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Designing a co-creation between higher education institute students and ABN AMRO's innovation hub Econic

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Designing a co-creation between higher education institute students and ABN AMRO's innovation hub Econic

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Abstract

Co-creation as a process of resources integration between multiple actors offers significant opportunities to enact open innovation. However, despite the spreading adoption of open innovation in various industries, studies with a comprehensive view regarding co-creation design are lacking. Recently, a study has developed a framework to facilitate a strategic approach to recognize and develop the most advantageous co-creation opportunities. The framework involves six co-creation dimensions with each a range of categories to encompass all aspects of co-creation. However, it lacks a thorough validation of the proposed dimensions and how they relate to each other. In this study, I apply the framework to a co-creation characterized by the involvement of students in ABN AMRO bank's innovation hub Econic. By considering the relevance of the proposed dimensions for this co-creation and how they relate to each other, new insights are obtained and the framework across different contexts are strengthened. Moreover, following on the motives Econic has to co-create with students, specific attention is given to the category task specificity of the dimension form. These findings build on preceding research to develop tools and processes related to co-creation and offer organizations a more robust and comprehensive framework to design co-creations.

1. Introduction

Historically companies have developed innovations in large ivory towers in an on going strive for company growth while protecting their resources. However, this model is eroding. What has emerged instead is an open-innovation model in which companies share resources with actors outside their company boundaries to co-create (Chesbrough 2006). In an open innovation environment firms co-create with external entities to integrate resources and conjointly create value that will lead to innovation (Perks, Gruber and Edvardsson 2012).

Prior academic research has extensively analysed individual aspects of common co-creation processes such as crowdsourcing, company alliances and university-industry knowledge transfer partnerships (KTP) (Sampson 2007, Simula and Ahola 2014). However, there is little research that provides a holistic perspective to strategically design co-creation. Only one paper could be found that considers the development of a co-creation as the formation of multiple key dimensions and involved actors, motives, form, duration, level of engagement, and interaction platforms (Frow, Nenonen, Payne, & Storbacka 2015). But since the framework is recently developed, it lacks a thorough validation of the proposed dimensions and how they relate to each other.

Students from higher education institutes (HEI) are interesting actors to co-create with, as they are inexpensive resources of knowledge and a high potential workforce with different perspectives. Study results show that people with higher educational levels are more likely to recognize business opportunities than people with lower educational levels (Koellinger 2008). Also do they have a higher proclivity for entrepreneurial activities (Arenius and De Clercq 2005, Acs, et al. 2004, Sternberg, Brixy and Hundt 2005) in which the academic environment fosters growth and innovation (Steffensen, Rogers and Speakman 2000). However, they have been largely neglected in academic research. For example, when knowledge transfer partnerships between universities and industry are studied, universities are considered as research institutes. In these studies solely university employees and PhD students are considered to conduct primary research that can be commercialized (Perkmann, et al. 2013, Cyert and Goodman 1997, Bekkers and Freitas 2008). However, no attempt is made to include bachelor and master students.

In line with open innovation ABN AMRO bank has recently founded innovation hub Econic, which is located in Eindhoven. It aspires to facilitate an open innovation environment where innovative ideas from inside as well as from outside the bank are developed. This way ABN AMRO hopes to stay ahead of the curve of financial technology (fintech) development and become the leading European bank in fintech innovations. As a result they hope to be the most preferred collaboration partner for fast-growing fintech companies and become a stronger magnet for investors and new talent.

After adopting an open innovation model for the different phases of innovation, ABN AMRO was inspired to involve students of higher education institutes (HEI) into their innovation process. The bank expects students to be able to reflect the innovation activities in Econic, provide new insights and exploit their knowledge to complement their own. However, since open innovation is new to ABN AMRO, just as co-operating with HEI in not an ad hoc form, it doesn't know how to effectively co-create with students. Therefore, to gain access to the students' resources and use them in the innovation process, this research aims to develop an Econic specific advice for the design of a co-creation with HEI students by answering the following question:

How should the form, duration, level of engagement and interaction platforms, as co-creation dimensions, be designed to facilitate resource integration between ABN AMRO's innovation hub Econic and higher education institute students?

In order to answer this normative question two sub questions are proposed to analyze the factors that instigate the co-creation.

How can ABN AMRO's innovation hub Econic be characterized?

What are the motives for ABN AMRO's innovation hub Econic to initiate a co-creation with higher education students?

With the development of this advise the research investigates the completeness of the by Frow, et al. (2015) recommended framework for co-creation. This includes the consideration of the relevance of the proposed dimensions and how they relate to each other in the morphological field of co-creation. By applying the framework to a co-creation characterized by the involvement of students it strengthens the knowledge of co-creation designs across different contexts and provides organizations a more robust and comprehensive framework to design co-creations. Particularly for this context it offers insight in the opportunities and difficulties of co-creating with higher education students.

The thesis is structured as follows: the first section provides a literature review on co-creation as the behaviors and interactions between multiple entities to innovate. The dimensions of co-creation are expounded, starting with the motivation that sets the foundation for other dimensions to design a co-creation. Concluding with the most common forms of co-creation and how research lacks a comprehensive approach to design a co-creation partnership. The subsequent part describes the research strategy and the methods to obtain and analyse the required data. As a result of the obtained data the following chapters include the design of the co-creation and the analysis to draw conclusions and provide theoretical and practical implications. Finally, the report ends with describing the study's limitations and suggesting directions for future research.

2. Literature review Co-creation

One general term that describes cooperation in open innovation is co-creation. ''Co-creation involves the joint creation of value by the firm and its network of various entities (such as customers, suppliers and distributors) termed here actors. Innovations are thus the outcomes of behaviors and interactions between individuals and organizations'' (Perks, Gruber and Edvardsson 2012, 935). This term is very general and covers the wide range of factors that are included in the new product development process. One can conclude that an endless amount of variations for co-creation can be shaped. But regardless the significant benefits co-creation can offer and the wide range of research fields it covers, little research is done considering the general designing of a co-creation.

Most research covers only co-creation aspects or specific forms of co-creation. This led to the request from scholars to develop general tools and processes for designing a co-creation (Barczak 2012). Only recent research has provided a strategic approach to identify the most profitable opportunity to co-create. By organizing the wide range of aspects in dimensions a general framework is developed to design a co-creation. The dimensions that were found important to take into consideration when designing a co-creation are: motives, forms, engaging actors, engagement platforms, level of engagement, and duration of engagement (Frow, et al., 2015). (Table 1) These elements form a holistic framework and cannot be assessed individually considering their impact on each other. When changing one element a required reconfiguration of the rest is likely.

Dimensions of co-creation

	Motives	Actors	Forms	Engagement platforms	Level of engagement	Duration of engagement
Categories	Financial motivation	Focal organisation	Co-generation of ideas	Digital applications	Cognitive	One-off
	Social benefits	Suppliers	Co-design	Tool and products	Emotional	Recurring
	Knowledge development	Customers	Co-production	Joint processes	Behavioural	Continues
	Psychological incentives	Competitors	Co-distribution	Physical engagement		
		Partners	Co-disposal			
		Influencers	Co-maintenance			
			Etc.			

Table 1 Co-creation Framework

2.1 Motives

The first element to consider when designing a co-creation is the dimension motive. The motive of the initiating actor contains the reason to set-up a co-creation that will drive the other design dimensions. Therefore, the dimension motivation can be considered as the foundation of the co-creation. When the motive is clear, the goals and corresponding objectives can be derived. Based on these goals and objectives the strategy that encompasses the design of the other dimensions can be chosen to facilitate the achievement of these goals. However, since a co-creation project involves at least two actors, the co-creation process involves different perspectives and possible different motives. Therefore when considering whom to involve in the co-creation process based on the other actors' characteristics and resources, the motives need to be taken into account as well. Consequently the dimension motivation has especially a strong connection with the dimension actors as the motives determine the involved actors but the actors also shape the motives.

The shape of the motives comes in many categories, especially when considering the possible diversity of the involved actors and most motives are actor specific. For example when considering the initiating firm the motive could be creating customer commitment while the motive of the involved customer is to develop know-how of the new product. Regardless the wide variety of the motives they can be divided in four categories: financial motivation, social benefits, knowledge development and psychological incentives (Hoyer, et al. 2010). (Table 2)

Motives
Financial motivation
Social benefits
Knowledge development
Psychological incentives

Table 2 Motive categories

2.1.1 Financial motivation
The financial motivation is the most obvious one for commercial organisations that have profitability as final objective. This could be achieved through indirect motivations such as creating more competitive offerings, access to resources for further development, decrease of costs and faster time to market. But also others actors may be motivated by financial rewards and could be received directly in the form of monetary compensations or indirectly through intellectual property.

2.1.2 Social benefits
Social benefits as a motivation stems from the recognition of participating in the co-creation process and comprise increased status and social esteem (Etgar 2008). One famous example is the Amazon.com ''Top 100 reviewer'' that formally states the added value of users to enhance the feeling of pride generated by participating in a co-creation process. For companies this type of motivation to co-create can be in the form of building brand awareness or company image.

2.1.3 Knowledge development
Another reason for actors to participate in a co-creation is to obtain technical or product knowledge. This may be straightforward for companies, as they require for example market and technical knowledge to successfully develop new products and services. But other co-creators may also be interested in new technical knowledge. As for example universities and research institutes who embedded knowledge development in their core objectives and want to participate co-operative research initiatives.

2.1.4 Psychological incentives

The last type of motivation comes in the form of psychological incentives and is harder to grasp since it involves an intrinsic feeling. This motivation can emerge due to the willingness of pursuing creativity, self-expression, pride or just charitable efforts. These are often independent of the nature of the goods or services created in the process, making it harder to specify the role of the actor (Etgar 2008). More comprehendible forms of psychological motivation are product dependent and could for instance come from the dissatisfaction of the current product or another form of high involvement.

2.2 Actors

When the motives of the focal organization are known it can approach other actors that can help obtain the correlating goals. However, as was mentioned before it has to be taken into account whether the motives of the other actors are compatible. If they are not compatible with the motives of the focal firm they will obstruct the achievement of the goals and make it unlikely to establish a successful partnership. Or when appears that the actors of interest have no incentives to engage in the proposed co-creation it is unlikely to take place at all. Because the motives mainly emanate from the actors' characteristics an analysis of both the focal firm's and the other actors' characteristics make the motive matching more efficient.

Besides analyzing the motives to find appropriate partners the resources that are involved need to be studied as well. This study should indicate what resources other actors possess that can complement the ones possessed by the focal firm in order to obtain the aimed goals. When this is determined co-actors that posses the required resources and have compatible motives can be approached.

2.2.1 Characterizing the focal organization

An organisation can be characterized from an innovative perspective by its response to the changing environment conditions. Based on these responses companies can be assigned to different classes: prospectors, analysers, defenders and reactors (Griffin and Page 1996). The prospectors highly value being the first with new products in new markets with new technologies. To do this they have to respond quickly to new business opportunities resulting in being the main developers of radical products. This will manifest itself in more exploring strategies for co-creation and motives that mainly involve the development of more competitive new products or faster time to market. While analysers carefully monitor competitors and quickly follow-up with an often more cost-efficiently or innovative product.

The defenders try to operate in a stable niche in the market where they can ignore industry changes as much as possible as long they do not directly influence the current operations. Reactors are not as aggressive and try to maintain established products. They only respond when it is utmost necessary, which leads to having incremental innovations as output. Therefore it is more likely when reactors engage in a co-creation their motive is to create customer commitment. The maintenance of their current customer base enables them to reduce the pressure to keep innovating to attract new customers.

2.2.2. Characterizing other actors

Similar to the focal actor the other actors can be organisations as well. Making it easier to match characteristics and corresponding motives and identify the involved resources. However, often enough the engaging actors are not organizations and cannot be characterized based on their response to the changing environment and need to be characterized otherwise.

The first step for characterizing the others is to categorize them. By applying models from the marketing literature, that consider the product supply chain, actors can be differentiated into five categories (Frow, et al., 2015). (Table 3) When looking up-stream, the value chain from

the focal firm perspective are the suppliers, when looking down-stream, there are the customers. Outside the value chain are the competitors that offer similar products and partners who do not need to have a direct connection to the focal firm. Lastly are the influencers who are indirect collaborators such as media, governmental and research institutes.

Actors
Focal organisation
Suppliers
Customers
Competitors
Partners
Influencers

Table 3 Actor categories

After categorizing the other actors, the categories that involve actors that are not organizations can be characterized based on the general qualities. For instance, the customers represent the market and are therefore often involved in the NPD process. This is because with their knowledge of the market they provide the resources the focal firm requires to obtain the goals. For example a motivation for the focal organisation to design a co-creation could be enhancing the customer experience and can be achieved by co-creating with customers. From the customers perspectives a possible motive could be a psychological incentive with as final goal to improve a product they are unsatisfied with. In this example the characteristics, motives and resources of both actors match perfectly.

The other category actors who are not classified as commercial organisations are the influencers. This is a broader category that involves a wider variety of actors that makes it harder to characterize. For example when considering media and research institutes. Both are in the influencer category but their fundamental motive for existence is transferring information or research and education. Therefore it is likely that when they engage in a co-creation it will be for different reasons and provide different resources. For instance, a company that wishes to build brand awareness and designs a co-creation in the form of a co-promotion will likely benefit most from the network and communication resources media will provide. While when they lack the technical knowledge to develop an idea it will be more helpful to set up a co-creation with a research institute.

Customers are often considered as individuals when it comes to co-creation, the same could be applied to actors of the category influencers. For example, it is possible to co-create with professors from research institutes on an individual level instead of establishing a co-creation with the research institutes. In this case the professors are actors on their own instead of a component of a network of knowledge, capacities and facilities. Depending on the motives of the co-creation it could be desirable to co-create with professors on an individual level or as a component of an institution. Therefore it is important to analyse the characteristics, motives and resources of other actors before including them in a co-creation, especially when the engaging actor falls in the influencer category.

2.3 Form

The form of co-creation is the subsequent dimension to design as it acts to facilitate the integration of actors' resources to obtain the goals of the co-creation. It includes the processes and activities to be performed and determines the roles the actors play during the co-creation. Hence, the forms of co-creation are strongly related to a specific NPD stage and are highly diverse due to the variety of motives and actors combinations. The most familiar ones are for example co-generation of ideas, co-design and co-production but many more can be identified

such as co-distribution, co-disposal and co-maintenance.

Besides the many already practiced co-creations is the form in a constant state of development and new ones may emerge in the future (Frow, et al., 2015). Moreover, a co-creation is not limited to only one form but can contain multiple forms in a single development process. This can be linear in consecutive phases or parallel in a single phase, which makes it harder to discern the forms of a co-creation. However, to gain a deeper understanding of the dimension form, a distinction is made between the physical and digital techniques that are used to practice the forms of co-creation. Based on this difference common co-creation forms are analyzed.

Forms
Co-generation of ideas
Co-design
Co-production
Co-distribution
Co-disposal
Co-maintenance
Etc.

Table 4 Form categories

2.3.1 Physical techniques
In the early stages of the NPD process organizations commonly involve lead users and focus groups to determine the needs of the market. By including the customers the area of opportunities is narrowed down and idea generation is intensified. The most dominant techniques of co-generation of ideas due to its easiness are face-to-face interactions. Organizations for example conduct in-depth interviews or involve users in development meetings to arrive at new ideas and identify opportunities (Alam 2002). However, a restriction is that customers in general are constrained by their inability to think beyond current experience and practice. To overcome this problem, techniques such as 'reverse brainstorming' or 'fly on the wall' can be used. These techniques involve developing a problem inventory list instead of a solution list or simply the observation of customers (Cooper, Edgett and Kleinsmidt 2002). This form that includes customers in the early stages of the NPD process, have shown to have a positive impact.

