

Master's Thesis – Master Innovation Sciences

Explaining Path Creation

An agency approach in regarding the path creation of artificial intelligence in the federal state of Saarland, Germany

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Summary

The question of how and why regions develop the way they do has been occupying geographers for a long time. The evolutionary economic geography introduced the idea of paths to explain the development of a region. A path includes the development of specific industries, or regional specializations. Within this idea a region is developing along a certain path that is assumed to depend on previous events and decisions of the past. The inclusion of time in combination with the notion of a path depending development leads to the question of how a path can come into being. Descriptions of the structure of a region have been able to partly explain its development but could not explain why regions with a similar structure develop differently. Because of this circumstance the idea of agency has been introduced. It regards the actions of actors and how those actions can change the development of a region. But how those actions create a new path remained unclear so far. This research tries to solve this question. To do so, the trinity of change framework of Grillitsch and Sotarauta (2019) which includes the three change agencies of innovative entrepreneurship, institutional entrepreneurship, regional leadership and the regional opportunity space is used to explain the influence of actors on the path creation process on the case of the path of artificial intelligence (AI) in the federal state of Saarland, Germany. The research utilizes 25 semi-structured interviews that have been gathered in the region to shed light on its path creation process. As a result, three different episodes within the path creation process have been found that include actions of increasing collaboration in between companies, fostering the regional start-up development and informing regional companies about the advantages of AI. The research shows that the path is implemented by the active use of the technology by companies and start-ups. Furthermore, it is found that the efforts of other actors do make the use of the technology possible, as they create the suitable environment to use the technology. Moreover, it is shown that it is important for an understanding of the path creation process to closer examine the interaction between the agency of actors and the structure and the region. Lastly, it is shown, that the regional path creation process cannot be performed by a single actor but needs the support of different actor groups.

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1 Introduction

How did the Silicon Valley, a deserted area around a military airfield, become the world's leading region for modern computer technology? Why is the neighborhood of Hollywood synonymously connected to the film industry? The question of how and why regions develop the way they do is a core question of economic geographers. The evolutionary economic geography (EEG) literature proposes one attempt to answer this question. Supporters of this school of thought try to connect the current development of a region with its past (MacKinnon, Dawley, Pike & Cumbers, 2019). A region is developing along a certain path that is assumed to depend on previous events and decisions. The EEG has devoted much attention to the question of how this path development and path dependency unfolds in space over time (Hassink, Isaksen & Trippel 2019). A path includes the development of specific industries, or regional specializations. The adaptation of path development and path dependency in combination with the factor of time however raises the question of how these paths come into being. Explaining the process of path creation which is understood as the "emergence and growth of new industries and economic activities in regions" (MacKinnon et al., 2019, p. 114) is important for path development and path dependency, as a path creation process lays the foundation for these concepts. Therefore, has the "question of how new regional growth paths emerge [...] repeatedly been raised [...] as one of the most intriguing and challenging issues in [the] field [of economic geography]" (Neffke, Henning, & Boschma 2011, p. 241).

The literature first approached the question of path creation with the description and the analysis of the structure of specific regions. Neffke, Henning & Boschma (2011) for example use the notion of path relatedness, in which a new path in a region is created when a this path has a close resource and institutional proximity to an already existing path. The formation of the automobile industry, next to the production of sewing machines (Boschma & Wenting, 2007) is an example of this phenomenon. A plain focus on the conditions of a region, however, can not explain why regions with a similar structure still develop differently. There is another important factor that has to be included in the analysis of regions and the EEG has been criticized for not paying enough attention to the role of the social, cultural and institutional environment of economic activities (Hassink, Isaksen & Trippel 2019). Hence, the concept of agency has been seen as a possible key in the understanding of regional development (Rodriguez-Pose, 2013). Agency connects to actions of actors, as agency describes the ability of actors to act (Scott, 2001 in Battilana, 2006; Gregory et al., 2009 in Grillitsch & Sotarauta, 2019). The interaction of structure and agency is part of a long-lasting debate on how structure can change. How can it be changed by actors, if their beliefs and actions are all determined by the structure they wish to change (Holm, 1995 in Battilana, 2006)? An agency perspective tries to resolve this problem and it tries to explain the impact of actors on the structure and not to see the overarching structure as purely determining the regional agencies.

Within EEG, the concept of agency has been widely adopted to firm-actors while ignoring other actors. This has led to criticism, as it essentially neglects the influence of other actors (Binz, Truffer & Coenen, 2016). These other actors and their actions become all the way more important in literature (Martin, 2014; Simmie, 2012; Sydow, Windeler, Müller-Seitz & Lange, 2012), as regional change is increasingly understood as a collective action of a variety of regional actors who work together to build a path (Collinge & Gibney, 2010). So far only a few

actor-centered studies have been conducted (e.g. Carvalho & Vale, 2018; Neffke, Hartog, Boschma & Henning, 2018). Despite these studies, the question of how and what actors do in regard to a path creation process remains unanswered.

Grillitsch and Sotarauta (2019) propose the trinity of change framework that aims at including an actor perspective on the explanation of regional path creation. It includes three forms of agency; innovative entrepreneurship, innovative entrepreneurship and leadership, as these agencies have a big impact on regional development. The regional structure is hereby presented by a regional opportunity space that is influenced by actors and influences them and their actions in return. So far, the framework has not been used and its application has not been tested empirically. Within this framework the impact of the different agencies on the regional path creation is analyzed. This framework will be used to answer the following research question:

RQ: How do actors collectively influence a regional path creation process, when creating a new industry?

While the previous exclusion of non-firm actors in the analysis of regional development has gone too far, it has still introduced the important notion that surely not all regional actors take a part in a path creation process. Furthermore, it is a limited number of actors that actively influence the process by their actions. A theory of path creation and practitioners who possibly want to influence the development of a path needs to know who has influence on the path creation. Hence, one additional sub question is put forward:

SQ1: Which actors take part in a path creation process?

Using the trinity of change framework provides insight on the process of path creation and reveals single actions of actors within the specific agency. To formally describe these actions the second sub question is proposed:

SQ2: Which roles do actors have and which actions do they perform?

The examination of the path creation process of AI in the German federal state of Saarland can help to answer these questions. The analysis of a path creation can take the form of a retrospective, examining past events, or examining current path creation processes while they are still in action. The latter can provide a more in-depth view, as actors are currently acting and do not have to remember their actions from a long time ago. The path of AI technology in the Saarland represents such a path that can be examined while it is being created. The region is said to be increasingly pressured by external economic forces. The creation of an alternative development path is thought to be a solution to impose structural change. With the demand of AI applications increasing the idea of a regional path creation that deals with the technology and satisfies the demand of AI is not far-fetched. Furthermore, as AI is becoming increasingly popular understanding its path creation might also help the spread of the technology itself. The federal state of Saarland in Germany provides good conditions for the creation of an AI path, as it hosts several research institutes, among others the German Research Centre for Artificial Intelligence, which have been active in the region for decades. However, until recently, without affecting the creation of a regional path of AI technologies that much.

Answering these research questions is beneficial in two ways. First, the framework of Grillitsch and Sotarauta (2019) is tested empirically for the case of AI in the federal state of Saarland, scrutinizing the validity of the three proposed forms of agency central to regional path creation processes. On this basis, the general conceptualization of regional path creation dynamics can be enriched. Particularly, more light can be shed on the interaction of agency and structure by empirically analyzing the interactions of the three agencies and the structure of the opportunity space as proposed by the trinity of change framework. Understanding this interaction can enrich previous studies that see the (technological or industrial) structure of regions as a major reason for their regional development (e.g. Neffke et al., 2011). Moreover, the analysis aims at contributing to a deeper understanding of the overall path creation process at the regional level, particularly by revealing which actions of actors have to be further examined to understand the regional path creation process in greater detail.

Second, it helps regional policymakers in future planning of how to introduce new paths into their region. By knowing which actors to talk to and which actions to foster, they can support regional path creation easier and more efficiently. Actors who are not policymakers, but who also want to initiate or contribute new path developments in their region can also identify mechanisms and actions they want to adopt from the Saarland to their own region. Furthermore, a detailed investigation of the AI-industry in the Saarland can be seen as a benchmark for the industry in the region, highlighting strengths and weaknesses that further help to build an AI-based industry in the Saarland.

2 Theory

The following chapter provides an overview over the history and current discussions of the concept of the path and the path creation process. It then goes on to elaborate more on the trinity of change framework of Grillitsch and Sotarauta (2019) and presents the different change agencies and the regional opportunity space in a more detailed manner.

2.1 Path Dependency and regional path creation

The classical idea of path dependence stems from David's (1985) paper of the QWERTY-Keyboard layout that has resisted change from the age of early typewriters in the late 19th century until today's computer keyboards. The modern QWERTY-Keyboard layout is one of the first examples of a technological development path that has been influenced by previous events (e.g. Dosi, 1982; Nelson & Winter, 1977). Here, the idea of a path describes the route of a technological development.

As the concept of path dependency matured, it has been adapted in other fields. Next to the path dependence of technologies other path dependencies could be identified. For example, within the development of companies who develop and produce goods as they are specialized on a production line. With the development of companies being path dependent, thus the development of overall economics can be said to follow a path (Arthur, 1990). The development of economics however cannot be thought without place. Economic activities are always place bound and moreover influenced by place. Within this concept, Storper (1995) introduced the *window of locational opportunity* which links the prospective development of industries in a region to the region's path. He links this development to the case of the third Italy, which describes a region in the northwest of the country. Here, the local economy of small shoe production consists out of small series, luxury shoes who are manufactured by micro enterprises and is deeply embedded into the regions social structure and history.

Martin and Sunley (2006) however do not regard the regional development as set by introducing a technology and vice versa. They see a dualism in the development of a technology and the development of a region. Both phenomena are closely linked to another. Technological advancements are, according to them, place-dependent, as a place cannot develop a technology beyond its capabilities but has to grow first to support the new technological development. In summary, it is thought that "economies change in path-dependent ways, shaped and constrained by past decisions, chance events and accidents of history" (Wolfe, 2010, p.139).

When thinking about path dependency and path development, one might also ask how a path comes into being. For the example of the QWERTY-Layout it is relatively simple as the letters have been arranged in a way that the typewriter arms of the most used letters of the english language do not obstruct each other. However, for the path development of regions it becomes increasingly difficult to answer this question. The current theory on path dependency and path development says little on how those paths can result from a *path creation* process (Dawley, 2014; Martin, 2014 in Hassink et al., 2019). Martin and Sunley (2006) argue that "new paths do not emerge in a vacuum" (p. 186), but always rise in the context of pre-existing industrial structures, technologies, and institutions which are regionally bounded (Martin, 2010). Accordingly, a theory of regional path creation becomes necessary to explain the emergence of paths in this non-vacuum.

The basic definition of path creation is “the emergence and growth of new industries and economic activities in regions” (MacKinnon et al., 2019, p. 3; see also Martin & Sunley, 2006). Isaksen and Trippel (2014) define the term more specifically: “the most wide-ranging changes in a regional economy. It [path creation] includes the establishment of new firms in new sectors for the region, or firms that have different variants of products, employ new techniques or organize differently that what have hitherto dominated in the region” (p.4). The later definition shall be used as the understanding of path creation in this research as it provides more detailed information on which characteristics a path creation includes. These characteristics can be examined more easily than the former, more generic description.

A review of the recent literature on regional path creation shows that the question of how new paths develop or are created is relatively new and that different viewpoints are being discussed in the literature. For instance, Martin (2010) proposes a conceptualization of path creation that differentiates between *path creation* as “purposive or intentional experimentation and competition among agents leads to the local emergence of new path” and *path development* as the “emergence and development of local increasing returns and network externalities assists the development of the path” (p. 21)¹. This research acknowledges the differentiation between path creation and path development but follows other researchers (e.g. Hassink et al., 2019; Isaksen & Trippel, 2014) and uses the term of path creation synonymous with path creation and path development, as both phases of Martin’s distinction are difficult to differentiate empirically. It is also possible that both distinctions might occur parallel within different areas of the region, which makes it increasingly hard to develop a causality of different actions within the region on Martin’s different phases of path theory.

2.2 Trinity of Change: An actor perspective on regional path creation

So far authors have mainly taken a macroscopic view on regional path creation (Martin, Martin & Gemuenden, 2019). This has led to a focus on the description of the structure of a region (Dawley 2014; Neffke et al. 2018). However, this structural view cannot explain why regions with similar structures still differ in their regional development (Grillitsch & Sotarauta 2019). The so far neglected concept of agency has been seen as a key to understand these regional processes (Rodriguez-Pose, 2013). Agency is broadly seen as “the ability of people to act, usually regarded as emerging from consciously held intentions, and as resulting in observable effects in the human world” (Gregory et al., 2009 in Grillitsch & Sotarauta, 2019, p. 4; similar to Scott, 2001 in Battilana, 2006). The role of agency has been primarily adopted in the context of the impact of firm-level agency on the overall development of a region (Boschma & Frenken 2012; Isaksen, Jakobsen, Njøs & Normann, 2019). However, this “downplays the influence of non-firm actors, institutions and public policy in creating and/or renewing industrial development paths in a region” (Binz et al., 2016, p. 173). Within this agency-based view regional development consist out of activities of different actors that often overlap, restrict or enable each other. Interaction between different actors, directing their actions is an integral part of

¹ Other concepts of the idea of regional development along a path include: the process of path layering (Martin, 2010), process of path conversion (Martin, 2010), process of path recombination (Martin, 2010), process of structured variety (Martin, 2010), path extension (Martin et al., 2019), path upgrading (Martin et al., 2019), path importation (Hassink, Isaksen & Trippel 2019; Martin et al., 2019), related and unrelated path diversification (Grillitsch et al., 2018 in Hassink et al., 2019) and path renewal (Hassink et al, 2019; Isaksen, 2015 in Isaksen & Jakobsen, 2017;).

regional path creation (Simmie, 2012; Sydow et al., 2012; Wolfe, 2010). This makes it more important to look at all actors equally and examine how their collective actions shape the regional path creation. This correlates with some views on how to describe a place. Collinge and Gibney (2010) see place as the product of social processes (Collinge & Gibney, 2010) in which a discrete number of actors with relationships between them form the shape and attributes of a region (Cooke, Uranga & Etxebarria, 1997).

Current literature does not argue for a complete actor centered view and the complete neglect of structure. Instead, authors increasingly suggest that regional development is neither completely answered by a complete agency approach nor a complete structural perspective, but by a synthesis of the two, as actors still seem to be “influenced by the structures in which they are located, for example by mobilizing resources to create more favorable structural conditions” (Fredin, Miörner & Jogmark, 2019, p.797). Studies of path creation should therefore focus on structure–agency dynamics. This shared perspective can explain how structure influences agency and vice versa. These micro-processes of interaction might, in total, explain the creation of a local path.

In their 2019 article, Grillitsch and Sotarauta introduce the trinity of change, a set of three types of agency and an overarching concept of structure in the form of an opportunity space. They use these conceptions to build a framework to understand the role of agency and structure in the path creation process and to explain why regions with similar structures differ in their regional development. The framework suits the question as it mirrors the idea of structure-agency dynamics. The authors introduce three different kinds of agencies that, according to literature, have the most impact on regional development and interact with a regional opportunity space that represents the regional structure.

The trinity of change includes innovative entrepreneurship, institutional entrepreneurship and regional leadership. Grillitsch and Sotarauta argue in the conceptual derivation of this framework that the choice of the agencies is based on their attributed impact on regional development. Innovative entrepreneurship takes advantage of the presence of regional opportunities and enables the specialization and the transformation of places as it introduces path breaking innovations (Grillitsch & Sotarauta, 2018, 2019; Carvalho & Vale, 2018). These innovations build the foundation of an ongoing path creation process. As a new growth path often requires institutional changes to fully flourish (Boschma & Frenken, 2018; Carvalho & Vale, 2018; Grillitsch & Sotarauta, 2019). Institutional entrepreneurship challenges existing institutions and tries to replace them with institutions that suit the new path. Both innovative and institutional entrepreneurship have to include collective action of many actors to sustainably establish a new path (Simmie, 2012; Sydow et al., 2012; Wolfe, 2010). The support of many actors establishes a broad foundation for a path to be built upon. Regional leadership helps to moderate between these different actors. By connecting different actors and resources, regional leadership especially makes institutional entrepreneurship easier to conduct. (Grillitsch & Sotarauta, 2019).

