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SME PARTICIPATION IN RESEARCH GRANT CONSORTIA – THE EMERGENCE OF COORDINATED ATTENTION IN COLLABORATIVE INNOVATION

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Keywords: SME, collaborative innovation, innovation consortia, grant proposal, coordination, attention-based view

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ABSTRACT

Research funding organizations routinely encourage SMEs to collaborate with organizations of different institutional backgrounds, such as other firms, universities, or research organizations. These collaborations are supposed to involve SMEs in knowledge flows across boundaries and generate innovative solutions to complex problems. However, we know little about how the project partners determine the priorities of their joint research in the first place and how the institutional composition influences priority setting. In this paper, we study attention coordination among SMEs and their partners for the emergence of priorities in joint research grant proposals. Applying content analysis to 207 grant proposals of innovation consortia that have received funding in the EU's Horizon 2020 program, we find that increasingly diverse consortia shift attention away from technological novelty and market creation towards more consideration for the innovation ecosystem.

PLAIN ENGLISH SUMMARY

SMEs in publicly funded research consortia often benefit from the diversity of partners but diversity also influences how partners write up the grant proposal. They put more emphasis on embeddedness in the ecosystem but less on technological novelty.

SMEs often collaborate with organizations of different institutional backgrounds, such as other firms, universities, or research organizations, in publicly funded innovation projects. While these collaborations are often beneficial, SMEs need to coordinate with their project partners about how to set priorities in the grant proposal. Our analysis, which is based on the proposal texts of 207 EU funded research consortia, reveals that increasingly diverse consortia put more emphasis on the embeddedness into an innovation ecosystem but less on achieving technological novelty. Our research has implications for SMEs that seek to collaborate for innovation and for public funding bodies that can better assess the likely innovation impact of a grant proposal.

Keywords: SME, collaborative innovation, innovation consortia, grant proposal, coordination, attention-based view

JEL Classification: O31, O38

INTRODUCTION

Collaborative innovation projects involving multiple organizations dominate most publicly funded research programs (Levén, Holmström, and Mathiassen, 2014; Rodríguez, Fisher, and Schuurbiers, 2013). Many of those programs have moved towards encouraging or requiring the involvement of small and medium sized enterprises (SMEs) for large-scale grants (Audretsch and Link, 2011). The European Union's Framework Programs for Research and Technological Development (FP) are a case in point. They usually require organizations to form diverse consortia including universities, research institutes, public entities, as well as private companies such as SMEs.[1] In fact, a key criterion in the evaluation of grant proposals is a consortium's composition (Olsen, Sofka, and Grimpe, 2016). The focus on SME participation stems from two interconnected rationales. On the one hand, SMEs are more likely to suffer from resource constraints for ambitious innovation projects (Hewitt-Dundas, 2006) while large firms are more likely to engage in these risky projects anyway (Audretsch and Keilbach, 2008). On the other hand, SMEs are likely to benefit disproportionately from the outcomes of the government supported innovation projects since resulting products and technologies can create new growth opportunities for them (Lindholm Dahlstrand, 1997; Audretsch and Link, 2011; Olsen *et al.*, 2016).

However, the participation in large-scale grant competitions puts many SMEs in an unusual context in which they cannot set priorities about innovation goals and approaches independently but have to coordinate them with a multitude of partners in the consortium. Collaboration is sup-

[1] See Article 9 in the Regulation (EU) no. 1290/2013 on the conditions for participation (http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/rules_participation/h2020-rules-participation_en.pdf). The regulation requires that participants originate from (at least) three different member states and constitute separate legal entities.

posed to stimulate knowledge flows across various scientific disciplines and industries, increasing the prospects of finding novel solutions that will be broadly accepted by the market and have strong societal impact (Defazio, Lockett, and Wright, 2009; Rodríguez et al., 2013). While consortia, compared to individual organizations, can attend to more facets of a complex task environment (Lawrence and Lorsch, 1967), consortium members need to reach an agreement on the priorities that can be formulated in a joint proposal and eventually be addressed in the project. However, extant research provides little guidance about how the consortium members determine the priorities of their proposal in the first place and whether the institutional composition of the consortium affects these joint priorities.

Understanding the emergence of joint priorities in consortia is particularly salient for the SME context because of two interconnected reasons. On the one hand, limited resources in SMEs require them to share costs and risks with partners in their innovation activities (Hewitt-Dundas, 2006). These constraints make them likely to favor collaborative innovation with immediate effects on sales and competitiveness (Audretsch & Keilbach, 2008; Baum, Calabrese, and Silverman, 2000). On the other hand, these priorities of SMEs for commercialization often times match the political objectives for the research grants, such as the European Union's FPs, envisioning rapid economic effects (Nepelski, Van Roy, and Pesole, 2019). This alignment of interests has tangible consequences. SMEs have, for instance, the most explicit targets for market relevant outcomes of government supported research projects such as prototypes (Polt, Vonortas, and Fisher, 2008). The combination of these factors makes it relevant to develop a structured logic for the mechanisms driving joint priority setting in consortia involving SMEs and other partners.

In this study, we explore the outcomes of the coordination process within innovation consortia in which SMEs participate by drawing from the attention-based theory of organizational behavior (Ocasio, 1997). Based on a comprehensive literature review, we identify four distinct priorities that are commonly considered as crucial in the context of public funding competitions of innovation activities (cf. De Prato, Nepelski, and Piroli, 2015; Lo and Li, 2018) and to which consortia typically allocate attention: technological novelty, market creation, ecosystem embeddedness, and innovation readiness. While considering the requests from the funding organization, consortia go through a coordination process reflecting the priorities of all partners with potentially widely diverging capabilities, goals and incentives. Attention coordination occurs through proposal drafts, negotiations and compromises. We reason that differences in the institutional composition of consortia involving SMEs are a crucial determinant for the degree to which their joint proposals devote comparatively more attention to some priorities than to others.

Extant literature on collaborative innovation is inconclusive about the effects that a diverse institutional composition of a consortium will have. Some evidence suggests that diversity is conducive to better attending to the diverse facets of complex innovation problems (e.g., Laursen and Salter, 2006; Grimpe and Sofka, 2009; Garriga, von Krogh, and Spaeth, 2013) by allowing for a division of labor in the search process (Fleming and Sorenson, 2004) and enabling novel combinations with existing knowledge (Rosenkopf and Nerkar, 2001). At the same time, diversity may hamper coordination, leading to mutual confusion or agreements that represent the lowest common denominator (e.g., Olsen *et al.*, 2016).

While most literature on collaborative innovation is focused on the outcomes of the projects once they have been started, the planning stage, which precedes the execution stage and in which

partners have to agree on the goals and approaches, has been less researched. Within our reasoning, the coordination of attention and joint priorities predetermine to a large extent how a consortium involving SMEs will conduct joint research (cf. Barr, 1998; Cho and Hambrick, 2006; Nadkarni and Barr, 2008). Given the lack of understanding how consortia initially dedicate attention to different priorities and the inconclusive role of institutional composition, we adopt an exploratory approach. Specifically, we make use of privileged access to 207 grant proposals of consortia with participating SMEs that received funding in the European Union's Horizon 2020 framework program and apply content analysis to the proposal texts to detect meaningful patterns of attention priorities. Subsequently, we relate the identified priorities to the institutional composition and other characteristics of the consortia. Our empirical findings support the notion that the institutional composition of consortia affects their research priorities. Increasingly diverse consortia pay comparatively more attention to the innovation ecosystem at the expense of technological novelty. Consortia also consider defining new markets for the intended innovations (market creation) when they have diverse partners but this effect is curvilinear and diminishes quickly after a certain threshold.

By applying content analysis to a large number of proposal texts normally inaccessible for research purposes, our research makes several contributions to extant literature and has important implications for SME and innovation policy making. First, we identify and substantiate four attention priorities in proposals that are directed towards distinct facets of an innovation problem (Felin and Zenger, 2014). The attention priorities reflect the content of a proposal and, in that sense, move beyond generic descriptions of organizational search in prior literature, for example along the breadth, depth, scope, pattern, or direction of search (Katila and Ahuja, 2002; Laursen and Salter, 2006; Grimpe and Sofka, 2009; Köhler, Sofka, and Grimpe, 2012).

Second, our research accounts for the fact that many innovation problems are solved collaboratively and that the formulation of a proposal is a negotiation process among specialized organizations that may search within their individual domains and prioritize differently (Lawrence and Lorsch, 1967; Knudsen and Srikanth, 2014). Understanding how the priorities of such research consortia emerge is crucial for SMEs which are rarely the most resourceful or scientifically acclaimed partners (Hewitt-Dundas, 2006). Teasing out the role of the institutional composition of a consortium therefore helps to better explain the collaborative process leading up to the submission of a proposal. This has implications for the literature that stresses the role of individual actors, such as universities, for organizational search in general (e.g., Laursen and Salter, 2004; Köhler *et al.*, 2012) and for SMEs in particular (e.g., Lee *et al.*, 2010; Spithoven, Vanhaverbeke, and Roijakkers, 2013).

