



Innovation Contests in Public Procurement: Challenges as a New Instrument?

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Abstract

Political decision-makers are showing great interest in the ability of public procurement to promote the innovative capacity of private companies through public contracts. Suppliers are increasingly seen as a source of innovation in the public sector. In this context, the use of innovation contests in public procurement is increasingly observed. Challenges represent a special type of innovation contests. A goal of the paper is to be it the concept of Challenges exploratively to examine and the use in the public procurement. In this paper, an exploratory case study was conducted to examine selected design elements of challenges and to identify factors critical to the success of challenges. This study helped to increase understanding about this type of innovation contest and to identify alternatives to previously used innovative public procurement tools. The results indicate that challenges have the potential to efficiently develop and utilize supplier innovations in public procurement.

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Julia Werneth: Conceptualization, Methodology, Investigation, Visualization, Writing – original draft

Christian von Deimling: Conceptualization, Methodology, Investigation, Writing – review & editing

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. An earlier version of this paper has been created by Julia Werneth in form of her Master Thesis.

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1 Introduction

Political decision-makers and researchers are showing great interest in the ability of public procurement to promote the innovative capacity of private-sector companies through public contracts. As a result, public procurement of innovation has emerged as an important innovation policy tool in recent years. (Edquist and Zabala-Iturriagoitia 2012); (Uyarra et al. 2020); (Uyarra and Flanagan 2010). Public procurement can help encourage private firms to increase their innovation activities (Uyarra et al. 2014), helping them overcome the "valley of death" between developing and commercializing an innovation (Edler and Georghiou 2007), and disseminate innovative solutions to the marketplace (Edquist and Zabala-Iturriagoitia 2012). The literature suggests that public procurement of innovation has the potential to meet procurement needs more efficiently than existing solutions, in addition to providing societal benefits (Uyarra et al. 2020). Recently, the use of innovation contests in public procurement can be increasingly observed in this context. Innovation contests can be defined as a time-limited competition organized by a public or private organization that invites the general public to develop a solution to a predefined problem or task through their expertise, skills, and creativity. (Piller and Walcher 2006; Bullinger et al. 2010). Innovation contests have been used for decades and are gaining importance again, especially since the development of information and communication technology (Piller and Walcher 2006). More and more organizations worldwide conduct innovation contests to serve socio-political purposes such as the promotion of sustainability in addition to innovation purposes. At the same time, innovation contests represent a growing field of research for scholars from different disciplines. Adamczyk et al. 2012 have identified a total of five research streams dealing with innovation contests. In addition to the economic perspective. (Baye and Hoppe 2003; Schöttner 2008) and the management perspective (e.g. Boudreau et al. 2010;Ebner et al. 2009) Innovation contests are also used in educational sciences (e.g. Gregson and Little 1999; Pack et al. 2004) , in innovation management (e.g. Bjelland, Osvald, M. and Wood 2008; Borins 2000) , and in sustainability research (e.g. Adler 2010; Greco et al. 2021) studied. According to Adamczyk et al. 2012 future research should examine more closely, both quantitatively and qualitatively, the target group, the design, incentive systems used, other instruments and concepts, the optimal organizational structure, the effects of expert knowledge within innovation contests, among other things. New studies have followed these recommendations to some extent and have already examined individual design elements of innovation contests such as the optimal duration of the contest (Korpeoglu et al. 2021) or also the incentive systems used (Hofstetter et al. 2018) examined. However, further instruments and concepts related to innovation contests remained unexplored.

Challenges are a special type of innovation contest that is increasingly being used in the public sector. A challenge is an incentive-induced contest to find possible solutions to an ambitious and, in today's context, usually socially relevant problem for which there is currently no efficient solution on the market. In this process, financial prizes are awarded to the person who can provide the best solution to a significant problem. Solving the problem requires significant commitment and often a breakthrough, disruptive solution (own definition based on Kay 2011; Nesta 2022). In the U.S., public organizations such as the Defense Advanced Research Projects Agency (DARPA) have been offering challenges since 1958 to incentivize the development of new technologies (Williams 2012). A well-known example is also the Big Green Challenge, which is a challenge to encourage action on climate change (Tjornbo and Westley 2012).

Despite the outlined importance of innovation contests in general and challenges in particular, as well as various policy directives, such as the EU Directives 2014/24/EU and private measures to use challenges, the systematic analysis of challenges is still underrepresented (Williams 2012). Previous literature has already examined historical cases of challenges (e.g. Sobel 1995) and a few studies also exist on more recent challenges (e.g. Hossain and Kauranen 2014). Other Innovation contests, for example hackathons, have also been discussed in the (e.g. Falk et al. 2021; Flus and Hurst 2021; Kollwitz and Dinter 2019). Although these articles explore how Challenges work in practice, the lack of empirical data remains a concern given the rise in advocacy. To date, articles on the implementation, stakeholders, and success factors of Challenges in public procurement are particularly lacking. As a result of the lack of scholarly engagement with the topic of challenges, it remains largely unclear what challenges are and how they can be used by public sector clients to promote innovation. To fill this research gap, this article aims to answer the following research questions:

- **RQ1:** What are the special characteristics of challenges and how can challenges be differentiated from other instruments of innovative public procurement?
- **RQ2:** Which factors can have a significant influence on the success of a challenge and what could the ideal process of a challenge look like?

This paper aims to promote the understanding of challenges in public procurement and to present the basic function mode of challenges. In the following the theoretical background of innovation contests as an instrument, in order to make supplier innovations in the public procurement accessible, is presented first. Subsequently, the methodology of the accomplished case study analysis is described and the results of the case study are presented and discussed. The paper concludes with implications for public procurement both in practice and in research.

2 Understanding how to access supplier innovations through innovation contests in particular through challenges

2.1 Access to supplier innovations: Insights from literature

Suppliers are increasingly seen as a source of innovation and important partners in joint development projects in both the public and private sectors (Azadegan 2011). Research has addressed the question of how the innovative power of suppliers can be harnessed by organizations (Wagner 2012; Wagner and Bode 2014). On the one hand, the contributions deal with the involvement of suppliers in product development projects (e.g. (Johnsen 2009); (Petersen et al. 2005) and on the other hand with the question of how suppliers can be encouraged to share their innovations, i.e. to increase the attractiveness (e.g. (Hüttinger et al. 2012); (Schiele et al. 2012).

Involving suppliers in product development projects is fundamentally about integrating supplier capabilities within the process of developing new products (Dowlatshahi 1998) and the tasks and responsibilities they can assume within the process (van Echtelt et al. 2008). It is believed that by involving suppliers early in the product development process, low costs can be realized with better quality and shorter time to market (Ragatz et al. 2002). The literature on customer

attractiveness is concerned with how organizations can identify innovative suppliers (e.g. (Koufteros et al. 2012; Melander and Tell 2014) and how organizations can shape supplier development (e.g. Giannakis 2008; Lawson et al. 2009).

