

# Radboud University



## The effect of individuals' work motivation and cognitive flexibility on output quality in a crowdsourcing for ideation context

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## **Abstract**

Organizations are increasingly focussed on new product development in order to maintain competitive in the current market. In order to produce high quality innovative products and services, managers apply new tools such as crowdsourcing in order to optimize the ideation process. Where traditional mechanisms such as leadership, resource allocation or job designs are well-researched concepts in literature, individuals' cognitive traits and motivational orientation showed to be under-examined. The main goal of this research has been to obtain insights in the effect of individuals' work motivation and cognitive flexibility in crowdsourcing ideation activities on the quality of the generated output. In order to obtain these insights, a study is conducted to examine the intrinsic motivation, extrinsic motivation and cognitive flexibility of contributors on the Philips Open Innovation platform, in relation to the quality of their output

The findings show that individuals' cognitive flexibility has a positive influence on output quality in an internal crowdsourcing context. This is in line with the argumentation of De Dreu, Baas and Nijstad (2008) and Perry-Smith and Mannucci (2015), who argued that cognitive flexibility facilitates better creative performance in tasks such as idea generation. In contrast with several studies, for example Ryan and Deci (2000) who argued that intrinsic motivation positively influences individuals' self-determination and task performance, through the higher amount of effort and dedication towards the task. In this study was found that individuals who are contributing for pleasure, enjoyment, out of interest, to learn or to be challenged do not produce significant higher quality results. Contrasting, significant evidence was found for the negative effect of extrinsic motivation on output quality. Implying that individuals who are contributing in order to gain monetary rewards, promotion, and recognition of superiors or status tend to produce output of lower quality.

Significant evidence was found for the negative effect of extrinsic motivation on Cognitive flexibility. This is in line with prior research of McGraw and Fiala (1982) and Grolnick and Ryan (1985). Individuals' who exert an extrinsic motivational orientation tend to be less engaged with the task, resulting in lower engagement with the task, which negatively influences individuals' capability of switching to a different approach or consider a different perspective, using broad and inclusive cognitive categories and holistic processing of information while conducting the task. Significant evidence was also found for the positive effect of intrinsic motivation on cognitive flexibility. Individuals' who are intrinsic motivated tend to perform better at flexible cognitive processing. Thus, the results indicate that individuals who are intrinsically motivated perform better on cognitive flexible processing capabilities, which results in higher creative performance.

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# 1. Introduction

## 1.1 Introduction

The importance of new product development for organizations cannot be stressed enough. Previous research has shown that newer products obtain a higher percentage of revenue and profit, high performing organizations are more proficient at new product development and that new product development is essential for an organization's viability (Rosenthal and Capper, 2006). The new product development process can be seen as an innovative multi-stage process where ideas develop to products (Kijkuit & Van den Ende, 2007). The first phase of new product development is the front-end phase, during which opportunities are identified and ideas are bond, developed and evaluated (Koen et al., 2010). Smith and Reinertsen (1992) argued that the most time and costs of the innovation process can be saved in the front-end phase. Markham (2013) confirmed this statement and adds that the front-end activities of innovation impacts overall product success, time to market, market penetration and financial performance. The front-end of innovation is seen as the work that is done toward developing a product, before entering the formal product development system (Markham, 2013), which includes work as technical feasibility demonstrations, early market research, financial viability analysis, business model development and business plan preparation (Markham, 2013, Ward, Aiman-Smith and Kingon, 2010). At this early stage, it cost relative low effort to optimize and the effects on the whole innovation process may be extremely high (Khurana and Rosenthal, 1997). Hereby, success in the front-end innovation can be seen as an idea entering the new product development stage (Koen et al., 2010). Cooper and Kleinschmidt (1994) emphasize that the greatest differences between successful and unsuccessful were found in the quality of execution of pre-development activities.

The front-end phase of innovation is seen as a collection of unpredictable and unstructured activities (Koen et al., 2001). Therefore several authors have attempted to create stage-gate models in order to structure the process (Cooper, 1990; Perry-Smith & Mannucci, 2015; Khurana & Rosenthal, 1988; Kijkuit & Van den Ende, 2007). A typical stage-gate system divides the innovation process into predetermined set of stages, composing a group of prescribed, related and often parallel activities (Cooper, 2008). An often-used distinction is made between the idea generation and idea development phases (Khurana & Rosenthal, 1998). The initial step of generating an idea can be seen as a divergent phase (Zhang & Doll, 2001), where ideas originate either from internal sources within the company, or external sources such as joint ventures, universities or customers (Day et al, 2001).

With the introduction of the Internet, organizations started to utilize the productivity and collective intelligence of the crowd to complement or even replace internal processes (Howe, 2006). Many organizations have started to adopt the intelligence of the crowd for the generation of ideas, for example IBM Jam, Dell's Idea Storm or Amazon's Mechanical Turk. Howe (2006) introduced the term 'crowdsourcing' and describes it as the act of outsourcing a task that is traditionally performed by a designated agent in a company to a large crowd. Crowds could consist of both internal and external actors (Stewart et al., 2009) or the general public (Haklay and Weber, 2008), with the underlying assumption that different crowds come with different knowledge and skills to provide different value to the organization (Erickson et al., 2012). Despite the increased interest from business and academic literature, few companies are able to manage crowdsourcing effectively (Boudreau and Lakhani, 2013). Therefore, it is important to understand which mechanisms are effective for obtaining high quality contributions from the crowd.

Zhou and Zhu (2012) emphasize that the individuals forming the crowd are responsible for the generation of creative ideas. In the literature, creativity is seen 'as the production of novel, appropriate ideas in any realm of human activity' (Amabile, 1997, p.40). Amabile (1983) articulated the componential theory of creativity, suggesting that creative outcomes are achieved by a combination of domain-relevant skills, cognitive processes and task motivation, which are influenced by individuals' social environment. In the idea generation phase, appropriate motivational orientation and cognitive processes facilitate a favourable outcome (Amabile, 1983). De Dreu, Baas and Nijstad (2008) defined cognitive persistence and cognitive flexibility as favourable processes to foster creativity. In addition, Perry-Smith and Mannucci (2015) champion cognitive flexibility as a crucial need for idea generation, since cognitive flexibility offers the individual the capacity to integrate content retrieved from his or her social environment to generate novel ideas transcending general practices (Perry-Smith & Mannucci, 2017). Flexible cognitive processing facilitates individuals' with the ability to adjust his or her thinking to overcome obvious thinking and adapt to new situation for creative outcomes (Chen et al., 2014). Several studies champion the effect of flexible cognitive processing on creativity (Collins and Koechlin, 2012, Barbey et al., 2013; Dietrich, 2004).

Amabile (1983) argued that, besides cognitive processes, individuals' work motivation influences creativity. And therefore, individuals' motivation influences the quality of the output in the idea generation phase. Motivational studies regarding crowdsourcing make a distinction between intrinsic and extrinsic motivation, in line with Ryan and Deci's (2000) self-determination theory. Intrinsic motivation is obtained by interest or enjoyment in the task

itself. Contradictory, extrinsic motivation is obtained by the favourable outcome, in the form of status or monetary rewards (Ryan & Deci, 2000). Despite the body of literature, there are contradictory views regarding the effect of motivational orientation on creativity, as well as the interaction between intrinsic and extrinsic motivation. Ryan and Deci (1985) champion intrinsic motivation for its positive effect on creativity, contrasting the detrimental effect of extrinsic motivation. Since intrinsic motivated individuals' act from interest and therefore perceive higher amounts of self-determination, which they found is related to creativity, performance and cognitive flexibility. Extrinsic motivators are perceived as controlling mechanisms, which negatively influences individuals' self-determination. Therefore, extrinsic motivators would negatively influence intrinsic motivated individuals' work performance. Eisenberger, Pierce and Cameron (1999) argue that under certain conditions, extrinsic conditions can enhance intrinsic motivation, since extrinsic motivators would stimulate ones autonomy. Frey and Jegen (2001) introduced the motivation crowding theory, with the main assumption that extrinsic rewards lowers intrinsic motivation if individual perceives the reward as controlling. In a crowdsourcing context, Frey et al. (2011) found that both extrinsic and intrinsic motivation influence crowdsourcing activities, in which intrinsic motivation generates more substantial contributions. Zupic (2013) argues that monetary incentive to generate extrinsic motivation might crowd out the intrinsic motivating factors of contributors, and therefore, might negatively influence the output of the crowdsourcing challenge.