Finally, we demonstrate the value of content analysis in aggregating information from proposal texts that can be used in the context of SME and innovation policy instruments. The identified and empirically validated attention priorities reflect the intentions of a consortium and can be used in the evaluation of project applications to publicly funded research as well as innovation programs in order to anticipate the likely project outcomes before funding has been allocated. Moreover, our findings inform SME and innovation policy making by going beyond general assessments of whether the diversity of partners in grant applications is per se good or bad for innovation outcomes. Instead, we identify particular tradeoffs in the attention that consortia will give to particular priorities depending on the partner composition. Policy makers can adjust their application requirements based on the priorities that they want to achieve.

RESEARCH CONTEXT: INNOVATION ACTIONS IN HORIZON 2020

We base our study on a unique dataset of funding applications submitted within Horizon 2020 by consortia of organizations. One of the cornerstones of the Europe 2020 strategy for smart, sustainable and inclusive growth (European Commission, 2010) has been a commitment to investing in research and innovation, particularly helping SMEs to enhance their innovation capacity and to overcome innovation barriers such as a lack of resources and access to networks. With a budget of around EUR 77 billion, Horizon 2020 is the European Union's Framework Program for Research and Innovation in the period 2014 to 2020 that helps to implement these policy priorities and objectives. Overall, Horizon 2020 strives to facilitate excellent science and technology development in Europe in order to create economic prosperity and to increase the quality of life.

Horizon 2020 puts special emphasis on a number of cross-cutting issues that are promoted across the three priorities "excellent science", "industrial leadership" and "societal challenges". They are intended to develop new knowledge, competences and technological breakthroughs with the aim to translate knowledge into economic and societal value (European Commission, 2016). One of these cross-cutting issues focuses on bridging discovery with market application stages and in that sense on facilitating innovation. The focus of Horizon 2020 on innovation is particularly pronounced in the priorities "industrial leadership" and "societal challenges". They feature the new instruments available in Horizon 2020 – Innovation Actions, Innovation Procurement, and Inducement Prizes – that are expected to play a prominent role in bridging discovery with market application stages and thus in helping to increase growth and employment in Europe. Innovation Actions describe activities aimed at producing new or improved products, processes or services while Innovation Procurement refers to pre-commercial public procurement

(PCP) or public procurement for innovative solutions (PPI) (European Commission, 2014a). Inducement Prizes are "challenge" prizes that offer cash rewards to those who can most effectively meet a defined challenge.

Our research is focused on all Innovation Action projects involving SMEs for which contracts were signed in 2015 and that started in 2015-2016. One of the main objectives of Innovation Action projects in Horizon 2020 is to have an innovation impact. Within this context, impact refers to the wider societal, economic or environmental cumulative changes over a longer period of time (European Commission, 2015b). Innovation impact focuses on bridging discovery and market application in order to achieve those changes (European Commission, 2012). According to the Horizon 2020 Monitoring Report 2015 (European Commission, 2016), a substantial share of the total European Union funding (19.9%, corresponding to EUR 1.4 billion) has been allocated to Innovation Action projects while only 6.5% of the signed grants were Innovation Actions. In comparison, EUR 18.5 million were allocated to six PCP and PPI projects, and Inducement Prizes played a minor role. This distribution of funding illustrates the economic importance of Innovation Actions within Horizon 2020. In that sense, our research context describes a typical situation in which a funding organization shapes the priorities that consortia need to dedicate attention to in order to obtain funding while the partners, at the same time, need to negotiate on which priorities to focus their research efforts.

THEORETICAL FRAMEWORK

Our unit of analysis is a grant proposal of an innovation consortium with SME participation. The proposal is jointly developed by multiple organizations with different institutional and geographical backgrounds that form a consortium based on various motivations. The diversity of partners

and their motivations can generate beneficial complementary effects but they can also yield coordination issues when devising a grant proposal (Nepelski and Van Roy, 2021). In the following, we therefore first discuss literature on the diversity of backgrounds and motivations of consortium partners as well as the role and heterogeneity of consortia's proposals in public funding programs, such the European Union's FPs. Given that the different motivations for joining an innovation consortium have consequences for (a) the coordination of attention in the proposal development process and (b) the setting of actual priorities that partners allocate attention to, we review literature on the respective topics in a next step.

Diversity of consortia partners and grant proposals

Innovation consortia supported by public funding programs, such as the European Union's FPs, usually require or at least are informally expected to involve a diversity of partners from various institutional backgrounds or geographical areas (Rodríguez et al., 2013). Prior studies reveal that such consortia typically include SMEs, large companies, universities, research organizations, public bodies such as governmental institutions, and other stakeholders who can affect or are affected by the innovation such as advocacy groups or non-governmental organizations (NGOs), (Nepelski *et al.*, 2019; Nepelski and Van Roy, 2021). Besides the organizational diversity, heterogeneity in terms of national origins of partners represents another cornerstone of publicly funded collaborative research projects to ease cross-border discovery and exploitation of new knowledge and innovative solutions. For example, a recent study on the international diversity of consortium partners in the FPs reveals that partners on average originate from six different countries, while projects include a minimum of two countries and a maximum of 30 countries (Nepelski et al., 2019).

The diversity of backgrounds of consortium partners also suggests that they join collaborative innovation projects based on distinct motivations. For SMEs, one of the main drivers for participating in innovation consortia is to transform technological knowledge into tangible outcomes, such as the commercialization of new products and services, to stimulate long-term growth and survival (Audretsch & Keilbach, 2008; Baum *et al.*, 2000). Given their liabilities of smallness, joining collaborations allows SMEs to overcome the lack of necessary resources and capabilities, such as financial capital, technological, market and managerial competences, that they need in order to realize more ambitious and risky innovation projects (Hewitt-Dundas, 2006). As such, SMEs' motivations are found to be strongly aligned with the strategic aim of the FPs to accelerate the development of novel, market-creating technologies (Nepelski et al., 2019). Specifically, SMEs exhibit more explicit objectives for joining consortia including the development of prototypes and patentable or complementary technologies with the ultimate goal to strengthen their competitive position (Polt *et al.*, 2008).

In contrast to SMEs, large firms pursue much less explicit innovation goals with their participation in consortia and are less willing to share economically relevant information with their partners (Nepelski and Van Roy, 2021; Röller, Siebert, and Tombak, 2007). Rather, these firms make use of such collaborations as a means to monitor the trajectories of different technologies and as networking platforms to widen their technical horizons (Polt *et al.*, 2008). In contrast to firms, universities and research organizations are more interested in the scientific aspects of technology development. These organizations therefore join consortia to tap into complementary resources to explore new areas of research and advance the scientific knowledge frontier (Caloghirou, Tsakanikas, and Vonortas, 2001; Carayol, 2003). Public bodies such as governmental insti-

tutions may choose to participate in innovation consortia to ensure that technological developments are in line with policy goals, often by acting as the problem owner of broader societal, environmental, or economic issues for which an innovative solution is desirable (Roelofsen *et al.*, 2011). Finally, other partners such as NGOs or advocacy groups may join consortia to represent the interests of relevant stakeholders, so that innovative solutions will be socially accepted and satisfy the needs and expectations of those stakeholders (Olsen et al., 2016).

The diversity of partners and their motivations may be fruitful for the innovation potential of the solutions pursued by the consortium. At the same time, the diversity can also hamper the search for an innovative solution, since the heterogeneity of organizational and geographical backgrounds can raise communication and coordination challenges (Nepelski *et al.*, 2019). The latter is particularly an issue when devising a grant proposal. Proposals for grants, such as the European Union's FPs, describe an innovation problem ex-ante and devise a plan of research and development activities addressing the problem before they are implemented (Cunningham and Link, 2016). Proposals are fairly detailed and rich in information since they are supposed to convince evaluators that the proposal is superior to alternative grant proposals submitted by other consortia and therefore deserves funding (Knudsen and Levinthal, 2007).

