R&D MANAGEMENT

Open innovation for institutional entrepreneurship: how incumbents induce institutional change to advance autonomous driving

Fiona Schweitzer[1,*], Maximilian Palmié[2], Oliver Gassmann[2], Jonas Kahlert[2] and Tobias Roeth[3]

[1]Grenoble Ecole de Management, Grenoble, 38000, France. fiona.schweitzer@grenoble-em.com
[2]Institute of Technology Management, University of St. Gallen, Dufourstrasse 40a, St. Gallen, 9000, Switzerland, maximilian.palmie@unisg.ch, oliver.gassmann@unisg.ch, jonas.kahlert@gmail.com
[3]School of Economics and Management, University of Kassel, Kleine Rosenstr. 3, Kassel, 34109, Germany. tobias.roeth@uni-kassel.de

Without fundamental institutional change, such as a change in laws and regulations, many new technologies cannot achieve their full potential. Efforts to induce institutional change in favor of such technologies are, therefore, increasingly critical for innovative firms. To study how German automotive firms induce change that accommodates autonomous driving (AD) solutions, we conducted a case study research encompassing analysis of 31 interviews, internal archival documents, and media data. Taking the firm as the level of analysis, we identify ten practices employed by innovating incumbents in the three steps of creating saliency for change, mitigating reservations against the desired change, and institutionalizing it. We find that these practices involve shaping-oriented and adaptation-oriented knowledge flows. Through the combined use of these practices throughout the three steps, firms 'open up' their development process, utilizing purposive inflows and outflows of knowledge to advance innovation. Our findings contribute to the literature on open innovation and institutional entrepreneurship and suggest that future open innovation research can profit from adopting an institutional entrepreneurship perspective.

1. Introduction

What is the use of an autonomous vehicle if you are legally required to keep your hands on the steering wheel the entire time? Many new products and technologies that cannot reach their full potential because they are not adequately accommodated by existing institutions face similar problems. Consequently, institutions – the 'rules, norms, and beliefs that describe reality for the organization,

© 2021 RADMA and John Wiley & Sons Ltd

explaining what is and is not, what can be acted upon and what cannot' (Hoffman, 1999, p. 351) – have a substantial influence on how successful a new technology ultimately becomes (Hengstler et al., 2016; Bogers et al., 2018; Purtik and Arenas, 2019).

The open innovation (OI) literature has devoted considerable attention to understanding how firms develop new products and technologies for the given institutional environment (Chesbrough, 2006; Mortara and Minshall, 2011; Enkel et al., 2020). OI literature investigates and explains purposive knowledge flows between the focal firm and external partners by which the parties attempt to advance innovation (Chesbrough, 2006; Cassiman and Valentini, 2016). According to this tradition, the OI literature has so far focused on technology-related knowledge flows that contribute to the development of innovative solutions as well as on the activities and capabilities that enable firms to engage in such knowledge flows (Bogers et al., 2017, 2018; Dąbrowska et al., 2019; Enkel et al., 2020).

However, the OI literature has paid little attention to knowledge flows surrounding an innovation's institutional environment as well as to the practices through which firms interact with and influence their institutional environment (cf. West and Bogers, 2014; Ahn et al., 2017; Bogers et al., 2017; Chesbrough, 2017; Zobel and Hagedoorn, 2018). Given their enormous impact on innovation success, it seems unfortunate that the OI literature has not studied them more extensively. In fact, scholars lament that existing research represents 'a rather focused (and potentially limited) interpretation of OI adoption, hindering a complete understanding of OI' (Ahn et al., 2015, p. 33), urging innovation management to focus on questions of institutional change and institutionalization in addition to the process of product or technology development (Ahn et al., 2015; Jaakkola et al., 2019).

In response, this paper integrates institutional entrepreneurship (IE) perspective into OI research. IE refers to the practices of 'actors who have an interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones' (Garud et al., 2007, p. 957). IE research has pointed to discursive tactics and political strategies (e.g., framing, collective action, and lobbying) that innovative firms could employ to induce institutional change in favor of their new technology or product (Kalantaridis and Fletcher, 2012; Gawer and Phillips, 2013; Walker et al., 2014). These tactics and strategies imply purposive knowledge flows between the focal firms and external parties. Consequently, OI and IE perspectives share substantial commonalities in their theoretical foundations, calling for further theory elaboration. However, the IE literature suggests that firms' engagement in tactics and strategies intended to induce institutional change might best be accompanied by adjustments in the firms' technology development process (Battilana et al., 2009; Kalantaridis and Fletcher, 2012). Yet, existing IE research tells us little about how this engagement actually affects their ongoing technology development process.

Extending the OI literature from an IE perspective, we study the following research question: Which practices do firms employ to induce change in the institutional environment in favor of new technology while developing this technology? By conducting inductive case-study research at the firm level, we identify ten practices that German automotive incumbents use. In order to curb their ability to realize the full potential of autonomous driving (AD) innovations, they apply three steps (creating saliency, mitigating reservations, and institutionalizing) that facilitate the desired change by overcoming barriers in the institutional environment (unaccommodating laws and regulations). Six of these practices involve shaping-oriented knowledge flows and four adaptation-oriented knowledge flows. Shaping-oriented practices seek to influence parties in the firm's external environment so as to instigate changes in institutions that are beyond the firm's immediate control (Purtik and Arenas, 2019). Adaptation-oriented practices allow firms to adapt to the dynamically changing institutional environment (Rindova and Courtney, 2020).

These findings extend the current OI and IE literatures in two important ways. First, the study broadens OI research by studying knowledge flows that have previously been neglected while identifying adaptation-oriented and shaping-oriented practices to induce institutional change. Second, it identifies practices that incumbent firms use when seeking institutional change in favor of a new technology before the technology is introduced to the market.

2. Theoretical background

OI is defined as 'purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively' (Chesbrough, 2006, p. 1). Three archetypical processes of OI can be distinguished: an 'outside-in,' an 'inside-out,' and a 'coupled' process (Gassmann and Enkel, 2004; Ahn et al., 2016). Firms that employ outside-in processes use purposive knowledge inflows from external sources to enrich their knowledge base (e.g., in-licensing). Firms that employ inside-out processes use purposive

 © 2021 RADMA and John Wiley & Sons Ltd

knowledge outflows to transfer proprietary ideas and insights from their new product development (NPD) process to the external environment (e.g., selling intellectual property). Firms that employ coupled processes combine outside-in and inside-out processes by mutually sharing and jointly creating knowledge with external partners (e.g., R&D alliances). Across these three process archetypes, the OI literature has predominantly focused on sharing or co-creating technological knowledge (Huizingh, 2011; Randhawa et al., 2016; Enkel et al., 2020). Only a few OI studies have dealt with the exchange or co-creation of non-technological knowledge, such as knowledge on social and ethical issues (Holmes and Smart, 2009; Dangelico and Pujari, 2010; Arnold, 2017).

While knowledge flows that focus on technical innovation per se are certainly important for successful innovation, some innovations require changes in their institutional environment to achieve their full potential (Purtik and Arenas, 2019). Efforts to create new institutions, transform existing institutions, or destroy old institutions are the subject of IE (DiMaggio, 1988). The institutional environment consists of 'regulative institutions' (e.g., laws, regulations), 'normative institutions' (e.g., conventions, work practices), and 'cognitive institutions' (e.g., values and shared conceptions) (Orr and Scott, 2008). These institutional elements are frequently interdependent and mutually reinforcing (e.g., a law may reflect certain values and be accompanied by certain conventions) (Scott, 2013). Consequently, institutional entrepreneurs who are interested in a change of law, for instance, should not completely disregard other institutional elements.

In principle, both incumbents (e.g., Garud et al., 2002; Gawer and Phillips, 2013; Kukk et al., 2016) and new entrants (e.g., Munir and Phillips, 2005; Lee and Hung, 2014) can become active and ultimately successful institutional entrepreneurs. However, incumbents and new entrants face fundamentally different opportunities and challenges with respect to IE; for example, in terms of the power to push for institutional change, the motivation to do so, or their perceived credibility in wanting particular changes (Garud et al., 2007; Walker et al., 2014). Incumbents and new entrants might, therefore, use different practices when conducting IE.

A review of the IE literature (e.g., Maguire et al., 2004; Battilana et al., 2009; Hung and Whittington, 2011) suggests that IE can be conceptualized as a three-step approach with each step serving a particular purpose: (1) Creating saliency (make a case for change), (2) mitigating reservations (gain acceptance and mobilize support for the intended change), and (3) institutionalizing the said change. While the IE literature has largely investigated practices that firms perform after a product is launched (e.g., Purtik and Arenas, 2019; Baker and Nenonen, 2020), OI research under an IE perspective is well-positioned to study activities that a firm performs while developing new technology.

