfigure?	
		d) Explore the relationship between dynamic capabilities and the business models;	What’s the relationship between dynamic capabilities and business models?	

PANEL 13 - THEORETICAL MATRIX - PART 2

RESEARCH PROBLEM	GENERAL OBJECTIVE	SPECIFIC OBJECTIVES	DATA COLLECTION TECHNIQUES	DATA ANALYSIS TECHNIQUES
How the dynamic capabilities relate to business models on small enterprises related to the digital transformation?	Analyze how the dynamic capabilities relate to business models on small enterprises related to the digital transformation.	a) Measure the development level of the organizations at the digital transformation process according to the selected maturity model;	Semi-structure interviews with key organizational resources; Non-participatory observation; Documental and Archival analysis	Content Analysis applied to the data collected and to the maturity model provided by Ganzarain and Errasti (2016), with assistance of the three stage process proposed Erol, Schumacher and Sihn (2016), and also taking into consideration the other reviewed models (Juffer *et al*., (2012); Veza, Mladinei and Gjeldum (2015); Long, Zeiler and Bertsche (2016), and Qin, Liu and Grosvenor (2016); Schumacher, Erol and Sihn (2016).
		b) Describe the organization business model according to the selected perspective	Semi-structure interviews with key organizational resources; Non-participatory observation; Documental and Archival analysis	Content analysis according to Miles and Huberman (1994), performed with the utilization of ATLAS.ti software and with the codes presented at appendix B.
		c) Explore the dynamic capabilities processes of Sense, Seize and Reconfigure;		
		d) Explore the relationship between dynamic capabilities and the business models;		

SOURCE: The Author (2019).

4. CASE STUDIES

This section will comprehend the case studies that were performed. To analyze the data, the cases will be reviewed first individually, pointing their characteristics and details. After that, we will explore the cross-case analysis, aiming to discuss the findings and compare the results, which allow the identification of patterns and differences.

4.1. CASE STUDY A - PACKID

This section will describe the case study performed at the organization named PACKID, which provides a temperature monitoring solution for other organizations, thus characterizing them as being a provider of the digital transformation and the Industry 4.0 technologies.

4.1.1. The PACKID Organization

PACKID is a small organization that was created in 2015. This organization provides a solution in the form of service for other industries. More specifically, they provide a real time monitoring of environment temperatures. According to the CTO, their solution is pretty scalable and can fit the entire distribution chain of small and large industries that request that type of service.

To have their solution developed, the CTO explained that they invested one and a half year of R&D to the organization. According to him, the development started when one of their business partners realized that it was difficult to have the temperature of refrigerated chambers monitored. In her words: "The quality control for this type of industry is very rigorous, and when I worked there, it was very difficult to meet their needs". They thus decide to develop a solution that is composed by both the hardware sensors (which will measure and monitor the temperature) and the software solution (that is responsible to collect and process the data that is generated).

Considering the technologies used by the organization, we can list the following ones as the more important ones: Ruby on Rails (which is a web application framework for development), the cloud services provided by Amazon (such as ElasticBenstalk and Amazon Relational Database Service - (RDS)), Postgresql (database), Node.js (used to integrate their hardware sensors with the software), Radio-Frequency IDentification (RFID), Near Field

Communication (NFC), LoRa Protocol, Bluetooth, General Packet Radio Services (GPRS), Machine learning, and also Big Data.

While most of those technologies are already known for their utilization at the IT sector, some of them are also pointed by the literature as being directly related to the Industry 4.0 scenario, such as the cloud computing, RFID sensors, Machine learning and also Big Data (KAGERMAN; WAHLSTER; HELBIG, 2013; GANZARAIN; ERRASTI, 2016; LIAO *et al.*, 2017).

Regarding their workforce, the interviewees stated that the organization currently have 12 employees. Of those, 7 are internal to the organization (The three business partners, two programmers, an international relationship agent and also an electrical engineer), and five are external employees that act as anchors between the organization and their network contacts.

The organization currently has eight customers, and of those, three of them deal with transportation (they have the temperature of the refrigerated chambers on trucks and other vehicles monitored); and the other five work with distribution centers or other process that encompass facilities with a fixed location (they have the temperature of refrigerated chambers at those facilities monitored).

Despite the fact that they currently have 12 employees and 8 customers, the CTO stated that 6 months ago (in April of 2018) they still had no customers and only 3 employees (the three business partners). According to him, that changed when they managed to understand that the approach used to acquire customers was incorrect. According to him, they realize that they should not sell ‘a real time temperature monitoring solution’, but a ‘solution that could provide cost and energy savings for their customers’.

4.1.2. Business Model conceptualization at PACKID

Considering the previous statement, we promptly saw that their **Value Proposition** had to change for them to acquire customers. That was mentioned by all interviewees, stating that nowadays they provide a ‘Temperature monitoring solution that can generate cost and energy savings for the organizations’.

Furthermore, the interviewees point that their value proposition changed due to the fact that their customers were still unaware of this ‘need for a change’ due to technology innovations. Regarding that, the CEO stated that when they tried to acquire customers by telling them the importance of the technology innovations, it did not work. But once they

changed that and started to highlight the benefits, and more specifically the cost savings from the technology innovations, they started to acquire customers.

The Developer and the CTO further stated that despite the fact that they do provide and install the hardware devices that will monitor the temperature, what they really sell for the customers is the access to their real time monitoring system.

Considering that, the **Value Capture (Monetization)** of their model was constructed based on a *pay-per-use* model, where customers are charged on a monthly basis according to the number of hardware sensors that are installed. In other words, that model is as a Software as a Service (SaaS) model.

The CEO explained that they already tried to sell their product with a fixed price (the traditional model), but it did not work. The CTO complimented that stating that according to him, fixed price for services are complicated to be elaborated, while a subscription model allows them to make changes more easily to the model.

Here we also noted the importance of complimentary assets to have the value captured. More specifically, we note that their SaaS model is dependent of the cloud services (which are mostly provided by Amazon). Apart from that, another complimentary asset is related to the hardware parts that measure and monitor the temperature. Alone, those assets are not able to generate value, but when put together with their system the value is generated, which results in a co-specialization with hardware vendors.

Regarding the **Customers Identification,** we identified that the organization usually perform an internal search for their customers. However, the interviewees pointed that the network contacts (which also includes the external employees of the organization) was fundamental for their customer acquisition, especially when considering their first customers.

Apart from that, we also noted that the organization attend in some in events related to Industry 4.0 initiatives. Those events and the prizes that they´ve won also assisted them to have potential customers identified and acquired. Furthermore, both the CTO and the CEO emphasized the importance of a prompt identification of customers, stating that Brazilian organizations tend to trust you more when you already have some customers at your portfolio.

Considering their **Customer Relationship,** we were able to identify that in order to ‘sense the customer needs’ the organization actually had to demonstrate to their customers that their solution was something important. Here, the importance of the network contacts also become evident, since according to the interviewees, some ‘mentors’ from their network assisted the organization to redesign its business model to a suitable one that resulted in customer acquisition. Apart from that, the interviewees also pointed that the ‘ways to get in

contact with the customers' were affected by technologies and by the digital transformation process itself. More specifically it was stated that nowadays a 'digital contact' is more frequent and easy to achieve, and in their case that type of contact is the main channel through which they maintain contact with their customers.

Furthermore, co-design and co-engineering are two items that were also identified. The Developer for example, state that their changes and innovations to the service provided are usually validated with their customers before put into practice, while at the same time they discuss future upgrades directly with their customers to properly sense their needs and improve the service provided.

4.1.3. Digital Transformation perspective at PACKID

Once we address the digital transformation process at this organization, we can clearly see that PackID is an organization that was created with the 4.0 concept in mind. That was demonstrated by the interviewees when we collected the information regarding their initial idea for the organization, where it was stated that since the beginning they wanted to have an organization that would be on the 4.0 concept.

Furthermore, this organization is characterized as being a provider of Industry 4.0 technologies, thus assisting other organizations to digitally transform themselves. Although it was not explicit mentioned that their objective is to transform regular industries into 4.0 industries (which is the case of the organization analyzed at case study C), they do assist with that transformation since they provide digitalization and automation for organizational processes.

Thus, if we consider the classification of Ganzarain and Errasti (2016) for the Industry 4.0, we can classify this organization as currently being at the level 5 (Detailed Business Model). In other words, this organization is performing the transformation of its business model towards the Industry 4.0.

At their specific case, we identified that the organization does have an Industry 4.0 vision, they are currently using Industry 4.0 technologies, they have their customer segments, value propositions and key resources already defined, and they are currently trying to better adjust their business model to fit the Industry 4.0 scenario.

As a matter of fact, their business model is one of the things that still does not fit the concept of the 'Industry 4.0'. That situation however is not caused by an issue on their side, but mostly due to the fact that their customers and suppliers do not display the same

development level that they do. Due to that, they had to adjust their model to something that is a mixture of an Industry 4.0 model and a traditional model.

That situation became more evident when we asked about their perception regarding the digital transformation process at the Brazilian scenario, where the CEO stated that Brazilian industries are still some steps behind other countries when we the Industry 4.0, which thus does not allow a properly 'Industry 4.0 relationship' to be developed.

The main reasons for that delay was pointed by the interviews as a mixture of cultural aspects and technology issues that Brazil displays at its organizational scenario. In the particular case of this organization, the mobile signal such as 3G and 4G is considered one of the main technology issue to deliver real time information.

Apart from that, the market segment that represents part of their customers was also pointed as being more difficult to deal with in terms of innovation when compared to other segments. More specifically, some of their customers are from rural regions and those usually are not yet inserted into an innovation ecosystem, nor have an innovation team at the organization, resulting that they are yet not aware about how much technology innovations could help their business (which reflect in the fact that the organization changed its approach of value proposition to acquire customers).

Considering the digital transformation dimensions of our framework, we noted that regarding **Employees**, training and integration where very often mentioned as two important items for the digital transformation process. A great emphasis was putted on training, since as stated by the CTO, "There's still a lack of qualified workforce for the Industry 4.0 and digital transformation technologies". The developer on the other hand, emphasized the technology integration, which reflects in an integration level that encompasses employees with different skills to have the products and services delivered.

Considering the **Partners and Suppliers**, the connectivity was mentioned as an important factor to consider at the Industry 4.0 scenario. More specifically, both the CEO and the CTO stated the importance of a more 'real time connection' with partners and suppliers to have their services delivered. Going further, all three interviewees mentioned difficulties that they´d to acquire partners that could provide the hardware parts they need, while the developer also mentioned that they already thought about travel to China and directly contact suppliers from there. That scenario leads us to reliability, an issues that the interviewees mentioned that they currently have with some partners since the hardware provided by some of them are still not meeting their quality needs.

And regarding **Production equipment**, we were able to identify that all four items from our model were mentioned. All the interviewees pointed that economy, increase of productivity and rapid access to data are things that the service provided by them could generate, while the CTO and the Developer also mentioned the load balance and the resistance to failures as being related to the digital transformation. Furthermore, the interviewees also mentioned that those items are able to be achieved due to the technology integration, which allows new products and services to become more complex and reliable.

4.1.4. Dynamic Capabilities at PACKID

To assess the development of dynamic capabilities at the organization, we asked questions that could provide us insights about the processes of Sense, Seize and Reconfigure (TEECE, 2007).

In this sense, at the first one (**Sense**) the CTO stated that every week they perform a meeting to discuss potential innovations and access critical issues that the organization is passing through. Upon that, they select the main issue that they currently have (or the most critical one pointed by their customers) to have it resolved. At the same time, they select the most interesting idea that could result in an increase on the value delivered for their customers to be developed. Apart from that, they also use market research and insights that are obtained from their customers. To work on both fronts, half of the team work resolving the issues and the other half work on the development of innovations to increase the value delivered.

This organization also attend to events that are related to Industry 4.0, digital transformation and also other technologies that could provide insights about important improvements or novel technologies that are being release worldwide, which assist them to address exogenous technologies and innovations that could potentially assist them in products and services development. Furthermore, their network contacts also assisted this first process, by helping them with customer identification and acquisition.

Considering the second process (**Seize**), we were able to identify that they do have a well-defined business model. At their model, target customers, product, and technology architecture are pretty well defined, and what they are currently adjusting and facing more difficulties is the revenue architecture.

Although they are currently generating revenue and thus capturing value, this item was pointed by all interviewees as the most difficult item to be defined. The reasons for that were (apart from the lack of an Industry 4.0 vision that their customer have), the difficult that

it is to measure an innovation in terms of a 'price'. As stated by the CTO "Our biggest rival at the market right now, which is present at 94% of the organizations, is the manual Excel sheet". Thus, they do not have a benchmark for their solution, which result in a scenario where there's no benchmark to properly define how much they should charge their customers.

Considering their decision making protocols, this organization displayed a great horizontal integration, which thus allows most of the employees to be involved with the decision making protocol, which facilitate the adoption of loosely coupled structures.

Aligned with that, we were able to identify a commitment from the interviewees with the organization. More specifically, the Developer emphasized the cultural dimension of the organization, which assist them to be able to continuously innovate their products, and, in his specific case, to be able to very easily understand the organization processes and the technologies that they used. That was also emphasized at the social media analyzed, where we identified a commitment of the employees to the organization, both with the solution provided and also with their customers.

However, if we consider the organizational boundaries, we found a different scenario than the one pointed by Teece (2007). According to the author, an organization with properly defined boundaries might be able to most easily define its business model. However, at the analyzed organization we note exactly the opposite, since their relationship with network contacts and the ecosystem (also involving assets and other resources) provided an important assistance to have their business model redesigned.

Lastly, at the third process (**Reconfigure**), we can note that this organization does have a loosely coupled structure, mostly due to the fact that it's a small one. That was evidenced by the decision making process, which was further explained by the CEO and the Developer stating that the entire organization is usually involved with that, in a very informal process, while assets realignment was very often performed from one department to another. Apart from that, we also identified some insights related to the concept of 'open innovation' present at the organization, since they aim to develop technical innovations with their partners and customers, using technology and innovations developed outside their organization.

Despite that, this organization also aim to minimize agency issues, thus establishing formal contracts that serve as a backup in case of any critical issue. As stated by Teece (2007), minimizing those issues can assist the creation of a governance structure that can sustain the dynamic capabilities development.

Furthermore, the literature points that at the Industry 4.0 scenario, assets co-specialization is fundamental to have greater value delivered to customers (KAGERMAN;

WAHSLTER; HELBIG, 2013; TEECE; LINDEN, 2017; TEECE, 2018b). At this organization, we were able to note that the technology and services provided by the organization does have asset co-specialization. That was evidenced by the Developer, who stated that their technologies are integrated to other ones provided by other organizations, thus connecting them to their software and hardware partners, which thus allows them to deliver value to their customers.

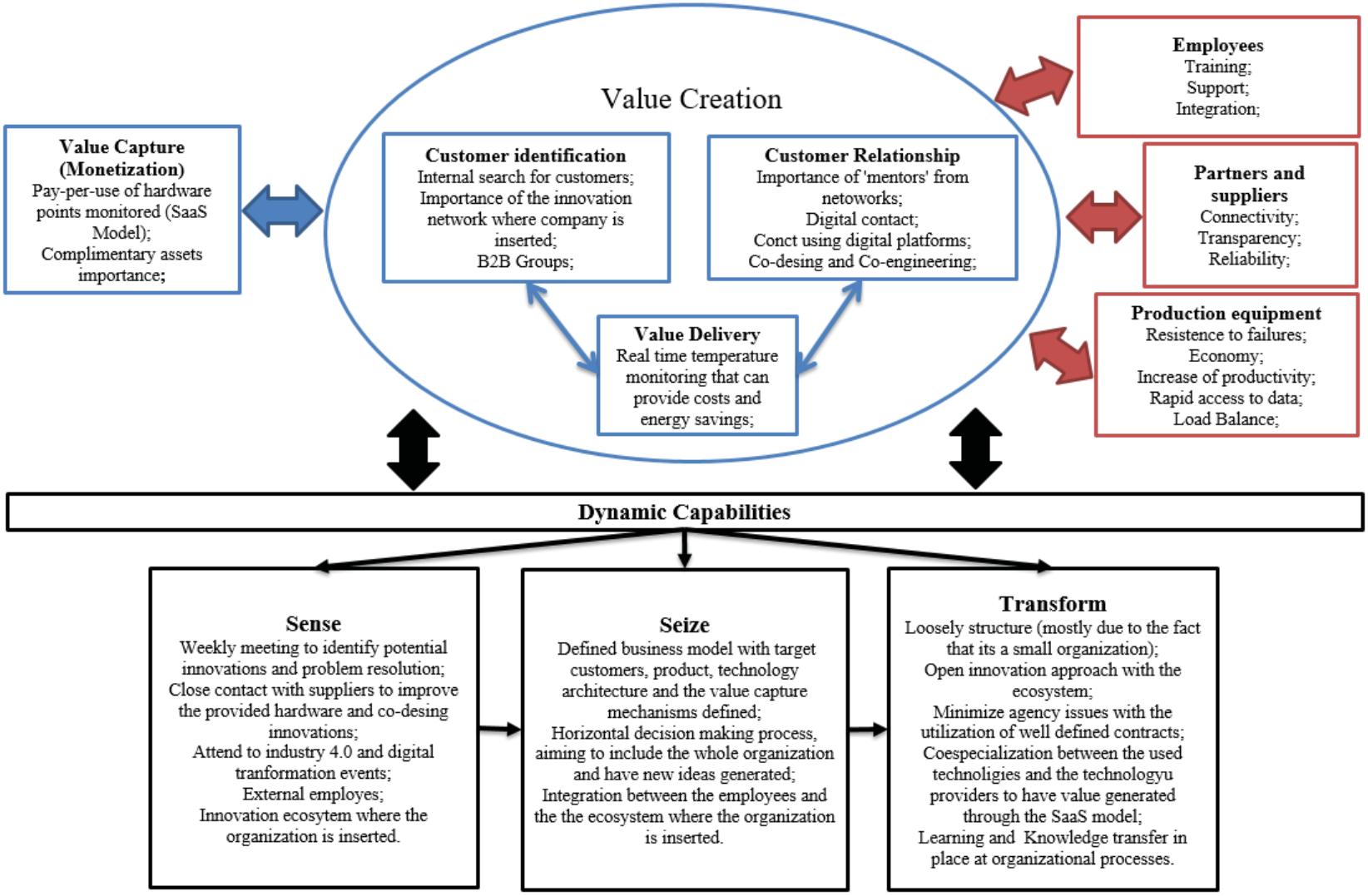
Another item that caught our attention was the knowledge transfer at the organization. Regarding that, the Developer stated that when he joined the organization he faced some difficulties to understand how their software was designed, mostly due to a lack of documentation. Thus, they started an initiative to document their processes and transfer the knowledge to the organization members, which resulted in a learning process to be in-place at the organization, which encompasses not just the organization itself, but also other organizations that they´ve contact with.

And lastly, intellectual property protection was somehow in-place at the organization. The scenario that they face with intellectual property is the same one that most organizations that provide a software solution face. Since there's no patent for software applications, the only thing that is available for them to protect their system is the ‘authors rights’, but according to the CTO this provides very little legal protection. Furthermore, the CTO stated that what does exist is a patent protection for their methodology: “A method to monitor temperature using sensors”. However, that patent was already created 30 years ago, thus, it does not apply anymore. Upon that, what they do is create other types of entry barriers to avoid being copied by competitors, such as a very technical integration between different hardware's and also a very complex software solution.

4.1.5. An integrated analysis at PackID

To further explore the relationship between three constructs explored at the present study (digital transformation, dynamic capabilities and business models), figure 14 summarizes the application of our framework to the PackID organization. That figure provides a summary of what was previously described at the sections 4.1.1, 4.1.2, 4.1.3 and 4.1.4 were we´ve highlighted the items that were more frequent mentioned by the interviewees.