2.2.1 Innovative Entrepreneurship

Earlier studies show that a strong presence of innovative entrepreneurship might partially explain a path creation process (Dawley, 2014; Holmen & Fosse, 2017; Sotarauta & Suvinen, 2018). Innovative entrepreneurship in the form of introducing technological innovations has to be therefore considered as an explanas in the path creation process, as these technological innovations trigger regional transformation and specialization (MacKinnon et al., 2019). In general, entrepreneurship is concerned with the discovery and the exploitation of profitable opportunities (Shane & Venkataraman, 2007).

The creation of these opportunities and therefore also innovative entrepreneurship can be restricted or enabled by the general structure of the region (Grillitsch & Sotarauta, 2019). There could be specific institutions in place that restrict an entrepreneur from pursuing a regional opportunity. The development of genetically modified plants for example cannot be successful if regional institutions oppose the idea, as regional efforts might rise to stop the research. This could lead to local farmers not lending their fields for tests, problems in finding suitable local employees or facing restricting local legislature that effectively hinders research. Activities of innovative entrepreneurs have therefore to fit to the possibilities and the limits a regional structure provides.

Following the Schumpeterian idea of an innovative entrepreneur, she has to mindfully deviate from existing paths and establish a new one as she is searching for future opportunities (Garud & Karn e 2001; Grillitsch, 2019). Ultimately, an entrepreneur has to seek to exploit these new opportunities. Innovative entrepreneurship consequently considers two phenomena. The presence of useful opportunities and the presence of venturesome actors (Shane & Venkataraman, 2007).

Opportunities in a Schumpeterian view deal with the combination of already established resources or the combination of single ideas in a new way with an uncertain outcome. The combination of resources across sectors or industries is beneficial for this development of opportunities, as these resources usually have not been combined, yet (Grillitsch, 2019). These opportunities are objective phenomena for a single entrepreneur or a group of entrepreneurs but are not known to all actors at all times (Shane & Venkataraman, 2007). For connecting different resources across sectors or industries, innovative entrepreneurs often hold social positions in various social structures (Grillitsch, 2019) that enables them to combine the resources of their respective social structure. An entrepreneur is not only able to create such an opportunity, but also thrives to realize and exploit a created opportunity (Grillitsch, 2019). Innovative entrepreneurs work alone. They can have the form of an organization, or a single human being (Grillitsch & Sotarauta, 2019; Weik, 2001). More peripheral institutional entrepreneurs are more likely to introduce more disruptive innovations (Leblebici et al., 1991 in Kirschbaum & Ribeiro, 2016).

Innovative entrepreneurs can be regarded as pioneers of path development. By taking advantage of regional opportunities and making a business they introduce new possibilities of growth to the region. Other entrepreneurs can witness the success of innovative entrepreneurs as a signal of demand for the product of institutional entrepreneurs. This encourages other entrepreneurs to pursue the same or similar opportunities of the initial innovative entrepreneur (Grillitsch &

Sotarauta, 2018). These opportunities however need to be anchored in the regional environment (Binz, et al. 2016).

In short, the role of innovative entrepreneurs can be characterized for this research as follows:

Innovative entrepreneurship initiates a path creation process by introducing new products and disrupting regional paths. The innovative entrepreneur creates own opportunities across the borders of different sectors and exploits these.

2.2.2 Institutional Entrepreneurship

The introduction of the trinity of change and the paragraphs on innovative entrepreneurship already stressed the importance for institutional change in a path creation process. Fitting institutions enable new development paths to prosper, while unfitting institutions block their development. The previous subchapter already provided the example of genetically modified plants for this occasion.

Institutional entrepreneurship deals with the adaption of institutions regarding the support of new paths. What an institution represents however is, regarding the path creation, within the context regions is often found to be vaguely defined within economic geography and related disciplines (Bathelt & Glückler, 2014). The most notable characteristic of institutions shows that institutions align individuals' expectations, thus creating trust among actors and cope with social interaction (David, 1994; Rodriguez-Pose, 2013). Bathelt and Glückler (2014) define institutions as “forms of ongoing and relatively stable patterns of social practice based on mutual expectations that owe their existence to either purposeful constitution or unintentional emergence” (p. 346).

An institutional entrepreneur is someone who challenges those stable patterns of social practice and introduces new norms and practices (Grillitsch & Sotarauta, 2019). Institutional entrepreneurs have an interest in introducing new institutions, but do not always have to intend the change, nor personally benefit from it (Battilana, Leca & Boxenbaum, 2009; DiMaggio, 1988; Garud, Hardy & Maguire, 2007; Grillitsch & Sotarauta, 2019). As institutional change is a social process including diverse interests and perspectives from different actors, institutional entrepreneurship requires joint action from a wide group of collective actors with mutual interests. (DiMaggio, 1988; Wijen & Ansari, 2007). A group of institutional entrepreneurs is also embedded in different structures and social relations (Granovetter, 1985 in Bathelt & Glückler, 2014). An implementation of a new institution is relying on the support of those social relations. This is done by aligning all relations into the same direction, the direction of support for a new institution. Misaligned social relations can block the implementation of a new institution. Furthermore, institutional entrepreneurs have different “point of views” about a field (Battilana, 2006; Battilana et al., 2009) which can induce different behavior in some institutional entrepreneurs, as they influence actors' cognition and actions in important and often unconscious ways (Battilana et al., 2009). This can increase the difficulty of aligning social relations to support the new institution.

Institutional entrepreneurs can be either organizations, a pool of different actors, groups of organizations or groups of individuals (Battilana, 2006). DiMaggio (1988) notes that quite often efforts of institutional entrepreneurs turn out to be unsuccessful. Even though they failed in

introducing a new institution Battilana (2006) still advocates for calling those actors who failed also institutional entrepreneurs.

Battilana et al. (2009) sketch the necessary prerequisites for successful institutional entrepreneurs. They describe conditions that enable institutional change, including the characteristics of the field that is the target of the institutional change and the social position of the institutional entrepreneurs within the respected field of change. Furthermore, the actions of institutional entrepreneurs include to introduce a vision for change and the mobilization of resources to implement the change. To support the institutional entrepreneur, field characteristics have to be favorable towards institutional change. They either have to be characterized by *jolts and crises*, which include technological disruption or social change for example or institutional arrangements within the field have to contradict each other, causing stress on the entire arrangement within the field. Without these prerequisites institutional entrepreneurs struggle to implement new institutions. An economically and institutionally stable region will not change its institutions or create new institutions. Those stable regions are unlikely to create new paths, as introducing a new path often requires institutional change (Grillitsch & Sotarauta, 2019). Moreover, rather economically and institutionally unstable regions are more likely to host institutional entrepreneurship and change and therefore regional path creation.

The social position of the institutional entrepreneurs has to enable them to induce a change. They either have to be at the center of institutional change themselves or strongly connected to an actor who is in order to steer the institutional development. They can control the downfall of existing and the development of a new institution by framing the current situation (Wijen & Ansari, 2007). Institutional entrepreneurs can show the problem a new institution helps to resolve and why it is preferred to the existing arrangements or give other arguments for the adaptations of the new institution (Battilana et al., 2009). Creating a vision is central to the institutional work of institutional entrepreneurs. To support their vision, institutional entrepreneurs have to open a discourse by creating a new narrative for the new institution. This narrative has to resonate with regional actors. Institutional entrepreneurs can also tell symbolic stories to actors why change is necessary or define regional protagonists and antagonists of regional change, so that actors connect the institutional change with the agenda of a pro- or antagonist. To do so they have to mobilize resources, like financial resources and other actors to support them (Weik, 2001).

As outlined above, regional path creation often requires institutional change (Grillitsch & Sotarauta, 2019). This institutional change enables a new path or technology to be created while often contain opposing other technologies to develop. A positive change in the acceptance of genetically modified plants for example would enable a regional path in this direction. Institutional entrepreneurship sets the basis for a path creation process. It can therefore be summarized as:

Institutional Entrepreneurship enables and restricts the regional path creation process.

2.2.3 Regional Leadership

The emergence of new regional path creation includes many actors and their actions (Bristow & Healy, 2014; Dawley, 2014) such as innovative and institutional entrepreneurship. According to Grillitsch and Sotarauta (2019) regional leadership is necessary to coordinate these different actors. Leaders can pool competencies, power and resources that benefit the development of new paths in the region (Grillitsch & Sotarauta, 2019). They also determine the direction of and inspire other actors for change (Grillitsch & Sotarauta, 2019; MacKinnon et al., 2019).

The concept of leadership finds its root in the organizational literature in which one actor has formal power over other actors and can steer the development of an organization, like in a business (Normann, 2013; Raagmaa & Keerberg, 2017). It has been adapted in the field of urban studies and found its way into regional theory (Collinge & Gibney, 2010). As the concept of regional leadership as well as associated concepts like place leadership and place-based leadership are relatively new endeavors in the field of regional science the stock of literature on these topics is not very extensive yet (Hu & Hassink, 2017; Normann, 2013; Raagmaa & Keerberg, 2017). Regional leadership is always contextual and depends on the specific region and topic. Therefore, a conceptualization has not been attempted yet. Instead, literature in regional leadership is dominated by case studies (Beer & Clower, 2014). These case studies however share the same idea of characteristics of regional leadership.

According to (Gibney, Copeland & Murie, 2009; Normann, 2013; Uhl-Bien, Marion & McKelvey, 2007), regional leadership can be categorized in two main groups. In the first group, Leadership is only performed by a single actor, like a political actor or the local government (Normann, 2013; Normann et al., 2017). Gibney et al. (2009) call this the old form of leadership. It is characterized by a hierarchal relationship between leader and follower and a linear way of communication. Leadership is also focused on the single leader and not open to other leaders or ideas. Hu and Hassink (2017) examine the example of a newly appointed mayor in a Chinese mining region. Within their research, leadership is mostly conducted by this single actor who possess formal power over other actors in the region.

Contrary to this, within the new form of leadership (Gibney et al., 2009), actors recognize their limits as a single agent to steer regional development (Normann, 2013) and form groups of regional leaders. This new form of leadership is focused on an open and collaborative approach of shared leadership and in between leaders. Here, the inclusion of local followers is important for the leadership process as leadership is more open and requires the unification of different local networks and using merged competencies of leaders to build the capacity to induce regional change (Collinge & Gibney, 2010; Normann et al., 2017; Sotarauta & Beer, 2017). Normann et al. (2017) give an example of shared leadership. They categorize actors of regional leadership in four Nordic regions in different fields (academic, government and industry) and examine the fields cooperation during the implementation of “green fields”.

The new form of regional leadership requires different actors to work on a shared vision (Grillitsch & Sotarauta, 2019; Sotarauta & Beer, 2017). Collaboration between leaders combines each leaders’ assets with one another, increasing the overall impact of their action (Henton, Melville & Walesh, 2002). The new form of regional leadership is more inclusive than

the old form of regional leadership, as it aims at merging different sectors, changing a region in more than one area (Collinge & Gibney, 2010; Stough, 2003).

Within the framework regional leadership can be understood as a supportive agency of institutional entrepreneurship (Grillitsch & Sotarauta, 2018). Regional leadership helps to align a vision among regional leaders and their followers that later can be used as a framing tool from institutional entrepreneurs. Furthermore, as regional leadership connects different leaders and their followers it becomes easier to reach out to them later by using the built network. It also prearranges resources that can be used by institutional entrepreneurs. The function of regional leadership therefore can be summarized as:

Leadership helps institutional entrepreneurship to perform better.

2.2.4 Opportunity Space

Creating a new regional path cannot be fully understood by only looking at individual actors and activities. Instead, path creation is assumed to be largely depended on collective learning, knowledge creation, knowledge transfer and interaction between relevant actors, i.e. path- and place-dependent knowledge and innovation conditions supporting or hampering the path creation process (Boschma & Martin, 2007; Boschma & Frenken, 2018).

Hence, we can assume that the agencies of the trinity of change do not work on their own but are embedded and influenced by a so-called opportunity space (Grillitsch & Sotarauta, 2018, 2019; Grillitsch, Rekers & Sotarauta, 2019). It describes the future in which some paths are more likely than others, depending on the regional preconditions. The structure of the opportunity space not only represents the past of a region but also perceived opportunities about the future. By including the past, but also the prospective opportunities and expectations, it shapes the agency of regional actors. The perceived opportunities are determined by (1) the behavior of actors, (2) institutions, and (3) characteristic features of the region in a specific timeframe, with the addition of past events that influence these three points. Characteristic features can be regionally available resources, for example. These resources determine the trajectory of regional development. They cannot be changed by will but do interact with the agency of the actors which changes the opportunity space.

According to Grillitsch & Sotarauta (2019) actors form the nucleus of path creation on a region. They are able to build networks to external actors and import external ideas or knowledge into the region. This information can be shared among other local actors, inspiring them to perform actions to implement a new path. How this information is processed however and if a number of actors spots an opportunity for a new path is also often actor specific, as they differ in how they can access and how dependent they are on regional resources (Neffke et al., 2018).

As institutions restrict and enable actors' agency (Battilana, 2006; Essletzbichler, 2009; Martin & Sunley, 2006) they therefore have a strong influence on innovation and economic activities and thereby the development of the industrial profile of regions (Grillitsch & Sotarauta, 2019). Examples of this have been given above. Institutions regulate how regional potential and creativity may be developed and used (Sotarauta & Suvinen 2018). This strongly influences the region's capability to introduce new paths or reflect on their existing paths. Institutions have also been named "carriers of history" (Essletzbichler, 2009; Gertler, 2018), as the only slowly

change over time institutions. They are shaped by the distinctive historical and political evolution of particular geographically defined polities of a region. This institutional history constrains or enables the agency of actors to induce institutional change (Boschma & Frenken, 2018). As institutional change is often needed for path creation this also constrains or enables the creation of new paths in a region (Grillitsch & Sotarauta, 2019).

With actors importing external ideas or knowledge and institutions acting as carriers of history, regional and time characteristics also influence the opportunity space. The constraint of time largely affects the opportunities of actors of importing new knowledge or new ideas into the region. Time and the lack of new ideas can also hinder the development of new knowledge within the region. What is currently possible and which information is available depends on the global and local advancements in new technologies and the available resources of the respective actor which both change with time (Grillitsch & Sotarauta, 2019).

3 Methodology

Research Design

This research aims at examining two particular issues: First, obtaining a deeper understanding on how actors on the micro-level influence a path creation process. Second, enriching the framework of the trinity of change by real world application with the case of AI in the German federal state of the Saarland. The research uses a qualitative research design, as the nature of the theoretical framework, which aims at describing the agency of regional actors and its interaction with the regional structural opportunity space, requires such a design to better understand how agency is performed and how it relates to the regional structure (De Vaus, 2001; Yin, 1989). Furthermore, as the case framework of the trinity of change and the idea of regional path creation is relatively new, the case is studied in a exploratory manner. The case study is conducted on the single case of AI in the state of Saarland. A single case has the advantage to focus on the key variables of the theoretical framework and its relationships among each other (Yin, 2002).

The single case of the AI technology in the state of Saarland is chosen for two reasons. AI is receiving increasing attention by the broader public and has the potential to have a big impact on society by changing the development of businesses and the way people interact and work. A recent Ernst & Young (2018) survey among managing directors showed that 89% of respondents expect to generate business benefits by using AI within the next five years, while only 4% of respondents stated that they already have AI based solutions in place. To close this gap an AI industry must be built to support, develop, set up and improve AI based applications within companies and the society. The analysis of how an AI industry is built is important for policy makers, as the demand for digitalization and AI is increasing and many regions may thrive to establish such industries. Understanding the underlying mechanisms will help them to implement these industries within their own region. Furthermore, the case of AI provides the opportunity to examine the path creation process while it is still in action. As the demand for AI based solutions is relatively new, so are the mechanisms that establish a new path. This provides the opportunity to timely examine the regional development and not be reliant on historic narratives.