Although several studies have examined individual's motivations of participation in crowdsourcing activities, the relationship between motivational orientation and the quality of output has not been investigated sufficiently. Garcia Martinez and Walton (2014) found that monetary rewards could indirectly influence the quality of output because of the increased size of the crowd, resulting in more submissions and a higher chance of generating good ideas. Rogstadius et al. (2011) conducted an experiment, examining the relationship between motivation and task performance in terms of output accuracy. Hereby it was found that monetary rewards did not contribute to task performance, contrasting with intrinsic motivation, where a significant effect was found. Kazai et al. (2013) found that crowd workers with intrinsic motivation tend to perform higher quality work in comparison with extrinsic motivated individuals. In his study participants were asked to play a game where accuracy was measured. The mentioned studies were conducted in an open crowdsourcing marketplace, asking the crowd to conduct a practical experimental task specifically designed for research purposes. There has not been similar research in an organizational context, with data collected from conducted projects in an internal crowdsourcing platform.

Concluding, current literature emphasizes the importance of cognitive processes as well as

motivational orientation for creative tasks such as idea generation. Flexible cognitive processing is found to have a positive effect on creativity. Regarding motivational orientation, there are contrasting views of the effects of intrinsic and extrinsic motivation on creativity, as well as on the interaction between intrinsic and extrinsic motivation. The mentioned studies were not conducted in a crowdsourcing context. Therefore, current literature does not offer insights in the effect of individuals' cognitive flexibility and work motivation in crowdsourcing activities for idea generation on the quality of the generated output. This thesis will attempt to fill this gap in the literature by examining the front-end crowdsourcing activities conducted by the Philips Open Innovation platform.

## **1.2 Research Objective**

As described, the existing body of literature lacks insights regarding the effect of individual's work motivation and cognitive flexibility on output quality, in the context of crowdsourcing for ideation in the front-end innovation phase. The aim of this research is to contribute to the body of literature of new product development, front-end innovation and crowdsourcing, by examining the effect of intrinsic and extrinsic motivational factors, as well as the effect of cognitive flexibility, on output quality in the context of crowdsourcing for innovation.

Therefore, the formulated research objective is:

*To obtain insights in the effect of individuals' work motivation and cognitive flexibility in crowdsourcing ideation activities on the quality of the generated output.*

## **1.3 Research questions**

As described, the goal of this research is to obtain insights in the effect of individuals' worker motivation and cognitive flexibility in crowdsourcing activities on the quality of the generated output. Investigating this relationship might generate a broader understanding of the effect of work motivation on idea quality in a crowdsourcing context. Also, the contribution of individuals' cognitive flexibility could potentially add value to the understanding of successful and less successful ideation initiatives. Therefore, the following research question is proposed:

*How does individual's work motivation and cognitive flexibility influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

In order to specify the research question, the following sub-questions are formulated:

*1. How does individual's work motivation influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

*2. How does the interaction between individuals' intrinsic and extrinsic motivation influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

*3. How does individuals' cognitive flexibility influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

*4. How does the interaction between individuals' work motivation and cognitive flexibility influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

## **1.4 Theoretical and practical relevance**

### **1.4.1 Theoretical relevance**

As stated, the goal of this study is to obtain insights in the effect of individuals' work motivation and cognitive flexibility in crowdsourcing ideation activities on the quality of the generated output. More specific, the focus will be on the front-end activities of idea generation. Research suggest that the most time and costs of the innovation process can be saved in the front-end phase because of the better foundation of ideas and projects (Smith & Reinertsen, 1992), organizational innovative performance depends on effective front-end activities (Rice et al., 2010) and improvements and insights on how to manage the front-end phase are likely to improve to overall innovative success of organizations (Kijkuit & Van den Ende, 2007). Thus, a better front-end of innovation results in more specific projects and higher market information, which saves both time and money in the latter phases of new product development. Therefore, insights on how motivational orientations influence the quality of output in crowdsourcing ideation activities has the potential to improve overall performance of the front-end as well as the new product development activities.

This thesis contributes to the body of knowledge by examining the concept of creativity in a crowdsourcing context. Amabile's (1983) componential model of creativity champions the effect of intrinsic motivation and cognitive processes for creativity and idea generation. The dual pathway of creativity, articulated by De Dreu, Baas and Nijstad (2008) emphasizes the effect of cognitive flexibility on creativity, where Perry-Smith and Mannucci (2015; 2017) view

cognitive flexibility as a crucial need for creative output in the idea generation phase, since cognitive flexibility offers individuals' the capacity to integrate content retrieved from his or her social environment to generate novel ideas transcending general practices. By examining the concepts of these authors in a crowdsourcing context, this thesis potentially adds to the empirical evidence, or contradicts the findings of the researchers, which could lead to new insights, contributions or directions for further research. Similarly, by examining the motivational component as introduced by Amabile (1983) as well as championed by Deci and Ryan (1985) as an essential part of individuals' creative performance, this thesis adds empirical evidence to their frameworks regarding motivation and creativity. Furthermore, contradicting views regarding the influence of extrinsic motivators on the relationship between individuals' intrinsic motivation and performance, as implied by several authors, will be discussed in the theoretical framework. By examining these effects, this thesis will contribute insights in the interaction between extrinsic and intrinsic motivation, as well as the way they affect the quality of output in crowdsourcing ideation activities.

Concluding, by examining the well-researched concepts introduced by Amabile (1983), Deci and Ryan (1985), De Dreu, Baas and Nijstad (2008) and Perry-Smith and Mannucci (2015), this thesis contributes by expanding the empirical evidence regarding their studies on the relative new field of crowdsourcing. Moreover, the relationship between individuals' motivational orientation and the quality of output of crowdsourcing ideation activities has not been investigated in prior research. By conducting this research, it is attempted to address this gap in the literature.

#### **1.4.2 Practical relevance**

From a managerial perspective, this research contributes by examining which motivational orientation of individuals facilitates higher quality output in crowdsourcing ideation activities. Kaufmann, Schulze and Veit (2011) investigated the effect of individual motivational factors on the participation of actors in crowdsourcing activities. It was found that payment was the main reason for participation, followed by the construct of enjoyment-based motivation. However, no research addressed the quality of output participants generated when reviewing the participants' motivational orientation. Therefore, more insights could potentially help managers build proper incentive mechanisms to activate individuals with the appropriate motivational orientation, with the purpose to produce high quality output. This could lead to a more effective and efficient crowdsourcing process by attracting the right individuals to contribute to the crowd.

## 1.5 Conceptual model

Based on the research objective, research questions and literature review the following conceptual framework will be used, as visualized in figure 1. The theoretic review, which will be conducted in chapter 2, will further explore these relationships.