FIGURE 14 - FRAMEWORK APPLIED TO THE PACKID ORGANIZATION



SOURCE: The Author (2019)

We can thus see some similarities between the reviewed literature and the organization scenario. More specifically, we were able to identify some interesting **Business Model** similarities with the proposition of Baden-Fuller and Haefliger (2013). Starting with the value capture, were we identify the importance of complimentary assets, which confirms that solutions related to the Industry 4.0 usually require assets provided by other organizations to generate value. Besides that, their model is characterized as a pay-per-use model, which is aligned with the study of Arnold, Kiel and Voigt (2017) where it's pointed that pay-per-use and pay-per-feature are models directly related to the Industry 4.0.

Regarding the customer identification and customer relationship, we are able to identify that most of their customers (if not all) are from the Business to Business (B2B) segment, while co-design and co-engineering were also present at some level at the organization and the 'digital contact' was often mentioned as an important way to get in touch with their customers. Those items are directly related to the work of Kiel, Arnold and Voigt (2017), Müller and Voigt (2017) and Müller, Buliga and Voigt (2018) who demonstrated that those items are directly to the Industry 4.0.

On the overall, we were able to identify that their business model displayed: (1) An emphasis to be a service oriented model (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017); (2) The importance of partnerships (KAGERMAN; WAHLSTER; HELBIG, 2013; BURMEISTER; LUTTGENS; PILLER, 2016); and (3) The emphasis on customers (KAGERMAN; WAHLSTER; HELBIG, 2013; KIEL), thus being aligned with the Industry 4.0 concepts.

Once we address the **Digital Transformation** process, we were able to identify that most items that were mentioned by the literature were also pointed by the interviewees. We highlight the Training and Support (from Employees dimension); and Rapid access to data and Economy (from Production equipment dimension).

Here, the interviewees also emphasized the difficulties that the Brazilian scenario present for the digital transformation Process at the organization, where the CEO emphasized the organizational culture as being something that blocks them to successfully implement their technology, while the Developer emphasized a mixture of technology problems and organizational culture as barriers that block the development of the Industry 4.0.

However, the CEO stated they usually try to understand their customer needs, thus identifying other ways to convince their customers of the importance of the Industry 4.0 and its related technologies, where again the importance of their network contacts were emphasized. This lead us to the **Dynamic Capabilities**, were we identified specific

microfoundations at each process (Sense, Seize and Reconfigure) that allowed the organization to develop this type of capabilities.

If we look at those processes (described in more details at section 4.1.4) we can note that most microfoundations pointed by Teece (2007) are present at the organization. However, one of the items from the Seize process (which deals with the enterprise boundaries) was not present. Rather, we identified exactly the opposite of what was pointed by Teece (2007).

That position of well-defined boundaries however, appear to be changing, because despite fact that Teece (2007) highlighted the importance of organizational boundaries, at his most recent works (see Teece and Linden, 2017; Teece, 2018a, 2018b) the author revisits the PFI framework and emphasizes the importance of innovation ecosystems, network contacts and the complimentary assets, as those become important factors for the competitive advantage. At the analyzed organization, all those three items also demonstrated to be important.

Furthermore, if we consider the study of Zeng, Simpson and Dang (2017), we identified a slightly different scenario than the one described by the authors. Here the first phase of the digital transformation (Establishment of a new focus) did not occurred. As a consequence, the dynamic capabilities related to this phase were not identified at the organization. The reason for this is related to the fact that here the organization did not 'transformed' itself to an 'Industry 4.0', it was created from the beginning with that concept in mind. However, that did change the other two phases pointed by the authors (Focus on resource transformation; and Co-evolution with the system), and at each of those phases we were able to identify some capabilities developed by the organization, which were summarized at panel 14.

At panel 14 we highlighted in **bold** the capabilities that we were able to identify at the organization, while the other ones are capabilities that were identified at the study of Zeng Simpson and Dang (2017), but not at our study.

At phase 2 the **Experimentation** and the **Construction of the extended network** were identified. The Experimentation was easily identified when we looked at the development of their service provided (which had one a half year of R&D applied to it, with a lot of a trials and errors), and also during the improvements of their service. The Construction of the extended network was one of the strongest capabilities that we identified which had microfoundations mentioned by all three interviewees mentioned, which according to them also assisted them to reshape their business model.

PANEL 14 - CAPABILITIES IDENTIFIED AT PACKID, BASED ON ZENG, SIMPSON AND DANG (2017)

PHASE	IDENTIFIED CAPABILITIES
2. Focus on resource transformation	**Experimentation;** Development of the already existing resource base; **Construction of the extended network.**
3. Co-evolution with the system	**Institutionalization of flexible routines;** **Improvement of the organization resources;** Coordination of the extended network.

SOURCE: The Author (2019), adapted from ZENG; SIMPSON; DANG (2017)

However, the capability 'Development of the already existing resource base' was not identified at this organization. What became more evident instead was the **Development of novel resources with the utilization of the network contacts that they´ve**. Thus, the organization is actually expanding its resource base through their network contacts and the ecosystem, rather than developing it inside the organization.

At the phase 3, **Institutionalization of flexible routines** and **Improvement of the organization resources** were identified at the organization. Upon the microfoundations and the decision making processes we managed to see that flexible routines are currently in-place at the organization, which was kind of expected since the organization is a small one. At the same time, the improvement of organizational resources was constantly occurring, which was identified upon the organizational processes to improve their solution and generate new ideas, and also with the processes to tap exogenous science and technology to the organization (with the assistance of external events and the network contacts that they´ve).

Furthermore, despite the fact that their network contacts demonstrated a huge impact for the organization development, we did not identify the coordination of the extended network occurring. However, that was also expected since different than the study performed by Zeng, Simpson and Dang (2017) were larger organization were analyzed, here we looked at a small organization with limited power inside its network.

If we consider the study of Helfat and Raubitschek (2018), we are able identify that the developed capabilities could be characterized as **Innovation Capabilities; Environment Scanning Capabilities; and Integrative Capabilities**, which according to the authors are related to the Digital Transformation Process (refer to section 2.4 for more details).

Considering that, we summarize the following capabilities that where identified at the organization: (1) Experimentation; (2) Construction of the extended network; (3) Institutionalization of flexible routines; (4) Improvement of the organization resources; (5) Environment and Customer sensing; and (6) Co-evolution with the network.

To summarize, we can list the following main findings from this first case study:

- According to the maturity model provided by Ganzarain and Errasti (2016), the organization was classified as being on level 5 - Detailed Business Model,
- The organization business model is pretty defined towards the Industry 4.0 (with some remarks due to their partners and customer's limitations);
- Most items from the literature related to digital transformation and the Industry 4.0 were identified at the organization;
- The organization demonstrated microfoundations that allowed them to develop dynamic capabilities;
- The network contacts and the ecosystem we´re often mentioned as being really important to assist the organizational development towards the Industry 4.0.

In other words, what really make a difference was the capabilities that the organization had to work with its network contacts and access the resources that the network could offer, thus allowing them co-evolve with the system.

4.2. CASE STUDY B - TauFlow

This section will describe the case study performed at the organization named TauFlow, which provides a solution based on CDF (Computational Fluid Dynamics) for their customers (for more details about this technology, see the International Journal of Computational Fluid Dynamics). Considering that, this organization digitalize, analyze and optimize processes related to outflows (air, fluids and other materials), which also characterize them as being a provider of the digital transformation and the Industry 4.0 technologies.

4.2.1. The TauFlow organization

TauFlow is a small organization that was created at the end of 2015. Their idea started when the Engineering Director, which at the time had finished his PhD and was

looking to start a Post-Doc, got in contact with the person that currently holds the position of Executive Director at the organization. More specifically, they further looked into some of the researches that the Engineering Director was performing. Around the same time, they also got in contact with their other business partner (which was graduated in civil engineering, and had specializations in lean manufacturing and business management).

They thus saw potential for the application of a technology named Computational Fluid Dynamics (CFD), which was the one that the Engineering Director had researched over the past years. That technology uses numerical analysis and data structures to analyze and provide solutions that involve flows of fluids and gases. In other words, numerical calculations are performed to simulate the flow process of material (liquid or gas) in an area defined by boundaries condition. Due to that, this technology requires the digitalization of engineering process, later applying computational simulations to it.

However, despite the fact that this technology is directly related to the digital transformation and to the Industry 4.0, the interviewees stated that their initial idea was not directly related to the '4.0 scenario'. According to the Commercial Director, what they wanted was to take disruptive technologies to the organizations. However, they saw some similarities between what they were offering and the concepts of the Industry 4.0, and upon that they decide to embrace this idea and connect their organization to the Industry 4.0.

According to the Engineering Director, what they do is the virtualization of engineering processes, which allow them to perform simulations using equations that will calculate the tridimensional flows of air, liquids and energy. Their objective with that approach is to improve the analyzed processes with a focus on the efficiency to generate cost and energy savings for organizations.

We also identified that this organization is currently involved with two different ecosystems: They are inserted at the UNICAMP ecosystem (as a resident organization); and they are also inserted at the FIEP ecosystem (as a non-resident organization). Their objective with approach was twofold: First, with UNICAMP they wanted to be closer to people and institutions involved with R&D, while with FIEP they wanted to be closer to industrial organizations that could be potential customers of their solution.

Regarding their workforce, the organization currently have 6 employees, the three business partners (the Executive Director, which currently acts as the CEO; the Engineering Director, responsible for the technical part of the organization; and the Commercial Director, responsible for the business prospecting); a trainee; and also two external employees, which works for them on project based contracts.

According to the Commercial Director, they currently have around 10 customers, and those include small, medium and large organizations (both national and multinational ones), The Engineering Director further stated that most of their customers are from industrial sectors, while some are specific from the air conditioning sector. Furthermore, it was mentioned that they usually try to acquire larger customers, but since there is a large number of small organizations demanding digitalization, those were included in their portfolio.

4.2.2. Business model conceptualization at TauFlow

Considering their Business Model, we were note that this organization has two **Value Propositions** for their customers. The first one is related to the consulting services that they provide, where they provide the digitalization of engineering processes that allow simulations using CFD to take place. Regarding that, the Commercial Director stated that what they offer for their customers (apart from the digitalization and cost/energy savings) is information, thus allowing their customers to better know how their processes are designed and where they could be improved.

Apart from that, their second value proposition is related to a R&D solution for organizations, thus assisting organizations that want to have R&D initiatives developed. At that scenario what they offer is their expertise and knowledge to have R&D developed for the organization, thus creating a partnership between them and their customer. However, the Commercial Director pointed that this is currently only on its initial stage, and their main carrier is still the first value proposition described.

Regarding the **Value Capture (Monetization)**, it was stated that for their first value proposition they've two main lines. The first one is the fixed prices per project (the traditional model), where the customer will be charged on a fixed amount to have the project executed. The second one is the 'success rate model', where their value capture will be a percentage over the improvement provided or their customer. For example, if they manage to provide a production improvement of 20%, they will receive an amount of that 20% for a defined period of time.

Regarding their R&D services, the Commercial Director stated that they also use a model that results in a cyclic payment (like a monthly subscription, for example). However, he stated that right now they receive very little value (in terms of money) from this initiative. Nevertheless, they are acquiring a large amount of knowhow with this initiative, and they

expect to have it further expanded in the future to be able to also capture value (in terms of money) from that.

At the **Customers Identification**, the importance of partners from the ecosystems became even more evident. All interviewees mentioned the importance of their ecosystems for customer acquisition, with emphasis to the support provided by FIEP. Furthermore, the events related to both startups and Industry 4.0 initiatives that they´ve attended were also mentioned by the Executive Director and the Commercial Director as being important for the customer acquisition.

Apart from that, the Commercial Director also stated that their internal initiatives for customer acquisition also assisted them. According to him, all three business partners already had from 12 to 15 years of work experience at other organizations, and the network contacts that they made at those organizations also assisted them with the customer identification and customer acquisition.

Considering their **Customer Relationship**, a scenario similar to the first organization analyzed was identified, where we note that they focus on emphasizing the energy and cost savings that they could provide for their customers. Furthermore, it was stated that they usually try to establish a close connection to their customers, thus making the customers 'trust' them more. According to the Executive Director that is necessary because they usually deal with sensitive and confidential information (the engineering processes) and if they fail to convince their customers that they can be trusted, they fail to retain this customer.

Apart from that, the Executive Director also emphasized the fact that for a large number of customers, they ended up performing way more than what is necessary to have their service delivered. According to him, that occurs because some customers are still underdeveloped not just in terms of Industry 4.0 but also in terms of 'good practices'. He further described a scenario where they'd to map down the customer engineering processes before digitalizing it because part of it was outdated and part of it was lost.

4.2.3. Digital Transformation perspective at TauFlow

Regarding the Digital Transformation process at this organization, the first thing that we note is that their initial idea was not to be an Industry 4.0 provider. However, due to similarities between that type of industry and the service provided by them, they ended up by entering the Industry 4.0 scenario.

Thus, this organization also works assisting other organizations to digitally transform themselves, which was mentioned by all the three interviewees.

If we consider the classification provided by Ganzarain and Errasti (2016) for the Industry 4.0, we can also classify this organization as also being at the level 5 (Detailed Business Model). In other words, we were able to identify that they do have an Industry 4.0 vision, they are using Industry 4.0 technologies, they do have their customer segment, value propositions and key resources defined, and they are currently adjusting their model to meet the Industry 4.0 scenario.

Just like on the previous organization, the same issues related to the digital transformation and the Industry 4.0 were pointed by the interviewees. More specifically, they state that organizations usually lack a more 'innovative' approach in order to allow the Industry 4.0 to take place. According to the Engineering Director, the Industry 4.0 is being developed at the Brazilian scenario, but that is taking longer than other countries and the reasons for that appears to be related to the fact that Brazilian organizations lack the innovation skills that were already in-place at other countries.

The Commercial Director further states that legal and contractual bureaucracy also affect the relationship between small and large organizations, while the Executive Director further expands that perception stating that three main factors could be pointed as issues for the digital transformation: (1) The Brazilian industries still does not believe in solutions and technologies developed by other Brazilian organizations (as stated by him, even if the Brazilian technology is proved to be better, some organizations prefer to bring an technology from outside, because they kind of 'do not trust what was developed here'); (2) The Brazilian industry does not have enough resources to develop R&D initiatives, especially due to the political and economic scenario that we currently face resulting in organizations to stick with the basic activities only; and (3) Our cultural scenario does not see value in people that develop innovations (long term projects), they see value in people that execute fast actions to resolve the daily issues that organizations has.

Furthermore, the Executive Director states that industries tend to apply a bunch of different processes to 'organize' themselves, (like PMBOOK and ITIL). However, those processes end up by blocking the innovation inside those organizations, because innovation cannot follow a linear process like they´ve learned to do. Nevertheless, he stated that this is changing as nowadays some industries are investing into 'innovation teams' to assist the development of innovation inside the organization.

Upon that, they pointed that for **Employees**, training is an important item (both regarding technological training and also considering the 'cultural' training). As stated by the interviewees, employees do need to get used to the novel technologies, but at the same time they need to learn the new 'way' of doing business at the integrated and interconnected world.

Considering **Partners and suppliers**, reliability was often mentioned as an important item to be considered at the Industry 4.0. However, what caught our attention at the present case was other factor: Cost savings. Despite the fact that it was not mentioned at our theoretical model (figure 17), that was often mentioned by the interviewees as one of the main items when considering partners and suppliers at the Industry 4.0 scenario. Nevertheless, one of the reasons for it to not be added to our model, is the fact that organizations usually take cost savings into consideration when dealing with partners and suppliers. What we noted here is the fact that they expect new partnerships to have a yet greater focus on cost savings.

And considering the **Production equipment**, we were able to identify that Economy and most often Increase of Productivity were mentioned as being directly related to the Industry 4.0. Due to the digitalization, we also identified that Rapid Access where the integration between technologies and organizations was also highlighted, thus being aligned with the Industry 4.0 literature.

4.2.4. Dynamic capabilities at TauFlow

Considering its first process (**Sense**), we highlight the two R&D approaches that this organization develop: The first is an internal one, which according to the Engineering Director usually start from PhD thesis of closer contacts, or from other research projects done by the organization members. Upon that, they internally continue the development of the selected project. According to the Executive Director, they currently have some projects being validated with São Paulo Research Foundation – FAPESP. The second one on the other hand is an external R&D service that they provide to other organizations, where they create a partnership to provide R&D services to their customers.

Apart from that, they also attend to events related to Industry 4.0 and digital transformation technologies to further get in contact with novel solutions and partners that could better sustain their competitive advantage. Those events also assisted them to identify customer needs and potential innovations.

And lastly, the network contacts from the ecosystem where the organization is inserted also provided assistance for them to sense the environment and customer needs, also

allowing them to have a close connection both with industries that represents potential customers for them, and also with institutions that could improve their R&D development.

Considering the second process (**Seize**), we identified that they do have a well-defined business model. At their model, customer segment, value proposition and customer relationship are properly defined, but if we consider the Industry 4.0 concepts, their Value Capture (Monetization) is where they still lack some changes to have a model that is more aligned with the Industry 4.0. Nevertheless, the Commercial Director stated that they are investing more on the success rate model, which is directly related to the Industry 4.0 (see KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017).

Furthermore, the monetization of their model was pointed by the interviewees as the most difficult item of the model to be defined. The reasons for that seems again to be related to the difficulty that it is to 'price' an innovation, since as stated by the Engineering Director, when it comes to innovation you do not have a benchmark to compare your solution and identify on how much you should charge your customers.

Their decision to stick with the classic model of monetization (fixed prices per project) is also directly related to the fact that most organizations still lack the necessary knowledge regarding Industry 4.0. As stated by the Executive Director, most organizations still do not know the 'success rate model', and due to that, they ended up by using classic monetization model to not lose the customer.

Regarding the decision making protocols, a horizontal integration was identified, which was also expected due to the fact that we are dealing with a small organization that has a small number of employees. Apart from that, the commitment from the employees and their 'trust' to the solution developed was also identified. The Commercial Director state that during the first years they had a very difficult time with the organization due to the economic and political situation. Due to that, they had to 'take money from their own pocket' to maintain the organization. Apart from that we also noted a commitment from the employees at the social media analyzed, where we noted that the business partners truly believe in their idea, promoting it with conviction that it can assist their customers. That commitment to the solution developed also reflected in some prizes that they´ve earned such as being a member of the 100 Open Startups, which lists the 100 most attractive startup organizations. In 2017, they ended up at the 14th position, while in 2018 they ended up at the 54th position.

Considering the organizational boundaries, we identified a slightly different scenario than the previous organization. Here, the boundaries were more defined when compared to our first case study. However, they were not defined like a 'classic industry', since the

organization also has a direct contact with two different ecosystems. What we found here was a midterm between our first case (where the boundaries were very blurred) and a 'classic' organization, where the boundaries are very defined.

According to the Industry 4.0 literature, organizations tend to have more blurred boundaries due to the interconnection and interchange of information that this type of industry demand (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017), which seems to be aligned with their development level towards the Industry 4.0.

And lastly, the third process (**Reconfigure**), showed us that the organization does have a loosely coupled structure. But again, that was expected due to the fact that the organization is a small one. Flexibility was frequent mentioned at the interviews as something important in order to acquire customer at the digital transformation scenario (the Engineering Director stated that if you are too rigid, you cannot adapt yourself to the demands of larger industries).

However, and also different from the previous organization, open innovation was more directly mentioned by all three interviewees, where we noted that the R&D projects that they develop (both internal and external ones) are directly related to the concept of open innovation. Furthermore, the Executive Director stated that they try to maintain a close contact with scholars and research institutions, since they believe that those can assist them to detect opportunities and reconfigure their resources in a more suitable way.