But including customers in the late stages of development have also shown great benefits. This could be in the form of testing and providing comments and feedback on various aspects of the new products or for new processes this could be participating in a simulation or trail (Alam 2002). Another valuable form of involving customers in the late stages is the co-launch as customers can create a buzz. This form of co-creation involves the generation of a word of mouth effect that widely spreads awareness about the new product. Once consumers become aware of a new product, interactions between the users can help other consumers understand what the product is about and how it can be used (Hoyer, et al. 2010). However, including customers in forms that are related to the middle stages appeared not to be beneficial. (Gruner and Homburg 2000). When considering the forms of co-creation in the development stage other actors are often included.

One of these forms related to the middle stages is an R&D alliance between multiple companies. These companies can integrate their resources such as knowledge, facilities, human resources and capital to develop existing ideas. However, one major difficulty that the companies face is the establishment of a sufficiently open knowledge exchange. They want to achieve the objective by providing the required knowledge but have to be aware to avoid unwanted leakage of competitive advantages. Therefore in co-development between firms it is of fundamental concern to control the outflow of resources and balance potential competing

concerns (Oxley and Sampson 2004).

Other forms of co-creation that are interesting to consider are knowledge transfer partnerships (KTP). These forms involve universities and research institutes that establish a partnership to exchange knowledge. The form of the cooperation strongly varies according to the industrial sector the organisation is in. The companies in industries that focus on the basic research (pharmaceutical, biotechnology, chemical industry) are more likely to engage in a co-creation with universities and research institutes due to exploratory motives which manifests itself in forms related to the early stages of NPD (Fernández-Esquinas, et al. 2015). Companies that do not focus on basic research find more frequently forms related to the later stages of development where knowledge is exploited such as co-design. The most frequent techniques to facilitate the NPD process are consultancy work provided by a university or public research centre in the form of reports, technical upgrading or advice and joint R&D projects that are jointly financed (Fernández-Esquinas, et al. 2015).

2.3.2. Digital techniques
The other category of techniques includes the digital techniques to use for forms of co-creation. The reason for the differentiation is the rapid technological development that caused the quick rise of new co-creation techniques that enabled the practice of different forms. As many forms of co-creation were limited due to time and money restriction the development of the internet as one of the technological developments brought down these barriers. The digital techniques enabled involving customers in large volumes and co-creation with distant organizations became profitable. Firms can now leverage these connection technologies in multiple ways. In the ideation stage this can result in for example using suggestion boxes, advisory panels and virtual communities to especially increase depth of idea input. Or to improve the breadth of the customer input an organization can use online questionnaires, market intelligence services or web-based conjoint analysis (Sawhney, Verona and Prandelli 2005). Which will make co-generation of ideas lead to the reduction of time, expenses and the risk of failure of the new product.

But in todays virtual environment actors are also enabled to directly participate in the later stages of the NPD process. For example, digital toolkits are developed to allow customers to co-design new products through a mechanism of trail and error. In this case users often work as communities in which an individual only develops a small part of the eventual product. These small parts are reviewed, adjusted and used to continue further development by the hundreds or thousands of others in the community. This concept of user cooperation has found its most significant expression in the form of open-source mechanisms for digital services and products. Also the possibilities for validation when a concept is developed have increased significantly by digitally other actors. Already in the development process users can continuously provide feedback. When the product is ready for launch a final test can be done in the form of beta testing. Which involves end-users trying out the product to simultaneously test multiple product configurations and numerous marketing mixes in order to choose the best solution.

2.3.3 Task specificity
One element that is incorporated in all form-categories but is not categorically distinguished in the co-creation framework is task specificity. Task specificity relates to the level of described terms, relations and constraints of the activities performed within the co-creation process (Yen and Lee 1993). It contributes to the communication among actors, structures the co-creation process and avoids ambiguities in situation interpretation (Paternò, Mancini and Meniconi 1997; Nouri, et al. 2013)

One task related theory that indicates the level of specificity is the situational strength theory that defines situational strength as ''implicit or explicit cues provided by external entities regarding the desirability of potential behaviours'' (Meyer, Dalal and Hermida 2010, 122).

The theory states that situational strength results in psychological pressure on an actor to take a particular course of action, reduce behavioural variance and avoid undesired subsequent task outcomes. By extensively reviewing operationalizations of situational strength Meyer et al. (2010) have developed a four element model to descibe common themes. This model includes the elements clarity, consistency, constraints and consequences. (Figure 1)
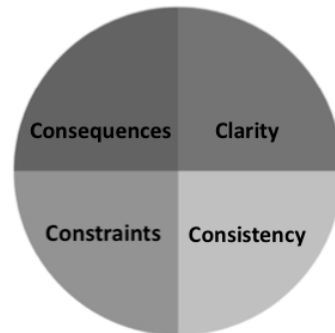
Figure 1 Model of situational strength (Meyer, et al. 2010)

The first element is clarity and refers to extent to which cues regarding task-related responsibilities or requirements are provided and understood. Actions that are relevant to the clarity of a task will limit the difference between interpretations of individuals by unambiguously provide information regarding the specific behaviours that are expected from the involved actors. The degree of clarity can be affected by multiple aspects such as the available sources of information, the efficient use of interaction platforms and communication channels, a supportive organizational climate, comprehensive instructions and management support.

The second element that is included in the model describes consistency and refers to the degree to which the task instructions regarding responsibilities and requirements are compatible with each other. Based on this definition can be concluded that consistency focuses on the similarity or difference between information from various sources regarding the desired behaviour. Activities that are relevant for this element include the reduction of source specific differences by providing information that uniformly indicate the desired approach. Therefore the element consistency can be manipulated by increasing the compatibility of information provided by the involved sources. This can be achieved by for example regulating the information provided by different actors, ensure similarity over time and establishing policies, norms and guidelines that do not conflict with each other.

The next element is constraints and implies to what extent a specific actor's freedom of decision-making and behaviour is limited by elements beyond the specific actor's control. This conceptualization of constraints can be broadly comprehended as situational characteristics that confine the expression of individual differences. It prevents actors to make decisions concerning which tasks to perform, when to perform these tasks and how to perform these tasks based on their own discretion. Constraints can be expressed in various forms of information and can therefore be affected in multiple ways, for example by formal and informal policies and procedures, close supervision and external regulations.

Consequences is the last element that the model encompasses and describes to what extent decisions and actions have positive or negative consequences for relevant actors. Task related aspects that are relevant for this element involve the stimulation of behaviours that decrease the effect and likelihood of the negative outcomes. Or, conversely, stimulate the behaviour that increases the effect and likelihood of positive outcomes. One aspect that always determines the consequence element is the nature of the task itself but the effect can be modified by for example performance related rewards or punishments.

Taken into account the four elements the situational strength model (Meyer et al. 2010) encompasses the level of task specificity can be increased or decreased to adjust the form of co-creation. For example in a co-generation of ideas to solve a particular problem the constraints are defined by the identified problem. Moreover, the consequences of solving the problem are already studied, the available information is likely to be consistent and is clarified what barriers need to be overcome to solve the problem. Therefore can be concluded that it involves a high level of task specificity compared to, for instance, a co-generation of ideas based on a new technology. In this co-creation are ideas generated with an exploratory perspective to find applications for the new technology, which results in unclear constraints. In addition, the limited information concerning the new technology that is likely to increase leads to low consistency, unawareness of the possible consequences and indistinctness concerning tasks that need to be performed to come to a new product. Thus can be concluded that this form of co-generation of ideas has a low task specificity (Piller and Walcher 2006).

2.4 Interaction platforms

Pointed out by the techniques used for different forms of co-creation the dimension that encompasses interaction platforms is a significant choice to contemplate. The decision affects the ability of co-creation actors to share resources, interact and adapt their processes to focus their efforts on the co-creation goals. Usually, these platforms are selected by the focal organization to enable efficient and effective co-creation. To be able to make a thoughtful decision many studies have analysed and characterized the available channels and platforms (Payne and Frow 2005; Frow, et al. 2015; Sawhney et al. 2005).

Regards that the outcomes of these studies are not consistent due to the difference in research backgrounds they have similarities. One common distinction that is made considers the form of the interaction platform. All studies discern physical and digital channels to transfer information and other resources. Another common category is the differentiation between formal and social networks. Even though it correlates to some extend with the digital and psychical distinction it focuses on the range of actors that are connected. The formal one is a closed channel focussing on specific actors with a personal involvement in the co-creation process. While the latter one is generally chosen for its ability of reaching a multitude of actors without personal interaction.

The combination of these distinctions resulted in multiple categories that were identified. (Table 5) The first category is digital application and involves platforms that are characterized by their speed and ability to connect a selective and wide range of actors. The second category involves tools and products that are used to facilitate interaction on a recurring or continuous base. Comparable is the category joint processes, that instead of using tools and products applies processes as a form of interaction. The other category that involves physical interaction without the use of tool and products is termed physical resources. It includes the physical meeting of actors to exchange and enhance knowledge.

Engagement platforms
Digital applications
Tool and products
Joint processes
Physical engagement

Table 5 Engagement platform categories

Of course there are within each interaction platform many different types of channels to choose from. But by taking into account the actors, motives, resources and context a category

selection can be made, which simplifies the finding of the appropriate channels. For example, considering the dimension interaction platforms for a knowledge transfer partnership between companies and universities the characteristics of the transferred knowledge determine the type of channels (Bekkers and Freitas 2008). When tacit knowledge is involved it can be more efficiently transmitted by labor mobility, while digital channels can more efficiently transmit explicit knowledge. The same applies to the discipline of the transferred knowledge and to a lesser extend to the characteristics of the involved actors. Moreover, the context highly influences the applicability of platforms and channels and can possible lead to the use of less appropriate ones. Therefore, to decrease the risk of wrongly or insufficiently transmitted knowledge companies that have the absorptive capacity, are advised to use more than one channel (Fernández-Esquinas, et al. 2015).

2.5 Level of engagement

Regardless the applied forms and interactions platforms to facilitate the integration of actors' resources, the co-creation will not be successful if the actors do not sufficiently interact. For indicating of the required interaction to achieve the co-creation goals the level of engagement dimension is designed. The level of engagement refers to the extent to which actors experience involvement (Hoyer, et al. 2010). The more engaged individuals are to approach or repel a target, the more value is added to or subtracted from it. (Higgins and Scholer 2009).

An actors' level of engagement differs per situation and stems from the social, cultural and political environment of the co-creation. As a co-creation itself requires cross-functional integration of processes, people, resources, and capabilities (Payne and Frow 2005), many different perspectives have to be taken into account to determine the required level of engagement. All of these elements demand strategic consideration whether the required level of engagement outweigh the expected output. Indicating that a low level of engagement for particular co-creations is adequate, while other co-creations that require more frequent interaction and effort are only worthwhile when the anticipated output is more valuable.

Literature research indicates that studies related to engagement mainly take a multidimensional perspective on engagement. But despite the preeminence of the multidimensional perspective almost half of the studies express engagement as a uni-dimensional concept (Brodie, et al. 2011). In this case the level of engagement lies in the spectrum of not engaged and highly engaged and can be divided into three categories. (Table 6) The lowest form of engagement is termed cognitive engagement and occurs when an actor just provides its resources to the other actors (Frow, et al. 2015). The second category that lies in the middle of the spectrum of actors' engagement is emotional engagement. It describes the commitment and willingness of an actor to devote extensive effort to co-create with the other involved actors. The highest form of engagement is behavioral engagement and implicates a change of behavior from the actor to achieve the aimed goals of the co-creation.

Level of engagement
Cognitive
Emotional
Behavioural

Table 6 Engagement categories

Research that takes a multidimensional perspective states that engagement consists of four components: absorption, dedication, vigor and interaction (Patterson, Ting and de Ruyter 2006). Absorption indicates the level of concentration on the focal engagement project and can be related to the cognitive level of engagement. Dedication refers to the feeling of being involved with the co-creation and reflects on the emotional level of engagement. The last two

components, vigor and interaction reflect on the behavioral category of engagement. In which vigor indicates the energy and mental resilience in interacting with the other actors and interaction involves the two-way communications between the involved actors. This perspective on the level of engagement uses a conceptual scope and enables an individual assessment of the four components. In contrast with the uni-dimensional perspectives, that has generalized the level of engagement by aggregating the components in categories to provide simplicity.

2.6 Duration

The last dimension to consider contains the duration of engagement and does not, as the term may imply, directly focus on the time period of the co-creation. Instead it refers to the sequence of the co-creation. The importance of the duration emerges from being able to make a well-considered investment in designing the other dimensions. As for example the investment in interaction platforms might not be profitable for a one-time co-creation, it might be when the co-creation is more often. Therefore, to make the decision for investment more transparent, the dimension duration is divided into three categories: one-off engagement, recurring engagement and continuous engagement. (Table 7) Typical for one-off engagements is the use of single interaction channels, while continuous engagement mostly use multiple channels (Frow, et al. 2015).

Duration of engagement
One-off
Recurring
Continuous

Table 7 Duration categories

2.7 Common co-creations

After analysing the six dimension of co-creation it can be concluded that the dimensions are highly interrelated. The selection of one dimension category will affect the design of the other dimensions. Taking into account the large amount of combinations it is required to make deliberate decisions when developing the appropriate co-creation. In order to gain a deeper upstanding of co-creation many researches have analysed one explicit element of a specific type of co-creations. The types of co-creations are often based on the involved actors, which leads to the categories of alliances between companies, crowdsourcing, and knowledge transfer partnerships.

To gain a comprehensive understanding of different co-creations, not only the individual dimensions are analysed but also the aforementioned types of co-creation as a whole. All of these types of co-creations can be characterized based upon the extent of the vertical scope and horizontal scope. The vertical scope specifies to what degree the co-creation involves sequential activities of the development process. The horizontal scope focuses on the size, complexity and uncertainty of the considered activities. An increase in either one of the scopes will lead to a more complex form of the co-operation and result in different levels of engagement and duration of the partnership. In which the effect of the horizontal scope is harder to determine due to its subjectivity (Oxley and Sampson 2004).

2.7.1 Alliances between companies
One type of co-creation that can be differentiated involves only companies. Due to speeding up technological development, shortening of product life cycles and the cost of continue updating equipment, companies increasingly co-create with other companies. The main motives are to share expenses, gain access to other knowledge and spread risks (Sampson

2007). What is specific for this kind of co-creation is the influence of other actors' environment. This can include the firms' strength of intellectual property, possible differences in contract law regimes, prior alliance experiences and organisational and cultural differences that can be both beneficial as limiting for the outcome of the co-creation.

The same applies to the overlap in technological portfolios. Alliances between companies that have moderate differences in technical knowledge contribute more to successful innovation than alliances in which the knowledge is minimally diverse or highly diverse. The effect of minimal diversity can be explained by the lack of additional value of the exchanged knowledge, while a high diversity increases the difficulty of learning from each other. This also influences the thoughtfulness with which knowledge has to be transferred since the barriers of leakage or unintended provision of competitive knowledge diminish as well.

2.7.2 Crowdsourcing

Another type of co-creation is crowdsourcing and can be defined as the act of outsourcing a task to a crowd rather than to a designated agent. In the case of co-creation the crowd refers to an external, broad and heterogeneous group and a designated agent refers to an organization, informal or formal team or individual (Simula and Ahola 2014). Since, customers have the most accurate and detailed knowledge about the market-needs they are essential to consult. However, this knowledge is mostly individual and tacit making it hard to obtain with traditional market research methods. As a result firms are unable to sufficiently fulfil the customers' needs and new products fail (O'hern and Rindfleisch 2010).

