Study on Innovation in Horizon 2020 Projects

A content analysis of 233 innovation project proposals awarded in 2015

Final report

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EXECUTIVE SUMMARY

Horizon 2020 puts special emphasis on a number of cross-cutting issues that are intended to develop new knowledge, competences and technological breakthroughs with the aim to translate knowledge into economic and societal value. One of these cross-cutting issues focuses on facilitating innovation by bridging discovery with market application stages. This study provides an exploratory analysis of the current likelihood of innovation impact of a small subset of Horizon 2020 projects by studying 227 Innovation Action and six public procurement projects (PPP) for which contracts were signed in 2015. These actions have only started recently and are ongoing. It is therefore not possible to assess project outcomes ex-post. Rather, this study applies a forward-looking methodology by applying cognitive innovation impact indicators to the project proposals. It seeks to trace a project's likely innovation impact back to the attention various consortia devote to specific innovation aspects in their project proposals. Following the attention-based theory of organisational behaviour, dedicated attention of a consortium might have an impact on how it will act in the future. Consortia neglecting particular issues are unlikely to consider these issues throughout the project. Thus, it can be hypothesised that, on the basis of differences in the attention towards specific topics, heterogeneity between the consortia regarding their input decisions will occur, which, in turn, will lead to differences in project outcomes and likely innovation impact.

The main analytical technique of this study is a content analysis of proposal texts. Content analysis builds on the insight that language is central in human cognition. Accordingly, cognitive schemas can be inferred from the systematic, replicable analysis of text. Given that grant proposals are carefully and purposefully written, they reveal a consortium's attention and priorities for certain issues vis-à-vis others, given that overall space is limited. The content analysis of this study rests on a multi-stage validation process and identifies the attention that proposals devote to four crucial innovation impact indicators (derived from an in-depth literature review): technological novelty (advancement in the technological performance frontier), market scope (potential to create a new product market), ecosystem embeddedness (connections with important organisations and stakeholders), and innovation readiness (technological and commercial maturity).

The content analysis of the proposal texts has some limitations. The study is based on counting the identified key words that are to measure the four innovation impact indicators. These keywords do not measure the material content of the proposals, nor the actual outcome of the projects. Therefore, the analysis is measuring the initial intention rather than the final results of the innovation project. Moreover, the writing of the proposal and the development of the innovation are activities which are linked but separate, which is why the findings based on proposals might not fully hold for the actual projects. These limitations have to be taken into account when using this study.

Following the content analysis, differences in attention allocation can be identified among proposals, and clusters of proposals emerge with distinct patterns. The following results and implications can be identified for the funding instruments under study:

- As intended by the Innovation Action and PPP funding schemes, attention to the commercialisation of innovation dominates the studied project proposals. Almost all Innovation Action and PPP call texts use technological novelty at least as a starting point, and all proposals contain indications of technological novelty. However, the average proposal pays roughly 33% more attention to innovation readiness than to technological novelty. Taking attention to readiness, ecosystem embeddedness and market scope together, consortia dedicate on

average almost three times as much attention to the commercialisation of technologies compared with describing technological novelty.

- A cluster of proposals containing "Pioneering" project consortia (64 out of 227) can be identified which pay comparatively more attention to achieving ambitious innovation impact vis-à-vis the goals of Horizon 2020. Consortia are significantly more likely to allocate their attention accordingly with increasing participation of private firms including SMEs. It is noteworthy that projects in this cluster combine attention to technological novelty and market creation (market scope).

- Another cluster of 58 proposals containing "Diffusing" project consortia can be identified with dedicated attention to diffusing innovation based on a broad representation of the innovation's ecosystem and its readiness. Within the ambition of Horizon 2020 for bridging discovery and market application, these consortia are clearly more specialised for the latter stages and can make an important contribution to achieving market success.

- A substantial share of Innovation Action projects can be characterised as "Sustaining" (105 out of 227). Project proposals in this cluster contain only modest focus on the four innovation impact indicators which may suggest that these projects do not correspond very well to the stipulated objectives of Innovation Actions. Nevertheless, the analysis only includes consortia that received funding. It is therefore not possible to compare "Sustaining" projects with those proposals that did not receive funding. Within the context of this study, "Sustaining" projects should therefore be considered as a baseline reference group for "Pioneering" and "Diffusing" cluster proposals.

- With the caveat of the limited number of six PPP proposals analysed in this study, they share many attention allocation similarities with Innovation Actions. However, the attention devoted to innovation readiness is comparatively lower. Market scope only plays a minor role, similar to the Innovation Actions. There is a risk that PPP currently do not allocate enough attention to the broader market application of innovation beyond public procurement.

- Overall, the comparatively low scores for market scope across all projects under study in comparison to the other cognitive innovation impact indicators suggest that, based on the content of the proposals, the current schemes are not geared explicitly towards supporting market creating innovation.

This study proposes and applies cognitive innovation impact indicators. Hence, conclusions can be derived on how these indicators relate to more traditional impact indicators such as surveys or patent counts. No single innovation impact indicator is per se superior to others. The cognitive innovation impact indicators proposed in this study can alleviate some of the weaknesses of more traditional approaches, e.g. the confirmation bias in surveys, long time delays and selective applicability of patent or publication counts or case-specific qualitative studies. The cognitive innovation impact indicators allow an early assessment of the likely innovation impact of the proposals, even before they are actually funded. They can be applied systematically to large numbers of proposals and allow a quantification of attention as well as subsequent interpretation. Hence, the following implications can be derived in the context of this study:

- The high levels of attention to innovation readiness in "Pioneering" and "Diffusing" clusters of project proposals provides an indication that these projects might achieve impact in the short to medium term. The comparatively lower attention to innovation readiness in PPP proposals suggests the opposite (albeit based on only 6 proposals under consideration).

- The allocation of attention to the four innovation impact indicators expressed in project proposals correlates positively and significantly with the attention expressed in the respective call texts. Hence, a cognitive transfer of attention priorities from call texts to funded consortia has successfully occurred.

- There is no evidence that innovation project proposals are research proposals in disguise, since technological novelty does not dominate proposal attention. Given that this study analyses exclusively granted project proposals it is equally likely that such proposals have not been submitted or that evaluators have performed their duties well and ranked them low. In both cases, the purpose of the grant scheme would have been accomplished.

1. INTRODUCTION

One of the cornerstones of the Europe 2020 strategy for smart, sustainable and inclusive growth (European Commission, 2010) has been a commitment to investing into research and innovation. With a budget of around EUR 77 billion, Horizon 2020 is the European Union's Framework Programme 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. Innovation is commonly understood as the commercial exploitation of new or improved products, services or processes (Schilling, 2016). 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/projects, 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. According to the Horizon 2020 Monitoring Report 2015 (European Commission, 2016), a substantial share of the total EU 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.

The Horizon 2020 Monitoring Report 2015 presents for the first time preliminary data on outputs of projects responding to calls in 2014 and 2015 (European Commission, 2016). The figures are collected through the continuous project reporting made by the beneficiaries and refer to publications in peer-reviewed journals, patent applications and granted patents. They show a total of 1760 publications, 109 patent applications and 29 granted patents across the three Horizon 2020 priorities "excellent science", "industrial leadership" and "societal challenges". While these numbers show very early indications of outputs directly related to or produced through EU intervention, they are hardly sufficient to draw conclusions about the innovation impact of Horizon 2020. 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, in that sense, focuses on bridging discovery and market application in order to achieve those changes (European Commission, 2012). Current counts of publication or patent outcomes for assessing the innovation impact of Horizon 2020 have two primary weaknesses. First, most projects have only just begun and the eventual innovation impact can only be assessed once the projects have been finalised and project outcomes have been commercially exploited. Second, publications and patents describe the results of scientific inquiry as well as invention and are, as such, more distant to actual exploitation, e.g. through innovative products or services. They

can, in other words, be characterised as intermediate innovation outcomes that create potentials for ultimate innovation impact.