3. Methods and data

Given the nascent state of research at the intersection of OI as an ongoing technology development process and IE, we employ a qualitative approach (Eisenhardt, 1989) to examine incumbents in the German car industry. We interviewed managers from automotive firms, industry experts (consultants), and representatives of stakeholder groups considered by the (interviewed) car manufacturers and media as playing a central role in the focal institutional change. We chose to study AD because the expert interviews and media analysis indicated that firms were severely limited in their AD ambitions by laws and regulations and have recently induced changes in favor of AD. The term AD denotes fully autonomous driving, which means that a vehicle performs all the driving functions without the need for vehicle occupants to interfere at any time or under any condition. The different levels of semi-autonomous driving in which the vehicle only acts autonomously for some tasks or in some contexts are considered a step towards AD (NHTSA, 2016). Our study pertains to incumbents' AD innovation portfolio, which includes current R&D projects as well as their innovation roadmap.

In line with the sample size recommendations for exploratory studies (Patton, 2002; Wareham et al., 2014; Palmié et al., 2021), we carried out 31 in-depth interviews with 8 firm representatives, 10 industry/technology experts (consultants, independent researchers, and journalists), and 13 representatives of key stakeholder groups (municipal/government bodies, NGOs, and users) (see Table 1). We interviewed diverse respondents to reduce bias and increase validity (Creswell and Miller, 2000). We also triangulated the interview data with secondary data (provided by firms and media).

The duration of the interviews was between 30 and 90 min. We asked firm representatives to identify key challenges and opportunities in the institutional environment, external players who influence this institutional environment, and practices they carry out to induce change in the institutional environment. When interviewing stakeholders, we similarly asked

© 2021 RADMA and John Wiley & Sons Ltd

Table 1. List of interviewees

No.	Role	Affiliation/Group
1	Senior engineer for assisted driving systems	Car Manufacturer
2	Benchmarking specialist for automotive driving concepts	Car Manufacturer
3	Product marketing responsible for assisted driving systems	Car Manufacturer
4	Chief technology officer for entire vehicle concepts, leading the development of an autonomous driving project	Car Manufacturer
5	Senior engineer for assisted driving systems	Car Manufacturer
6	Head of division for external affairs and technical regulations, responsible for homologation, type approval, and technology regulations	Car Manufacturer
7	Senior corporate communications manager focusing on public affairs in respect to connectivity and safety issues	Car Manufacturer
8	Chief technology officer for total vehicle development	Car Manufacturer
9	Retired partner in a consultancy specializing in the automotive industry	Consultancy
10	Chief executive officer of a consultancy with special competence in the automotive field	Consultancy
11	Senior consultant specializing in the automotive industry	Consultancy
12	Professor of technical engineering (focusing on car motors)	Research Institution
13	Chief executive officer of a consultancy with a special competence in the automotive field	Consultancy
14	Senior consultant specializing in the automotive industry	Consultancy
15	Journalist in a leading media house having a well-balanced coverage of diverse automotive topics	Media
16	Independent journalist writing for high-quality newspapers on the autonomous industry	Media
17	Journalist	Media
18	Department head for data privacy issues	Municipality
19	Planning director, engaged in several local mobility projects	Municipality
20	Senior officer responsible for transportation issues at a public institution	Government
21	Scientist with a focus on autonomous driving at a leading German university	Research Institution
22	Senior expert at an automobile club	Non-governmental Organization
23	Chief expert for traffic at an environmental pressure group	Non-governmental Organization
24	Senior consultant at an association of the automotive industry	Non-governmental Organization
25–31	Technology-savvy users	Consumers

them to identify opportunities and challenges with respect to AD and explain the activities they employ to influence the development of AD.

Our interviews addressed both institutional barriers that were in existence at the time of our interviews and those that had already been overcome. Addressing past barriers allowed the respondents to reflect on achieved successes and failures. Addressing ongoing barriers and the associated activities with an uncertain outcome ensured that the respondents did not reinterpret or exclude challenges and activities after the outcome became known (Garud and Rappa, 1994; Verworn, 2009). Appendix A illustrates the interview guidelines.

We audio-recorded all but two interviews and transcribed them. For the two remaining interviews, we used handwritten notes. We applied Gioia's inductive data analysis technique (Gioia et al., 2012) to analyze our data: First, we identified *in vivo* codes from the raw data. Data coding and interpretation started after the completion of the first interview so that we could include emergent ideas in subsequent interviews (Siggelkow, 2007). Second, we developed first and second-order constructs to group codes together. Third, we went back and forth between the literature and the data to refine the construct structure and create our conceptual framework. In addition, we presented our findings to academics, study participants, and other practitioners to receive their feedback. Table 2 shows our data structure. We present our first-order and second-order constructs, as well as the aggregated theoretical dimensions in a manner similar to Baert et al. (2016). Appendix B provides representative quotations for the coding.

 © 2021 RADMA and John Wiley & Sons Ltd

Table 2. Data structure

Change inducing activities (First order codes)	Change inducing shaping and adapting practices (Second order codes)	Three step IE process (Aggregated theoretical constructs)
1.a. Highlighting socio-cultural benefits	1. Show relevance of change for society and stakeholders in charge of laws and regulations **(Shaping)**	Create saliency
1.b. Linking to economic matters on a national level (job-creation, international competition)		
1.c. Sharing benefit info with media		
2.a. Identifying common ground with competitors	2. Cooperate with players from industry for better coordination, but not for exerting overt pressure on stakeholders **(Shaping)**	
2.b. Searching formal and informal exchange possibilities		
2.c. Joint position statements with competitors		
2.d. Exchanging and agreeing on technical standards		
2.e. Prudence with industry-external partners		
3.a. Develop AI solutions that increase societal benefits	3. Include technical features in semi-AD solutions that reflect concern about society **(Adapting)**	
3.b. Implementing technical standards		
4.a. Need for support from multiple sources	4. Highlight support from independent parties (e.g., research institutes, NGOs) **(Shaping)**	Mitigate reservations
4.b. Searching third party supportive evidence		
4.c. Searching quantitative evidence		
5.a. Running pilot projects in defined areas	5. Seek harmonious, mutually beneficial interactions with stakeholders (e.g., demonstration projects) **(Shaping)**	
5.b. Encouraging live experience with concept cars		
5.c. Exchanging lessons from pilot projects		
6.a. Involving lead users	6. Incorporate learnings from interaction with stakeholders **(Adapting)**	
6.b. Implementing technical change		
7.a. Participating in government-led roundtables	7. Support governmental decision-making, but do not publicly claim a major role **(Shaping)**	Institutionalize the desired change
7.b. Interacting with other opinion-forming entities		
7.c. Leaving driving role		
8.a. Avoid confrontation and controversy by launching reliable solutions	8. Pursue a 'progressive' rather than a 'big bang' approach to give stakeholders time to accustom themselves to new technology **(Shaping)**	
8.b. Giving stakeholders time to become accustomed		
8.c. Avoiding negative NGO action		
9.a. Developing technology after reaching an ethical agreement	9. Incorporate consensual agreements into programming of algorithms **(Adapting)**	
9.b. Developing technology based on data privacy guidelines		
10.a. Dynamic learning from user feedback	10. Share (reliable) intermediate solutions with the outside **(Adapting)**	
10.b. Building trust in semi AD		

4. Findings

Our key interest is to understand what activities incumbent German car manufacturers carried out to induce change in institutions that were impeding the successful commercialization of AD innovations but that were beyond the firms' immediate control.

4.1. Need for new/transformed institutions

The car manufacturers highlighted laws and regulations as key institutions they wished to see changed to prepare the market for autonomous cars. They mentioned the need for a legal framework to test AD prototypes on regular public roads in defined areas and a legal body for the development of road transport telematics, including rules for data-exchange between road infrastructure, cars, and other parties.

Unanimously, firm representatives and stakeholders emphasized the lack of clear rules regulating liability questions and third-party claims in cases of accidents between semi-autonomous and autonomous cars. In addition, they noted that existing laws need to be adapted, such as the UN's 1968

© 2021 RADMA and John Wiley & Sons Ltd

Vienna Convention on Road Traffic, which requires drivers to be in full control of their vehicles at all times:

Currently, the value for the user is limited mainly by legislation [and] not by technology, because you are not permitted to write emails or sleep while driving [as] you have to be behind the steering wheel. This makes the idea of automated driving a little boring […]. So you see that the political setting of the points has a direct impact […]. (Journalist)

Although incumbent car manufacturers were well aware that some consumers are skeptical about autonomous solutions and artificial intelligence (AI), they viewed consumer perceptions as a less imminent challenge to AD:

You start with the more innovative people—let them try it. Introduce semi-autonomous driving devices that help people who drive a lot, have higher income, and are technology aficionados. Once it's in their heads, they spread the word, you can show the benefits to them, and this also helps the others to learn step-by-step. (Senior engineer, car manufacturer)

All interviewees stressed that laws and regulations determine what technological solutions car manufacturers develop and how useful different levels of autonomous driving and specific technical features developed at these levels will be to consumers once the solutions are introduced. Consequently, inducing a change in the regulative institutions during technology development can be interpreted as an activity to increase the chances of later market acceptance.

4.2. Incumbent car manufacturers' practices along the three steps of IE

The incumbent car manufacturers in our study employed ten practices to induce change in institutions that were beyond their own control. We present these practices using the three-step approach outlined in the Section 2.