However, despite the fact that the literature points that Industry 4.0 could promote a more informal relationship between organizations not just in terms of partnerships but also regarding customers (KAGERMAN; WAHLSTER; HELBIG, 2013; DOH; DESCHAMPS; DE LIMA, 2016; KIEL; ARNOLD; VOIGT, 2017), we noted a slight different scenario at this organization. Here, the organization does have an informal relationship when we consider their partnerships. However, when we consider their service provided, formal relationships were preferable, thus encompassing formal contracts.

The reason for that seems to be related to the fact that formal relationships with well-defined contracts provide more security for small organizations, as those are more vulnerable to the environment and the actions taken by dominant market players. Thus, the use of those contracts seems to be a smart move, since Teece (2007) point that organizations should aim to minimize agency issues in order to assist the development of a governance structure that could sustain the dynamic capabilities development.

And lastly, regarding intellectual property, the Executive Director stated that they do have requested a patent for one of their solutions. However, he stated that due to the slowness

of such process, they prefer to continue the improvement of their solution, thus creating technological barriers to protect their idea. Furthermore, he stated that a patent could end up putting them in a comfort zone, resulting in an internal barrier to have innovations developed at their organization.

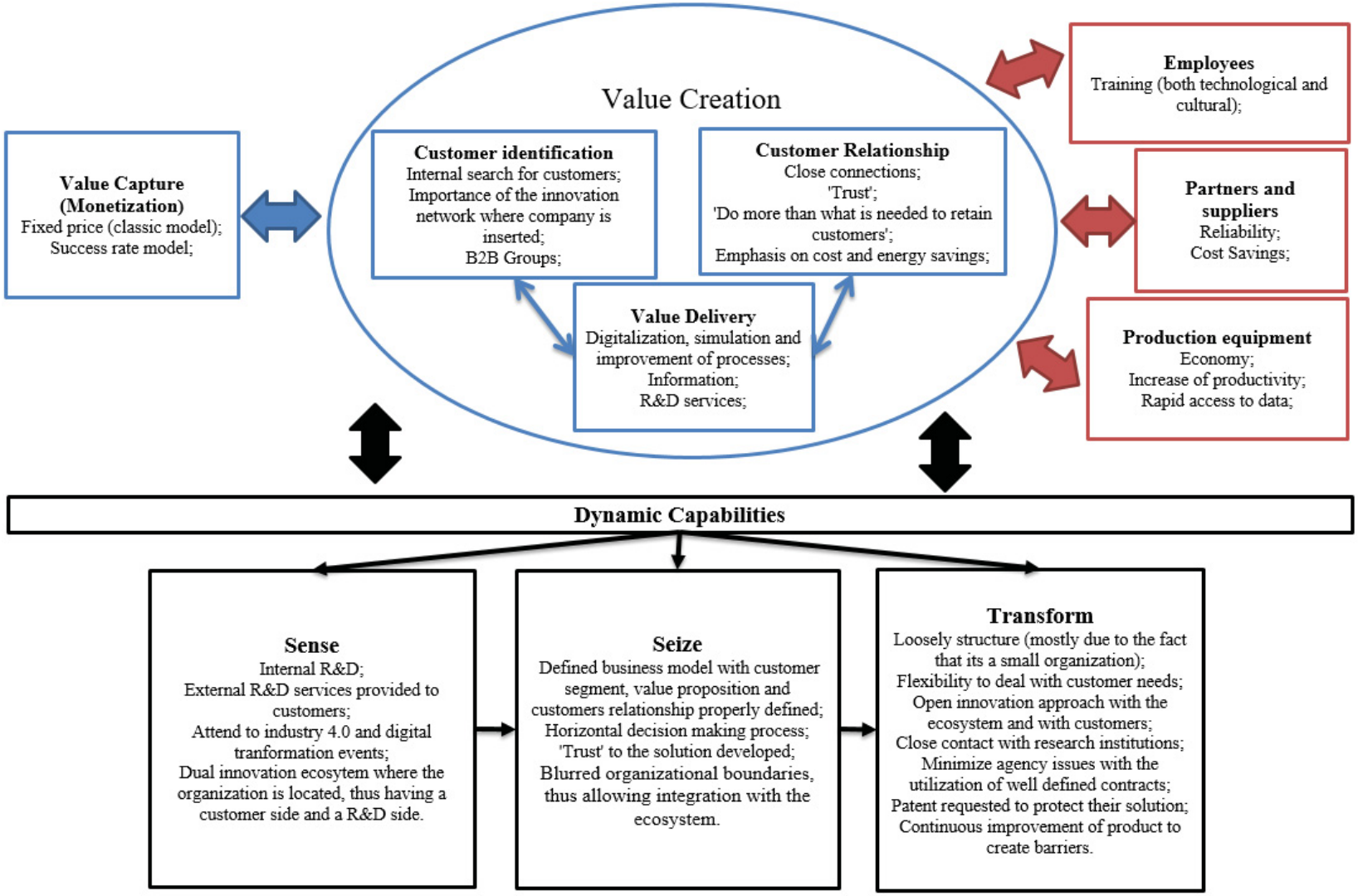
4.2.5. An integrated analysis at TauFlow

Aiming to further explore the relationship between the three constructs, at figure 15 we´ve summarized the application of our framework to this organization. Just like our previous case, figure 20 provides a summary of what was previously described at sections 4.2.1, 4.2.2, 4.2.3 and 4.2.4, highlighting the items most frequent mentioned by the interviewees.

Considering their **Business Model**, we can see some similarities with the proposition of Baden-Fuller and Haefliger (2013), such as the Customer Identification, were we note that their customers are directly related to the B2B scenario, thus being aligned with other studies that point B2B segments as being directly related to the Industry 4.0 (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2018). Furthermore, we noted the importance of the ecosystems that the organization has contact with, which thus assisted them to have potential customers identified, which is one more time aligned with our reviewed literature and more specifically with Teece and Linden (2017) and Teece (2018a; 2018b), where the interconnection between organizations and the concept of 'digital platforms' is discussed.

At the Customer Relationship, we noted that this organization also emphasized the cost and energy savings for their customers. That is related to the fact that their customers still lack the 'Industry 4.0 view', thus not seeing value in technologies unless the savings that they will get from it are specified. Furthermore, we identified that in order to retain their customers, the organization had to create a great trust relationship. That is aligned with the Industry 4.0 literature, where its pointed that customers will be more difficult to be retained at the digital world, which occurs mostly due to a great integration level that demands sensitive information to be shared among organizations (KIEL; ARNOLD; VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2018).

FIGURE 15 - FRAMEWORK APPLIED TO THE TAUFLOW ORGANIZATION



SOURCE: The Author (2019)

At their Value Capture, the use of the success rate model is also aligned with other studies that have pointed models that result in a cyclic payment (such as pay-per-use and pay-per-feature) as being often used at the Industry 4.0 scenario (ARNOLD; KIEL; VOIGT, 2017; MÜLLER; VOIGT, 2017).

Nevertheless, we also noted some differences between the reviewed literature and the organization business model. More specifically, when we consider the consulting services provided by the organization, we were able to identify that asset co-specialization was not often mentioned, and co-design and co-engineering where only slightly mentioned. Those items however, became widely evident when we consider their R&D initiatives.

However, that could be a strategy to protect their assets, as they do not share information regarding the stream that currently generate more revenues for them (consulting services), while at the same time they manage to use a more open approach with their R&D initiatives that allows them to interact more closely with the ecosystems and their network contacts.

Apart from that, we also identified a service orientation (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017); as well as an emphasis to customer focus (KAGERMAN; WAHLSTER; HELBIG, 2013; KIEL; ARNOLD; VOIGT, 2017) on their business model. The importance of partnerships was also identified, but not on the same way as the first case analyzed. Here the partnerships are important for R&D initiatives and for the customer acquisition (such as the partnership they made with FIEP), while on the first case the partnerships were more important from the development of their final product.

Considering the **Digital Transformation**, the challenges posed by this process at the Brazilian scenario were one more time emphasized by the interviewees. Thus, at the Employees dimension, trainings were pointed as extremely necessary for the organizational development towards the Industry 4.0. Considering the Partners and Suppliers, reliability and cost savings were identified. And regarding Production equipment, economy, increase of productivity and rapid access to data where identified at the interviews. On the overall, most items from our reviewed literature were also identified at that organization.

When we turn to the **Dynamic Capabilities**, at the first process (Sense) we note that this organization displayed a dual R&D approach, which thus allows them to more promptly sense the environment and the customer needs. The external R&D combined with Industry 4.0 and technologies events that they´ve attend further assisted them to look for exogenous technologies that might boost the innovation development. That is further complimented by the twofold ecosystem approach that they use.

We can thus see that this approach is directly related to the propositions of Teece (2007) regarding environment sense, where the author points that organizations should look to outside of its boundaries to be able to properly sense the environment opportunities and the customer needs. Furthermore, this is also aligned with Teece (2018a; 2018b), which states the importance of organizations ecosystems to have environment scanning capabilities developed.

At the second process (Seize) we noted that the organization does have a defined business model, and their boundaries are somewhat defined. As already mentioned, the literature points that organizational boundaries tend to become more blurred due to the digital transformation (KAGERMAN; WAHLSTER; HELBIG, 2013; TEECE; LINDEN, 2017). Thus the approach used by this organization seems to be aligned with the literature, especially when we consider their dual ecosystem approach and their dual R&D approach.

And at the third process (Reconfigure) what caught our attention was the open innovation approach, which mixed with a loosely structure allows them to continue the innovation development. Nevertheless, complimentary assets did not become so evident as they did on the previous analyzed organization, but on the other hand, their interaction with other institutions were more intense than the previous one.

Considering that, we were able to identify that the organization also developed microfoundations at each process that allowed them to develop dynamic capabilities. If we compare that with the study of Zeng, Simpson and Dang (2017), we can see that just like the first organization, this one did not had to 'Establish a new focus'. Even thou their initial idea was not to be an Industry 4.0 provider, their solution was so close connected to it that they did not had to really change their focus to be able to enter this world.

However, different from the previous organization, at the second phase (Focus on resource transformation), the **Development of already existing resource base** was identified at this organization, which is aligned with the internal R&D activities that they develop. At that phase, **Construction of the extended network** was also identified at this organization

At the third phase (Co-evolution with the system), the **improvement of organizational resources** was identified, thus characterizing a scenario that is also different than the previous organization, since although the other two capabilities pointed by Zeng, Simpson and Dang (2017) were not identified, this organization focused on the improvement of its own organization resources.

In this sense Panel 15 summarizes these capabilities, where the ones highlighted in **bold** are the ones that we identified at organization, and the rest are the ones present at the study of Zeng, Simpson and Dang (2017).

PANEL 15 - CAPABILITIES IDENTIFIED AT TAUFLOW, BASED ON ZENG, SIMPSON AND DANG (2018)

PHASE	IDENTIFIED CAPABILITIES
2. Focus on resource transformation	Experimentation; **Development of the already existing resource base;** **Construction of the extended network.**
3. Co-evolution with the system	Institutionalization of flexible routines; **Improvement of the organization resources;** Coordination of the extended network.

SOURCE: The Author (2019), adapted from ZENG; SIMPSON; DANG (2017).

Again, despite the fact that the network contacts and the ecosystem demonstrated a huge impact for the organization, the coordination of the extended network did not occur, which one more time was expected because here we are looking at a small organization with limited influence at the network.

Furthermore, if we consider the study of Helfat and Raubitschek (2018), we are able identify that the developed capabilities could also be characterized as **Innovation Capabilities; Environment Scanning Capabilities; and Integrative Capabilities**, which according to the authors are related to the Digital Transformation Process (refer to section 2.4 for more details).

Considering that, we identify the following capabilities as being related to the Digital Transformation at the organization: (1) Development of the already existing resource base; (2) Construction of extended network; (3) Environment and customer sensing; (4) R&D Capabilities; (5) Improvement of the organization resources; and (6) Co-evolution with the network.

To summarize, we can list the following main findings from this second case study:

- According to the maturity model provided by Ganzarain and Errasti (2016), the organization was classified as being on level 5 - Detailed Business Model;
- The organization business model is pretty defined towards the Industry 4.0 (with some remarks due to their customer's limitations);
- The organization displayed microfoundations that allowed them to develop dynamic capabilities;

- Integrative capabilities affected both the organizational development and also the development of other types of capabilities.
- The ecosystem and network contacts really make a difference to assist the organizational development towards the Industry 4.0.
- Organizational culture was pointed as one of the greatest challenges for the digital transformation and the Industry 4.0 development.

So far, what really caught our attention in both cases was the importance that the network contacts and the ecosystems displayed for the organizational development towards the Industry 4.0, which is aligned with Teece (2018a; 2018b) propositions regarding the importance of ecosystems, partnerships and network contacts at the digital era.

4.3. CASE STUDY C - goEPIK

This section will describe the case study performed at the organization named goEPIK, which provides a digital transformation solution that connects people and processes. This organization also uses augmented reality (AR) to increase the digitalization level and user experience provided. Thus, they are also characterizes as being a provider of the digital transformation and the Industry 4.0 related technologies.

4.3.1. The goEPIK organization

goEPIK is an organization that was created at the beginning of 2017. According to the Operations Director, their idea of having a business relate to AR and also Virtual Reality (VR) started when her other business partner (which at the time was finishing his graduation and developing his final project using those technologies) spoke to her about having an organization created to deal with that. According to her business partner, those technologies were already pretty advanced in France and he was looking to bring that to Brazil. To further explore this, they went to Paris in order to check possible applications of that technology. However, once they returned to Brazil they realized that did not know exactly what they could or which customers could be potential ones.

Thus, they started some initiatives to check the applicability of those technologies, until they managed to close a very good deal with an education institute. They thus saw a potential market segment (education) for their technology, and decided to create their first

organization, which had as its objective the addition of disruptive technologies to classrooms and educational methods.

However, they soon realized that this market segment was very complicated to deal with, since the education market is long known for its conservative approach regarding technologies, which resulted in difficulties for them to acquire more customers at that segment.

On the meantime, they managed to get in contact with the FIEP institute. Upon that, they´ve joined the FIEP ecosystem and start to get in contact with industrial organizations that were also members of this ecosystem. With the assistance of those organizations, they realize that this technology could be used with operational tasks of industrial organizations. They thus realized that they could provide VR technology for operational tasks of industrial organizations, which was when they started to get closer to the Industry 4.0 scenario. Once they made that change to their customer segment, they started to acquire more customers.

Upon that, the Operations Director stated that they end up working with two different technologies (AR and VR) at the same organization. However, to earn a greater market share they decide to create another organization to work specifically with AR, and upon that goEPIK was created.

From January 2017 (time of its creation), the organization expanded its business and it now has 15 employees. Different from the other organization that they've created, goEPIK is more focused on Industry 4.0 itself, where according to the Operations Director they do not deliver just AR for their customers, but an integration between people and processes, with the utilization of AR to provide a more immersive approach. To connect those organizational resources, they use the cloud services provided by organizations such as Amazon and Microsoft.

A precise number of customers was not provided, but the interviewees stated that they've customers that range from small to larger industries. The Developer further exemplified that, stating that they've three types of customers: (1) Customers that want to be part of the Industry 4.0, but does not yet know what exactly it is yet (to those they work mainly with the digitalization process); (2) Customers that already have some initiatives towards the Industry 4.0 (where they work mainly trying to assist with technical and organizational issues); and (3) Customers that are already with a good development level towards the Industry 4.0 (which he pointed as being extremely rare, to which they work analyzing the digitalization that was already performed and also improving it).

To address all these types of customers, the Developer also stated that they deliver three different levels of service to their customers: (1) a Web view that allows managers to have a real time tracking of process; (2) An application (device) view, which also includes AR glasses, thus allowing employees to perform their tasks (this second level connects to the first level and allows the managers to have real time information); and (3) The training view, which usually runs on AR devices such as Microsoft HoloLens and HTV Vive, thus allowing immersive organizational trainings to take place (hat third level is also connected to the other levels), which thus characterizes their integrated solution.

4.3.2. Business model conceptualization at goEPIK

Regarding their Business Model, at the **Value Proposition** the interviewees stated that what goEPIK delivers to their customers is the digitalization of industries processes, thus connecting people and processes, with the utilization of AR to assist and create a more immersive experience for their users.

Apart from that, a very interesting information was provided by the Developer: the fact that they do not sell the hardware parts of their system. According to him, they only indicate potential hardware vendors that could satisfy their customer needs, but the AR devices and also other sensors are not sold or produced by them.

Considering the **Value Capture (Monetization)** of their model, we identified they use mainly on a pay-per-use model. More specifically, they use a SaaS model where users are charged on a monthly basis to maintain the access to the service provided by the organization. Apart from that SaaS model, they are also using the ‘success rate model’. According to the Operations Director, they currently have only a single customer with that model, but they aim to expand that to other organizations.

We also identified the importance of complimentary assets for this organization, since just like in our first case, the organization relies on products and services provided by other organizations to have value delivered and captured. We give a special emphasis for the cloud computer providers (which were emphasized by all interviewees), and the AR devices provider (which were emphasized by the Developer).

Regarding the **Customers Identification,** we noted that this organization does perform an internal search for their customers. However, the ecosystem and network contacts that they´ve and more specifically the support provided by FIEP was pointed as being fundamental for their customer acquisition. The Operations Director also stated that other

events related to the Industry 4.0 and startups assisted them not just to identify and acquire customers but also to reshape their business model.

As a matter of fact, both the Developer and the Operations Director emphasized the prizes that they´ve earned at those events (such as being at the first place at the 100 Open Startups 2017, and on the fourth place at the 100 Open Startups 2018), which allowed them to have a closer contact with industrial organizations that are looking to digitally transform themselves.

Considering their **Customer Relationship**, we identified that this organization use standards mechanisms to understand their customer needs, such as process mapping and regular meetings. What is noteworthy is that this organization was able not just to sense their customer needs, but also their market needs. In other words, they noted that most organizations were still underdeveloped when we consider the Industry 4.0 scenario, and they thus decided to work specifically with digital transformation at those organizations.

That was emphasized by the Operations Director, where she explained that their solution is introduced to their customers in 'waves'. Thus, during the first wave they will work specifically at the digitalization process itself, ensuring that the employees will use their AR devices to perform maintenance and transferring the industry processes to the digital world. After that, the other waves will include technologies such as machine learning, predictive analysis, ultimately increasing the automation level of the organization.

With that approach, they do not have some issues that other analyzed organizations have (such as encountering customers that are not yet ready to have an Industry 4.0 technology implemented).

Digital contact with the customers was also mentioned by both the Developer and the Operations Director as being something very important when we consider the digital transformation, while co-design and co-engineering was also identified not just with their customers and partners, but also with other organizations that provide similar solutions. In the words of the Operations Director, "we noted that if we assist those organizations we could potentially create new partnerships and leverage our solutions."

4.3.3. Digital transformation perspective at goEPIK

Considering the digital transformation at this organization, we note that different from the other cases, this organization works directly with the digital transformation process.

Considering the Ganzarain and Errasti (2016) maturity model, we can also classify this organization as being at the level 5 (Detailed Business Model). In other words, this organization does have an Industry 4.0 vision, they do have a detailed business model that encompass customer segment, value proposition and key resources that are properly defined towards the Industry 4.0. However, and just like the other cases, their monetization (value capture) is where they still lack some Industry 4.0 development. Despite the fact that they are using a SaaS model (which is related to the Industry 4.0 scenario), the model itself is not yet very flexible, mostly due to rigidities and limitations from their customers. Nevertheless, the Developer stated that as they implement their solution to the customers' structure, their model gets closer and closer to the Industry 4.0 concept.

Furthermore, and just like on our previous cases, the Brazilian scenario was also pointed as being very challenging when we consider the digital transformation. According to the interviewees, a mixture of culture and technology issues was pointed as being the main barriers that prevent the Industry 4.0 development.