This study provides an exploratory analysis of the current likelihood of innovation impact of a small subset of Horizon 2020. The focus of this study is on Innovation Actions and public procurement projects (PPP) for which contracts were signed in 2015. Because these actions have only started recently and are therefore still running, it is not possible to assess project outcomes ex-post. Rather, this study applies a forward-looking methodology based on the proposals that were submitted to the calls and subsequently contracted. The goal of the study is to identify the likely innovation impact of a project.

The main analytical tool used in the study is a content analysis of the proposal texts. Social science research has frequently relied on content analysis. It builds on the insight that language is central in human cognition. Accordingly, cognitive schemas can be inferred from the systematic, replicable analysis of text (Duriau et al., 2007). Examples for the application of content analysis methods can be found in the systematic use of media reports for the identification of public disapproval (Vergne, 2012) or letters to shareholders for managerial cognition (Nadkarni and Barr, 2008). Proposal texts are a particularly fitting text source for applying content analysis because Horizon 2020 uses standardised procedures and guidelines for the development and evaluation of proposal texts which ensure that texts are uniformly structured and comparable.

The application of a content analysis requires that indicators are chosen that can be reliably measured by this analytical technique. Indicators are commonly defined as the measurement of an objective to be met, a resource mobilised, an effect obtained or a context variable (European Commission, 2015b). This study develops and analyses four indicators that can be assumed to mirror facets of a project's likely innovation impact: technological novelty, market scope, ecosystem embeddedness, and innovation readiness. These indicators are measured for each of the 233 Innovation Action and public procurement projects under study. Moreover, they are combined with data on the composition and other characteristics of the project consortia in order to derive a comprehensive assessment of the likely innovation impact.

The content analysis of the proposal texts has some limitations. The study is based on counting the identified keywords that are to measure the four innovation impact indicators. These keywords do not measure the material content of the proposals, nor the actual outcome of the projects. Therefore, the analysis is measuring the initial intention rather than the final results of the innovation project. Moreover, the writing of the proposal and the development of the innovation are activities which are linked but separate, which is why the findings based on proposals might not fully hold for the actual projects. These limitations have to be taken into account when using this study.

The ultimate goal of this study is to derive conclusions for the Innovation Actions and public procurement projects as new instruments in Horizon 2020 at the instrument and the programme level. At the instrument level, typical characteristics of proposals that score highly on the selected indicators are identified and can be implemented as recommendations for the configuration of consortia in future calls for proposals. At the programme level, the assessment of the likely innovation impact of funded projects provides one building block in the overall assessment of the effectiveness of these instruments as suitable tools to achieve the stipulated objectives.

The report is organized as follows. Section 2 presents and discusses the innovation impact indicators chosen for the analysis vis-à-vis the academic literature on this topic. Section 3 presents the methodology and data sources used in the analysis while the results are presented in Section 4. Section 5 closes with a discussion and implications followed by concluding remarks.

2. COGNITIVE INDICATORS OF INNOVATION IMPACT

Many projects funded in Horizon 2020 are expected to have an innovation impact. However, the projects' innovation impact is not readily measurable because projects under consideration in this study have just been started and their full impact will only be observable in the more distant future. Moreover, innovation impact originates from the interaction of multiple innovation outcomes (e.g., technological performance, customer adoption, market success) which can hardly be captured by traditional indicators such as counts of patents or new products.

Therefore, this study takes an alternative approach and traces projects' innovation impact back to the attention various consortia devote to specific innovation aspects in their project proposals. Following the attention-based theory of organisational behaviour (Ocasio, 1997), attention is defined here as the "noticing, encoding, interpreting, and focusing of time and effort" by a consortium on innovation issues and action alternatives and mirrors the developing focus of a consortium's cognitive endeavour (Eggers and Kaplan, 2009). Dedicated attention of a consortium might have an impact on how it will act in the future (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 throughout the project. The relationship between attention and actual action is well established in the literature on managerial cognition in the context of organisational renewal. Specifically, prior studies have provided empirical evidence for the impact of managerial attention (measured through text analysis) on subsequent, observable organisational actions such as strategy changes (Cho and Hambrick, 2006), new product launches (Eggers and Kaplan, 2009), and patenting and alliance activities (Kaplan et al., 2003). Studying the 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 organisation's attention towards a specific innovation aspect (e.g., towards a new technology), the more likely it will have developed necessary skills and expertise to succeed in this dimension (e.g., entering into a new product market faster than competitors). Thus, it can be hypothesised that, on the basis of differences in the attention towards specific topics, heterogeneity between the consortia regarding their input decisions is likely to occur, which, in turn, will lead to differences in project outcomes and innovation impact between the consortia. In this, one has to bear in mind that proposal writing is an activity often decoupled from the innovation development – which is why a certain "noise" might be observed stemming from the involvement of professional partners in proposal writing.

A basic premise of this study is that a consortium's attention is represented in a consortium's project proposal (cf. Kaplan, 2011; Eggers and Kaplan, 2009) in which distinct attention foci can be set and expressed. A proposal reflects a plan that includes the purpose and objectives of the innovation and indicates measures the consortium seeks to take to develop and commercialise the innovation. Due to set rules for the ultimate length of any proposal, a consortium is forced to concentrate its attention to the aspects it considers being most important and, thus, may emphasise different innovation facets to a varying degree.

To explore relevant facets of innovation impact that might be differentially emphasised in proposal texts, a thorough review of the extant academic literature was conducted. The objective of this review was to synthesise a set of indicators providing a meaningful systematisation of relevant innovation facets that can be reliably measured in the content analysis of proposal texts. As a starting point, existing literature review articles on innovation (Brown and Eisenhardt, 1995; Krishnan and Ulrich, 2001; Montoya-Weiss and Calantone, 1994) were screened for an initial set of important innovation aspects. This set was then refined by a review of further literature with

reference to the following criteria. First, only articles published in high-quality academic management and innovation journals (including some practitioner-focused journals such as Harvard Business Review) as well as innovation-related publications of the European Commission such as the Innovation Radar methodology (De Prato et al., 2015) were considered. Second, potential indicators and related sub-items should exhibit a strong contribution to innovation impact in terms of 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). Thereby, they should be consistent with previous definitions of Horizon 2020 indicators (European Commission, 2015b). Third, the respective indicators should capture conceptually discriminable contributions to innovation impact, assumed to also be cognitively distinguishable by a consortium. Although some overlap might be inevitable, indicators should be sufficiently different from one another in order to uncover different attention foci within proposals.

Based on this review procedure, four so-called *cognitive indicators of innovation impact* were identified: technological novelty, market scope, ecosystem embeddedness, and innovation readiness. These indicators are used to measure the attention the consortia devote to crucial innovation facets and, thus, can also be referred to as attention foci. In the following, these indicators are described and discussed in more detail.

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).

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). In this regard, the technological novelty indicator focuses on the technology-based magnitude of change rather than on the market-based consequences of an innovation (Govindarajan and Kopalle, 2006). Hence, it only captures the degree of radicalness of the technological dimension of the innovation but does not mirror whether it also induces dramatic changes in the market. For instance, a completely new technology (or novel combination of existing technologies) may create a new market and attract new customers – also referred to as "architectural innovation" (Abernathy and Clark, 1985). However, it may also be applied to existing markets only without any changes of market linkages, while providing existing customers with a significantly better technological solution – also labelled as "revolutionary innovation" (Abernathy and Clark, 1985).

Market Scope

Market scope 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 et al., 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).

Based on the reviewed literature, innovations with a high degree of market scope are typically reflected in two related, but distinct forms of new-market creation: as new-market disruption (cf. Christensen et al., 2015) or as "Blue Ocean" strategy (cf. Kim and Mauborgne, 2005). In the former case, the innovation disrupts existing market linkages or an entire industry by displacing established products or services (Christensen and Bower, 1996; Abernathy and Clark, 1985). Typically, at the time of its introduction such an innovation serves only customers in niche markets who value the innovation's new characteristics. However, over time, due to further improvements, the innovation attracts more and more customers in mainstream markets and replaces existing offerings, while crowding out incumbent providers (Govindarajan and Kopalle, 2006; Christensen et al., 2015).