First, firms need to create saliency for the desired change among responsible parties. Saliency stimulates these parties' interest in dealing with the topic and collecting information (Mitchell et al., 1997). Second, institutional entrepreneurs must mitigate any reservations that these parties might have when analyzing the information. Otherwise, such reservations can drastically reduce the willingness to support the initiative (Markard et al., 2016; Bunduchi, 2017). Third, firms can take actions to facilitate the parties' legislative decision-making, so that focal change is institutionalized (Tian et al., 2017). We subsequently describe the practices that the incumbent car manufacturers in our study carried out within these three steps. Table 2 captures these practices.

4.3. Practices to create saliency

The incumbent car manufacturers in our study used narrative frames to show the relevance of the desired change for society at large when speaking to media and to governmental representatives. They perceived the exchange with media as mainly important to make the topic more approachable to key external decision-makers, although it also served to inform the general public. They identified governmental representatives as key external stakeholders because they were the decision-makers in charge of implementing the corresponding laws and regulations.

We make clear that it impacts the way how Germany is perceived in the world and where new jobs are created. And this is interesting for them [the government], too. (Head of division for external affairs, car manufacturer)

Through such framing, the car manufacturers sought to link new ideas (autonomous driving) to broadly accepted narratives (relevance of jobs in the car industry for the German economy and society, relevance for Germany to be perceived as an innovation leader in the world) that directly matter to the government representatives they sought to influence.

The car manufacturers approached the specific stakeholder in charge of implementing the corresponding laws individually but also coordinated their endeavors within their industry to frame petitions to the government on the change required in laws and regulations to enable AD:

It does not make sense for you to press ahead and ask for legal permission for this or that great feature. In this case, you bite the dust […]. We combine our messages there to speak in a unified way. If we agree that we want X and Firm A went to the authorities and asked for Y, then A would get slapped. We agree on a certain approach for the authorities in the VDA committee and then we go for it. (Senior engineer, car manufacturer)

The car manufacturers perceived tensions between their need to speak to governmental representatives with a unified voice and the danger of being seen as overly coercing change. On the one hand, collective action makes it easier for benevolent governmental representatives because they do not have to pick sides between conflicting alternatives. On the other hand, the incumbents realized that some might perceive collective action as unwelcome power agglomeration and used narratives to appease skeptics:

 © 2021 RADMA and John Wiley & Sons Ltd

Luckily, I say as a citizen, unfortunately, maybe, as an employee of [car manufacturer], just because the VDA lobbies for this, does not mean politicians immediately do it. Sometimes it is coined this way in the newspapers, but it is not that way. We provide our arguments and explain our point of view, and others explain theirs. (Head of division, car manufacturer)

In line with this quotation, interviewees mentioned that car manufacturers exchange knowledge actively, formally, and informally at conferences, hearings, and at other events where car manufacturers, political representatives, and other players (e.g., insurance firms) meet to explain the AD technology and its potential benefits. The car manufacturers also carried out traditional OI practices, such as collaborating with competitors and suppliers to agree on technical standards.

4.4. Practices to mitigate reservations

External stakeholders do not see AD as unequivocally positive. While some shared the manufacturers' enthusiasm for AD, others raised reservations about the technology's safety, mainly regarding unresolved insurance and ethical issues, safety, and increased technology dependency:

The federal government is not interest in modern transport policy, but in facilitating new business fields for the German car industry. Although safety questions should be key, […] I have the impression that drivers are turned into guinea pigs. (Representative of political opposition)

To counter such criticism, the car manufacturers highlighted the support for AD from independent parties (e.g., research institutes, NGOs). For example, they referred to an independent report showing AD's benefits in energy efficiency and reduction of road casualties. Direct exposure activities such as letting key external decision-makers (i.e., governmental representatives) experience AD through test-driving concept cars at fairs and other demonstration projects were prime practices they employed to mitigate reservations in interaction with stakeholders. One car manufacturer collaborated with the mayor of a large European city, who was particularly interested in reducing the number of road casualties:

The mayor of [a European city] has himself set the goal of positioning his city as the city with the highest quality of life in the world. This is why he's so focused on issues around air pollution. He also wants to reduce the number of fatalities from car and traffic accidents. The pilot should provide evidence that AD contributes to this end. (Planning director, municipality)

Incumbent car manufacturers intended not only to enhance the legitimacy of their endeavors through demonstration projects but also to learn more about the technologies in real life ('*we learn about their problems and this helps us to redesign and adapt the approach to make it better for everyone*', Chief technology officer, car manufacturer). Working closely with 'lead users' (Franke et al., 2006) and incorporating the lessons from tests with external stakeholders into the ongoing development process is a prime example of the outside-in process of OI, which is defined as 'enriching the firm's own knowledge base through the integration of suppliers, customers, and external knowledge sourcing' (Gassmann and Enkel, 2004, p. 6). Collecting and utilizing data from real-life applications is especially important in the context of AI and AI-based technological solutions such as AD because such data can be immensely valuable in improving the underlying algorithms (Tarafdar et al., 2019).

4.5. Practices to institutionalize the desired change

When it comes to the actual legal and regulatory decisions that bring about institutional change in favor of AD, the car manufacturers avoid being seen as the central actors pushing for regulatory change.

[An 'ethics roundtable,' which was promoted by the government] was initiated by us via our industry association, but sometimes it's better to make [the policymakers] feel [that] they [are the] initiators. (CEO, car manufacturer)[1]

This approach stands in contrast to the findings in IE literature regarding less powerful actors. When less powerful actors advance institutional change, they position themselves close to it since this strong connection later helps them sell their innovative solution (Maguire et al., 2004; Kishna et al., 2017). The incumbent car manufacturers in our study, however, do not want to be perceived as topic owners; they prefer being seen as a small piece in the overall machinery that is driving institutional change.

We do not want to push it and then have NGO protests when the innovations have been introduced. [We seek to] find consent on ethical and data privacy issues early on, so that we know how to program the algorithms. (Senior corporate communications manager, car manufacturer)

© 2021 RADMA and John Wiley & Sons Ltd

This quotation also illustrates that seeking consent with relevant stakeholders at an early stage of NPD affects the ongoing innovation process. The algorithms are among the most important technological components for developing AD (Hengstler et al., 2016). By incorporating consensual agreements into the programming of algorithms, car manufacturers opened up their development process to stakeholder concerns.

Incumbent car manufacturers in our study are not looking for individual far-reaching legal decisions, but rather they pursue progressive strategies that seek a string of favorable decisions on successive incremental innovations. With a fully autonomous car clearly in their long-term technology roadmap, they take several small, incremental steps toward reaching the goal.

> Technology-wise, we would have been ahead by now, but we chose this little step. Otherwise, they [would] perceive the innovation as a landing from extraterrestrials. They would then surely object to it. (Technical expert, car manufacturer)

Rather than seeking one far-reaching change, incumbent car manufacturers felt they would increase their chances of obtaining consent and support through progressive strategies. They find value in buying time for the technology to develop, for the stakeholders to become accustomed to the innovation, and for themselves to learn from the processes. Rather than disrupting their institutional field (Zietsma and Lawrence, 2010; Pinkse et al., 2014) by endeavoring to introduce AD in one go, they seek gradual adaptations of institutions. Although these progressive strategies do not involve technology-focused measures traditionally associated with the inside-out process of open innovation – out-licensing technology, selling intellectual property, or multiplying technology through different applications – they have the characteristic of a socio-culturally-focused inside-out process. In this process, they leverage their 'knowledge by opening the firm's boundaries and gaining advantages by letting ideas flow to the outside' (Gassmann and Enkel, 2004, p. 11) to shape the institutional environment and dynamically adapt their new product development to the ongoing changes in their institutional environment.

5. Discussion

OI research deals with inflows and outflows of knowledge throughout the innovation process. Most OI studies focus on the direct involvement of external parties in a firm's technology development tasks, for example, on the generation of ideas with online crowds (West and Bogers, 2014; Randhawa et al., 2016). This traditional focal-firm perspective has recently been supplemented with a network/platform/ecosystem perspective on OI which studies the dynamic interactions of actors who co-create, complement, or adapt technological solutions (Tiwana et al., 2010; Holgersson et al., 2018; Dąbrowska et al., 2019). Such network processes move beyond the immediate control of a single firm (Bogers et al., 2017; Zobel and Hagedoorn, 2018; Marullo et al., 2021). To date, research in both the traditional focal-firm perspective and the emerging network/platform/ecosystem perspective has primarily focused on knowledge flows and activities related to the innovative solution per se rather than on knowledge flows and activities related to changes in the institutional environment of the innovation.