According to the Developer, the organizational culture is usually a challenge for them, and it tends to be even more critical when you consider that critical information is usually directly related to the digital transformation. In his words: "You arrive at the organization with your idea of digital transformation and they will look at you and say: Ok, I'll simply give you all that sensitive information and trust you?". Thus, trust was one more time pointed as a very important item to be built with their customers.

Furthermore, we identified that the ecosystem and the support provided by FIEP also assisted them to build that 'trust' with their customers. As stated by the Operational Director: "Once you manage to be a member of an ecosystem (such as FIEP, for example) it gives more credibility to your organization and thus industries tend to trust you more".

Apart from that, the events that they´ve attended and the prizes that they´ve won were also pointed as important items for their customer acquisition. Regarding that item, the Operations Director stated: "Those prizes that we´ve earned really assisted us, because this demonstrate to our customers that we are someone that will do business right and that can be trusted".

Regarding the digital transformation, at the **Employees** dimension the interviewees pointed that Trainings, Integration and also Novel job functions and workplaces as being directly related to the digital transformation process. As a matter of fact, that was the first organization that mentioned novel job functions and workplaces as something important for the digital transformation. The reason for that might be the fact that since they work digitally

transforming their customers, they are able to see the creation of those novel job functions and workplaces.

Considering the **Partners and suppliers**, all four items from our model were mentioned by the interviewees (Connectivity, Transparency, Joint Analysis and Reliability). Thus, this was the first organization that mentioned the item Joint Analysis as an item related to Partners and suppliers. The developer provided us more details about this item, stating that they realized that if they assisted other organizations that deliver similar solutions, they could create a partnership and thus leverage their solution to other potential customers that this other organization has contact with.

And lastly, at **Production equipment** we were able to identify that Increase of Productivity and Rapid Access to Data where pointed as being important items when considering the digital transformation process. According to the interviewees, one of their main ideas with the digitalization is to increase the productivity, as well as the time needed to access the data (which we identified upon the developer explanation of the three level of services that they provide).

4.3.4. Dynamic capabilities at goEPIK

Starting with the first process (**Sense**), we noted that this organization used three main approaches: A first one is related to the Industry 4.0 and startups events that they attend, where they aim to keep in touch with novel technologies and solutions that could be added to their scenario. The second one is related to an internal search that they perform, thus directly getting information from their customers. And a third one is related to a closer contact with other organizations that provide similar solutions, which encompass not just their partners and suppliers but also their competitors. According to them, their idea is to transform their competitors into partners, which can result in a greater customer acquisition for them. At that organization we also noted a closer contact between their partners and suppliers than on the previous ones, thus allowing them to better develop integrated solutions.

Considering the second process (**Seize**), we were able to identify that their business model is very well defined. Just like on the previous cases, the ecosystem and network contacts also assisted them to have their model reshaped, which was mentioned by the Operations Director, pointing that once they entered the ecosystem they managed to change their customer segment and also their value proposition that was being delivered to their customers.

Considering their decision making protocol, the Developer stated that they do have a horizontal approach, however that was not as horizontal as the previous two organizations and the reason for that seems to be the fact that they have more employees than the other organizations, which is combined with a considerable growth month after month. According to the developer, the final decision is usually taken by the CEO or by the 'innovation director' that is responsible for the project in question.

Furthermore, we note that their organizational boundaries are also blurred, thus being aligned with the Digital Transformation and Industry 4.0 approaches, where the organizational boundaries tend to become blurred and overlap one another (KAGERMAN; WAHLSTER; HELBIG, 2013).

Apart from that, their commitment was also evidenced at the data collection. During the record of the first interview, we noted that an organization was recording a documentary about goEPIK, aiming to demonstrate how the managed to achieve success at their business. Due to that, one of our interviews was delayed in about 40 minutes due to a meeting that they were attending to. That provided the researcher the possibility to perform a non-participatory observation and during that observation we aimed to identify the commitment from the employees, and what they usually do at their 'free time' at the organization. Upon that we noted that even at the 'free times at the coffee machine', the conversations were usually about projects or potential innovations for the organization. Furthermore, a very 'informal' scenario was also identified, which can further assist the share of ideas and the information flow.

And lastly, at the third process (**Reconfigure**) we were able to note that the organization does have a loosely coupled structure, which again can be influenced due to the fact that this one is a small organization. Their decision making protocol and the team distribution at the organization facility further demonstrated that, where we identified an easy interchange of information not just between their employees but also with other organizations that were sharing the same facility.

Asset co-specialization was also evidenced during our interviews, where we noted that this organization have a closer relationship with their partners and suppliers than the other ones that we´ve analyzed. This results in a greater asset co-specialization at the organization, where they establish a business model that gives more emphasis to partners and suppliers. In other words, thus sharing information and creating solutions with its customers, partners, suppliers and also with their competitors, to foster innovation and exogenous technologies to their internal structure.

At the same time, they try to minimize agency issues, with the utilization of formal contracts with their customers. However, the Developer stated that they usually try to establish a relationship based on trust, instead of one based on a contract. According to him, they only use their contract in case some critical issue arises, while other daily tasks and minor issues are resolved upon their trust on one another.

Considering patent protection, it was stated that they do have a patent for their brand, but just like the other organizations, the protection of software solutions is very difficult, and due to that they rely on a creating technological barriers such as integration and connectivity, that prevent competitors of copying their solution.

4.3.5. An integrated analysis at goEPIK

Figure 16 demonstrates our framework applied to goEPIK organization. Again, this figure summarizes what was described at the previous sections of this case study, thus highlighting the main findings from sections 4.3.1; 4.3.2; 4.3.3 and 4.3.4.

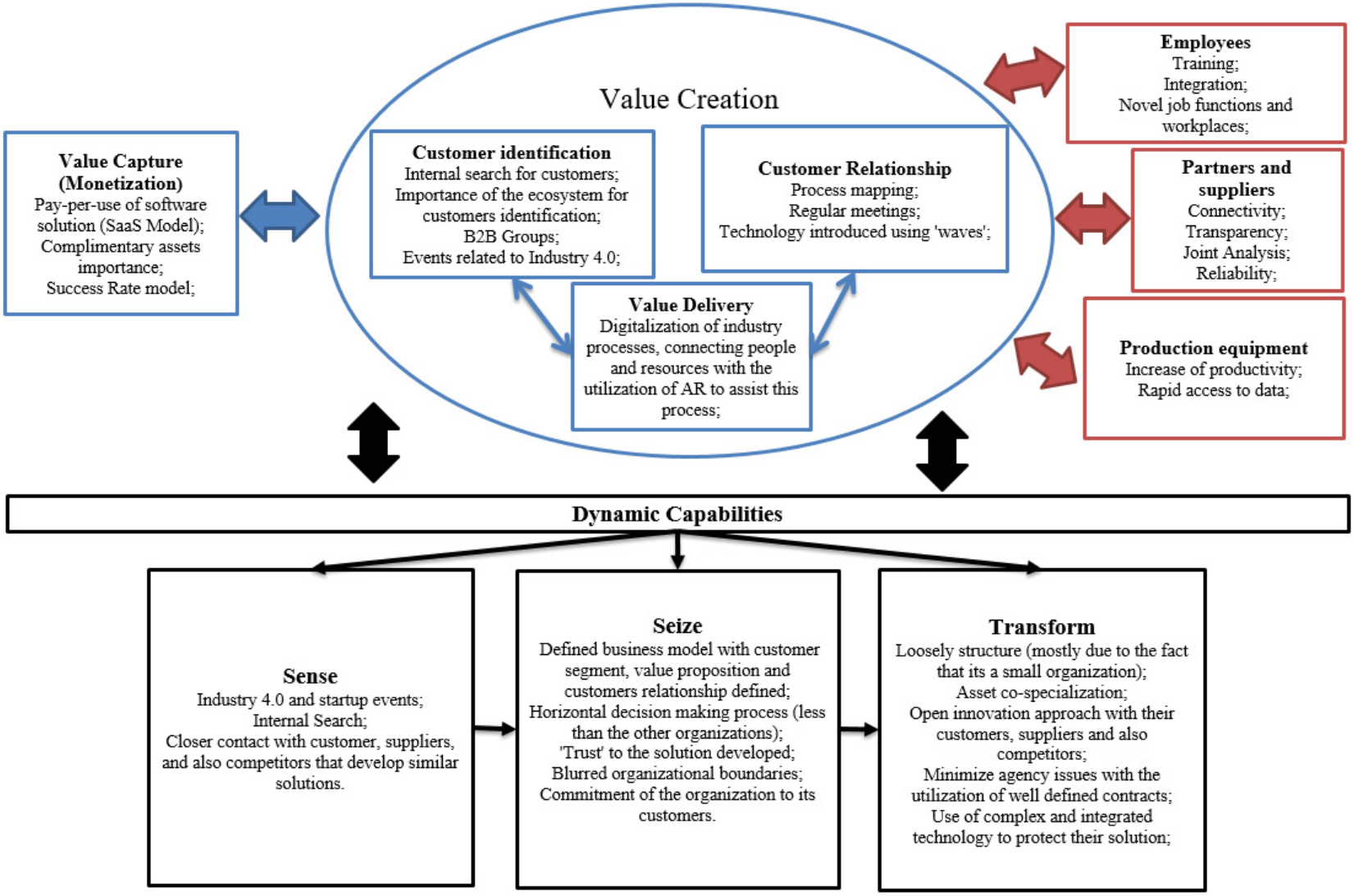
Regarding their **Business Model**, a scenario very similar with the first two analyzed organizations was identified, thus pointing to similarities with the work of Baden-Fuller and Haefliger (2013). Just like on our previous cases, we noted that their customer segment is mainly a B2B one, while a prompt identification of customers was often mentioned by the interviewees as being important to leverage competitive advantage at the organization. To prompt identify customers, the ecosystem and network contacts that the organization has demonstrated to be very important, which is thus aligned with the works of Teece (2018a; 2018b).

However, different than the previous two organizations that gave more emphasis to the costs and energy savings for their customers, this one did not had to do it since they word specifically with digital transformation at their customers.

At the value capture is where they still lack some development towards the Industry 4.0. Nevertheless, their model is still aligned with other studies related to the Industry 4.0. (ARNOLD; KIEL; VOIGT, 2017; MULLER; VOIGT, 2017).

Apart from that, asset co-specialization was also identified at this organization and in a level that is higher than our previous cases, which is a result of their integration with customers and suppliers, thus being aligned with the literature related to the digital transformation (KAGERMAN; WAHLSTER; HELBIG, 2013; TEECE; LINDEN, 2017; TEECE, 2018b).

FIGURE 16 - FRAMEWORK APPLIED TO THE GOEPIK ORGANIZATION



SOURCE: The Author (2019)

Considering that, a service orientation was also identified at their business model, (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017); just like a customer centric approach (KAGERMAN; WAHLSTER; HELBIG, 2013; KIEL; ARNOLD; VOIGT, 2017), and also the importance of partnerships (KAGERMAN; WAHLSTER; HELBIG, 2013; BURMEISTER; LUTTGENS; PILLER, 2016), which assisted them to develop co-specialized solutions that allows them to created and delivered to their customers.

Regarding the **Digital Transformation**, one more time the challenges of the Brazilian scenario where emphasized by the interviewees, where they complained about the approach that some larger industries have upon small ones and also due to the cultural approach, which prevent innovation to be developed at the organizations. Nevertheless, the analyzed organization demonstrated to be the most developed of our case studies when we consider the digital transformation. And at least one of the reasons for that seems to be related to the network contacts and the ecosystem where they are inserted. For this specific case, both the co-specialization of assets and the importance of the ecosystem became more evident than the previous ones.

Regarding the **Employees**, trainings were pointed as being important for them to understand the dimension of the Industry 4.0, Novel job functions and workplaces were pointed as something that will really need to be addressed at the organizations. At **Partners and Suppliers**, connectivity and Joint Analysis were frequent mentioned by the interviewees and at the **Production equipment**, increase of productivity and rapid access to data were the items identified.

If we turn to the **Dynamic Capabilities**, we can clearly see that at their first process (Sense), this organization was the one that presented a very close approach not just with its customers but also with its competitors, thus aiming to develop solutions that really encompass other organizations of their ecosystem.

At the second process (seize), we emphasize the fact that this organization was the one that presented the most developed model towards the Industry 4.0 concept, thus having it more flexible to perform changes. Furthermore, their organizational boundaries were also the most blurred ones, a result of their approach with the ecosystem and with the network contacts to have solutions developed, which is aligned with the propositions of Teece (2018a; 2018b), regarding organizational boundaries in digital platform scenarios.

And regarding the third process (Reconfigure) what caught our attention at that case was the asset co-specialization, which was more evident than the other analyzed organizations so far. At their specific scenario, we noted that to have their value delivered to customers they

need (apart from their system), the cloud computing, a good network connection, the AR devices and also some other sensors that will be added to their customer environment, and all of those items are provided by their partners. According to Baden-Fuller and Haefliger (2013) asset co-specialization is pointed as being important for value capture of models that deal with novel technologies, and Teece (2018a; 2018b) emphasizes the importance of complimentary assets is the context of digital organizations.

Considering that, this organization also developed microfoundations at each process that allowed them to develop dynamic capabilities. If we consider study of Zeng, Simpson and Dang (2017), we can see that this organization also passes through two of the three phases that the authors describe for the digital transformation (Focus on resource transformation; and co-evolution with the system). This organization also did not have to pass through the first phase (Establishment of a new focus), because it was created with the 4.0 concept in mind.

At the Focus on resource transformation, we can note the **Experimentation** capability, mostly due to the fact that their novel technology had to be tested with different customer segments, until they found a suitable one to receive it, while multiple changes were also performed to their product.

Apart from that, the **Construction of the extended network** was also important for them, which was emphasized by all interviewees. According to them, the network contacts of their ecosystem provided very useful resources for the organizational growth, while at the same time it assisted them with the business model redesign. Furthermore, and just like on our first case, this organization did not develop its internal organizational resources. Rather, they worked to develop novel resources with the ecosystem, thus designing solutions that encompass multiple partners and suppliers.

At the Co-evolution with the system, the **institutionalization of flexible routines** was identified, which is characterized by the approach that the organization uses to work with their customers and partners. As stated by the developer, they usually try to maintain an informal approach with their partners and customers, only using formal contracts in case something really bad happens. Furthermore, our non-participatory observation demonstrated those flexible routines, thus creating a scenario where information flow can occur and innovation can flourish.

Considering that, panel 16 summarizes these capabilities, with the ones highlighted in **bold** as the ones identified at the organization, while the rest represents capabilities identified at the study of Zeng, Simpson and Dang (2017).

PANEL 16 - CAPABILITIES IDENTIFIED AT GOEPIK, BASED ON ZENG, SIMPSON AND DANG (2018)

PHASE	IDENTIFIED CAPABILITIES
2. Focus on resource transformation	**Experimentation;** Development of the already existing resource base; **Construction of the extended network.**
3. Co-evolution with the system	**Institutionalization of flexible routines;** Improvement of the organization resources; Coordination of the extended network.

SOURCE: The Author (2019), adapted from ZENG; SIMPSON; DANG (2017).

Furthermore, this organization also did not develop the coordination of the extended network capability, which again seems to be related to the fact that this organization is a small one, thus not having all the power that large organizations have to coordinate the network.

Furthermore, considering the study of Helfat and Raubitschek, (2018), we can note that the developed capabilities could be classified as **Innovation capabilities**, **Environment sense capabilities**, and **Integrative capabilities** which the authors point as being related to the Digital Transformation.

Here, we can clearly see that the organization does have an organizational culture towards innovation, which is assisted by their network partners and the ecosystem. The Operations Director clearly points that when we asked about the importance of the network contacts, stating that "It would be very difficult, if not impossible for us to develop this type of service if it wasn't for the support provided by the network contacts." Furthermore, she also stated that: "They assisted us to achieve resources, to better design our model and also to get a closer contact with our customers".

Upon that, we identify the following capabilities as being related to the Digital Transformation process at the organization: (1) Experimentation; (2) Construction of the extended network; (3) Institutionalization of flexible routines; (4) Environment and Customer sensing, (5) Development of partnerships and co-specialized solutions; and (6) Co-evolution with the network.

To summarize, we can list the following main findings from this third case study:

- According to the maturity model provided by Ganzarain and Errasti (2016), the organization was classified as being on level 5 - Detailed Business Model;

- The organization business model is pretty defined towards the Industry 4.0 (with some remarks due to their customer's limitations);
- The organization developed specific microfoundations that allowed them to develop dynamic capabilities;
- The network contacts and the ecosystem where they're inserted displayed an important role in assisting the organization development at the digital transformation process.
- Organizational culture was pointed as one of the greatest challenges for the digital transformation and the Industry 4.0 development at the Brazilian scenario.

One more time, the network contacts and the ecosystem played a major role in assisting them to develop the organization towards the Industry 4.0 concept.

4.4. CASE STUDY D – Organization D

This section will describe the case study performed at the organization that will be called Organization D, which mainly create and deliver industrial dumpsters for other organizations. Thus, different from our other case studies this organization is characterized by being a user of the digital transformation process and Industry 4.0 technologies.

4.4.1. The Organization D

Organization D is a small organization that mainly produce and sell industrial dumpsters to other organizations. In other words, they transform steel plates (cutting and welding them) into dumpsters that are later used by their customers.

That organization was acquired one year ago by a person who now acts as the CEO for this organization. More specifically, he acquired the resources from another organization that was being shot down, and use those resources to start a new organization.

Considering that, the Organization D was created in December of 2017. Currently, they´ve 15 employees, but according to the Human Resources (HR) Manager, they are hiring more people almost daily due to the organization growth.

The organization currently have a single facility, but they are also looking to expand it to a second one, located right at the side of the first one, which will thus double their physical space available. At the same time, they are looking to add a second floor to their first

facility, also increasing the physical space that the organization has. According to the Industrial Manager, that need to be performed to meet their customers' demands that is increasing almost daily.

Regarding their customers, a precise number was not provided, but we were able to note from the non-participatory observations that they´ve customers that range from medium to large organizations, while most of them appear to be large industrial organizations.

According to the External Consulting Analyst, the money that the CEO invested to acquire the resources and open this organization was already recovered, and due to that they can now plan to invest and expand the organization resources.

At this organization, due to their large amount of work, we only managed to do two small interviews with internal employees (one with the HR Manager and another one with the Industrial Manager), and a third one with an External Consulting Analyst that they´ve. However, we performed two non-participatory observations at their organization. A first one, which last about 90 minutes encompassed the observation of managerial activities inside their 'business room'. And a second one, which least for about 60 minutes, encompassed the observation of their production line. With those observations, we were able to collect important information that assisted us to analyze the organizational scenario and the challenges that they currently face.

4.4.2. Business model conceptualization at Organization D

Turning to the organization Business Model, the interviewees pointed that their **Value Proposition** is focused on three main items: Product quality, delivery time, and product costs.

The HR Manager stated that they want to deliver a product in less time, with a higher quality than their competitors. Furthermore, she also stated that even if their products is a bit more expensive, that is compensated by the fact that their high quality will in the long run generate cost savings for their customers.

The External Consulting Analyst further stated that they´ve developed a new procedure to create their industrial dumpsters, which allows them to perform less cuts and welds to the product. With that, they ended up losing some parts of the steel plates that they acquire. However, this results in more quality, durability and resistance to their product. It was further stated that currently they are the only organization that use that technique to create the dumpsters.

Furthermore, the External Consulting Analyst also stated that the waste generated from this process is currently being sold by them only as industrial garbage, which thus provide very little return for them. However, they are looking to develop other products with that waste, thus minimizing their losses.

Regarding their **Value Capture (Monetization)**, we identified that this organization also uses the traditional value capture model (thus having a monetization based on fixed prices for the products that are delivered). Furthermore, and also different from the other organizations that we´ve analyzed, this one rely less on co-specialized assets to have their value proposition created. They do have their partners that will provide the resources that they need (such as weld and cutting machines and steel plates), but if we consider the value that they are delivering to customers, we can see that the entire product is developed by them.