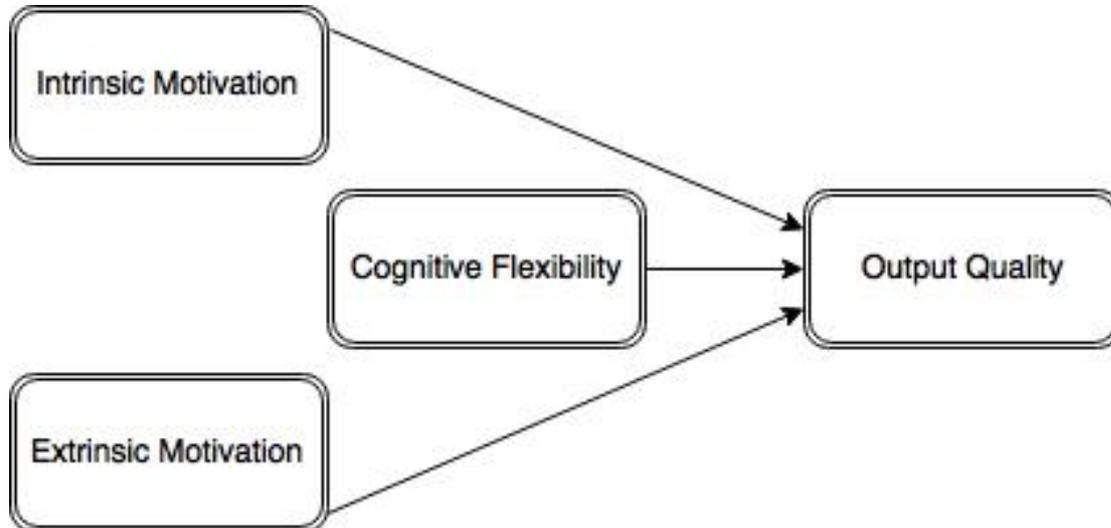


Figure 1: conceptual framework

## 1.6 Dissertation of research

First, chapter two will give a theoretical overview of the key terms, concepts and variables in order to clarify the research context, as well as to cover insights in the current literature. Chapter 3 will further elaborate on the organizational setting, operationalize the key variables, and explain the statistical methods used. In chapter 4 the data will be analysed and the results will be presented. Also, the hypothesis will be tested based on the data. Chapter 5 will summarize the findings, offer a discussion based on findings, and clarify the theoretical and practical implications as well as the directions for further research.

## **2 Theoretical background**

In this chapter a review will be given of previous literature on the key concepts of this study. As stated in the introduction, this research will be conducted in the context of crowdsourcing for idea generation in the front-end of innovation. First, a distinction will be made between innovation and creativity. The proponents of creativity will be discussed, and an elaboration on relevant cognitive and motivational studies will be given. Furthermore, the research context will be further described. This chapter will be concluded with answering the sub-questions as formulated in chapter 1.3, as well as the articulation of hypotheses.

### **2.1 Innovation and creativity**

Innovation and creativity has remained a largely separate field of research, with broadly overlapping definitions and constructs (Perry-Smith & Mannucci, 2015). Amabile (1996) viewed innovation as the successful implementation of creative ideas within an organization. 'Creativity is seen as the production of novel, appropriate ideas in any realm of human activity from various aspects of life or occupation' (Amabile, 1997, p.40). Following these definitions, creativity is concerned with the generation of ideas, and innovation is the implementation of creative ideas. Amabile (1983) articulated his componential theory of creativity, regarding individuals' creativity. Here, creativity was facilitated by individuals' expertise, creative-thinking skills and task motivation (Amabile, 1983). Typical traits of creative individuals are intellectual and artistic values, able to tolerate ambiguity, driven to excellence (West, 1997). In contrast, team level creativity research focuses on team traits such as cohesiveness between team members, group longevity, group structure and leadership (King & Anderson, 1995). As stated, the focus of this research will be on the idea generation within an internal crowdsourcing context, which is conducted by individuals. Amabile (1983) argues that in the idea generation phase, individuals' motivation and creative relevant processes facilitate a favorable outcome (Figure 3). This chapter will further examine the characteristics of creativity based on the componential theory of Amabile (1983).

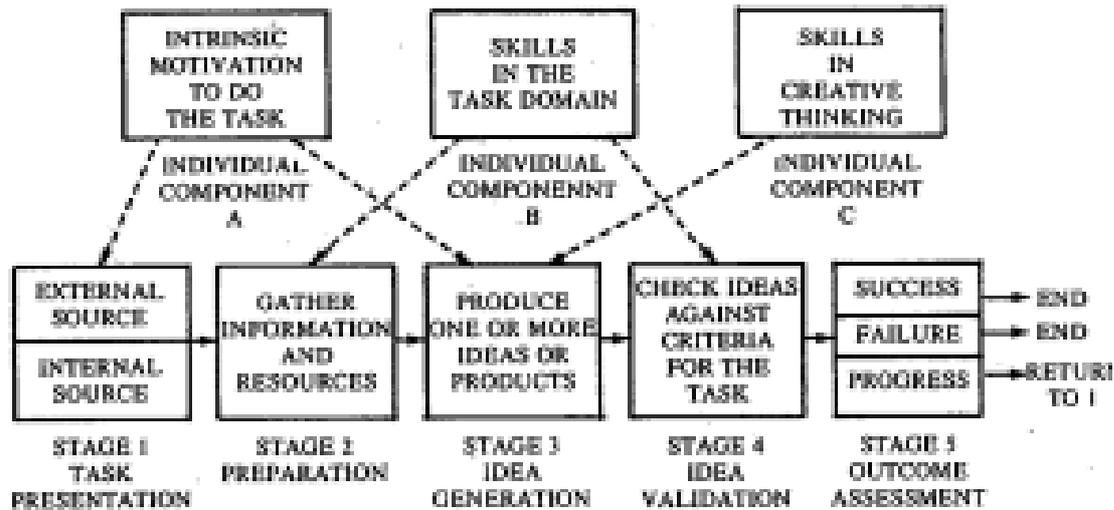


Figure 2 - Componential model of individual creativity (Amabile, 1983, p.139).

### 2.1.1 Components of creativity

Amabile (1983) articulated the componential theory of creativity, describing the creative process as well as the various influencers on the process and its outcomes. The componential theory is based on the assumption that there is a degree of creativity in the work of every individual. Here, creativity is a continuum, from low creative work to high creative work, and each individual's work can be assigned to a certain point on this continuum. Amabile (2012) defines three within-individual components that influence creativity:

Domain-relevant skills are concerned with the specific knowledge, expertise, technical skills, intelligence and talent regarding the particular domain in which the individual is acting. These skills are used as a base, which the individual can use throughout the creative process.

Creativity-relevant processes include '*cognitive style and personality characteristics that are conducive to independence, risk-taking and taking new perspectives on problems, as well as a disciplined work style and skills in generating ideas*' (Amabile, 2012, p.3). These cognitive processes enable individuals to break out ordinary thinking patterns and generate creative solutions.

Task motivation is concerned with individual's intrinsic motivation. The componential theory articulates that '*people are most creative when they feel motivated primarily by the interest, enjoyment, satisfaction, and challenge of the work itself - and not by extrinsic motivators*' (Amabile, 2012, p.3). Amabile (1983) argues that extrinsic motivators can undermine intrinsic motivation, which negatively influences creativity. Furthermore, Lazarus (1991) argues that motivation underlies cognition, because motivation provides the incentive necessary for activation of a cognitive process (Carver & Scheier, 1998), implying that without motivation,

individuals would have no reason to act. Thus, for the generation of creative ideas, individuals need specific knowledge regarding the subject of interest, the ability to use cognitive processes in order to process this knowledge and are preferably intrinsically motivated for the activation of these cognitive processes.

The outside component influencing the three within-individual components is the individual's social or work environment. The social environment includes all extrinsic motivators that potentially undermine intrinsic motivation, as well as other factors in the environment that can stimulate or diminish intrinsic motivation and creativity. While environmental factors that can reduce creativity are criticizing norms regarding new ideas, political or bureaucratic problems within the organization, focus on the current situation, low-risk attitude among management or time pressure (Amabile, 2012). Stimulating factors which foster creativity are a sense of challenge in the work, collaboration, skill diversification, autonomy in the work, encouragement from management regarding the development of new ideas, actively sharing among individuals throughout the organization and recognition for creative work (Amabile, 2012). Summarized, the social environment influences individual's motivation and cognitive processes that produce creativity based on individual's domain-relevant knowledge. As stated, Amabile (1983) argues that in the idea generation phase, motivation and creative relevant processes facilitate a favorable outcome. Next paragraph will further explain these relevant creative processes based on the dual pathway model of creativity articulated by De Dreu et al. (2008).