Alternatively, the innovations can create uncontested market space, labelled as "Blue Ocean", without disrupting an existing market (Kim and Mauborgne, 2005; Lindič et al., 2012). This kind of innovation embraces new, additional demand by redefining a customer problem and adding a new type of offering that did not exist before (Kim and Mauborgne, 1999). It complements rather than replaces existing offerings, as it typically addresses former non-customers and is not aimed at displacing incumbent providers (Kim and Mauborgne, 2015). A low degree of market scope, on the other hand, indicates that the innovation tends to maintain and reinforce existing market linkages, while serving a new offering (but within established categories) to the same customers who already bought the previous offering (Abernathy and Clark, 1985).

For the purpose of this study it is important to separate technological novelty from market scope since both 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, 2015). Accordingly, market scope 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 commercialisation 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). It corresponds to the degree to which the consortium understands itself as part of a system of multilateral actors that need to co-operate in order for the innovation to materialise (Adner, 2006, 2017).

Borrowing insights from neighbouring research on innovation networks (Gemünden et al., 1996) and external knowledge sources (Köhler et al., 2012; Grimpe and Sofka, 2009), four major groups of ecosystem members were identified that a consortium may take into consideration when pursuing its innovation activities: (a) market-related members such as end-users and customers, competitors, distributors, consultants, intermediaries, as well as organisations from other related industries; (b) supplier-related members such as main suppliers, co-suppliers, and complementors; (c) science-related members such as universities and research institutes; and (d)

members of the wider innovation environment such as public, legal, political and governmental institutions, advocacy groups, or civil society organisations.

The notion of an innovation ecosystem goes beyond the concept of an innovation network (cf. Adner, 2017): while an innovation network reflects a pattern of connectivity in which network ties enable information flows (e.g., Powell et al., 1996), an ecosystem is additionally coupled with a specific purpose (e.g., the development of a specific drug) and may be regarded as a configuration of activities determined by a focal value proposition (Adner, 2017). As such, members of an innovation ecosystem do not necessarily have to be affiliated with one and the same industry (Teece, 2007) but may come from different industries because cross-sectoral fertilisation can stimulate open innovation (Levén et al., 2014; Laursen and Salter, 2006).

A high degree of ecosystem embeddedness indicates that the consortium clearly identifies and understands its own innovation ecosystem (Adner, 2006; Adner and Kapoor, 2010) and closely collaborates with other members of the system (Davis, 2016). A strong embeddedness allows for positive spill-over effects between the consortium and the other ecosystem members during the development and commercialisation of the innovation (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 commercialised (De Prato et al., 2015). On the basis of the reviewed literature, three main types of activities can be identified that underlie innovation readiness and that a consortium may pursue to prepare and ensure commercialisation. The first type of activities is associated with the late stages of the development process (Krishnan and Ulrich, 2001; Montoya-Weiss and Calantone, 1994) and includes technical tasks such as proving the technical feasibility of the innovation (Hart et al., 2003), designing, testing, and validating prototypes (Thomke, 1998), validating the production process for the best prototype (Krishnan and Ulrich, 2001), configuring the physical supply chain (Fisher, 1997), as well as slowly scaling up production as necessary for product and market testing (Terwiesch and Bohn, 2001).

The second type of activities covers different strategic and operational marketing tasks a consortium has to take into account to ensure market launch and diffusion (cf. Hultink et al., 1997). Strategic marketing activities include market positioning and product introduction timing (Chiesa and Frattini, 2011) as well as the specification of a business plan and model to capture financial value from the innovation (Zott et al., 2011; Amit and Zott, 2001). Operational marketing tasks cover activities related to the classical marketing mix (Vorhies and Morgan, 2003, 2005; Vorhies et al., 2009), including product management (e.g., product-market research, product demonstration, branding), pricing (e.g., price-setting), promotion (e.g., advertisement, communication), and distribution (e.g., distribution channels, logistics). The third type of activities related to innovation readiness encompasses measures helping a consortium to protect the competitiveness of its innovation (Pisano and Teece, 2007; De Coster and Butler, 2005), including intellectual property

rights (e.g., patents, copyrights, trademarks, trade secrets), product certification, or "natural" barriers to imitation (e.g., unique product features, difficulty in reverse engineering).

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). A low level of innovation readiness reflects that the innovation is in an earlier stage of the development process and rather far from being commercialised (European Commission, 2014b). While ecosystem embeddedness emphasises how well the development and commercialisation 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 realise the innovation in the market place (cf. Krishnan and Ulrich, 2001).

Table 1 gives an overview of the cognitive indicators of innovation impact including their definition, principles, and selected literature references.

Table 1: Overview of cognitive innovation indicators

Cognitive Innovation Indicator	Definition	Principles	Selected References
(1) 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)
(2) Market Scope	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 scope that changes established market linkages and displaces existing offerings. • Blue ocean strategy as an alternative manifestation of high market scope 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, 2015); Charitou and Markides (2002)

Cognitive Innovation Indicator	Definition	Principles	Selected References
(3) Ecosystem Embeddedness	The extent to which the development and commercialisation of an innovation is embedded in a community of organisations 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 materialise. • 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 (2006, 2017); Levén et al. (2014); Olsen et al. (2016); Talke and Hultink (2010)
(4) Innovation Readiness	The extent to which an innovation achieves a satisfactory level of technological maturity and is likely to be successfully commercialised.	• 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 commercialisation 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)

3. METHODOLOGY

The empirical methodology adopted in this study involves a number of different analyses which are based on data for all 227 Innovation Actions and six public procurement project proposals 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 requested EC contribution, the total project cost, and the evaluation score of the consortium. These data serve to provide a basic description of the projects under study, but they are also combined with data generated from the proposal texts of these projects. The proposals are confidential and were made available for the purpose of this study by the European Commission.

Content Analysis

The main analytical technique of this study is 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 et al., 2007). Consequently, this study adopts the idea that the cognitive innovation indicators 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 standardised procedures and guidelines for the development and evaluation of proposal texts 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):

- Based on an analysis of the relevant literature and existing tools, typical formulations of innovation-related project impacts are identified. This analysis results in an operational understanding in the way the innovation impact would be expressed in a proposal text and creates an initial list of words and short phrases for each one of the four dictionaries. In this regard, the Innovation Radar methodology (De Prato et al., 2015) plays a particularly important role in complementing the list.

- In a second step, experienced grant writers and evaluators in H2020 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 were also asked for additional words or short phrases which 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 scope, ecosystem embeddedness, 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. Hence, the dictionaries cover at least a core set of words and phrases that allows consistent

classifications of proposal texts. Example words and phrases include:
- Technological novelty: advanced, breakthrough, first of its kind
- Market scope: differentiate, disrupt, mainstream
- Ecosystem embeddedness: cross-sectoral, society, supply chain
- Innovation readiness: business plan, prototype, scaling up

The entire 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 scope 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 distinct and allows a meaningful differentiation between indicators. Using the software tool LIWC, the resulting dictionaries are applied to all relevant sections of proposal texts (with the headings "Excellence", "Impact" as well as "Implementation"), i.e. excluding sections which contain standardised administrative information. 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 read and assessed with regard to their likely innovation-related project impact. 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 innovation-related indicators of interest. Krippendorff's alpha is 0.75 for technological novelty, 0.64 for market scope, 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.[1]

- 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.