The German federal state of Saarland is aiming to satisfy the increasing demand of AI based solutions. Within its recent history the region has mainly been seen as an industrial working house in Germany. From the 19th century on the region has been an important location of steel production and since the later half of the 20th century also a center of car production (Schulz & Dörrenbächer, 2007). Both industries still shape and define the regional economy until this day. Both also have recently become under pressure from external developments which forces the region to change. This force for regional change, structural change as it is called in the region to reinforce the thought of a sustainable change, leads the region to explore new opportunities and create new paths to survive. It is therefore likely to discover processes of path creation here.

The region also already has a long-lasting history of AI. Within academia AI can be seen as an already established path. For instance, the region hosts one location of the German Centre for Artificial intelligence since 1988 and houses other research institutes that conduct research in the field of AI. Traces of AI in the region can even be found since the 1960s (Wilhelm, 2009).

The development of an AI industry in the region can therefore be seen as the exploitation and search for a regional opportunity. AI has been identified as such an opportunity but has long been downplayed or was not feasible for a possible opportunity for regional development. The use of, so far neglected, opportunities that are rediscovered under the influence of external pressure can surely be found in other regions as well. The development of AI in the Saarland can therefore function as an example of regional development for those regions.

In order to answer the research question on how actors influence a path creation process, the research follows a deductive-inductive approach (Bryman, 2012). It is deductive because the empirical analysis follows the trinity of change framework of Grillitsch and Sotarauta (2019). This framework guides the selection of interviewees, the interview questions and the initial analysis. Secondly, the inductive part of the research focuses on the refinement of the initial framework based on the findings and on an in-depth analysis of the activities of actors which will contribute to the theory of path creation.

Sampling Strategy and Data Collection

Following Bryman (2012), a theoretical purposive sampling strategy was primarily followed, as he suggests this strategy when conducting inductive qualitative research. Interviewees have been selected based on their relevance to answer the research question and their probability to widen the understanding of different concepts and the domain of the analytical framework. Having the framework and the development of AI in the region in mind, several actor groups have been targeted. These groups include governmental actors, researchers, academic teacher, start-ups, start-up supporting actors, public advocates for the technology and firms. Governmental actors and public proponents of AI technology have been selected based on their previous actions which had to include a preference towards AI or more broadly towards new information technologies in general. Based on the theory chapter, these actors are associated with regional leadership and institutional entrepreneurship towards AI, as they seem to have a sufficient social position and access the necessary resources. Likewise, start-up supporting actors have been chosen based on their actions towards fostering entrepreneurship in the region. By fostering entrepreneurship, they increase the room for opportunities for innovative entrepreneurship which can establish new paths in the region. Lastly, researchers, academic teachers, firms and start-ups have been chosen when their current research, teaching or business making included topics of AI. Because of their closeness to the topic, these actors are thought to be most likely to be innovative entrepreneurs. They have access to opportunities in the form of modern developments in the technology before anyone else and might use this knowledge to establish a new path. Additionally, by examining firms and start-ups the current progress of the path creation process may be described.

Which actions or subfields of computer science are covered by the term of AI is still debated within computer science scholars. As this research does not aim to deal with nuances of the technology, this discussion is left aside. Instead, the classification of Hammond (2016) is used to differentiate the different actions regarding AI. The periodic table of AI is widely used. For example, by Germany's digital association bitcom. Based on this periodic table, the closeness of actions towards AI technology is evaluated. Researchers, academic teachers, firms and start-ups who mainly perform those actions are considered to be a potential part of the path whilst actors who perform other activities while claiming to use AI are not part of the sample.

The sampling of interview partners followed two strategies. First, potential interviews for each actor group have been identified via internet research and the use of different databases. For governmental actors (political) all actors who fit the sampling criteria have been contacted. This can be said as their field of activity is publicly available. Activities of other governmental actors did not fit the AI criteria. For the public advocates of AI, supposedly all actors who fit the sampling criteria for public advocates have been identified. For start-ups, research institutes and university published a list of start-ups or spin-offs of their respective organization. These lists certainly do not include all start-ups that use AI based technologies, but it has been used as a reference to contact all start-ups that fit constraint of working with AI. For firms a database of the national ministry of research and education has been used that includes all applications for research grants that are based on AI. Out of these companies all that fitted the closer AI filter of this research have been contacted. Second, snowball sampling has been applied. During the interviews, interviewees have been asked for further recommendations for other potential interview partners. The sampling process stopped as the same recommendations have been mentioned repeatedly. The snowball sampling mainly added actors in the field of public advocates, research, teaching and start-up supporters.

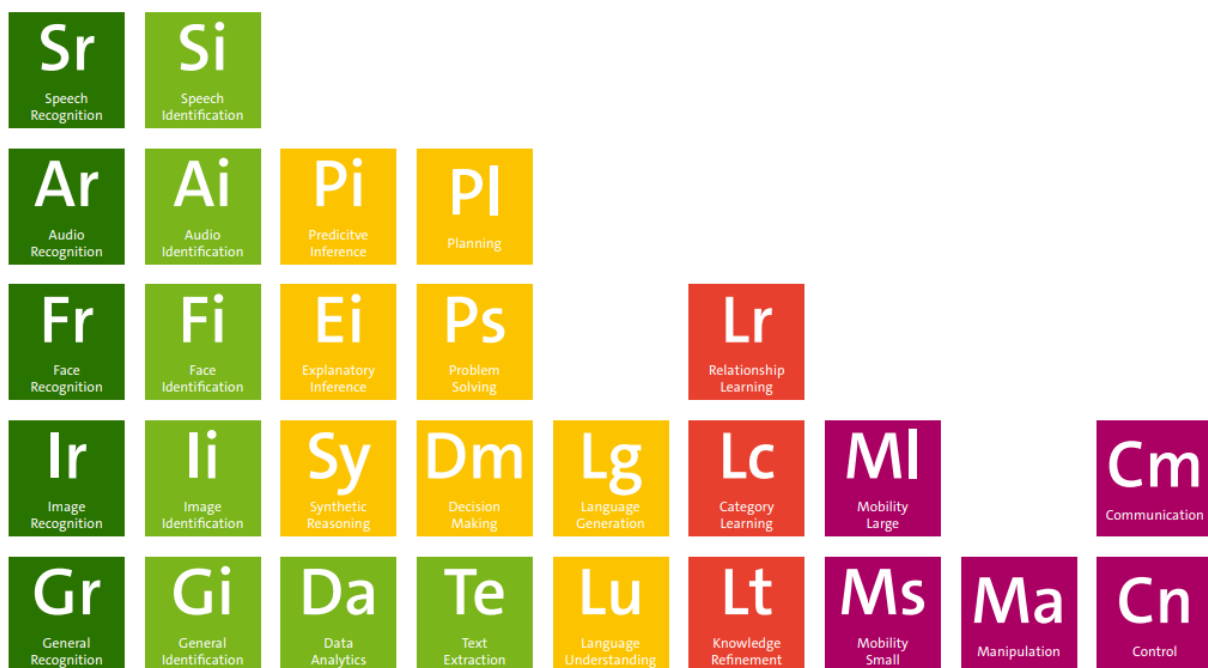


Fig. 1: Periodic table of AI (bitcom, 2018)

In total, 25 semi-structured interviews have been conducted between November 2019 and March 2020. Semi-structured interviews have been chosen as they allow pre-made questions being answered, while being open for additional input from the interviewee (Bryman, 2012). Table 1 shows a quick overview of the distribution of interviews for the different groups.

Following the theoretical framework, an interview guide has been built that covers all aspects of the framework. Due to time constraints within each interview, not the whole pool of questions has been put forward to each interviewee. The questionnaire for each interviewee has rather been built by picking questions from the pool that fitted the respected interviewee. These has been made based on the assumptions which agency each group would conduct and personal

specifics of the interviewee. Backup questions had been prepared if the interviewee indicated that she also had knowledge from other fields. The pool of interview questions can be found in the appendix.

Table 1: Distribution of interviewees per group

# IVs	4	5	5	3	4	4
Actor group	Teaching	Research	Support (AI + Start-ups)	Politics	Industry	Start-ups

Interviews have been conducted until thematic saturation was reached. At this point no new significant insights have been rising from additional interviews. Interviews still gave new details or how they personally view different concepts, but this did not add much insight onto the concepts, nor changed the general description of the concept. Depending on interviewees preference, interviews have been conducted personally (15 IVs), by phone (7 IVs) or via Skype (3 IVs). With the exception of one interview, all interviews were held in German and lasted between 30 and 90 minutes. All but one interviewee gave their permission to record the interview. Within the single non-recorded interview, the interviewer took notes alongside the interview. An anonymized overview of all interviewees can be found in the appendix.

Operationalization and Data Analysis

The initial analytical framework (table 2), on which also the questionnaire is based upon, is used for the operationalization and data analysis of the interviews. The analytical framework is based on the theoretical ‘trinity of change’ framework of chapter two. The domain of the framework, the main fields of the research consist of the three agencies of innovative entrepreneurship, institutional entrepreneurship and the structure of the opportunity space. The subdomains build up the different domains and also have been discussed in the theory chapter. From the theoretical subdomains concepts have been built to categorize observations and attribute them to the different sub-domains to be able to describe them later on in the research process. The concepts have been used to code the transcribed interviews. The concepts have been observed within the interviews either directly in text, or by setting the text segments in context to other interviews or general information about the region or the interviewee. Concepts have been adapted to the case of AI where necessary. For example, the description of the general environment of AI is present in the analytical framework, but not specifically mentioned in the theory section.

The transcribed interviews have been the target of two rounds of coding using the software MAXQDA. Because of the deductive-inductive approach, coding first started open to identify the initial concepts in the interviews. Concepts that did not fit into the initial framework have been adapted in the form of a new code. These updated concepts have been used to perform a round of axial coding on the transcripts which led to the results. During axial coding the newly emerging codes have been compared with the initial code that has been theoretically grounded to build new codes that summarizes common patterns of both codes. These concepts have been

refined and led to an updated analytical framework. The final analytical framework can be found in the appendix, while the results can be found in chapter four.

Table 2: Initial analytical framework

Domain	Subdomain	Concepts
Innovative Entrepreneurship	Opportunities	Creation of own opportunities
	Market disruption	Inherently new product that breaks with existing paths and tries to establish a new one
	Social Structure	Embeddedness in multiple social structures (Academia, Industry)
		Personal mobility (Ability to switch between social structures)
Transformation capability	Combined Knowledge from different social structures	
Institutional Entrepreneurship	Field characteristics	Heterogeneity of institutional arrangements in the field
		Jolts and crises. i.e. technological disruption, social shifts
	Actors social position	Position within the field that is to be changed
		Intersection between different fields
		Contact to other actors with a better social position
	Vision for divergent change	Framing of the problem
Showing that there is a need to change		
Mobilization of allies for the vision	Use of discourse (protagonist, antagonist, etc.)	
	Resource mobilization	
Leadership	Mode of leadership	Sharing leadership among different organizations
		Connecting different leadership actors
		Congruency of the vision
	Vision	Framing the vision
		Highlight benefits for followers
	Capacity to enforce change	Access to Resources
		Connectedness to actors in the region
		Trustful relationship between leader and follower
		Ability of the leader to create new connections to follower
		Ability of the leader to create new connections among actors in the region
Opportunity Space	Opportunity Space	Existing Economy
		Local and extra local networks
		Entrepreneurial Climate
		Current state of AI
		Institutions benefiting or hindering AI

Research Quality Indicators

The use of the proposed framework and the data collection and analysis approach assure reliability and internal validity. Internal validity was pursued by applying constant comparison between the newly developed theoretical concepts and the acquired empirical data via strict coding rules (Bryman, 2012). The results stay as close to the data as possible and are backed up by appropriate quotes from the interviews. Additionally, as multiple interviews are conducted with local practitioners, an in-between comparison of their statements about the regional development can also be performed.

External validity is limited by the performance of a single case study that supposes contextuality of the findings relative to the examined region. The abstracted findings of this research however may also be applied to different technologies within other regions.

4 Results

4.1. AI development in Saarland: Case descriptions and background information

The federal state of Saarland is located in the western part of Germany, sharing borders with the French region Grand-Est and Luxembuorg. Within Germany it is surrounded by rural areas of the federal state of Rhineland-Palatinate. The Saarland is also Germany's second smallest federal state, right before the city state of Bremen with roughly one million inhabitants.

The region is rich in coal which determined the economy of the Saarland for the past centuries, as it has been an important location for heavy, iron related industries. Because of its natural resources, the Saarland also has been a target of foreign assimilation. It changed its belonging since the Napoleonic times several times from France to Germany to an independent state and back. Since 1957 it is part of Germany again. The iron industry and manufacturing shape the region until this day (IV 9, 11, 12), as many people still work in manufacturing, mostly in the automotive industry. The German "Mittelstand" is not that prominent within the region, when compared to other German federal states (IV 25). Companies in the Saarland have more employees than the German average, which means that the overall number of companies is relatively small, and the region is mainly dominated by bigger companies (IV 25). Often, bigger manufacturing companies, such as Ford or Bosch, only have a production site in the Saarland, with the headquarter being located elsewhere (IV 7, 22).

The Saarland is currently subject to a progressing structural change. Competition on the world market for steel and coal and in the automotive sector set companies in the region under enormous economic pressure. The shift in the automotive sector from gas to electric vehicles, for example threatens the business of local exhaust pipe and gearbox manufacturer, because their products are no longer needed in future automobiles (IV 15). These factories are often just subsidies of non-local companies which sets the region additionally under pressure as those companies are more likely to focus a change and adaption in their own local factories, leaving the plants in the Saarland vulnerable to closings. Next to the external economic pressure on local firms, the dependency of the region on external manufacturer causes an additional economic threat to the region (IV 2).

Early developments in the 1960s already set the course for the regional path of AI creation. Back then, the chair of Mathematics and Informatics at the Saarland University was one of the first chairs of its kind in Germany. In 1988 the German Centre for Artificial Intelligence (DFKI) has been founded with one of its two co-locations being based on the campus of the Saarland University (IV 17). One of the stimuli for the establishment of the DFKI has been a commission for the regional development of the Saarland back in the 1980s (IV 9). Since then the DFKI has been joined by multiple research organizations on the campus, namely the Max Plank Institute for Informatics in 1993, the Max Plank Institute for Software Systems in 2004 and the CISPA-Helmholtz Center for Information Security. The latter three are all part of the biggest four research organizations in Germany (IV 24).

Since 2001 the region is working on an innovation strategy that has now reached its third iteration. The overall goal of this strategy is to reduce the economic dependency on external firms and the mono-structural focus on only steel and automotive industry, and to develop more promising and future-oriented industries within the region. The focus areas are thereby

historically grown, like with AI, in which the region has a long-lasting history of research institutes that built regional competencies. Other areas include life science and material research, for example.

During the analysis of the interviews three aspects have been found that promote the creation of the AI path in the region: First, the fostering of local business creation focusing on AI. This has been found either as a university spin-off in which research results build the base of the new venture or as an independent start-up in which the entrepreneur herself developed an idea that includes AI technology (IV 9, 11). Second, strengthening the competences of local firms that already work on and develop AI based solutions. This shall get other companies into developing AI based solutions and increase the knowledge and experience exchange among local actors. The third aspect concerns the increase of the demand, application and adoption of AI based solutions in local companies. To achieve higher adoption rates among local companies, companies are informed about the potential benefits that AI might introduce in their businesses.

To shed light on the three different aspects of implementing the AI ecosystem in the region, particularly on the role of actors in achieving developing a new regional “AI path” in the Saarland, the empirical results are split up into the three episodes of “a new idea of collaborative working”, “creating a start-up culture in the region” and the “AI information Program for Companies”. Within these episodes the different features of the three change agencies and their interaction with the opportunity space are presented and analyzed independently, in order to elucidate these different aspects and mechanisms that concern the three change agencies. The three episodes have been built around three topics (collaboration, start-ups, informing companies) that have been the central point of many interviews and have been brought up by different interviewees. During the interview, the interviewees also connected other aspects to the three topics which have been included in the analysis.