## **2.2: Creativity and Cognition**

De Dreu, Baas and Nijstad (2008) further examined the cognitive processes regarding creativity in the dual pathway model of creativity, and defined two types of processes: cognitive persistence and cognitive flexibility. Cognitive persistence refers to the extent to which an individual invests cognitive resources and systematically focuses attention and effort on the task at hand (Nijstad et al., 2010). Hereby, generating novel ideas is achieved through prolonged effort and systematic exploration of the problem, as well as incremental search processes (Baas, 2013). Cognitive persistence is reflected in generating a lot of ideas within a few categories, focusing on incremental enhancement of product or processes. Contrasting, cognitive flexibility is seen as the ease with which people can switch to a different approach or consider a different perspective, using broad and inclusive cognitive categories and holistic processing of information (Baas, 2013). Cognitive flexibility leads to original ideas because it facilitates finding new connections among knowledge and ideas (Nijstad et al., 2010). Several authors have examined the relationship between cognitive

flexibility and creativity (Colins and Koechlin, 2012), in which is found that the flexibility in thought and behavior facilitates a shift of thought leading to the generation of innovative and creative ideas (Barbey et al., 2013; Dietrich, 2004). The main reasoning is that creative achievement does not depend solely on a single cognitive process (Arden et al., 2010) but is achieved by distributed neural network and multiple cognitive processes (Jung et al., 2013). Therefore, individuals' ability to adjust his or her thinking in the face of contextual changes as well as the ability to overcome obvious thinking and adapt to new situations is seen as critical for creative behavior and outcomes (Chen et al., 2014).

## **2.3: Motivation**

As described in the componential model of creativity (Amabile, 1983), individuals' intrinsic motivation and cognitive processes are conducive to creativity as well as favorable outcomes in the idea generation phase. Here, motivation underlies the activation of cognitive processes (Lazarus, 1991). Research shows that motivation plays an important part in influencing individuals' performance (Buelens et al., 2010). Motivated employees are more driven and engaged which will result in a higher work effort. In organizations, monetary rewards in the form of bonuses, provisions or stock options seems to be the most used instrument to induce motivation for employees (Dewhurst et al., 2010), which are examples of extrinsic motivators. However, studies have shown that intrinsic motivation leads to better results in terms of performance (Amabile, 1996; Deci & Ryan, 1987). Several researchers found a decline in motivation by external rewards (Deci & Ryan, 1987; Kohn, 1999), especially when tasks need creative solutions (Amabile, 1996) or complex heuristic thinking (Pink, 2010). This section will give an elaboration regarding the types of motivation and its implications, as well as their interaction, through different theoretical lenses.

### **2.3.1 Self-determination theory**

Individuals differ in the source of motivation to conduct a task, as well as differ in the level of motivation to perform a given task. Ryan and Deci (1985) created the Self-Determination Theory (SDT), including a taxonomy that proposes a continuum of motivation, ranging from unwillingness in the form of amotivation, passive compliance in the form of extrinsic motivation and internal commitment in the form of intrinsic motivation (Figure 4). STD's main point implies the distinction between controlled motivation and autonomous motivation. Here, an individual's intrinsic motivation can be seen as autonomous motivation (Gagne & Deci, 2005). Extrinsic behaviour is divided in four subtypes, based on the degree of autonomy

versus the degree of control in behaviour (Ryan & Deci, 2000). Intrinsic motivation can be seen as the prototype of self-determined behaviour (Ryan & Deci, 2000). STD is structured from several mini-theories, which will be discussed to clarify the meta-theory based on the work of Ryan and Deci (1985; 2000).

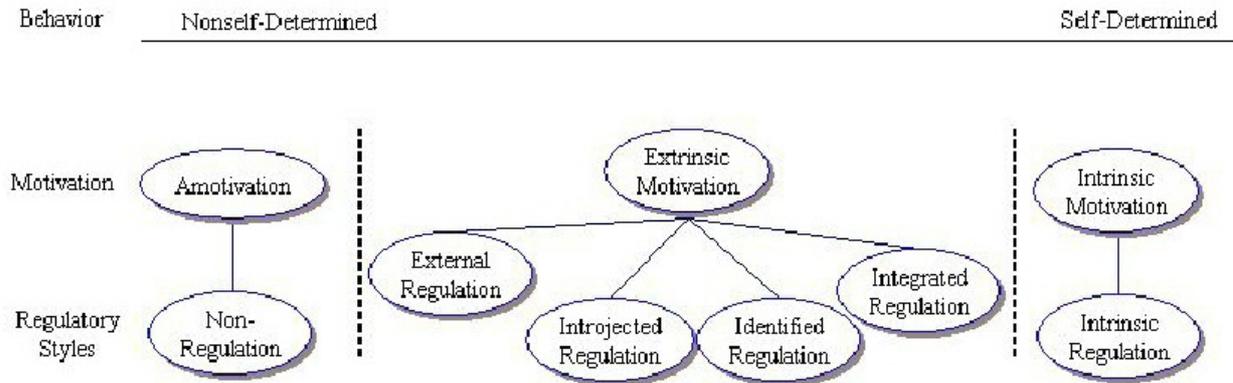


Figure 3: The Self-determination Continuum (Ryan & Deci, 2000)

Basic Needs Theory (BNT) elaborates on the relationship between human needs and their health and well-being. Ryan and Deci (2000) argue that three innate psychological needs determine the outcome, which are the levels of autonomy, competence and relatedness. Therefore, contexts that support these needs should result in better wellness and foster optimal functioning. Autonomy refers to the extent to which an individual can determine his or her own behaviour (Ryan & Deci, 2006). Contrasting, heteronomy refers to controlled regulation, or regulation which occurs under external pressure. Literature suggests that autonomous functioning individuals and teams are more productive and engaged regarding a task, resulting in a higher intrinsic motivation (Deci, 1971), creativity (Amabile, 1983) and performance (Baard, Deci & Ryan, 1998). The need for competence can be seen as individuals' confirmation of possessing the capabilities or skills to successfully conduct a task. This positively influences self-esteem, where individuals' perception of their competence to conduct a task successfully will increase their intrinsic motivation (Deci, 1971). The need for social relatedness implies the need for a secure and safe environment when conducting the task, which is expected to have a positive effect on intrinsic motivation (Deci & Ryan, 2000). Conditions that facilitate individuals' feeling of autonomy, competence and relatedness are argued to promote the highest quality of motivation and engagement, resulting in better performance, persistence and creativity (Ryan & Deci, 2006). Therefore, organizations should provide conditions that increase individual's feeling of autonomy, competence and relatedness.

Causality Orientations Theory (COT) describes individuals' differences in behaviour toward various tasks. Hereby, three types of orientations regarding motivation are articulated:

amotivation, intrinsic motivation and extrinsic motivation. These types of motivation differ in the motives that give rise to an action. 'To be motivated means to be moved to do something' (Ryan & Deci, 2000, p.54). The authors add the notion of amotivation, this is the least self-determined form of motivation, and implies a lack of intention to act or do something. Amotivation is the result of individuals' disbelieve in being competent enough to do the task, not seeing the value of the task or the absence of the believe that the task will lead to something of value (Ryan & Deci, 2000). Extrinsic motivation is activated by external incentives, such as direct or indirect monetary compensation, or recognition by others (Ryan & Deci, 1985). Intrinsic motivation refers to doing something on the merit of pleasure or fulfillment that is initiated without obvious external incentives (Ryan & Deci, 1985). Organismic Integration Theory (OIT) focuses on the various forms of extrinsic motivation. Extrinsic motivation is divided into four subtypes: external regulation, introjection, identification, and integration. These subtypes are perceived as a continuum of internalization. The more internalized the extrinsic motivation, the more the person will be acting from internal rationale. OIT argues that extrinsic motivation is not achieved from interest in performing a specific task, but comes from the value of praise by another individual, an external award or the risk of punishment (Vansteenkiste et al., 2006). Cognitive Evaluation Theory (CET) focuses on the effect of social context on intrinsic motivation. More specifically, in what manner interpersonal control, rewards and ego influence motivation. Intrinsic motivation refers to doing something on the merit of pleasure or fulfillment that is initiated without obvious external incentives (Ryan & Deci, 1985). When contextual factors are aligned with an individual's needs, this will have a positive effect on the individual's intrinsic motivation and engagement. CET emphasizes that competence and autonomy are critical to foster intrinsic motivation. Next chapter will review several theories that contain contradicting views regarding motivation.