A basic premise of this study is that a consortium's attention is represented in the proposal (cf. Kaplan, 2011; Eggers and Kaplan, 2009) in which distinct attention priorities can be set and expressed. There are two reasons why consortia need to focus attention. First, grant authorities set boundaries for eligible proposals, such as the length, duration, research field or maximum funding. Second, there are limits to the overall attention available (Ocasio, 1997). A consortium is forced to concentrate its attention to the aspects it considers as most important. Accordingly, different proposals emphasize different innovation facets to a varying degree. For these reasons,

consortia need to set priorities and make trade-offs in their proposals. The tradeoffs are of particular interest for our study since consortia have to coordinate among their members how much attention they want to allocate to particular research questions and innovation activities at the expense of others. Proposals reflect the common denominator across the different motivations of consortium partners and thus are unique representations of the coordinated attention outcomes of consortia.

Coordination of attention

Our considerations on the coordination of attention are rooted in the attention-based theory of organizational behavior (Ocasio, 1997), which refers to attention as "noticing, encoding, interpreting, and focusing of time and effort" on innovation issues and action alternatives and mirrors the developing focus of a consortium's cognitive endeavor (Eggers and Kaplan, 2009). We reason that the allocation of attention to specific innovation aspects will ultimately drive the consortium's actual research and innovation activities (cf. Ocasio, 1997; Barr, 1998; Cho and Hambrick, 2006; Nadkarni and Barr, 2008). Put differently, consortia neglecting particular issues, i.e. not dedicating attention to them, are unlikely to consider these issues in the project. Analyzing grant proposals allows us therefore to study attention allocations while ex-post evaluations of collaborative innovation projects such as patents or publications (e.g., Szücs, 2018) are unlikely to reflect the original research intentions and tradeoffs of a consortium.

The relationship between attention and actual action is well established in the literature on managerial cognition in the context of organizational renewal. Specifically, prior studies have provided empirical evidence for the impact of managerial attention on subsequent, observable organizational actions such as strategy changes (Cho and Hambrick, 2006), new product launches (Eggers and Kaplan, 2009), as well as patenting and alliance activities (Kaplan,

Murray, and Henderson, 2003). Studying attention helps to unveil the planned input decisions a consortium wants to make regarding its innovation activities. As suggested by prior cognition research (e.g., Eggers and Kaplan, 2009; Kaplan et al., 2003), the greater an organization's attention towards a specific innovation aspect (e.g., towards a new technology), the more likely it will have developed the necessary skills and expertise to succeed in this dimension (e.g., entering into a new product market faster than competitors).

The way attention emerges in organizations, or more broadly speaking in social entities, depends on the entities' decision makers as well as the formal and informal communication and procedural channels that shape interactions among them (Ocasio, 1997). These interactions create attentional coupling of the decision makers in order to build joint dialogue and focus on a common set of problems (Wilson and Joseph, 2015; Rerup, 2009). Even when explicit procedures and communication channels are not yet well-established (as can be assumed for newly formed consortia when they define priorities in a proposal), attentional coupling can still occur: Joint goals and objectives, such as the common intention to find a solution to a problem, can serve as a means to integrate different players (Wilson and Joseph, 2015). This can ensure that individual decisions become mutually reinforcing and the development of shared attention is facilitated (Gavetti, 2005).

The allocation of attention towards specific domains, however, is contingent on the characteristics of the actors involved. Different actors may come to completely different interpretations of identical problems due to differences in experiences, backgrounds, and disciplines (Wilson and Joseph, 2015). Thus, the degree to which decision makers within the same social entity are heterogeneous or homogeneous can influence the directions to which social entities dedicate their shared attention (Cho and Hambrick, 2006).

While the general mechanisms of how attention emerges hold for almost every social entity, the process of allocating attention to specific facets of an innovation problem differs between consortia and individual researchers or firms (e.g., Grimpe, 2012). Consortia can draw from the attention capacities of all consortium members while at the same time having to coordinate among one another about the degree to which particular items enter the final proposal. On the one hand, consortia can engage specialized organizations from different domains (disciplines, industries, technologies) and consider many different problem facets or potential solutions in a joint effort. On the other hand, the benefits from the division of labor create a need for integration (Lawrence and Lorsch, 1967), i.e. the organizations in a consortium need to coordinate to devise a joint plan on how to solve the innovation problem. In other words, organizations need to align their models of the search space to achieve coordination (Knudsen and Srikanth, 2014).

We suggest that a consortium's proposal is the outcome of a coordination process in which the partners seek to influence the allocation of attention to certain dimensions of innovation. Universities, for example, may be interested in performing research, which aims at creating technologically novel insights, while firms may seek to address challenges promising successful commercialization. As a result, consortia emerge that – while they may work on similar challenges stipulated by a funding organization – differ in their proposals and the emphasis they place on certain aspects of a potential solution to the innovation problem. Knudsen and Srikanth (2014) highlight that the organizations in a consortium may confound each other if they stick to their model of the search space and what an effective solution to the innovation problem entails. Coordination among the participants by communicating and sharing knowledge may decrease confusion (Puranam, Raveendran, and Knudsen, 2012), yet it narrows down the search space to an

area that represents the lowest common denominator for all organizations – a situation characterized as joint myopia (Knudsen and Srikanth, 2014).

In principle, proposals can differ along many different attention priorities which are highly influenced by the distinct motivations of partners for joining an innovation consortium. In the next section, we therefore review extant literature for the most relevant priorities for our context, i.e. the Innovation Actions of Horizon 2020. We introduce four aspects that we assume consortia involving SMEs to allocate attention to in their search for solutions to an innovation problem and that relate to the main motivations of consortium partners.

Attention priorities in grant proposals

Successful innovation can manifest in several ways depending on the priorities that innovators allocate attention to. Since fully capturing the complexity of different manifestations of innovation success in an empirical analysis is difficult, we focus on four dimensions that prior literature, case studies and conversations with policy makers suggest to be critical for bridging discovery and market application (i.e. ensuring the commercial exploitation of an innovation) and/or making a difference to economy and society (i.e. having the potential to increase growth and employment). Our sources include review articles on innovation (Brown and Eisenhardt, 1995; Krishnan and Ulrich, 2001; Montoya-Weiss and Calantone, 1994) and innovation-related publications of the European Commission such as the Innovation Radar methodology (De Prato *et al.*, 2015). Moreover, the attention priorities are meant to be discriminable manifestations of innovation success, cognitively distinguishable by a consortium. Although some overlap might be inevitable, the priorities should be sufficiently different from one another in order to uncover differences within proposals. Based on this review procedure, we identify technological novelty, market creation, ecosystem embeddedness, and innovation readiness as the four attention priorities

that are commonly referred to as relevant in the context of publicly funded competitions of innovation activities.

Technological novelty

Technological novelty refers to the extent to which an innovation advances the technological performance frontier more significantly than the existing technological path (Gatignon et al., 2002; Govindarajan and Kopalle, 2006) and constitutes a major transformation of existing products and services (O'Connor and DeMartino, 2006). While technological novelty can reflect a technological breakthrough, it can also be traced back to a completely new combination of already existing technologies, processes, and knowledge (European Commission, 2015a; O'Connor, 2008). According to the basic differentiation of innovations (Dewar and Dutton, 1986), the varying degrees of technological novelty intended by the consortia can be described on a continuum ranging from radical to incremental. Thus, a high degree of novelty corresponds to a radical advancement of the technological performance frontier rendering the existing product or service designs as well as the prevailing technologies obsolete (Subramaniam and Youndt, 2005; Chandy and Tellis, 2000). Conversely, a low degree of novelty relates to incremental refinements or gradual progressions of existing technologies that strengthen the potential of existing solutions and extant product or service designs (Subramaniam and Youndt, 2005; Ettlie, 1983).

Market creation

Market creation relates to the extent to which an innovation has the potential to create a new market (Hamel and Prahalad, 1991) and introduces a different set of features compared to existing products and services that is attractive to a new class of customers (Govindarajan and Kopalle, 2006; Christensen, Raynor, and McDonald, 2015; Darroch and Miles, 2011). It refers to the degree to which a consortium’s innovation can unlock untapped demand (Kim and

Mauborgne, 2005) or address a new customer segment (Gilbert, 2003), thereby creating the potential to develop and expand an entirely new market or market segment. It relates to the magnitude of change in customer value propositions achieved through differences in features and performance characteristics relative to established products and services (Govindarajan and Kopalle, 2006; Charitou and Markides, 2002). Technological novelty and market creation can be achieved independently. For instance, Starbucks or Southwest Airlines have shown that the creation of new, additional demand does not need to be based on cutting-edge technologies (Kim and Mauborgne, 1999). Accordingly, market creation explicitly captures the extent to which a consortium pays attention to its innovation creating new demand but not whether this is achieved by a radically new technology or based on existing technological solutions.