These research streams in public procurement are complemented by contributions dealing with the public procurement of innovation (PPI). The contributions deal in particular with the potential and the framework conditions for the use of public procurement as a type of innovation policy measure (e.g. Edler and Georghiou 2007), the classification of different types of PPI (e.g. Edquist and Zabala-Iturriagoitia 2012) , and barriers to PPI adoption (e.g. Georghiou et al. 2014). PPI is a demand-side innovation policy instrument (Edler and Georghiou 2007; Edquist and Zabala-Iturriagoitia 2012; Geroski 1990) in which a public organization issues a contract for the fulfilment of a specific task with a fixed time frame, which is to be accomplished through the development of a new product or service (Edquist and Zabala-Iturriagoitia 2012). The goal of a PPI is to satisfy new emerging needs, modernize the public sector, and promote private sector start-ups to satisfy societal needs and address major societal problems (Edquist and Zabala-Iturriagoitia 2012). Thus, the use of PPI is not only about promoting the development of new products, but also about identifying and satisfying human needs and societal problems. These problems are often linked to major societal challenges that require enormous efforts and a coordinated policy mix to solve. PPI should therefore be combined with other innovation policy instruments such as public funding for research and development (Edquist and Zabala-Iturriagoitia 2012).

Especially in catalytic PPI (the public purchaser is not the end user of the innovation; it acts as a catalyst for the innovation and market penetration is subsequently achieved by the private sector), market penetration for innovation occurs partly from public procurement and partly through private sector demand. This allows societal needs to be satisfied by innovations whose development would not have been possible without the public sector. Edquist and Zabala-Iturriagoitia 2012 conclude that this type of PPI should be used and developed as a policy tool to address major societal challenges in order to open up new markets and generate systemic change. However, they also make clear that this type of PPI can only have its impact if the appropriate organizational capabilities and efforts are made on the part of public procurement (Edquist and Zabala-Iturriagoitia 2012). As the PPI is an innovation policy instrument, it seems justified to get an overview of the different innovation policy instruments. Edler et al. 2016 propose a taxonomy of innovation policy instruments. Among the demand-side innovation instruments, private demand for innovation, public procurement (measures and advance procurement), and innovation incentives in the form of competitions can be found. This taxonomy illustrates the similarity between innovation contests and PPI. Liotard and Revest 2018 take up this idea and show parallels and specificities of PPI and innovation contests. Among others, they elaborate on the common objective of these two innovation policy instruments, the focus on commercialization also note that, similar to PPI, innovation contests are a multifaceted tool to address societal needs and can appeal to different target groups.

2.2 Innovation contests as a means to tap into supplier innovations

Innovation contests are defined in research as time-limited competitions organized by a public or private organization that challenge the general public to develop a solution to a predefined problem through your expertise, skills, and creativity (Piller and Walcher 2006; Bullinger et al. 2010). Different types of innovation contests can be distinguished based on the number of organizations involved (innovation contests between two organizations or within one organization), size of reward (only the winner receives the reward, proportional distribution of reward) and types of award (ex-ante prizes where the outcome is unknown and first developed and ex-post prizes where already developed innovations are rewarded) (Adamczyk et al. 2012). The literature is increasingly concerned with innovation contests designed to address societal challenges, such as combating climate change (Arnold and Ramakrishnan 2009). Innovation contests have the potential to initiate change toward greater sustainability and to promote sustainable change (Adamczyk et al. 2012).

To understand how innovation contests work, the design elements of innovation contests have been studied in the literature. According to Bullinger and Moeslein 2010 innovation contests can be characterized by the design elements presented in Table 1. The presented design elements of innovation contests are to be used in this work, in order to make a further classification and classification of innovation contests in public procurement.

Design element	Characteristics / Description
Media	Innovation contests can be distinguished by the choice of media. They can be conducted online and / or offline (Boudreau, K. J., Lacetera, N., & Lakhani, K. R. 2008; Brabham 2009).
Organizer	The organizers of innovation contests can be individuals, as well as companies, public organizations, and non-profit organizations (Ebner et al. 2009).
Task specificity	The organizer designs the innovation contest around a specific topic, and the specificity of the task can vary. Innovation contests can be designed with very open tasks, i.e., from low specificity to very high specificity (Bullinger et al. 2010).
Degree of elaboration	The desired level of the final outcome of an innovation contest can range from a rough idea, an elaborated concept, prototype development to a fully elaborated solution (Ebner et al. 2009).
Target group	Distinction between specific (restriction to country, qualification, etc.) and non-specific target group (Ebner et al. 2009)
Participation as	Participation as an individual, team, company (Boudreau et al. 2010)
Contest period	Ranges from very short-term (a few hours to a maximum of 14 days), short-term (15 days to 6 weeks), long-term (6 weeks to four months), to very long-term (more than four months/ongoing). (Boudreau et al. 2010)
Reward / Motivation	monetary or quasi-monetary incentives (e.g., awards), non-monetary incentives (e.g., enjoyment), or a mix (Piller and Walcher 2006)
Community functionality	Internet-based applications for information exchange, interaction, discussion, community building, design of products. (Piller and Walcher 2006)
Evaluation	Self-evaluation, peer review, and evaluation by a panel of experts. (Ebner et al. 2009)

Tab. 1: Design elements of innovation contests (Based on Bullinger and Moeslein 2010)

Regardless of the chosen design of an innovation contest, careful planning and execution of an innovation contest is considered a basic requirement to achieve the underlying objectives. According to Ebner et al. 2009 the right communication tools, a suitable motivational structure and trust-building elements represent the most important success factors.

2.3 Different types of innovation contests in public procurement

Within public procurement, the use of different types of innovation contests can be observed with the use of PPI (Pihlajamaa and Merisalo 2021). In addition to innovation partnership and competitive dialogue as public procurement instruments, the pre-commercial procurement instrument introduced by the European Commission in 2006 is increasingly discussed in the literature (e.g. Edquist and Zabala-Iturriagoitia 2015; Rigby 2016). Pre-commercial procurement is defined as "a process by which public authorities in Europe can steer the development of new technologically innovative solutions that can address their specific needs" (European Commission 2006b, p. 2). Pre-commercial procurement aims to advance technology research and innovation capacity in Europe while making public procurement more efficient and qualitative by using public need as a driver of innovation (European Commission 2006a; Edquist and Zabala-Iturriagoitia 2015). Pre-commercial procurement is generally carried out in the three steps: solution exploration, prototype development and testing phase. After the testing phase, and thus after the completion of the pre-commercial procurement, a separate tender can be conducted under procurement law, which can be imitated either by the public organization that conducted the pre-commercial procurement or by another public organization interested in the results of the pre-commercial procurement (Edquist and Zabala-Iturriagoitia 2015). In addition to the instruments from public procurement already presented, other types of innovation contests, which increasingly originate from the private sector, are also becoming increasingly established in public procurement research and practice. These include, for example, hackathons and challenges. Hackathons represent an innovation contest in which participants work in small groups to solve a technological problem within a set time frame. Most often, the aim is to create a software prototype (Raatikainen et al. 2013). Hackathons vary widely in their purpose and execution. A hackathon is usually divided into the phases of idea generation and team building, the actual development of the prototypes, and a presentation of the prototype (Komssi et al. 2015). Hackathons are also increasingly used in public procurement alongside other innovation contest. The increased attention to these types of innovation contests can be explained partly by changes in the law, but also by the advance of digitalization (Liotard and Revest 2018). In addition to the development of innovative solutions Pihlajamaa and Merisalo 2021 shows that the public sector can promote mutual learning and networking in particular and positively influence the understanding of local and global problems in society.