Considering the **Customers Identification**, we noted that this organization rely mainly on an internal search for customers. As stated by the HR Manager, they have a marketing team that is mainly responsible to get in contact with potential customers (that team currently has 2 employees). Regarding that, the External Consulting Analyst stated that the 'marketing guys' where previously closing a small number of deals, and when the resources were acquired by the current CEO, they reshaped their goals and processes and now each person from the marketing team is able to sell over 4 times more than before.

Lastly, once we consider their **Customer Relationship**, we identified that this organization also uses standard mechanisms to understand their customer needs, such as regular meetings and process mapping. The HR manager also stated that they do have plans to create an after-sales support team, to further understand their customer needs and thus be able to create more value from their products.

4.4.3. Digital transformation perspective at Organization D

Once we turn to the digital transformation at this organization, we can clearly see a different scenario than the one identified at the previous organizations. First, this organization is characterized as being a 'user' of the digital transformation and Industry 4.0 technologies. Due to that, this organization was not created with the 'Industry 4.0 concept in mind', like the previous ones.

Despite that, we also asked questions related to the digital transformation process for the interviewees, thus aiming to identify their understanding and the organizational

development, which was complimented with information collected at the non-participatory observations.

Considering that, the Industrial Manager stated that they do have plans to use digital transformation technologies at the organization. However, they still did not saw a prompt need to have it done. In his words “We know that we need to apply those technologies such as automation and so on, but our segment still did not demand that, you know. Thus we have plans to have it started for at next year, but currently we are able to continue our organizational growth without it.”

Furthermore, the Industrial Manager also stated that they are currently aiming to create some partnerships with industries that are related to robotics, which according to him can further assist the addition of this type of technology to the organization.

That was also mentioned by the HR Manager and the External Consulting Analyst. According to them, the organization is currently presenting a considerable growth, and they are investing heavily on acquiring new facilities and hiring more employees, but they know the importance of having automation and other technologies added to the organization.

With our non-participatory observations, we were able to better address their currently development state. Upon that, we noted that their process is currently very manual (both regarding administrative tasks and also regarding their production line). For example, their working hours are nowadays manually recorded on an excel spreadsheet, and the sales process is also mainly manual, still not displaying the integration between customers and suppliers. At their production line, we note that the production processes are also manual, with forklifts moving the steel plates through the production line, while they also rely mainly on human workforce to perform their activities. Although they do have technologies that facilitate the work (such as very technical and precise plasma welds), the production line activities are still manually performed.

Furthermore, the External Consulting Analyst stated that they pretend to use automation in the near future (thus being aligned with the position of the Industrial Manager). However, he also stated they are still unsure about how to add that to the organization.

The interviewees also point the organizational culture as something that might create great barriers for automation and technologies addition to the organization. According to them, they need to convince their employees that the technology can be used for a mutual benefit, and not to replace them. The Industrial Manager stated that they want to add technology and automation to their production facility, but they also do not want to get rid of their employees. What they want to do it use their employees to boost the development, thus

getting them involved with this process since the beginning and assigning them to work at the novel jobs functions that will appear.

At their production line, we also noted that they still do not use any types of sensors or automation mechanisms to perform their activities, while at the management tasks, various manual and operational tasks seemed to occupy their daily activities.

What was identified at the organization is a classic scenario where an organization present a huge growth in a short period of time, and due to that the organizational resources that are currently available (mostly workforce) did not catch up with that growth yet.

Upon that, if we consider the maturity model provided by Ganzarain and Errasti (2016), we can classify this organization as currently being at the level 2 (Managed). In other words, the organization is aware of the importance of Digital Transformation process and they do have plans to have technologies and automation added to the organization. However, they still did not apply those technologies and they also do not have a business model that is aligned with the Industry 4.0 concept (which is expected, since the literature points that the business model changes often occur in parallel with the technology application at the organizations) (see KAGERMAN; WAHLSTER; HELBIG, 2013; GANZARAIN; ERRASTI, 2016; KIEL; ARNOLD; VOIGT, 2017).

At our interviews, we also aimed to identify their perception regarding how the digital transformation would affect the organizations considering Employees; Partners and suppliers; and Production equipment.

Considering that, at the **Employees**, Training and Support were mentioned as being two of the most important items. The Industrial Manager stated that he believes that not just a technical training, but also a cultural training is needed because the technology addition will represent nothing if your employees do not accept that technology. In his words: “Employees need to understand the benefits from technology, and not see that as their enemy. If the last happen, a failure will for sure occur.”

Furthermore, novel jobs and functions were also mentioned, since the interviews stated that their idea is to reposition their employees to new positions and job functions that will be created upon the technology addition.

At the **Partners and suppliers** dimension, the most mentioned item was reliability. What we noted at our interviews and also at the observations is that they do have partnerships with some suppliers (most of them that provide steel plates for them), but a greater reliability (especially with delivery times) would be really important for them. Apart from that,

connectivity was also mentioned, mostly due to the fact that they according to them, a close connection in terms of communication would affect the reliability.

And lastly, at **Production equipment** the items Increase of productivity, and Economy where pointed as the most important items for the organization. According to them, the increase of productivity is the most important one, while regarding economy they believe that it will occur on the long run, mostly due to the fact that large amount of investments will need to take place to apply technology at the organization. But on the long run, they believe that they will save money with those investments.

4.4.4. Dynamic capabilities at Organization D

Considering the dynamic capabilities, at the first process (**Sense**) we note that different from the other organizations, this one relies mainly on one item to sense the environment and customer needs. Although they are currently aiming to create partnerships with industries related to robotic (as pointed by the Industrial Manager), the only mechanism that is currently in place at their organization is the identification of potential market segments and customer needs performed by their market team.

Considering the second process (**Seize**), we were able to identify that despite the fact that they do not have an Industry 4.0 business model', they have a very well defined business model (which encompass all items from the model used at our study being properly defined). That seems to be aligned with the fact that their organizational boundaries are very well defined, which is different than what we saw at the other analyzed organizations, where the boundaries where usually blurred and not properly defined.

And lastly, at third process (**Reconfigure**) we noted that they do have insights about 'open innovation', aiming to create partnerships and knowledge sharing with other organizations. However, that was not yet in place at their organization. As stated by the Industrial Manager "We are planning that for the future", while the HR Manager stated that "We do know the importance of innovation to an organization, and we do have plans to have it further developed here."

Furthermore, their governance structure also has insights that could lead to dynamic capabilities development, where they try to minimize agency issues (with the utilization of formal contracts with their partners and customers).

Despite that, a loosely coupled structure was also identified at this organization (which was also expected since this one is a small organization), however although a loosely

coupled structure was identified, their structure displayed more rigidity than the other organizations, thus providing a clear differentiation between employees that work with administrative and managerial tasks, and employees that work with product assemble items. However, that was expected since this organization adopted a classic organizational design, thus being different from startup organizations that usually display less rigidity and a more horizontal structure.

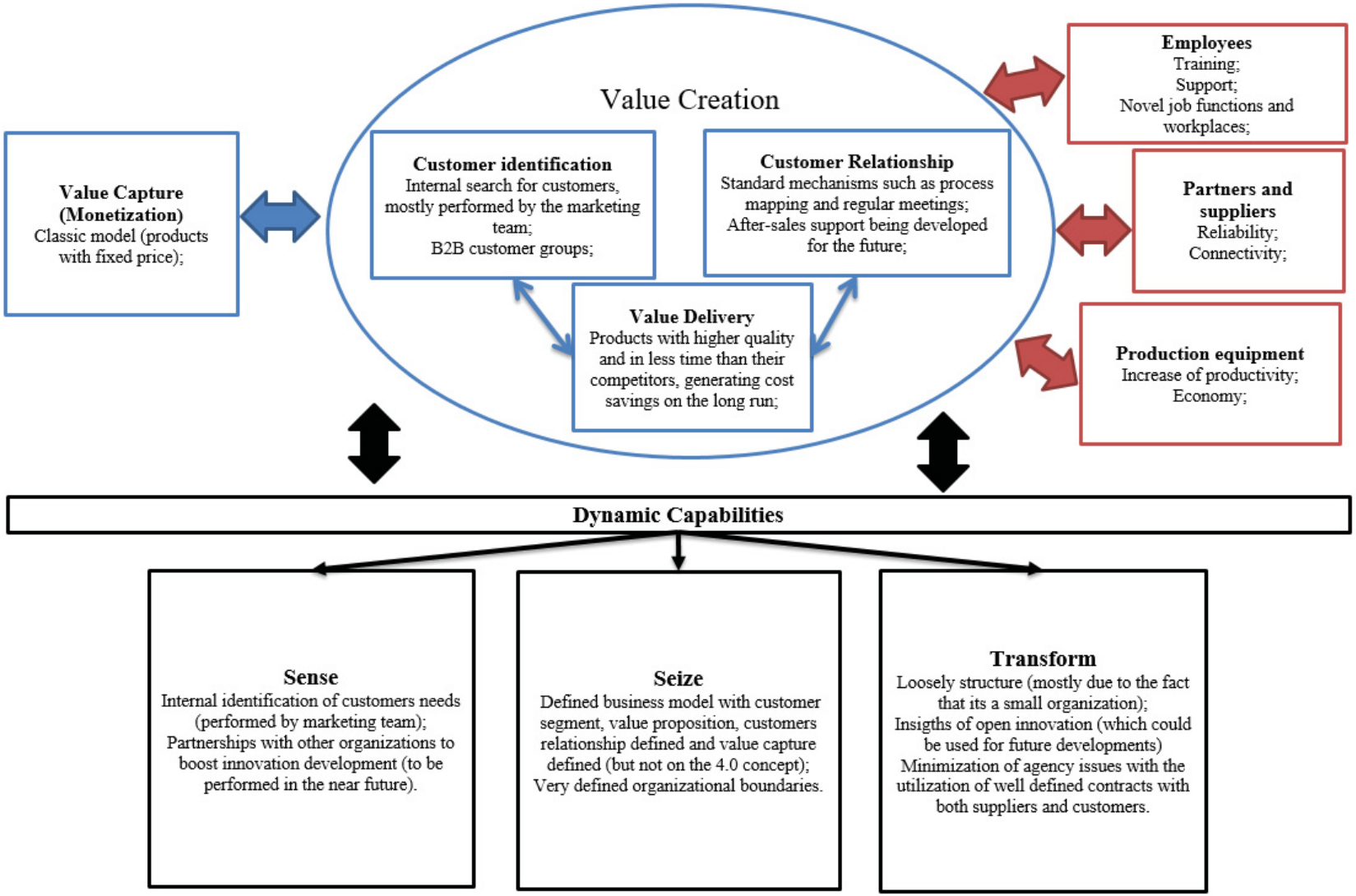
4.4.5. An integrated analysis at Organization D

In order to summarize what was previously described, figure 17 represents the application of our framework to the analyzed organization, pointing the main items from the sections 4.4.1; 4.4.2; 4.4.3 and 4.4.4. It's important to note that although we applied the same framework that we used for the previous organizations, a different scenario was identified at this current one.

Regarding their **Business Model**, we identified that they do have a well-defined model. However, different from the other organizations, their model is not directly aligned with the Industry 4.0 concept, which does not mean that their model is not a good model. As a matter of fact, their model proved to be a good one, which reflected upon their organizational growth and also their revenue streams that are constantly increasing. What we are pointing here is that their model not yet display the idea of servitization (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017); and a focus on partnerships (KAGERMAN; WAHLSTER; HELBIG, 2013; BURMEISTER; LUTTGENS; PILLER, 2016) that is often mentioned at the digital transformation and Industry 4.0 literatures.

Despite that, we can still note some similarities with the propositions of Baden-Fuller and Haefliger (2013), like the fact that this organization also has B2B customer groups as their main market segment, and the fact that a rapidly identification of customer and users was also necessary for their business to grow. But apart from that, most items from the model of Baden-Fuller and do Haefliger (2013) does not ‘meet’ the scenario of the present organization. Which seems to be related to the fact that they are not selling a ‘novel’ technology. Nevertheless, that did not create any challenges to have their model applied to the organization, which thus demonstrates that the structure of their model can also be applied to organizations that are not directly dealing with novel technologies.

FIGURE 17 - FRAMEWORK APPLIED TO THE ORGANIZATION D



SOURCE: The Author (2019)

In other words, this organization uses a more ‘traditional model’ to do their business, focusing on internal competences and resources to have the value created and delivered to their customers, which reflected upon their asset co-specialization being only slightly identified as their product is produced almost entirely with equipment that they own, which is different from the previous organization, that relied heavily on technologies and other products provided by partners and suppliers from their network).

Once we turn to the **Digital Transformation**, a different scenario is also identified, where we thus saw that they are characterized as being a user of the Industry 4.0 technologies. Furthermore, this organization still uses standard industry processes to perform their activities. That become evident when we performed the non-participatory observations. For example, during the production line observation a forklift presented a problem and remained stopped for some time. That forklift was moving steel plates from a truck to the start of the production line and if they did not manage to resolve the issue, the production line would need to be stopped because the other forklift (they currently have two) was moving the dumpsters between the production line phases.

That limitation was also mentioned by the External Consulting Analyst, pointing that in a first moment, they are looking to acquire more forklifts (to have at least a spare one if necessary), while on the long run, they want to have something more automated, like treadmills to move the items through the production line.

Furthermore, the interviewees also mentioned that the cultural scenario displayed by Brazilian organizations is one of the greatest challenges for the digital transformation process and the Industry 4.0 development. The HR Manager stated that she believes that Brazilian industries have a culture of “only invest when it's extremely necessary”, thus not properly addressing innovation. If we consider that the literature points that Industry 4.0 is directly related to innovation (KAGERMAN; WAHLSTER; HELBIG, 2013; SHROUF; ORDIERES; MIRAGLIOTTA, 2014; KALTENECKER; HESS; HUESIG, 2015; KIRAZLI; HORMANN, 2015), that can be easily identified as a problem.

That organization however, was not completely unaware of the Industry 4.0 importance. They do demonstrate that they know that digital transformation and its related technologies are important and they do have plans to start the application to their organizational scenario. In other words, they do have some roadmaps for the Industry 4.0 development at their organization, but their business model is still not aligned with that, and that's the reason of why they were classified as being at the Level 2 (Managed) at Ganzarain and Errasti (2016) scale of Industry 4.0 development.

Considering the **Dynamic Capabilities**, we also noted a slightly different scenario at this organization. First, this organization presented different perspectives of dynamic capabilities than the other ones. For example, at the first process (Sense), we noted that they relied mainly only on one microfoundation, while a second one (development of partnerships with industries related to robotics) is on their roadmap for the future. The second and third processes (Seize and Reconfigure) also demonstrated a scenario similar to the first one, with few microfoundations displayed by the organization, most of them being currently present only on insights for future developments.

Furthermore, this organization presented its boundaries being very well defined, which is also different from the previous ones that we´ve analyzed. That appears to be directly related to the organizational development towards the digital transformation and the Industry 4.0. Teece and Linden (2017) and Teece (2018a; 2018b) point that technologies such as the ones related to the digital transformation will result in more blurred boundaries, which was also pointed by other studies related to the Industry 4.0 (see KAGERMAN; WAHLSTER; HELBIG, 2013; SPATH *et al*., 2013; LASI *et al*., 2014; MÜLLER; BULIGA; VOIGT, 2018).

Considering that, we did not identify the development of dynamic capabilities at this organization. We do identify that they´ve some microfoundations that can assist their development, but those are not yet allowing them to have dynamic capabilities developed.

At this point, a question related to dynamic capabilities might arise: If the organization did not develop dynamic capabilities, how is that they still have competitive advantage to generate profit and continue the organizational growth? The answer to that question is present at our reviewed literature: Ambrosini and Bowman (2009) and also Teece (2018a) stressed that dynamic capabilities cannot by themselves generate competitive advantage. Those capabilities can assist the development of competitive advantage. Furthermore, Eisenhardt and Martin (2002) and Ambrosini and Bowman (2009) pointed that dynamic capabilities are related to competitive advantage on the long run, thus allowing organizations to maintain their competitive advantage for a greater period of time (if the newer resource base is not copied).

In other words, this organization did not display the dynamic capabilities, but they displayed very well defined ordinary capabilities, which combined with a properly defined business model and the organizational resources that they currently have resulted in competitive advantage being generated on short run.

However, to continue generating competitive advantage, this organization must develop other microfoundations that could lead them to have dynamic capabilities developed,

which will allow them to renewal their resource base, ultimately assisting competitive advantage to be continuously generated (TEECE, 2007).

Furthermore, if we relate this scenario to the Industry 4.0 and more specifically with the study of Zeng, Simpson and Dang (2017), we can see that different from the other organizations, this one will need to first pass through the first phase described by the authors (Establishment of a new focus), in order for it to digitally transform itself.

For this organization, the capabilities of this phase that are pointed by the authors (Unlearning from past experiences; Investment in new resource bases; and Construction of a new culture that encompass collective learning) will very likely need to be developed, thus allowing this organization to start its digital transformation process towards the Industry 4.0

If we consider the Study of Helfat and Raubitschek, (2018) and the results of our previous case studies, we can also see that this organization will need to develop Innovation capabilities, Environment sense capabilities, and Integrative capabilities, which will allow them to continue their development towards the Industry 4.0.

To summarize, we can list the following main findings from this fourth case study:

- According to the maturity model provided by Ganzarain and Errasti (2016); the organization was classified as currently being on the Level 2 - Detailed Business Model;
- The organization business model is pretty well defined (however, it's not yet aligned with the Industry 4.0 concept);
- The organization have some microfoundations that can assist the development of dynamic capabilities. Upon that, other microfoundations should be developed to properly allow the development of dynamic capabilities to take place;
- This organization presents a scenario that is different from the previous ones in most of its aspects, including: their position regarding the Industry 4.0; their organizational boundaries; their relationship with partners and suppliers; and also the development of dynamic capabilities;
- Nevertheless, similar items were pointed by this organization as being important for the digital transformation process, thus demonstrating that they do have some roadmaps to have it implemented in the future.

Considering the case studies that were here explored, we will turn now to a cross-case analysis, where we aim to further explore the similarities and differences between the organizations, relating those with the study objectives.

4.5. A CROSS-CASE ANALYSIS OF THE ORGANIZATIONS

To further explore the case studies, this section will comprehend a cross-case analysis of the organizations, where we will aim to identify patterns and differences among them, which was performed upon the specific objectives of our study.

4.5.1. Measure the development level of the organizations at the digital transformation process according to the selected maturity model;

To further explore the objectives of our study objectives, we can split the analyzed organizations is two different groups. The ones classified as ‘providers’ (encompassing case studies A, B and C); and the one classified as a ‘user’ (encompassing case study D).

At our study it became clear that the providers aimed from the beginning to be Industry 4.0 organizations, while the user represent an organization that was created as a standard industry, and plan to later transform itself into an Industry 4.0 organization.

Due to that, the providers already presented a great development level towards the Industry 4.0, which resulted in them being classified at the level 5 (Detailed Business Model) on the maturity model provided by Ganzarain and Errasti (2016). In other words, these organizations displayed: (1) An Industry 4.0 vision; (2) A roadmap for the Industry 4.0; and (3) Concrete projects related to the Industry 4.0 (GANZARAIN; ERRASTI, 2016, p.1124), and they are currently adjusting their business model to meet the Industry 4.0 needs.

The organization classified as a ‘user’ on the other hand, demonstrated a different scenario, thus being classified at level 2 (Managed) according to the model provided by Ganzarain and Errasti (2016). That organization demonstrated that they do have an Industry 4.0 vision, and they also have a roadmap that encompass the application of Industry 4.0 technologies at the organization. However, they did not transform that vision into concrete Industry 4.0 projects yet, nor have they changed they business model accordingly.