An alternative and emerging method is co-creation in the form of crowdsourcing with customers as actors. Also this type of co-creation can be applied to several stages of the new product development process and lead to for example new idea generation (Poetz and Schreier 2012), design contests (Bullinger, et al. 2010) and problem solving (Brabham 2008). Even though these forms have different motives their common objective is to use the collective knowledge of a heterogeneous crowd.

One distinctive form is community crowdsourcing that uses a densely connected network of individuals with explicit skills and knowledge as a crowd. Due to the focus on particular expertise the participation is restricted to members of the specific group. Open crowdsourcing in contrast with community crowdsourcing focuses on the multitude of involved individuals instead of restricting the participation to a limited crowd. Since the goal is to generate as much input as possible it aims to lower the barriers for any actor to contribute. The third typical form of crowdsourcing is crowdsourcing with the help of a broker. In this case a broker functions as a facilitator to connect potential ideators and problem solvers with organizations seeking new ideas or specific solutions to their problems. The reasons for this indirect approach may vary per situation. It might be due to the risk of leakage of sensitive information, revealing future plans or compromising IP positions (Simula and Ahola 2014).

2.7.3 University-Industry partnerships

The last type of co-creation that is put forward is knowledge transfer partnerships and more specifically between universities and industry. Numerous studies are devoted to collaborations between academic researchers and non-academic organisations. These interactions include formal activities such as collaborative research, contract research, consulting, as well as informal activities like providing ad hoc advice and networking with practitioners (Perkmann et al. 2013). Studies analyse an abundant amount of factors that influence the university-industry relationship such as structural elements of a firm, situational factors and a firm's strategic search for innovation. In almost all of these studies universities are considered as research institutes that conduct research to obtain new basic knowledge that can be transferred to the industry (Chau, Gilman and Serbanica 2016). But due to basic character of the developed knowledge the interaction is often limited to specific industries and early exploration stages of the development process.

Apart from the partnerships concerning basic research from an industry perspective not much research is conducted considering university-industry co-creation. However, due to a changing trend in society where universities are expected to commit to economic development besides their role as research and education institutes, new opportunities arise. In line with this trend some researches explore the partnership opportunities from a university perspective. They conclude that universities can contribute to economic development indirectly by the education of human resources and directly by commercialization of research. One direction that leads to both contributions is entrepreneurship-education. It encompasses the conveying of hard facts and tacit knowledge to teach entrepreneurial skills. To effectively do so practical implementation is required (Rasmussen and Sørheim 2006, Haase and Lautenschläger 2011). But despite that student-industry co-creations can provide this practical experience, exploratory research of designing such a partnership is lacking.

2.8 Research gap

Literature indicates that co-creations offer firms and the involved actors significant opportunities to facilitate resource integration that can lead to enhanced innovative output (Perks, Gruber and Edvardsson 2012). Even though prior academic research has extensively analysed individual aspects of common co-creation processes, there is little research that provides a holistic perspective to strategically design co-creations.

Only one paper could be found that considered the development of a co-creation as the formation of multiple key dimensions (Frow, et al. 2015). Since the framework is recently developed, it lacks a thorough validation of the proposed dimensions and how they relate to each other. Especially when considering that the process of co-creation is highly dependent on context related factors such as cultural issues, industry type, organization size, rules and regulations, market maturity, etc., many influences are unexplored. Therefore, additional research can strengthen the knowledge of co-creation design across different contexts and determine the relevance of the suggested dimensions and whether they cover the complete morphological field of co-creation.

When considering the dimension actors to diversify the context, students from higher education institutes (HEI) are interesting to include since they have been largely neglected in academic research. For example when knowledge transfer partnerships between universities and industry are researched, universities are considered as research institutes. In these studies solely employees and PhD students, who conduct primary research that can be commercialized, are studied (Perkmann et al. 2013; Cyert and Goodman 1997; Bekkers and Freitas 2008).

However, bachelor and master students are inexpensive resources of knowledge and a high potential workforce. Study results show that people with higher educational levels are more likely to recognize business opportunities than people with lower educational levels (Koellinger 2008). Additionally, they have a higher proclivity for entrepreneurial activities (Arenius and De Clercq 2005; Acs, et al. 2004; Sternberg, Brixy and Hundt 2005) in which the academic environment fosters growth and innovation (Steffensen, Rogers and Speakman 2000).

Putting this into context of ABN AMRO's innovation hub Econic, students are desirable actors to co-create with as they are expected to provide resources that can benefit the innovation process. But how to design co-creation to profit from these student specific resources is not researched. Therefore this research will validate the co-creation framework

by studying and designing the dimensions to develop a co-creation between Econic and HEI students. (Figure 2)
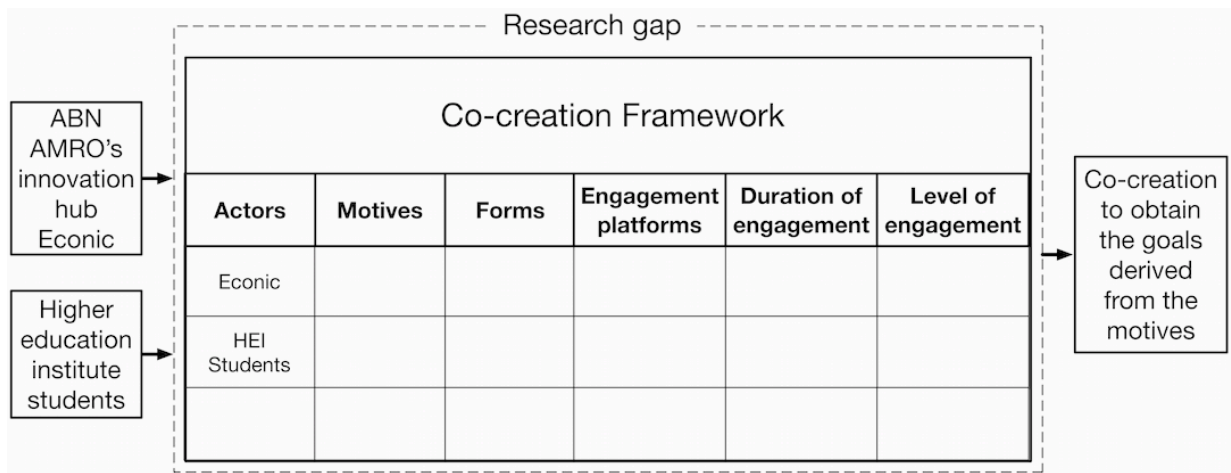
Figure 2 Research gap

3. Research question

With the foundation of innovation hub Econic to facilitate open innovation, ABN AMRO was inspired to involve students of higher education institutes (HEI) into their development process. The bank expects students can be of added value with the provision of complementary knowledge and new insights that are not restricted by a banking background. However, since open innovation is new to ABN AMRO, just as co-operating with HEI in a non ad hoc form, it doesn't know how to effectively co-create with students. Therefore to gain access to the students' resources and use them in the innovation process, the main research question is as follows;

How should the form, duration, level of engagement and interaction platforms, as co-creation dimensions, be designed to facilitate resource integration between ABN AMRO's innovation hub Econic and higher education institute students?

As resources is a broad term that for example can vary from financial- and human- to technical resources, the main research question covers an extensive research field. However, literature indicates that the focal actor and its motives are the instigating factors of the co-creation and their examination will narrow down the breadth of the study and set clear boundaries. Therefore the sub-questions are:

How can ABN AMRO's innovation hub Econic be characterized?

What are the motives for ABN AMRO's innovation hub Econic to initiate a co-creation with higher education students?

By answering the two descriptive sub questions the current state of affairs is described and explained. This analysis lays the foundation to answer the normative main research question and develop a tailored co-creation for Econic. With applying the co-creation framework in a new context its validation is tested while generating actionable knowledge of direct practical value for Econic.

4. Research design

Based on the aforementioned research questions a research design was developed. This design encompasses the research strategy, the research process and the data collection methods to align the activities and efficiently collect and analyse empirical evidence.

4.1 Research strategy

The research strategy aims to direct the research by setting the boundaries, the context and embedded units of analysis. Considering this study involves 'an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence' (Robson 2002, 178) the strategy can be defined as case study. This strategy provides a multidimensional perspective that is used to create a shared view of the phenomenon that is being studied (Kohlbacher 2006). In this research the studied phenomenon will be the development of a co-creation between Econic and HEI students that will be designed according to the framework developed by Frow, et al. (2015). (Figure 3)

Since Econic has no prior experience in co-operating with HEI students in not an ad hoc form, the design of a co-creation is experienced as an exploratory process. But by applying the framework (Frow, et al. 2015) in another context to design a tailored co-creation, prior research results are tested. Therefore, from a general perspective, the study can be seen as validating preceding study results and thus this research can be characterized as confirmatory research.

| ABN AMRO's innovation hub Econic |
| ABN AMRO - Student Co-creation |
Embedded unit of analysis: Actor characteristics	Embedded unit of analysis: Engagement platform
Embedded unit of analysis: Motivation	Embedded unit of analysis: Level of engagement
Embedded unit of analysis: Form	Embedded unit of analysis: Duration of engagment

Figure 3 Research design

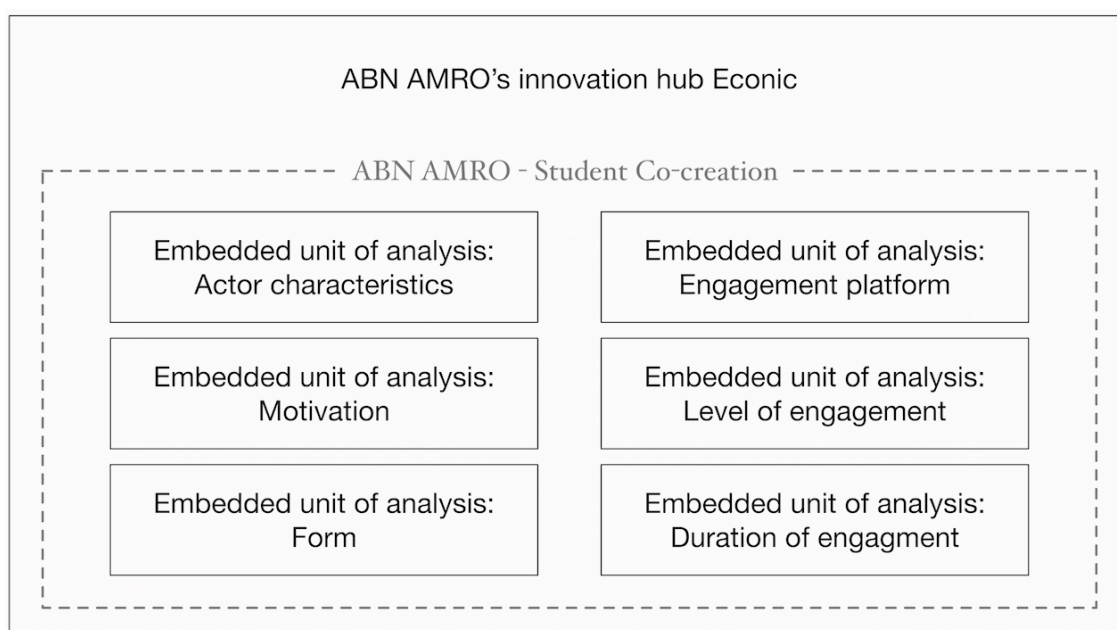## 4.2 Research process

The process of this research consists of multiple steps that are characterized by different methods of collecting and analysing or applying data. (Figure 4) It starts with the literature review to study prior research on co-creations and connects it to the Econic context to demonstrate its relevance. However, little academic research is done that provides a holistic

view on co-creation. Most research concentrates only on an individual element of a specific type of co-creation. The only study that was found to provide a comprehensive perspective on designing co-creations was recently conducted and thus far scarcely tested. This sets the direction of the master thesis by providing a framework to study co-creation designs between Econic and HEI students.

Literature review	Document analysis	Interviews	Design	Questionnaire
Research co-creation dimensions	Data for specifying interviews	Determine Econic's context	Design co-creation according to the obtained data	Evaluate co-creation
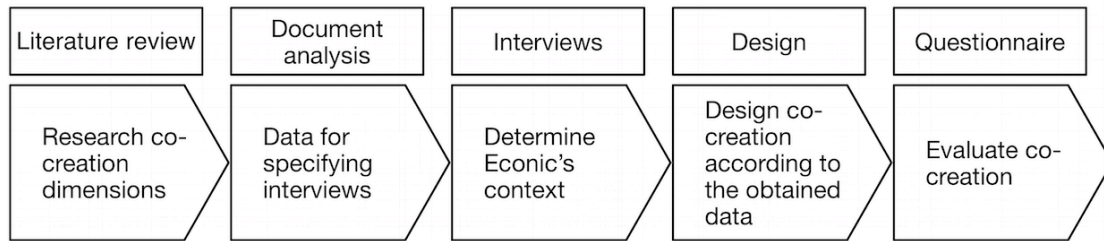
Figure 4 Research process

4.3 Data collection

The consecutive steps of the research process involve three different data collection methods that are related to different sources. The document analysis and interviews are used to obtain qualitative data in order to answer the two sub questions. Moreover, it will lead to the design of the other dimensions and form an initial answer of the main research question. However, since the knowledge of the relationships between the dimensions and validation of the framework are limited it cannot with certainty be said that the initial design is satisfactory. Therefore it is decided to enact the proposed co-creation design and assess it with use of a questionnaire. The questionnaire will obtain both qualitative and quantitative data to evaluate the proposed design and test the assumed relationships. As a result a deeper understanding of the framework is developed and a final answer to the research question can be formed.

4.3.1 Document analysis
Document analysis is a systematic process of obtaining, reviewing and evaluating both printed and electronic documents. Similar to other methods in qualitative research, it requires that data is studied and interpreted in order to draw meaning, develop understanding, and build up empirical knowledge (Bowen 2009). The documents that are studied can be found either within the focal organisation or externally and may widely vary in type, for example, manuals, reports, brochures, presentations, press releases, event programs, evaluation forms and meeting minutes, etc. All these types of documents can provide meaning, understanding, and discover insights relevant to the research question (Merriam 1988). However, before analysing it is required to evaluate the legitimacy of the documents based on the reference, source, purpose and target audience. (Appendix A) When the documents are considered valid they can be organized into themes, categories and case examples to structurally conduct content analysis (Labuschagne 2003).

The reason to use document analysis in general is the efficiency of the method. Document analysis is relatively not time-consuming since it requires the selection of available data instead of the collection of data. Moreover, documents can provide a broad coverage and exactness of names, references, and events. Compared with interviews, the non-reactive aspect will not lead to altered data due to social interactions and possible unintended influences of the researcher (Bowen 2009).

In this research the document analysis has multiple purposes. The first and most self-evident purpose is to provide data on the context and develop a deeper understanding on the studied environment. The information and insights derived from document analysis will contribute to

the establishment of the knowledge base. This also supports the verification of findings from the other resources and research methods to strengthen and validate the obtained data. However, since the foundation of Econic is quite recent, the expectation of finding documents that consider past events will be minimal. Therefore it is likely that the information the documents contain will mainly serve as a guide to help generate additional interview questions to come to a more deep and specific interview.

4.3.2 Semi-structured interviews
An interview can be generally described as a purposeful discussion between researchers and respondents to gather valid and reliable data that is relevant to the researched case. One typology that is commonly used distinguishes methods of interviews based on the level of formality and structure (Saunders 2011). Resulting in three different types: structured interviews, semi-structured interviews and unstructured or in-depth interview.

Structured interviews use predetermined questions to which the answers are fitted in a standardized schedule and subsequently gather quantitative data. Since this stage of the data collection focuses on the understanding of the motivation of ABN AMRO to initiate a co-creation and explore its design, quantitative methods are undesirable.