In addition to hackathons, challenges are also increasingly being used in public procurement. A challenge is an incentive-induced contest to find possible solutions to an ambitious and, in today's context, usually socially relevant problem for which there is no efficient solution on the market. With the founding of DARPA in 1958, challenges were initially used to satisfy primarily technological needs of the military in order to establish and expand the strategic superiority of the American military. The targeted orientation of Challenges to societal challenges can be observed from the end of the 1990s with the establishment of, for example, the XPrize Foundation or Nesta. However, comprehensive studies on Challenges cannot be identified in the literature so far.

In summary, it can be stated that different types of innovation contests are already used in public procurement. When classifying the design elements of innovation contests according to (Bullinger and Moeslein 2010) the following picture emerges (Fig. 2).

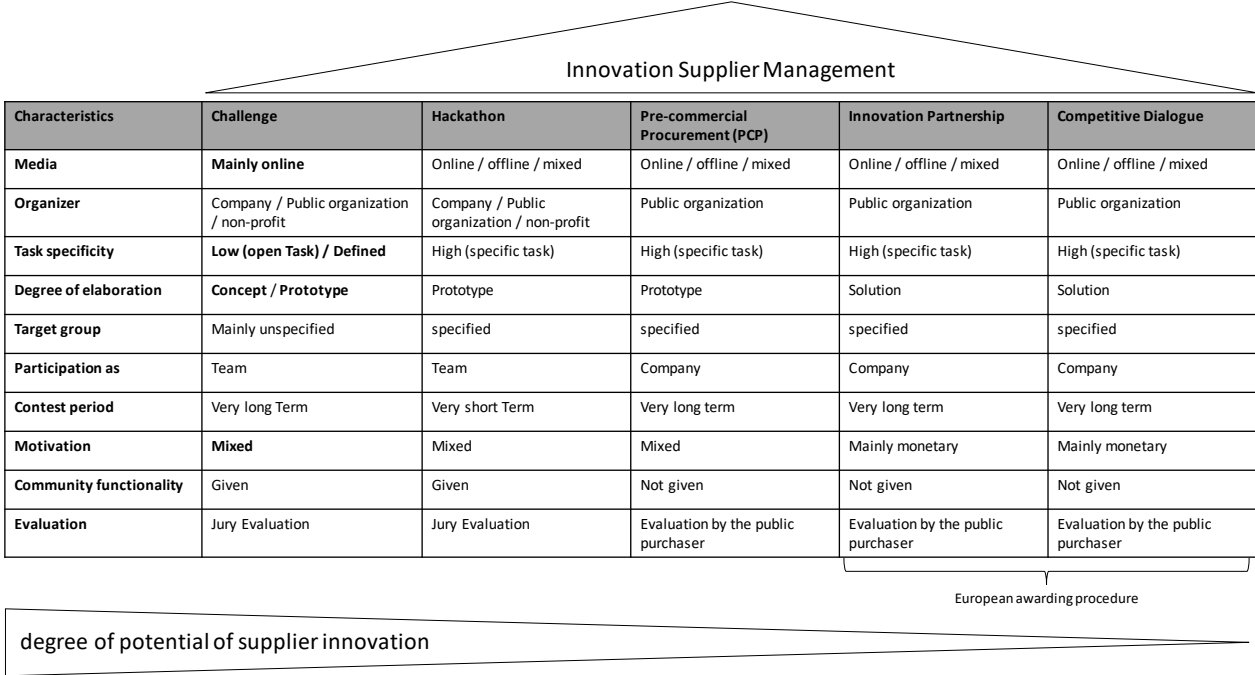


Figure 1: Classification of selected innovation contests in analysis grid

Figure 1 illustrates that challenges and hackathons can be used in public procurement outside the instruments of procurement law to promote supplier innovations. Challenges continue to be characterized by the fact that early ideas and concepts from innovators are also used to develop innovations and address a broad target group.

3 Methodology

3.1 Overall research design

To answer the research questions posed, a case study design is used in this paper. The case study design was chosen to allow for a holistic approach and to investigate challenges in a real-world context (Gibbert and Ruigrok 2010) and to demonstrate interactions (Merriam and Tisdell 2016). This aspect makes it an ideal tool for studying challenges, as the flexibility and diversity of this tool are high and societal and political pressures are highly interfering with economic goals. In addition, this approach facilitates triangulating observations by allowing for multiple data sources (Eisenhardt and Graebner 2007). During the study validity and reliability of the results were ensured by following the recommendations of (Gibbert et al. 2008). The case study was conducted according to a systematic approach, following the contributions of Eisenhardt 1989; Stuart et al. 2002; Voss 2010, and Yin 2018 conducted. To ensure analytical generalizability, the findings on the state of the research were used as a template and then compared with the empirical results of the case study. Validity is also ensured through multiple proof and verification of the case study design using key informants as well as replication logic in the selection of case studies.

3.2 Selection of case studies to gain contextual insights through document analysis

To increase analytical generalizability and ensure comparability, strict selection criteria were defined for the organizations to be included in the sample (Eisenhardt and Graebner 2007). First, a document analysis was conducted with six organizations. The selection of the cases under consideration for the document analysis followed the approach of Seawright and Gerring 2008 using a variety of cases. The organizations selected for this study were categorized based on their intent (Challenge Objective). In summary, six public organizations, divided into three public organizations that have the objective of addressing societal challenges and three public organizations that have the objective of meeting the needs of public clients, participated in the study (see Table 2). These cases were selected to cover different nationalities, to represent newly established and longstanding organizations, and to cover different funding models.

Category	Organization	Nation	Year established	Funding
Objective: to overcome societal challenges	X-Prize	USA	1994	Sponsors
	Nesta	UK	1998	National Lottery and Sponsors
	SPRIN-D	Germany	2019	State budget
Objective: To meet the needs of public-sector customers	DARPA	USA	1958	State budget
	IÖB	Austria	2006	State budget
	KOINNO	Germany	2022	State budget

Tab. 2: Sample of the document analysis

Expert interviews were then conducted with one public organization per category. The selection of public organizations for the expert interviews was based on the accessibility of the interview partners.

3.3 Case study and expert selection for in-depth knowledge acquisition

Semi-structured expert interviews and a document analysis were conducted to collect the data. For the document analysis, publicly available documents from the six public organizations were used to gather insights into the objectives of challenges, organizational characteristics, the challenge model used and their incentive systems, and the use of the results. A guideline was created for the expert interviews, which was discussed and refined by means of an internal test as well as an expert assessment. In the present case study, the interview partners were selected by contacting the respective organizations according to their position, experience and willingness to participate in an interview. A total of seven experts were interviewed, and their affiliations, positions, and backgrounds are shown in Table 3.

Experts	Case	Stakeholder group	Position	Organization	Duration	Assignment of internal code
Expert 1	KOINNO	Organizer	Manager	KOINNO	33 minutes	E1
Expert 2	SPRIN-D	Organizer	Challenge Officer	SPRIN-D	50 minutes	E2
Expert 3		Organizer	Partnership Officer	SPRIN-D	31 minutes	E3
Expert 4		Participant	Co-founder	SME	32 minutes	E4
Expert 5		Participant	Founder and CEO	SME	30 minutes	E5
Expert 6		Participant	Scientist	Research facility	29 minutes	E6
Expert 7		Participant	Co-founder	Start-Up Company	24 minutes	E7

Tab. 3: Sample of the expert interviews

The interviews were conducted as video conferences and lasted between 24 and 50 minutes. All interviews were recorded and subsequently written down as a protocol of results. The data were analysed by means of qualitative case study analysis according to (Eisenhardt 1989) analysed. The units of analysis were the cases. The starting list of codes was based on the findings from the document analysis.