Throughout the analytical process, quality management is applied through iterative steps and recursive improvement. The application of a content analysis requires that indicators are chosen that can be reliably measured by this analytical technique. The choice of four cognitive indicators therefore also reflects the ambition to achieve discriminant validity in the relevant dictionaries. Some dictionaries may be too broad to capture a single construct, e.g. product markets versus markets for technology. Other dictionaries may have too much overlap with the dictionaries of other constructs, i.e. requiring a more precise differentiation between constructs. Moreover, certain indicators, such as the Technology Readiness Level (TRL) which is typically measured on an ordinary scale from 1 to 9 (European Commission, 2014b), are less amenable to be measured through content analytical techniques because the score

[1] 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 scope is slightly below that threshold. Yet, lower values have been suggested acceptable in exploratory (rather than confirmatory) studies such as this one (Neuendorf, 2002).

generated through content analysis cannot be readily converted into a particular TRL. Content analysis is also not an efficient way to measure the composition of the consortium.

In an exploratory part of the study, the dictionaries derived from the content analysis of grant proposals are applied to the call texts to which each of the proposals responds. Correlations between call and proposal texts are calculated and discussed with regards to how much the foci expressed in the call texts can be re-traced in the respective proposal texts.

The four variables generated through content analysis therefore measure the emphasis that grant writers have put on each of the four cognitive innovation indicators. A higher value in one variable indicates that a higher percentage of words used in the proposal were found in one of the dictionaries, i.e. applicants spent more words describing one of the four facets of innovation impact.

Cluster Analysis

The four variables generated through content analysis are subsequently combined with the CORDIS data on the project level and used in a cluster analysis. Specifically, the cognitive innovation indicators are used as cluster variables while the remainder of variables are used to describe the resulting cluster solution in order to identify patterns and derive implications. The overall aim of a cluster analysis is to reduce heterogeneity by defining groups of proposals that are similar within the group and as dissimilar as possible between the groups (Milligan and Cooper, 1987). The clusters are then interpreted based on the average values of the cluster variables within each cluster. This grouping is similar to the method used in the Innovation Scoreboard, where indicators are combined and countries are ranked as "innovation leaders", "followers", etc. To account for the differences between Innovation Actions and public procurement projects, the cluster analysis is only performed on the 227 Innovation Actions in the data while the six public procurement projects will be discussed separately, i.e. they represent their own cluster and will be discussed alongside the others.

Since this study pursues an exploratory approach, the cluster analysis uses a hierarchical clustering method. Instead of partitioning the data in a single step according to a particular number of clusters that is set ex-ante, this type of method runs a series of partition steps ranging from a single cluster including all cases to as many clusters as cases exist (Everitt et al., 2011). Specifically, the study applies Ward's (1963) agglomerative hierarchical clustering procedure to the data, which merges two clusters on the basis of the sum of squared errors. That is, at each fusion step the total within-cluster sum of squared errors is minimised (Everitt et al., 2011). Ward's method is considered as one of the most reliable and robust clustering methods and thus generally recommended in the literature. The results of simulation studies, which compare different clustering algorithms, have shown that Ward's algorithm, in most cases, yields very good partitions and tends to correctly assign cases to clusters (Scheibler and Schneider, 1985; Backhaus et al., 2008).

To establish the appropriateness of Ward's method for the present analysis, the preconditions for applying this method were checked (cf. Backhaus et al., 2008; Ketchen and Shook, 1996). First, variables are continuous and not too highly correlated. Second, no outliers were found based on the single-linkage method which tends to result in broad and unbalanced clusters. Third, the data is expected to produce clusters of similar sizes with similar spread. Fourth, a distance measure reflecting the dissimilarity between cases is used as a proximity metric rather than a similarity measure reflecting the similarity between two cases. In particular, this study applies the so-called Euclidean Distance measure which does not influence the weighting of variances and, thus, is more suitable for the study's data structure than

the squared Euclidean Distance which weights small differences lower and large differences higher (Backhaus et al., 2008).

A crucial step in cluster analysis is the choice for the appropriate number of clusters, i.e. to find a meaningful number of clusters between the two extremes of only one cluster containing all projects and one cluster for each of the projects. Prior literature has developed several approaches in order to identify an appropriate cluster solution (cf. Ketchen and Shook, 1996). As a first approach, a so-called dendogram, a mathematical and graphical representation of the clustering process also known as tree diagram, is drawn. In a dendogram, clusters are indicated by nodes and the distance at which clusters are merged are represented by the length of the respective stem, thereby giving a first indication of possible cluster solutions (Everitt et al., 2011). As a second approach, the values at which cases are combined to build a cluster, the so-called agglomeration coefficients (also representing the sum of squared errors), are plotted on a y-axis against the number of possible clusters on an x-axis. The point at which the resulting curve shows a clear flattening, also referred to as the "elbow criterion", corresponds to the appropriate number of clusters because from this point the clusters being merged are very dissimilar (Ketchen and Shook, 1996). To substantiate these graphical approaches, Mojena's (1977) criterion is used, according to which a good cluster solution is indicated by the highest number of clusters for which the standardised agglomeration coefficient exceeds a certain cut-off value for the first time (Backhaus et al., 2008). The literature suggests cut-off values between 2.75 and 3.50 to determine an appropriate number of clusters (Everitt et al., 2011).

The clusters are subsequently characterised along relevant applicant and project information, e.g. the size of the consortium, the project cost and its composition (higher and secondary education, private for profit, public body, research organisations, and other types of organisations).

4. RESULTS

Descriptive Results

Table 2 shows the descriptive statistics of the cognitive innovation impact indicators 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. Moreover, the remaining columns show the standard deviation as well as the minimum and maximum values of the variables in the data. We find the highest average value for the innovation readiness indicator (colour-coded in green), followed by technological novelty, ecosystem embeddedness (colour-coded in yellow) and market scope (colour-coded in red). 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 place very strong emphasis on the respective facet of innovation impact.

Table 2: Cognitive innovation impact indicators for Innovation Actions (n=227)

Variable	Mean	Std. Dev.	Min	Max
Technological novelty	1.82	0.69	0.58	4.57
Market scope	1.26	0.51	0.39	4.31
Ecosystem embeddedness	1.36	0.52	0.54	3.87
Innovation readiness	2.43	0.61	1.19	4.94

The interpretation of the mean values of the four innovation indicators 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 analysed.

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 scope. This seems in accordance with the stipulated objectives of Innovation Actions to facilitate innovation in contrast to funding research activities. Nevertheless, proposals also stress technological novelty while remaining relatively quiet on ecosystem embeddedness and market scope.[2]

Table 3 further describe the projects under study. The requested EC contribution and total project costs are EUR 6.30 million and EUR 9.78 million, respectively, but there is considerable variation among the projects, as evidenced by the rather low minimum and high maximum values. Projects have on average 13 participants but the largest project includes 50 participants. Projects turn out to be dominated by private companies: There are on average seven companies involved in a project, accompanied by slightly more than two higher education institutions and two research organisations. Public entities and other types of participants only play a minor role. Of the private companies, about half of them are SMEs. 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 almost six different countries collaborate in a consortium. The mean evaluation score is 13.

Table 3: Descriptive statistics for Innovation Actions (n=227)

Variable	Mean	Std. Dev.	Min	Max
Requested EC contribution (mEUR)	6.30	6.19	0.33	39.33
Total project cost (mEUR)	9.78	16.81	0.35	181.08
Number of participants	13.04	9.27	1	50
Number of higher education institutions	2.32	2.41	0	17
Number of private companies	7.30	6.38	0	43
Number of public bodies	0.58	1.49	0	12
Number of research organisations	2.16	1.75	0	9
Number of other participants	0.63	1.33	0	10
Number of SMEs	3.49	2.85	0	19
Participant breadth	3.14	1.06	1	5
Country breadth	5.88	2.63	1	16
Evaluation score*	13.02	1.02	10	15

* evaluation score is missing for eleven projects

[2] 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).