4.2 A new idea of collaborative working

The idea of a collaborative working culture and environment between different companies is becoming increasingly popular for all companies in the region. Two prime examples of this development are the initiatives of the East Side Fab and the CISPA Innovation Campus. The East Side Fab is part of a joint project of the local government and regional companies. The publicly subsidized base of the East Side Fab has been opened at the end of 2019 and the overlying supporting and managing organization founded in January 2020 (IV 23). For companies, the East Side Fab enables the possibility to openly work together with other companies on a project to project basis. The goals of the projects are not pre-defined but result from shared interests of companies that are identified by company employees at the location of the East Side Fab. The second example, the CISPA Innovation Campus, has not been established yet, as it is still in the planning phase. The goal of this initiative is to build a campus in the region to serve as a shared space for academia, established companies and start-ups to work together, meet, help and positively stimulate each other (IV 12).

Both initiatives are based on the idea of collaborative working between different actors. Companies that collaborate is not a new phenomenon to the region though. They had collaborative projects before, but those projects have been less frequent and not as intensive as companies now plan (IV 23). At the moment, it is envisioned that companies work together in the same

building and permanently share their resources in form of employees and financial capital on the site of the East Side Fab (IV 3). This shall result in an easier knowledge transfer between companies as employees share their knowledge on joint projects with each other. Furthermore, the initiatives shall enable company employees at the East Side Fab to be more flexible as they are not bound by contractual borders within a collaborative project as they most likely would be outside of the initiatives, as one interviewee explained:

“One advantage over the current status is that the objectives are open. When I write a research proposal, I have about half a year ahead of me and I have very narrowly defined objectives. This means that I have to find my partners in advance, I have to determine the topics in advance, and I have, let's say, a three- to four-year plan which I have to adhere to. In the East Side Fab, the companies make advance payments, which means that the employees who are in the East Side Fab are still relatively unbound and can act freely. This means that if new issues arise, the East Side Fab can adapt to them. And yes, it is also possible to find new topics without having to write a proposal in advance. I see the advantage in the agility and flexibility that the East Side Fab offers.” IV 23

The interviewee also gave an AI based example and the added benefit of working collaboratively on a shared platform for the technology.

“One example is the detection of loose bulk material in the production process. For example, if I have a lot of loose components in a box and I want to pick them with a robot arm, then these parts have to be taken out of the box and be transferred into the factory storage. And this is a problem that many different of the involved partners have [...] And what we see is that a cooperation between a manufacturer and a user of such a system could create added value.” IV 23

This example shows that the added benefit of the initiatives for AI can be found in the collaboration of different companies. Shared problems of different companies are solved in collaboration, decreasing the costs and the effort for a single company to search for a solution. For individual companies, collaboration within the East Side Fab seems to enable a practical solution in the first place, but for the region it can open new opportunities for AI development. The reason is that; first, companies can directly benefit from a more open knowledge exchange, local knowledge spillovers and can directly acquire capabilities to use AI based solutions via new collaborations that are formed within the initiatives. Second, a more indirect but equally relevant effect for regional path creation might be the fact that companies that are more experienced with AI based solutions can introduce the technology to firms that hesitate to use AI or are skeptical about the technology as a way to solve problems within the company's workflow. Hence, the establishment of an AI knowledge base in the region can be strengthened, as an increasing number of companies is using the technology and providing test beds for local AI developers.

Moreover, it is important to note that the reason why companies just recently started to work together more closely comes, according to interviewees, down to two reasons. Firstly, companies experience the structural change that has been mentioned before, either by themselves or by other adjacent companies. This forces companies to question their own strategies and introduce change in their production, their research and development and other departments in order

to survive (IV 20). Secondly, companies witness an increasing number of examples of disruptive developments in other industries, like Airbnb for hotels and Spotify within the music industry. This forces companies to search for disruptive developments in their own industry and to be dynamic, open for new developments, and permanently rethink their business model (IV 25).

Driving the development of possible disruptive innovations has consequently been mentioned as one of the goals of the initiatives (IV 23). Which kind of innovations and technologies are planned cannot be said yet because of the immature state of the East Side Fab and the CISPA Innovation Campus and the intrinsic openness of the projects being pursued within these initiatives. The search for possible new disruptive innovations creates a chance for emerging technologies such as AI, or for existing technologies to be adapted in a new environment, bearing disruptive potential with them. A new environment in the form of a new firm or new perspective can create a new use case of AI, for example.

It seems that the development of a new specialization in AI in the region is driven by external pressures that companies perceive and the consequential new goal of companies in the initiatives to create disruptive innovations that include AI. Both, the external pressure and the resulting development of companies in the initiatives boost the interest and accelerate the progress of new AI based applications in the region.

At its core, the two initiatives solely represent a platform for different actors to meet, exchange and build a community of actors. However, building a community makes connecting to other actors and starting joint projects easier, as a form of trust has already been built. Actors from politics and supporting organizations pointed out that this community form of trust presents an opportunity for different types of actors with different backgrounds and interests to interact in the same community (IV 1, 9). The interviewees specifically emphasized the opportunity for companies to get closer to academia and vice versa, or for start-ups to connect to established companies. However, while the benefits for start-ups haven been mentioned in several interviews, the opportunities to connect to start-ups and academia has not received much attention from interviewed companies.

Moreover, neither start-ups nor academia have broadly perceived those initiatives as an opportunity either. All actors have been primarily interested in knowledge exchange or collaboration within the same type of actors, but from different fields. This type of interdisciplinary exploration has also been named as one core argument of collaboration (IV 2, 15, 23). One interviewee pointed out this importance in the case of AI.

“If you go one step further [...] out of your own discipline into the other, then you often find solutions that are difficult to solve within your own discipline. [...]. I think that's also the way we mainly deal with AI. So that we go and look at things like edges of AI. And then how can we connect this work in this larger ecosystem.” IV 2

One company also gave an example of how interdisciplinary or recombinant innovation works within the initiatives.

“We give room for modern working, we give room for interdisciplinary exchange, we give room for the Machine Learning Guru to exchange with the machine building

specialists. we have that now. Facts have already been created. On the larger level, that there is already a productive overlap here.” IV 15

Until now, cross innovation networks and the connection of a larger number of local actors have mainly been established via a politically induced impulse and a provided platform from the local government (IV 11). However, the examples of the two initiatives show that the need for a political impulse might be over. For instance, the CISPAC Innovation Campus has been an initiative of the CISPAC Cybersecurity Center, which reached out to other actors and the government to discuss their idea (IV 12). For the East Side Fab it is not clear who initiated the platform (IV 3, 9, 23), but as companies are self-governing the process of exchange, it is a step away from being dependent on the leading function of the local government.

The example of the two collaborative initiatives show that it seems to be sufficient when an adequate number of different actors declare a common cause like collaborative working an important part of their agenda. In this way, a new bottom-up dynamic of local actors (companies, start-ups, academia) who engage in interdisciplinary innovation networks can create new stimuli for innovation and possibilities for the development of AI in the region. Collaboration between actors expands the fields in which AI based solutions can be applied. Because of the self-governing nature of the two initiatives, AI can become embedded in the regional economy by the activities of innovating actors themselves and without a strong governmental support.

The idea of working collaboratively can also be found apart from companies and is deeply embedded into the region. Actors from academia, support organizations and companies gave examples of strong collaborative spirit or community thinking in the region.

“The automotive supplier that builds its new research facility here. Why in Saarbrücken? They could do it anywhere. Because they said that the plant here in Saarland is the one where people are most likely to work together, where they solve problems together. That's why they chose Saarbrücken as the location.” IV 1

“Almost every professor who has been somewhere else gives feedback that everyone here is very much behind the team spirit. Well, I can't judge it, I've never been to another university, but the feedback we get very often is that it's unusual here.” IV 24

Community thinking and the former need for a strong government can be traced in the history of the Saarland. As a mining region, the so called “Kumpelkultur” (mineworker-culture) has been deeply embedded in the region. It describes the solidarity and collaboration of the mineworkers who had to help each other deep down the mineshafts as they had been on their own (IV 2). Being a former mining region, steel magnates as heads of steel companies had a huge influence on the course of the regional development. People often relied on them with no initiatives rising from the people, as the magnate looked after them (IV 20). This behavior continued later on, as democratic governments formed. The regional agenda towards collaborative work has been expanded and the need for a strong leader has been neglected by the two initiatives.

Overall, external economic pressure and global competition forced regional companies to action, overcoming the need for a single leader. For the case of Saarland, it seems that these mostly self-governed activities towards more collaboration are strongly based on cultural values or a regional identity that have already been present in the region in the past. The external

pressure also opens the door for AI as a possible solution for established companies to stay competitive on an international market.

The role of actors in developing a regional culture of collaboration

Opportunity

The results show that the region provides two opportunities based on which regional restructuring and change could occur: First, as an institution of collaboration has already been established, rephrasing and developing this institution further seems to be an easier task than establishing a new institution completely. Second, the change in leadership can enable new functions of leadership that support the idea of new collaboration more than preceding forms of leadership.

These opportunities in turn enable new chances for the region. The region can benefit from the new institution of co-working in multiple ways. It strengthens the local networks between different actors, enables joint projects between different firms, firms and start-ups or firms and academia and encourages them to change their behavior to work together more closely. Joint projects strengthen the regional economy because bigger projects can be realized, and firms can share their resources among each other. Start-ups can be more successful as they have direct connections to potential customers or users of the innovation in form of firms. Increasing the number of companies also strengthens the base of AI, increases the prominence of the topic in the region and beyond, potentially attracting other AI focused companies, and thus strengthening the regional path of AI. The further development of AI based solutions benefits from the collaboration of local companies as companies from many different fields and with many different knowledge backgrounds come together in specific initiatives to work and explore together potential AI-based solutions. This increases the probability of innovative and disruptive ideas. Furthermore, AI can benefit by experienced companies who might introduce the technology to more inexperienced firms as a solution for a shared problem.

Innovative Entrepreneurship

Whether innovative entrepreneurship is present within the new idea of collaboration cannot be fully said, as both initiatives supporting the idea have either not been founded or are not in full operation yet. But the idea of innovative entrepreneurship is supported and made possible within the context of the institution of the new idea of collaboration.

Within the first already founded initiatives though, it can be found that by working together innovative actors temporarily create or develop a social structure in which knowledge and experiences are shared with among each other. This temporary exchange replaces the need for single actors to be embedded in multiple fixed structures or to have to move between different social structures to gather input from various sources. As actors often come from different sectors and industries, the novel recombination of diverse knowledge and experiences has the capacity to transform the knowledge to an innovative idea within the boundaries of a temporary project. These new innovative ideas however are often not perceived as new opportunities for new ventures. They are mainly perceived as the solution for the shared problem that innated the project in the first place. For example, with the detection of loose bulk material in the production process that one interviewee presented. In the context of entrepreneurship, it is noteworthy that companies do not intend to break with their existing business or create a new business model based on AI. They do not thrive to disrupt the market with new ideas focused on AI, as

it would harm their own current core business. Even though the initiatives are not yet functionally active yet, these obstacles hinder companies to be innovative entrepreneurs.

Institutional Entrepreneurship

Following Glückler and Lenz (2018), institutions can be understood as regular patterns of social interaction that are based on mutually shared expectations which are secured by sanctions in case of deviance. Within the episode of a new idea of collaborative working, inter-organizational collaboration has been identified as an emerging institution. Actors behave cooperatively based on the shared assumption that other actors or organizations do it likewise. The external pressure of the regional structural change and technological disruptions in different industries are driving the implementation of the new collaboration institution. However, the intra-organizational innovation networks are rather an expansion of the historically grown regional identity and the existing values related to community thinking, bringing collaboration into a broader context from an intra-organizational community thinking to an inter-community thinking. Under the new institution, companies in the region are seen as part of a community and not just as the single organization.

Within the new idea of collaboration, institutional entrepreneurs lie in the center of change. These actors either had the initial idea for the two initiatives (East Side Fab and CISPA Innovation Campus), fulfill a crucial role in developing the concept of both initiatives or are directly practicing the institution of cross-organizational collaboration, thus further establishing the institution by daily reproducing it. Institutional entrepreneurs include companies, the CISPA, other supporting actors, research institutes and actors from politics. Participating companies of the initiatives are currently often bigger companies that have existed in the region for a longer period of time or municipal companies. They are deeply embedded into the social fabric of the region, like other supporting organizations or research institutes. It seems that the local embeddedness and local credibility gives these actors a high social position in order to act as institutional entrepreneurs and present a convincing vision about the implementation of a new institution, of intra-organizational collaboration. The social position in combination with the external jolt which is related to a strong global economic competition enables the development of an institution of cross-organizational collaboration.

The institutional entrepreneurs have a clear communication regarding their vision of increasing cooperation and collaboration within the region. The managing East Side Fab organization for example stated their goals of collaborative working at their opening event (IV 23). They build their vision primarily on the argument that the new arrangement of collaboration is preferential to the status quo, as companies within the East Side Fab could be more innovative and gain contacts to other companies that they would not get otherwise. They do not use the argument of external pressure, forcing the companies to work together in order to bundle competences or save resources, but propagate a more positive vision in terms of regional unity of firms, whilst some institutional entrepreneurs also include start-ups and academia. Moreover, institutional entrepreneurs do not frame an unspecific problem that the initiatives could be solving but aim at the interests and goals of companies. Collaboration is framed as an opportunity to be more innovative and to increase the number of business contacts to promote the new institution as superior to the current status.

Regional Leadership

The regional leadership function in the region shifted from a traditional form of regional leadership characterized by centrality and linearity to the new form of leadership. In the past, the government centrally initiated cross innovation networks. The new form of regional leadership sets itself apart, as it is organized decentralized. This form of shared leadership includes new attributes of collaborative action, an open and inclusive nature of regional leadership, interdisciplinarity, contains diverse networks and focusses on people and knowledge. These attributes show the willingness of regional leaders to share leadership among different organizations and leader's capability to connect and include other leaders.

These attributes are also shown within the two initiatives. They are based on the idea of collaboration and include different actors from a wide range of different backgrounds. Its core idea is based on gathering people, work together, create new knowledge and share it with one another. The power of regional leaders is shared among each other and not based on formal power over another. Power means the ability of participation in the way of actions of leaders. However, actors from different groups are not present within the regional leaders of the new idea of collaboration. Connecting and including a different kind of actors as regional leaders could widen the range of possible follower of the leaders, as they could perceive more legitimacy via the inclusion of other groups like actors from academia or start-ups. The democratization of leadership is finally shown in the way actors are directing their resources, without the involvement of another formal entity. They invest knowledge, human and financial capital as much as they want.

Overall analysis

Innovative entrepreneurship in the region that fosters the development of AI is based on the new idea of collaborative working. Different actors with different backgrounds can increase the number of new innovations in the area of AI, as the technology is constantly adapted to new problems and use cases in different industries. At the same time, companies do perceive their developments in AI as a tool and not as an opportunity to create a new business.

The influence of external economic pressure has led regional companies to rethink their current practices in order to find a way to successfully face this pressure. The regionally deeply embedded institution of collaboration has been seen by many companies as an opportunity to reform their practices and to benefit from the positive results of innovative entrepreneurship that have been described in the previous paragraph. This reform of practices is put in place by performing institutional entrepreneurship and regional leadership. Companies share their vision and their resources to collectively implement the institution of collaboration on an intra-company level. This decentral implementation has been described as the new form of regional leadership in previous paragraphs. This new form of regional leadership is supporting the institutional entrepreneurship as it prepares and unites the necessary resources for the implementation of the new institution. For example, by founding a management board as is the case in the East Side Fab.