3.4 Developing the analytical framework

Based on the analysis grid presented in 2.3 with the ten identified design elements of an innovation contest according to Bullinger Moeslein 2010, four selected design elements are examined in the following case study investigation (Table 4). First, the organizer of a challenge is examined on the basis of the organizational form, the type of financing, the structural organization, the applied phase model as well as the legal requirements for carrying out the challenge within public procurement. Subsequently, the innovation purpose as well as the objectives of a Challenge are considered, in order to characterize the task specificity. The degree of elaboration is determined with the help of the innovation intensity, the determination of the Technology Readiness level and a result view. Finally, by examining the incentive systems used and the design of the challenge, the design element of motivation is considered in detail.

The design elements were selected for further investigation because they differentiate in their characteristics when compared to the other types of innovation contests mentioned and cover the elements input, throughout as well as output of the transformation process.

Design element	Focus of the Study	Description	Reference
Organizer	Form of organization Funding Organizational structure Phase model Legal requirements	Investigate the form of organization, the method of funding for monetary incentives and organization, and the legal basis for the use of Challenges.	(Smith 2001); (Ahmady et al. 2016)
Task specificity	Innovation Purpose Main topics Objectives	Overall objective of the Challenge	(Bullinger and Moeslein 2010); (Hallerstede, S. H., & Bullinger, A. C. 2010)
Degree of elaboration	Innovation intensity Technology Readiness Level Results	Types of innovation by degree of change, start and end technology readiness level, expected results and use of results	(Smith et al. 2003); (Ebner et al. 2009)
Motivation	Financial incentive Support, Dealing with intellectual property Stakeholder relationships	Combination of the incentive systems used and motivation of the participants through support services and the way in which the Challenge is carried out.	(Filler 2006); (Ogawa and Piller 2006); (Boudreau, K. J., Lacetera, N., & Lakhani, K. R. 2008)

Tab. 4: Analysis grid of the case study investigation

4 Results

4.1 Contextual information on conducting challenges across selected case studies

First, along the selected dimensions, the six organizations are examined based on the document analysis and initial findings on the defined design elements are presented.

4.1.1 Organizer

To examine the organizer, Table 5 first presents the organizational characteristics of the organizations. When looking at the funding model, it is noticeable that SPRIN-D has a separate role in the category of overcoming societal challenges. While two of the three organizations aiming to overcome societal challenges are mainly funded by private sector organizations, SPRIN-D's financial resources are provided by a government budget. Organizations in the category "Meet demand public client", on the other hand, are mainly financed by government funds. In addition to the traditional organizational structure with two management levels, as can already be observed at DARPA, the challenge platform model is increasingly gaining acceptance. In this model, the challenges are merely mediated by the organizations. Overall, it can be seen that the organizations are resorting to different funding models, organizational forms and management structures. These depend, among other things, on the objectives of the organizations, the national infrastructure, the political system and individual needs.

A central element of challenges is the challenge model. Overall, it can be seen that the process of a challenge takes place in different phases in all organizations. The application phase is followed by the selection of participants and then the selection of winners. A different process can be seen in particular at IÖB and KOINNO. In these two organizations, there is no comprehensive, longer-lasting monitoring of the participants. The winners are announced immediately after the application deadline. The winners are then invited to an innovation dialog. For the other organizations, the participants will be selected after the end of the application phase. The number of participants is gradually reduced during the Challenge, so that at the end of the Challenge and after months of support and further development of the innovations, one team usually emerges as the winner.

	Overcoming social challenges			Meet demand public client		
	XPRIZE Foundation	NESTA	SPRIN-D	DARPA	IÖB	KOINNO
Finance	Via sponsors	Foundation-capital: National Lottery Funding via sponsors	government budget	government budget	Challenge mediation: government budget Implementation: public client	Challenge mediation: government budget Implementation: public client
Organization	Non-profit Organization	Charitable organization, foundation (established by an Act of Parliament. National Lottery Act 1998).	Subsidiary of the Federal Government (GmbH), accompanied and financed by the BMBF and BMWi	Independent agency, subordinate to U.S. Department of Defense	Initiative of BMK and BMAW	Sponsored project carried out on behalf of the BMWK by the German Association for Materials Management, Purchasing and Logistics

	Overcoming social challenges			Meet demand public client		
	XPRIZE Foundation	NESTA	SPRIN-D	DARPA	IÖB	KOINNO
Organizational structure	Board and team with program manager, HR, finance, legal and infrastructure manager. Board of Directors (management, financial oversight), Board of Trustees (advisory body) Experts from business and research	Challenge team with program, challenge design, development, communications, and evaluation managers, as well as program coordinators. Advisory committee (experts from business and public sector), Jury and practice teams	Top management: founding director and managing director Challenge team with challenge officer, partnership officer Jury with members from research and industry	Two management levels with temporary program managers, experts, private industry, government agencies, military Strategic network with partners from the Ministry of Defense, universities, private sector	IÖB invites tenders for the challenges submitted by public contracting authorities Challenge team is assembled by the organizer	Challenge platform is operated by KOINNO Challenge team is assembled by the organizer
Challenge Model	Phase model with two phases Phase 1: Application phase and selection of Challenge participants, Phase 2: Selection of the Challenge winners	Phase model with four phases, Phase 1: Definition of the research question, Phase 2: Application process, initial pre-selection, Phase 3: Selection of finalists, Phase 4: Winner selection	Phase model with two to three phases Phase 1: Selection of the Challenge finalists, Phase 2: Selection of winners	Phase model with four phases Phase 1 to 3: In each phase the requirements for the innovation are increased, at the end of phase 3 selection finalists, Phase 4: Winner selection	Phase 1: Submission and evaluation of solutions, Phase 2: Announcement of the winners and management of the innovation dialogue	Phase model with two phases Phase 1: Submission and evaluation of solutions, Phase 2: Announcement of the winners and management of the innovation dialogue

Tab. 5: Characteristics of the organizers

4.1.2 Task specificity

When examining the objectives of the Challenges, it becomes clear that, in addition to solving societal challenges, the organizations studied also use Challenges as a tool for market exploration and to meet the needs of public-sector clients.

Characteristic	Overcoming social challenges			Meet demand public client		
	XPRIZE Foundation	NESTA	SPRIN-D	DARPA	IÖB	KOINNO
Innovation Purpose						
Social challenge	x	x	x	Subordinate goal	Subordinate goal	Subordinate goal
Concrete procurement needs	-	-	-	National Security	Needs of the public clients	Needs of the public clients
Focus	Satisfaction of basic needs, medical care, education, sustainable energy	Equal opportunities, medical care and a sustainable future	Sustainable Development Goals	Innovations to build/expand the military's strategic superiority.	Needs of public clients, exemplary role of the state to be fulfilled	Need, market does not provide solution

Tab. 6: Innovation purpose and key topics

4.1.3 Degree of elaboration

The three public organizations in the first category not only want to overcome societal challenges at the end of a Challenge, but also expect the public to be sensitized to certain issues and to initiate systemic change. They want to help innovators implement their ideas and concepts, close the gap between research and business, and identify and develop leapfrog innovative approaches to ultimately develop scalable innovations with market potential. While DARPA emphasizes that high-risk and breakthrough innovations should be promoted, IÖB and

KOINNO also see Challenges as an opportunity for public clients to increase their visibility and use Challenges as a tool for market exploration. The results of a Challenge should primarily be used to convince private investors of the innovations and enable the innovators to enter the market through the network built during the Challenge. The Challenge can be given to private sector organizations, research institutions, government agencies, or in the case of DARPA, the military. KOINNO and IÖB strive to assign the problems of a Challenge in the course of an innovation dialogue or public tender. In summary, the goal of a Challenge is not to develop a finished product or service at the end of each Challenge, but rather to develop it to the point where other investors are willing to support the innovation.