Table 4 shows the scores of the cognitive innovation impact indicators of the six public procurement projects. Although the overall number of projects is low, interesting differences with the 227 Innovation Actions emerge. The most pronounced cognitive innovation impact indicator turns out to be ecosystem embeddedness, closely followed by innovation readiness and technological novelty. Market scope only plays a minor role, similar to the Innovation Actions. In general, the mean and maximum values of the four indicators appear to be much lower compared to the Innovation Actions.

Table 4: Descriptive statistics public procurement projects (n=6)

Variable	Mean	Std. Dev.	Min	Max
Technological novelty	1.75	0.40	1.01	2.18
Market scope	1.08	0.15	0.89	1.28
Ecosystem embeddedness	1.92	0.33	1.48	2.33
Innovation readiness	1.84	0.43	1.19	2.50

Table 5 shows further descriptive statistics for the public procurement projects. They are considerably smaller on average than Innovation Actions. The requested EC contribution and total project cost are EUR 2.96 million and EUR 4.70 million, respectively. Projects have on average nine participants and most of them are public bodies, followed by research organisations, private companies, and higher education institutions. This indicates a considerably different composition of the consortia. Moreover, SME involvement is relatively rare. Regarding the breadth measures, we find that almost four different types of participants and five different countries are involved in the consortium. The mean evaluation score is 11.75.

Table 5: Descriptive statistics for public procurement projects (n=6)

Variable	Mean	Std. Dev.	Min	Max
Requested EC contribution (mEUR)	2.96	1.45	0.78	4.72
Total project cost (mEUR)	4.70	1.46	2.70	6.77
Number of participants	8.83	3.82	6	15
Number of higher education institutions	1.17	1.47	0	4
Number of private companies	1.50	0.84	0	2
Number of public bodies	2.67	2.07	0	6
Number of research organisations	2.33	3.01	0	8
Number of other participants	1.00	0.63	0	2
Number of SMEs	0.67	0.52	0	1
Participant breadth	3.83	0.75	3	5
Country breadth	5.33	1.97	3	8
Evaluation score	11.75	1.60	10	14

In sum, the tables showing descriptive statistics for Innovation Actions and public procurement projects indicate considerable differences between the two types of projects. These differences also warrant an exclusion of the only six public procurement projects from the cluster analysis. The public procurement projects will however be discussed together with the results of the cluster analysis for the Innovation Actions.

Qualitative Results

The manual reading of 40 randomly selected proposal texts not only serves – as indicated – to quantitatively 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, text boxes will be presented by indicator containing selected quotes from the proposals with above median scores of the respective indicators. All quotes are anonymised.

The quotes expressing technological novelty tend to stress the ground-breaking 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 characterised 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.

Technological novelty
"[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 scope 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 scope is also very closely linked to descriptions of technological novelty or innovation readiness for immediate commercial exploitation.

Market scope
"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).

Ecosystem embeddedness
"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.

Innovation readiness
"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 the four identified dimensions of innovation impact. This not only validates the automated content

analysis of the proposals but also holds insights on how these attention foci are typically described in longer paragraphs of text. This allows for a more systematic identification and evaluation of the likely innovation impact in proposals.

Comparison of Call and Proposal Texts

In a next step, content analyses using the four cognitive innovation impact dictionaries are applied to the 38 call texts to which the 233 proposals responded. While content analyses have been applied to call texts before (Olsen et al., 2016), it is important to note the difference in interpretation compared with proposal texts. Call texts describe an abstract research need or ambition, not a concrete proposal for addressing it. Hence, any content analysis reveals differences in attention paid to various facets of innovation when expressing a research need or ambition.

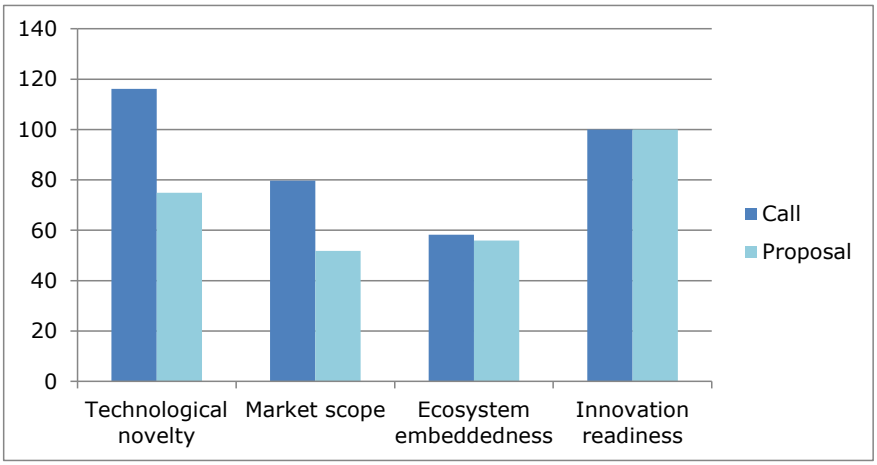
Table 6 provides an overview of the results from the content analysis using call texts. The 38 call texts contain on average 3.95% of words relating to technological novelty, 2.71% for market scope, 1.98% to ecosystem embeddedness and 3.40% to innovation readiness. The averages are consistently higher than for the proposal texts and the extremes are more pronounced as evidenced by a larger range between minimum and maximum values.

Table 6: Descriptive statistics call texts (n=38)

Variable	Mean	Std. Dev.	Min	Max
Technological novelty	3.95	1.98	0	8.12
Market scope	2.71	1.80	0	7.69
Ecosystem embeddedness	1.98	1.33	0	6.46
Innovation readiness	3.40	1.57	0.74	7.05

When comparing the indicator averages for call texts with proposal texts, call texts devote comparatively more attention to technological novelty than to innovation readiness. The differential focus of call and proposal texts is further described in Figure 1. In this figure, the indicator scores are normalised to 100 for innovation readiness. Interestingly, call texts pay about 16% more attention to technological novelty than to innovation readiness. Both for technological novelty and market scope the differences between calls and proposals are particularly pronounced. The focus on ecosystem embeddedness is about the same in both calls and proposals. These results indicate that, while calls stress technological novelty more than innovation readiness, proposals place much stronger focus on innovation readiness than on technological novelty. Given that Innovation Actions seek to increase the chances that technologies are commercially exploited through innovation, the comparatively higher focus on novelty than on readiness in call texts seems counterintuitive. Then again, the proposals of funded projects do focus on readiness to a much higher extent than on all other dimensions of innovation impact.

Figure 1: Comparison of call and proposal text attention foci



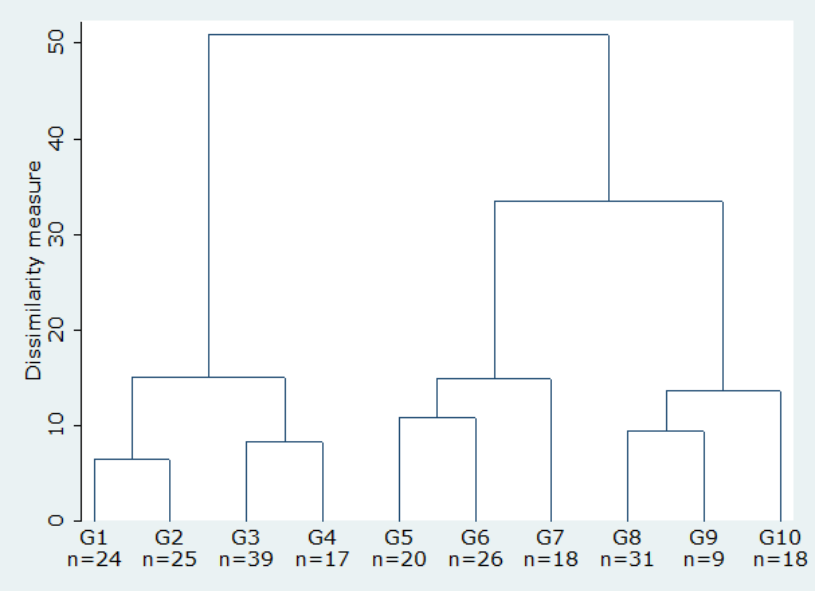
However, such comparisons of averages may be driven by extreme values and correlation analysis can provide additional insights. In fact, correlation analyses reveal that cognitive innovation impact indicators between calls and proposals are consistently positively correlated and highly significant (99% levels). The correlation between attention expressed for technological novelty in call texts and in proposal texts is 0.49, for market scope 0.41, for ecosystem embeddedness 0.48 and for innovation readiness 0.24. While no reference figures for optimal levels of correlation exist, these correlation coefficients indicate quite some congruence between the attention foci expressed in call and proposal texts. It suggests that precisely worded call texts are important tools for conveying emphasis and preferences of a research need or ambition providing guidance for consortia and their proposals. The call texts under study achieve this to a lesser degree for innovation readiness.