Our paper extends OI research by including an IE perspective. This perspective helped us distinguish between adaptation-oriented and shaping-oriented knowledge flows. Adaptation-oriented knowledge flows aim at adjusting the technology development process to a given institutional environment. They represent the inflows and outflows of knowledge that seek to improve the technical quality or commercial viability of a new product and that are typically investigated by OI researchers (Bogers et al., 2017, 2019). Shaping-oriented knowledge flows go beyond the new technology itself and aim at making institutions accommodate the innovation. Investigating shaping-oriented knowledge flows broadens the study of OI partners from actors directly involved in the production and consumption of the innovative solution (e.g., suppliers, customers, complementors, distributors) to actors with a more indirect relationship to the innovation, such as media or government. These latter actors contribute indirectly to innovation success by co-designing the socio-cultural and normative-regulative environment that the innovation will face after its launch. Thus, the IE perspective put forward in the present paper responds to the recent suggestion to understand OI 'as a wide innovation spectrum, which requires different types of knowledge and involves various types of change' (Ahn et al., 2017, pp. 735–736; see also Bogers et al., 2018).

As illustrated in Figure 1, our study identified ten practices that companies use to induce institutional change along with the three theoretical steps of creating saliency, mitigating reservations, and institutionalizing the desired change (Battilana et al., 2009; Hung and Whittington, 2011). Four of these practices elicit adaptation-oriented knowledge flows, while six practices elicit shaping-oriented knowledge flows. We uncovered that shaping and adaptation are

 © 2021 RADMA and John Wiley & Sons Ltd

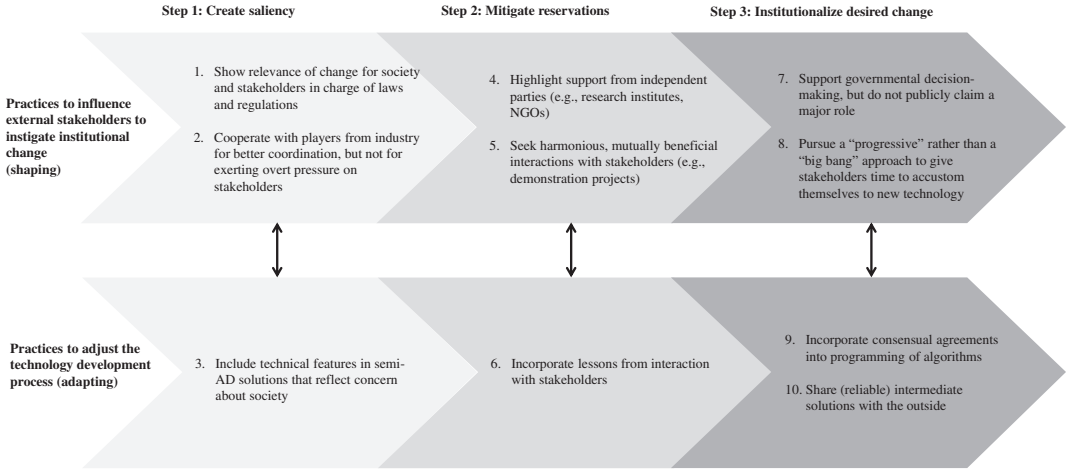


Figure 1. Overview of practices to induce institutional change while the technology development process is still underway.

integral elements in all three steps. The following section first discusses our findings with respect to adaptation and shaping separately, before addressing them jointly.

5.1. *Discovery 1: incumbents shape their environment while shying away from coercive use of power*

Recent research in the field of IE (Nenonen et al., 2019; Purtik and Arenas, 2019) shows how firms influence perceptions of business partners and customers about innovations they have launched. Such activities are often referred to as 'market shaping' (Baker and Nenonen, 2020; Nenonen and Storbacka, 2020). Consistent with this literature, we find that firms also perform 'shaping activities' in the pre-market phase when they develop their technologies. We also note that the nature of the practices in the pre-market phase is different from the practices that have previously been observed in the post-launch phase. According to prior IE research, firms often use their power as a means to overcome reservations, to enter political work aimed at overpowering regulators, and to enforce institutional change against resistance (Greenwood and Suddaby, 2006; Kishna et al., 2017; Ozcan and Gurses, 2018). This research often describes institutional change processes as battlefields in which institutional entrepreneurs attempt to maximize (e.g., by partnering with others) and exert (e.g., by entering framing contests) power to overwhelm their opponents (Maguire and Hardy, 2009; Ozcan and Gurses, 2018). The incumbent car manufacturers in our study did not use their power in such a confrontational manner. Rather, they actively sought more harmonious, mutually beneficial interactions with external stakeholders. They feared that offensive use of power could cause a more critical and less favorable assessment of the emerging innovation among the relevant stakeholders. They felt that broader consensus building within society rather than pushing too hard or too fast for the changes they desired is conducive to shaping the institutional environment in favor of AD.

5.2. *Discovery 2: incumbents adapt their NPD portfolio to dynamically evolving socio-cultural and legal institutions*

The incumbent car manufacturers in our study perceived the expectations and opinions of governmental decision-makers regarding AD to change dynamically through direct interactions with AD prototypes and continuous learning about semi-AD solutions. While the car manufacturers sought to influence the expectations and opinions of the relevant stakeholders, they were aware that their corresponding efforts are only one of many elements in the dynamics that shape institutions and that their immediate influence on these dynamics was limited (cf. Williams and Edge, 1996; Nenonen et al., 2019). Adaptation-oriented knowledge flows focus on responding to such dynamics and the remaining uncertainty about the emergent change by minimizing observed knowledge gaps and incorporating additional knowledge into the technology development process (Rindova and Courtney, 2020). Previous research has shown that firms can strengthen the stock of technological knowledge they can use for innovative solutions when they

© 2021 RADMA and John Wiley & Sons Ltd

open their development process to external sources (Chesbrough, 2003; Schweitzer et al., 2020). Our study indicates that car manufacturers also cooperate with external actors to gather socio-cultural and regulatory knowledge to nurture their technology development process. The practices they pursue towards this end – e.g., demonstration and pilot projects – resemble the practices highlighted in the existing literature as typical means to respond to emerging market opportunities (Rindova and Courtney, 2020) and typical means to implement the outside-in process of OI (Gassmann and Enkel, 2004; Ahn et al., 2016). That incumbent firms can use similar practices to deal with knowledge gaps in the technological, market, and regulatory sphere suggests that companies may be able to address knowledge gaps and uncertainties in more than one sphere at a time.

5.3. *Discovery 3: the relevance of combining adaptation-oriented and shaping-oriented knowledge flows*

Whereas firms with an adapting posture perceive the environment as externally given and seek to flexibly react to information about it, firms with a shaping posture treat the environment as malleable and intend to influence its evolution (Nenonen et al., 2019; Rindova and Courtney, 2020). Previous research theorizes firms as holding either a shaping or an adapting posture (Nenonen and Storbacka, 2020). In contrast, our findings from the ongoing technology development process show that firms engage in both shaping-oriented knowledge-flows (indicated by the upper area in Figure 1) and adaptation-oriented knowledge-flows (indicated by the lower area in Figure 1) during technology development. The firms in our study combined these two groups of practices to induce change in favor of AD. For example, we find that car manufacturers sought to institutionalize the desired change (step 3) by combining four practices. They contributed to governmental roundtables on ethical and liability issues around AD, where insurance companies, lawyers, data privacy specialists, and other stakeholders also voiced opinions and provided expertise (shaping-oriented knowledge flows, see practice 7 in Table 2). Based on these discussions, the car manufacturers continued technology development, programmed AD algorithms (adaptation-oriented knowledge flows; see practice 9 in Table 2), and shared their solutions with external stakeholders (adaptation-oriented knowledge flows; see practice 10 in Table 2). These measures add to their efforts to develop reliable solutions that avoid confrontation and controversy and to pursue progressive strategies that give stakeholders time to accustom themselves to the new technology (shaping-oriented knowledge flows, see practice 8 in Table 2). At a more abstract level, we find instances of shaping-oriented knowledge flows requiring adaptation-oriented ones to 'catch-up' with external developments by translating them into technology development and, vice versa, instances of adaptation-oriented knowledge flows as enablers of shaping-oriented work to 'push forward'. This interplay between shaping- and adaptation-oriented knowledge flows contributes to a close fit between the institutional environment and the innovation. Combining both types of knowledge flows seems particularly crucial when the institutional environment changes dynamically (Schweitzer et al., 2011; Bogers et al., 2019). As needs for change and knowledge about change evolve over time (Moeen et al., 2020; Vargo et al., 2020), being able to shift between adaption-oriented and shaping-oriented knowledge flows might be an important dynamic capability for firms in hitherto unaccommodating institutional environments.

6. Contributions and outlook

Our study investigates the practices used by incumbent German car manufacturers to induce AD-friendly institutional change while the technology is still under development. Our study makes key contributions to both OI and IE research.