### **2.3.2 Contradicting theories**

Another perspective on intrinsic motivation is given in the widely examined theory of the Job Characteristic Theory (JCT), articulated by Oldham et al. (1987). JCT explores the conditions under which employees perform the best. The main assumption of JCT is that enrichment of the task could affect employee satisfaction and performance. The authors formulate three psychological states that lead to a positive work motivation.

- **Meaningfulness of work:** The degree to which the worker perceives the task as intrinsically meaningful and sees the potential to create value.

- Responsibility for outcome: The degree the worker feels responsible for the result of the task.

- Knowledge of results: The degree of feedback of the workers performance.

Specific core job dimensions could achieve these psychological states, which should be present in the task. Meaningful work is achieved by the combination of skill variety, task identity and task significance. Here, the worker identifies the job as important and therefore perceives higher intrinsic motivation. Autonomy provides the worker with the responsibility for its results, where feedback gives the worker knowledge of his results and progress.

Hackman and Oldham (1980) argues that when workers know that they have carried out well on a task that is important to them, he or she will obtain intrinsic rewards from a motivational perspective. Contrasting to SDT, in JCT intrinsic motivation is seen as an outcome, instead of a mediator between behaviour and outcomes such as performance. Therefore, JCT denies the effect of motivational orientation on task outcome. Furthermore, JCT does include theory regarding extrinsic motivation, which narrows the scope of this theory.

Eisenberger, Pierce and Cameron introducing their General Interest Theory (GIT) in 1999 also give another perspective on motivation. GIT assumes that motivation is based on the relevance of the task. Here, the relevance of the task is seen as to which amount the task content or context helps satisfying personal needs, wants and desires. In contrast to STD, GIT includes more psychological needs such as the desire to provide novel contributions or identification with task giver's judgment. Eisenberger, Pierce and Cameron (1999) argue that under certain conditions, extrinsic conditions can enhance intrinsic motivation. Offering a reward confirms that the reward-giver does not control the individual to conduct the activity, but instead must create beneficial circumstances to pursue this person to do the task. The individual has the autonomy to decide to conduct the task. Therefore, offering a reward has a positive effect on autonomy, which in turn positively influences intrinsic motivation. In line with Pryor (1985), a person who receives information about a potential reward for a given task, has the choice to accept or decline the task, and therefore is able to control the situation. From this reasoning, extrinsic motivators should provide higher levels of intrinsic motivation in self-determination theory.

Frey and Jegen (2001) introduced the motivation crowding theory (MCT) by integrating economic theories of incentives with psychological theories. MCT's main assumption is that extrinsic rewards lowers intrinsic motivation if individual perceives the reward as controlling. Contrasting, extrinsic rewards that are perceived as supportive will raise intrinsic motivation. Traditional economic theories do not include the possibility of negative effects from extrinsic rewards. As an example, the authors argue that volunteers in charity organizations are less

motivated if a compensation for their effort is offered, since the relationship of the individual with the organization has changed from a personal choice to an economic arrangement. Therefore, extrinsic motivators would negatively influence intrinsic motivation. In conclusion, despite the exhaustive body of literature regarding motivation, there are still contradicting views regarding the interaction between intrinsic and extrinsic motivational orientation.

## **2.4: New-product development**

This chapter will further elaborate on the context this research is conducted in. In the current dynamic market, organizations face rapid changes in consumers' demands and needs, faster technological evolution as well as more aggressive global competition than ever (McIvor & Humphreys, 2004). Therefore, organizations need to successfully develop and launch new products in order to remain competitive (Kotler, Wong, Saunders, and Armstrong, 2005). To obtain innovations, organizations must facilitate an organizational culture, in which individuals are stimulated to generate new and innovative ideas (Fry, 1987). The NPD process can be seen as an innovative multi-stage process where ideas develop into products, that are ready to be launched into the market (Kijkuit & Van den Ende, 2007). Bernstein and Macias (2002) use a more generic definition, and refer to NPD as bringing a new product to the market. Koen et al (2010) visualized a distinction in phases (figure 1) regarding the creation of new products. The first phase of new product development is the front-end innovation phase (FEI), during which opportunities are identified and ideas are bond, developed and evaluated (Koen et al., 2010). The outcomes of this phase are projects, which are further developed in the NPD phase. The final stage, commercialization, implies the launch of the product into the market. Smith and Reinertsen (1992) argued that the most time and costs of the innovation process can be saved in the front-end phase. The focus of this research will be on this front-end phase of innovation, and more specifically the idea generation phase.

Creating an efficient and effective NPD process is proven to be quite a challenge. Cooper (2009) argues that many organizations face problems with the great levels of uncertainty in high innovative projects. Therefore, most organizations end up developing a more low risk, but also low value project in order to avoid this uncertainty. Another issue according to Cooper (2009) is the lack of time and money investment in the beginning of the project. Due to the lack of in-depth research or development planning, many projects face difficulties in the later phases of development. These difficulties arise from inadequate project design or planning, poor leadership, insufficient market research, unreliable data or insufficient quality

in the execution (Cooper, 1998). In order to cope with these difficulties, Cooper (1990) suggests using stage-gate modeling.

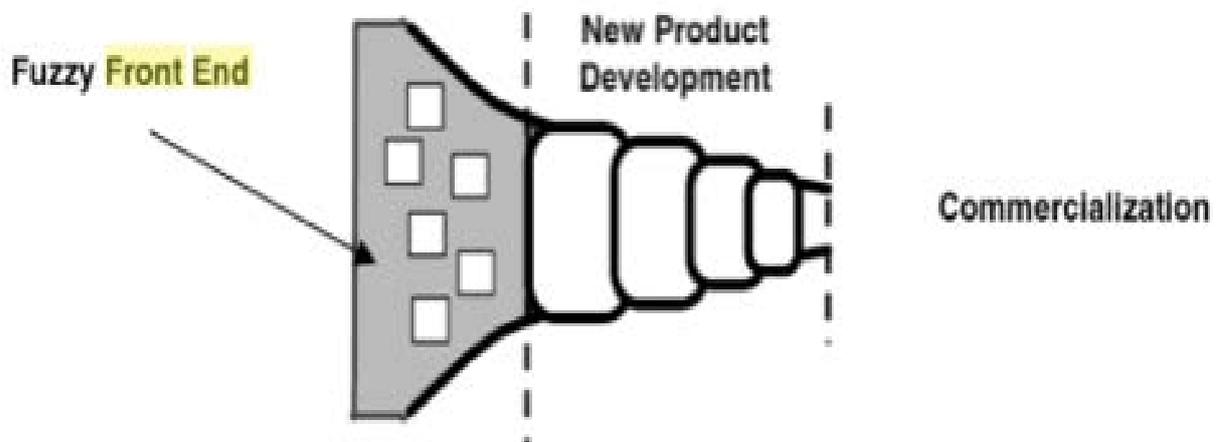


Figure 4: Innovation process retrieved from Koen et al. (2010)

#### 2.4.1 Stage gate system

Recent literature visualizes the NPD process in a stage-gate model. Cooper (1990) emphasizes that organizations may refer to their systems by different names and may appear unique. However, in practice surprising similarities between the different organizational stage-gate approaches can be seen. 'Stage-gate systems recognize that product innovation is a process, and like other processes can be managed' (Cooper, 1990, p. 45). Thus, the stage-gate model is a conceptual and operational map, where ideas pass several steps or stages in order to develop products ready for launch. According to Cooper (2008) a typical stage-gate system divides the innovation process into a predetermined set of stages, composing a group of prescribed, related and often parallel activities. The entrance to each stage is a gate, control checkpoints. Each gate is characterized by a set of inputs, criteria and an output. The inputs consist of the deliverables that the project leader must bring to the gate. The criteria are the items upon which the project will be judged; the outputs are the decisions at the gate. Typically a Go/Kill/Hold/Recycle decision is made, together with the approval of an action plan for the next stage. Figure 5 shows a typical stage-gate system as described by Cooper (1990). A hold or recycle decision implies that a project does not proceed to a further stage, but is saved for later use or integrated into a new project.