Finally, all proposal texts under consideration are positively evaluated and eventually contracted. The positive correlations are also likely to indicate that evaluation processes perform well in selecting proposals that have a close attention overlap with the call. Larger divergences between call and proposal attention foci are likely to be found in proposals with lower evaluation scores.

Cluster Analysis

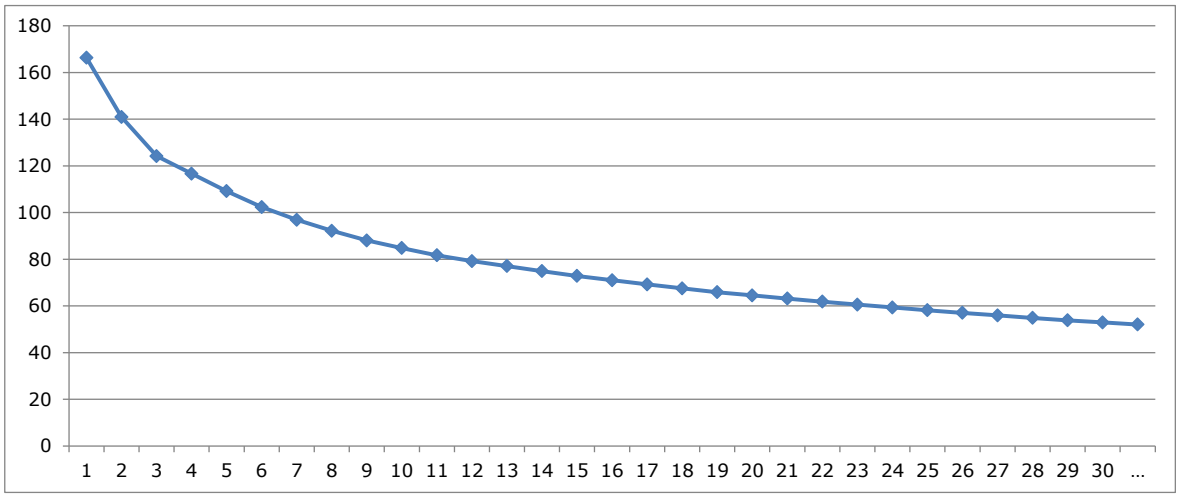
The major challenge for cluster analytical techniques is the decision for an appropriate number of clusters that provides a meaningful segmentation of the projects in the data but at the same time does not conceal the heterogeneity among the projects. Using the four innovation indicators as cluster variables leads in a first step to two graphical representations that facilitate the identification of clusters. Figure 2 shows the dendrogram of the clustering process after Ward's method using the Euclidean distance as distance measure. The figure depicts the stepwise agglomeration of projects to clusters. To allow a meaningful interpretation of the clusters, the resulting solution should neither contain too few nor too many clusters (Everitt et al., 2011). Figure 2 turns out to be clearly suggestive of a three-cluster solution that combines 105 Innovation Action projects in the first cluster, 64 projects in the second cluster and 58 projects in the third cluster.

Figure 2: Dendrogram of the cluster solution



The appropriateness of a three-cluster solution can be tested by applying the "elbow criterion". For that purpose, Figure 3 shows the sum of squared errors depending on the number of clusters chosen. The "elbow" indicates the point at which a rather large reduction in the sum of squared errors per additional cluster compares favourably to a relatively smaller reduction. Literature suggests that this point indicates the number of clusters to be chosen (Ketchen and Shook, 1996; Backhaus et al., 2008). Figure 3 shows that this is the case with a three-cluster solution.

Figure 3: Sum of squared errors depending on the number of clusters



Finally, the choice for the number of clusters should be substantiated by applying the Mojena criterion which, in our case, also provides support for a three-cluster solution (Mojena, 1977; Everitt et al., 2011).

In the next step, the three clusters need to be further characterised in order to allow for a meaningful interpretation. Table 7 shows the mean values of the cluster variables by cluster, comparing them to the public procurement projects (PPP). A first glance on the mean values shows important differences between the three clusters. Cluster 1, which also is the cluster containing by far most of the projects, scores comparatively low for all four innovation impact indicators. Clusters 2 and 3 each show a distinct profile, with Cluster 2 scoring highly on technological novelty, market scope and

innovation readiness and Cluster 3 exhibiting high scores for ecosystem embeddedness and innovation readiness. In comparison to the cluster solution of the Innovation Action projects, the public procurement projects score relatively low but they nevertheless show rather high ecosystem embeddedness. It has to be noted though that these average values are based only on six observations.

Table 7: Mean of cluster variables by group

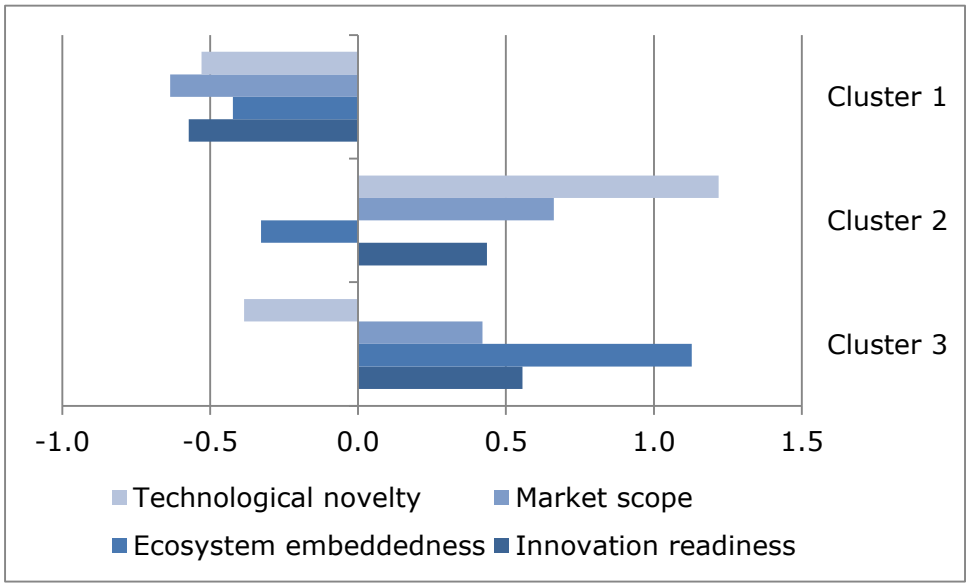
Clusters	Obs.	Technological novelty	Market scope	Ecosystem embeddedness	Innovation readiness
Cluster 1	105	1.46	0.93	1.14	2.08
Cluster 2	64	2.66	1.60	1.19	2.69
Cluster 3	58	1.56	1.47	1.95	2.77
PPP	6	1.75	1.08	1.92	1.84
Total	233	1.82	1.25	1.38	2.41

To facilitate the interpretation of the cluster solution, Figure 4 shows the T-values of the cluster variables in the cluster solution, i.e. standardised deviations of the variables within the clusters relative to the overall sample mean. The figure confirms the first assessment of the descriptive statistics of the cluster variables. Cluster 1, the largest cluster with 105 projects, shows low values for all four innovation indicators relative to the sample means of the variables. In other words, projects in this cluster exhibit relatively low focus on the four facets of innovation impact in their proposal texts. We label this cluster therefore as "Sustaining", i.e. projects that in their proposal dedicated modest attention to the four facets of innovation impact to be achieved through the funding. "Sustaining" in that sense characterises projects with an innovation impact likely to be limited and restrained.