First, the OI literature widely pinpoints the benefits of opening up the innovation process to multiple external sources of knowledge (Chesbrough, 2003; Enkel et al., 2020). However, it has so far predominantly focused on the exchange of technological and customer-needs information. For example, Alexy et al. (2013) propose multiple OI strategies based on the selective revelation of different kinds of technological knowledge. Building on von Hippel (1988), they distinguish problem-related and solution-related knowledge. The underrepresentation of non-technological knowledge in the OI literature is detrimental because some scholars argue that 'at the core of open innovation is the ability to create an ecosystem where people, organizations, and sectors can foster co-creation' (Bogers et al., 2018, p. 10). In most cases, the exchange of technological knowledge is in and of itself likely to be insufficient to create such ecosystems. Consequently, existing research 'represent[s]

 © 2021 RADMA and John Wiley & Sons Ltd

a rather focused (and potentially limited) interpretation of OI adoption, hindering a complete understanding of OI' (Ahn et al., 2015, p. 33). OI scholars have repeatedly urged their field to understand OI 'as a wide innovation spectrum, which requires different types of knowledge and involves various types of change' (Ahn et al., 2017, pp. 735–736) and have called for more research to broaden the OI domain (e.g., Alexy et al., 2013; Bogers et al., 2017; Chesbrough, 2017). Responding to these calls, our study examines knowledge flows targeted at inducing institutional change. Our paper complements the few existing OI studies that have dealt with non-technological knowledge. While these studies have examined knowledge on social and ethical issues (Holmes and Smart, 2009; Dangelico and Pujari, 2010; Arnold, 2017), our paper focuses on knowledge related to institutional change. This focus allows us to respond to a call from the general innovation literature, namely that innovation management should consider not only the process of technology development but also questions of institutional change and institutionalization (Jaakkola et al., 2019). The dedicated OI literature has argued that the latter questions have 'not yet been sufficiently understood' by OI research (Ahn et al., 2017, p. 728). Addressing this knowledge gap, our study finds that incumbent car manufacturers employ adaptation-oriented practices by which they adjust their technology development process as well as shaping-oriented practices by which they seek to influence external stakeholders as they develop AD solutions. Our focus on AD is in line with the argument that a broader conceptualization of OI—going beyond technological knowledge flows—is especially relevant in the early stage of development for digitally enabled technologies, which are to enter highly regulated but impactful sectors such as health, energy, and transport (Bogers et al., 2018; Enkel et al., 2020). In these cases, the level of uncertainty surrounding the emerging technologies and the need for changes in the institutional frameworks are particularly high. OI scholars have further identified a lack of knowledge about successful OI practices in the absence of clear formal, hierarchical structures to control and govern exchange (Bogers et al., 2017; Zobel and Hagedoorn, 2018). The practices that companies employ to induce institutional change identified in the present paper also speak to this knowledge gap.

Our study follows recent research, which has extended the boundaries of OI research by linking OI with other bodies of relevant literature (Ahn et al., 2017; Ritala and Stefan, 2021). Specifically, adopting an IE perspective on OI enables us to show that incumbents combine six shaping-oriented practices and four adaptation-oriented practices to induce institutional change in favor of AD while the technology is still under development.

Second, much of the IE literature has so far paid little attention to the activities employed by innovative incumbents to induce institutional change in favor of new technology while the main technology development process is underway. Two notable exceptions are the works of Gawer and Phillips (2013) and Purtik and Arenas (2019). Gawer and Philipps (2013) explored the internal and external institutional work undertaken by Intel Corporation as its industry switched from a supply chain to a platform logic. Purtik and Arenas (2019) analyzed how incumbents challenge and shape societal norms and expectations as well as user habits and routines in favor of environmentally sustainable technologies. While both focus on socio-cultural change, our focus on how firms can induce change in regulatory institutions surrounding a new technology complements such prior efforts. We identified novel practices not well featured in the IE literature. Existing IE research often emphasizes the role of power to enforce change (DiMaggio, 1988; Garud et al., 2007) and the role of motivation to effect change (Garud et al., 2007; Walker et al., 2014). The IE literature suggests that institutional entrepreneurs cooperate to increase their collective power and push for institutional change against resistance (Greenwood and Suddaby, 2006; Kishna et al., 2017; Ozcan and Gurses, 2018). Furthermore, previous IE research often perceives incumbents to have the power to enforce change (DiMaggio, 1988; Garud et al., 2007) while lacking the willingness to effect it (Garud et al., 2007; Walker et al., 2014). Consequently, previous studies primarily focus on practices for building motivation, largely ignoring the ways in which motivated incumbents advance institutional change. Their reasoning is that once motivated, incumbents would simply 'force change, even without the need for a supporting system' (Kishna et al., 2017, p. 264). In contrast to these previous findings, the incumbent car manufacturers in our study were clearly motivated to induce institutional change, but they adopted cautiously crafted practices rather than a brute force approach to accomplish this goal. Specifically, they avoid confrontation and controversy, incorporate consensual agreements into the programming of algorithms, support governmental decision-making without publicly claiming a major role, and share (reliable) intermediate solutions with the outside in order to institutionalize the desired change. All these practices can be interpreted as activities undertaken before launching

© 2021 RADMA and John Wiley & Sons Ltd

AD solutions to avoid tensions and battlefields once the AD solutions enter the market.

Since our study – like other exploratory research (Kukk et al., 2016; Kishna et al., 2017) – is based on a single industry and country, future research should explore the generalizability of our findings to other empirical contexts. Many radically new technologies, such as AD, hemp-based cosmetics, and genetically modified crops require an institutional change to achieve their full potential. We, therefore, believe that adopting an IE perspective on OI offers much potential for future research. For instance, future research could examine how the shaping- and adaptation-oriented practices vary across different sets of institutions that companies seek to change or analyze the shaping- and adaptation-oriented practices of non-incumbent firms. Because engaging in IE is likely to contain elements of coopetition, future research could also explore how firms seeking institutional change deal with the tensions that occur among them (Ritala et al., 2016; Ritala and Stefan, 2021) or with the paradoxical tensions they might experience between their own willingness and power to induce change. We hope that our study will inspire more efforts in these directions.

Acknowledgement

We thank the editors, the anonymous reviewers, as well as Ann-Kristin Zobel for their helpful comments.

REFERENCES

Ahn, J.M., Ju, Y., Moon, T.H., Minshall, T., Probert, D., Sohn, S.Y., and Mortara, L. (2016) Beyond absorptive capacity in open innovation process: the relationships between openness, capacities and firm performance. *Technology Analysis & Strategic Management*, **28**, 1009–1028.

Ahn, J.M., Minshall, T., and Mortara, L. (2015) Open innovation: a new classification and its impact on firm performance in innovative SMEs. *Journal of Innovation Management*, **3**, 33–54.

Ahn, J.M., Minshall, T., and Mortara, L. (2017) Understanding the human side of openness: the fit between open innovation modes and CEO characteristics. *R&D Management*, **47**, 727–740.

Alexy, O., George, G., and Salter, A.J. (2013) Cui bono? The selective revealing of knowledge and its implications for innovative activity. *Academy of Management Review*, **38**, 270–291.

Arnold, M. (2017) Fostering sustainability by linking co-creation and relationship management concepts. *Journal of Cleaner Production*, **140**, 179–188.

Baert, C., Meuleman, M., Debruyne, M., and Wright, M. (2016) Portfolio entrepreneurship and resource orchestration. *Strategic Entrepreneurship Journal*, **10**, 346–370.

Baker, J.J. and Nenonen, S. (2020) Collaborating to shape markets: emergent collective market work. *Industrial Marketing Management*, **85**, 240–253.

Battilana, J., Leca, B., and Boxenbaum, E. (2009) How actors change institutions: towards a theory of institutional entrepreneurship. *Academy of Management Annals*, **3**, 65–107.

Bogers, M., Chesbrough, H., Heaton, S., and Teece, D.J. (2019) Strategic management of open innovation: a dynamic capabilities perspective. *California Management Review*, **62**, 77–94.

Bogers, M., Chesbrough, H., and Moedas, C. (2018) Open Innovation: research, practices, and policies. *California Management Review*, **60**, 5–16.

Bogers, M., Zobel, A.-K., Afuah, A., Almirall, E., Brunswicker, S., Dahlander, L., Frederiksen, L., Gawer, A., Gruber, M., Haefliger, S., Hagedoorn, J., Hilgers, D., Laursen, K., Magnusson, M.G., Majchrzak, A., McCarthy, I.P., Moeslein, K.M., Nambisan, S., Piller, F.T., Radziwon, A., Rossi-Lamastra, C., Sims, J., and Ter Wal, A.L.J. (2017) The open innovation research landscape: established perspectives and emerging themes across different levels of analysis. *Industry and Innovation*, **24**, 8–40.

Bunduchi, R. (2017) Legitimacy-seeking mechanisms in product innovation: a qualitative study. *Journal of Product Innovation Management*, **34**, 315–342.

Cassiman, B. and Valentini, G. (2016) Open innovation: are inbound and outbound knowledge flows really complementary? *Strategic Management Journal*, **37**, 1034–1046.

Chesbrough, H. (2003) *Open Innovation*. Cambridge, MA: Harvard University Press.

Chesbrough, H. (2006) *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston, MA: Harvard Business School Press.

Chesbrough, H. (2017) The future of open innovation. *Research-Technology Management*, **60**, 35–38.

Creswell, J.W. and Miller, D.L. (2000) Determining validity in qualitative inquiry. *Theory into Practice*, **39**, 124–130.

Dąbrowska, J., Lopez-Vega, H., and Ritala, P. (2019) Waking the sleeping beauty: Swarovski's open innovation journey. *R&D Management*, **49**, 775–788.