When looking at the TRL, differences between the organizations can be observed. At the beginning of the Challenge, a TRL of 1 to 4 is expected from the innovations, depending on the organization and the specific Challenge. At the end of the Challenge, the TRL ranges from 4 to 8. The challenges of IÖB and KOINNO take on a special role here, since the result of the Challenge is not linked to a specific TRL, but the winners of the Challenge receive further support based on an innovation dialog with the public clients. Overall, it is clear that challenges support ideas and innovations at a very early stage of development and aim to further develop initial ideas so that the innovators are able to attract further investors at the end of the challenge.

	Overcoming social challenges			Meet demand public client		
Characteristic	XPRIZE Foundation	NESTA	SPRIN-D	DARPA	IÖB	KOINNO
Innovation intensity						
radical	x	x	x	x	x	x
incremental	-	x	-	-	x	x
Technology Readiness Level						
Start	2	1 to 4	1 to 3	3	1	1
Result	6	4 to 8	2 to 7	7	Innovation Dialog	Innovation Dialog
Expected results	Solving a clearly defined technical problem to create a better world through innovation	Create breakthrough innovations, help new innovators achieve their goal, and create systemic change by raising public awareness of specific issues.	Further develop ideas into scalable innovations with market potential, bridging the gap between research and business and developing marketable products that address societal challenges. Identify / further develop leapfrog innovative approaches to make them attractive to investors.	High-risk innovations are accompanied and supported by DARPA up to the prototype development phase	Conduct market research on the part of public-sector clients for the tendered problem. Identify innovative solutions that have the potential to meet the objectives of the Challenge.	
Use of the results	Participants are supported in the development of innovations to the point where they are able to market them independently / through the network they have built up.	The innovations are to be further commercialized primarily by the Challenge participant. NESTA supports the participants in advancing the development of the innovations to the point where they are able to market them independently or through the established network.	After completion of the Challenge, the innovations should, if possible, be brought to market by further investors and develop their social and economic impact and contribute to overcoming societal challenges.	After the prototype phase, the project is handed over to the military or private sector for subsequent implementation and commercialization. The use of the results is primarily intended for the U.S. military.	Award in the course of a call for tenders or direct award for the advertised objective of the Challenge	

Tab. 7: Innovation intensity and outcome design

4.1.4 Motivation

When looking at the incentive systems used, the financial incentive seems to play an important role. For example, four of the six organizations studied offer financial incentives of up to millions of euros to motivate participants. In addition to financial incentive systems, the organizations also use various instruments to motivate participants (including positive PR and networking). Participant support is seen as a key success factor and is provided by program managers, coaches or the organization itself. The organizations try to create a further incentive for the participants by granting the participants full rights to the intellectual property created during the challenge. Table 8 summarizes the challenge models and incentive systems used.

	Overcoming social challenges			Meet demand public client		
	XPRIZE Foundation	NESTA	SPRIN-D	DARPA	IPM	KOINNO
Financial incentive	Up to \$2.5 million for first place	Up to \$12 million for first place	Up to 700,000 euros per team in the first year	Up to \$2 million for first place	Does not offer financing itself	Does not offer financing itself
Support	Is done by program managers from research, business, government, or the military	Performed by jury (from research and science), for each challenge individually	Performed by coaches (from research and science) with excellent expertise	Performed by program managers from research, business, government, or the military	Is carried out by the public client, IÖB is available as an advisor	Is carried out by the public client, KOINNO is available as an advisor
intellectual property	Remains with the participant	Remains with the participant	Remains with the participant, SPRIN-D receives right of use	Remains with the participant	Remains with the participant	Remains with the participant

Tab. 8: Challenge model and incentive systems

4.2 In depth insights on conducting challenges across selected case studies

The results of the expert interviews are presented below using the four identified design elements to further summarize the findings of the document analysis.

4.2.1 Organizer

The findings from the interviews made it possible to further characterize the Challenges instrument. It became clear that an important core element of challenges is the idea of contest and that the focus of a challenge is placed on the demonstration and implementation of the solution approaches submitted. This is also perceived as such on the part of the challenge participants. One interviewed expert described the objective for participating as follows: "the bottom line is, similar to a grant (...) to show that you are particularly progressive, particularly innovative and better than the others in a certain innovative area." (Interview, E7) It has also been shown that pre-commercial procurement is an important financing instrument to create the legal conditions for the implementation of challenges. An important issue for the participants seems to be the handling of their intellectual property. In principle, this should remain with the participants in order to promote the growth of innovative companies, accelerate the commercialization of innovations and motivate the challenge takers to participate in the

challenge. The most important findings on the input factors that were collected during the interviews are summarized in Table 9.

Category	Findings	Case
Understanding about challenges	Innovation contests that sets an ambitious goal to solve a concrete and socially relevant challenge in a contest involving several teams and different approaches to solving the problem.	SPRIN-D
	There will be a clear focus on demonstrating and implementing the solutions presented.	SPRIN-D
	Challenges move outside the instruments of procurement law and can also be understood as a form of market exploration.	KOINNO
Legal requirements	Pre-commercial procurement can be used as a financing instrument; legal hurdles may arise in the case of a state organization, in particular due to budgetary law	SPRIN-D KOINNO

Tab. 9: Understanding of challenges and legal requirements

4.2.2 Task specificity

At the end of a Challenge, the organizers not only want to overcome societal challenges, but also expect that the public will be sensitized to certain issues and that systemic change will be initiated. They want to help innovators implement their ideas and concepts, close the gap between research and business, and identify and develop leapfrog innovative approaches to ultimately develop scalable innovations with market potential. KOINNO also sees the Challenges as an opportunity for public sector clients to increase their visibility and use Challenges as a tool for market exploration (Table 10).

Category	Findings	Case
Challenges objectives	The challenge objective is a serious problem that cannot be solved easily.	SPRIN-D
	Goal: Identify and support potential leapfrog innovations, promote high-risk and not-yet-investment-ready innovations, close the gap between research and business, support market-changing and society-changing innovations, sustainably improve the lives of society, open up new technology fields and markets, encourage public-sector clients to seek innovative solutions	SPRIN-D KOINNO

Tab. 10: Objectives of challenges

4.2.3 Degree of elaboration

The interviews showed that the organizations have different expectations with regard to the concrete output of a Challenge, as can be seen in Table 11. While SPRIN-D's goal with the challenges is to develop the solution approaches to the point where it can be determined whether the innovations could be leap innovations, KOINNO aims to identify as many high-quality solution approaches as possible that could then be tendered and implemented. A universally applicable technology readiness level (TRL) is not set for any of the organizations. In the case of SPRIN-D, the TRL is determined for each Challenge individually according to the prevailing conditions and the question of at what point other players are willing to invest in these solution approaches and bring them to market. However, at the end of the final phase of the Challenge, a prototype should be developed that can be successfully deployed in an operational environment. SPRIN-D does not pursue the goal of seeing the solution approaches through to market launch, but rather until other actors or instruments are ready to take this on. KOINNO, on the other hand, acts as a facilitator of the challenge and brings innovators together with

public clients, so that in the end an innovation dialogue can take place between these stakeholders.