Cluster 2 shows a noticeably different profile. Technological novelty, market scope and innovation readiness are highly pronounced, suggesting that projects in this cluster dedicate high attention to achieving breakthrough technological results which are intended to help create markets. These results should also be rather close to actual exploitation while the embeddedness into the ecosystem is relatively low. Thus, we refer to this cluster as "Pioneering".

Cluster 3, again, differs quite substantially from the other two clusters in that it puts high emphasis on ecosystem embeddedness, followed by innovation readiness and market scope. Less attention is dedicated to the technological novelty of the project. Projects in this cluster hence aim at achieving diffusion and exploitation of the innovative solution within the ecosystem which is why we refer to this cluster as "Diffusing".

Figure 4: T-values of the cluster variables in the cluster solution



Overall, and as expected, the four cluster variables measuring the cognitive innovation impact indicators are significantly different across the three clusters, as an analysis of variance (ANOVA) shows.

As a next step, the three-cluster solution and the group of public procurement projects will be discussed with regard to the variables available to characterise the projects. Table 8 shows the results. The columns contain the mean values of the respective variables by cluster, PPP and overall. The final column presents the results of an analysis of variance (ANOVA) and indicates whether the differences of the variable means are statistically significant between the four groups (i.e. the three clusters and the group of PPP).

Interesting differences emerge. First, the groups differ vastly in the average size of the projects. In absolute terms, "Pioneering" projects turn out to have the highest requested EC contribution, closely followed by "Sustaining" projects. When it comes to total project cost, "Pioneering" projects show the highest value followed by "Sustaining" projects. "Diffusing" projects and PPP are considerably smaller, both in terms of the requested EC contribution and the total project cost. These differences turn out to be statistically significant. Comparing the requested contribution with the total project cost leads to stark differences across the clusters: The ratios of requested contribution to total cost are 73%, 49%, 81%, and 63% for the three clusters and PPP, respectively. In that sense, "Pioneering" projects require a rather low share of budgetary contribution from the EU while dedicating high attention to technological novelty, market scope and innovation readiness. In contrast, "Sustaining" and "Diffusing" projects require a high share of budgetary contribution with – in the case of "Sustaining" projects – comparatively low focus all four dimensions of innovation impact.

Looking at the number of participants in the projects, we do not find statistically significant differences between the groups. "Diffusing" projects and PPP have fewer participants which coincides with the lower funding volume. With regard to the institutional composition of the projects we find stark differences between the groups. "Sustaining" projects are relatively dominated by higher education institutions while "Pioneering" projects typically involve relatively more private companies and research organisations. "Diffusing" projects have relatively fewer company participants. PPP are characterised by a strong presence of public bodies in the consortium. The number of SMEs is highest in "Pioneering" projects and lowest in PPP.

Moreover, we find that the breadth of participants, i.e. the number of different types of participants present in the consortium, is highest in the group of PPP, indicating high diversity within those projects, while it is lowest for "Pioneering" projects. Apparently, the planned activities in this group of projects require higher focus and less institutional diversity. Nevertheless, projects in this group are characterised by the highest number of different countries represented in the consortium while PPP show the lowest diversity with respect to country origin of the participants. Finally, the evaluation score does not vary much between the three clusters but turns out to be considerably lower in the group of PPP.

Table 8: Characterisation of the cluster solution

Variables	Cluster 1 «Sustaining»	Cluster 2 «Pioneering»	Cluster 3 «Diffusing»	PPP	Total	Sig.
Requested EC contribution (mEUR)	6.94	7.07	4.26	2.96	6.21	**
Total project cost (mEUR)	9.46	14.42	5.26	4.70	9.65	**
Number of participants	13.45	14.09	11.14	8.83	12.93	
Number of higher education institutions	2.42	2.16	2.31	1.17	2.29	
Number of private companies	7.61	8.84	5.03	1.50	7.15	***
Number of public bodies	0.75	0.06	0.84	2.67	0.64	***
Number of research organisations	1.98	2.56	2.05	2.33	2.17	
Number of other participants	0.64	0.44	0.81	1.00	0.64	
Number of SMEs	3.37	4.31	2.79	0.67	3.42	***
Participant breadth	3.11	2.98	3.36	3.83	3.16	*
Country breadth	5.70	6.09	5.95	5.33	5.86	
Evaluation score	12.96	12.95	13.23	11.75	12.98	**
Obs.	105	64	58	6	233	

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

5. DISCUSSION AND IMPLICATIONS

This study makes two primary contributions to the assessment of likely innovation impact within a certain subset of Horizon 2020, based on the exploratory analysis of the proposals. First, it systematically establishes cognitive innovation impact indicators which connect heterogeneity in innovation impact with differences in the attention that consortia pay to particular innovation aspects. Four central pillars for innovation impact are related to cognitive processes and the allocation of attention. Second, this study advances the measurement of cognitive innovation impact indicators by applying content analyses and condensing the results through cluster analyses. Implications can be derived for both the funding instruments under study and for the methodological development of innovation impact indicators.

Implications for the Funding Instruments under Study

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 recently been started, 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 conclusions.

Within the conceptualisation of cognitive innovation impact, any proposal text represents the sum of the attention of the consortium (space considerations enforcing priority setting). Consortia are heterogeneous in the degree to which they dedicate attention to particular aspects, i.e. divide the pie of overall attention. Projects focussing on research activities rather than on the commercial exploitation of innovation can be expected to be dominated by considerations for technological novelty. Then again, it would be unreasonable to assume little to no attention to technological novelty in proposals directed at innovation. Almost all innovation and PPP call texts use technological novelty at least as a starting point, and all proposals contain indications of technological novelty. That said, the average proposal pays roughly 33% more attention to innovation readiness than to technological novelty. Taking attention to readiness, embeddedness and market scope together, consortia dedicate on average almost three times as much attention to the commercialisation of technologies compared with describing technological novelty. These results cannot rule out that individual innovation proposals may be research projects in disguise. However, this study finds little evidence in the large scale analysis that such concerns can be generalised.

Apart from these general considerations, the following key insights can be derived from the analyses:

- A cluster of proposals containing "Pioneering" project consortia can be identified which pay comparatively more attention to achieving ambitious innovation impact vis-à-vis the goals of Horizon 2020. Consortia are significantly more likely to allocate their attention accordingly with increasing participation of private firms including SMEs. It is noteworthy that projects in this cluster combine attention to technological novelty and market creation (market scope).

- "Pioneering" consortia apparently require a combination of technological novelty and market scope instead of an isolated pursuit of market scope in the absence of technological novelty. This suggests that the identification of innovation that is potentially market creating requires careful assessment of the underlying technology and its novelty.

- Another cluster of proposals containing "Diffusing" project consortia can be identified with dedicated attention to diffusing innovation based on a broad representation of the innovation's ecosystem and its readiness. Within the ambition of Horizon 2020 for bridging discovery and market application, these consortia are clearly more specialised for the latter stages and can have an important contribution for achieving market success.

- In the two clusters containing "Pioneering" and "Diffusing" projects, attention to market scope and innovation readiness are closely linked. While projects in the former cluster attach higher attention to technological novelty, projects in the latter cluster stress ecosystem embeddedness. The joint occurrence of emphasis on market scope and innovation readiness in an overall large number of projects suggests that market creation requires a leap forward in the readiness of the underlying innovation.