4.3 Creating a start-up culture in the region

Start-ups in the context of AI are found to have multiple functions. Within the industry of AI start-ups are often the result of a research project of a regional research institute or a local educational organization. They firstly, transport results from local research into the industry. Secondly, they are still strongly connected to their former host organizations and can additionally act as a mediator between joint projects of academia and the industry. They can take on some tasks from academia that would otherwise hinder a joint project between academia and the industry like the following example shows:

“We said to our super theorists from a research institute on the campus ‘you can optimize, just approach the Problem from a computer science perspective and think about how the whole process could be better designed’. And the actual implementation was done by a start-up. So, for the actual implementation that would prevent researchers from publishing, we put a start-up in between. That can work well, but it heavily depends on a case basis.” IV 24

One example for the close connection with the former host organization is a start-up that provides a digital platform for psychometric testing. Regional AI researchers recognized the possibility to use the current technology to analyze language and draw conclusions on the cognitive state of the patient in terms of his mental health. The research has been funded by a European research fund for two years and conducted in cooperation with a French and later with a regional medical research institute. The goal was to develop a prototype for a later to found firm that tests the cognitive state of a patient.

The project has been originally initiated by two senior AI researchers and is now led by a former PhD student of their research group who has also been part of the research project (IV 13). They recapitulated their development phase like this:

“We have not been able to think concretely enough to think about a tool for neuropsychologists and market it as a medical device. We did not get that far. But we have discovered that the research is so far that we can use analysis in the broadest sense of language, for example to draw conclusions about the cognitive abilities or states of mind. But that it would then become a medical device and that it would run on the iPad. That was of course not clear. So, it came step by step. It's an iterative process.” IV 14

Start-ups that bridge the gap between the industry and academia appear to have three effects on the regional path development of AI. First, as start-ups are often the result of research projects start-ups, or in this case spin-offs are taking advantage of the state-of-the-art knowledge that they gained from the research. A large number of start-ups that make commercial use of their scientific knowledge, like the one that provides psychometric testing are beneficial for the region. This can strengthen the overall development of AI in the region and create a comparative advantage to other regions without a strong scientific expertise in this field. Second, direct contact with academia also gives companies an advantage over their competitors, as they benefit from scientific knowledge. Additionally, companies as a whole may conduct more AI related projects that pave the way for AI as the result of the easier contact with research facilities via start-ups, like in the first case. Third, start-ups are also more flexible than companies. They often have more time to experiment with their ideas and are not bound or constricted by

company structures. Many start-ups working in AI increase the probability of innovative products that are locally developed and start to build a path for AI. The local government therefore also wants to increase the number of start-ups, as it perceives them as a key to implement the path of AI in the region (IV 11). Fostering the number of regional start-ups however requires a suitable environment for entrepreneurs.

Support for start-ups in the region can be split into two categories, consultative and financial support. Both categories inhabit multiple and diverse actors. Organizations that give consultative advice range from on campus consultation from a single research institute, via general consultancy support from the university to external start-up consultancy offers that are publicly or privately initiated (IV 1, 5, 6, 13). The consulting organizations aim at providing advice and information to start-ups, such as how to run a business or which form of capital are available. They also host informative events for the broader public to increase the prominence of the topic of entrepreneurship in the region, like start-up weekends (IV 1, 24). These events are mostly jointly organized by multiple consulting organizations, who also emphasized the importance of collaboration between multiple consultancies. Some indicated that this cooperation could still be enhanced, though. As one actor put it:

“But it is often the case, that it is also a typical Saarland thing. The people behind the different organization want to stick out, through projects, out of the other start-up consultants or supporters. And this leads to the fact that we have many organizations of which everyone cooks his own little soup. But the bigger picture is missing because everyone wants to distinguish himself.” IV 10

Start-up companies do have their own perception of the supporting start-up ecosystem. According to them, the quality of start-up consultancy hugely depends on the specific start-up consultant and not necessary the overseeing organization (IV 14, 21). Additionally, consultancy in these organizations do not necessarily fit start-ups, especially high-tech start-ups. This reduces the impact that these consultancies could have and additionally lessens the status of these consultancies within the community of the start-ups.

Next to consultancy, financial capital is important for implementing a start-up ecosystem. Start-up supporters described many variations of access to financial capital. The early phases of a start-up in the region are mostly financed by research funds or EXIST grants which are national grants that fully finance core team of a start-up in the product development phase in which it is still experimenting with the original idea (IV 6, 10, 16, 21). Start-ups that already have developed their product rely on local financial support. For start-ups in this phase there are also national funds, but start-ups mainly get in contact with the local development bank and business angels. A network for venture capitalists is currently being built.

The experience of start-up supporters does not always fit those of regional start-ups. The latter describe their financial situation in their early experimentation phase as positive (IV 10, 14, 16, 21). EXIST scholarships and research grants are sufficient for the initial phase of the start-ups. However, the situation after those financial aids is mostly perceived as difficult. For public privileged credits, start-ups often don't see their effort in handling with bureaucracy paying off in the sums they could gain via those grants. The local public investment banks are also not seen

as a good resource for money, as the process for applying for a credit has been described as slow.

“I also know of some DFKI start-ups that have opened a branch in the Palatinate [the next adjacent federal state to the Saarland], because the local public investment bank there says you must have a representative here, but we only tell you after two weeks whether we want to work with you or not, and after six weeks you will have money. The investment bank here behaves in the way of: We think about it for six months, whether we want to work with you or not. The next time some committee meets.” IV 21

But start-ups also report a change within the past months. They have the feeling that the overall ecosystem is opening up, as connecting with other start-ups is getting easier, getting connections to the local government requires no to a small amount of effort and the quality of speakers within the events of the start-up consultancies is increasing (IV 10). Additionally, it is noticeable that different actors try to change the interaction between the start-up consultancies to a more collaborative approach. Furthermore, it is noticed that some consultancies are trying to improve the financial situation for start-ups. For example, by building a network for possible venture capitalists. With those, start-ups do not have to make a loan at the bank which they have to repay, which often takes longer, as a positive turnover of start-ups mostly takes several years (IV 22).

Overall, interviewees have described an improvement of the start-up environment within the last decade (IV 6) that has accelerated within in recent years (IV 1, 12). Interviewees also report that an awareness of entrepreneurship is slowly establishing within students and academic personal and that an increasing amount of academics consider establishing an own company. Entrepreneurship either also is or will be more integrated within some research institutes and educational organizations (IV 1, 12). Teaching is changing. For example, in new study programs of informatics. There, students are encouraged to include application-oriented projects within their studies (IV 5). Overall, Interviewees reported that AI has been an increasingly prominent topic for start-ups in the past year (IV 1). However, the total number of start-ups has not changed drastically. Even though interviewees described that the mentality of academics and students has been changing, this has not led to an increase in turnover in newly founded start-ups (IV 12).

To support the development of regional start-ups, local actors are trying to establish a positive environment for entrepreneurs. Start-ups perceive the current environment not as entrepreneurial friendly. It lacks support in some areas important for start-ups, for example in the accessibility of regional capital. This ecosystem has to be improved to be suitable for start-ups. Start-ups however also report a change in the region which shows that the improvement of the entrepreneurial environment is making progress. Furthermore, start-up supporters are trying to induce a regional change towards regional entrepreneurship. These new start-ups then can take advantage of an improved ecosystem, which makes it easier for them to start a business. While there is some cooperation between the different start-up supporters it could still be enhanced. Additionally, supporters seem to lack some resources in terms of fitting speakers, for example, to enhance the environment for start-ups. Overall, this dampens the effort of start-up supporters as the topic of entrepreneurship just slowly changes in the region.

The role of actors in developing a regional start-up culture

Opportunity

The high density of AI researchers and experts in the region through the various research institutes can be seen as an opportunity for the region. This means knowledge on AI is already locally present and does not have to be created or imported but has to be put into use to benefit the development of an ecosystem around AI. This gives the region a relative advantage over other regions that include an AI industry but lack strong research facilities. Research facilities can also be used as developers of regional opportunities. As they are working on cutting edge technologies, new research results could be firstly used regionally and inspire the foundation of new start-ups.

The development of AI in the region can benefit from a change in the start-up culture and an increasing number of start-ups in various ways. Firstly, as start-ups grow to become the firms of tomorrow, an increase in AI focused start-ups reinforces the future development of the AI technology in the region. Secondly, start-ups can be used to bridge the gap between academia and the industry. The advantage of the region as a center of excellence with various research institutes and different chairs at the university that deal with the development of AI can be used more efficiently. This can give the path of AI a comparative advantage when compared to other regions, boosting its development. Thirdly, often start-ups can turn out to be more innovative than companies as they can experiment more freely and are not affected by different company restrictions. This can lead to more disruptive and innovative AI products that can also strengthen the region's place as an AI center.

Innovative Entrepreneurship

Innovative Entrepreneurship can be found in the region and has been implemented via the work of start-up supporting organizations. Their main goal is to increase the number of local start-ups. The total number of start-ups has increased but can be still considered as small in relation to the region. Those new entrepreneurs can realize opportunities that the region provides to them. These opportunities can include different research projects, contacts to companies who want to have a specific application of AI developed or other opportunities. As the awareness for entrepreneurship has increased in recent years, so has the number of individuals that thrive to realize opportunities they find. Even though the number is still not high. The closeness of entrepreneurs in the field of AI to research institutes and the university is related to two other aspects of innovative entrepreneurship. Individuals close to these organizations are often embedded in various social arrangements. For example, as a professor and entrepreneur, as a group leader who has contacts to a company or as a student who works at a local company. This opens the opportunity for knowledge to be combined in novel ways. Hereby, it seems that the entrepreneurs do not really try to establish a new path or break with an existing one in the region. Instead, they try to enrich the already existing paths with AI. Like again with the platform for psychometric testing, the start-up wants to expand the option that a doctor has for diagnosis, but do not want to disruptively change the medical sector, yet

Institutional Entrepreneurship

The institution of creating a start-up culture in the region is the one of entrepreneurship that aims at fostering start-ups. Institutional Entrepreneurs aim at actors to think more

entrepreneurial and recognize the option of building a start-up by using their ideas and knowledge. The supporter of start-ups, meaning start-up consultancies, financiers and their like and the government can be considered as institutional entrepreneurs, as they are trying to implement the institution of entrepreneurship in the region. For example, by hosting different events to push the idea of entrepreneurship. Institutional entrepreneurs do have issues in implementing the new institution. Regarding their social position, they are not the object of change, but have to convince others to change. Nor do they have the chance to contact other actors with a higher social position in the field of start-ups, as start-ups themselves remain rather small and are not able to make an impact on the regional institution of entrepreneurship on their own. Another problem is that there often is not the need for students and university staff to think about entrepreneurship and adapting the institution as they cannot directly identify themselves with the topic.

The reasoning of why fostering start-ups in the region is important is not a convincing one for the targeted audience of possible entrepreneurs. The overall idea of why entrepreneurship is important bases on bridging the gap between the industry and academia and the development of new ideas in the area of the path development of AI, but also on the creation of jobs for the region as a whole. This does not resonate well with possible entrepreneurs, as they want to achieve other goals. Additionally, institutional entrepreneurs are missing suitable resources, as cooperation between different institutional entrepreneurs could be enhanced.

Overall, an institutional change in the region towards more entrepreneurship seems to be difficult to achieve as the targets of the change are not necessarily those who force the change and mostly cannot identify with the causes and benefits of the change towards the implementation of the new institution. For the individual possible entrepreneur, the reason of venturing is not targeted at improving the regional position of entrepreneurship but bound to personal reasons. An actor has no benefit, nor is she punished by following the institution of entrepreneurship. This leads to a lack of actors who want the new institution to succeed. The actions of institutional entrepreneurs can therefore not be regarded as an institutional change.

Regional Leadership

Leadership in the episode of the start-ups in the region can be found in the start-up supporters, such as the consultancies. They detect, articulate and manage place specific challenges. For instance, they see increasing the number of AI related start-ups and increasing the overall number of start-ups in the region as an opportunity for the region to grow and establish a growth path of AI. They want to achieve this goal by improving the culture of entrepreneurship in the region in order to increase the number of start-ups.

They have the capacity to introduce new ways of thinking, and via that convince others to action. This is shown by the events that they perform to influence new possible entrepreneurs like the start-up weekends and the results they achieved so far. Even though the number of start-ups has not risen enormously, leaders have been able to introduce the mindset of entrepreneurship so that people can identify themselves with the topic more easily.

Another indicator for regional leadership is the way leaders try to accomplish their shared goals. Literature describes leaders as a fragmented group of multiple different agents. This is the case as start-up supporters originate from different actors like government, research institutes,

financiers who work on the same goal. What's questionable though is the leader's willingness to share power with others, as interviewees reported that some organizations often prioritize their own work over others even though they want to achieve the same goal.

Leadership can be found in the region with leaders working on the same goal, improve the environment of entrepreneurs and increase the total number of start-ups, even though collaboration could be enhanced. Additionally, the lack of resources seems to change, which enables leaders to push their vision further.

Overall analysis

Start-ups in the case of the path creation process of AI can be used to bridge the gap between academia and the industry, which makes use of the regional knowledge already embedded because of the presence of research institutes. Start-ups also take advantage of this knowledge by exploiting this knowledge, performing innovative entrepreneurship in order to develop a product. This might push the creation of the AI path. The path of AI also takes advantage of the flexibility of start-ups to make use of new opportunities compared to companies.

These actions and the agency of innovative entrepreneurship are enabled by supporting the development of start-ups in the region. Start-up supporters are trying to lead the region towards more entrepreneurial thinking. Supporters share this vision of more entrepreneurship in the region and are collectively leading the region towards more entrepreneurship. They work together on shared events, even though regional leaders of entrepreneurship themselves see a lack of intensive cooperation. Within these events they push the idea of entrepreneurship towards possible entrepreneurs. Institutional entrepreneurship is currently not found within the region due to the lack of fitting enabling conditions and the lack a strong social position of institutional entrepreneurs to implement the change. The enabling conditions could be enhanced by regional leadership, if regional leadership get more actors to identify themselves with the topic of entrepreneurship in order to support a change the institution regarding entrepreneurship.

4.4 AI Information Program for Companies

Multiple actors, ranging from academia, over support organizations to companies from the AI industry, have reported that the interest in AI has increased within the last two to four years (IV 1, 4, 17, 22). The attraction for the topic varies between companies by size and industry. Small and medium enterprises (SMEs) are currently less interested in AI solutions as bigger companies. AI developers reported that SMEs usually have no embedded research structure like bigger companies and a small budget for innovations so that they are not able to develop AI based projects on their own (IV 1, 7, 9). Additionally, the workforce in SMEs is often bound in handling the daily business (IV 15, 25). This often leaves not enough time to think about future developments and investments. In the case of AI, it is also often seen as a side investment among companies, as their daily business is not centered on AI. Moreover, currently many companies are missing the prerequisites for AI based projects in the form of a digitalized workflow (IV 7, 23). As companies are interested in the technology and start to inform themselves and are requesting suitable solutions and information which fit their needs.

The interest and the call for information on AI of companies is guided by support organizations and academia. They are organizing different forms of events for companies, ranging from open house days, via talks to workshops (IV 3, 17, 18, 24, 25). Within these events they inform

companies on where AI applications are already in use and inform companies and the society which scenarios of future AI developments are possible and which are the result of over-hyping the technology (IV 17, 18). One interviewee described their informing activities like this:

“One must increase the level of informedness in the sense of expectation management. On the one hand there are product developers or companies. And on the other hand, there are politics, trade unions and the broader public. The two of us have just been talking about a small range of complications for human-robot collaborations. But in real-world application, everything goes one step further. We know that there will be a care problem, and in this respect, we as a society seem to believe that human-robot collaboration could lead to people in care being cared only by machines. That is an ongoing discussion. Our task now is to ensure that the expectations of the performance of robots are not so cinematically over-exaggerated, so that in the end, people no longer think about how care can and should actually look like.” IV 17

Within the different events, academia and support organizations often meet different levels of previous knowledge among the participants. They try to get companies to the same level of knowledge which then influences the companies’ perception of AI. This directs the future development of AI projects within these companies and the region, as companies continuously repeat what they have learned. Companies within the AI industry rate the actions of support organizations and academia positively and want to participate themselves (IV 22) to strengthen the development of the technology in the region and to take advantage of the increasing interest of companies on AI.