An unstructured interview is informal and explores a general area in-depth. No predetermined questions are asked but the interviewee is given the opportunity to freely speak about the proposed topic. Also this type of interview is not preferable since the document analysis already established a specific focus just as the embedded co-creation dimensions have. Therefore the evident choice here is a semi-structured interview that will be prepared with predetermined themes and open-ended questions to guide the interview, given the development of the interview is decided to omit questions or ask additional ones for a deeper understanding.

In preparation of the semi-structured interviews a general overview is developed. This includes the direction of interview questions, the list of interviewees and a note to ask permission to record the interview to enable effective data analysis (Appendix B-C) (van Aken, Berends and Van der Bij 2012). Since the interview is conducted to require qualitative data it can't be based on a formal schedule of questions that is asked word-for-word in a predetermined order. Instead the schedule provides guidance by listing topics that need to be addressed during the interview and additional probe questions to follow-up responses and elicit greater detail from the interviewee (Cassell and Symon 2004). These topics follow on from the document analysis, personal experience with Econic, informal discussions with team members of the Econic and prior experiences as a student with student-company interactions.

The interview is structured according to the interviewees and the corresponding information they are expected to provide. The overall aim of the desired information is to produce a range of co-creation design suggestions that will obtain the goals that are derived from the motives to co-create with students. This information can be divided into multiple categories. The first category involves gaining a deeper understanding of the interviewee's background related to their role and responsibilities in Econic. The second set of questions investigates the Econic environment and includes goals, objectives, strengths and weaknesses. Continuing with the third part that encompasses the processes conducted within Econic, activities that are included and inquire suggestions to improve these processes. The following part focuses on recommendations on how the interaction with students should be shaped. Concluding with reflecting the aforementioned recommendation by determining requirements to come to a successful conclusion of the co-creation.

4.3.3 Questionnaire

Questionnaire is a broad term that is generally applied to answer questions in order to gather data for quantitative analysis (deVaus 2002). In this research is the term questionnaire used for a method to collect data in which students participating in the co-creation answer a set of questions and Econic participants answer a set of questions. This differentiates questionnaires from the aforementioned interviews and indicates the possibility to efficiently obtain a multitude of responses.

The types of data that can be collected with a questionnaire can be categorized as opinion, behaviour and attribute variables (Dillman 2007). Opinion variables collect respondents' perceptions concerning a specific topic. Behaviour variables collect previous, current or future activities and experiences. And attribute variables are related to the characteristics and capacities the respondents posses. All of these variables will be relevant to test the co-creation that is designed based on the data obtained with the document analysis and interviews.

Designing a questionnaire that produces accurate information and reflects the views and experiences of a given population requires developing procedures that minimize the error. The overall error can be divided in four categories (Dillman, Smyth and Christian 2009). The first one is the coverage error and occurs when the sample of the questionnaire does not encompass the whole population and members who are excluded differ regarding the measures of interest from those who are included. The sample error is a precision deficiency caused by generalizing the questionnaire results from questioning only a part of the population of interest instead of the total population. The third error is the nonresponse error and occurs when individuals who do not respond differ in a way that is important to the study from the individuals who do respond. Lastly is the measurement error that stems from a respondents' inaccurate or imprecise answer (Groves, et al. 2009).

One of the elements that affect the error is the construct of the questionnaire. The construct is based on the information that is intended to be obtained and is characterized by the type of questions asked. Questions can be divided into two types: closed-ended and open-ended. Closed-ended questions provide a list of answers the observant has to choose from. By limiting the answer possibilities the observant is directed to provide specific information. This leads to time efficiency and enables the researchers to easily code the results to have numeric data and perform quantitative analysis. However, the limitation could be a disadvantage because it does not reveal the underlying reasons to choose the answer.

Open-ended questions are included in the questionnaire for a more general analysis of the co-creation. The strength of the open-ended format is that it allows respondents to answer freely without any boundaries. This format is desired when researchers do not want to influence the respondents' answers. Moreover, it can acquire more precise information as respondents can provide an answer instead of choosing from general categories or a range of values. This can lead to a lower measurement error. The downside of open-ended questions is that more respondents skip the open-ended questions because they require more effort, which can lead to a nonresponse error.

4.4 Validity

The validity of a research relates to the outcome of the research and the process of how it is obtained. A valid research has a justified process that uses reliable measurements to provide good reasons to believe that the outcome is adequate. Research validity can be divided in two groups: internal and external (van Aken, Berends and Van der Bij 2012).

Internal validation refers to the completeness and adequacy of studied relationships to form a conclusion. In order to obtain internal validity it is required to eliminate other plausible, competing explanations and can be done by theoretical triangulation. This method involves the use of multiple sources and methods of data collection to study the case from multiple perspectives. By the establishment of converging lines of evidence the research findings will be more robust and the internal validity of the research will be increased (Yin 2013).

External validation encompasses the generalizability of the research results to other contexts and depends upon the differences between the studied subjects (van Aken, Berends and Van der Bij 2012). By increasing the number of different subjects the results are more generally applicable thus the research has a higher external validation. This specific research aims to strengthen the external validation of the co-creation framework by testing its applicability for designing an Econic - Student co-creation.

5. Analysis

The analysing process involves organizing and interpreting data to transform it in useful information. The process can have multiple facets that encompass a wide range of techniques. However because the approaches to analyse the data obtained from documents and interviews are both qualitative methods focused on the same topics to discover useful information to suggest a design for co-creation in the Econic context, they are very much alike. In contrast with the analysing process of the data obtained with the questionnaire. This data will be partially numeric and can therefore be statistically analysed with the use of the R Studio software.

5.1 Document analysis

The collection, validation and scanning of the documents to determine their applicability for the research is followed by document analysis. This process contains elements of content analysis and thematic analysis. Meaning that the content of the selected documents are closely reviewed to perform coding and theme construction. Based on the data characteristics categories are created that relate to the research questions. The codes correlating with the categories are supplementary to the interviews later conducted in this study. The themes and codes generated in the document analysis will help to integrate the data gathered by these different methods. To efficiently collate and compare the individually obtained data an abridgement in Excel is made with the data differentiated according to the codes. (Appendix D). This enables a systematic interpretation, examination and evaluation to turn the data in useful information that provides a basis for decision-making.

5.2 Interview analysis

For analysing the interviews the audio records made during the interviews will be transcribed. This will allow, similarly to the document analysis, to summarise, categorise and structure the findings to support the interpretation of the data. The summarizing involves the condensation of meaning and results in an overview of key points (Saunders 2011). It provides an indication of the relevance to the research questions and guidance for further data collection. Using the abridgement made in Excel a deductive approach is applied in the analysis of the data. Similar to the document analysis, this structure helps to unitize parts of transcribed data to systematically describe the context, recognize relationships and draws conclusions.

5.3 Questionnaire analysis

The questionnaire will be analysed using a qualitative method for interpretation of the open-ended questions and quantitative methods for the closed-ended questions. The qualitative method is similar to the document analysis and interviews and will be using the same categorization and codes for interpretation. The quantitative data of the questionnaire is initially examined and successively analysed with the performance of statistical methods.

5.3.1 Data examination
The data examination involves the process of orderly portraying and observing the data to reveal characteristics that are not apparent and may be overlooked. The first step is to explore the data set in order to identify missing records and identifying the outliers. Outliers are observations that are substantially different from the other observations (i.e. have an extreme

value) and have a disproportionate influence on statistical analysis. This might be caused by an error in the data collection that can lead to wrong interpretations (Hair, et al. 2009). Identifying outliers can be done visually or, in normal distributed data, with the calculation of the Z-values. The Z-value is based on the deviation of the data point from the mean and is in a small sample size considered an outlier when it exceeds ±2,5 (Hair, et al. 2009).

5.3.2 Distribution
For applying the appropriate analysing methods the distribution of data sample is evaluated. If variation from the normal distribution is too large many statistical tests are not applicable. Therefore, in order to evaluate the distribution the Shapiro-Wilk test will be performed. It compares the mean and standard deviation of the data sample to the ones of a normal distribution. The null-hypothesis of this test is that the data set is normally distributed and will be rejected when the p-value is less than 0,05 (Hair, et al. 2009).

For additional verification will the data be graphical represented in a normal probability plot. In the normal probability plot, that is often called a QQ plot, a straight line represents the normal distribution. The actual distribution of the data sample is then plotted against this line so that any differences are easily identified and interpreted.

5.3.3 Interrater reliability (IRR)
'The within-group interrater reliability is the most frequently applied index for interrater agreement on Likert-type scales' (Wagner, Rau and Lindemann 2010, 593). This measure calculates the $r_{WG(J)}$ value based on the mean of observed variance and expected variance in case of no agreement between respondents. The $r_{WG(J)}$ represents the agreement in terms of the proportional reduction in error variance while considering the applied Likert-scale range. The value varies between no agreement ($r_{WG(J)}= 0,0$) and perfect agreement ($r_{WG(J)}= 1,0$) in which 0,7 is an acceptable threshold value (Wagner, Rau and Lindemann 2010).

5.3.4 Latent constructs
The Cronbach's alpha is used to assess the internal consistency of multiple items. The α is calculated based on the average inter-correlation among the questionnaire items while taken into account the number of items. The value indicates the extent to which the items that are grouped together are actually measuring the same latent construct. The goal of this procedure is to condensate the obtained information by reducing the amount of items in accordance with the theory with a minimal loss of information.

The value for Cronbach's alpha ranges between 0 and 1. A low value indicates that the items, which are grouped together, show little correlation and are mostly independent from one another. When the items that are grouped together have a high level of co-variance and the number of items is high, the Cronbach's alpha will approach 1. The high alpha supports the theory that the grouped items measure the same latent construct. Although the recommended cut-off value of α coefficients strongly differs, most of them lie around 0,65 whereas 0,5 is generally considered as unacceptable (Hair, et al. 2009).

5.3.5 Statistical relationships
In order to find a relationship between constructs, significant variance between groups of observations is required. Dependent of the distribution of the data the method for examining variance and analysing relationships between constructs is chosen. One of the most often used techniques for normal distributed data is analysis of variance (ANOVA). ANOVA primarily focuses on the difference between means of groups to identify differences in observations. When the p-value is less than 0,05 the null hypothesis is rejected and the difference is considered significant (Hair, et al. 2009)

However, when the data appears not to be normally distributed the mean cannot be used as an adequate factor to indicate the difference between groups. Therefore, instead of the ANOVA

method the Kruskal-Wallis test will be performed. This nonparametric test that is often used for ordinal data, is estimated to have at least 90% of the power of its parametric counterpart ANOVA (Cohen 2008). This method is based on ranking all the observations and the sum of the ranks per observation group (T_i) while taking into account the number of groups (k) and the total amount of observations (N). (Equation 1) As the calculated value (H) follows the chi-square distribution with $df= k-1$ the corresponding p-value can be found. When the p-value is below 0,05 the null hypothesis can be rejected and stated that groups of observations significantly differentiate (Cohen 2008).

$$H = \frac{12}{N(N+1)} \sum_{i-1}^{k} \left(\frac{T_i^2}{n_i} \right) - 3(N+1) \qquad (1)$$

When a relationship is indicated by the significant difference between constructs the effect size can provide additional insight. In case of the ANOVA the effect size is based on the actual correlation between the constructs. When applying the Kruskal-Wallis test the portion of variance (η^2) in the dependent variable is explained by the calculated chi-square in relation with the number of groups and observations (Cohen 2008). (Equation 2)

$$\eta^2 = \frac{H - k + 1}{n - k} \qquad (2)$$

6. Context ABN AMRO

The document analysis and interviews revealed that ABN AMRO bank wants to increase the focus on innovation in corporate banking on an organizational level. The bank wants to do this by connecting the dots between existing innovation initiatives to create a sustainable network that promotes open innovation. To facilitate this network ABN AMRO bank has opened innovation hub Econic in Eindhoven. This is a platform for open innovation that in a broad sense is related to corporate banking. Econic enables two-way learning and growth opportunities for both external initiatives and initiatives from within the bank. It differentiates itself by being the first open innovation model in a bank that is physically located inside the bank yet outside regulatory compliance. In this ecosystem no initial financial participation from the bank is planned which implicates high impact with low risk.

6.1 Econic

Econic is a breeding ground for new ideas and a launchpad that helps existing start-ups develop. ABN AMRO bank gives guidance and facilitates the infrastructure for growth by allowing these start-ups to plug into their international network of relevant commercial connections. The benefit for ABN AMRO bank is that it enables them to improve scouting for new relevant business opportunities and be the first in line to utilize the innovations. Besides attracting promising opportunities in the form of start-ups Econic has developed an internal track that stimulates employees to be entrepreneurial and generate innovative ideas.

6.1.1 Econic processes
In co-operation with Epic040, which is an external start-up-experienced team, managers from ABN AMRO bank have developed a "lean start-up methodology" program to operate Econic. This program involves an inside-out and an outside-in approach. The inside-out approach aims to involve all layers, ranks and functions of the ABN AMRO organization to provide meaningful input that eventually will grow and nurture a culture of responding with creativity and innovation to cope with current and future challenges. The outside-in approach aims to kick-start the innovative environment by involving external start-ups that will lead to inclusion of external knowledge and improved awareness of the current market developments

In the inside-out approach ABN AMRO employees go through the four phases of innovation: ideation, concept, start-up and scale-up. While in the outside-in approach external start-ups that are included in the Econic environment are initially in the start-up phase and later on proceed to the scale-up phase. (Figure 5)

In the ideation phase the activities encompass the inspiration of bank employees to generate new ideas, training to pitch them and support to build a development team. In the concept phase the innovation teams are supported in the form of concept training, validation, one-on-one coaching and the expansion of their network. The start-up phase involves tailored coaching of both internal and external start-ups to develop and sell the new product. In the final scale-up phase initiatives are supported that are already beyond the start-up phase and encounter the challenge of exponential growth and market development. Using the network of ABN AMRO they will be enabled to continue business scale-up.

6.1.2 Econic characteristics

Econic can be characterized as an innovative start-up environment supported by the experience of the start-up experts from Epic040 and the network of ABN AMRO. This environment is set apart from the deeply rooted bank dynamics and its embedded rules and regulations. However, it is fully aware of the bank's daily businesses, which involves customer interaction, collaboration with coworkers, knowledge of operating systems and experience with banking processes. This construct transforms ABN AMRO from a reactor to a prospector by offering the possibility to explore and develop new business opportunities and to improve current businesses.

Regardless the strength created by the combination of experience of Epic040 and the external start-ups with the resources of ABN AMRO to create an environment that is very entrepreneurial, none of the actors have extensive experience in Fintech. However, this is not considered as a weakness but as an opportunity. Because it's not the purpose of Econic to be a Fintech hub, its real purpose is to drive innovation in corporate banking or banking in general and achieve the overall goal of changing ABN AMRO's company culture to become more adaptable to change and stay relevant in the future banking environment.

The atmosphere that is created at Econic can best be described as informal with a learn-by-doing mentality where it is allowed to make mistakes. It supports the exploration of new opportunities instead of following the best practices and proven methods to minimize the chances of failure. In contrast with ABN AMRO's bureaucratic culture, the Econic environment stimulates accessibility to encourage the sharing of information and quickly make decisions. With this approach Econic beliefs that open innovation can most efficiently be practiced and innovative initiatives rapidly be validated, developed, and implemented.

6.2 Co-creation at Econic

By adopting an open innovation model when following through the phases of innovation, ABN AMRO was inspired to involve students of higher education institutes (HEI) into their innovation process. The main reason for this was the conviction of being able to tap into a great pool of resources in the form of knowledge from different backgrounds, creativity and new perspectives. It is expected that students will be able to reflect the developments of Econic's innovation teams without a banking background and provide them with new insights. Moreover, they are the next generation bank managers and clients and possibly have completely different expectations of the future bank. These expectation can be put to use in

many forms, for example the generation of ideas, the development of ideas, market analysis, product testing and many more.