The experts in both cases agree on the potential impact of challenges. Challenges can have an enormous impact on society and the economy if implemented correctly. One SPRIN-D employee describes the potential impact of a challenge as follows: "So if we are successful, then the challenges or the results of them have a very significant impact on society, both on markets and on societies. (...) This means that we are actually breaking new ground in terms of both society and the market. And this aspect of being disruptive in the market and perhaps also creating new markets is also something that is quite central to the Challenges." (Interview E2)

During the discussion with the expert from KOINNO, it also became clear that, in addition to the social and economic effects, a Challenge can also have a direct influence on changing the behaviour of public-sector clients. Challenges should help to bring public clients together with the market as quickly and efficiently as possible, so that marketable solutions can emerge. The use of challenges should also encourage contracting authorities to communicate with the market and focus on solving a problem rather than on compliance with the law. This could lead to a change in thinking on the part of the clients, so that an intensive exchange between the market and the clients is created and the acceptance of the use of market solutions is increased.

The greatest challenges in the design of challenges on the part of the participants lie in the development of an individual challenge design and the flexibilization of the use of financial resources. One expert summarized the question of developing an individual challenge design and the aspects to be considered as follows: "So I think that actually the biggest challenge is the design of each individual challenge. And continuous learning is also very important. But it's also quite clear that the transferability of findings is always limited, so to speak, because each subject area has its own challenges, so to speak." (Interview, E2)

Participants appreciate the flexibility in the use of funds as well as the unbureaucratic and fast process within the Challenge. One of the biggest challenges for participants is the planning uncertainty resulting from the phase model. They would also like to see the handling of their intellectual property communicated in as much detail as possible and the selection of teams that make it to the next phase explained even more transparently. Early information on financial resources, as well as outlining the timing of decisions to allow for more planning certainty, would also be desired by some of the participants interviewed. The expert in the case of KOINNO sees a further challenge in the time perspective of implementation and in attracting as many motivated participants as possible.

Category	Findings	Case
Target achievement	The solution approaches are to be developed to the point where it can be determined whether they could be a leap innovation. The focus is clearly on demonstrating and showing the performance of the targeted innovations.	SPRIN-D
	A generally applicable TRL is not defined for all challenges. Rather, this is determined individually from challenge to challenge according to the prevailing framework conditions and the question of when other players would be prepared to invest in these solutions and bring them to market.	SPRIN-D KOINNO
	However, at the end of the final stage, a prototype should be developed to the point where it can be successfully deployed in an operational environment.	SPRIN-D
	Challenges do not pursue the goal of seeing the solution approaches through to market launch, but rather until other actors or instruments are ready to take over.	SPRIN-D

Category	Findings	Case
	At the end of the challenges, as many high-quality solution approaches as possible should be identified, which can then also be explicitly tendered and implemented.	KOINNO
Impact	Far-reaching positive effects on society and the economy are expected: behavioral changes among public purchasers, efficient merging of public purchasers with the market, promotion of communication between public purchasers and the market and research, focus on solving problems and challenges, increase of acceptance to use market-based solutions	SPRIN-D KOINNO
Challenges	Development of an individual challenge design, flexibilization of the use of funds	SPRIN-D
	On the part of the participants: planning uncertainty due to the phase model, desire for early communication regarding financial resources	SPRIN-D
	Adjusting the policy framework could provide more flexibility and attention to the Challenges instrument.	SPRIN-D

Tab. 11: Target achievement, impacts and challenges

4.2.4 Motivation

A central element of motivation is the relationship between the stakeholders. The interviews showed that intensive support of the challenge participants by teams of experts with a high level of technical as well as organizational expertise is essential for the success of a challenge. They also help to motivate the participants throughout the Challenge and to achieve top performance. In addition to motivation through intensive support and the financial incentive, networking, improvement of the image and the unbureaucratic process of a Challenge are the main motives on the part of the Challenge participants. One of the challenge participants describes the relationship with the challenge provider as follows:

"we have a very open mind, a very transparent relationship. We deal in SPRIN-D the mostly I would say probably only with [name withheld] we have an excellent relationship with him. He tells us what are our opportunities or what are things that are going on, he also prepares opportunities for networking, getting in touch with other organizations, participating in the challenge and so on. Those are all nice things to do, which we are very grateful to him for." (Interview, E5)

Challenges offer the organizers and especially public clients the opportunity to meet the political pressure, problem-solving pressure, the increase in resource efficiency and the cost pressure and can increase their visibility as a client and improve their image or the image of the public sector with challenges. When planning a Challenge, it has proven helpful to discuss the objectives with various experts in order to design a Challenge that is as ambitious as possible but can be implemented realistically. The announcement and dissemination of the challenge should take place via various communication channels and can also be used to further optimize the challenge design. The implementation of the challenge in a phase model as well as a structured and unbureaucratic application process are further success factors of a challenge. Overall, a structured but flexible process and intensive support for participants, as well as consultation with a comprehensive group of experts, ensure that things run smoothly during a challenge. Another important topic among the participants seems to be the handling of their intellectual property. In principle, this should remain with the participants in order to promote the growth of innovative companies, accelerate the marketing of innovations and motivate the participants to take part in the Challenge.

Category	Findings	Case
Motivation	The motivation of the challenge participants is a decisive factor for success.	SPRIN-D
	In addition to financial support, the main motives are networking, improvement of the corporate image and the non-bureaucratic design on the part of the challengers.	SPRIN-D KOINNO
	Other motives: to make the public sector rethink, to increase visibility for one's own company and one's own idea	KOINNO
	The main motivation of the organizations, lies in the unbureaucratic and exciting possibility to contribute through this instrument to the management of societal challenges by promoting innovative ideas and approaches.	SPRIN-D
	Challenges also offer a way to meet political pressure, problem-solving pressure, resource efficiency and cost pressure, as well as the self-demand to solve a particular problem.	KOINNO
Procedure and implementation	The objective of the Challenge should be ambitious, but realistically achievable. To achieve this balancing act, it is necessary to hold discussions with many different experts who have specialist knowledge but also have a certain wide-angle view.	SPRIN-D
	A challenge announcement can be used to identify potential challenge takers and optimize the challenge design.	SPRIN-D
	The Challenge should be disseminated through various communication channels to reach as many interested parties as possible.	SPRIN-D KOINNO
	The application process should be well structured, unbureaucratic and easy to evaluate and compare.	SPRIN-D
	The flexible and transparent design of a challenge in a phase model has proven to be promising.	SPRIN-D
	Intensive support from professional coaches should be provided throughout the Challenge.	SPRIN-D
Stakeholder relations	Intensive support of the challenge participants by teams of experts, both from a technical and organizational point of view, contributes to the success of the challenge.	SPRIN-D
	The expert teams should be communicative, transparent as well as professional and have a lot of expertise in the respective area. Stakeholder relations should be characterized by mutual trust, open communication and a willingness to perform.	SPRIN-D
Dealing with intellectual property	should in principle remain with the challengers in order to promote the growth of innovative companies, accelerate the industrial commercialization of innovations and reduce procurement costs for the public sector.	SPRIN-D KOINNO
	The right of use should only be assigned to organization if the challenge taker is not able to further develop his own solution approach.	SPRIN-D