Besides informing about AI, supporting actors and academia are also going one step further and are often introducing a use case for companies (IV 17, 18). The support for companies in this area is necessary as actors from academia, support organizations and AI developing companies report that companies who want to use AI often do not have a specific use case in which AI technology is applicable or no clear target what they want to achieve when using the technology (IV 15, 17, 18). The actors from academia, support organizations and AI developing companies also claim that especially SMEs would benefit from using AI in their workflow (IV 23). Because of that reason, academia and support organizations go beyond plain informing companies but work with them on active use cases and possible targets within the company. By doing so, companies learn to perceive AI technology as a tool to solve certain problems like actors from academia, supporting organizations, teaching and AI companies do (IV 4, 5, 7, 15, 17, 22). Additionally, AI related companies reported that when they link the technology to a specific use case, their customers are more willing to engage in the technology (IV 4, 7, 22). Getting actors to identify themselves and think about AI technology in their perspective is therefore far more impactful for getting people into using AI and strengthening the development of AI than just showing the basic facts of the technology.

While informing people on the possibilities of AI technologies is more neutral in relation to the path creation of the technology, developing use cases leans more into a technology push, as emphasized by one academic interviewee:

“But that is often more of a technological push than the company come and say here exactly this, and we need it” IV 4

Within the case of informing, informants are merely steering the path creation process that would also occur without their support. Compared to this, creating use cases with companies is different, as the motive of actors and the results for the technology are different. The development of use cases in cooperation with companies is an active support for the path creation process. Informants are accelerating the path creation process by their actions.

Using AI operatively also changes the working environment of employees sustainably. They often have to adapt to that new situation and change their processes as one interviewee reported:

“In the case I have just presented to you, we are talking about two groups of people who work in product development in the textile industry. These are designers on the one hand and textile engineers on the other. And while for textile engineers it is the simpler exercise, it is certainly a challenge to convince a designer that there is now a piece of software that makes predictions about the product quality of garments that he then has to integrate into the design process.” IV 4

Overall, the results show that AI support organizations and research institutes get companies in the region closer to the technology by informing what is currently possible and more importantly develop use cases that fit companies’ needs. By doing so, companies start to identify with the technology, start to use it and actively support it.

Getting Technology in Use by Informing Actors

Opportunity

Having informed organizations on AI, such as research institutes or AI supporters in the region, opens the door for building an information program for AI interested companies. Without them, this could not have been implemented. Those supporters are also very well connected, which makes it easier for them to inform the companies.

The information program provides a big opportunity for the path development of the AI technology in the region. It firstly seems to provide attention for the technology within companies. Although many companies are interested in the technology and want to inform themselves, there are still many actors in the region who have no connection to AI. The information complex also tries to include and initiate a development and interest on AI within these companies. Secondly, by using and identifying a use case of the technology for companies, companies become advocates for the technology, recommend it to other companies and support the path creation process. Thirdly, by getting companies to use AI, the base of the technology within the region is strengthened. A demand for AI from companies creates a demand on the side of AI developing companies, driving this sector to grow. This mechanism is similar to the one described in episode one, but the cause is a different one. Within episode one, companies wanted to use AI by themselves. Here, in episode three, the need for AI is induced by third-party actors. The growth of the AI sector increases the demand on AI specialists by companies who use AI and by companies who develop AI, respectively. This can increase the number of students in the sector, as the sector of AI becomes more prominent as a possible employer. Many AI specialist and developer of AI can form the core of an AI ecosystem, attracting AI companies to move to the region. Out of this core, a new system around AI, i.e. a new path can grow within the region. Without this nucleus, it would also be hard to establish an ecosystem.

Innovative Entrepreneurship

No innovative entrepreneurship can be found in the episode of the information complex. The single companies do hold different social positions but only within their separated social structure. They may interact with one another on different events of the start-up supporters, but not as deep as it could enable cross innovation between companies. AI supporters and research institutes do work together with different industries. Yet, a project is mostly specific to a sector with the outcome, which is the development of a use case for the company, mostly predetermined. New opportunities are not created by this process, as actors are not open to perceive these opportunities. What is possible, though, is the transfer of a use case from one industry into another. Companies use the opportunities that are given to them in form of a use case, but only with the support of the AI supporters or other companies. They are not able to realize opportunities that have been created regionally by themselves. Furthermore, as companies in this case are merely technology adaptors and implement AI with the help of a third party, they often lack the competences to develop opportunities by themselves.

Institutional Entrepreneurship

The new institution that can be defined is the new way of working digitally with AI based technologies. The main target of this institution is to get companies to implement a more digitalized workflow by showing the advantages of the technology via examples or a direct implementation within companies. New technology also shapes the way actors work, as their way of doing things is altered by the new technology. It also alters how agents interact with one another. For example, in a company a worker might not be assisted by a co-worker, but by an AI based digital assistant, which in turn changes the relationship between co-workers. How interaction between co-workers, between companies and regional and non-regional partners actually change depends on the technology that is put in use.

Institutional Entrepreneurs include research institutes, regional economic development agencies, governmental supported initiatives and the chamber of commerce and industry as they push companies into be informed about and start using AI based technologies. These actors are all well connected to regional firms and have a relatively high social position among firms that shall be informed about AI. This is due to the embeddedness of institutional entrepreneurs into the region's social fabric.

The vision of the working digitally and with the supported by AI technology is not necessarily well introduced to potential follower. Institutional entrepreneurs often do not give compelling reasons to follow the vision. Instead, companies are motivated for change by the economic pressure they perceive. The main mechanism in which institutional entrepreneurs mobilize allies is therefore by introducing use cases to companies that those companies benefit from financially. By presenting use cases, entrepreneurs become motivated for the technology and support the new institution.

Moreover, it can be observed that the institutional entrepreneurs do not necessarily directly support each other, as collaboration is rather rare and only a limited number of actors work together. However, they indirectly support each other by pursuing the same goal, pushing the same narrative and focusing their resources (knowledge, financial and human resources) on the implementation of working digitally and using AI technologies. This can be considered as a

new institution because actors have a shared expectation of regularly working digitally and interacting in a new way, when an institution is considered as a regular pattern of social interaction that is based on mutually shared expectations.

Regional Leadership

The analysis reveals aspects of regional leadership regarding AI within the information complex. Instead of one central actor or a small number of regional pioneers pushing for raising more awareness raising and information diffusion, a wide range of actors from different fields, ranging from AI supporters, over publicly funded organization to private companies funded organizations, share their workforce and the vision to implement and accelerate the use of AI within regional companies. Hence, typical leadership activities, such as guiding a technology transfer, are rather fragmented, and no one within the local leaders for AI has formal power over the other. Instead, leadership is shared while working on joint events, for example. This resembles the new form of leadership. Additionally, followers do trust the regional leaders, either because of long lasting collaborations or because of a deep embeddedness and authority on the topic of AI within the region.

Overall

The opportunities for AI in the information complex consist in the allocation of knowledge to local firms on the technology of AI which widens the user base and diffusion of the technology within the region. This is enabled by the presence of previous knowledge on AI in the region in the form of research institutes and AI supportive organizations who have been able to build a knowledge stock for the past decades which can be used to inform companies. It produces an increasing demand for AI within the region which in turn can attract AI specialists who can form a nucleus for the path of AI. From this, other activities can evolve, like founding more start-ups that cover the field of AI.

4.5 Synthesis of results

Characterizing the path of AI in the region

The creation of the path of AI is an ongoing endeavor and is still in the early stage of a path creation process. During the interviews the infancy of the current state of regional AI implementation has been set in contrast to the excellent research institutes that develop AI applications. Political actors also perceive the creation of an AI path as a slow, but steadily ongoing process. The development and exploitation of the AI path is framed as a future event (e.g. Staatskanzlei des Saarlandes, 2020). Political actors are also planning with the creation of an AI path. It is envisioned that the path could be part of a positive structural change that breaks the monostructure of the current Saarlandian economy, the industries of automotive and steel production.

The reason why the path creation of AI in the Saarland is still in an early phase has already been partly indicted in the account of the three episodes. All efforts of creating a path of AI described within the episodes have either just been put into place or have just recently been intensified. Within the episode of collaboration, the East Side Fab has just been operational since the beginning of 2020 with an expected discovery phase to find shared projects of several months. The CISPA Innovation Campus has even not been fully planned yet. The development of the entrepreneurial space has been steadily improved within the last years. Interviewees

started to notice a change within the past months and with some change in the configuration of some start-up supporters in 2020, the entrepreneurial space is steadily improving. Furthermore, the interest of start-ups into the technology of AI has only been increasing relatively recently, since 2019 (IV 1). The information program has also been put into place in a more structured way within 2019. Some regional companies that are specialized in AI say that the market for AI has not been booming but is steadily increasing. Regional knowledge about AI is therefore already exploited in some use cases, but mostly still used to explore some more use cases and combined with new ideas. Partly in other fields.

The creation of an AI path is a special case regarding the analysis of the implantation of a path creation process. AI can be regarded as a general-purpose technology (GPT). The theory of a GPT stems from economics and describes the impact of technologies on the overall economic growth (Bresnahan & Trajtenberg, 1992). Other GPTs that have been described include electricity and the development of an IT-infrastructure. To count as a GPT, the technology should 1) spread to most sectors, 2) improve over time, 3) spawn innovations (Jovanovic & Rousseau, 2005). All three characteristics fit the creation of AI in the region and have been shown in episode one and three. As a result, the story of the path creation of AI in the Saarland might show alternative mechanisms compared to the development of other technologies within the region. Furthermore, when regarding AI as a GPT, a regional path of AI is not exclusive to the Saarland but will cover all regions in the long run. This also means that the creation of an AI path in the region is also induced by the development of the technology and the demand of sectors that want to implement the technology one way or the other.

Mechanisms for AI Development in the region

The mechanisms for the creation of the infant path of AI in the Saarland are manifold. An external (or internal) shock has to weaken the regional structure. Actors rethink their situation and challenge the regional structure. Moreover, a weak regional structure allows change within the region and a widening of the agency of actors. To establish a path of AI, regional actors aim at widening the base of practitioners of AI. These practitioners include established companies and start-ups.

The application of AI needs highly trained specialists, as AI can be considered as high technology. It is therefore primarily academics who apply and develop AI based solutions. These academics include former students, current research staff or professors. A direct application of their academic knowledge and research was found to be conducted within start-ups. The research of academic entrepreneurship (e.g. Abreu & Grinevich, 2013) deals with the exploitation of academic knowledge and the application of this knowledge during the development of a commercial product. Academic entrepreneurs who use AI within their products have been found within the region. These academic entrepreneurs perform the agency of innovative entrepreneurship to take advantage of the knowledge they gained from their academic career and transform it into a new product. The AI technology either provides the core of the product or a beneficial enlargement to the product. Overall, the application of AI in start-ups is found to widen the base of practitioners.

To increase the rate of start-ups using AI technology, one has to increase the total number of start-ups. Regional actors are found in the form of start-up supporters and governmental actors

who try to build a favorable environment for start-ups by leading the region into more entrepreneurship thinking and are trying to implement supporting institutions for more entrepreneurship. Stam (2015) provides a small overview of the theory of entrepreneurial ecosystems. Current literature of the theory is primarily aimed at ecosystem stakeholders. The description of the entrepreneurial ecosystem approach of Stam incorporates different factors that describe a suitable environment for entrepreneurs, e.g.: financial support, supportive services and intermediaries. Start-up supporters in the case of the AI in the Saarland are found to try to improve those environmental attributes in order to increase the number and quality of start-ups in the region, thus widening the base of practitioners for AI.

The other group of practitioners is established companies. Here, knowledge about the technology and its applicability often does come from the university, research institutes, or other actors that are in close contact with academia or from other firms.

Technology transport, the transfer of knowledge about a new technology from academia into the industry has been a long-lasting discussion within literature. Here, the university-industry relationship is described, and improvements are discussed (e.g. Perkmann et al., 2013). The primary target is to get the newly created knowledge to the actual practitioner (e.g. Debackere & Veugelers, 2005). Closing the often-described gap between regional academia and the industry has been one important talking point within the interviews. There have been some measures found to improve the relationship between the two, like the inclusion of start-ups. Those actions do often go beyond plain informing in the case of AI development in the region. Actors are trying to induce a demand within companies by proposing suitable use cases for them, in which AI technology can be applied. Here, knowledge about AI is transferred and the base of practitioners is widened.

Another mechanism for technology transport has been found in the cooperation of firms. Actors are working towards a new idea of collaboration that fosters and institutionally supports this cooperation. Within the initiative of the East Side Fab and the planned CISPA Innovation Campus companies are sharing their experiences and their knowledge in shared projects. This knowledge spillover (e.g. Malmberg & Maskell, 2002) stimulates the spread of knowledge about AI and the knowledge about AI use cases in between companies. Shared projects of companies, networks of practitioners of the technology (e.g. Lettl, Herstatt & Gemuenden, 2006) also get the technology to companies who have not yet been fond of it. By showing them an applicable use case and the advantages, they might be convinced to use the technology. Within their joint projects companies also often use their own knowledge to create new innovations, without relying on external help which is specialized on AI technology (e.g. von Hippel, 1976). However, this developing of use cases signals other companies, possible developer of AI technology, that there is a demand for AI applications, inducing the latter to try to satisfy the demand. This also leads to a growth of the providers of AI technology.

Opportunities that influenced or hampered AI development in general

Four different dimensions of the opportunity space have been found. First, an *economic dimension*. The external economic pressure on the region challenges the stability of regional practices, institutions and the sense of social security. It pushes actors to rethink their position and

challenge the dominant regional structures that are found to be less stable because of the economic pressure.

Second, the *social dimension*. Challenging the regional structures leads to the implementation of new structures. In the case of the Saarland it is shared leadership that is found to be evolving. This form of new leadership enables other opportunities and actions, for example, the development of the entrepreneurial ecosystem and the new idea of collaboration.

Third, the social dimension is accompanied by a *cultural dimension*. The institution of the “Kumpelkultur”, with its long-lasting history in the region, supports the new idea of collaboration, as the idea is a plain modification of the already established culture. The cultural dimension on the other hand also hampers the AI development. Because of its history of steel production and employment in larger companies, people in the region seem to be more conservative about their working life. The big companies always cared about their payment and their daily life. Because of this, people in the region seem to be reluctant towards the idea of entrepreneurship, probably even more so than is already the case in Germany. This makes it harder to implement a culture of entrepreneurship.

Fourth, the *technological dimension*. The strong knowledge base due to the many research institutes and leading research in the field of AI enables the creation of a regional path of AI. Without this knowledge this path could not be established. The presence of the research institutes has another effect. It introduces human capital in the form of AI specialists into the region. Even though the Saarland competes with other regions on keeping these specialists in the region, but without the research institutes it would be even harder, as the region would have to attract these AI specialists.

Agencies and their activities

With the help of the adapted framework, the agency of *innovative entrepreneurship* can be summarized as follows: The social structure of some actors allows them to combine knowledge. Either as one actor occupying many positions within different organizations, for example a professor who is also a member of different boards, or a group of actors which is sharing the knowledge of different organizations with another, like within the case of the initiatives. These entrepreneurs are found to be able to transform this knowledge into new opportunities on the application of AI. These opportunities however are often left alone and not exploited further. Companies who are mere applicants of AI technology do use these opportunities to improve their workflow. It is mainly the entrepreneurs within start-ups who exploit the opportunities they either found or created themselves. An example has been presented in episode two, in which a research project has been developed further into a start-up. Additionally, companies are found to just start to experiment with AI technology to improve their workflow. In the case of market disruptions from start-ups, the path of AI is too immature for start-ups to already have established an observable disruptive solution. As the topic of AI has been reported to have grown in start-ups since 2019, start-ups still need time to develop and establish their products. However, current start-up products could have the potential to disruptively change some markets, like the medical industry for example.