On the other side, Econic can offer the students the opportunity to put their knowledge into practice. They will experience the practical side of innovation and entrepreneurship instead of the theoretical aspects they learn in their studies. This will provide new insights for their future career decisions and enables them to develop a professional network in both the start-up environment as in the banking environment.

However, thus far there is no prior experience in co-creation partnerships between Econic and students. The Epic040 team does have some in a different context and state that it is important to involve students that are in the last phase of their education who are intrinsically motivated. These students have sufficient knowledge to be of added value and do not require additional motivation to create value. Epic040 also experienced that co-creations with students who participate to obtain study credits can be less motivated or that the study assignment may conflict with the requirements of the co-creation. However, when the co-creation is not based on a study related assignment it might compete with study related responsibilities and it is likely that students prioritize their study activities over the opportunity to co-create. Therefore it is important that the co-creation is adapted to the schedule constructed by the learning institute.

6.3 Current situation at Econic

At this moment the internal track that involves ABN AMRO employees, consists of five development teams (Appendix E) that have been through the ideation phase and passed the battle of innovation event that functioned as the first gate. The ideas they have developed differ greatly but are all related to corporate banking in some way. For example one is called Flash and aims to develop a portal that speeds up the credit approvals by automatically integrating all the required information and calculating the risks to save time and money. While another, named Projindle focuses on a matching platform that links employees with specific capabilities to the right projects to make the process of completing the project more efficient.

Now that the internal development teams have continued to the concept phase they are expected to take the validation of the idea to the next level. For that they require a minimum viable product (MVP) to test the core assumptions they have made for their product i.e. *how* their idea creates value, *whom* it targets and *what* it takes to make the business idea work. A MVP is a product that entails just enough features to test and facilitate validated learning to progressively continue further development. By adding only limited new features before every test phase the risk and expenses due to invalid assumptions are limited. However, the development teams do not have the knowledge to turn their ideas into actual products to do initial testing.

7. Co-creation design: Econic – Students

The data obtained with the document analysis and interviews was interpreted to analyse Econic's context. This information was applied to the co-creation framework to design a co-creation between Econic and students, what resulted in a 24-hour hackathon and is summarized in   Table 8.

Dimensions of co-creation

	Actors	Motives	Forms	Engagement platforms	Duration of engagement	Level of engagement
Categories	Econic management team	Knowledge development	Co-design	Physical engagement	One-off	Behavioural
	Econic development teams		Development of MVP		(Likely to be recurring)	*Variance in involvement*
	Computer science students		Hackathon		24 hours	
			Variance of tasks specificity			

Table 8 Co-creation Framework Econic-Students

7.1 Dimension Actors

The actors who will be involved in the hackathon can be divided into three categories: Econic management team, Econic development teams and the students with a computer science background.

The Econic management team consists out of two internal managers and a trainee from ABN AMRO bank and the external team of start-up experts, Epic040. The role of the ABN AMRO bank managers in Econic is to 'support and advice the Econic development teams in their innovation process and get them into contact with the available networks' (H. Klomp, personal communication, Sept. 5, 2016). Epic040's role is to 'bring the experience of entrepreneurship to Econic in the form of advice, workshops and assistance in the innovation process (J. Flanagel, personal communication, Sept. 8, 2016). Therefore can be concluded that the Econic management team does not directly participate in the development of the innovations but has a facilitating role that enables the development teams to innovate.

The second category of actors involves five Econic development teams that are in the concept phase of the innovation process and can be considered as the focal actors. These teams consist out of ABN AMRO bank employees that have 'extensive knowledge considering the banking sector and the processes within ABN AMRO to generate great ideas. However, most of them won't be able to develop these ideas' (P. van Duijnhoven, personal communication, Aug 22, 2016). The ideas they have produced are widely diverse but have in common that 'they are all

improvements of corporate banking business models or new business models related to corporate banking' (P. van Duijnhoven, personal communication, Aug 22, 2016).

The last category of actors contains higher education institute students and falls under the category influencers. Students in general are considered to have an innovative mind-set (Steffensen, Rogers and Speakman 2000), a large knowledge base (Koellinger 2008) and, very relevant for this research, not a corporate banking background. Instead, these specific HEI students have a computer science background that involves knowledge and capabilities related to software design. Moreover, as Epic040 has experienced in other co-creation contexts that 'bachelor students compared to master students require more guidance and are therefore considered of less added value (N. Scheurs, personal communication, Aug. 25, 2016), it is decided to focus on students who are in their last years of study.

Additionally, because Epic040 has experienced that working with students in an organisational setting will lead to 'constraints for both the co-creation design and the schedule in order to meet the curriculum' (A. Soetemeer, personal communication, Sept 13, 2016), students are involved on an individual level. This also enables the opportunity to diversify the software development capacities as students from different educational institutes and study directions can be involved due to the absence of conflicting organisational restrictions. Moreover this will provide a greater community to include at least two students per development team from.

7.2 Dimension Motives

The fundamental motive that initiated the co-creation stems from the overall goal to make ABN AMRO bank future proof by becoming more innovative. This begins with creating an entrepreneurial mind-set among bank employees by involving them in Econic's innovation process. However, despite the years of experience and extensive banking knowledge 'the understanding is that valuable innovation cannot come from within the bank due to employees' compartmentalised and sectorial view' (C. Tomese, personal communication, Aug. 24, 2016). Therefore, to overcome this limitation, Econic has created an open innovation environment where external actors can contribute to the innovation process. The desire to specifically co-create with HEI students is because 'they are the bank managers and customers of the future who consider the bank from a different perspective' (P. van Duijnhoven, personal communication, Aug 22, 2016). Moreover, 'due to their different background, network and knowledge they are able to include the external environment into Econic's innovation process and be complementary to the development of the employees' ideas' (P. van Duijnhoven, personal communication, Aug 22, 2016).

The dimension motive that involves the development teams can be analysed on a more operational level. They want to co-create with students to 'obtain complementary knowledge that will lead to the development of a digital MVP' (J. Flanagel, personal communication, Sept. 8, 2016). Moreover, with the development of a digital design, 'the ideas will be approached differently and evaluated from a different perspective, which will lead to the acquirement of new insights' (P. van Duijnhoven, personal communication, Aug 22, 2016). Therefore based on these two motives the overall motivation of the development teams to co-create with students can be categorized as knowledge development.

The motives the students have to participate in the hackathon cannot be influenced by Econic and are therefore not included in the framework. However, the design of the hackathon aims to comply with a wide range of these possible motives to attract a sufficient amount of students. For that reason it is decided that every participating student will receive a monetary compensation to fulfil the financial motivation. Other motivations from the categories: social

benefits, psychological incentives and knowledge development, will likely to be fulfilled as well. For example it is expected that the hackathon will fulfil the social benefit motive with the idea it is 'an official internship that is hosted by ABN AMRO' (J. Flanagel, personal communication, Sept. 8, 2016). Especially students who are in the last phase of their study and are already focussing on their career are expected to highly value references of activities they have performed so they can put these on their resume.

The knowledge development motivation can be satisfied by the experience the students obtain by being involved in an innovation process within a corporate organisation. By participating in the hackathon 'the students will develop a better insight into the career opportunities in a start-up environment as well into the career opportunities in a corporate organisation (P. van Duijnhoven, personal communication, Aug 22, 2016). Additionally they will have 'the opportunity to put theoretical knowledge into practice while learning how to establish a business from up close' (A. Soetemeer, personal communication, Sept 13, 2016).

The last category of motivation the students may have, derives from psychological incentives. This motivation can emerge due to the willingness of pursuing creativity, self-expression, pride or just charitable efforts. These motivations are intrinsic and harder to grasp even by the students themselves. However, it is expected to comply with this motive based on the believe that 'the ideas that the teams are developing will change something, so being involved in the co-creation means being part of something bigger instead of doing just a job (J. Flanagel, personal communication, Sept. 8, 2016).

7.3 Dimension Form

The form of the co-creation is mostly characterized by the stage of development and the corresponding activities, which are in this context: the concept phase and the development of a MVP. For this co-creation a MVP will be in the form of designing a digital tool that enables the development teams to validate their product ideas.

Since it involves a digital tool it is possible to apply a digital form of co-creation. For example, with the use of a digital toolkit that allows designers to online co-create with a trial and error mechanism. In this case a student could work on only a small part of the eventual tool that is later on reviewed, adjusted and used to continue further development by other students. With this digital form of co-creation a complete product can be developed and have multiple validations and improvements concerning its digital aspects.

However, 'the purpose of the MVP is to have an initial product that can validate the development teams' most fundamental assumptions before continuing development (J. Flanagel, personal communication, Sept. 8, 2016). In a digital form of co-design the Econic development teams' input will be even more limited due to their lack of digital knowledge. Therefore it is also very probable that with a digital form of co-design the focus of the development changes to only optimizing the digital aspects of the product rather than focussing on the ability to validate an idea. So it is decided to not apply a digital form of co-design.

The choice to create a digital MVP with a form of face-to-face co-design has led to the conclusion that a hackathon would be most suitable. A hackathon is generally described as an event that brings together programmers and subject-matter-experts to collaborate intensively over a short period of time on software projects. These include the pitching of the subject, programming and presenting the developed digital prototypes (Briscoe and Mulligan 2014). This physical form of co-creation is a pressure cooker that will facilitate knowledge integration to develop a digital product as quickly as possible.

Considering the tasks that students in the hackathon will be given, literature indicates that elements of task specificity can be designed to direct the students to obtain the desired results. However literature does not provide specifics on how to design these elements to apply students' knowledge effectively while obtaining new perspectives.

It is likely that clear expectations with precise constraints and elaborated consequences will provide obvious guidelines to effectively and efficiently apply students' knowledge. Therefore based on the motive to include students for their knowledge of software development it seems relevant to design high levels of task specificity.

The other motive to include students involves learning by obtaining new insights and the use of other perspectives. However, in case of high task specificity the students will be directed to apply a desired approach, show particular behaviour and are restricted in their interpretations. Therefore it is expected that high levels of task specificity will hinder the individual input of the students and limits the provision of new insights and perspectives. So based on the learning motive and the expected effect, it is desirable to have low levels of task specificity.

Because of the two motives and the expected difference in required design of task specificity to obtain the desired outcome it is decided not to deliberately direct this aspect of the dimension form. Instead it is chosen to not give the development teams instructions on how to provide tasks to the students. This will lead to different levels of task specificity that together with the outcome of the co-creation can be measured per team to analyse the effects and develop an advice.

7.4 Dimension Engagement platform

The desired engagement platform was already mentioned in the description of the form and involves face-to-face interaction. This physical engagement fits Econic's environment that 'stimulates accessibility and non-bureaucratic interaction to rapidly and efficiently innovate' (H. Klomp, personal communication, Sept. 5, 2016). Therefore it is chosen to facilitate personal interaction between the development teams and the students regardless the digital possibility. Moreover, this way it is expected to be more efficient in knowledge integration and it provides the students with a sense of close involvement which enhances the commitment.

7.5 Dimension Duration of engagement

This hackathon is the first co-creation between Econic development teams and students and can be considered as a one-off event. But taking into account that the inside-out innovation program is successful thus far and the start of a second inside-out program is already planned, it is likely for the co-creation to be re-established. Especially when considering that the second program involves ABN AMRO employees who probably also don't have the required digital design capabilities while a digital MVP is likely to be required. Therefore it is assumable that this hackathon is the first initiative of a recurring co-creation.

It is also possible that the hackathon is the start of a continuous co-creation from a development team's perspective considering that software design knowledge is not only required in the initial phase of the design process but throughout. However, 'continuing the co-creation with students is the development teams own responsibility, the Econic

management team will facilitate the initial connection but the form and funding of further co-creation is up to them' (J. Flanagel, personal communication, Sept. 8, 2016).

In addition to the by Frow, et al. (2015) provided categories of the dimension duration to indicate the pattern of the co-creation, the category timespan is added. This category was already initiated by applying the form of a hackathon, which involves intensive collaboration over a short period of time. The reason to specifically choose this time span comes from Econic's tight schedule and entrepreneurial mentality of 'you are allowed to make mistakes but do it quickly and get on with improving' (A. Soetemeer, personal communication, Sept 13, 2016). This has led to a continuous, 24-hour lasting event to fit Econic's planning and quickly generate results.

7.6 Dimension Level of engagement

The participation in the hackathon of all involved actors already shows commitment and willingness to devote extensive effort to co-create and indicates a higher level of engagement. Considering the required behavioural change in terms of performing tasks that are new to the students and the development teams, there can be concluded that the level of engagement is behavioural. However, when assessing the level of engagement as the extent to which the students experience involvement, it is harder to design. 'It is desired to design high levels of involvement to stimulate openness and extensive effort to co-create' (P. van Duijnhoven, personal communication, Aug 22, 2016). But due to practical reasons, personal characteristics of the students and differences in the ability of development teams to contribute to the development of the MVP, it is likely to have various levels of involvement during the hackathon.

8. Hackathon questionnaires

The questionnaires are conducted to evaluate the design of the hackathon and provide a deeper understanding of the dimensions and their relationships. Considering that all of the dimensions could be fixed as a result of the document analysis and interviews, except for the form and level of engagement, the questionnaire will be mainly directed towards these two dimensions. This has led to the development of a participants' and a development teams' questionnaire that will measure the varying elements and the effect they have on the outcome of the co-creation. (Appendix F) Additionally, both questionnaires will include a general evaluation to reflect the hackathon as a whole and gain additional insights to improve the fixed dimensions.

In the design of the questionnaire special attention is given to the nonresponse error and measurement error. To guard against the nonresponse error is chosen for a questionnaire on paper directly after finishing the hackathon. This will provide the opportunity to ensure that the hackathon participants fill out the questionnaire and when a nonresponse error occurs to obtain the reason. The attention towards measurement error is focused upon acquiescene. This style of behaviour refers to the tendency of the respondent to constantly answer affirmatively regardless of the content of the question. For reducing this type of measurement error is chosen to word some question negatively.

8.1 Participants' questionnaire

One of the questionnaires will be proposed to the participating students and aims to measure the experienced level of involvement and task specificity. The questions that refer to task specificity are constructed according to the of situational strength elements:

Clarity:
1. The degree of which the assignment was multi-interpretable.
2. The clearness of the assignment requirements.
3. The clearness of expectations the development teams had towards the students.

Consistency:
4. The consistency of the assignment over time.
5. The compatibility of the instructions given by different development team members.

Constraints:
6. The degree to which the assignment is open for individual input.
7. The level of constraints.
8. The level of autonomy concerning the execution of the assignment.

Consequences:
9. The clarity of the consequences of not meeting the requirements.
10. The clarity of the consequences of exceeding the requirements.

8.2 Econic development teams' questionnaire

The other questionnaire intends to measure the success of the co-creation based on the achieved objectives. Because the study is from an ABN AMRO perspective the measured objectives only stem from the motives of the Econic development teams. The general motive

for co-creation is categorized as knowledge development, which comes from the lack of information technology (IT) knowledge to develop a MVP and the desire to obtain new perspectives.

The evaluation of the MVP as outcome of the co-creation is based on three success criteria that are generally applied to assess IT projects: The first one measures to what extent the IT system works as expected and solves the problems. The second criterion evaluates the users' satisfaction and the third considers the reliability of the IT system. By putting these criteria in context of designing a MVP to enable the validation of the essential elements of a new product idea, the following success measures are determined:

1. The MVP works as expected and is able to test the most essential elements of the suggested idea
2. The MVP is user friendly, easy to use and has a good feel and look
3. The MVP has a high reliability and is ready to implement

To reflect the outcome of the co-creation on a more general level that includes the desire to obtain new insights and has a knowledge exchange approach, the following subjects are included:

4. The satisfaction of the required input and delivered outcome of the hackathon.
5. The amount of newly obtained perspective due to interaction with students.
6. The degree of learning from co-creating with students.