Here, it's important to emphasize that the maturity model selected for the present study demonstrated to be really interesting for its application on small organization, especially when one wants to deal with business model changes, which thus assisted the researcher to identify if the organization was indeed changing its business model due to the at the digital transformation process and not due to other organizational processes.

4.5.2. Describe the organization business model according to the selected perspective;

Regarding the organizations business models, we were also able to identify that the providers presented some similarities among them. More specifically, at those organizations we identified the items mentioned by the literature as being related to the Industry 4.0: (1) Emphasis on partnerships; (2) Service orientation; and (3) Emphasis on customers (KAGERMAN; WAHLSTER; HELBIG, 2013; BURMEISTER; LUTTGENS; PILLER, 2016; ARNOLD; KIEL; VOIGT, 2017; KIEL; ARNOLD; VOIGT, 2017; MÜLLER; VOIGT, 2017; MÜLLER; BULIGA; VOIGT, 2018) were also present at the organizations.

Furthermore, the organization classified as a 'user' also presented an emphasis on customers, which may be related to the fact that organizations tend to construct their models with an emphasis on customers (see CHESBROUGHT; ROSENBLOOM, 2002; OSTERWALDER, 2004; MÜLLER; BULIGA; VOIGT, 2018). As a result, an emphasis on customers will probably be displayed by most, if not all, organizations, not just the ones related to the Industry 4.0.

Furthermore, the providers mentioned that the value capture was the hardest part of their model to be defined, with the interviewees usually displaying complaints about the difficult that it is to 'price' an innovation. That may be one of the reasons for the fact that the value capture is where the organizations displayed the greatest limitations to having Industry 4.0 concepts applied.

At case study A (PACKID) and case study C (goEPIK) the importance of complimentary assets for both the value creation and for the value capture became evident. case study B (PACKID) also displayed that, but on a lower level than the other two providers. Case study D on the other hand did, displayed a level of complimentary asset way lower than the providers to have value created or captured, which seems to be directly related to the organization development towards the Industry 4.0 since as pointed by the literature, complimentary assets display an important role when we deal with novel technologies (BADEN-FULLER; HAEFLIGER, 2013), or when we talk about digital transformation (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017), or digital organizations (TEECE, LINDER, 2017; TEECE; 2018b).

Nevertheless, all four organizations have as their main customer group the B2B segment, while for the providers the ecosystems and the network contacts was extremely important for customer identification and acquisition.

On the overall, and comparing the providers with the user, we can point that the greatest differences between them relied on the value capture, on the value proposition, and also on the customer identification, while the customer relationship did not display significant difference between the organizations.

4.5.3. Explore the dynamic capabilities processes of Sense, Seize and Reconfigure;

Through the individual analysis of the organizations, we aimed to identify microfoundations that could lead to dynamic capabilities development. Upon that, we do identify that the providers displayed microfoundations that allowed them to develop those capabilities.

Each of these organizations displayed microfoundations that allowed them to have dynamic capabilities developed. Furthermore, we also noted some similarities between the microfoundations identified. First, we identify that all three organizations used events related Industry 4.0 and technologies to assist the sensing process. Second, all three organizations demonstrated to have blurred organizational boundaries, with case study A (PACKID) and C (go EPIK) being more blurred than case study B (TAUFLOW). Third, all three organizations displayed a loosely coupled structure, with asset co-specialization also being present at a high level (being greater at case studies A and C).

Furthermore, insights about ‘open innovation’ were also identified at providers one, thus being aligned with the literature regarding the relationship between organizations when we consider the digital transformation process (TEECE; LINDEN, 2017; TEECE 2018a, 2018b).

The microfoundations identified at each of those three organizations, resulted in the development of some capabilities that we´ve listed at each of the analyzed cases. Some capabilities were also developed by more than one organization and in this sense, panel 17 summarizes the 10 capabilities that we´ve identified at the providers, with the respective information of which organization developed it, while panel 18 summarizes the main microfoundations of each capability that was identified, thus allowing one to take a better look at how they are sustained at the organizations.

At panel 17, we can thus see that three capabilities where developed by all three organizations (Construction of the extended network; Environment and customer sensing; and Co-evolution with the network). Considering that, we could state that those three capabilities have a central role when we consider the digital transformation process. And two of those

capabilities are related to the 'network' where the organizations are inserted, thus sustaining the positions of Teece (2018a; 2018b), and also Helfat and Raubitschek (2018), regarding the importance of network contacts for the digital transformation process.

PANEL 17 - SUMMARY OF CAPABILITIES THAT WERE IDENTIFIED AT THE ORGANIZATIONS

	CAPABILITY DEVELOPED (YES/NO)		
IDENTIFIED CAPABILITY	CASE STUDY A	CASE STUDY B	CASE STUDY C
Experimentation	**YES**	NO	**YES**
Construction of the extended network	**YES**	**YES**	**YES**
Institutionalization of flexible routines	**YES**	NO	**YES**
Improvement of the organization resources	**YES**	**YES**	NO
Environment and customer sensing	**YES**	**YES**	**YES**
Co-evolution with the network.	**YES**	**YES**	**YES**
Development of the already existing resource base	NO	**YES**	NO
R&D capabilities	NO	**YES**	NO
Development of partnerships and co-specialized solutions	NO	NO	**YES**

SOURCE: The Author (2019)

At the same time, only case study B (TAUFLOW) developed the capability related to R&D development, and only case study C (goEPIK) developed the capability related to partnerships and co-specialized solutions. That does not mean that the organizations do not develop R&D or co-specialized solutions, what we are pointing is that at these organizations demonstrated microfoundations that lead them to develop dynamic capabilities that assist with their respective processes.

Furthermore, due to the fact that the providers were 'created with the 4.0 concept in mind', resulted in then not passing through the first phase of the digital transformation that Zeng, Simpson and Dang (2017) point at their study (Establishment of a new focus). Case study D on the other hand, was not created with that concept in mind, and due to that this organization will very likely need to pass through that first phase, resulting that this organization might end up developing some capabilities from the first phase pointed by the authors. The Industrial Manager for example, stated that: "We know that investment in other

resources would be needed for us to digitally transform ourselves". While the RH Manager emphasized the importance of a 'cultural change', stating that: "One of the greatest things for organizational change would be regarding the cultural dimension, where we need to 'forget' about the classic way where technology is seen as something that only replace humans."

PANEL 18 - MAIN MICROFOUNDATIONS OF EACH CAPABILITY THAT WAS IDENTIFIED AT THE ORGANIZATIONS

	IDENTIFIED MICROFOUNDATIONS		
IDENTIFIED CAPABILITY	CASE STUDY A	CASE STUDY B	CASE STUDY C
Experimentation	**Trial and error approach with the developed solutions;** **Constantly changes performed to the model items;** **Constantly changes performed to organizational processes.**	–	**Trial and error approach with the developed solutions;** **Constant changes performed to organizational processes.**
Construction of the extended network	**Great relationship with network contacts;** **Being highly involved with an specific ecosystem related to startups and technology;** **Events related to Industry 4.0 and its technologies.**	**Great relationship with network contacts;** **Being highly involved with two different ecosystems (one related to technology and another with related to R&D);** **Events related to Industry 4.0 and its technologies.**	**Great relationship with network contacts;** **Being highly involved with an ecosystem related to technology;** **Events related to Industry 4.0 and its technologies.**
Institutionalization of flexible routines	**Informal workplace and assignments in general including meetings;** **Employees encouraged by managers to develop new ideas for the organization;** **Support provided by managers.**	–	**Informal workplace and assignments in general including meetings;** **Informal relationship with customers, only using formal contracts when needed;** **Support provided by managers.**
Improvement of the organization resources	**Internal focus to improve the resources that they own;** **Constantly improvement of already deployed solutions;** **Weekly meeting to discuss potential issues pointed by their customers.**	**Internal focus to improve the resources that they own;** **Mapped processes to improve the quality of the digitalization procedure.**	–

(Continue)

(Continued)

	IDENTIFIED MICROFOUNDATIONS		
IDENTIFIED CAPABILITY	CASE STUDY A	CASE STUDY B	CASE STUDY C
Environment and customer sensing	**Events related to Industry 4.0 and its technologies; Regular meetings with customers; Use of technology mentors to better understand its applicability; Weekly meeting to discuss potential issues pointed by their customers;**	**Events related to Industry 4.0 and its technologies; Regular meetings with customers; R&D initiatives with customers; Dual ecosystem approach;**	**Events related to Industry 4.0 and its technologies; Regular meetings with customers; Development of co-specialized solutions with customers;**
Co-evolution with the network.	**Processes to assist the development of other organizations members of the ecosystem; Co-specialization of resources to assist the development of more than one organizations.**	**Processes to assist the development of other organizations members of the ecosystem; Co-specialization of resources to assist the development of more than one organizations.**	**Processes to assist the development of other organizations members of the ecosystem; Co-specialization of resources to assist the development of more than one organizations.**
Development of the already existing resource base	–	**Internal processes to develop the resource base; R&D processes performed by the organization members upon academic research.**	–
R&D capabilities	–	**R&D initiatives developed internally by the organization members; R&D initiatives performed with their customers.**	–
Development of partnerships and co-specialized solutions	–	–	**Processes that aim to increase the development of solutions using partners and customers resources; Informal relationship maintained with partners for solution development.**

SOURCE: The Author (2019)

Upon that, we stated that this organization could also use the three step processes provided by Ganzarain and Errasti (2016) to assist its development towards the Industry 4.0. If we analyze their organizational development, we can see the they do have an Industry 4.0 vision (the first step of the process), and they are currently adjusting their roadmap for the Industry 4.0 (second step of the process). After that, if they follow the model provided by Ganzarain and Errasti (2016), they will enter the 'Projects' (third step of the process), thus

transforming their ideas into concrete Industry 4.0 projects that would allow them to adjust their business model accordingly.

4.5.4. Explore the relationship between dynamic capabilities and the business models;

Regarding this objective of our study, we first need to recall the differentiation of business model changes and business model innovations (which was explained in details at the section 2.3.3). At the present study, we adopted a business model definition/conceptualization that consider the model to be a dynamic entity (CAVALCANTE; KESTING; ULHOI, 2011; WIRTZ *et al*., 2016). Thus, we consider that the model can be 'changed' or 'adapted' along the way, reflecting in new ways for the organization do business.

In this sense, Cavalcante, Kesting and Ulhoi (2011) pointed to four types of business model changes that might could occur at an organization: Creation, Extension, Revision and Termination (see Panel 8 for more details). Furthermore, Voelpel, Leibold and Teike (2004) consider that only in-depth modifications will result in innovations or in the creation of entirely new business models, usually being connected to disruptive technologies or concepts such as 'change the game rules' (HAMEL, 2000).

If we consider those affirmations with what was presented at our case studies, and more specifically with the capabilities that were identified at the organizations, we can note a different scenario between the organizations.

Considering our case study A (PACKID), we note that this organization does changed its business model. More specifically, a change related to their value proposition (from a 'solution that provides real time monitoring', to a 'solution that have an emphasis on delivering cost and energy savings for their customers') was often mentioned by the interviewees, which occur with the assistance of the network contacts that they'd.

If we consider the Cavalcante, Kesting and Ulhoi (2011) perspective, we could consider that change to be a **revision** of their business model, which according to Panel 8 is related to an (1) Intervention of already existing processes; (2) Removal of something that results in changes for the already established business model (thus also requesting process to be adapted or created); or (3) Change of already established organizations practices. According to the authors, that revision might occur due to the inefficiency of an already established business models, actions taken by the competitors, and also newcomer companies that pose a threat for the already established business models.

If we take a look at the capabilities that this organization developed: (1) Experimentation; (2) Construction of the extended network; (3) Institutionalization of flexible routines; (4) Improvement of the organization resources; (5) Environment and Customer sensing; and (6) Co-evolution with the network, we are able to note that the capabilities related to the network directly assisted that business model change. Thus, the capabilities **(2) Construction of the extended network**; and **(6) co-evolution with the network** seems to play a major role. Apart from that, the capability **(5) Environment and Customer sensing** also seems to play a major role in allowing them to revise and change their business model, since with that capability, the organization managed to truly understand its customer and market needs and upon that perform changes that will reflect in more value creation and value capture.

Apart from that, other changes that were performed to their model (such as the modification of their revenue model), seems to be affected by the capabilities above mentioned, since the interviewees emphasized the importance of their network contacts and the ecosystem for the organization development and for the business model changes that they've performed.

Considering our case study B (TAUFLOW), we are able to note that this organization also performed some changes to its business model. According to the interviewees, the value capture of their model is something that constantly change, to which the Engineering Director stated that they are aiming to "Better understand their customer needs and thus create a revenue model that would be more suitable for them." According to the perspective of Cavalcante, Kesting and Ulhoi (2011), those changes can also be considered 'revisions' of their model, thus encompassing interventions of already existing processes.

Furthermore, this second organization also have a second value proposition that encompass R&D services provided by them. According to the Executive Director, that was not present at the organization since the beginning, thus being added to their 'portfolio' sometime after the organization creation. In this sense, this change could be considered an extension of their model, which according to Cavalcante, Kesting and Ulhoi (2011), represents the addition of new activities, the extension of already existing processes, or the exploitation of commercial opportunities.

Considering the capabilities that the organization developed (1) Development of the already existing resource base; (2) Construction of extended network; (3) Environment and customer sensing; (4) R&D Capabilities; (5) Improvement of the organization resources; and

(6) Co-evolution with the network, we are able to note that one more time the network capabilities **(2) Construction of extended network** and **(6) Co-evolution with the network**, displayed and important role for the business model changes (not on the same level as it did on the first organization, but the interviewees also mentioned the importance of the network for their business model changes). Considering their second change (the R&D services that were added to their model), we note that the **(4) R&D Capabilities**, also displayed a major role, thus allowing them to properly deliver this value to their customers. But on the overall, other changes mentioned by the interviewees such as adaptations made to the model (especially with the value capture) were directly affected by the **(3) Environment and customer sensing** capability, since just like on our first case, this was the 'root item' that allowed them to properly address their customer and the market needs, ultimately resulting in business model changes that reflected upon value creation and value capture.

Considering our case study C (goEPIK), we note a scenario slighter similar to our case study A. Here, the organization also pointed some specific business model changes that they´ve performed, such as the change of their customer segment. According to the Operations Director, they´ve changes their customer segment once they´ve entered the FIEP ecosystem (where contacts from network give them the hint to perform that change). Considering that, that type of change can also be considered a revision of their model (according to the perspective of Cavalcante, Kesting and Ulhoi, 2011). Apart from that change, the interviewees also pointed that some minor changes such as their monetization (value capture) is constantly being performed to better address their customer needs.

If we consider the dynamic capabilities that we´ve identified at that organization ((1) Experimentation; (2) Construction of the extended network; (3) Institutionalization of flexible routines; (4) Environment and Customer sensing, (5) Development of partnerships and co-specialized solutions; and (6) Co-evolution with the network), we can see that the network capabilities **(2) Development of network contacts** and **(6) Co-evolution with the network** presented again a huge importance for the organization development and for their business model changes.

Apart from that, the capability **(5) Development of partnerships and co-specialized solutions**, also present a huge potential to create business model changes at their scenario. As stated by the Developer "We are currently working to create partnerships and solutions with other organizations, which also includes our competitors, and we believe that this will for sure change our model". Apart from that, the capability the capability **(4) Environment and Customer sensing** also demonstrated to be one of the capabilities really assisted them to

change their business model. As stated by the Operations Director “Business model changes usually happen when you're able to understand the customer needs. Without it, it's pointless to change the model”.

Our fourth case study (Organization D), demonstrate a different scenario. Here, we did not identify dynamic capabilities being developed at the organization. That however does not mean that this organization does not changed its business model. As stated by Teece (2018a), dynamic capabilities can assist with business model change. Thus, an organization with dynamic capabilities can more easily change and adapt its model. This might be one of the reasons of why we the interviewees of case study D only slightly mentioned business model changes occurring at their scenario. As stated by the HR Manager “We still did not saw that need for a change, but we know that eventually it will need to take place, and if we consider the technology application, changes are inevitable to our model”.

Furthermore, if we consider the differentiation that Voelpel, Leibold e Teike (2004) provide between business model ‘changes’ and business models ‘reinventions’ (see section 2.3.3 for more details), we could consider that the modifications that we identified at the organizations can only be considered only ‘business model changes’, and not ‘business model reinventions’. In other words, we identified that the organizations indeed changed their business models, and that some dynamic capabilities assisted them to change their model. However, according to these authors perspective those changes did not result in entirely new business models, thus not truly encompassing business models innovations.

Nevertheless, the differentiation provided by Voelpel, Leibold e Teike (2004) pointing that only business models reinventions (creation of entirely new business models) are considered innovations does not follow the positions of Cavalcante, Kesting and Ulhoi (2011), Putten and; Schief (2012), and also other authors such as Baden-Fuller and Haefliger (2013), and Teece (2010, 2018a). For Cavalcante, Kesting and Ulhoi (2011) for example, the four types of change that might occur to a model (Creation, Extension, Revision and Termination) are considered business models innovations.

In line with those authors, we state that the organizations classified as providers (Case studies A, B and C) managed to innovate their model with the assistance of dynamic capabilities, some of those being directly related to the digital transformation process. In this sense, Panel 20 summarizes the capabilities that according to our perception where directly involved with the business models changes at the providers’ organizations.

As one can note, all organizations had at least two capabilities related to the ‘network’ where the organizations is inserted, which results in a scenario aligned with the

position of Hylving (2015), Teece and Linden (2017), Helfat and Raubitschek (2018), and also Teece (2018a; 2018b), where the concepts digital organizations are discussed, pointing that the 'network' of relationships that the organization has and the ecosystem where it's inserted start to demonstrate its importance for innovations and also for business model changes at the digital era.

PANEL 19 - CAPABILITIES MORE INVOLVED WITH BUSINESS MODELS

CASE STUDY	CAPABILITIES MORE DIRECTLY INVOLVED WITH BUSINESS MODEL CHANGES
Case Study A - PackID	Construction of the extended network
	Co-evolution with the network
	Environment and Customer sensing
Case Study B- TauFlow	Development of network contacts
	Co-evolution with the network
	R&D Capabilities
	Environment and customer sensing
Case Study C- goEPIK	Development of network contacts
	Co-evolution with the system
	Development of partnerships and co-specialized solutions
	Environment and Customer sensing

SOURCE: The Author (2019)

Considering that, our next section will encompass the conclusion of the present study, where we aimed to summarize its main findings, the limitations and also some future research directions.

5. CONCLUSIONS

The present study had as its main objective ‘Analyze how the dynamic capabilities relate to business models on small enterprises related to the digital transformation.’ To achieve this objective, we reviewed the literature related to the constructs digital transformation, dynamic capabilities, and business models. Upon that review, we constructed a theoretical framework that served as the base for us to analyze the organizations.

Four case studies were performed, encompassing three providers and one user of the Industry 4.0 technologies. The providers (case studies A, B and C) were classified as being at the level 5 at Ganzarain and Errasti (2016) maturity model, and the organization classified as a ‘user’ (case study D), was classified as being at the level 2 at Ganzarain and Errasti (2016) maturity model.

With the theoretical framework used for the analysis, we state that the objective of the present study was achieved, where we identified that at the organizations classified as providers, dynamic capabilities were developed and those some of those capabilities directly related to the organizations business models, assisting the changes performed at their models.

Furthermore, the utilization of two different types of organizations (provider and user) allowed us to further identify differences among those organizations, which thus emphasized the importance of network contacts and also the ecosystem for the providers group.

As a matter of fact, the network contacts and the ecosystem where the organizations are inserted demonstrated to be one of the most important items for the organizational development. What was identified at the providers is a scenario where they would probably not be able to develop themselves if it wasn't for the network contacts and the ecosystem assistance. That was specifically mentioned by at least one interviewee of each organization, where they emphasized the: (1) Acquisition of customers; (2) Assistance with business model changes; and (3) The acquisition of resources provided by the network.