- A substantial share of Innovation Action projects can be characterised as "Sustaining". Project proposals in this cluster contain only modest focus on the four innovation impact indicators. That in turn indicates low ambition to increase the chances that technologies will be successfully commercialised. It is striking that "Sustaining" projects constitute the largest group of projects. Nevertheless, the analysis only includes consortia that received funding. It is therefore not possible to compare "Sustaining" projects with those proposals that did not receive funding. Within the context of this study, "Sustaining" projects should therefore be considered as a baseline reference group for "Pioneering" and "Diffusing" cluster proposals.

- With the caveat of the limited number of PPP proposals analysed in this study, they share many attention allocation similarities with Innovation Actions. However, the attention devoted to innovation readiness is comparatively lower. There is a risk that PPP currently do not allocate enough attention to the broader market application of innovation beyond public procurement.

- Overall, the comparatively low scores for market scope across all projects under study in comparison to the other cognitive innovation impact indicators suggest that, based on the content of the proposals, the current schemes are not geared towards supporting market creating innovation. Then again, the creation of new markets is difficult to describe ex-ante as market creation largely depends on product markets and demand conditions that are hard to predict in detail ex-ante because market research techniques can only be applied to existing markets.

- Attention allocation expressed in call texts largely guides the attention allocation of consortia in proposal texts and/or evaluators. However, despite being Innovation Actions, call texts put comparatively higher emphasis on technological novelty than on market scope, ecosystem embeddedness and innovation readiness although the latter three indicators are particularly associated with the commercial exploitation of innovation.

Implications for Innovation Indicators

No single innovation impact indicator is per se superior to others. The cognitive innovation impact indicators proposed in this study can alleviate some of the weaknesses of more traditional approaches. Ideally, evaluations combine multiple indicators, such as cognitive innovation impact indicators based on content analysis combined with a continuous monitoring through surveys as in the Innovation Radar (De Prato et al., 2015). Cross-validation of indicators for a selected set of proposals has the largest potential for obtaining reliable sets of indicators. Table 9 provides an overview of the strengths and weaknesses of different innovation indicators.

The cognitive innovation impact indicators proposed in this study 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 prioritise. Cognitive innovation impact indicators are based on the idea that the allocation of attention and the prioritisation 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.

The analysis presented in this study does not allow qualifying one of the four cognitive innovation impact indicators as more important than the others in its overall contribution towards innovation impact. Rather, the theoretical reasoning and empirical analysis suggest that consortia need to reflect on all four indicators in their

proposals in order to increase the chances for successful innovation. Each indicator reflects a distinct dimension of innovation impact, and a dedicated allocation of attention to these four dimensions can be assumed to translate into focus on innovation impact while actually carrying out the planned activities in the project. While it is still too early to conclude whether the articulated focus on innovation in the projects will materialise, the four indicators allow an eye on the extent Horizon 2020 will deliver on innovation.

This study proposes four indicators to measure the extent to which Horizon 2020 will deliver on innovation in the short, medium and longer term. These indicators focus on innovation instead of research impact by connecting the attention for technological novelty with attention to product market considerations for commercialisation, i.e. market scope, ecosystem embeddedness as well as innovation readiness. On average, the studied project proposals devote almost three times as much attention to the latter issues 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 commercialisation provides confidence that Horizon 2020 will have important innovation outcomes in the short and medium term. Especially the attention that "Pioneering" and "Diffusing" project consortia devote to innovation readiness suggests that impact is likely to occur rather sooner than later. Projects in these clusters comprise the majority of innovation projects under consideration. 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 behaviour. Potential future studies could draw on both cognitive and other types of innovation indicators (i.e. survey-based, qualitative and quantitative) to verify the findings of this report and assess potential long-term consequences. In relative terms, public procurement projects allocate less attention to innovation readiness. With the caveat of small sample size for these projects in mind, it is comparatively less likely that they will contribute to the innovation goals of Horizon 2020 in the short term.

Finally, a cross-check of the proposed indicators of this study with the evaluation criteria of projects within the relevant schemes provides confidence in the selection of projects. First, all projects fulfil at least a minimum level of attention to technological novelty, market scope, ecosystem embeddedness as well as innovation readiness. Second, the allocation of attention to these four indicators expressed in project proposals correlates positively and significantly with the attention expressed in the respective call. Hence, a cognitive transfer of attention priorities from call texts to funded consortia has successfully occurred. Finally, there is no systematic evidence that innovation project proposals are research proposals in disguise, since technological novelty does not dominate proposal attention. Given that this study analyses exclusively granted project proposals it is equally likely that such proposals have not been submitted or that evaluators have performed their duties well and ranked them low. In both cases, the purpose of the grant scheme would have been accomplished.

Table 9: Overview of strengths and weaknesses of different innovation indicators

	Cognitive innovation impact indicators	Survey-based innovation impact indicators	Quantitative innovation impact indicators (e.g. publications, patents)	Qualitative innovation impact indicators (e.g. case studies)
Strengths	Non-intrusive administration Large scale application Applicable and observable for unsuccessful consortia Systematic and replicable Short processing time and availability	Quantitative results Benchmarking Comparison over time Cross-country comparisons	Quantitative results Benchmarking Comparison over time Cross-country comparisons Comparable quality standards	Deep, context-specific insights Tailored to innovation Comprehensive set of impacts, e.g. societal
Weaknesses	Expressed intention may not be followed by action Professional grant consultants eliminate heterogeneity	Vulnerable to confirmation bias Potential for ex-post rationalisation Administrative effort for innovators Costs for surveying, sampling Survival bias	Limited to selected outcomes Limited to selected sectors and industries Potentially long time delay	Time and cost intensive Important selection biases Significant efforts from innovators Potential for ex-post rationalization Potential for conformity biases

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APPENDIX

DICTIONARY TECHNOLOGICAL NOVELTY

Word stems and phrases		
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

DICTIONARY MARKET SCOPE

Word stems and phrases		
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

DICTIONARY ECOSYSTEM EMBEDDEDNESS

Word stems and phrases		
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

DICTIONARY INNOVATION READINESS

Word stems and phrases		
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

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Innovation actions were introduced in Horizon 2020 to help bringing discoveries to the market. Most of them demonstrate the application of new knowledge in real-life conditions. The very first projects started in 2014 and it still is too early for them to produce final results, but a short study was commissioned to look into the projects based on proposal texts (*Grimpe, C. et al., Study on Innovation in Horizon 2020 Projects, EC*). For this study, 227 Innovation Actions and six innovation procurement actions were selected that started in 2015, most of them in the PPPs such as Ecsel, Clean Sky, Factories of the Future, Energy Efficient Buildings, Clean Vehicle, but also in other calls (FTI, ICT, NMP, environmental technologies, Galileo and others). The texts of the granted projects were analysed using content analysis methodology, based on keywords that indicate four innovation aspects: technological novelty, market scope, ecosystem embeddedness and innovation readiness.

The projects were grouped in three categories. 64 out of the 227 innovation actions score high on technological novelty, market scope and innovation readiness, but low on ecosystem embeddedness. These are called 'pioneering' projects. They seem to focus on breakthrough technological results that may create markets. To the contrary, another 58 innovation actions emphasise ecosystem embeddedness and score lower on the other three aspects. These are called 'diffusing' projects that aim at diffusion and exploitation of the innovative solution in the ecosystem. The remaining 105 innovation actions pay only modest attention to each of the four aspects. These are called 'sustaining' projects. The composition of the consortia differs: pioneering projects involve relatively more private companies, esp. SMEs, and research institutions. The diffusing projects have less companies and more public bodies. The sustaining projects are dominated by higher education institutions. It is still too early to characterise these innovation actions and their impacts, but these initial findings indicate that a quarter have a disruptive, market-creating potential, and that companies and research institutions play a leading role in these initiatives.

The six innovation procurement projects share many attention allocation similarities with the innovation actions. However, the attention devoted to innovation readiness and market scope is comparatively lower. There is a risk that these projects do not allocate enough attention to the broader market application of innovation beyond public procurement.

These conclusions are based on the texts of the projects at their start. The results of the projects are expected in 2018-2019.

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