9. Results quantitative analysis questionnaire

The questionnaires provided two data samples, the data from the participants' questionnaire that from now on will be addressed as PQ-data and the Econic developments teams' data that will be addressed as EQ-data. In the PQ-data are only the closed-ended questions included that relate to task specificity and level of engagement (questions 1:12). In the EQ-data are only the closed-ended questions included that relate to the development of the MVP and knowledge development (questions 1:8, 10, 12). Before performing the statistical analysis, the negatively worded items are reversed to avoid negative co-variance. This was only required for the participant's questionnaire items 3, 6 and 8 using the formula: 6 – recorded value = new value.

9.1 Missing data

The PQ-data sample consists of 9 observations of 12 items and the EQ-data sample consists of 12 observations with 10 items. None of the samples have observations that are incomplete because a respondent failed to answer one or more questions. However, as there are only 9 observations in the PQ-data sample even though there were 10 participants, it can be concluded that some data is missing. From the participant who didn't fill-out the questionnaire a response was received that will be taken into account in the qualitative analysis of the questionnaire to avoid interpretation bias. The practical impact of the missing data is the reduction of the sample size, which leads to reducing the statistical power of the analysis.

9.2 Outliers

Even though no extreme deviations can exist because the data points are limited to floor and ceiling values due to the Liker-scale, the data is examined for outliers. It was elaborated in the method description of the questionnaire analysis that for identifying outliers in normal distributed data the Z-values can be calculated. However, as the normality analysis will show, no decisive answer considering the distribution of all items can be given to solely rely on the Z-value. Therefore there is chosen to look for deviating data points by examining the Likert-scale plot supported by the Z-value. (Appendix G-H)

The examination of the data revealed that item EQ 3 had a significant irregularity. This item was consistently rated with the exception of one data point that had a Z-value of -2,55. However, further examination showed that this data point came from a respondent who in general rates lower than his fellow team members. Moreover, the respondent is part of the innovation team that on average rates lower than the other teams. Therefore is concluded that the outlier does not derive from a measurement error and is not excluded from the data sample.

9.3 Normality

For applying the appropriate analysing methods the normal distribution of data sample is evaluated. The Shapiro-Wilk test shows that only five items from the PQ-data and one from the EQ-data have p-values above 0,05, which indicates normal distribution. (Appendix H) However, considering both data samples are very small, the statistical tests are less significant. Therefore, to assess the actual degree of departure from normality visual

observations are conducted as well.

Below there are six QQ-plots shown of which the two on the left are normally distributed according to the Shapiro-Wilk test and the four on the right are not. The data points in the plots on the left are distributed over the five groups of the Likert scale and are centered on the green line that represents normal distribution.

The data points in the middle plots are also centered on the green line of normal distribution but only have the exact values 3, 4 and 5. Most points have a value of 4 and fewer points have a value of 3 or 5, indicating the peaked form of normal distribution. Because the data sets involve discrete data, it could be concluded that the statistical test renders values that indicate non-normal distribution while the QQ-plots do show normal distribution.

However, the two plots on the right clearly show, just like the statistical test, deviation from the normal distribution. Therefore it cannot be concluded with sufficient certainty that the data samples are normally distributed. Based on this conclusion it is decided to use Cronbach's alpha and the Kruskal-Wallis test for further analysis.
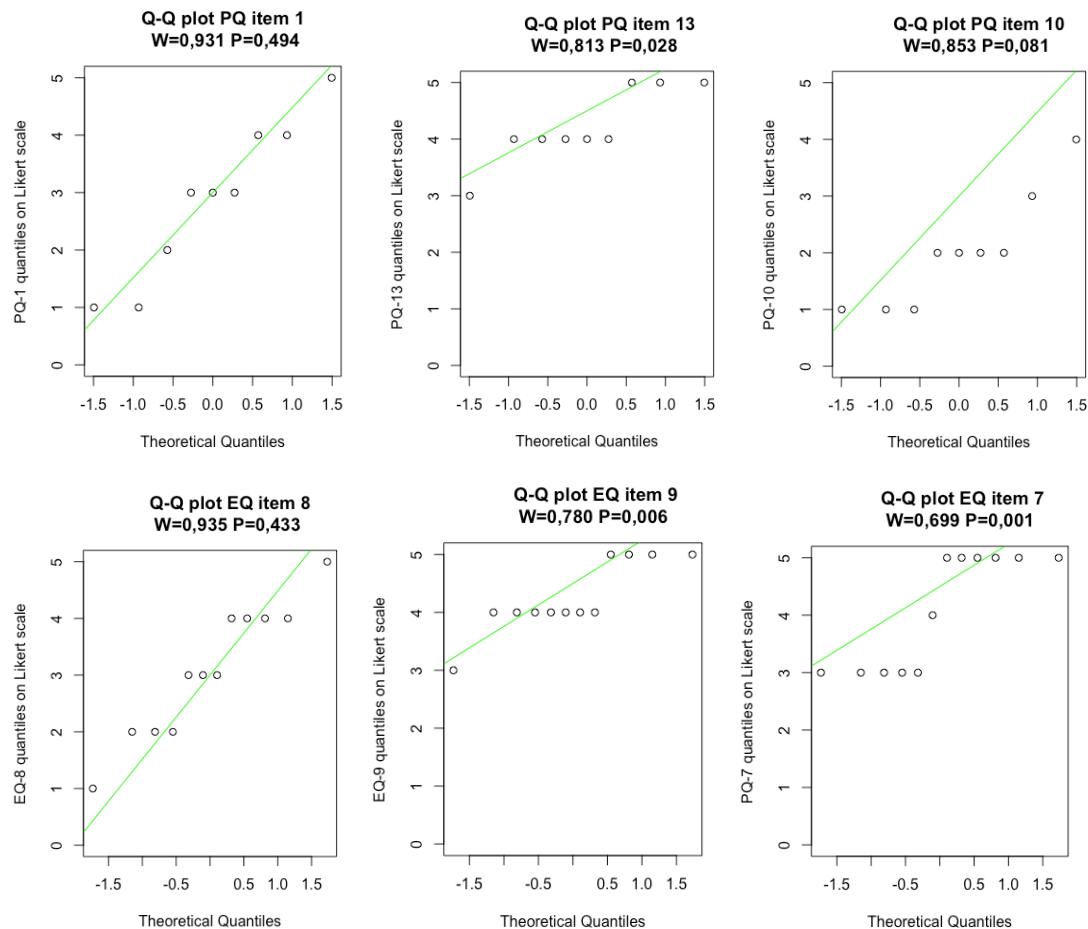

Figure 6 Q-Q plots

9.4 Interrater reliability (IRR)

To accurately combine multiple ratings later on into single values that indicate the tested constructs per hackathon team, the PQ and EQ data samples are clustered accordingly. As was expected, the $r_{WG(J)}$ values below indicate a high degree of agreement among participants

and developers of the same hackathon team. The high interrater reliability suggests that the independent rating of participants and developers led to a minimal amount of error variance and therefore the statistical power for subsequent analyses is not substantially reduced. The ratings of both the participants and the development teams are therefore considered suitable for testing.

PQ-data sample	$r_{WG(J)}$	Number of respondents
Projindle PQ	0,929	2
Dreamfunder PQ	0,979	2
Flash PQ	0,967	2
Compl@ PQ	-	1
Talentspotting PQ	0,878	2

EQ-data sample	$r_{WG(J)}$	Number of respondents
Projindle EQ	0,959	3
Dreamfunder EQ	-	1
Flash EQ	0,981	4
Compl@ EQ	0,910	2
Talentspotting EQ	0,994	2

Table 9 Interrater reliability (IRR)

9.5 Latent constructs

Both questionnaires are built up from multiple constructs derived from theory. The items in the participants' questionnaire shape the constructs engagement and task specificity, which is divided in clarity, consistency, constraints and consequences. The items of the Econic development team questionnaire compromise the constructs validation, user-friendliness, and reliability to evaluate the MVP and the construct knowledge development. By calculating the Cronbach's alpha of these item-groups, it can be assessed to what extent they measure the same concept.

PQ Items	Construct	α
1,2,3	Clarity	0,333
4,5	Consistency	0,391
6,7,8	Constraints	0,674
9,10	Consequences	0,679
11:14	Engagement	0,410

EQ Items	Construct	α
1:3	MVP validation	0,852
4:6	MVP user-friendliness	0,612
7,8	MVP reliability	0,368
10,12	Knowledge development	0,908

Table 10 Cronbach's Alpha constructs

Table 10 shows that for the participants' questionnaire the alphas of the constructs clarity, consistency and engagement are below the cut-off value of 0,65 (Hair, et al. 2009). For the EQ-questionnaire are the alphas for the constructs user-friendliness and reliability unacceptable.

When studying the items of the construct clarity it is noticed that item PQ3 significantly differentiates from the rather consistent items PQ1 and PQ2. Considering that item PQ3 is negatively worded to avoid acquiescence error it is assumed that this design has led to measurement errors, which result in a low α and is therefore excluded.

Items PQ4 and PQ5 of the construct consistency show a low level of co-variance, which indicates that they measure dissimilar constructs. Based on the formulation of the questions it is decided that the items are separated in a measurement for the consistency and compatibility of given instructions.

In the construct engagement the engagement between participants and development teams is measured as well as the engagement between participants and the Econic management team.

However, in the design of the hackathon it was emphasized that the Econic management team has a solely facilitating role and would not be involved in the development of the MVP. Therefore, it is decided to exclude item PQ14 from the analysis.

The construct of the EQ-questionnaire that requires reconsideration is reliability and involves two items. One item directly addresses the reliability of the MVP and the other refers to the readiness for implementation of the MVP. Therefore the two items are analysed individually.

After the evaluation of the constructs with a low α, the items are remodelled as depicted in Table 11. All constructs that involve two or more items have a α above 0,6 thus can with sufficient certainty it can be assumed that they measure the same construct.

<table>
<tr><td>PQ Items</td><td>Construct</td><td>α</td><td>EQ Items</td><td>Construct</td><td>α</td></tr>
<tr><td>1,2</td><td>Clarity</td><td>0,967</td><td>1:3</td><td>MVP validation</td><td>0,852</td></tr>
<tr><td>4</td><td>Consistency</td><td>-</td><td>4:6</td><td>MVP user-friendliness</td><td>0,612</td></tr>
<tr><td>5</td><td>Compatibility</td><td>-</td><td>7</td><td>MVP reliability</td><td>-</td></tr>
<tr><td>6,7,8</td><td>Constraints</td><td>0,674</td><td>8</td><td>MVP ready to use</td><td>-</td></tr>
<tr><td>9,10</td><td>Consequences</td><td>0,679</td><td>10,12</td><td>Knowledge development</td><td>0,908</td></tr>
<tr><td>11,12,13</td><td>Engagement</td><td>0,766</td><td></td><td></td><td></td></tr>
</table>

Table 11 Cronbach's Alpha new constructs

9.6 Difference in observations

Before calculating the effects of the task specificity and engagement on the MVP and the knowledge development, the observations per hackathon group are tested for differences. The boxplots (Figure 7, Figure 8) show some difference in the means of measured constructs per group. However, to determine whether the differences are statistically significant the Kruskal-Wallis test is applied.
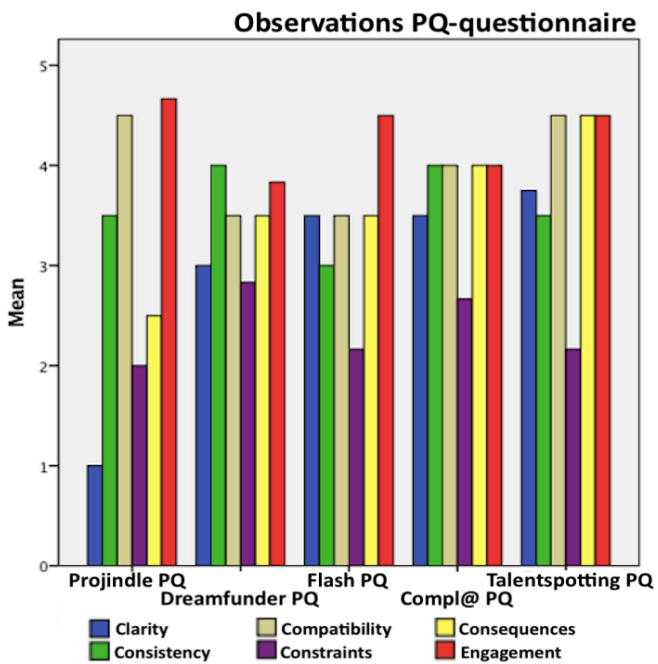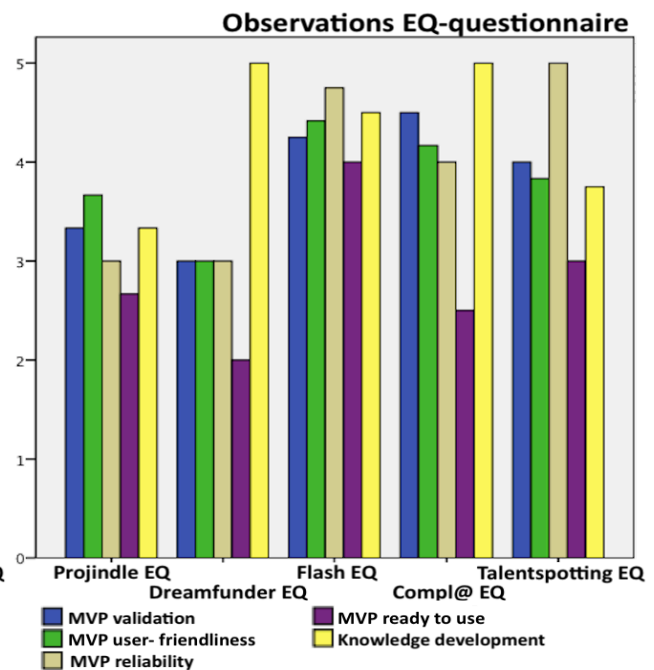

Figure 7 Boxplot PQ-data

Figure 8 Boxplot EQ-data

Table 12 and Table 13 show that none of the p-values are under the cut-off value of 0,05. Therefore, for none of the constructs the null-hypothesis can be rejected. Meaning that the number of observations is too low in relation with the measured variance between hackathon groups to indicate a significant difference. Although these results indicate that the measured effects of task specificity and engagement on the MVP outcome and knowledge development do not comply with common α values to be statically significant, it provides an indication.

	Clarity	Consistency	Compatibility	Constraints	Consequences	Engagement
Chi-Square	4,508	2,071	4,000	2,138	3,273	4,170
df	4	4	4	4	4	4
Asymp. Sig.	,342	,723	,406	,710	,513	,384

Table 12 Kruskal-Wallis Test PQ-questionnaire

	MVP validation	MVP user-friendliness	MVP reliability	MVP ready to use	Knowledge development
Chi-Square	6,870	8,079	8,113	4,224	7,017
df	4	4	4	4	4
Asymp. Sig.	,143	,089	,088	,377	,135

Table 13 Kruskal-Wallis Test EQ-questionnaire

Looking at the boxplot it is noticeable that the level of clarity is by far the lowest for Projindle PQ and is followed by Dreamfunder PQ. The other PQ teams all rate the clarity construct relatively high. When analysing Projindle EQ and Dreamfunder EQ it shows that they both score distinctively lower than the other EQ teams on MVP validation, user-friendliness and reliability. This observation is in line with the assumed relationship that high levels of task specificity will enable effective use of actors' knowledge. However, the assumed benefit that low clarity as an aspect of task specificity enables individual input and therefore will enhance learning and obtaining new insights is not shown in the boxplot. Instead, Projindles EQ, which is expected to have a high rated knowledge development, has the lowest rated knowledge development construct.