The different subdomains of the agency of *institutional entrepreneurship* add up to the following description: Within the subdomain of the field characteristic no conflict of institutional

arrangements have been detected. Instead, an increasing economic pressure and the internal structural change of the economy enable institutional change. The interest of companies in AI technology also shows that the region is eager for regional change and business improvement to oppose the external pressure. Institutional entrepreneurs who use this weakened regional structure take different social positions within the three episodes. In the first episode, the institutional entrepreneurs' firms are part of the field of change. Within the second- and third-episode institutional entrepreneurs are external actors from the field of change, which makes it harder for them to perform their agency of institutional entrepreneurship. The second and third episode differ in one point though. Institutional entrepreneurs in episode three have well-established and trustful connections to actors within the field of change. These actors can support their efforts, making it easier to change the field. Joint projects between institutional entrepreneurs and actors of the field of change support the notion of a good relationship. Furthermore, within all episode's joint projects among institutional entrepreneurs have been found. Cooperation between institutional entrepreneurs simplifies their change agency. To push the change of an institution, institutional entrepreneurs are found to prefer to show the possibilities of the new institution, rather than framing the current institution as bad or antiquated. They show, for example, the advantages of a working collaboratively.

The adaption of the analytical framework of *regional leadership* leads to the following description: For the mode of leadership important actors have been named when asked about them. More often, however, interviewees reported that there is no single regional leader in the field of AI but described it as a collective regional effort. Within all three episodes, regional leadership has been also found as being a collective effort, rather than the product of a single actor. Within all episodes, leaders have been well connected. However, they have been primarily connecting to the same group, meaning start-up supporters among each other and less to other groups like research institutes. This homogeneity of regional leaders who share their power could explain the congruency in the vision for the region, as actors from the same actor group are more likely to share the same vision. Towards possible followers, this vision is framed by highlighting its benefits. To frame the vision properly, regional leaders often work together and share their recourses. This for example includes human resources for the planning of a public talk or the implementation of a local series workshops, or financial resources. It furthermore includes knowledge that is transferred to and between companies. To reach out to possible follower, to inform them on local workshops and to transfer knowledge to them, regional leaders have to have an adequate regional network. The access to such a network and the size of the network has been found to differ largely between the different regional actors which strongly influences their capacity to induce change.

5 Conclusion

The question of how and why regions develop the way they do has been occupying studies in the field of geography for a long time. The evolutionary economic geography introduced the idea of regions developing alongside a path that is determined by its past. When taking the factor of time into account one might also ask how today's paths that are determined by its past came into being and developed the way they did. The concept of path creation tries to theoretically describe this question (e.g. Hassink et al., 2019; Isaksen & Trippel, 2014; Martin & Sunley, 2006). The first approach to explain the creation of a path has been to describe the regional preconditions, the structure of a region and the opportunities it provides to a path creation process (e.g. Boschma & Wenting, 2007; Neffke et al., 2011). This alone however cannot explain why regions with a similar structure still develop differently. The idea of agency has been introduced as a possible key to explain regional development. The evolutionary economic geography adapted this view and solely focused on the agency of firm-actors. After some critique (e.g. Binz et al., 2016), this view has been widened, and newer research now also includes the notion of an agency perspective of many actors within one region but is still theoretically underdeveloped. The inclusion of many different actors is needed, as path creation is increasingly seen as an inherent social process that must include a range of different regional actors to be successful (Collinge & Gibney, 2010). Grillitsch and Sotarauta (2019) introduce the trinity of change framework and with three different forms of agency; innovative entrepreneurship, institutional entrepreneurship and regional leadership. Together with an abstraction of the structure of a region, the opportunity space, these agencies draw a guideline on how to examine agency in the role of path creation and the interaction of agency with structure. The, yet empirically unused, framework and previous research however also leave the question of how actors can influence a regional path creation process unanswered. Therefore, the following research question has been put forward:

*How do actors collectively influence a regional path creation,
when creating a new industry?*

To answer this question, the framework has been adapted and applied in a single case study to the path creation process of artificial intelligence in the federal state of Saarland in Germany. The case has been chosen as it was highly likely to find path creation processes in the region. For the study 25 semi-structured interviews have been carried out. The selection of interviewees has been closely connected to their overall and supporting role regarding the technology of AI.

The case of AI development in Saarland shows that the variety of actions that influence regional path creation is wide. The path in the case of AI in the Saarland can be seen as the implementation of new production techniques and the establishment of new firms that focus on the use of AI. This is in line with the definition of path creation from Isaksen and Trippel (2014) that has been presented in the theory chapter. Many different actions and actors foster or block the regional path development. To support the research question by starting to describe the wide range of actions and actors within the path creation process the following sub questions have been put forward:

SQ1: Which actors are part of a path creation Process?

SQ2: Which roles do actors have and which actions do they perform?

All actor groups that have been identified as being close to the technology of AI or closely attached to the topic did participate in the path creation process of AI. These actors include academic teachers, research institutes, supporting actors for AI and for regional entrepreneurship, political/ governmental actors, start-ups and companies. Some single actors did however have a higher influence on the creation of the path, based on their access to resources, their social position and the character of their actions, but in general all actor groups did participate within the path creation process.

The roles of actors can be categorized into two groups. First, those actors who perform actions regarding the path creation process and at the same time are objects of actions of other actors. These actors directly influence the path creation process by their own actions, i.e. establishing the path by using the technology. Second, those actors who target actors of the first group. The second group of actors builds favorable structures and opportunities for the first group of actors in order to drive the path creation process forward. Both groups of actors do take advantage of a changing regional structure. This structure is destabilized by external forces, for example economic pressure. Regional actors reply to this unstable regional structure by introducing change.

Actions of actors aim at widening the number of practitioners of the technology, regarding firms and start-ups as practitioners. The practitioners of the technology do create the path by actively using and introducing the technology as described by the agency of innovative entrepreneurship. These practitioners include companies from the first episode who solve commonly shared problems together and if AI is used within the solution increasing the number of operational AI applications. These also include start-ups from the second episode, which exploit their knowledge about AI by introducing new products. Lastly, these include companies from the third episode that have been brought closer to the technology of AI by introducing use cases and motivating them to use AI based solutions.

The second actor group, the environment builder, includes research institutes, governmental actors, technology and start-up supporters that aim at building a favorable environment for the practitioners and the technology. This firstly includes building the necessary preconditions for the practitioners, for them to be able to survive in the first place. These preconditions are built by the performance of the agencies of institutional entrepreneurship and regional leadership. The actions in episode two show how actors try to establish an institution of entrepreneurship. These actions are connected to an entrepreneurial ecosystem that fosters and supports start-ups in their actions.

The second action of these environment builders includes the transport of knowledge about the technology to the practitioners via improved academia-industry relationships or directly via university spin-offs. The transport of knowledge also includes the building of a platform for (possible) practitioners to exchange their knowledge among each other and explore new applications. Increasing these acts of interactions is also based on a change of regional institutions and needs regional leadership to implement them. Enhancing academia-industry relationships for example requires structural changes on both sides, both physically and by establishing new institutions. The transport of knowledge can also induce a change in the regional institution, as

framed in episode three. Furthermore, by introducing new applications to possible practitioners, the number of practitioners increases, as they start to identify themselves with and get interested in the new path, thus reinforcing the path.

6 Discussion

Theoretical contribution

This research has aimed at exploring the implications of an actor's perspective, trying to get insights about the interaction of the regional structure and agency within a path creation process as well as to test the theoretical framework of Grillitsch and Sotarauta (2019) empirically. Separate aspects of this research connect to other theoretical discussions, like on entrepreneurial ecosystems (Stam, 2015), the university-industry relationship (e.g. Perkmann et al., 2013), academic entrepreneurship (e.g. Abreu & Grinevich, 2013), knowledge-spillover (e.g. Malmberg & Maskell, 2002) and user innovation (e.g. von Hippel, 1976). Overall, this research has three implications for theory.

First, it has been shown that actors can have an active influence on the structure of the region (Martin & Sunley, 2006). Actors did create additional opportunities with their actions. In the framework of Grillitsch and Sotarauta (2019), these opportunities have been considered to be part of the regional structure. Actors did, for example, introduce the new idea of collaboration. This enabled a new platform for collaboration, both on the physical, and on the institutional level. Both attributes have not been present in the previous structure before. The need for this structural change, to change the behavior of actors also shows the restrictive character of structure regarding agency (Martin & Sunley, 2006). The structure needed to be changed to widen the option of collaboration for companies. Collaboration before has been smaller and restricted by the regional structure. These findings highlight the importance to examine the structure-agency relationship in order to understand regional development and that even though actors are embedded in a regional structure, they can still change it (Battilana et al., 2009). It also supports the conceptualization of the framework of Grillitsch and Sotarauta. In their framework, the opportunity space restricts the agency of actors, but can also be changed by, for example, institutional entrepreneurship enabling innovative entrepreneurship to work properly and more efficient. The findings also highlight the importance of actors. It is actors who have to exploit the opportunities the region provides. This is in line with MacKinnon et al. (2019), as they show that it is actors who take advantage of regional assets and combine them to create a new path. The plain existence of these assets does not explain a path creation process, but the relationship of actors and those assets does. Furthermore, as one of the first applications of the trinity of change framework, the found importance of a structure-agency also shows the fitting conceptualization of the framework. The three change agencies of innovative entrepreneurship, institutional entrepreneurship and regional leadership do interact with the opportunity space, thus reflecting the idea to examine the structure-agency relationship. It is suitable to be used in further research to analyze path creation processes.

Second, it has been shown that a theory of path creation has to include multiple actors and actor groups. Here, the research follows the call of Hassink et al. (2018) to shed more light on multiple actors who perform their agency on multiple levels. This research shows that companies and start-ups are supported in their endeavor to apply new techniques and develop new products by a range of other actors that aim at creating a suitable environment for the actions of companies. Within the first episode it is the companies who build themselves a suitable environment. However, within episode two and three start-ups and companies are being supported. Firstly, by building a suitable environment for start-ups, for them to thrive. Secondly, by informing

companies and pushing them towards using the technology by presenting a use case. As proposed by the framework of Grillitsch and Sotarauta it is not a single form of agency, but multiple different forms that are part of a path creation process. This finding also supports the critique on the initial approach of the EEG to only include firm-actors in an actor perspective on regional development (Binz et al., 2016). While certainly not all actors within a region are part of a path creation process, it includes more than just those who build the path by using the technology, but also regional supporting actors. The importance of a multi-actor approach, that is highlighted by MacKinnon et al. (2019), also adds to the idea of indigenous path creation of Dawley (2014). He proposes that start-ups, higher education and research institutes can induce an indigenous path creation process that is not reliant on external input. The found multi-actor approach suggests that these actors may have the knowledge to create a new path, but they also have to be supported by other actors who support the path and who build a favorable environment for the path to expand.

Third, this research shows the need for a specific event that disrupts the regional economy. Battilana et al. (2009) for example show the need for pressures in the form of jolts and crises. These include “social upheaval, technological disruption, competitive discontinuity, and regulatory changes [...] might disturb the socially constructed, field-level consensus and invite the introduction of new ideas” (p. 74). Within the case of the Saarland the prerequisites for change, namely the knowledge about AI, have already been present for years. It is only now, in the sign of increasing globalization and technological advantages that both threaten the regional economy, that these prerequisites are thought to be a good opportunity for regional development. Only now, under the external economic pressure, the region is developing new institutions which support change.

Practical contribution

This research shows proponents of a new path different perspectives in how to approach the implementation of a new path in their region. They can facilitate the creation of a path by building a suitable environment for industries to grow. In this case, proponents act as institutional entrepreneurs and regional leaders. In order to fulfill those two agencies, proponents can check if the field characteristics of the path and related fields enable the implementation of change to make room for the path. Furthermore, proponents can work on their social position in the field of change, by either take an active part in the field of change or by having close contacts to actors who have a high social position within the field of change. Furthermore, in order to gain support for their targeted change, they can frame a vision that fits the aims of their targeted supporters. Lastly, they can improve their capacity to change by increasing their connectedness in the region and the amount of financial and human resources that is invested in creating room for industries.

Next to creating room for the path to grow, regional proponents of the path can also push the development of the path more actively. Proponents can spread the idea of the path among start-ups and companies who can pave the path via their agency of innovative entrepreneurship. They need to regard the path as an opportunity for their business development. In order to do so, proponents of a path can spread the knowledge about the technology that constitutes the path among these actors. Company networks can distribute this knowledge via the interaction of different companies. Start-ups need to be supported, as they can introduce more abrupt change

than company actors, because they are more flexible and take advantage of appearing opportunities. Lastly, knowledge of the new technology has to be shared within the region. The university-industry relationships (see Perkman et al., 2013) can also be enhanced. The university-industry relationships also often introduce region specific opportunities (Dawley, 2014).

Overall, the facilitation of a path includes many actors that perform different agencies within different levels of a path creation process, as shown by the three episodes in the result section. Supporters of a path creation process might keep this in mind and look out for actors who think similarly to share their actions among different levels along the path creation process that combined foster a specific path creation process, like in the case of the different actions regarding company collaboration, establishing an entrepreneurial ecosystem or informing companies.

Limitations

The research framework has been adapted from the trinity of change framework of Grillitsch and Sotarauta (2019). The different agencies and the opportunity space have been expanded by literature on those topics as shown in the theory section. The base of literature on regional leadership however is still relatively scarce. With most contributions consisting out of the description of regional leadership within case studies, a conceptual theory of regional leadership is still missing. This lessens the theoretical ground of this research. Furthermore, Grillitsch and Sotarauta base their choice of the different change agencies on the argumentation that 1) innovative entrepreneurship introduces new paths into the region; 2) institutional entrepreneurship makes opportunities for innovative entrepreneurs available; 3) regional leadership steers the direction of the development. While this line of thinking is intrinsically logical, other change agencies could also be introduced to shed light on other aspects of regional path creation. Döringer (2020) for example proposes the inclusion of policy entrepreneurship, governmental entrepreneurship next to institutional entrepreneurship.

Another point of discussion regarding the framework is the strict focus on a Schumpeterian idea of innovative entrepreneurship. Within the case of AI in the Saarland many companies do use AI based technologies and often even develop them on their own. These companies do contribute to the creation of AI within the region and innovatively implement new developments and opportunities in their workflow. However, they do not thrive to exploit new innovations by opening a new business and disrupting the market, but by using them to improve their own business. This behavior does not qualify them as an innovative entrepreneur in a Schumpeterian sense and therefore not as entrepreneurs in the trinity of change, despite their undeniable effect of pushing the technology in the regional path creation process.

Regarding the general-purpose technology characteristics of AI as it branches out into different industries, the question of what constitutes a path can be put forward. If a path creation process is explained with the development of companies and firms, would the introduction of AI in companies to improve their production constitute as a path creation process? Following the definition of Isaksen and Trippel (2014) in which path creation also includes “firms that [...] employ new techniques or organize differently that what have hitherto dominated in the region” (p.4) the answer would be yes. However, this would be questionable within the definition of (MacKinnon et al., 2019): “the emergence and growth of new industries and economic activities

in regions” (p. 3). Depending on the definition, the case of AI in the Saarland would therefore either count as a case for examining a path creation process or not.

The research itself is clearly constructed, as the description of the episodes are backed by suitable interview quotes. The analysis and the discussed results are a direct derivative of the three episodes of the result section and can be checked on consistency. The gathered data, the description of the path creation of AI in the federal state of Saarland has been triangulated by interviewing different actors that described their actions and as well as their perception of other interviewees actions regarding the path creation process. This data however is not backed by other data sources such as reports or grey literature. As the regional development is a special topic, these reports however would most likely be a product of a regional actor which lessens the triangulation quality of these data sources. Despite the absence of a second data source, the construct of the research, the core description and argumentation of the case are found to be valid and comprehensible.