Dangelico, R.M. and Pujari, D. (2010) Mainstreaming green product innovation: why and how companies integrate environmental sustainability. *Journal of Business Ethics*, **95**, 471–486.

DiMaggio, P. (1988) Interest and agency in institutional theory. In: Zucker, L.G. (ed.), *Institutional Patterns and Organizations: Culture and Environment*. Cambridge, MA: Ballinger. pp. 3–21.

Eisenhardt, K.M. (1989) Building theories from case study research. *Academy of Management Review*, **14**, 532–550.

 © 2021 RADMA and John Wiley & Sons Ltd

Enkel, E., Bogers, M., and Chesbrough, H. (2020) Exploring Open innovation in the digital age: a maturity model and future research directions. *R&D Management*, **50**, 161–168.

Franke, N., Von Hippel, E., and Schreier, M. (2006) Finding commercially attractive user innovations: a test of lead-user theory. *Journal of Product Innovation Management*, **23**, 301–315.

Garud, R., Hardy, C., and Maguire, S. (2007) Institutional entrepreneurship as embedded agency: an introduction to the special issue. *Organization Studies*, **28**, 957–969.

Garud, R., Jain, S., and Kumaraswamy, A. (2002) Institutional entrepreneurship in the sponsorship of common technological standards: the case of Sun Microsystems and Java. *Academy of Management Journal*, **45**, 196–214.

Garud, R. and Rappa, M.A. (1994) A socio-cognitive model of technology evolution: the case of Cochlear implants. *Organization Science*, **5**, 344–362.

Gassmann, O., and Enkel, E. (2004) Towards a theory of open innovation: three core process archetypes. *R&D Management Conference (RADMA)*. Lissabon.

Gawer, A. and Phillips, N. (2013) Institutional work as logics shift: the case of Intel's transformation to platform leader. *Organization Studies*, **34**, 1035–1071.

Gioia, D.A., Corley, K.G., and Hamilton, A.L. (2012) Seeking qualitative rigor in inductive research notes on the Gioia methodology. *Organizational Research Methods*, **16**, 15–31.

Greenwood, R. and Suddaby, R. (2006) Institutional entrepreneurship in mature fields: the big five accounting firms. *Academy of Management Journal*, **49**, 27–48.

Hengstler, M., Enkel, E., and Duelli, S. (2016) Applied artificial intelligence and trust—the case of autonomous vehicles and medical assistance devices. *Technological Forecasting & Social Change*, **105**, 105–120.

von Hippel, E. (1988) *The Sources of Innovation*. New York: Oxford University Press.

Hoffman, A.J. (1999) Institutional evolution and change: environmentalism and the US chemical industry. *Academy of Management Journal*, **42**, 351–371.

Holgersson, M., Granstrand, O., and Bogers, M. (2018) The evolution of intellectual property strategy in innovation ecosystems: uncovering complementary and substitute appropriability regimes. *Long Range Planning*, **51**, 303–319.

Holmes, S. and Smart, P. (2009) Exploring open innovation practice in firm-nonprofit engagements: a corporate social responsibility perspective. *R&D Management*, **39**, 394–422.

Huizingh, E.K.R.E. (2011) Open innovation: state of the art and future perspectives author. *Technovation*, **31**, 2–9.

Hung, S.-C. and Whittington, R. (2011) Agency in national innovation systems: institutional entrepreneurship and the professionalization of Taiwanese IT. *Research Policy*, **40**, 526–538.

Jaakkola, E., Aarikka-Stenroos, L., and Ritala, P. (2019) Institutionalization process of service innovation. In: Maglio, P., Kieliszewski, C., Spohrer, J., Lyons, K., Patrício, L., and Sawatani, Y. (eds), *Overcoming Competing Institutional Logics in Service Ecosystems. Handbook of Service Science*, Volume II. Cham: Springer. pp. 497–516.

Kalantaridis, C. and Fletcher, D. (2012) Entrepreneurship and institutional change: a research agenda. *Entrepreneurship & Regional Development*, **24**, 199–214.

Kishna, M., Negro, S., Alkemade, F., and Hekkert, M. (2017) Innovation at the end of the life cycle: discontinuous innovation strategies by incumbents. *Industry and Innovation*, **24**, 263–279.

Kukk, P., Moors, E.H.M., and Hekkert, M.P. (2016) Institutional power play in innovation systems: the case of Herceptin®. *Research Policy*, **45**, 1558–1569.

Lee, C.-K. and Hung, S.-C. (2014) Institutional entrepreneurship in the informal economy: China's Shan-Zhai mobile phones. *Strategic Entrepreneurship Journal*, **8**, 16–36.

Maguire, S. and Hardy, C. (2009) Discourse and deinstitutionalization: the decline of DDT. *Academy of Management Journal*, **52**, 148–178.

Maguire, S., Hardy, C., and Lawrence, T.B. (2004) Institutional entrepreneurship in emerging fields: HIV/AIDS treatment advocacy in Canada. *Academy of Management Journal*, **47**, 657–679.

Markard, J., Wirth, S., and Truffer, B. (2016) Institutional dynamics and technology legitimacy – a framework and a case study on biogas technology. *Research Policy*, **45**, 330–344.

Marullo, C., Martelli, I., and Di Minin, A. (2021) The many shades of 'openness': an application of item response theory to open innovation research. *R&D Management*, **51**, 127–146.

Mitchell, R., Agle, B., and Wood, D. (1997) Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts. *Academy of Management Review*, **22**, 853–886.

Moeen, M., Agarwal, R., and Shah, S. (2020) Building industries by building knowledge: uncertainty reduction over industry milestones. *Strategy Science*, **5**, 218–244.

Mortara, L. and Minshall, T. (2011) How do large multinational companies implement open innovation? *Technovation*, **31**, 586–597.

Munir, K.A. and Phillips, N. (2005) The birth of the 'kodak moment': institutional entrepreneurship and the adoption of new technologies. *Organization Studies*, **26**, 1665–1678.

Nenonen, S. and Storbacka, K. (2020) Don't adapt, shape! Use the crisis to shape your minimum viable system – and the wider market. *Industrial Marketing Management*, **88**, 265–271.

Nenonen, S., Storbacka, K., and Windahl, C. (2019) Capabilities for market-shaping: triggering and facilitating increased value creation. *Journal of the Academy of Marketing Science*, **47**, 617–639.

© 2021 RADMA and John Wiley & Sons Ltd

NHTSA. (2016) *Automated Vehicles for Safety*. Available at: https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety#topic-road-self-driving.

Orr, R.J. and Scott, W.R. (2008) Institutional exceptions on global projects: a process model. *Journal of International Business Studies*, **39**, 562–588.

Ozcan, P. and Gurses, K. (2018) Playing cat and mouse: contests over regulatory categorization of dietary supplements in the United States. *Academy of Management Journal*, **61**, 1789–1820.

Palmié, M., Boehm, J., Lekkas, C.K., Parida, V., Wincent, J., and Gassmann, O. (2021) Circular business model implementation: design choices, orchestration strategies, and transition pathways for resource-sharing solutions. *Journal of Cleaner Production*, **280**, 124399.

Patton, M.Q. (2002) *Qualitative Research and Evaluation Methods*, 3rd edn. Thousand Oaks, CA: Sage Publications.

Pinkse, J., Bohnsack, R., and Kolk, A. (2014) The role of public and private protection in disruptive innovation: the automotive industry and the emergence of low-emission vehicles. *Journal of Product Innovation Management*, **31**, 43–60.

Purtik, H. and Arenas, D. (2019) Embedding social innovation: shaping societal norms and behaviors throughout the innovation process. *Business & Society*, **58**, 963–1002.

Randhawa, K., Wilden, R., and Hohberger, J. (2016) A bibliometric review of open innovation: setting a research agenda. *Journal of Product Innovation Management*, **33**, 750–772.

Rindova, V. and Courtney, H. (2020) To shape or adapt: knowledge problems, epistemologies, and strategic postures under knightian uncertainty. *Academy of Management Review*, **45**, 787–807.

Ritala, P., Kraus, S., and Bouncken, R.B. (2016) Introduction to coopetition and innovation: contemporary topics and future research opportunities. *International Journal of Technology Management*, **71**, 1–9.

Ritala, P. and Stefan, I. (2021) A paradox within the paradox of openness: the knowledge leveraging conundrum in open innovation. *Industrial Marketing Management*, **93**, 281–292.

Schweitzer, F.M., Gassmann, O., and Gaubinger, K. (2011) Open innovation and its effectiveness to embrace turbulent environments. *International Journal of Innovation Management*, **15**, 1191–1207.

Schweitzer, F., Van den Hende, E.A., and Hultink, E. (2020) There's more than one perspective to take into account for successful customer integration into radical new product innovation: a framework and research agenda. *IEEE Transactions on Engineering Management*, **67**, 813–829.

Scott, W.R. (2013) *Institutions and organizations: Ideas, interests, and identities*. Thousand Oaks, CA: Sage Publications.

Siggelkow, N. (2007) Persuasion with case studies. *Academy of Management Journal*, **50**, 20–24.