Therefore, based on this indication it is advised that Econic designs co-creations with high levels of task specificity to enable effective use of actors' knowledge without the restriction of obtaining new insights.

10. Results qualitative analysis questionnaire

The most notable insight the qualitative analysis offered for this study was that not all external hackathon participants were students. Instead, only seven of the ten participants were registered at a university. The reason for co-creating with non-students and proceed with the hackthon was because an insufficient amount of students' enrolled.

The open questions show that participants overall positively evaluate the hackathon. Especially the unique form of a 24-hour co-creation, which created low barrier, enthusiastic interaction was highly valued. This form of co-creation fulfilled for most external participants the motive of obtaining a unique learn- and work experience in combination with the financial compensation to join the hackathon. From an Econic developers' perspective the hackathon was a great but exhausting experience. It provided the opportunity to rapidly create an MVP even though it did not completely turn out as intended. Moreover, the learning aspects the developers obtained varied from sharing insights in how programmers and designers work to the opportunities software can offer.

A point that received significant criticism was the organisation. Due to poor communication it was unclear for both students and Econic developers what the requirements for the hackthon were. They indicated that it was not well organized in terms of clear plans, requisite tools and especially the matching of capabilities. The Econic developers noted that the amount of students with relevant skills for their MVP was unsatisfactory. On the other side, the students' expectations considering the sort of software to develop were not well met. The most obvious example was that one student stopped during the hackathon. She later on replied that she came to the hackathon to learn and experience something while it felt like Econic used the students for their cheap labour.

Regardless the points of improvement, the questionnaire indicated that everyone involved is open to participating in a future hackathon. Moreover, multiple Econic developers and participants would even like to continue the co-creation partnership that was initiated with the hackathon.

11. Conclusion

The goal of this master thesis was to develop an advice specifically for ABN ARMO's innovation hub Econic on how to design a co-creation with higher education students. To obtain this goal research questions were formulated based on the dimensions included in the co-creation framework developed by Frow, et al. (2015). The company specific character of the research questions instigated a field-based research that followed a practical relevant approach to generate actionable knowledge of direct practical value for Econic. As the research has elaborated, the co-creation dimensions are strategically important aspects to consider in an open innovation environment.

11.1 Theoretical contributions

This research contributes to closing the research gap in the product innovation management literature that was identified by Barczak (2012) and Cottam and Leadbeater (2004). From scholars they requested to develop general tools and processes for designing co-creations since prior academic research was lacking. Preceding literature from different backgrounds (e.g. marketing management, R&D management, product innovation management) that relate to co-creation has extensively focused on analysing individual aspects of common co-creation processes such as crowdsourcing, company alliances and university-industry knowledge transfer partnerships (KTP) (e.g. Sampson 2007; Bullinger, et al. 2010; Simula and Ahola 2014). Or provided a generalized view of co-creation without considering the underlying effect of the dimensions individually (e.g. Payne, Storbacka and Frow, 2008; Perks, Gruber and Edvardsson 2012). By continuing on the efforts that Frow, et al. (2015) made with the development of a framework that holistically analyzed co-creation, this study strengthens the closing of the research gap.

More specifically, the research directly contributes to the co-creation framework of Frow, et al. (2015) by validating it in another context. The appliance of the framework to a co-creation between ABN AMRO's innovation hub Econic and HEI students developed a deeper understanding, pointed out the deficiencies and provided new insights.

One of the contributions directly applicable to the framework involves the suggestion of a new category in the dimension duration. This dimension only includes the duration pattern but neglects the timespan of the co-creation. Because the interview analysis has shown the importance of the timespan for the hackathon it was concluded that the dimension duration was deficient. By suggesting to include a category that involves the timespan of the co-creation that enables planning on a practical and strategic level, a concrete contribution is made to the article of Frow, et al. (2015)

The other contribution in the form of a suggestion to design more efficient co-creations with the use of the framework relates to task specificity. Management and behavioural literature provides general constructs to eleborate task specificy (e.g. Meyer et al. 2010; Yen and Lee 1993) or have applied these structures to different contexts to test their effects (e.g. Paternò, Mancini and Meniconi 1997; Nouri, et al. 2013). This study contributes to that field of research with testing the effects of task specific on the use of the co-actors knowledge and obtaining new insights in a hackathon. Even though the results of the questionnaire do not show a significant difference to draw conclusions, it provides additional insights concerning the effects of task specificity to obtain co-creation goals. Therefore, based on the results of this study, supported by previous study results, it is suggested to include task specificity as a category of the dimension form to improve the framework of Frow, et al. (2015)

Additionally has this research demonstrated that industry-university co-creation does not, as most industry-university related studies do (e.g. Perkmann, et al. 2013, Cyert and Goodman 1997, Bekkers and Freitas 2008), have to solely involve PhD students or professors who conduct primary research that is commercialized. Moreover, by designing a co-creation with HEI students, a direction is provided to entrepreneurship management literature that lacks practical implementations of teaching entrepreneurial skills (e.g. Rasmussen and Sørheim 2006, Haase and Lautenschläger 2011).

11.2 Practical recommendations

With the establishment of Econic, ABN AMRO aims to comply with the increasing critical role of innovation through collaboration. However, establishing co-creations with an unstructured approach may be inefficient, ineffective or even risky. Therefore it is recommendable to carefully design future co-creations to improve the chances of obtaining the desired outcome. The studied co-creation framework will provide structure and guidance to identify and design future co-creation opportunities. Based on the analysis of the hackathon with HEI students the following recommendation can be made for future co-creations.

The first recommendation involves the dimension actors and relates to the study of required resources. This study should specifically indicate what resources the other actors should possess to complement Econic's resources and be of added value. After the required resources are determined, potential co-actors, that posses these resources, can be approached. In the case of the hackathon students with a general computer science background were approached with the request to turn innovative ideas into a MVP. After the enrollment, the students were informed that the required skills for the hackathon involved the ability to build typical web applications with some logic in the backend and a nice user interface. This indistinct selection of students led to the acquirement of skills that didn't fully complement the required ones to most efficiently co-create. Therefore it is recommended for future co-creations to more extensively study and formulate the required resources to enable strict co-actor selection.

In addition to the study of actors it has to be verified whether the potential actors have compatible motives to engage in the co-creation. In the case of the hackathon this was not sufficiently done. Instead, to ensure sufficient students participated, the hackathon was designed to comply with a wide range of possible motives. The questionnaire pointed out that the motives for the students were well met with the financial compensation, provision of a new experience and ability to contribute to an innovation process, in contrast with the learning experience motive, which, for some students was unsatisfactory. But an important notice is that these insights build on a questionnaire with a large coverage error. The examination of students' motives excludes the students who did not participate because their motives were not met. For that reason it is recommendable to examine more extensively the motives of potential co-actors and clearly communicate these motives will be met.

The third recommendation relates to the suggested new category time-span of the dimension duration. The co-creation in the form of a hackathon was one interaction of 24 hours. This design provided a unique experience that resulted in an incentive for most participants to engage. The continuous one time interaction facilitated an efficient process with immediate results. Moreover, the design made it more plausible to fit the planning of a group of students than multiple shorter meetings. However, the educational timetable was not kept in mind, which resulted in many students who were unable to participate due to exams that were planned shortly. Therefore it is advisable to keep in mind the time-span of the co-creation and how this influences the involvement of the potential co-actors and the form of the co-creation.

The other categories of the dimensions duration were not sufficiently considered in the design of the hackathon. It was noticed that the hackathon could function as the introduction of a continuing co-creation partnership and that it probably is a recurring event due to the planned second inside-out program that generates new development teams. However, no communication channels and resources were allocated accordingly. In the case of continuous co-creation it would be reasonable to already invest in communication channels between the students and development teams before the hackathon. This will provide the students with specific information to co-create more efficiently during the hackathon. Considering the recurring character of the hackathon it is advisable to invest in Econic's visibility among HEI students. The increased publicity will enable more students to enrol and allows Econic to more strict select students.

The final recommendation derives from the motive to specifically co-create with students due to their non-bank related perspectives. The examination of the effect of task specificity on the outcome of the co-creation suggests that a high level of clarity facilitates effective use of co-actors' knowledge. And since it also indicates that the level of clarity does not affect learning or obtaining new perspectives, the consideration of a trade-off does not apply. Therefore is advised to have a high level of clarity when co-creating with students.

11.3 Limitations

Unavoidable, this research has limitations in its process to discover co-creation opportunities while testing a morphological framework for the co-creation design. The most significant limitation of this study was caused by the amount of hackathon participants and development teams to provide data for the statistical analysis. The number of observations resulted in an insignificant statistical outcome to draw conclusions. Therefore, the effect of task specificity on the outcome of co-creation can only be interpreted as indication and not as clear result.

Another limitation this study has relates to the external validity of the results. The research questions address the design of the co-creation dimensions between higher education students in general. The co-creation that is designed is limited considering the involvement of students with a computer science background during the concept phase of the NPD. However no reason was found to assume that co-creation in other phases of the NPD or students with other backgrounds will result in other evaluation of the dimensions.

11.4 Future research

The most obvious future research suggestion to make is to resume the examination of the effects that task specificity has on the outcome of a co-creation. By following in the same direction the suggestions made in study can be supported or refuted to come to an indisputable conclusion

An additional suggestion for future research is in the form of additional validation of the co-creation framework in different contexts. These studies can more specifically define the existing co-creation dimensions and categories or explore new ones. A more explicit direction would be the exploration of the missing time aspect that was discovered in this research.

Another suggestion for future research involves longitudinal case studies that can examine the impact co-creation has on innovation and firm performance. With the consideration of the time aspect, it would be interesting to determine when the investment to develop and implement a specific co-creation design is profitable.

A final suggestion for future research is to take a similar approach as the examination of the task specificity effects but for another individual element. In this case a deeper understanding of the influence of a specific aspect on the outcome is developed. The understanding will provide the ability to increase the efficiency of the co-creation by changing only particular elements.

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Appendix A: Analysed documents

Document reference	Date	Source of the document	Purpose of the document	Target audience	Data analysed
Input for meeting on innovation program	March 2016	Epic040	Input for discussing cooperation ABN AMRO and Epic040	ABN AMRO Econic managers & Epic 040	- Motives for Econic - Strengths Epic040 - Open innovation approach
Establishing an open innovation ecosystem for corporate banking June 2016	June 2016	The Y-group (external consultancy firm hired by ABN AMRO)	Characterizing Econic	Internal ABN AMRO management	- Motives for open innovation - Elements of the scope of Econic - The operating model - The fit of Econic in the ABN AMRO network - Governance and timeline
FinTech Innovation Hub – Presentation notes	Jan 2016	Econic (ABN AMRO)	Promotion of Econic	Both internal and external ABN AMRO	- Motivations to found Econic - Goals of Econic - Processes
Mid term evaluation of ECONIC **The innovation hub at ABN AMRO Vestdijk-Eindhoven**	July 2016	Anique Soetemeer (Epic040)	Evaluation of Econic	Econic board (ABN AMRO) & Econic team (ABN AMRO & Epic040)	Econic current status of: - Processes - Objectives - Successes/failures - Reviews of participating internal and external teams

Table 14 Analysed documents

Appendix B: Interviewees

Name	Function
Hans Klomp	Project team manager (ABN AMRO)
Patrick van Duijnhoven	Project team manager (ABN AMRO)
Anique Soetermeer	Project team manager (Epic040)
Coen Thomesen	Project team member (ABN AMRO trainee)
Jošt Flaganel	Project team member (Epic040)

Table 15 Interviewees

Appendix C: Interview protocol

Introduction

Thank you very much for participating in this study. As you will probably know I'm conducting this research for my master thesis that is in partial fulfilment of the master Innovation Management at the TU/e. For this research I was asked by Patrick van Duijnhoven to investigate the how students can be involved in Econic. This eventually led to the main research question: How should the co-creation dimensions be designed to facilitate resources integration between ABN AMRO's innovation hub Econic and students from the TU/e.

After analyzing documents provided by ABN AMRO and conducting a first series of interviews with ABN AMRO employees concerning the motives, goals and activities of Econic, I continue with a second series of interviews. For this seconds series of interviews I would to involve you, as an active team member of Econic to get a deeper understanding of the processes, activities and environment of Econic. With multiple perspectives on this information I expect to have a range of design parameters that I can propose to students of the TU/e and with their response design a co-creation.

The expected duration of the interview is 45 min and is structured as follows. It starts with obtaining some background information continuing with characterizing Econic, the processes within Econic, opportunities for co-creation, success factors and limitations. When the time seems to runs short it may be necessary to interrupt you in order to push ahead and complete the overall line of questioning. And for we begin I would to ask for your permission to record the interview to facilitate taking notes. The files will be kept strictly confidential and will be only used for this research. Is it oke to audio record the interview?

0. Gain an understanding of the interviewee's background
   0.1 As was concluded from the document analysis and previous interviews, the Econic team is composed of ABN AMRO employees and the external Epic040 team. How would you describe your function in the Econic team?
   0.2 Could you elaborate the activities and responsibilities related to this function?

Let's continue with describing Econic to get a better overview of the environment.

1. How would you characterize Econic considering it's goal, abilities and involved actors?
   1.1 What are Econics goals?
      1.1.1 What are its long-term goals?
      1.1.2 What are its short-term short term goals?
      1.1.3 What are its objectives?
   1.2 In the Econic program both internal and external teams are involved. What does Econic offer them?
      1.2.1 Does this offer differs for internal teams and external teams?
   1.3 What are Econic' strengths and weaknesses?
   1.4 What are the roles of the actors involved?
      1.4.1 Econic team member from Epic040?
      1.4.2 Econic team member from ABN AMRO?

Thank you for your answer. This was the most general question. The next questions aims to obtain a deeper understanding about the activities that are going on in Econic.

2. As I understand there were three routes of development of which two were conducted. The outside-in approach of external start-ups and the inside-out approach with ABN AMRO employees. Could you describe these processes?
   2.1 What are the activities that are involved with these processes?
      2.1.1 Are these activities similar for all teams?
      2.1.2 What is the duration of these activities?
      2.1.3 What interaction platforms are used while conducting these activities?
   2.2 Do you have any suggestions to improve the development process
      2.2.1 Would you suggest any additional activities?
      2.2.2 What kind of additional support do you think can improve the conduct of these activities?

Thank you for your answer. The following questions will be focused on the co-creation with students.

3. Higher Education Institute students have a large knowledge base and a proclivity for entrepreneurial activities. Do you think a co-creation between TU/e students and Econic can be established?
   3.1 What do you think students can offer Econic?
      3.1.1 In what form will this be?
         3.1.1.1 In what part of the process?
            3.1.1.1.1 With what activities?
            3.1.1.1.2 What will the duration of the co-creation be?
      3.1.2 Considering the trade-off between the expected time investment and the added value, what would for Econic be the desired level of engagement (the intensity of interaction)?
         3.1.2.1 What will be the desired interaction platform to communicate with the students?
      3.1.3 To what extend do you think the form will be the same if the co-creation is a recurring engagement?
         3.1.3.1 Is it dependent of the internal and external teams?
   3.2 What do you think Econic can offer students?

Thank you for your answer. As final theme I would like to ask you about the requirements Econic has.

4. Reflecting on the things you suggested students can offer Econic and Econic can offer students, what do you think is required to come to a successful conclusion of the co-creation?
   4.1 What are the success factors for the co-creation?
   4.2 How do you suggest obtaining these success factors?
   4.3 What factors do you think will cause failure and should be avoided?