Ecosystem embeddedness

Ecosystem embeddedness refers to the extent to which the development and commercialization of an innovation is embedded in a community of organisations and individuals who can affect or are affected by the innovation, such as suppliers, customers, and other stakeholders (Teece, 2007; Clarkson, 1995). A high degree of ecosystem embeddedness indicates that the consortium clearly identifies and understands its own innovation ecosystem (Adner and Kapoor, 2010) and closely collaborates with other members of the system (Davis, 2016). A strong embeddedness allows for positive knowledge spill-over effects between the consortium and the other ecosystem members during the development and commercialization of the innovation and thus enables knowledge to diffuse widely (De Prato et al., 2015). Moreover, it ensures sufficient supplies of critical components and access to complementary assets, such as manufacturing capabilities and distribution channels (Teece, 1986, 2006), as well as increases an innovation's social acceptance or support from relevant stakeholders, making it unlikely for the consortium to be confronted by

resistance or protests (Olsen *et al.*, 2016). In contrast, a low degree of ecosystem embeddedness corresponds to a low awareness of the ecosystem with little attention to and collaboration with other members; in this case, a consortium will risk to oversee opportunities that occur outside of its internal focus (Chesbrough, 2003) and will more likely face diffusion barriers for its innovation (Talke and Hultink, 2010).

Innovation readiness

Innovation readiness corresponds to the extent to which an innovation achieves a satisfactory level of technological maturity (European Commission, 2014b) and is likely to be successfully commercialized (De Prato et al., 2015). A high level of innovation readiness indicates a high degree of technical maturity of the evolving innovation and its closeness to market (De Prato et al., 2015). Conversely, a low level of innovation readiness reflects that the innovation is in an earlier stage of the development process and rather far from being commercialized (European Commission, 2014b). While ecosystem embeddedness emphasizes how well the development and commercialization of the innovation is embedded in a supporting infrastructure of different stakeholders, and, thus, focuses more on structural aspects (Adner, 2017), innovation readiness embraces the activities and tasks that the consortium has to undertake to realize the innovation in the market place (cf. Krishnan and Ulrich, 2001). Table 1 gives an overview of the attention priorities including their definition, principles, and selected literature references.

[Insert Table 1 about here]

DATA AND METHODS

Data

The empirical methodology adopted in this study involves a stepwise application of different analyses, which are based on data for all 207 Innovation Action project proposals with SME participation whose contracts were signed in 2015. Data on those projects were taken from the CORDIS database, which includes information on the participants – their names, type and home country – as well as on the projects – the total project cost. These data are combined with data generated from the proposal texts of these projects. The details of the proposals are confidential and were made available for the purpose of this study by the European Commission.

Variables

Attention priorities

The measurement of the four attention priorities is based on a content analysis of the proposal texts. Content analysis builds on the assumption that cognitive schemas can be inferred from the systematic, replicable analysis of text (Duriau, Reger, and Pfarrer, 2007). Consequently, this study adopts the idea that the attention priorities as defined above can be measured through the language adopted by the participants in a consortium's proposal. In other words, dedicating attention to different aspects related to the planned and foreseen innovation impact of the project is assumed to be reflected in the proposal text of the consortium, which will guide the research and innovation activities performed within the project. In this regard, proposal texts are a particularly fitting source for applying content analysis because Horizon 2020 uses standardized procedures

and guidelines for the development and evaluation of proposal texts[2], which ensure that texts are uniformly structured and comparable.

An important step of any content analysis is the creation of a dictionary of words or short phrases which can capture each construct of interest (Duriau et al., 2007). The methodology follows recent research on content analysis by applying a three-step protocol which iteratively improves reliability and validity of the dictionaries (Olsen *et al.*, 2016; Vergne, 2012). As a first step, we analyze the relevant literature for precise construct definitions and relevant keywords for each of the attention priorities (Table 1). Subsequently, we create suitable synonyms for the initial keywords in line with the construct definitions and obtain an initial set of keywords and typical formulations of the attention priorities. This analysis results in an operational understanding in the way the attention to a particular aspect would be expressed in a proposal text and creates an initial list of words and short phrases for each of the four dictionaries (De Prato et al., 2015).

In a second step, experienced grant writers and evaluators in Horizon 2020 were asked to assess the likelihood of the words on the initial word list for appearing in proposal texts. Twelve experts are involved in this step of the analysis, including two senior managers from private firms, two senior researchers from research institutes, three university academics and five experts from the European Commission. The experts are also asked for additional words or short phrases that they believe were missing. The resulting dictionaries consist of a list of words for which at least six experts agree that they have an above average chance of appearing in a proposal text for each indicator. To measure technological novelty, market creation, ecosystem embeddedness,

[2] See Regulation (EU) no. 1290/2013 laying down the rules for participation in Horizon 2020, especially Article 13 on proposals, Article 15 on selection and award criteria, and Article 16 on evaluation review procedure (http://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/rules_participation/h2020-rules-participation_en.pdf).

and innovation readiness, we retain a list of 49, 32, 52, and 69 words, respectively. Sensitivity checks with more stringent (e.g. agreement from a minimum of nine experts) or more lenient dictionary inclusion restrictions lead to consistent classifications of proposal texts with correlations ranging between 0.71 and 0.99.[3] We conduct consistency check estimations with more stringent dictionary definitions and find consistent results.

Hence, the dictionaries cover at least a core set of words and phrases that allows consistent classifications of proposal texts. Example words and phrases to measure the four attention priorities (in brackets) include advanced, breakthrough, first of its kind (technological novelty), differentiate, disrupt, mainstream (market creation), cross-sectoral, society, supply chain (ecosystem embeddedness), and business plan, prototype, scaling up (innovation readiness). The complete dictionaries can be found in the appendix. Overall, the overlap of the dictionaries, i.e. the number of words that appear in more than one dictionary, is low. The items of the technological novelty dictionary could potentially overlap with the 153 items of the other dictionaries but do so only in 3.3% of the cases (e.g. "disrupt"), market creation in 5.9% (e.g. "user"), ecosystem embeddedness in 5.3% (e.g. "supply chain") and innovation readiness in 9.8% (e.g. "patent") of the cases. Hence, the vast majority of words and phrases of each dictionary is sufficiently distinct. Using the software tool LIWC, the resulting dictionaries are applied to all relevant sections of proposal texts (with the headings "Excellence", "Impact" and "Implementation"), i.e. excluding sections which contain standardized administrative information. The text per proposal amounts

[3] Since the length of the dictionaries originates from a validation exercise involving 12 experts, there is no ex-ante optimal length. All items of a given dictionary are supposed to *reflect* the same construct, e.g. innovation readiness. In principle, the items are synonyms for one another (Duriau *et al.*, 2007). Dictionary length indicates that the experts could think of many suitable synonyms, not that proposals have to use many different words for expressing attention to a given construct. The diversity of dictionary items in a given text is likely to indicate linguistic style but not necessarily more attention to a given construct. All other things equal, a proposal using "marketing" six times should not be treated differently than a proposal using "marketing" three times and "advertising" three times (both words are part of the innovation readiness dictionary).

to about 100 to 150 pages on average. The software calculates the percentage of words from the dictionary in any relevant section of each proposal.

As a last validation step, 40 proposal texts were independently read and assessed with regard to their attention priorities. This allows to calculate the intercoder reliability (Krippendorff, 2004) between the software generated and manually generated assessment. If the intercoder reliability is high, the dictionaries can be assumed to yield a valid and reliable measurement of the attention priorities. Krippendorff's alpha is 0.75 for technological novelty, 0.64 for market creation, 0.85 for ecosystem embeddedness, and 0.70 for innovation readiness. Overall, these coefficients indicate a satisfactory level of intercoder reliability, which confirms the validity of the indicator scores generated through content analysis.[4] Reading the proposal texts also allows the identification of particularly insightful passages of text that contain content and context for the planned innovation impact. These passages of text will be highlighted together with the results from the content analysis and in that sense enable a qualitative validation of the results.