Nevertheless, it's interesting to point some remarks about our findings. More specifically about the fact that the provider organizations can be considered startup organizations. Those organizations where classified as being on the level 5 of development at the Ganzarain and Errasti (2016) maturity model, however their development is very likely to be aligned with their initial strategy for the organizations, where since the beginning they aimed to be an organization on the '4.0 concept'. In this sense we could argue that those

organizations could be 'native digital organizations', resulting that they were already created to be a digital organization.

Considering that, a discussion relating the analyzed organizations with the literature of small enterpriser and newcomer enterprises can be made (MCKELVIE; DAVIDSSON, 2009; WOLDESENBET; RAM; JONES, 2011; INAM; BITITCI, 2015) an interesting analysis can be made.

The last authors, for example, aimed to understand the role of organizational capabilities and dynamic capabilities in the context of micro enterprises, where the authors compare the literature with the primary data collected from organizations that they´ve analyzed. At their study, the authors point that the literature states that when we consider innovation, small organizations have innovations based on clusters and networking, while at their research, the organizations had innovations driven by technological improvement and customer needs. At our scenario however, we found a mixture of both cases, being slightly more directed to the results pointed by the literature, where innovations are mainly performed with assistance of the organizational network, but at the same time the organizations also take into consideration technological and customer needs.

Another item where differences can be noted is related to the training and staff development activities. At two organizations that we´ve analyzed (case studies A and C), trainings and other development tasks were already in-place, but those were in a very small scale, thus being aligned with the literature. At their study Inan and Bititci (2015) found that no training or development activity was present at all at the organizations.

Apart from that, the item networking is one that also caught our attention, since, according to the authors, the literature points that small organizations have a **limited** external networking, while the findings from their primary data displayed that small organizations have a **very limited** external networking.

Our findings on the other hand, displayed a different scenario, where the provider organizations displayed a great relationship with network contacts, up to the point where even some dynamic capabilities were identified at it. The organization classified as a user on the other hand, displayed a scenario more aligned with the study of Inan and Bititci (2015) and the literature that they´ve reviewed, thus demonstrating a very limited external network.

That scenario can be related to two different things: First, to the fact that the organizations classified as providers are directly related to the industry 4.0 itself, since the literature points that partnerships and the network contacts will have a great influence on organizations (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT,

2017). Second, it could be related the fact that the organizations classified as providers could also be considered startup organizations, since the literature points that organizations related to technology scenarios and emerging markets will highly depend on network contacts to do their business (WOLDESENBERT; RAM; JONES, 2011; GARG; DE, 2013).

Furthermore, Inan and Bititci (2015) also point that the literature related to SMEs stress the fact that those have **limited** knowledge of funding and support available from local government, and with the primary data that they´ve collected, a **very limited** scenario was displayed instead. That is aligned with our case study D, where the organization indeed displayed a limited knowledge related to government support. However, the other three organizations displayed a very different scenario, demonstrating a good amount of knowledge related to government support, with emphasis to case study B, where the interviewees demonstrated that they constantly attend to governmental funding activities. This can be related to the fact that the providers displayed an immersive network and ecosystem relationships, which further assisted them to acquire that type of information.

What can be noted from those results is that the providers differ from the study of Inan and Bititci (2015), and due to that, the dynamic capabilities developed by them tend to differ as well. Our case study B clearly demonstrates that with its R&D capability. According to Teece (2007), that capability is considered a core dynamic capability, but micro enterprises usually cannot finance or develop R&D activities (INAN; BITITCI, 2015). However, the organization from case study B was very involved with R&D activities, using partnerships with other organizations to have R&D performed.

The other two organizations classified as providers also displayed R&D initiatives being performed, and in order to finance those they rely on governmental assistance and also from assistance of their network contacts and the ecosystem.

Furthermore, Inan and Bititci (2015) state that two research questions still need to be answered when we consider the dynamic capabilities at micro enterprises: (1) How organizational capabilities are related with each other in micro enterprises; and (2) How organizational capabilities can be developed in micro enterprises.

Upon that, we state that our study assists by somehow addressing these questions, upon which we pointed that the capabilities related to the network assisted other capabilities to be developed, and upon the processes of sense, seize and reconfigure (TEECE, 2007) we addressed how the analyzed organizations managed to develop dynamic capabilities, were again the importance of the network and the ecosystem where emphasized.

The study of McKelvie and Davidsson (2009) also aims to address that question, using a quantitative approach to measure if the following items: (1) founder human capital, (2) access to employee human capital, (3) access to technological expertise, (4) access to other specific expertise and (5) access to two types of tangible resources, impacted the development of four types of dynamic capabilities (Idea generation capability; Market disruptiveness capability; New product development capability; and New processes development capability) in a sample of new firms from Sweden.

According to the authors, their results demonstrate that the organizational resources and the changes performed at those resources are important for dynamic capabilities. However, "[...] the respective impact of different types of resources will varies for different types of dynamic capabilities." (MCKELVIE; DAVIDSSON, 2009, p.S76).

Furthermore, the authors found some interesting results, such as the fact that the financial capital demonstrated to not be significant for the first three capabilities and for the fourth one (New processes development) it demonstrated a partially reversed result, which seems to go against our reviewed literature, where the organizations complain about the lack of financial resources to perform improvements. The reasons for that could be, as pointed by McKelvie and Davidsson (2009), some sample limitations and even how some of their variables were operationalized. As stated by the authors, they work is an initial idea of transforming into a quantitative approach something that is often explored using only qualitative approaches.

Apart from that, our results could be different since the investments necessary to enter the 4.0 scenario are extremely high, resulting in a scenario where organizations highly depend upon financial resources to develop their products and deliver their services. As a matter of fact, the organizations classified as providers often stressed that the network contacts and the ecosystem assisted them to access resources with lower prices than what they would normally need to pay While the organization classified as a user, presented results more aligned with the ones of McKelvie and Davidsson (2009) and Inan and Bititci (2015), thus not displaying R&D initiatives and relying only on insights from their customers to develop innovations and sense the environment needs.

Again, that seems to be related to the fact that the organizations that we´ve analyzed are inserted in a different scenario from the ones analyzed by McKelvie and Davidsson (2009) and Inan and Bititci (2015), since according to Kagerman, Wahlster and Helbig (2013) and Teece (2018a, 2018b), the industry 4.0 and the digital organizations demand partnerships to be able to properly address this challenging scenario. If we consider that startup organization

are often relate to a scenario similar to the one that industry 4.0 poses, it could be expected that some similar results between these organizations would take place.

Taking for example the organizations of our study, the providers (case studies A, B and C) were (apart from being native digital organizations), startup organizations, while the organization classified as a user (case study D) was neither a native digital organization nor a startup company. In this sense, the literature stress that this organization would need to transform itself into an industry 4.0 organization, where its pointed that a greater relationship with the network, open innovation approaches and also more flexible routines are necessary at the 4.0 scenario. However, we could further state that startup organizations also display a similar scenario to that one, mostly due to the fact that this type of organization often lack resources such as financial and technological, demanding it to be more flexible and dependent of network contacts.

Upon that, we state that the organizations from our study that were classified as providers could also be classified as startup organizations, which might end up blurring our findings between what indeed is a result of a 'native digital' organization and what is a result of a 'startup organization', but at the same time the results and the comparison made with our case study D demonstrates that organizations will need to become more flexible in order to address the 4.0 scenario, resulting that startups might perform better than a newcomer that does not display their characteristics when we consider the 4.0 scenario.

Furthermore, we also note some similarities on the digital transformation perception displayed by the interviewees. Considering the **Employees** dimension, the item Training was mentioned by all four organizations, while Support, Integration and Novel job functions and workplaces were mentioned by in two organizations. At the **Partners and suppliers** dimension, Reliability was mentioned at all four organizations, while Connectivity was mentioned at three organizations and Transparency was mentioned at two organizations. And regarding **Production equipment** dimension, Increase of productivity was mentioned at all four organizations, while Economy and Rapid access to data was mentioned at three organizations.

In this sense, we note that most items from our theoretical framework where mentioned by the interviewees, which thus characterize our model as being aligned with the scenario that Brazilian organizations face and also with their perception when we consider the Industry 4.0 and the digital transformation process.

Nevertheless, some differences with the literature that was reviewed can also be stated, such as the fact that all four organizations pointed that the Brazilian cultural scenario is

something that presents the greatest challenge for the digital transformation process and the Industry 4.0. According to the interviewees, Brazilian organizations do know the importance of technology and innovations, but they do not have a proactive approach when it comes to innovation, only investing in new technologies when it's extremely necessary. Our fourth case study further demonstrates a practical example of that scenario, where we noted that the interviewees know the importance of innovation and new technologies, but they still did not saw a prompt need to innovate in order to maintain their competitive advantage.

That is different than what is demonstrated at the reviewed literature (KAGERMAN; WAHLSTER; HELBIG, 2013; ARNOLD; KIEL; VOIGT, 2017), (most of it coming from Europe Union and more specifically Germany), where it's pointed that a change on the mindset of the organizations will need to take place, but the culture itself is not seen as something that will challenge the Industry 4.0 development. Their greatest concerns are on the technology itself, and when we talk about small organizations the support that those organizations need since industry 4.0 investments tend to be very high (which again support the creation of partnership and ecosystems between the organizations, aiming to lower costs and share resources).

However, despite the fact that we´ve analyzed both providers and also a user of Industry 4.0 technologies, which further assisted us to identify key differences between these types of organizations, our study still has some have limitations. First of all, we'd access to a limited number of interviews, observations and also documents at each organization. Second, we only analyzed one organization classified as being a ‘user’ of Industry 4.0 technologies. And third, the analysis of the data collected is always subjected to the cognitive aspects of the researcher. Nevertheless, the utilization of the case study protocol, created according to YIN (2014) methodology, aimed to minimize these limitations aspects, thus adopting a strategy that could grant more validity and reliability for the present study.

In this sense, we stress that the objective of our study was not to create generalizations, but to explore a phenomenon occurring at a specific environment, thus allowing us to have more detailed information about something happen. In this sense, this approach allowed us to collect in-depth information about the organizations, thus allowing their processes and practices to be identified, and upon that the microfoundation of the dynamic capabilities and their relationship with the other constructs to be explored.

Considering the results identified, the present study can contribute with the literature related to business models and dynamic capabilities, providing a practical example of how these capabilities relate to business models, which thus represents a practical example of the

studies of Teece (2007; 2014; 2018a; 2018b), also demonstrating similar results to the study performed by Vicente, Ferasso and May (2018).

At the same time, the present study also extends the literature related to business models at the Industry 4.0 scenario (KIEL, 2017; KIEL; ARNOLD; VOIGT, 2017; MULLER; BULIGA, 2017; MULLER; BULIGA; VOIGT, 2018), thus providing a more in-depth approach that allows us to understand how organizations change and adapt their models at the digital transformation process.

The present study also contributed for the literature related to dynamic capabilities at the digital transformation process (ZENG; SIMPSON, DANG, 2017; HELFAT; RAUBITSCHEK, 2018; TEECE; 2018b), thus assisting with the identification of capabilities that are related to the analyzed scenario.

Nevertheless, it's still very difficult to identify how the dynamic capabilities assisted the organizations to digitally transform themselves. In our case, we are talking about capabilities that were developed by a 'native digital' organization, which thus resulted that this organization was already created with the 4.0 concept in mind (cases studies A and C) or with the objective of being a 'digital organization' (case study B).

At the study of Zeng, Simpson and Dang (2017) for example, the authors explore identify capabilities that assisted two manufacturing industries to transforms themselves. If we take a look at our study, we can see that some capabilities identified by the authors were also identified at our case studies (Experimentation, Construction of the extended network, Institutionalization of flexible routines; Improvement of the organization resources; and Development of the already existing resource base). In this sense, we could state that those capabilities will very likely assist the analyzed organizations to continue their development towards the Industry 4.0, since at the study of Zeng, Simpson and Dang (2017) they managed to assist the analyzed organizations. But in order to confirm that, we need to perform a longitudinal study with the organizations here analyzed, thus allowing us to understand the relationship between those capabilities with future steps of the digital transformation that those organizations may pass through.

Furthermore, our objective with the utilization of a jointly analysis of those three constructs was to expand not just the literature related to the constructs themselves, but also the relationship between them, which we believe that was achieved at the present research.

And lastly, due to the fact that the organizations classified as providers could also be considered startup organizations, the literature related to dynamic capabilities at SME organizations (WOLDESENBET; RAM; JONES, 2011; GARG; DE, 2013) and also at new

firms (MCKELVIE; DAVIDSSON, 2009) could also be further explored, stressing the similarities and differences that we briefly addressed at the concluding part of this study.

Considering the practical implications, our results can serve as a roadmap for organizations that seek to develop themselves towards the Industry 4.0. In the case of providers, they could refine their strategy upon the results here presented, thus better addressing the capabilities that indeed made a difference for their organizational development and business model changes, while for the organization classified as a user, it could redefine its strategy to enter the industry 4.0 scenario, thus focusing on microfoundations that can assist the development of dynamic capabilities that could assist it to maintain competitive advantage at the 4.0 scenario.

Apart from that, if we consider the importance of network contacts and the ecosystems such as the ones provided by FIEP (case studies B and C) and UNICAMP (case study C), we state that governments should invest more heavily on the development of organization network and ecosystems, as those provide support not just for organizations related to the industry 4.0, but to other small organizations as well. In this sense, the development of policies and investments that sustain those should be considered as a very good strategy to boost the industry 4.0 development at the Brazilian scenario.

Upon that, future studies could also better address the relationships between the three constructs here explored, thus analyzing more organizations from different sectors, which can allow further comparisons to be made. Longitudinal approaches could also be used since those will for sure provide an interesting analysis on the development and the relationship of the dynamic capabilities with the other constructs here explored.

Lastly, some recent literatures related to dynamic capabilities could also be explored under this novel scenario, such as the ‘Indirect Capabilities’ (SPRING; ARAUJO, 2014), and the ‘Network Oriented Dynamic Capabilities’ (ALINAGHIAN; RAZMDOOST, 2018), since the network and the ‘ability’ that the organizations has to interact with other organizations at the ecosystem is extremely important for the digital industries (TEECE, LINDER, 2017; TEECE, 2018b), for newcomer organizations (INAN; BITITCI, 2015), and with the results of our study, for the 'native digital organizations' as well.

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APPENDICES

APPENDIX A - INTERVIEW GUIDE USED FOR THE PRESENT RESEARCH

MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DO PARANÁ
SETOR DE CIÊNCIAS SOCIAIS APLICADAS
Programa de Pós-graduação em Administração

Interview Guide

The following items will be addressed during the interview process, not necessarily following the provided order (except for Opening and Closing statements). Thus, the approach and the specific questions to address each of those items were choose by the interviewer during the process.

Opening

- Presentation of researcher and its project;
- Explanation of study objectives;
- Explanation of questions related to data usage and data publication;
- Documents signing;
- Identification of all key informants;
- Identification of data related to the organization in general (facilities, number of employees and number of customers);

First Part - Interviewee data

- Name, age and education;
- Career before and at the current organization;
- Relationship with the digital transformation process;
- Job function at the current organization and how long it's been working there.

Second part - Organization data

- How does the organization start, and why?
- Growth perspectives for the next years;
- Description of organizational growth during the years (with numbers of customers, employees and annual turnover);

Third Part - Digital Transformation

- Interviewee perception about the digital transformation and the Industry 4.0 at the Brazilian scenario;
- Technologies related to the industry 4.0 that are used by the organization;
- Greatest difficulties faced due to the digital transformation;
- Facilitators related to the digital transformation;
- Partnerships with other organizations and institutions;
- Interviewee perception about currently industry 4.0 development at the organization;
- Interviewee perception about resources needed for the digital transformation;

Fourth Part - Dynamic Capabilities:

- Process related to sensing opportunities (R&D at the organization, identification of market changes, technologies and process that are external to the organization, compliment of internal innovations);
- Process related to seizing opportunities (Decision making in terms of innovation, organizational boundaries, team commitment, definition of business model);
- Process related to reconfiguring resources (Co-specialized resources, knowledge management, decentralization, governance);

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Fifth Part: Business Model

- Interviewee perception about business models;
- Construction of the organization business model;
- Interviewee perception about business model changes that occurred due to the digital transformation;
- Greatest challenges related to business models
- Industry 4.0 orientation: Services, Partnership, Customers.

Closing:

- Additional information that the interviewee might want to add.

APPENDIX B - CODES USED FOR CONTENT ANALYSIS

DIMENSION	SUB-DIMENSION	CODE	MEANING
General	Industry 4.0 (general items)	TRD	Digital Transformation
		I4.0	Industry 4.0
		4.0TECH	General technologies related to Industry 4.0
		4.0INT	Integration related to industry 4.0
		4.0EVE	Events (forums, congresses) related to Industry 4.0
		4.0INV	Investments related to Industry 4.0
		4.0EMPA	Employees activities related to Industry 4.0
	Organization(general items)	ORNET	Organizational network
		ORECO	Organizational ecosystem
		ORPAR	Organizational partnerships
		ORSUP	Organizational suppliers
		ORPRO	Organizational processes
		ORRES	Organizational resources
		PRINO	Processes innovations
		PDINO	Products innovations
Industry 4.0	Employees	EMPTR	Training related to employees
		EMPSP	Support related to employees
		EMPINT	Integration related to employees
		NJFWP	Novel job functions and workplaces
	Partners and suppliers	PSCON	Connectivity
		PSTRA	Transparency
		PSJA	Joint Analysis
		PSRE	Reliability
	Production Equipment	PERF	Resistance to failures
		PEINP	Increase of Productivity
		PERAD	Rapid Access to data
		PELB	Load Balance
		PEECO	Economy
Dynamic Capabilities	General	DC	Dynamic Capabilities
	Sense	DCRD	R&D Activities
		DCEXT	External processes
		DCSUP	Suppliers
		DCCOMP	Complement of innovation
		DCMCN	Processes related to market and customer needs
	Seize	DCBM	Delineation of business model
		DCDMP	Decision making protocols
		DCENTB	Enterprise boundaries
		DCCOM	Commitment
	Reconfigure (Transform)	DCDES	Decentralization of organization
		DCGOV	Governance of organization
		DCCOS	Co-specialization of assets (DC)
		DCKM	Knowledge management

(Continue)

(Continued)

DIMENSION	SUB-DIMENSION	CODE	MEANING
Business Model	Business model Framework	BM	Business model
		BMVC	Value Capture
		BMCI	Customer identification
		BMVD	Value Delivery
		BMCR	Customer relationship
		BMCH	Business model changes

APPENDIX C - DOCUMENT NO.1

MINISTÉRIO DA EDUCAÇÃO
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Programa de Pós-graduação em Administração

Prezado (a) participante:

Você está sendo convidado (a) a participar, como voluntário (a), de uma pesquisa conduzida pelo aluno Giovani Cruzara, mestrando em Administração na Universidade Federal do Paraná, na linha de pesquisa "Inovação e Tecnologia".

Esta pesquisa tem por objetivo analisar como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio.

Sua participação nesta pesquisa consistirá em responder às perguntas feitas pelo pesquisador (Giovani) e adicionar informações que não lhe foram perguntadas, se considerar pertinente. A expectativa de duração da entrevista é de 20 a 60 minutos. Essa será gravada em áudio (mediante o consentimento do entrevistado) e as gravações ficarão arquivadas com o pesquisador com acesso restrito, e livre de identificação até o momento da finalização da pesquisa. Posteriormente, essas serão deletadas.