Tab. 12: Motivation and incentive systems

5 Synthesis and discussion

5.1 Organizer

When considering the organizer of a Challenge, it can basically be a public or private sector organization or a non-profit organization. When examining the organizations in the public sector, it became apparent that they use pre-commercial procurement as a financing instrument or use the Challenge purely as a market exploration instrument and end in an innovation dialog. Overall, it can be observed that the organizations make use of different financing models, organizational forms and management structures. A central element of a Challenge is the phase model used. In all the organizations examined, the Challenge is divided into different phases. These basically include the application process, the selection of participants, the selection of finalists, the determination of the winner and the subsequent delivery of the project to the business community. The number of participants is gradually reduced over the course of the Challenge, so that one team usually emerges as the winner at the end of the Challenge. This phase model is shown in Figure 2. A different process can only be observed in the case of IÖB and KOINNO. In these two organizations, there is no comprehensive, longer-term support for

the participants. The winners are announced immediately after the application deadline. The winners are then invited to an innovation dialog.

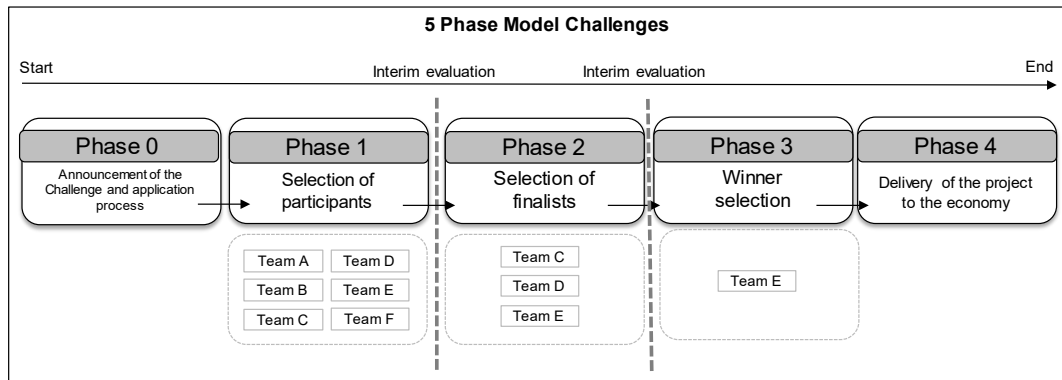


Fig. 2: Phase model

5.2 Task specificity

The goal of a Challenge can be, on the one hand, to address societal challenges and, on the other hand, to satisfy a concrete need of a public client. In the second case, the Challenges are used as market exploration tools and aim at an innovation dialog. In addition, Challenges are intended to stimulate a change in thinking on the part of both society and public-sector clients. Regardless of the objective of the Challenge, it is characterized by the fact that it sets an ambitious goal / problem, but the solution path is designed very open. The way in which the problem is to be solved is not known beforehand and offers the participants a great deal of freedom in designing the solution. Challenges help innovators turn their ideas into innovations and close the gap between research and business.

5.3 Degree of Elaboration

The goal of a Challenge is not to develop a finished product or service at the end, but to develop it to the point where other investors are willing to support the innovation or identify as many high-quality approaches as possible that can then be put out to tender. Challenges support ideas at a very early stage of development and aim to develop initial ideas to the point where innovators are able to attract further investors at the end of the Challenge. At the end of the Challenge, the goal is usually to develop a prototype that can be successfully deployed in an operational environment. The KOINNO and IÖB Challenges are the exception here and act more as a facilitator of the Challenge by bringing innovators together with public clients so that an innovation dialog can take place between these stakeholders at the end.

Challenges can have an enormous impact on society and the economy if implemented properly. In addition to a behavioural change and awareness function, they foster communication between new innovators and public purchasers. Among the biggest challenges on the side of the organizers, the development of the challenge design and the flexibility of financial resources are mentioned. On the participants' side, planning uncertainty is the biggest challenge. On the other hand, the participants appreciate the flexibility in the use of funds as well as the unbureaucratic and fast process within the Challenge.

5.4 Motivation

When looking at the incentive systems used, the financial incentive seems to play an important role. For example, four of the six organizations studied offer financial incentives of up to millions of euros to motivate participants. In addition to financial incentive systems, various instruments are also used to motivate participants to take part in the Challenge (including positive public relations and networking). Participant support is seen as a key success factor and is provided by program managers, coaches or the organizers. The organizations try to create a further incentive for the participants by granting the participants full rights to the intellectual property created during the Challenge.

The interviews show that intensive support for participants by teams of experts with a high level of technical and organizational expertise is essential for the success of a Challenge. They help to motivate the participants throughout the Challenge and to achieve top performance. In addition to motivation through intensive support and the financial incentive, networking, image improvement and the unbureaucratic process of a Challenge are the main motivations on the part of the participants.

5.5 Use of the findings to develop a process model

A key challenge for organizers is to develop an individual challenge design. We have used the findings from the research to conclude by developing a possible process model (Figure 4) that could be used as a guide for the development of an individual challenge design.

When planning a challenge, it has proven helpful to discuss the objectives with various experts in order to design a challenge that is as ambitious as possible but can be implemented realistically. The announcement and dissemination of the challenge should take place via various communication channels and can also be used to further optimize the challenge design. The implementation of the challenge in a phase model as well as a structured and unbureaucratic application process are further success factors of a challenge. Overall, a structured but flexible process and intensive support for the challenge participants, as well as consultation with a comprehensive group of experts, ensure that everything runs smoothly during a challenge.