While our use of content analysis reflects a more "top down" approach by ex-ante defining dictionaries based on theoretical considerations and prior empirical evidence, an alternative approach may have been the use of topic modeling (e.g., Prüfer and Prüfer, 2020), which reflects a "bottom up" approach to identifying a number of topics prevalent in the documents. Topic modeling is a text-mining tool that seeks to uncover hidden semantic structures. While intuitively attractive as a complementary approach to analyzing the proposal texts, the results of applying a

[4] Krippendorff's alpha is a conservative measure of the observed and expected disagreement between raters (in this case between the software-generated rating and the one generated through manual reading of the proposals) and ranges between 0 and 1. When raters agree perfectly, alpha takes a value of 1, which indicates perfect reliability. When they agree as if chance had produced the results, alpha is 0, which indicates the absence of reliability. In the social sciences, values of alpha greater than 0.667 are commonly accepted (Krippendorff, 2004). The results show that the alpha for market creation is slightly below that threshold. Yet, lower values have been suggested acceptable in exploratory (rather than confirmatory) studies such as this one (Neuendorf, 2002).

topic model to the proposals are of little use for identifying attention priorities. This is because the proposals describe very different innovation and technology development projects in detail. The resulting topics identified are therefore very much reflective of particular technologies or contexts in practice rather than about different facets of innovation impact that we are interested in for our research. Hence, we restrict our analysis to the content analysis as outlined above.[5]

Explanatory variables

Based on information taken from the CORDIS database, we calculate our main explanatory variables of interest, which measure the institutional composition of the participants in the consortium. On the one hand, we include a measure of "breadth" that is defined as a count measure of the number of different partners in the consortium similar to Laursen and Salter (2006). These include higher education institutions, private companies, public entities, research centers, and other participants. The corresponding variable hence varies between 1 and 5. On the other hand, we include five variables measuring the number of these partners in the consortium as a share of the total number of participants, with the share of other participants being the reference. We also calculate a measure of the breadth of different countries that the partners come from to account for geographic diversity. In consistency check estimations, we use measures of participant and country diversity that are based on inverse Herfindahl indices. The estimation results are qualitatively consistent and can be obtained from the authors upon request.

To account for the size and duration of the projects, we use the total project budget (EUR) in logarithm and the project duration (months) in logarithm. Moreover, we are interested in whether the organization that assumes the project coordinator role influences the allocation of priority

[5] We perform additional topic modelling analyses on the proposals which in fact reveal such particular technology or context patterns. This confirms our choice of a "top-down" approach with predefined dictionaries.

since coordinators interact with the funding body and are therefore in a particular position to exert influence on the consortium partners (Cunningham *et al.*, 2020). Hence, we include dummy variables indicating whether the coordinator is a higher education institution, research organization, public body or other organization, with private firms being the reference category.

Additionally, we control for the specific call in Horizon 2020 to which a project proposal responds. In that regard, we run the content analysis on the call texts themselves in order to generate four measures on the stipulated and desired attention priorities of the proposals. If the call text, for instance, puts high emphasis on technological novelty, we would certainly expect the proposal to prioritize technological novelty, too.

Methods

Our methods involve two parts. First, we perform the text analysis and show descriptive statistics on the four attention priorities as well as the other variables described. In addition, we illustrate the respective formulations in a qualitative analysis by showing exemplary formulations in proposals scoring particularly high for a certain attention priority. Second, we estimate OLS regressions explaining the four attention priority variables, with the institutional composition variables as main explanatory variables. Standard errors are clustered by the call to which the proposals respond.

Obviously, the coefficients from this analysis can only be interpreted as multivariate correlations and not causal effects. Our empirical data do not allow us to map the dynamics of the consortium formation process during which some organizations take a lead in drafting a proposal and other organizations select into the consortium based on whether they can agree with the initial draft of the priorities. In other words, the composition of the consortium may have reflected the attention priorities at an early stage of the proposal writing process.

RESULTS

Descriptive results

Table 2 shows the descriptive statistics of the four attention priority variables for the Innovation Action projects under study. The mean values indicate the percentage of words in the respective proposal texts that appear in the respective dictionaries. We find the highest average value for the innovation readiness priority, followed by technological novelty, ecosystem embeddedness and market creation. The values of the standard deviation are relatively low, indicating rather low variation of the variable value within the data. However, particularly the maximum values show that there are some proposals in the data that focus their attention more strongly on certain aspects.

The interpretation of the mean values of the four priorities can only be made relative to one another, not in absolute terms. This is because the frequency of using certain words depends considerably on the specific type of text that is analyzed. However, evidence from prior research employing content analysis shows very similar average values for constructs derived through this method (e.g., Olsen *et al.*, 2016). In relative terms, the results show that proposals place considerably higher emphasis on outlining the readiness of the innovation to be developed compared to its market creation. This seems in accordance with the stipulated objectives of Innovation Actions to facilitate innovation in contrast to funding basic research activities. Nevertheless, proposals also stress technological novelty while remaining relatively quiet on ecosystem embeddedness and market creation.

[Insert Table 2 about here]

Table 2 further describes the projects under study. The total project costs are on average EUR 10 million but there is considerable variation among the projects, as evidenced by the rather low

minimum and high maximum values. Consortia with SME participation turn out to be dominated by private companies, followed by universities and other research organizations. Public entities and other types of participants only play a minor role. Given the consortium composition, projects can be assumed to have a rather strong focus on applied research and exploitation – a focus that would presumably be different had the projects involved a higher share of higher education and research institutions. Consequently, the average breadth of participants, i.e. the number of different participant types in a consortium equals three while the country breadth indicates that participants from six different countries collaborate in a consortium.

Table 3 shows the pairwise correlations of the variables. There are no alarmingly high correlations between the variables, and the mean variance inflation factor is 2.14, well below the commonly applied threshold of 10 (Belsley, Kuh, and Welsh, 1980).

[Insert Table 3 about here]

Illustration of proposal content and attention priorities

The manual reading of 40 randomly selected proposal texts not only serves – as indicated – to validate the results of the content analysis by means of interrater reliability statistics, but also to provide a qualitative validation that rests on the identification of particularly telling paragraphs of text. In the following, we present passages of text by attention priority variable, containing selected quotes from the proposals with above median scores of the respective indicators. All quotes are anonymized.

The quotes expressing technological novelty tend to stress the groundbreaking nature of the technology to be developed, its newness and potentially "paradigm-shifting" effect. Moreover, proposals often also highlight the novel combination and recombination of already existing technologies which academic literature has frequently characterized as the main source of innovation

(e.g., Köhler et al., 2012). In several places, descriptions of technological novelty are linked to the readiness of the innovation for exploitation.

> *"[Project acronym] brings knowledge and demonstration of two disruptive technologies, additive manufacturing and internet technologies, to the industrial partners, including SMEs, in the traditional toy and nursery furniture sectors, strengthening their competiveness and growth."*

> *"[Project acronym] will provide innovative solutions to overcome existing bottlenecks associated with Pulsed Electric Field preservation in the food industry for improving food quality, optimizing process efficiency, reducing energetic cost and introducing foods with new properties in the market, with the final goal of providing a real-scale demonstration of the viability of the PEF technology."*

> *"The technology has the potential to completely change the landscape of iron and steelmaking in Europe over a 15 year period."*

High attention to market creation is reflected in the following quotes. They not only describe possibilities to enter new markets, develop niche markets, or create entirely new markets, but they also often times suggest a change in the value proposition to potential customers. In some quotes, attention to market creation is also very closely linked to descriptions of technological novelty or innovation readiness for immediate commercial exploitation.

> *"Creation of new market opportunities both inside and outside Europe. Market potential outside Europe is identified in semi-arid environments (e.g. Morocco), or monsoon environments (e.g. India) where there is a major need to optimize water resource use."*

> *"Together with [participant name] and [participant name], we want to disrupt the very market where we compete and change the rules that run it, reducing operation costs by 80%!"*

> *"The [project acronym] technology will boost Europe's industrial leadership in advanced manufacturing and processing. In addition, it will foster employment and open new market opportunities in this field. This would relate both to the European steel industry itself, as well as the many European engineering companies supplying the plant and equipment."*

Attention to ecosystem embeddedness is explicitly expressed in the following quotes. Here, proposals describe the communication, diffusion and dissemination of their project outcomes, the integration into innovation networks, as well as their considerations for stakeholder acceptance and support. These activities can be expected to accelerate the uptake of innovations and to increase their societal impact (e.g., Olsen *et al.*, 2016).

> *"The proposed project disseminates its results between medical, technological and managerial domains, accordingly to a coherent plan of activities, centered around an active involvement of the various stakeholders on a multinational level. Every stakeholder will take part to one or more dissemination activities of the project. […] The definition of communication needs for every stakeholder is an essential step towards the institution of an effective network of collaborators, partners and stakeholders themselves."*

> *"We see [project acronym] as an innovation system in the sense of Freeman as 'a network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies'. [Project acronym] will be such an innovation system, because it will gather the above mentioned stakeholders in order to develop new applications, methods and services."*

> *"In order to increase the intended impact beyond the implementation of the European Railway Traffic Management System (ERTMS) / European Train Control System (ETCS) standard, the [project acronym] consortium will disseminate information about the project's objectives, activities and results to a wide variety of stakeholders throughout the Rail and Global Navigation Satellite System (GNSS) sector. Beyond those partners within the consortium and those involved in the research activities, this includes Railway Undertakings, Infrastructure Managers, GNSS equipment producers and integrators, GNSS services providers, Research Centres and sub-system suppliers."*

Finally, attention to the readiness of the innovation is typically expressed by focusing on prototyping, demonstration and validation. The quotes indicate in some places a close connection between innovation readiness and ecosystem embeddedness, which indicates that the consortium not only considers leaps in readiness but also the exploitation of such leaps with different groups of customers or stakeholders.