Tarafdar, M., Beath, C.M., and Ross, J.W. (2019) Using AI to enhance business operations. *MIT Sloan Management Review*, **60**, 37–44.

Tian, Z., Shi, J., Hafsi, T., and Tian, B. (2017) How to get evidence? The Role of government-business interaction in evidence-based policy-making for the development of internet of things industry in China. *Policy Studies*, **38**, 1–20.

Tiwana, A., Konsynski, B., and Bush, A.A. (2010) Platform evolution: coevolution of platform architecture, governance, and environmental dynamics. *Information Systems Research*, **21**, 675–687.

Vargo, S.L., Akaka, M.A., and Wieland, H. (2020) Rethinking the process of diffusion in innovation: a service-ecosystems and institutional perspective. *Journal of Business Research*, **116**, 526–534.

Verworn, B. (2009) A structural equation model of the impact of the "fuzzy front end" on the success of new product development. *Research Policy*, **38**, 1571–1581.

Walker, K., Schlosser, F., and Deephouse, D.L. (2014) Organizational ingenuity and the paradox of embedded agency: the case of the embryonic ontario solar energy industry. *Organization Studies*, **35**, 613–634.

Wareham, J., Fox, P.B., and Giner, J.L.C. (2014) Technology ecosystem governance. *Organization Science*, **25**, 1195–1215.

West, J. and Bogers, M. (2014) Leveraging external sources of innovation: a review of research on open innovation. *Journal of Product Innovation Management*, **31**, 814–831.

Williams, R. and Edge, D. (1996) The social shaping of technology. *Research Policy*, **25**, 865–899.

Zietsma, C. and Lawrence, T.B. (2010) Institutional work in the transformation of an organizational field: the interplay of boundary work and practice work. *Administrative Science Quarterly*, **55**, 189–221.

Zobel, A.-K. and Hagedoorn, J. (2018) Implications of open innovation for organizational boundaries and the governance of contractual relations. *Academy of Management Perspectives*, **34**, 400–423.

Note

[1] One journalist who was interviewed doubted that the Ethics Commission was actually initiated by the car manufacturers and believed that it was initiated by the government. Either way, the above quotation of the CEO of a car manufacturer underscores the perspective that the incumbents do not want to be seen as leaders of the initiative.

Fiona Schweitzer is a Full Professor of Marketing at the Grenoble Ecole de Management. Her academic research focuses on the role of marketing in new product development, customer integration into the innovation process, and proactive marketing in high-tech and digital industries. She has won several best-paper awards and has presented and published her work at various scientific conferences and in academic journals, such as the *Journal of Product Innovation Management*, *International Journal of Innovation*

 © 2021 RADMA and John Wiley & Sons Ltd

Management, *Creativity & Innovation Management*, *Psychology & Marketing*, and *Research Technology Management*.

Maximilian Palmié is an Assistant Professor of Energy and Innovation Management at the University of St. Gallen (Switzerland). He received his PhD in Management from the University of St. Gallen. His research focuses on sustainability innovation and the micro-foundations of technology and innovation management. His work has been published in journals such as *Entrepreneurship Theory & Practice*, the *International Journal of Management Reviews*, the *Journal of Cleaner Production*, the *Strategic Entrepreneurship Journal*, or *R&D Management*.

Oliver Gassmann is a Professor of Innovation Management and Managing Director of the Institute of Technology Management at the University of St. Gallen, Switzerland. His research focuses on how companies innovate and benefit from innovation. His research has appeared in leading journals, such as *Research Policy*, *R&D Management*, *Journal of Management*, *Long Range Planning*, or *International Journal of Technology Management*. In 1998, he was awarded the RADMA prize for his leading commitment to research with practical relevance in innovation management. In 2009, he was designated one of the most active top 50 researchers by IAMOT in Orlando (US).

Jonas Kahlert is a PhD graduate from the University of St. Gallen, Switzerland. His research adopts a stakeholder-theoretic perspective on how firms seize new business opportunities in a joint approach with their ecosystem partners. He has presented and published his work at various scientific conferences, in book chapters and journals, such as the SMS Special Conference and the R&D Management Conference. Jonas was awarded a scholarship from the Swiss National Science Foundation for staying one year at Stanford University as a visiting researcher to deepen his research at the intersection of strategic management and innovation management. He now is Head of Professional Services, Alps Region at Google.

Tobias Roeth is a post-doctoral researcher at the Chair of Technology and Innovation Management at the University of Kassel, Germany. In 2018, he received his Ph.D. from the University of Kassel and his bachelor's as well as master's degrees in business administration and management from the University of Kiel, Germany. He was a visiting scholar at Arizona State University. His research focuses on new product development, innovation portfolio management, as well as sensemaking research. His published work appears in academic management journals, including *Journal of Product Innovation Management, Industrial Marketing Management, International Journal of Innovation Management*, and *Journal of Business Research*.

© 2021 RADMA and John Wiley & Sons Ltd

APPENDIX A
Interview questions

Key topics in the interview		Guiding questions
Part 1. Firms/ Other actors	Professional background of the interviewee, involvement in autonomous driving	How long have you been working on autonomous driving issues?
		Firms (all), other actors (where applicable):
		Please tell us about the project you are currently working on.
		What is your role in this project?
		What is your opinion on autonomous driving?
Part 2. Firms/ Other actors	Key challenges and opportunities in the institutional environment	What are the key opportunities faced by autonomous driving currently?
		What are the key challenges faced by autonomous driving currently?
	Key actors' influencing challenges/opportunities	Think about the society at large, the politicians, media, and other stakeholders outside the firm: how supportive or unsupportive are they with respect to your project (*only for firms*) – autonomous driving in general (*for firms and other actors*)?
Part 3. Firms	Actions taken by the innovating firm	You mentioned (challenges/opportunities): which stakeholders have a significant influence on your ability to seize the opportunity/tackle the challenge? By how much?
		What is the position of these stakeholders towards autonomous driving? What are they doing, and what do you think they should do with respect to autonomous driving?
		What is your relationship with (actor XY)? What have you – alone or with others – done to influence (actor XY) towards taking positive actions with respect to autonomous driving? What was the reaction? What are your plans for the future?
Part 3. Other actors	Activities to facilitate/ hinder AD, along with the reasons for and outcomes of their activities, type/content of contact with firms	You mentioned (challenges/opportunities): in your opinion, who has a bigger influence on a firm's ability to seize the opportunity/tackle the challenge? By how much? Please tell us more about this. What is their position towards autonomous driving? What are they doing, and what do you think they should do with respect to autonomous driving?
		What is your/your organization's influence in this respect? What are you – alone or with others – doing for or against autonomous driving? What are your plans for the future?

APPENDIX B
Extracts of the coding system

Steps	Examples of codes and quotations
Create saliency	**Show relevance of change for society and stakeholders in charge of laws and regulations**
	'It could be attractive for lorry drivers. Currently, they have very strict schedules. They have to take a 45-minute break after every 4.5 hr of driving. With autonomous systems, such regulations could become looser and allow drivers more flexibility.' (Car manufacturer)
	'One day it might lead to a more inclusive society; a fully autonomous car would allow people who cannot drive traditional cars, to drive, think of the blind or very old people.' (Media)
	'It helps German car manufacturers stay competitive, innovative—it fits their strengths, so from a job-creation perspective, autonomous driving is very positive.' (Consultant)
	'We intensively informed media about autonomous driving issues. Something did change here. Politicians, for a long time, did not pay attention to the topic. This is now slowly changing. The media hype around the topic made politicians more aware and more ready to deal with the topic.' (Car manufacturer)
	The majority of accidents today are due to human error, AD can help here. (Media)
	'Of course, the legislator recognizes that the [national] automotive industry is not the only one working on it. So, this topic has suddenly become not only a topic for one OEM but also a strategic national topic. The automotive industry in Germany is accorded a very high priority since many jobs depend on it.' (Research institutions)
	'We show that not only the German automotive industry is working on this issue, but that new international players have also moved in. Then, suddenly the politicians became very interested, because then it is no longer just a matter of car manufacturers, but an issue relating to industrial politics.' (Car manufacturer)

 © 2021 RADMA and John Wiley & Sons Ltd

Appendix B (Continued)