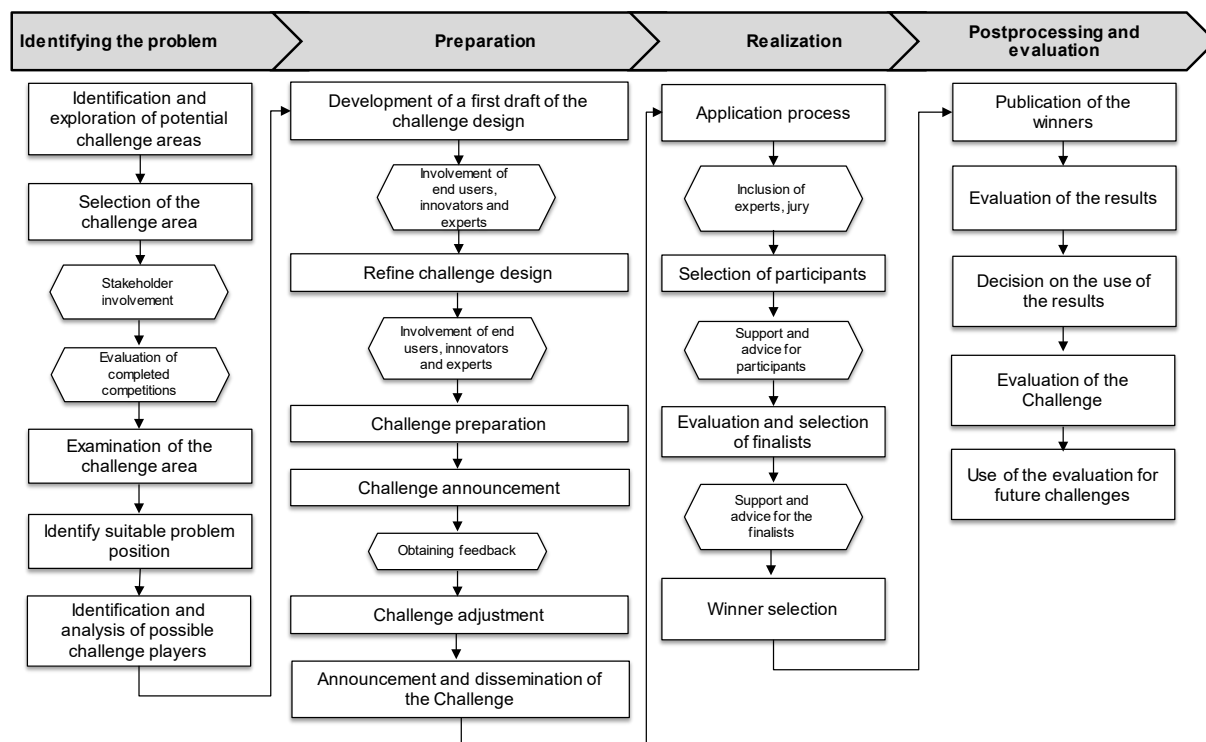


Fig. 3: Challenges process model

6 Conclusion and implications

In this study, the concept of challenges in public procurement was examined. For this we concerned ourselves first with innovation contests as a possibility of the management of supplier innovations and differentiated different kinds of innovation contests from each other around the first research question to answer:

RQ 1: What are the distinctive characteristics of challenges and how can challenges be differentiated from other innovation contests in public procurement?

Challenges were identified as one type of innovation contest in public procurement, along with hackathons, pre-commercial procurement, innovation partnership, and competitive dialogue. The distinction from the other types was based on the ten design elements of innovation contests according to (Bullinger and Moeslein 2010). It was found that challenges differ from other innovation contests in particular in the openness of the task, the degree of elaboration of the solution (here, results ranging from concepts to prototype development are possible), the contest of the team (individual composition, the teams do not have to come from one organization), the incentive systems used (in addition to monetary incentives, participants are also motivated by networking, improvement of image and access to expertise) and the form of evaluation (evaluation by experts). In the course of the case study, it was possible to identify other special features, such as the usually high problem relevance to social challenges and the potential to sustainably change existing structures, markets and society. The case study analysis then examined the challenges of various public organizations in terms of potential success factors and design using four selected design elements of an innovation contest to answer the second research question:

(2) What factors can significantly influence the success of a challenge and what might the ideal process of a challenge look like?

In the course of the study, both the document analysis and the expert interviews identified important success factors for the design and implementation of challenges by examining the organizer, task specificity, degree of design, and motivation. These success factors relate primarily to the use of a phase model with continuous exchange with experts, the use of multiple incentive systems (positive public relations, networking, access to expert knowledge), intensive support for participants. The developed process model also combines various success-critical factors in the individual design of a challenge design. Overall, a structured but flexible process and intensive support for the challenge participants as well as the involvement of a comprehensive circle of experts can contribute to the smooth running of a challenge.

For the practice of public organizations, the work available here offers first views of the organization and execution of challenges. In particular, the high procurement volume in the public sector and the requirement to use this potential to promote innovation in order to meet social challenges shows the potential and added value of challenges in public procurement.

The promotion of the perception of challenges in public procurement should be further advanced at national and international level. In particular, a change in thinking on the part of public purchasers is also required in order to implement the instrument of challenges efficiently and to increase innovative strength. Start-ups, innovation departments of established companies and research institutions should increasingly be considered as the target group for challenges on the part of the participants. Public purchasers should use the potential of challenges for their own market exploration and needs assessment in order to promote innovative solutions, contribute to solving societal challenges, and enable efficient and innovative needs assessment.

For science, the work presented here offers important starting points for terminology, conceptualization, design options and empirical investigation of challenges in public procurement. This work contributes to the discussion about the possibilities of public procurement to further promote innovation. With an explorative investigation of challenges this study contributes to increase the understanding over this kind of innovation contests and to point alternatives out to so far used instruments of innovative public procurement. Initial success factors were identified and a process model for challenges was proposed. However, it is also clear that further research is needed to answer open questions such as the efficient evaluation and performance measurement of challenges. The evaluation of the results of a challenge has received too little attention so far. Recommendations and metrics for the evaluation of Challenges should therefore be further investigated and an evaluation of the effectiveness of Challenges should be further empirically investigated to be used as an incentive for the implementation and participation in a Challenge. To date, the identified incentive systems differ only slightly among public organizations. The identification and implementation of additional incentive systems should also be further investigated.

Appendix A – A

Original quotes from the interviews

Expert	Original quote	Translated quote
E7	es geht ja im Endeffekt darum, ähnlich wie bei einer Förderung (...) zu zeigen, dass man in einem gewissen innovativen Bereich besonders fortschrittlich, besonders innovativ ist und besser als die anderen	the bottom line is, similar to a grant (...) to show that you are particularly progressive, particularly innovative and better than the others in a certain innovative area
E2	also wenn wir erfolgreich sind, dann haben die Challenges oder die Ergebnisse daraus ganz markante Auswirkungen auf die Gesellschaft, sowohl auf Märkte als auch auf die Gesellschaften. (...) Das heißt, dass wir sowohl in Bezug auf Gesellschaft als auch in Bezug auf Markt tatsächlich neue Wege gehen. Und gerade auch dieser Aspekt disruptiv im Markt und vielleicht auch neue Märkte schaffen, ist auch etwas, was ganz zentral ist für die Challenges	So if we are successful, then the challenges or the results of them have a very significant impact on society, both on markets and on societies. (...) This means that we are actually breaking new ground in terms of both society and the market. And this aspect of being disruptive in the market and perhaps also creating new markets is also something that is quite central to the Challenges.
E2	Also ich glaube, dass tatsächlich die größte Herausforderung ist das Design jeder individuellen Challenge. Und da ist auch das kontinuierliche Lernen ganz wichtig. Was aber auch ganz klar ist, dass sozusagen die Übertragbarkeit von Erkenntnissen immer nur begrenzt möglich ist, weil jedes Themengebiet sozusagen so seine eigenen Herausforderungen hat.	So I think that actually the biggest challenge is the design of each individual challenge. And continuous learning is also very important. But it's also quite clear that the transferability of findings is always limited, so to speak, because each subject area has its own challenges, so to speak
E5	we have a very open mind, a very transparent relationship. We deal in SPRIN-D the mostly I would say probably only with [name withheld] we have an excellent relationship with him. He tells us what are our opportunities or what are things that are going on, he also prepares opportunities for networking, getting in touch with other organizations, participating in the challenge and so on. Those are all nice things to do, which we are very grateful to him for.	

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