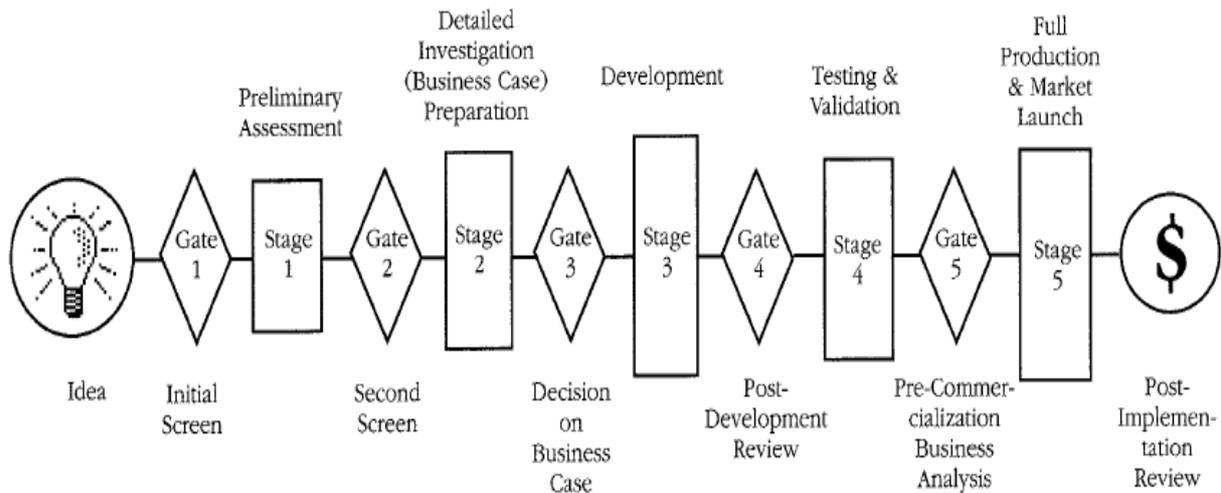


Figure 5 – Stage-gate model retrieved from Cooper (1990).

Cooper and Kleinschmidt (1993) argue that a well-organized stage-gate system generates a higher percentage of successful product development projects. The reasoning of the authors is that because of the quality checks integrated in the stage-gate systems, organizations ensure that certain activities are undertaken, as well as the quality of the work is verified. Therefore, there is a standard of market information available and the minimum quality of this information. The use of the criteria per gate facilitates better evaluation of the project, resulting in earlier detection and potential correction of failures. The better information available, together with less recycle and earlier detection and correction of faults result in shorter project-to-launch time. In line with the argumentation of Cooper and Kleinschmidt (1993), Van Oorschot et al. (2010) argue that the implementation of stage-gate systems help organizations to reduce uncertainty and risk.

Besides the benefits of implementing stage-gate systems, certain limitations and challenges arise as well. Keizer (2008) defines several challenges regarding stage-gate systems. Firstly, the structure of the system can reduce creativity and flexibility. Because of the strict process, which can be seen as bureaucratic and time consuming by individuals, there is less focus on the creative aspect of innovation. Second, gate criteria are often focused on feasibility or market potential instead of alignment with the strategy of the organization. Therefore certain projects might not be relevant for the organization but still get developed further. Third, Keizer (2008) argues that projects potentially show progress in the stage-gate systems because of emotional attachment of individuals. In contrast, Van Oorschot et al. (2010) emphasize that potential viable projects could be rejected by following the stage-gate systems rules too strictly. To handle these challenges and limitations, authors suggest adjusting or simplifying certain aspects of the strict stage-gate system processes, to integrate the organization's specific context and needs (Cooper, 2008; Van Oorschot et al., 2010).

Cooper and Mills (2005) add that a well-organized NPD process is not sufficient. An organization needs an appropriate innovation strategy, sufficient and specific resource commitment focusing on the right projects, as well as the right people to facilitate the generation and development of ideas to products (Cooper & Mills, 2005).

#### **2.4.2 Front-end Innovation**

As stated, the first phase of new product development is the front-end phase, during which opportunities are identified and ideas are bond, developed and evaluated (Koen et al., 2001). In this phase the basis work is done toward developing a product, before entering the formal product development system, which includes work as technical feasibility demonstrations, early market research, financial viability analysis, business model development and business plan preparation (Markham, 2013). Koen et al. (2001) view the front-end phase as the unpredictable and unstructured activities conducted before the development stage. Kim and Wilemon (2002) argue that the front-end starts when opportunities are identified and explored, and ends when the decision to terminate, or commit to the project, is made. Khurana and Rosenthal (1998) offer a quite similar definition, stating that the front-end phase is a process that starts with the identification or consideration of an idea, and ends with the final judgment of termination or acceptance of the project. According to Smith and Reinertsen (1992) the most time and costs of the innovation process can be saved in the front-end phase, but it is also seen as the most challenging phase because of the high uncertainty (Rice et al., 2001).

Several authors referred to front-end innovation as the 'fuzzy front-end' (Cooper, 1990; Stevens, 2014), due to the high uncertainty and the absence of clear stages. Managing these uncertainties is one of the most difficult challenges regarding front-end innovation (Kim & Wilemon, 2002). In order to cope with these uncertainties, several authors introduced stage-gate systems regarding front-end innovation (Khurana & Rosenthal, 1988; Cooper, 1983; Perry-Smith & Mannucci, 2015; Kijkuit & Van den Ende 2007). As Cooper (1990) argues, although the names of the stages differ, the frameworks contain several similarities. All frameworks have similar output as a goal: to produce quality ideas for further exploration in the NPD process. The focus of this study will be on the idea generation phase, which will be further discussed in the next section.

### **2.5 Crowdsourcing**

With the introduction of the Internet, organizations started to utilize the productivity and collective intelligence of the crowd to complement or even replace internal processes. Howe

(2006) introduced the term 'crowdsourcing' and describes it as 'the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined and generally large network of people in the form of an open call' (p. 5). This implies allocate a task, traditionally performed by a designated agent in a company, to a large crowd of individuals. Crowdsourcing is used in many different forms and tasks, and the literature defines various different categories. Howe (2009) summarized these categories in three main forms of crowdsourcing:

1. The prediction market - The use of collective wisdom to correctly estimate, predict or forecast a given event.
2. Crowd casting - An organization defines a problem, broadcasts it to a large and undefined network of potential solvers in order to find a solution.
3. Idea jam - An online brainstorming session used to generate new ideas of any kind, instead of solving a well-defined problem.

Boudreau & Lakhani (2013) suggest using crowd casting to tackle or solve problems in the case that it is not clear which skills or capabilities will generate the best solution. Howe (2009) argues that idea jams are a cost-effective option to generate innovation. Hereby, a diverse crowd reviews problems or challenges, individuals with different perspectives and skills, and the size of the crowd are essential for innovative solutions (Boudreau & Lakhani, 2013). Hossain and Kauranen (2015) articulated seven crowdsourcing applications that have been identified by previous research: idea generation, micro tasking, open source software, public participation, citizen science, citizen journalism and wiki's. The focus of this research will be on the idea generation application of crowdsourcing.