Some patterns of actions that were found closely resemble theoretical discussions, which validates the findings of these behaviors (user innovation, knowledge spill-over, academic entrepreneurship, university-industry relationship, entrepreneurial ecosystem). However, as the research of an actor perspective is still small, no pattern could be matched to other empirical studies using the trinity of change framework, but only cross-validated with the theoretical propositions of the framework itself. Findings are therefore backed by the aforementioned current literature strands.

Regarding the first sub question, it has been found that all interviewed actors do have some part in the path creation process. This is not to be mistaken with a statement that all actors in the region to take part in the path creation process. Moreover, this is a result of the sampling strategy and the willingness of actors to give an interview. Actors have been filtered according to their closeness to AI. Additionally, actors who have been contacted, but felt that they do not fit the criteria of being close to the topic of AI would refuse to give an interview in the first place. Additionally, internet and database research could have left out important actors that do influence the path creation process but do neither have an online representation nor are listed in databases targeting AI. Companies for example could have already implemented AI technology internally, but not publicly communicate this fact. Furthermore, the snowball sampling does have the danger of clustering. Different actors referring to each other ignores the possibility of a second cluster that could also be important for the research. Actors that would not be able to contribute to regional path creation would not be interviewed, leaving the question open whether all region actors are actually contributing to the creation of the path. As the total population is not fully known, the sample of interviewees can therefore not be fully claimed to be either representative or representative.

The generalizability of this research is hampered because of the single case research design of AI in the Saarland and the theory it examines. The interaction between regional structure and agency of the actors can be described as specific to the region. Other regions might have different preconditions than the Saarland, like an already established entrepreneurial ecosystem or the lack of institutions of collaborations. The change of the regional structure and the creation of opportunities is bound on the initial characteristics of the regional structure. The identified

mechanisms that change the regional structure in the Saarland are therefore not easily adaptable to other regions. Furthermore, the insights that have been gained by the examination of the AI technology are also not simply generalizable. As the technology of AI has been identified as general-purpose technology, mechanisms that are attached to the implementation are not simply adaptable to industries that develop out of non-general-purpose technologies. The information program for example, which aims to get all companies in the region to adapt the new technology might not be present with non GPTs, thus decreasing the generalizability of the insights of the path creation of AI.

Future research

Future research can build on this research to improve the understanding of the path creation process with an actor's perspective in three ways.

First, more empirical studies would be necessary to increase the reliability of the findings and to add to the single case evidence resulting from analyzing a specific region (Saarland) and a specific technology (AI). The study of path creation should be repeated within several contexts. This research can be used as a starting point to compare the developments of AI in the Saarland with regions with a similar internal structure, meaning regions that are similarly characterized by structural change and external economic pressure, after centuries of heavy industries dominating the region. Alternatively, it can also be compared to different regions engaging in the development of AI technology in AI or challenge the findings of this research by applying the framework to a different regional structure with a different technology as a basis for path creation. Moreover, as this research already established a foundation of the path creation of AI in the Saarland, further studies could also investigate the development of the path, as it has been identified as being in the early stage of the path creation process. This could show how and whether agencies and their interaction with the regional structure change over time. This would also follow the proposition of Grillitsch et al. (2019) to perform a study of path dependency with a longitudinal research design.

Second, as the notion of agency and insights in structure-agency interactions provided useful insights in the formerly macroscopically described theory of path creation, both might be adapted in other theories of regional development. While Lundvall (1988) put forward the idea of "learning by interaction" within innovation systems, which can be closely connected to the action of individual actors, the innovation system approach still "has been quite static and has not emphasized the importance of actors in system changes" (Isaksen & Jakobsen, 2017, p. 357). Despite the inherent "systems-approach" of innovation systems, an agency perspective could shed more light on the mechanisms of learning and of interaction. This could in term deepen the understanding of how a system works.

Moreover, regarding the case of the Saarland in which a new technology emerges in a relatively constricted geographical space the idea of path creation might also be discussed in the light of cluster theory (e.g. Porter, 2000; Scott, 1988). The found traces of knowledge spill over among firms within the first episode of collaboration are often a strong argument for building a cluster. The idea of time in the development of clusters and change in regional structure by the agency of actors might help within cluster theory in order to gain more insights in the implementations and implications of institutions, for example. Vice versa, some ideas of cluster theory, for

instance regarding the aforementioned knowledge spillover, might help in the description of a regional path.

Thirdly, the framework used in this study can be improved. During the analysis of the interviews it has been found difficult to differentiate between the concepts of institutional entrepreneurship and regional leadership, as they are very much alike and often overlap. Having some attributes in multiple concepts does not increase the understanding over the underlying phenomena, but rather makes it more difficult. Some researchers, and even Grillitsch and Sotarauta (2018) initially themselves, see institutional entrepreneurship as a form of regional leadership (e.g. Hu & Hassink, 2017). More thought has to be put into the relationship between regional leadership and institutional entrepreneurship to understand whether and how these actions fundamentally differ and how to use this difference in the analysis of the behavior of regional agency.

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Appendix

Appendix 1: Pool of Interview questions

Innovative Entrepreneurship	How did you get to the idea of the start-up?
	How did the founding process proceed over time?
	Where did you acquire the necessary expertise for your business?
	What is the main objective of the company? Building new competencies, or rather strengthening existing ones?
	What is the market for the product?
	Which competitors are there?
Institutional Entrepreneurship	What is your unique selling point?
	Where have you worked until now?
	How do they see the current development of the software landscape and especially that of AI in the Saarland?
	What opportunities or problems do you see in this development?
	How do you use AI?
	Do you share with others about your use of AI?
	How do you communicate the topic of AI to the outside world?
With which partners have you exchanged information about AI and where are they located?	
Leadership	Do you know of any other projects related to AI?
	On what basis do you exchange information with other actors? Are you organized?
	Which actors can you think of when talking about AI in Saarland?
	With which of these do you also have contact yourself?
	Do you know how they exchange/ organize themselves with third parties?
	Are you involved in this exchange?
	How do you find new partners yourself?
	Do you make contacts yourself?
	How does the partner selection for projects work?
	How is the direction/goal of a project defined?
For what reasons do you work together with others?	
How well does the cooperation with third parties work?	
In your opinion, is there someone who coordinates cooperation in the field of AI?	
Opportunity Space	How does your current organization support start-ups?
	How and by whom are founders/companies supported?
	How do you see the start-up/innovation culture in Saarland?
	How has your work changed over the years? Which processes would be different today than in the past?
	How do you see the start-up culture in Saarland and the access to necessary resources? (knowledge, money, power, etc.)
What advantages does the AI technology bring you? Would it also be possible in any other way?	

Appendix 2: Overview of Interviews

ID	Role	Appointment	Modus	Duration (min)
1	Support 1	20.12.19	Phone	60
2	Teaching 1	12.11.19	Personal	87
3	Support 2	14.11.19	Personal	49
4	Research 1	26.11.19	Phone	30
5	Teaching 2	02.12.19	Personal	34
6	Research 2	02.12.19	Personal	42
7	Industry 1	23.12.19	Skype	47
8	Teaching 3	11.12.19	Personal	44
9	Politics 1	17.12.19	Personal	60
10	Start-up 1	09.12.19	Skype	32
11	Politics 2	05.02.20	Personal	60
12	Research 3	16.01.20	Phone	50
13	Support 3	10.12.19	Skype	45
14	Start-up 2	15.01.20	Personal	65
15	Industry 2	03.01.20	Phone	34
16	Start-up 3	09.01.20	Personal	30
17	Research 4	15.01.20	Personal	61
18	Research 5	09.01.20	Personal	40
19	Teaching 4	22.01.20	Personal	34
20	Politics 3	04.03.20	Personal	88
21	Start-up 4	10.01.20	Phone	35
22	Industry 3	08.01.20	Phone	42
23	Industry 4	24.01.20	Phone	47
24	Support 4	22.01.20	Personal	50
25	Support 5	26.02.20	Personal	39

Appendix 3: Final analytical framework; changes to initial framework in italic

Domain	Subdomain	Concepts	Example quote
Innovative Entrepreneurship	Opportunities	Creation of own opportunities	<i>Since this research project was a very, innovation-driven project, it was not a basic research project, one of our ideas was to say: Yes, you could make a start-up out of it. And that's what we did.</i>
	Market disruption	Inherently new product that breaks with existing paths and tries to establish a new one	<i>This is also the first medical device of this kind on the market. And we also have the hope that we can become the market leader. And here we come back to the initial idea: I want to prevent people from getting sick. If we have a large number of tests, then we can suddenly start to find these small deltas, these deviations from standards earlier. And inform people there is something with their health. And then we have to bring this tool or these tests to the doctors in Germany. That they do it regularly from, say, 50 years on. The more tests we have, the more we can do and prevent people getting sick. And that's what we really want.</i>
	Social Structure	Embeddedness in multiple social structures (Academia, Industry)	<i>I am a member of a stock company's Advisory Board and advise those on the Executive Board level. I founded a start-up here two years ago with colleagues. Doing Data Science Consulting and also just starting my second start-up. Just received two million euros in funding for a research project. Apart from that, I was at SAP for two years and know people from the industry.</i>
		Personal mobility (Ability to switch between social structures)	Same as above
	Transformation capability	Combined Knowledge from different social structures	<i>In the project we had contact to a clinic in Nice, with whom we worked very closely. In the second year here in Homburg the university hospital also had psychologists and psychiatrists with whom we worked together. And from this we developed the use cases. And this fusion between psychology, technology and in this case medicine. This interdisciplinarity. And when people work together, that's what happens.</i>
Institutional Entrepreneurship	Field characteristics	Heterogeneity of institutional arrangements in the field	None
		Jolts and crises. i.e. technological disruption, social shifts	<i>All tools or the topic of AI in general, the range of applications and the associated, completely undisputed impact on the overall economic development, we clearly see great development opportunities, which, in our view, can only really be developed at another level if we succeed in developing these networking or ecosystem structures more productively between the various stakeholder circles and groups - and this is an opportunity, so to speak, could</i>

			<i>also simply say a challenge, because it is simply not trivial and so many developments interlock.</i>
Actors social position	Position within the field that is to be changed		<i>At my job, I have been focusing for decades on informing and sensitizing users and companies here in the country about information and communication technologies.</i>
	Intersection between different fields		Characteristic of the Interviewee
	Contact to other actors with a better social position		<i>Eastside Fab as a digital hub, yes. We have planned workshop activities with various stakeholders in the area of AI, which we also support.</i>
	<i>Joint projects</i>		<i>At ZeMa, which is also the merger of several chairs, the HTW and the UdS, the focus is on mechatronics and automation computing.</i>
Vision for divergent change	Framing of the problem		<i>The Saarland went out of coal and steel. We already had a plan how this was going on. And at that time, it meant we'd make the automotive and supply industry here. Only we both know that until just now it was going very well. But and I know this from talks with politicians from Saarland. Now we urgently need to think about how to continue after automotive. Because automotive will be a different world in 10 years, everyone knows that.</i>
	<i>Showing the possibilities of change</i>		<i>I also support and promote digitization in Saarland and what is happening at the universities there is just great. And the Saarland has excellent conditions in this area. But we also have to say that in comparison to a region like Munich, we have to accept this opportunity for us. Because we will never have the Microsoft headquarters. An industrial giant like BMW will never settle here. I mean, my efforts were already cool for jobs before the whole software and the whole AI wave and the whole robotics came.</i>
Mobilisation of allies for the vision	<i>Developing a use case</i>		<i>It was more about simply explaining to the customer what AI does, and that's done quickly and in the end you just have to show where they get the benefit. That means it's much more about finding suitable use cases and also starting first projects and showing first results that are practically trend-setting.</i>
	Resource mobilisation		<i>The Mittelstand 4.0 Competence Center is more or less like a research project that is being funded by the federal ministry of economy. And is aimed at informing regional companies about AI</i>
Leadership	Mode of leadership	Sharing leadership among different organisations	<i>In the case of regional players, we work together with the state chancellery. We work together with the Chamber of Commerce. Of course, with the one in the Saarland Informatics Campus. The organizational unit, the quasi communication unit, is responsible for all informatics activities. We are integrated into the Saarland</i>

		<i>Ambassadors, where we also speak to the outside world. We work together with the MINT representatives to make clear how much talent and how many different talents are actually necessary to make artificial intelligence something that is a tool that can really achieve goals. We work with schools, with general schools, with vocational schools. In this respect there is a lot of cooperation.</i>
	Connecting different leadership actors	<i>Well, I have been working with the Institute for Information Systems for a long time. And at some this organization has been founded, this AWSi for Digital PR products and processes and I just know the people. I know all the protagonists and that's why there was always contact.</i>
	Congruency of vision	Comparisson of different interviews
	<i>Important actors</i>	<i>The DFKI. That has such a large radiation outwardly and is also so introduced, internationally, nationally by the work of prof. Whalster also incredibly interlaced in all committees. Sure, that's the number one</i>
Vision	Framing the vision	<i>There it was also about the topic AI for medium-sized businesses. And there you get again impulses from outside, or from other centers, what they develop in order to open up the topic of AI for small and medium-sized businesses.</i>
	Highlight benefits for followers	<i>Our goal is so say there's AI and sensitizing the corporations to AI, that the corporations say okay, maybe that's for us. That will perhaps bring us an advantage, or build up the necessary skills so that the companies can solve the problem themselves.</i>
Capacity to enforce change	Access to Resources	<i>We can support these projects [CISPA Innovation Campus, East Side Fab] by taking over the construction and project costs</i>
	Connectedness to actors in the region	<i>This institute is here since the 70s. They have a larger network and traditional partnership with many industries.</i>
	Trustful relationship between leader and follower	<i>Quote above also indicates trustful relationship</i>
	Ability of the leader to create now connections to follower	<i>Every day new partners join the network, because we are of course present at many events and we are expanding our network every day. And this of course goes through the individual persons and the individual offices. So when we are somewhere, we take the contacts with us and also look, if it is interesting in some way, than we arrange an exchange.</i>
	Ability of the leader to create now connections among actors in the region	<i>We have now also networked companies with each other, where we have no benefit at all. For example, we can now see that there is a thematic overlap, we recommend an exchange, we make intros. Some projects have even emerged from this. So I don't</i>

			<i>think that this is done specifically or with any intention, but simply because for us it is simply part of it, it simply makes sense and also with regard to regional support, for example, it is of course always very nice and we are also happy when companies from the region can then network with each other or start joint projects.</i>
		<i>Technology transfer</i>	<i>A thing is the transfer is over people, it also means that the employees know that it is part of DFKI's success if they go to another company and use their experience over there.</i>
Opportunity Space	Opportunity Space	Existing Economy	<i>We are a country that is strongly influenced by industry and automobiles and it is becoming apparent that there will be radical upheavals.</i>
		Local and extra local networks	<i>We go abroad with companies if they want to somehow expand and establish themselves in foreign markets and connect to other companies</i>
		Entrepreneurial Climate	<i>But I do think that there are still many companies here that would do well to think outside the box. I've been around for a long time and we simply have a lot of companies that absorb all the support there is. And then there are companies, you have been working for years to finally get in touch with them, to come to our office and maybe go with us to a trade fair, or to a trade show. Nothing. There are many who are open-minded about the topic of innovation. Whatever that may be in all its facets, but there are certainly many who have a lot of catching up to do.</i>
		Current state of AI	<i>Well, everyone is still relatively new on the topic of AI. But I wouldn't see that as a specific Saarland theme. This is a general, Germany-wide topic, where it takes time to get into the concrete applications. Of course, the most likely area is the internal processes. But when it comes to setting up a completely new business model, not much has happened yet. But as I said, that's not specific to the Saarland, I wouldn't say that. I would, and then we would be following the federal trend.</i>
		Institutions benefiting or hindering AI	<i>AI is always a problem of acceptance. The employees see that already now something new is to be introduced. What does it bring me anyway? Or it costs so much money. Return on Invest is only so much later. Let's just leave it alone, or the topic is too complex. Let's not dare to approach it yet. We simply recommend doing it every now and then. Start small. Setting small goals and quickly realizing that even with these small projects you can achieve a big benefit quite early</i>