Conclusion

This was the last question. Do you want to add anything? Thank you for your time. I look forward to presenting the results and suggesting a co-creation design that will be a win-win situation for Econic and the involved students.

Appendix D: Themes and codes

Figure 9 Themes and codes

Appendix E: Econic development teams

Development team	Team goal
Compl@	Development of a secure portal for the client acceptance process with all client compliance data in one place that is always up to date and shareable with 3rd parties to help ABN AMRO employees get back to client engagement.
Dreamfunder	Building a platform to connect entrepreneurs with ABN AMRO's investment partners and providing diligence, risk assessment and matchmaking will revolutionize the investment process and become the friendly bank for entrepreneurs.
Flash	A portal that speeds up the credit approvals by integrating all the information required and calculates the risks automatically and sends the client a summary with their credit potential within minutes, which will save time and money.
Talent spotting	Develop a starters program that will build up a pool of young, available talents who have been trained to be an innovative banker and are be able to jump right into positions in the bank where they can help develop the bank of the future.
Projindle	A platform that matches problems and employees to make the project more efficient due to having people with the right capabilities on the right project and ensure that only people who are motived are assigned to the project.

Table 16 Econic development teams

Appendix F: Questionnaires

Participant questionnaire

<u>Personal details</u>

Which learning institute do you attend?

What is your course of study?

What is your year of study?

<u>What was the name of the team you worked with?</u>

Clarity

1. Was it clear that was expected from you?
☐ *No, not at all*　　☐ *No*　　☐ *Neutral*　　☐ *Yes*　　☐ *Yes, very much*

2. Were the requirements for the assignment clear?
☐ *No, not at all*　　☐ *No*　　☐ *Neutral*　　☐ *Yes*　　☐ *Yes, very much*

3. Did you feel that the instructions that were given were multi-interpretable?
☐ *No, not at all*　　☐ *No*　　☐ *Neutral*　　☐ *Yes*　　☐ *Yes, very much*

Consistency

4. Were the given instructions consistent over time?
☐ *No, not at all*　　☐ *No*　　☐ *Neutral*　　☐ *Yes*　　☐ *Yes, very much*

5. Were the instructions given by different innovation team members compatible?
☐ *No, not at all*　　☐ *No*　　☐ *Neutral*　　☐ *Yes*　　☐ *Yes, very much*

Constraints

6. Was the assignment open for individual input?
☐ *No, not at all*　　☐ *No*　　☐ *Neutral*　　☐ *Yes*　　☐ *Yes, very much*

7. Did you feel constraints for the assignment?
☐ *No, not at all*　　☐ *No*　　☐ *Neutral*　　☐ *Yes*　　☐ *Yes, very much*

8. Did you have autonomy concerning the execution of the assignment?
☐ *No, not at all*　　☐ *No*　　☐ *Neutral*　　☐ *Yes*　　☐ *Yes, very much*

Consequences

9. Was it clear to you what the consequences of not meeting the requirements were?

□ *No, not at all*   □ *No*   □ *Neutral*   □ *Yes*   □ *Yes, very much*

10. Was it clear what the consequences of exceeding the requirements were?
□ *No, not at all*   □ *No*   □ *Neutral*   □ *Yes*   □ *Yes, very much*

<u>Engagement</u>

11. Was the innovation team involved during the development process?
□ *No, not at all*   □ *No*   □ *Neutral*   □ *Yes*   □ *Yes, very much*

12. Did you feel involved the development process?
□ *No, not at all*   □ *No*   □ *Neutral*   □ *Yes*   □ *Yes, very much*

13. Did you have much interaction with the innovation team?
□ *No, not at all*   □ *No*   □ *Neutral*   □ *Yes*   □ *Yes, very much*

14. Did you have much interaction with the Econic management team?
□ *No, not at all*   □ *No*   □ *Neutral*   □ *Yes*   □ *Yes, very much*

<u>Satisfaction</u>

15. Would you like to continue co-creating with the innovation team?
□ *No, not at all*   □ *No*   □ *Neutral*   □ *Yes*   □ *Yes, very much*

What was your motivation to participate in the hackathon?

16. How do you rate the Hackathon?
□ *Very Poor*   □ *Poor*   □ *Satisfactory*   □ *Good*   □ *Very Good*

Could you elaborate why?

17. Would you participate in an Econic hackathon again?
□ *Definitely not*   □ *No*   □ *Perhaps*   □ *Yes*   □ *Definitely!*

Could you elaborate why?

Development teams questionnaire

Personal details

What is the name of your development team? [   ]

Validation ability of the MVP

1. Is the MVP able to test the hypotheses that are stated in the value proposition canvas?

No, not at all   No   Neutral   Yes   Yes, very much

2. Does the designed MVP meet the expectations?

No, not at all   No   Neutral   Yes   Yes, very much

3. Does your MVP succeed in performing its intended task?

No, not at all   No   Neutral   Yes   Yes, very much

User friendliness of the MVP

4. Are you satisfied with the ease of use of the MVP?

No, not at all   No   Neutral   Yes   Yes, very much

5. Are you satisfied with the feel and look of the MVP?

No, not at all   No   Neutral   Yes   Yes, very much

6. Are you satisfied with the user-friendliness of the MVP?

No, not at all   No   Neutral   Yes   Yes, very much

Reliability of the MVP

7. Are you satisfied with the reliability of the MVP?

No, not at all   No   Neutral   Yes   Yes, very much

8. Is the MVP ready to implement?

No, not at all   No   Neutral   Yes   Yes, very much

Co-creation with students

9. Are you satisfied with the required input and delivered outcome of the hackathon?

No, not at all   No   Neutral   Yes   Yes, very much

10. Did the students offer new usable perspectives?

No, not at all   No   Neutral   Yes   Yes, very much

11. Would you like to continue co-creation with the students who developed your MVP?

No, not at all   No   Neutral   Yes   Yes, very much

12. Did you learn from the co-creation with students?

No, not at all   No   Neutral   Yes   Yes, very much

Could you elaborate what you have learned?

```



```

13. How do you rate the hackathon?
    Very Poor   Poor   Satisfactory   Good   Very Good

Could you elaborate why?

```



```

14. Would you participate in an Econic hackathon again?
    Definitely not   No   Perhaps   Yes   Definitely!

Could you elaborate why?

```



```
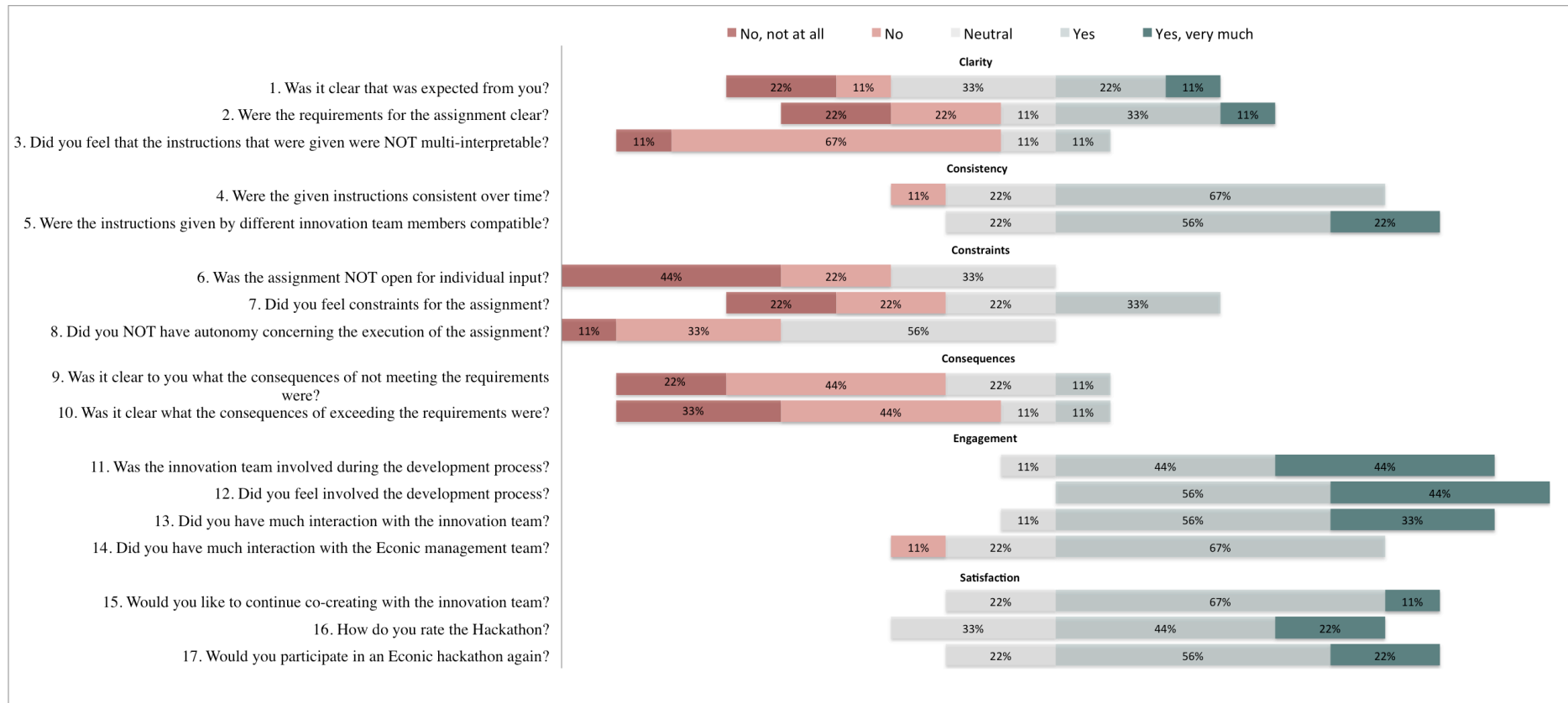
Appendix G: Likert-scale plots

Figure 10 Likert-scale plot participants Questionnaire
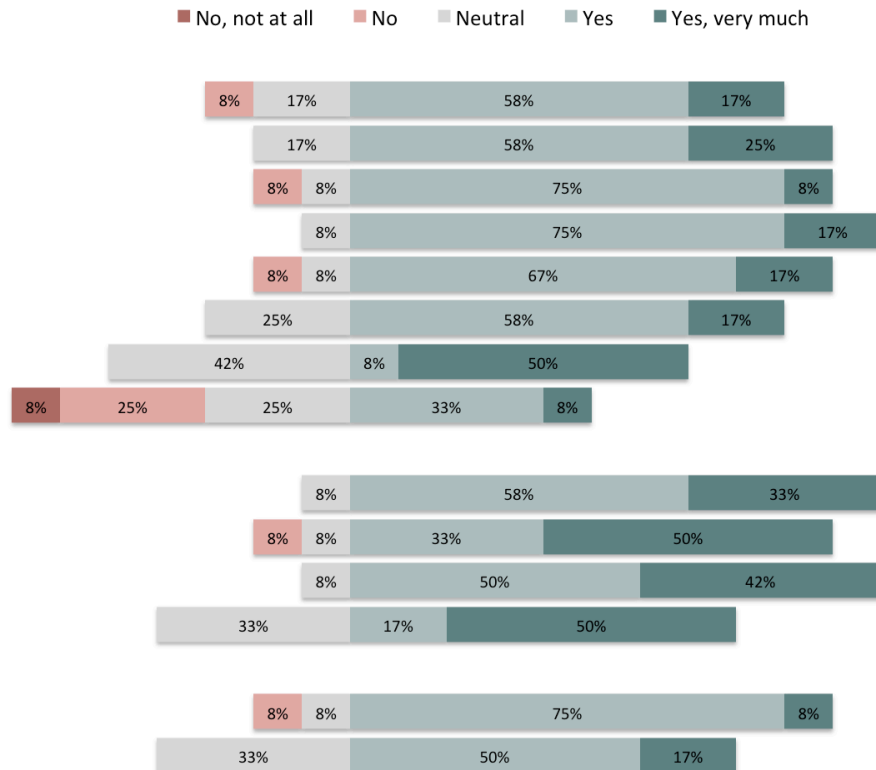
Figure 11 Likert-scale plot Econic Questionnaire

Appendix H: Data overview

ID	PQ1	PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	PQ9	PQ10	PQ11	PQ12
P1. Projindle	1	1	4	3	5	1	4	3	1	1	5	4
P2. Projindle	1	1	2	4	4	1	1	2	4	2	5	5
P3. Dreamfunder	2	2	2	4	4	2	3	3	2	3	4	4
P4. Dreamfunder	4	4	2	4	3	3	3	3	3	4	3	4
P5. Flash	4	4	3	4	4	1	4	2	3	2	5	5
P6. Flash	3	3	2	2	3	2	2	2	2	2	4	4
P7. Compl@	3	4	2	4	4	3	2	3	1	1	4	5
P8. Talentspotting	5	5	1	4	5	1	1	1	2	2	5	5
P9. Talentspotting	3	2	2	3	4	3	4	3	2	1	4	4
Highest	5	5	4	4	5	3	4	3	4	4	5	5
Lowest	1	1	1	2	3	1	1	1	1	1	3	4
Mean	2,89	2,89	2,22	3,56	4,00	1,89	2,67	2,44	2,22	2,00	4,33	4,44
Standard deviation	1,36	1,45	0,83	0,73	0,71	0,93	1,22	0,73	0,97	1,00	0,71	0,53
Highest Z-value	1,55	1,45	2,13	0,61	1,41	1,20	1,09	0,76	1,83	2,00	0,94	1,05
Lowest Z-value	-1,38	-1,30	-1,47	-2,14	-1,41	-0,96	-1,36	-1,99	-1,26	-1,00	-1,89	-0,84
Shapiro-Wilk												
W	0,931	0,907	0,787	0,684	0,835	0,780	0,870	0,763	0,9035	0,853	0,805	0,655
P-value	0,494	0,296	0,014	0,0001	0,049	0,012	0,122	0,008	0,273	0,081	0,024	0,0004

Table 17 Data overview Participants Questionnaire

ID	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6	EQ7	EQ8	EQ10	EQ12
E1. Projindle	3	3	2	4	4	3	3	2	2	3
E2. Projindle	4	4	4	4	3	3	3	4	4	3
E3. Projindle	3	4	3	4	4	4	3	2	4	4
E4. Dreamfunder	2	3	4	4	2	3	3	2	5	5
E5. Flash	4	4	4	5	4	5	5	4	5	5
E6. Flash	4	4	4	4	4	4	4	3	4	3
E7. Flash	4	5	4	4	5	5	5	4	5	4
E8. Flash	5	5	4	4	5	4	5	5	5	5
E9. Compl@	4	4	4	5	4	4	3	4	5	5
E10. Compl@	5	5	5	4	4	4	5	1	5	5
E11. Talentspotting	4	4	4	3	4	4	5	3	4	5
E12. Talentspotting	4	4	4	4	4	4	5	3	3	3
Highest	5	5	5	5	5	5	5	5	5	5
Lowest	2	3	2	3	2	3	3	1	2	3
Mean	3,83	4,08	3,83	4,08	3,92	3,92	4,08	3,08	4,25	4,17
Standard deviation	0,83	0,67	0,72	0,51	0,79	0,67	1,00	1,16	0,97	0,94
Highest Z-value	1,40	1,37	1,63	1,78	1,37	1,62	0,92	1,65	0,78	0,89
Lowest Z-value	-2,20	-1,62	-2,55	-2,10	-2,42	-1,37	-1,09	-1,79	-2,33	-1,24
Shapiro-Wilk										
W	0,843	0,809	0,688	0,699	0,737	0,770	0,778	0,935	0,778	0,737
P-value	0,030	0,012	0,001	0,001	0,002	0,004	0,005	0,433	0,005	0,002

Table 18 Data overview Econic Questionnaire