Several definitions of crowdsourcing are available in the literature. For example, Heer and Bostock (2010) refer to crowdsourcing as a relatively new phenomenon in which web workers complete one or more small tasks. Oliveira, Ramos and Santos (2010) define crowdsourcing as 'a particular way to open up the innovation process, using large networks of individuals to access, capture and explore internal and external knowledge, technologies and competencies'. The definition of Oliveira et al. (2010) will be used for this research. Recent literature views crowdsourcing as a co-innovation process, where organizations use the knowledge and wisdom of the crowd (Greengard, 2011). The definition of Oliveira et al. (2010) focuses on the knowledge and innovative capacity of the crowd, which is necessary for ideation, making it suitable for this research.

### **2.5.1 Crowdsourcing: benefits and limitations**

Howe (2006) emphasizes that the main advantage for organizations regarding crowdsourcing lies in the access to a very large community of potential workers. These workers possess a diverse set of skills and capabilities and are able to complete activities within a shorter time frame, and often for less money compared to assigning the task to an expert. Surowiecki (2004) argues that groups are often smarter than the smartest people in them. 'the web provides a perfect technology of aggregating millions of disparate, independent ideas and solutions in the way market and intelligent voting systems do, without the dangers of too much communication and compromise' (p. 19). Greengard (2011) argues that 'crowdsourcing is very efficient - with the right community in place - at gathering information quickly and effectively' (p. 22). Crowdsourcing can help speed up response, fill the information gap, as well as cut expenses since it is cheaper than traditional information gathering techniques (Greengard, 2011; Whistla, 2009). This results in lower cost-to-market and shorter time-to-market (Howe, 2006). Furthermore, research found that ideas generated by crowdsourcing offer more novel products, as well as reduce the risk of product failure (Chesbrough, 2003). Concluding, crowdsourcing offers the potential to produce innovative ideas and products faster and cheaper, by using the skills and perspectives of a large crowd of individuals.

However, there are some challenges and limitations regarding crowdsourcing. Doan et al. (2011) describe four challenges regarding crowdsourcing: how to attract and retain users, how to combine user contributions, what contributions can the user make and how to evaluate the contributions. Janssen (2011) points out three issues: incentives and motivation, openness and information sharing, type of consumer and interaction with consumer. Zheng, Li and Hoa (2011) also emphasize that it is important to foster participation of the crowd. Greengard (2011) emphasizes that organizations should be careful when selecting users, because 'when anyone can join the fray, bad data and faulty observations can get tossed into the mix' (p. 20). Hossain and Kauranen (2015) endorse this statement, and argue that the quality and accuracy of the crowd-sourced information is an important concern. Therefore, the specific ideas or information with potential for the organization need to be selected. Mack and Landau (2015) argue within this selection process, too many submissions could make the organization potentially waste resources on separating the good from the bad.

### **2.5.2 Internal Crowdsourcing**

Internal crowdsourcing is a specific form of crowdsourcing in which the respondents or submitters are solely individuals from within the organization, in the form of a platform that enables employees to post ideas, comment, improve or evaluate ideas posted by others. Boudreau and Lakhani (2013) argue that the organization's internal resources and capabilities have the tendency to be diminished by external crowds, implying that external crowdsourcing would generate more favorable outcomes for the organization. This is due to the fact that employee's responsibilities discourage them from seeking challenges. Villaroel and Reis (2010) emphasize that firms whom implement online innovation platforms aim to access ideas and knowledge from individuals. Here, the crowd always knows more than the individual (Howe, 2009) and internal crowdsourcing has the potential to unveil ideas for innovation from employees which otherwise would not be captured (Yap, 2012), because it would be outside the scope of individuals network or job description. Internal crowdsourcing initiatives therefore have the potential to increase communal development, bridge hierarchy and may lead to the creation of competitive advantage due to innovations (Villaroel & Reis, 2010).

## **2.6: Ideation**

As stated by Amabile (1983), when conducting ideation individuals' motivation and creative relevant processes facilitate a favorable outcome. This phase takes place in the beginning of the stage-gate model of front-end innovation. The goal of the idea generation phase is to produce a large amount of good ideas for the organization. The initial step of generating an idea can be seen as a divergent phase (Zhang & Doll, 2001). In this phase, ideas are rather ambiguous and ill defined, and need time to be further clarified and developed in the latter stages of the front-end innovation (Khurana and Rosenthal, 1998). An important aspect of idea generation is individuals' creativity, as stated by Amabile (1997), creativity can be seen as the production of novel, appropriate ideas in any realm of human activity from various aspects of life or occupation (Amabile, 1997, p.40). Organizations need to actively promote the idea generation process in order to motivate employees (Smith, 2006). Ideas are often formulated when different competencies and technologies merge, which creates a dynamic setting and an explorative environment (Stringer, 2000). Ideas can originate either from internal sources, within the company, or external sources, such as joint ventures, universities or customers (Day et al, 2001). The idea generator should be integrated in the development process, to monitor and protect the original thought (Petri, 2000). Ahmed (1998) emphasizes that during the idea generation phase numerous problems can occur, like insufficient feasibility of an idea, missing direct leadership or incompatibility with the organization's strategy. Therefore, it is important for organizations to structure the ideation process to

facilitate in the context specific needs (Cooper, 2008). Contrasting, the idea generation process itself, should be an organic, flexible process in order to foster creativity (Cooper, 2008). As stated by Amabile (1996) cognitive processes and intrinsic motivation are important aspects in the idea generation phase to foster creativity. 'People are most creative when they feel motivated primarily by the interest, enjoyment, satisfaction, and challenge of the work itself - and not by extrinsic motivators (Amabile, 2012, p.3). Furthermore an appropriate cognitive style enables individuals' to break out and generate creative ideas and solutions for the organization. The next chapter will introduce the concept of crowdsourcing for idea generation.

### **2.6.1 Crowdsourcing for ideation**

Within a crowdsourcing context, ideation usually takes the form of idea competitions or challenges. An ideation contest is the situation in which an individual asks the crowd to submit ideas concerning a pre-defined task (Hossain & Kauranen, 2015). After a decided amount of time the best idea is selected. Here, the submitter of the best idea could be rewarded in the form of several rewards. An ideation contest can be organized either by the firm that wants to collect new ideas regarding a specific topic, intermediaries who solicit ideas from crowds for organizations or individuals who need contribution regarding a task (Hossain & Kauranen, 2015). Respondents or submitters are usually recruited through a public invitation, where individuals can decide to contribute or not to the given contest (Boudreau & Lakhani, 2013). Ideation competitions tend to work best when it is not clear which combination of capabilities and knowledge is needed to solve the challenge (Boudreau & Lakhani, 2013). As stated, large crowds of individuals produce better results than few professionals (Howe, 2009). Several authors underscribe this view based on research, acknowledging that crowdsourcing is an effective model for ideation and problem solving (Houssain & Kauranen, 2015; Villaroel & Reis, 2013; Brabham, 2008; Lakhani & Jeppesen, 2010). Brabham (2008) argues that in most beneficial cases the crowdsourcing initiative attracts motivated and capable individuals who provide a larger quantity of solutions, with higher quality, fast while using fewer resources than traditional business forms.