> *"Three teams consisting of partner representatives will focus on (i) process prototyping and demonstration, (ii) product prototyping and validation towards safety and market requirements, and (iii) overall demonstration. A unique ambition is to involve particularly SME parties, via a Sounding board Group, consisting of potential users (food suppliers, food processors and dry product users), as well as food auctioneers, growers associations and retail."*

> *"A Project Exploitation Plan will be developed describing joint and individual partner's exploitation strategies. The Exploitation Plan will cover potential products, competitors and the technology benchmarks. It will describe the [project acronym] market position and identify the potential market segments as well as specific academic and commercial strategies to be implemented."*

> *"The main idea of the project is the finalisation of development, industrialization and commercialisation of the innovative in-wheel motor technology (patent pending) developed by [participant name]. The solution was already validated in real operating conditions showing a competitive performance with a very positive market-feedback."*

In sum, the quotes from the proposal texts show that consortia deliberately use certain words and short phrases in order to express attention to particular aspects. This not only validates the automated content analysis of the proposals but also provides insights how these attention priorities are typically described in longer paragraphs of text.

Regression results

Next, we turn to the results of the OLS regression models, which regress the scores of the four attention priority variables on our explanatory variables described above, putting particular emphasis on the institutional composition of the consortia. Table 4 shows the first part of the results. Models 1, 3, 5 and 7 only include the linear term of the participant breadth variable while the other models include the squared term in addition to test for a curvilinear relationship. Model 1 shows a significant negative relationship between the participant breadth and the attention given to technological novelty in the proposals. Apparently, technological novelty benefits from lower diversity in the types of participants, as does market creation (Model 3). The significant negative squared coefficient in Model 4 indicates that the relationship between participant breadth and

market creation may actually take an inverse U-shape even though the coefficient of the linear term is only close to the commonly applied 90% significance level (p=0.109). This finding may indicate that a higher number of different participants initially drives an attention focus on market creation, but as breadth increases, the association quickly weakens. Models 5 and 6 show the results for ecosystem embeddedness. Here we find that including more different types of participants is associated with a stronger focus on ecosystem embeddedness. Finally, Models 7 and 8 cannot substantiate a significant relationship between participant breadth and the focus on innovation readiness.

With respect to the control variables, we find the overall size of the project measured in terms of project cost to be unrelated to a specific priority while including participants from a larger number of countries is only positively associated with a stronger focus on ecosystem embeddedness. Project duration turns out to have no significant association with the attention priorities either. Moreover, we do not find a significant association of the variables indicating the institutional type of the coordinating organization with one exception. If the coordinator is classified as "other" organization, the consortium allocates less attention to innovation readiness. However, there are only four such projects (1.93%) in our sample. As expected, the variables measuring the importance of the respective priorities in the call texts are largely positively associated with the corresponding priority formulated in the proposal text.

[Insert Table 4 about here]

Next, we turn to the results that include the shares of the participant types in order to provide further detail into the nature of the participants. Table 5 shows the results. Interestingly, we find most significant associations in Model 3 on ecosystem embeddedness. Model 3 indicates that the

shares of universities, research organizations, large companies and SMEs are negatively associated with the focus on ecosystem embeddedness. This has to be interpreted against the share of other participants which constitutes the reference category. Such other participants include, for example, interest groups or stakeholder organizations, which are apparently very much driving a consortium's focus on ecosystem embeddedness. We also find a negative association between the share of public bodies and the focus on innovation readiness. All control variables turn out to be consistent with the results presented in Table 4.

[Insert Table 5 about here]

Overall, our results show considerable heterogeneity in the relationship between the institutional composition of the consortia and their focus on specific priorities. This indicates that consortia involving SMEs have to accept trade-offs with respect to the priorities that they seek to focus on, given not only the limited space available for the proposal but subsequently also the limited funding available once the project has been granted. While a higher degree of variety overall seems to be negatively associated with technological novelty, a more diverse institutional composition drives a focus on both market creation and ecosystem embeddedness. However, we do not find any significant association between the institutional composition and innovation readiness.

DISCUSSION AND CONCLUSION

This study investigates collaborative innovation projects in which SMEs participate, a mainstay of publicly funded research programs (Levén *et al.*, 2014; Rodríguez *et al.*, 2013). Based on the analysis of 207 grant proposals funded by Horizon 2020, we identify four attention priorities that consortia dedicate attention to: technological novelty, market creation, ecosystem embeddedness, and innovation readiness. Consortia, members need to reach an agreement on the priorities that

can be formulated in a proposal and eventually be addressed in the project. We subsequently explain the four attention priorities by the institutional composition of the consortia.

In sum, our results indicate that the institutional composition of the consortia can in fact explain at least parts of the pattern of attention allocation in the consortia with SME participation. Most notably, we observe the differential role that the participant breadth plays for joint priority setting on technological novelty, market creation and ecosystem embeddedness. While the correspondence between the call text and the proposal certainly indicates that the consortia have largely been successful in translating the requirements into their proposals, our results indicate that the institutional composition influences how consortia decide to dedicate attention beyond what is required in the call texts. However, the institutional composition only explains part of the attention allocation pattern, and the likely influence by actors such as universities, which could be expected to focus on technological novelty rather than the priorities more oriented towards commercialization, does not materialize.

In that sense, our research contributes to the literature in three ways. First, SME participation in research grant competitions is increasingly salient for innovation policy since government support may enable this large group of firms to overcome resource constraints (Audretsch and Keilbach, 2008) and propel the dissemination of innovations (Lindholm Dahlstrand, 1997; Audretsch and Link, 2011). While SMEs find themselves frequently in consortia when they apply for large research grants, extant research rarely accounts for the consequences of this consortia structure for the resulting innovation projects. Our research starts with untangling the black box of how the research priorities of consortia involving SMEs emerge. Future research can

build on our model of coordinated attention mechanisms among partner organizations and explore, for example, whether the resulting consortia priorities deviate from SMEs' original innovation priorities or influence them productively.

Second, our study addresses the fact that many innovation problems require an collaborative approach in order to be solved, while the proposal describing a solution emerges from a negotiation process among specialized organizations searching within their individual domains and thus setting priorities differently (Lawrence and Lorsch, 1967; Knudsen and Srikanth, 2014). Studying the role that the institutional composition of a consortium plays in formulating a proposal therefore increases our understanding of the way innovation goals and activities are defined and pursued in collaborative innovation projects. In doing so, we contribute to the literature that highlights the importance of individual actors for organizational search processes in general (e.g., Laursen and Salter, 2004; Köhler *et al.*, 2012) and with respect to SME participation in those processes in particular (e.g., Lee *et al.*, 2010; Spithoven *et al.*, 2013).

Finally, we demonstrate the value of content analysis in aggregating information from proposal texts that can be used in the context of SME and innovation policy instruments. The identified and empirically validated attention priorities of a consortium can be used in the evaluation of project applications to publicly funded research programs in order to anticipate the likely project outcomes before funding has been allocated. Moreover, our findings regarding the relationship between the institutional composition of consortia and attention priorities are important for SME and innovation policy making in that they allow for a reassessment of the role of diversity as a stipulated characteristic of consortia in funding applications. These insights lead to several implications for SME and innovation policy.

Implications for SME and Innovation Policy

Horizon 2020 features the Innovation Action and innovation procurement instruments in order to play a prominent role in bridging discovery with market application stages and thus in helping to increase growth and employment in Europe (European Commission, 2014a). Yet a major challenge for the effective allocation of funding in this respect is to verify whether these instruments actually deliver on innovation or rather seek to primarily support research activities without the desired pronounced focus on the commercial exploitation of innovation. Since the projects under study have only been started in 2015, addressing this challenge within the scope of this study necessarily remains incomplete. However, the results presented in this study based on the analysis of the proposal texts allow to draw several implications.

In that sense, SME and innovation policy can make use of the identified attention priorities as innovation indicators that may alleviate some of the weaknesses of more traditional approaches. Ideally, evaluations combine multiple indicators, such as the identified priorities based on content analysis combined with a continuous monitoring through surveys as in the Innovation Radar (De Prato et al., 2015). The attention priorities proposed here allow an early assessment of the likely innovation impact of the proposals, even before they are actually funded. They build on the assumption that the participants in a consortium have to devise a joint approach for solving an innovation problem in order to successfully exploit the project outcome. This joint approach requires the consortium to allocate attention to areas related to innovation impact. Due to limited attention and resources, consortia have to prioritize. The indicators are based on the idea that the allocation of attention and the prioritization of resources as described in the proposal will be carried through during the term of the project, leading to higher or lower innovation impact along the four dimensions identified. While it is still too early to conclude whether the articulated

focus on innovation in the projects will materialize, the four priorities allow an early indication for the extent Horizon 2020 will deliver on innovation.