Steps	Examples of codes and quotations
	Cooperate with players from within the industry for better coordination, but not for exerting overt pressure on stakeholders
	'It does not make sense for you to press ahead and ask for legal permission for this or that great feature and then you bite the dust […] If you want to make it happen, you have to work together.' (Car manufacturer)
	'There are many events, conferences, congresses on this topic and often important stakeholders participate, so you exchange, in some cases more formally, in others more informally, and you explain your perspective and the changes you ask for.' (Car manufacturer)
	'The whole department is away a lot on business—to talk to politicians and on conferences… to sensitize them to this innovation, to inform them, and to bring them in and potentially form alliances. If you went alone, it simply wouldn't work.' (Car manufacturer)
	'There are these opinion formation processes in the legal framework, and it is important to speak with one voice as an industry in these fora.' (Car manufacturer)
	'The car manufacturers then saw that it is important to work together on this issue in the VDA. We saw the benefit of playing this jointly in the association. Autonomous driving started four or five years ago. It makes sense.' (Supplier)
	'Others might be 'in' for other reasons. And this might become a big challenge and end up in a mess, even if it looks teasing in the beginning.' (Car manufacturer)
	'Basically, support from other players makes your case stronger, but too much diversity or choice of the 'wrong' supporters is dangerous.' (Car manufacturer)
	'Then, we met in the context of a workgroup and quickly realized that we could join forces and pull together here.' (Car manufacturer)
	'They need to agree on technical standards to get ahead with AD.' (Consultant)
	'All issues that end up in standardization are discussed with competitors on the German level and even the European level. If all cars had different X, it would be chaotic.' (Car manufacturer)
	Include technical features in semi-AD solutions that reflect concern about society
	'Clarity about technical standards and the development projects for roads are among the pivotal things we need to put our money into, the right things, to develop our technology the right way.' (Car manufacturer)
	'We have encouraged and implemented many devices that increase road safety – AD also serves the purpose. Think of semi-AD solutions such as lane assistants and more complex advanced driving assistance systems…. We really encourage any useful AI device, take alco-lock systems or detections of a driver's sleepiness – even if they are not directly connected to AD, indirectly such solutions add to linking AI to something beneficial in society, and this helps the case for AD.' (Car manufacturer)
	I feel that they constantly improve cars to reduce the negative sides of driving. They listen to the critics and make it better. Not all drivers are good drivers, and AD might help to reduce accidents due to mistakes of bad drivers – this is what I like about it. Although me, personally, I love driving, I enjoy being behind the steering wheel (Consumer)
	'Many people seem to have this big fear of AI, but AI can make the world a better place, it's fascinating. It always depends on the purpose – anti-drunk driving devices, for example, are a good thing. So often, people die because a drunken driver hits them. If an AI solution prevents alcoholics from driving, that's awesome. And if blind people live a more independent life, because of AD that's awesome, too. (Consumer)
Mitigate reservations	**Highlight support from independent parties (e.g., research institutes, NGOs)**
	'The government needs to see evidence that this will work. And this evidence should come from the firms and multiple, independent sources.' (Consultant)
	'We targeted institutes from the environmental field and similar players and explained the new technology and discussed it with them.' (Car manufacturer)
	'There are studies indicating that autonomous driving reduces accidents and fuel consumption due to better passing maneuvers and anticipatory driving.' (Municipality)
	'We can … simply say we need a law for a new truck … that uses improved technology, etc. This is, however, not interesting to policymakers… [However, if we say that] due to [a truck's] autonomous driving capabilities and its communication abilities [with] the infrastructure and other trucks, more than 5% of fuel savings are possible … – and certainly also can show proof –… fleet managers and policymakers can become [more] interested.' (Car manufacturer)

© 2021 RADMA and John Wiley & Sons Ltd

Appendix B (Continued)

Steps	Examples of codes and quotations
	'It could reduce congestion. A large proportion of traffic in cities is caused by drivers driving round after round to find a parking space nearby. The autonomous car does not have to park next to the restaurant, it drops the driver, finds its place a bit outside, and comes back when you need it.' (Research institution)
	Seek harmonious, mutually beneficial interactions with stakeholders (e.g., demonstration projects)
	'[The mayor] has now launched and funded initiatives and research projects on drivers' assistance systems, which now not only focus on pedestrian protection but also on the whole subject of autonomous driving. He wants a partner to create more awareness and put more funds in this topic in the future.' (NGO)
	'An initiative with city managers for urban development projects makes sense—a kind of demonstration project where you not only demonstrate the technical product—you can do that at a fair, but you also demonstrate the innovation in its social system and context. That's important for reducing doubt and building trust.' (Municipality)
	'It [the demonstration] enables them to see that AD is not just an academic concept, but can really work. Of course, they are also more open for project funding and other issues.' (Consultant).
	'They give us quite exclusive possibilities to see their innovations early on. I accompanied a test-driver, that was exciting. Surely, I share this good experience with my readers.' (Journalist)
	'They initiate projects with the more broad-minded municipalities to try what can work and how it can work. Sharing positive results and experiences afterward they then try to convince more skeptical ones.' (Consultant)
	'Different systems and technologies can be tested on a considerably long section of highway A9 […] This is an invitation for the industry to present their developments and innovations to the federal government and to test them.' (Representative of the federal government)
	Incorporate learnings from interaction with stakeholders
	'The demonstration project helps to study the impact; citizens learn about it, we learn about their problems, and this helps us to redesign and adapt the approach to make it better for everyone.' (Car manufacturer)
Institutionalize the desired change	**Support governmental decision-making but do not publicly claim a major role**
	'The Ministry of Transport called for the round table in 2013 to look into the issue from different angles. The car industry participated. Suppliers, insurance firms, the ADAC [a big German automobile club], and lawyers were also in. The idea is to discuss on a broad societal basis; everyone is free to voice their concerns and motivations, and we discuss the required legal framework: how to deal with data protection, liability rules, and so on.' (Government representative)
	'It is in the interest of the legislators, that they get a wide picture of the different opinions from all stakeholders. On this basis, they say then, 'OK, let's do it that way.' And it does not come to you as a total surprise because you helped prepare the lengthy consensus by finding approaches with other stakeholders.' (Car manufacturer)
	'We are in close exchange with X [a Federal Highway Research Institute] on many technical details regarding autonomous driving. There are legal grey areas that need interpretation, and they need our insights for their consultancy work. When the homologation experts have difficulties in explaining details, we provide the required details. It is a mutually beneficial relationship. We help them do their job and vice versa. For example, X is an advisory body, like others, to the KBA [the Federal Motor Transport Authority]. They made it clear to KBA that [our autonomous solution] is a partly automated form of driving, not a fully automated one. This made it easy for us to get the necessary permissions. X had a key driver role in this respect; a very useful one.' (Car manufacturer)
	'[An 'ethics roundtable,' which was promoted by the government] was initiated by us via our industry association, but sometimes it's better to make [the policymakers] feel [that] they [are the] initiators.' (Car manufacturer)
	'Sometimes you have to lean back and give them [government] the feeling they are driving it.' (Car manufacturer)
	'You have to build trust in the innovation. And this holds true not only for users but also for politicians. They will not be able to evaluate a fully autonomous system and will be reluctant to legalize it, when they have not yet seen a single semi-automated system on the roads. So, it is better to take your time and make little steps forward.' (Car manufacturer)
	'If there is a willingness on the part of the government or the legislator, then it can move fast … faster. Then such a technology can get widely accepted quite fast.' (Consultant)

 © 2021 RADMA and John Wiley & Sons Ltd

Appendix B (Continued)

Steps	Examples of codes and quotations
	'They go on their knees before industry, and move before the car manufacturers even have to ask.' (Non-governmental organization)
	Pursue a 'progressive' rather than a 'big bang' approach to give stakeholders time to accustom themselves to new technology
	'Technology-wise, we would have been ahead by now, but we chose this little step. Otherwise, they [would] perceive the innovation as a landing from extraterrestrials. They would then surely object to it.' (Car manufacturer)
	'Enforcing a speedy realization serves little for your case… it is a question of trust. If you use [innovation X] for the first time, you will not say, 'OK, I press the button and go away.' You will stay close and watch what happens, and you will make sure that you can interfere when necessary. You have to build trust in the innovation. And this holds true not only for users but also for politicians. They will not be able to evaluate a fully autonomous system and will be reluctant to legalize it, if they have not seen a single semi-automated system on the roads. So, it is better to take your time and take little steps forward.' (Car manufacturer)
	Avoid confrontation and controversy by launching reliable solutions only
	'We don't even want to see it on the streets too early. Even if it is a competitor instead of us, doing it wrong, it is negative for AD in general, and thus bad for us too' (Car manufacturer)
	'It is fascinating but it also has its dangers. I did a test drive with a pro on my side and I would not want to drive through the city center with a fully automated car on my own for now.' (Media)
	'If they bring X to the market now and it crashes, we all have a problem. So, it is good for the emerging autonomous driving field at large that some things are not yet legally possible.' (Car manufacturer)
	'We do not want to push it and then have NGO protests on the streets when the innovations are introduced. We understand concerns. We find that technical solutions should only come to the market when they are 100% safe.' (Car manufacturer)
	Incorporate consensual agreements into the programming of algorithms
	'We need clarity on ethical issues. Driving decisions that were up to individual human drivers' discretion up till now require algorithmic rules in AD. The ethical commission that the government initiated is a first and important step that provides input for us to continue with this.' (Car manufacturer)
	'It is also good to find consent on ethical and data privacy issues early on, so that we know how to program the algorithms.' (Car manufacturer)
	Share (reliable) intermediate solutions with the outside
	'Well, if it still has a brake pedal and a wheel, then fine. But without that, there is simply a lot of skepticism. Consumers are afraid of giving total control to a car. Semi-autonomous driving empowers them but for fully autonomous driving, I am not so sure.' (Research institution)
	'It is important to see how they react to these changes. The interaction, the feedback helps us plan our next step.' (Car manufacturer)

© 2021 RADMA and John Wiley & Sons Ltd