Os dados do presente estudo serão utilizados na Dissertação de Mestrado do aluno Giovani Cruzara. Considerando isso, uma vez escrita a versão definitiva da dissertação, as partes que contenham dados relativos à sua organização serão enviadas ao Sr (a) para que esses possam ser revisados e validados para a posterior finalização e apresentação do trabalho. Nesse sentido, qualquer informação que os responsáveis da organização julguem que necessite ser substituída ou omitida, essa o será feito de acordo.

Além disso, o pesquisador se compromete em entregar para a organização participante um relatório detalhando o estudo conduzido e os resultados obtidos a partir desse.

Caso você concorde em participar desta pesquisa, assine ao final deste documento, que possui duas vias, sendo uma delas sua, e a outra, do pesquisador responsável. Seguem os telefones e o endereço institucional do pesquisador.

Giovani Cruzara
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E-mail: giovani.cruzara@outlook.com

Declaro que entendi os objetivos e benefícios de minha participação na pesquisa, e que concordo em participar.

_____, ____ de _____ de 2018.

Nome e assinatura do (a) participante:

_____

Nome e assinatura do pesquisador:

_____

APPENDIX D - DOCUMENT NO.2

TERMO DE CONSENTIMENTO E PARTICIPAÇÃO EM PESQUISA

Por meio da presente autorização, informo que aceito participar da pesquisa que investiga sobre como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio. Essa pesquisa é de responsabilidade do pesquisador Giovani Cruzara - discente do Programa de Pós-Graduação em Administração da Universidade Federal do Paraná (UFPR), Mestrado em Administração, na linha de pesquisa em Inovação e Tecnologia - e sob a supervisão do professor Dr. José Roberto Frega.

Para cumprimento da referida pesquisa, serão realizadas entrevistas pelo próprio discente junto aos gestores e colaboradores das empresas participantes. Os dados obtidos nas entrevistas serão usados para fins acadêmicos e de pesquisa, não tendo nenhuma finalidade comercial.

Como participante da pesquisa, declaro que concordo em ser entrevistado (a), uma ou mais vezes pela pesquisadora, em local e data previamente ajustados, permitindo a gravação das entrevistas.

Autorizo a divulgação do nome da empresa _____ junto aos resultados da pesquisa, comprometendo-se o pesquisador a utilizar as informações prestadas somente para os propósitos de pesquisas acadêmicas.

Ao final da pesquisa, o pesquisador compromete-se em compartilhar os resultados com a organização.

_____

Local, data.

_____

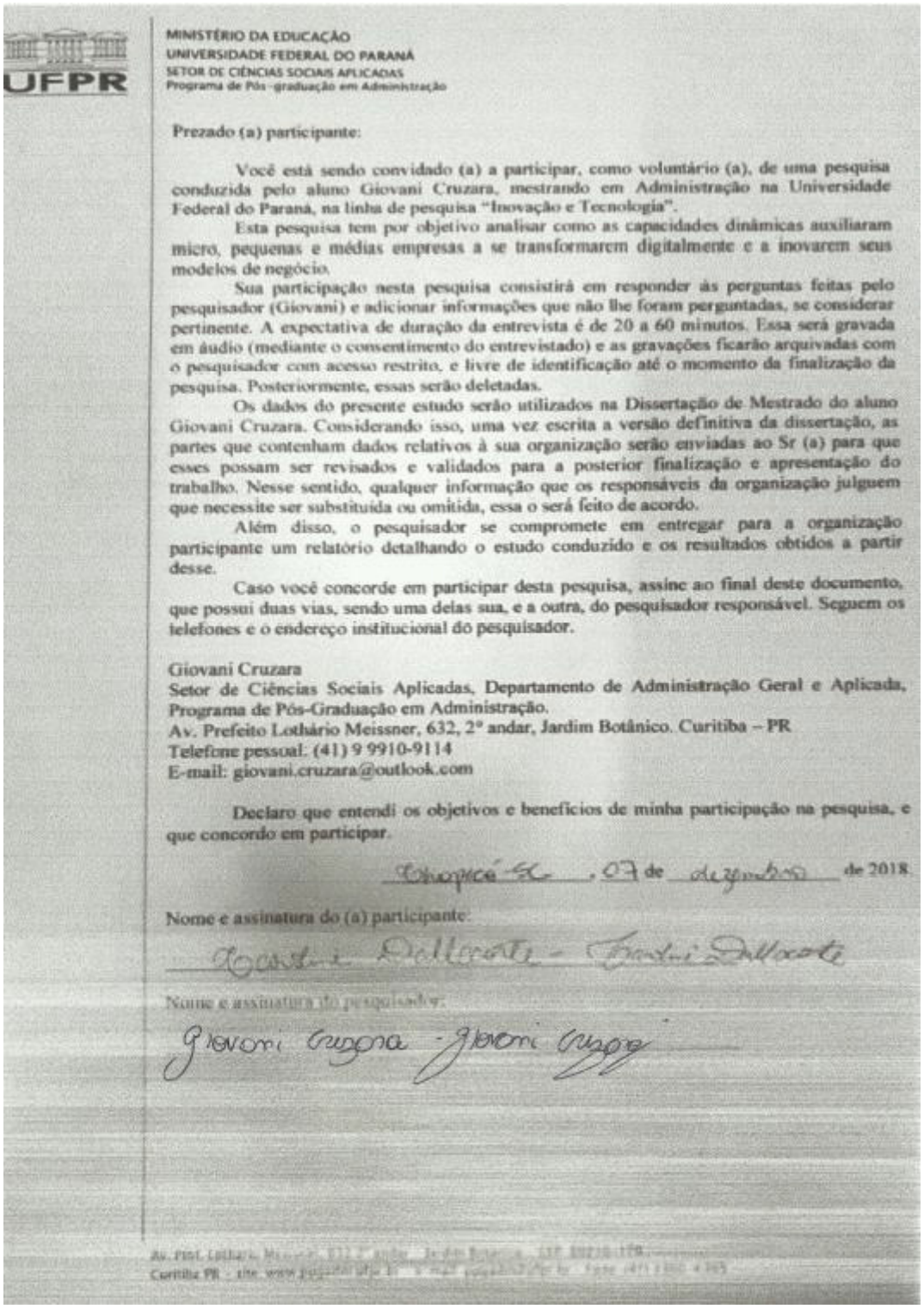
Assinatura do Entrevistado (a)

Nome do entrevistado (a): _____

Cargo que ocupa na organização: _____

E-mail e telefone do entrevistado: _____

APPENDIX E - DOCUMENT NO.1 (CASE STUDY A - PACKID)



MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DO PARANÁ
SETOR DE CIÊNCIAS SOCIAIS APLICADAS
Programa de Pós-graduação em Administração

Prezado (a) participante:

Você está sendo convidado (a) a participar, como voluntário (a), de uma pesquisa conduzida pelo aluno Giovani Cruzara, mestrando em Administração na Universidade Federal do Paraná, na linha de pesquisa "Inovação e Tecnologia".

Esta pesquisa tem por objetivo analisar como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio.

Sua participação nesta pesquisa consistirá em responder às perguntas feitas pelo pesquisador (Giovani) e adicionar informações que não lhe foram perguntadas, se considerar pertinente. A expectativa de duração da entrevista é de 20 a 60 minutos. Essa será gravada em áudio (mediante o consentimento do entrevistado) e as gravações ficarão arquivadas com o pesquisador com acesso restrito, e livre de identificação até o momento da finalização da pesquisa. Posteriormente, essas serão deletadas.

Os dados do presente estudo serão utilizados na Dissertação de Mestrado do aluno Giovani Cruzara. Considerando isso, uma vez escrita a versão definitiva da dissertação, as partes que contenham dados relativos à sua organização serão enviadas ao Sr (a) para que esses possam ser revisados e validados para a posterior finalização e apresentação do trabalho. Nesse sentido, qualquer informação que os responsáveis da organização julguem que necessite ser substituída ou omitida, essa o será feito de acordo.

Além disso, o pesquisador se compromete em entregar para a organização participante um relatório detalhando o estudo conduzido e os resultados obtidos a partir desse.

Caso você concorde em participar desta pesquisa, assine ao final deste documento, que possui duas vias, sendo uma delas sua, e a outra, do pesquisador responsável. Seguem os telefones e o endereço institucional do pesquisador.

Giovani Cruzara
Setor de Ciências Sociais Aplicadas, Departamento de Administração Geral e Aplicada, Programa de Pós-Graduação em Administração.
Av. Prefeito Lothário Meissner, 632, 2º andar, Jardim Botânico. Curitiba – PR
Telefone pessoal: (41) 9 9910-9114
E-mail: giovani.cruzara@outlook.com

Declaro que entendi os objetivos e benefícios de minha participação na pesquisa, e que concordo em participar.

Chapecó-SC, 07 de dezembro de 2018.

Nome e assinatura do (a) participante:

Nome e assinatura do pesquisador:

Giovani Cruzara - Giovani Cruzara

Av. Prof. Lothário Meissner, 632, 2º andar, Jardim Botânico, CEP 80210-170
Curitiba PR - site: www.[illegible] Fone: (41) [illegible]

APPENDIX F - DOCUMENT NO.2 (CASE STUDY A - PACKID)

TERMO DE CONSENTIMENTO E PARTICIPAÇÃO EM PESQUISA

Por meio da presente autorização, informo que aceito participar da pesquisa que investiga sobre como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio. Essa pesquisa é de responsabilidade do pesquisador Giovani Cruzara - discente do Programa de Pós-Graduação em Administração da Universidade Federal do Paraná (UFPR), Mestrado em Administração, na linha de pesquisa em Inovação e Tecnologia - e sob a supervisão do professor Dr. José Roberto Frega.

Para cumprimento da referida pesquisa, serão realizadas entrevistas pelo próprio discente junto aos gestores e colaboradores das empresas participantes. Os dados obtidos nas entrevistas serão usados para fins acadêmicos e de pesquisa, não tendo nenhuma finalidade comercial.

Como participante da pesquisa, declaro que concordo em ser entrevistado (a), uma ou mais vezes pela pesquisadora, em local e data previamente ajustados, permitindo a gravação das entrevistas.

Autorizo a divulgação do nome da empresa PACKID junto aos resultados da pesquisa, comprometendo-se o pesquisador a utilizar as informações prestadas somente para os propósitos de pesquisas acadêmicas.

Ao final da pesquisa, o pesquisador compromete-se em compartilhar os resultados com a organização.

Chapecó-SC, 07/12/2018

Local, data.

Cardini Dallacorte

Assinatura do Entrevistado (a)

Nome do entrevistado (a): Cardini Dallacorte

Cargo que ocupa na organização: Sócio

E-mail e telefone do entrevistado: 49 988040179

APPENDIX G - DOCUMENT NO.1 (CASE STUDY B - TAUFLOW)

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Prezado (a) participante:

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Esta pesquisa tem por objetivo analisar como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio.

Sua participação nesta pesquisa consistirá em responder às perguntas feitas pelo pesquisador (Giovani) e adicionar informações que não lhe foram perguntadas, se considerar pertinente. A expectativa de duração da entrevista é de 20 a 60 minutos. Essa será gravada em áudio (mediante o consentimento do entrevistado) e as gravações ficarão arquivadas com o pesquisador com acesso restrito, e livre de identificação até o momento da finalização da pesquisa. Posteriormente, essas serão deletadas.

Os dados do presente estudo serão utilizados na Dissertação de Mestrado do aluno Giovani Cruzara. Considerando isso, uma vez escrita a versão definitiva da dissertação, as partes que contenham dados relativos à sua organização serão enviadas ao Sr (a) para que esses possam ser revisados e validados para a posterior finalização e apresentação do trabalho. Nesse sentido, qualquer informação que os responsáveis da organização julguem que necessite ser substituída ou omitida, essa o será feito de acordo.

Além disso, o pesquisador se compromete em entregar para a organização participante um relatório detalhando o estudo conduzido e os resultados obtidos a partir desse.

Caso você concorde em participar desta pesquisa, assine ao final deste documento, que possui duas vias, sendo uma delas sua, e a outra, do pesquisador responsável. Seguem os telefones e o endereço institucional do pesquisador.

Giovani Cruzara
Setor de Ciências Sociais Aplicadas, Departamento de Administração Geral e Aplicada, Programa de Pós-Graduação em Administração.
Av. Prefeito Lothário Meissner, 632, 2° andar, Jardim Botânico. Curitiba – PR
Telefone pessoal: (41) 9 9910-9114
E-mail: giovani.cruzara@outlook.com

Declaro que entendi os objetivos e benefícios de minha participação na pesquisa, e que concordo em participar.

Curitiba, 10 de Outubro de 2018.

Nome e assinatura do (a) participante:

Nome e assinatura do pesquisador:

APPENDIX H - DOCUMENT NO.2 (CASE STUDY B - TAUFLOW)

TERMO DE CONSENTIMENTO E PARTICIPAÇÃO EM PESQUISA

Por meio da presente autorização, informo que aceito participar da pesquisa que investiga sobre como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio. Essa pesquisa é de responsabilidade do pesquisador Giovani Cruzara - discente do Programa de Pós-Graduação em Administração da Universidade Federal do Paraná (UFPR), Mestrado em Administração, na linha de pesquisa em Inovação e Tecnologia - e sob a supervisão do professor Dr. José Roberto Frega.

Para cumprimento da referida pesquisa, serão realizadas entrevistas pelo próprio discente junto aos gestores e colaboradores das empresas participantes. Os dados obtidos nas entrevistas serão usados para fins acadêmicos e de pesquisa, não tendo nenhuma finalidade comercial.

Como participante da pesquisa, declaro que concordo em ser entrevistado (a), uma ou mais vezes pela pesquisadora, em local e data previamente ajustados, permitindo a gravação das entrevistas.

Autorizo a divulgação do nome da empresa TAU FLOW junto aos resultados da pesquisa, comprometendo-se o pesquisador a utilizar as informações prestadas somente para os propósitos de pesquisas acadêmicas.

Ao final da pesquisa, o pesquisador compromete-se em compartilhar os resultados com a organização.

Curitiba, 11 de outubro de 2018

Local, data.

Marcílio José Caetano

Assinatura do Entrevistado (a)

Nome do entrevistado (a): MARCÍLIO JOSÉ CAETANO

Cargo que ocupa na organização: DIRETOR EXECUTIVO

E-mail e telefone do entrevistado: marciocaetano@tauflow.com

41 995791795

APPENDIX I - DOCUMENT NO.1 (CASE STUDY C - GOEPIK)

MINISTÉRIO DA EDUCAÇÃO
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Programa de Pós-graduação em Administração

Prezado (a) participante:

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Esta pesquisa tem por objetivo analisar como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio.

Sua participação nesta pesquisa consistirá em responder às perguntas feitas pelo pesquisador (Giovani) e adicionar informações que não lhe foram perguntadas, se considerar pertinente. A expectativa de duração da entrevista é de 20 a 60 minutos. Essa será gravada em áudio (mediante o consentimento do entrevistado) e as gravações ficarão arquivadas com o pesquisador com acesso restrito, e livre de identificação até o momento da finalização da pesquisa. Posteriormente, essas serão deletadas.

Os dados do presente estudo serão utilizados na Dissertação de Mestrado do aluno Giovani Cruzara. Considerando isso, uma vez escrita a versão definitiva da dissertação, as partes que contenham dados relativos à sua organização serão enviadas ao Sr (a) para que esses possam ser revisados e validados para a posterior finalização e apresentação do trabalho. Nesse sentido, qualquer informação que os responsáveis da organização julguem que necessite ser substituída ou omitida, essa o será feito de acordo.

Além disso, o pesquisador se compromete em entregar para a organização participante um relatório detalhando o estudo conduzido e os resultados obtidos a partir desse.

Caso você concorde em participar desta pesquisa, assine ao final deste documento, que possui duas vias, sendo uma delas sua, e a outra, do pesquisador responsável. Seguem os telefones e o endereço institucional do pesquisador.

Giovani Cruzara
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Telefone pessoal: (41) 9 9910-9114
E-mail: giovani.cruzara@outlook.com

Declaro que entendi os objetivos e benefícios de minha participação na pesquisa, e que concordo em participar.

Curitiba, 16 de outubro de 2018.

Nome e assinatura do (a) participante:

Nome e assinatura do pesquisador:

APPENDIX J - DOCUMENT NO.2 (CASE STUDY C - GOEPIK)

TERMO DE CONSENTIMENTO E PARTICIPAÇÃO EM PESQUISA

Por meio da presente autorização, informo que aceito participar da pesquisa que investiga sobre como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio. Essa pesquisa é de responsabilidade do pesquisador Giovani Cruzara - discente do Programa de Pós-Graduação em Administração da Universidade Federal do Paraná (UFPR), Mestrado em Administração, na linha de pesquisa em Inovação e Tecnologia - e sob a supervisão do professor Dr. José Roberto Frega.

Para cumprimento da referida pesquisa, serão realizadas entrevistas pelo próprio discente junto aos gestores e colaboradores das empresas participantes. Os dados obtidos nas entrevistas serão usados para fins acadêmicos e de pesquisa, não tendo nenhuma finalidade comercial.

Como participante da pesquisa, declaro que concordo em ser entrevistado (a), uma ou mais vezes pela pesquisadora, em local e data previamente ajustados, permitindo a gravação das entrevistas.

Autorizo a divulgação do nome da empresa Goepik junto aos resultados da pesquisa, comprometendo-se o pesquisador a utilizar as informações prestadas somente para os propósitos de pesquisas acadêmicas.

Ao final da pesquisa, o pesquisador compromete-se em compartilhar os resultados com a organização.

Curitiba, 16 de outubro de 2018

Local, data.

Assinatura do Entrevistado (a)

Nome do entrevistado (a): Priscila dos Santos Maia

Cargo que ocupa na organização: Diretora Operacional

E-mail e telefone do entrevistado: priscila@goepik.com.br

(41) 99277-0037

APPENDIX K - DOCUMENT NO.1 (CASE STUDY D - ORGANIZATION D)

MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DO PARANÁ
SETOR DE CIÊNCIAS SOCIAIS APLICADAS
Programa de Pós-graduação em Administração

Prezado (a) participante:

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Esta pesquisa tem por objetivo analisar como as capacidades dinâmicas auxiliaram micro, pequenas e médias empresas a se transformarem digitalmente e a inovarem seus modelos de negócio.

Sua participação nesta pesquisa consistirá em responder às perguntas feitas pelo pesquisador (Giovani) e adicionar informações que não lhe foram perguntadas, se considerar pertinente. A expectativa de duração da entrevista é de 20 a 60 minutos. Essa será gravada em áudio (mediante o consentimento do entrevistado) e as gravações ficarão arquivadas com o pesquisador com acesso restrito, e livre de identificação até o momento da finalização da pesquisa. Posteriormente, essas serão deletadas.

Os dados do presente estudo serão utilizados na Dissertação de Mestrado do aluno Giovani Cruzara. Considerando isso, uma vez escrita a versão definitiva da dissertação, as partes que contenham dados relativos à sua organização serão enviadas ao Sr (a) para que esses possam ser revisados e validados para a posterior finalização e apresentação do trabalho. Nesse sentido, qualquer informação que os responsáveis da organização julguem que necessite ser substituída ou omitida, essa o será feito de acordo.

Além disso, o pesquisador se compromete em entregar para a organização participante um relatório detalhando o estudo conduzido e os resultados obtidos a partir desse.

Caso você concorde em participar desta pesquisa, assine ao final deste documento, que possui duas vias, sendo uma delas sua, e a outra, do pesquisador responsável. Seguem os telefones e o endereço institucional do pesquisador.

Giovani Cruzara
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Telefone pessoal: (41) 9 9910-9114
E-mail: giovani.cruzara@outlook.com

Declaro que entendi os objetivos e benefícios de minha participação na pesquisa, e que concordo em participar.

Araucária, 29 de outubro de 2018.

Nome e assinatura do (a) participante:

Patrícia Palaturin

Nome e assinatura do pesquisador:

Giovani Cruzara - UFPR
(41) 99910-9114