Our results show that the studied project proposals devote almost three times as much attention to market creation, ecosystem embeddedness and innovation readiness compared with technological novelty. Such systematic quantifications of attention allocation across large numbers of project proposals are a unique advantage of content analyses. While this allocation of attention cannot be directly translated into consortia budget provisions and market outcomes, the large share of attention devoted to commercialization provides confidence that Horizon 2020 will have important innovation outcomes in the short and medium term. However, long term consequences cannot be credibly predicted based on attention allocation at any given point in time since attention is likely to be re-allocated based on experience and feedback, e.g. through customer responses or competitor behavior. Future research should therefore investigate the actual project outcomes once they become available and compare those to the stipulated dedicated attention by the consortium partners. Moreover, comparative results for larger samples of grant proposals can help to improve the generalizability of our findings.

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TABLES

Table 1: Overview of the four selected attention priorities

Attention priority	Definition	Principles	Selected references
Technological novelty	The extent to which an innovation significantly advances the technological performance frontier and constitutes a major transformation of existing products and services.	• Focusing on an innovation's technology-based magnitude of change rather than on market consequences. • Ranging on a continuum from radical to incremental innovation. • Technological breakthrough and completely new combination of existing technologies as typical manifestations of high technological novelty that have the potential to make prevailing solutions obsolete.	Gatignon et al. (2002); Govindarajan and Kopalle (2006); O'Connor and DeMartino (2006); Subramaniam and Youndt (2005); European Commission (2015a)
Market creation	The extent to which an innovation has the potential to create a new market and introduces a different set of features compared to existing products and services that is attractive to a new customer segment.	• Focusing on an innovation's market-based magnitude of change regardless of its technological novelty. • Relating to the extent of shifts in customer value propositions. • New-market disruption as a typical manifestation of high market creation that changes market linkages and displaces existing offerings. • Blue ocean strategy as an alternative manifestation of high market creation that creates uncontested market space and complements existing offerings.	Hamel and Prahalad (1991); Govindarajan and Kopalle (2006); Christensen et al. (2015); Kim and Mauborgne (2005); Charitou and Markides (2002)
Ecosystem embeddedness	The extent to which the development and commercialization of an innovation is embedded in a community of organizations and individuals who can affect or are affected by the innovation (e.g. suppliers, customers, and other stakeholders).	• Viewing an innovation ecosystem as a system of multilateral actors whose interactions enable an innovation to materialize. • Going beyond the mere conception of innovation networks since an ecosystem is also determined by a focal value proposition. • Strong ecosystem embeddedness allows for spill-over effects between partners, ensuring access to complementary assets, and increasing an innovation's social acceptance and support among relevant stakeholders.	Teece (1986, 2007); Clarkson (1995); Adner (2017); Levén et al. (2014); Olsen et al. (2016); Talke and Hultink (2010)
Innovation readiness	The extent to which an innovation achieves a satisfactory level of technological maturity and is likely to be successfully commercialized.	• Focusing on the content of activities for rolling out an innovation rather than on the structural configuration of such activities (as captured by the ecosystem indicator). • Technical development tasks, strategic and operational marketing efforts, as well as measures protecting an innovation's competiveness as main types of activities underlying an innovation's readiness. • High levels of technological maturity and commercialization preparation efforts indicate a high degree of innovation readiness.	European Commission (2014b); De Prato et al. (2015); Krishnan and Ulrich (2001); Hultink et al. (2007); Vorhies and Morgan (2005); Pisano and Teece (2007)

Table 2: Descriptive statistics (n=207)

Variables	Mean	Std. Dev.	Min	Max
Technological novelty	1.82	0.69	0.58	4.57
Market creation	1.27	0.51	0.48	4.31
Ecosystem embeddedness	1.38	0.51	0.54	3.87
Innovation readiness	2.43	0.62	1.19	4.94
Participant breadth	3.25	1.01	1.00	5.00
Share of higher education institutions	0.18	0.14	0.00	0.67
Share of research organisations	0.18	0.14	0.00	1.00
Share of private companies	0.57	0.19	0.00	1.00
Share of public bodies	0.03	0.06	0.00	0.33
Share of other participants	0.04	0.07	0.00	0.55
Total project cost (mEUR)	10.02	17.39	0.35	181.08
Country breadth	6.01	2.44	1.00	14.00
Project duration (months, log.)	3.68	0.26	3.00	4.36
Coordinator is higher education institution	0.19	0.39	0.00	1.00
Coordinator is other organization	0.02	0.14	0.00	1.00
Coordinator is public body	0.07	0.25	0.00	1.00
Coordinator is research organization	0.26	0.44	0.00	1.00
Coordinator is private company	0.47	0.50	0.00	1.00
Call text technological novelty	3.79	2.13	0.00	8.12
Call text market creation	2.97	1.74	0.00	7.69
Call text ecosystem embeddedness	1.94	1.04	0.00	6.46
Call text innovation readiness	3.65	1.55	0.74	7.05

Table 3: Pairwise correlations (n=207)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Technological novelty	1.00																			
2. Market creation	0.55	1.00																		
3. Ecosystem emb.	-0.14	0.20	1.00																	
4. Innovation readiness	0.39	0.70	0.21	1.00																
5. Participant breadth	-0.14	-0.21	0.38	-0.15	1.00															
6. Share HES	-0.15	-0.01	0.15	-0.01	0.15	1.00														
7. Share REC	-0.01	0.03	0.00	0.04	0.01	-0.26	1.00													
8. Share PRC	0.25	0.12	-0.37	0.08	-0.51	-0.51	-0.50	1.00												
9. Share PUB	-0.23	-0.25	0.32	-0.20	0.55	-0.02	-0.08	-0.31	1.00											
10. Share OTH	-0.14	-0.15	0.34	-0.11	0.52	-0.07	-0.07	-0.33	0.14	1.00										
11. Total project cost	0.21	-0.15	-0.08	-0.04	0.09	-0.15	-0.13	0.21	-0.02	-0.01	1.00									
12. Country breadth	0.01	-0.22	0.27	-0.12	0.58	0.06	-0.11	-0.14	0.21	0.27	0.30	1.00								
13. Project duration	0.06	-0.23	-0.12	-0.11	0.15	-0.05	0.03	-0.04	0.01	0.13	0.20	0.17	1.00							
14. Coord. HES	-0.10	-0.02	0.04	-0.04	0.03	0.49	-0.14	-0.22	-0.01	-0.09	-0.13	0.02	0.14	1.00						
15. Coord. OTH	0.00	-0.07	0.11	-0.11	0.11	-0.03	0.05	-0.12	-0.03	0.30	0.00	0.01	0.00	-0.07	1.00					
16. Coord. PUB	-0.06	-0.14	0.11	-0.09	0.20	-0.19	0.08	-0.05	0.28	0.08	0.06	0.17	0.23	-0.13	-0.04	1.00				
17. Coord. REC	0.00	0.04	0.03	0.05	0.09	-0.17	0.35	-0.16	-0.03	0.09	-0.12	0.00	0.06	-0.28	-0.08	-0.16	1.00			
18. Call technological nov.	0.51	0.31	-0.23	0.10	-0.06	-0.13	-0.12	0.26	-0.19	-0.03	0.05	0.07	-0.08	-0.14	-0.05	0.04	-0.06	1.00		
19. Call market creation	0.19	0.43	-0.04	0.12	-0.14	-0.01	-0.13	0.19	-0.16	-0.06	-0.17	-0.13	-0.40	-0.04	-0.14	-0.10	-0.03	0.64	1.00	
20. Call ecosystem emb.	-0.24	0.19	0.47	0.06	0.03	0.05	-0.08	-0.13	0.15	0.25	-0.14	-0.14	-0.29	-0.03	0.13	-0.03	-0.01	-0.20	0.21	1.00
21. Call innovation read.	0.16	0.34	-0.15	0.23	-0.19	-0.07	0.01	0.14	-0.14	-0.11	-0.16	-0.23	-0.30	-0.03	-0.17	-0.17	0.04	0.49	0.72	-0.09

Table 4: OLS regressions explaining the attention priorities

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Technological novelty		Market creation		Ecosystem embeddedness		Innovation readiness	
Participant breadth	-0.093**	0.286	-0.051*	0.305	0.111***	0.253	-0.072	0.188
	(0.045)	(0.264)	(0.026)	(0.185)	(0.032)	(0.151)	(0.052)	(0.244)
Participant breadth (sq.)		-0.059		-0.055*		-0.022		-0.04
		(0.042)		(0.029)		(0.023)		(0.038)
Total project cost (EUR, log.)	0.156	0.142	0.025	0.012	0.013	0.008	0.091	0.082
	(0.100)	(0.103)	(0.047)	(0.045)	(0.049)	(0.047)	(0.060)	(0.063)
Country breadth	-0.022	-0.020	-0.024	-0.022	0.045***	0.046***	-0.012	-0.01
	(0.018)	(0.019)	(0.019)	(0.018)	(0.016)	(0.016)	(0.022)	(0.022)
Project duration (months, log.)	-0.104	-0.064	-0.119	-0.082	-0.215	-0.201	-0.212	-0.185
	(0.268)	(0.281)	(0.155)	(0.163)	(0.179)	(0.185)	(0.234)	(0.236)
Coordinator is higher ed. inst.	0.027	0.001	0.067	0.042	0.096	0.086	0.031	0.013
	(0.103)	(0.098)	(0.095)	(0.091)	(0.082)	(0.082)	(0.115)	(0.110)
Coordinator is other inst.	0.173	0.164	-0.121	-0.130	0.140	0.137	-0.407**	-0.413**
	(0.186)	(0.225)	(0.139)	(0.158)	(0.113)	(0.110)	(0.179)	(0.201)
Coordinator is public body	-0.237	-0.203	-0.115	-0.083	0.202	0.214	-0.065	-0.042
	(0.149)	(0.146)	(0.171)	(0.152)	(0.148)	(0.137)	(0.235)	(0.218)
Coordinator is research org.	0.091	0.083	0.086	0.079	0.051	0.048	0.075	0.069
	(0.082)	(0.078)	(0.087)	(0.085)	(0.065)	(0.064)	(0.100)	(0.099)
Call text technological novelty	0.185***	0.185***	0.052	0.052	-0.034	-0.034	0.035	0.035
	(0.040)	(0.040)	(0.034)	(0.034)	(0.031)	(0.031)	(0.042)	(0.042)
Call text market creation	-0.047	-0.057	0.042	0.032	-0.025	-0.028	-0.104	-0.111*
	(0.068)	(0.069)	(0.057)	(0.058)	(0.056)	(0.056)	(0.063)	(0.065)
Call text ecosystem emb.	-0.051	-0.035	0.095	0.110*	0.230***	0.235***	0.119*	0.130*
	(0.052)	(0.054)	(0.057)	(0.060)	(0.067)	(0.068)	(0.065)	(0.067)
Call text innovation readiness	-0.019	-0.007	0.026	0.037	0.036	0.04	0.144***	0.153***
	(0.048)	(0.049)	(0.036)	(0.036)	(0.041)	(0.042)	(0.040)	(0.042)
Constant	-0.198	-0.736	1.005	0.500	0.916	0.715	1.496	1.128
	(1.379)	(1.462)	(0.804)	(0.870)	(0.948)	(0.999)	(1.175)	(1.126)
R2	0.35	0.36	0.26	0.27	0.41	0.41	0.11	0.12
N	207	207	207	207	207	207	207	207
F	7.68	11.79	5.48	5.55	7.77	8.30	5.69	4.79
P-value	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00

* p<0.10, ** p<0.05, *** p<0.01

Table 5: OLS regressions explaining the attention priorities (cont.)

	Model 1 Techn. novelty	Model 2 Market creation	Model 3 Eco. embeddedness	Model 4 Innov. readiness
Share of higher education institutions	-0.028	0.188	-0.803*	-0.06
	(0.773)	(0.578)	(0.406)	(0.731)
Share of research organisations	0.528	0.444	-0.860**	-0.055
	(0.700)	(0.478)	(0.364)	(0.689)
Share of large companies	0.162	0.039	-1.447***	-0.235
	(0.627)	(0.488)	(0.344)	(0.715)
Share of SMEs	0.548	0.306	-1.353***	-0.253
	(0.694)	(0.533)	(0.359)	(0.739)
Share of public bodies	-0.739	-1.195	-0.089	-2.325*
	(0.854)	(0.869)	(0.694)	(1.182)
Total project cost (EUR, log.)	0.189*	0.057	0.053	0.095
	(0.106)	(0.046)	(0.050)	(0.062)
Country breadth	-0.032	-0.026	0.047***	-0.019
	(0.020)	(0.018)	(0.014)	(0.021)
Project duration (months, log.)	-0.154	-0.162	-0.244	-0.261
	(0.261)	(0.175)	(0.162)	(0.245)
Coordinator is higher ed. inst.	0.061	0.054	0.053	-0.003
	(0.106)	(0.088)	(0.081)	(0.132)
Coordinator is other inst.	0.044	-0.23	0.107	-0.552**
	(0.185)	(0.166)	(0.127)	(0.212)
Coordinator is public body	-0.277*	-0.087	0.172	0.032
	(0.143)	(0.161)	(0.150)	(0.225)
Coordinator is research org.	0.033	0.038	0.036	0.032
	(0.079)	(0.086)	(0.068)	(0.095)
Call text technological novelty	0.180***	0.047	-0.034	0.03
	(0.040)	(0.032)	(0.029)	(0.042)
Call text market creation	-0.04	0.041	-0.014	-0.118*
	(0.067)	(0.056)	(0.051)	(0.063)
Call text ecosystem embeddedness	-0.037	0.114*	0.202***	0.134*
	(0.058)	(0.059)	(0.065)	(0.066)
Call text innovation readiness	-0.03	0.025	0.036	0.156***
	(0.046)	(0.034)	(0.040)	(0.040)
Constant	-1.032	0.325	1.894*	1.674
	(1.956)	(1.136)	(1.119)	(1.342)
R2	0.36	0.28	0.45	0.15
N	207	207	207	207
F	9.00	6.92	12.99	4.80
P-value	0.00	0.00	0.00	0.00

* p<0.10, ** p<0.05, *** p<0.01

APPENDIX

Appendix 1: Dictionaries

Technological novelty		
advan*	highly efficient	solution*
breakthrough*	improv*	solv*
chang*	innovati*	step*
combin*	invent*	substantial*
compared to state of the art	leading	superior
compared to state-of-the-art	major	sustainable
compared to the state of the art	new	technolog*
compared to the state-of-the-art	novel*	than state of the art
disrupt*	optimis*	than state-of-the-art
enhanc*	optimiz*	than the state of the art
first of a kind	patent*	than the state-of-the-art
first of its kind	process*	transformat*
first-of-a-kind	product*	ultra*
first-of-its-kind	progressiv*	world leading
fundamental*	radical*	world-leading
high yield	revolution*	
high-yield	significan*	

Note: * indicates all possible word endings

Market creation		
addition*	disrupt*	product*
applica*	end-user*	redefin*
augment*	enduser*	replac*
challeng*	entry	revenue*
client*	industry	scop*
competit*	internat*	segment*
complement*	introduc*	substitut*
consumer*	mainstream	transform*
customer*	market*	turnover
demand*	niche*	user*
differentiat*	pioneer*	

Note: * indicates all possible word endings

Ecosystem embeddedness		
accept*	ecosystem*	public
bridg*	engag*	relation*
bring together	environment*	resell*
bringing together	exchang*	shared
citizen*	feedback	social
civil	holistic	societ*
cluster*	inclus*	socio-economic*
co-operat*	inter-sectoral	socioeconomic*
collabor*	interact*	spill-over*
communit*	interdisciplinar*	spillover*
complement*	intermediar*	stakeholder*
consult*	involv*	supplier*
consumer*	joined	supply chain*
cooperat*	joint	transfer*
cross-sectoral	licens*	universit*
customer*	networking	user*
distribut*	participat*	
eco-system*	partner*	

Note: * indicates all possible word endings

Innovation readiness		
accelerat*	feasibilit*	readiness
adapt*	financ*	ready
advertis*	fund*	return on investment
appl*	incubat*	roi
approv*	intellectual propert*	roll out
assess*	invest*	sales
benchmark*	ip*	scale up
brand*	launch	scale-up
business model	loan*	scaling up
business plan	manufactur*	scaling-up
certificat*	market research	standard*
commerciali*	market share*	start up*
communication strategy	marketing	start-up*
competitiveness	matur*	startup*
consumer*	patent*	supply chain*
copyright*	pilot*	test*
customer*	pric*	tool
demonstrat*	private equity	trademark*
deploy*	production	update
disseminat*	promoti*	user*
distribut*	proof*	validat*
entrepreneur*	protecti*	value proposition
exploit*	prototyp*	viab*

Note: * indicates all possible word endings