### **2.7 Output Quality**

The NPD literature offers rather vague or ambiguous definitions of success regarding ideation (Girotra et al., 2010). The general reason for measuring success or performance is the desire for improvement (Behn, 2003). However, the selection of adequate measures is not a simple endeavor (Radin, 2006). Cooper (1990) argues that the interpretation of

success differs, because of the different perspectives on evaluating success. For example, organizations will review success differently according to their goals. Inside organizations, departments or project teams will review success differently, and even on individual level a different assessment of success can be made. Perry-Smith and Mannucci (2017) perceive the idea generation phase successful when a single, novel idea is selected which is deemed more promising, useful or valuable than others. Girotra et al. (2010) argue that authors have used different measures of success, mainly in quantity of ideas or average quality of ideas generated. However, the distinction of ideas quality in either success or failure, will discard valuable information (Cooper, 1990). Therefore, Cooper & Kleinschmidt (1995) argue that multiple-criteria scales should measure front-end output. Schenk and Guitard (2009) articulate that the main performance indicators of crowdsourcing are usefulness, quantity and uniqueness of output. Flemming (2004) emphasizes that organizations often generate a lot of ideas, but with mostly low quality ideas. Therefore, it is important to focus on the quality of ideas (Girotra et al., 2010). NPD literature typically integrates novelty and feasibility as indicators for quality of ideas (Helquist, Santanen & Kruse, 2007). Summarizing, defining output quality regarding ideation is reliable on the specific context of the ideation process. For this research, a multi-scale measure of output quality will be used, based on several indicators of quality for the specific context of ideation in an internal crowdsourcing context.

## **2.8: Hypothesis development**

The goal of the theoretical framework is to address relevant concepts and theories. In order to develop hypothesis, an elaboration based on the sub-questions of this study will be described. From this elaboration the hypothesis will be articulated, which will be statistically tested. The first sub-question that will be discussed is:

*How does individuals' cognitive flexibility influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

The first sub-question involves the relationship between cognitive flexibility and the success of crowdsourcing ideation. As stated, individuals' cognitive flexibility is the ease with which people can switch to a different approach or consider a different perspective, using broad and inclusive cognitive categories and holistic processing of information (Baas, 2013). Amabile (1997) articulated the componential theory of creativity and found that creativity-relevant processes including cognitive style and personality characteristics that are

conducive to independence, risk-taking and taking new perspectives on problems are crucial when generating creative ideas and solutions. De Dreu, Baas and Nijstad (2008) further examined the cognitive processes regarding creativity in the dual pathway model of creativity, and defined two types of processes: cognitive persistence and cognitive flexibility. In a research based on the dual pathway model of creativity, it was found that cognitive flexibility leads to original ideas because it facilitates finding new connections among knowledge and ideas (Nijstad et al., 2010). As stated, creativity is seen as the production of novel, appropriate ideas in any realm of human activity from various aspects of life or occupation (Amabile, 1997). Therefore, there is a high correlation between the output of cognitive flexible processing and creative behaviour. Chen et al. (2014) also found a relationship between flexible cognitive processing and creative behaviour, arguing that individuals' ability to adjust his or her thinking in the face of environmental change as well as the ability to overcome obvious thinking and adapt to new situation is crucial for creative outcomes. Several studies confirm this conclusion (Collins and Koechlin, 2012, Barbey et al., 2013; Dietrich, 2004) in which the adaptability of thought and behavior facilitates a shift of thought leading to the generation of innovative and creative ideas. The main reasoning is that creative achievement does not depend solely on a single cognitive process (Arden et al., 2010) but is achieved by distributed neural network and multiple cognitive processes (Jung et al., 2013). Several fields of research underline this statement, for example, the recent research of Ritter and Mostert (2016) that investigated learning methods to develop creativity found that training in cognitive flexibility enhanced the amount of creative ideas generated by individuals. Another example is a neurologic research of Chen et al. (2014) who found that differences in creative achievement of individuals are associated with both brain structure and corresponding intrinsic functional connectivity, which are involved in cognitive flexibility and creative processing. Thus, research shows a clear relation between creativity and cognitive flexibility, which results in the generation of creative ideas and solutions.

The idea generation phase, which is researched in this thesis can be seen as the initial step of the front-end innovation, a divergent phase in which ideas are generated (Zhang & Doll, 2001). With ideation in a crowdsourcing context, success can be seen as the production of creative output for the specific ideation challenge (Howe, 2006). Perry-Smith and Mannucci (2017) define the idea generation phase as the process of generating a novel and useful idea. In line with the dual pathway model of creativity, the idea generation is seen as a creative process, where not the accumulation of new knowledge but cognitive processes influence outcome most. As example, Perry-Smith and Mannucci (2017) point out that more knowledge could elicit more rigid cognitive pathways, which negatively influences individuals cognitive flexibility (Amabile, 1996). Cognitive flexibility is seen as an essential need

regarding idea generation, which enables remote and uncommon associations between conceptually distant ideas (De Dreu, Baas & Nijstad, 2008). Cognitive flexibility offers individuals' the capacity to integrate content retrieved from his or her social environment to generate novel ideas transcending general practices (Perry-Smith & Mannucci, 2017). Summarizing, creativity is essential in the front-end of innovation with as goal the generation of novel ideas. Cognitive flexibility allows individuals' to shift between and integrate different types of knowledge and ideas. Due to the strong relationship between cognitive flexibility and creativity, it is expected that individuals' cognitive flexibility will have a positive effect on the quality of generated ideas in a crowdsourcing context.

*Hypothesis 1: Individuals' cognitive flexibility will have a positive influence on output quality in an internal crowdsourcing context.*

*How does individual's work motivation influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

As the motivational theories illustrate, different incentives and implications regarding individual's motivational orientation exist. It is shown that employees who are motivated have more ambition, innovative capacity, and creativity and are more persistent to achieve desired goals (Parashar, 2016). According to the self-determination theory of Ryan and Deci (2005) intrinsic motivation will have a positive effect on individual's work performance, cognitive flexibility and creativity. Individuals' intrinsic motivation is aimed at satisfying individuals' own right and provides direct satisfaction of psychological needs (Vansteenkiste, Lens & Deci, 2006) When individuals' are intrinsic motivated, they tend to put in more effort and are more dedicated regarding the task, since it's performed out of their own interest. Therefore, intrinsic motivation has a long-term impact on individuals' effort (Aletraris, 2010). Thus, being intrinsically motivated activates individuals as well as make them more committed to the goal. Amabile (2012) advocates intrinsic motivation as one of the key ingredients of creativity in the componential theory of creativity. The author argues that 'people are most creative when they feel motivated primarily by the interest, enjoyment, satisfaction, and challenge of the work itself' (Amabile, 2012, p.3). In the context of crowdsourcing, Kazai et al. (2013) found that crowd workers with intrinsic motivation tend to perform higher quality work in comparison with extrinsic motivated individuals. Also, Frey et al. (2011) found that both extrinsic and intrinsic motivation influences crowdsourcing activities, in which intrinsic motivation generates more substantial contributions. Despite the continuing debate on the effect of motivation on creativity, among scholars there has been a consensus among scholars that intrinsic motivation is beneficial for creative task performance (Sung & Choi, 2015). Furthermore, Buettner (2015) proposes that the effect of

individuals' motivational behaviour in crowdsourcing activities does not significantly differ from individuals' general motivational behaviour. Therefore, it is expected that intrinsic motivation will have a positive influence on idea quality in a crowdsourcing context.

*Hypothesis 2: Individuals' intrinsic motivation has a positive influence on output quality in an internal crowdsourcing context.*

Recall that the main goal of behaviours from employees who are extrinsically motivated is to receive organizational rewards or benefits from the achievement of an organizational goal or task (Lin, 2007). In contrast with intrinsic motivation, Self-determination theory (Ryan & Deci, 2000) argues that since extrinsic motivation is less self-determined, individuals' produce less creative solution and perform worse compared to intrinsic motivation. When individuals' experience barriers to their self-determination in the form of reduced autonomy, their intrinsic task interest reduces or even vanishes, which lowers individuals' creativity (Deci et al., 2001). Therefore, because of the controlling nature of extrinsic motivators, the individual might feel less freedom in his or her action and will produce less creative ideas or solutions. Contrasting, performance-related motivators could make individuals perceive higher value and personal achievement in the task, thus enhancing the feeling of self-determination resulting in a higher level of creativity (Malik et al., 2015). Despite the discussion of the relationship between extrinsic motivation and creativity, findings of Byran and Khazanchi (2012) indicate that extrinsic motivation may increase creativity. Extrinsic motivation induced by rewards for creativity functions as an incentive for action as well as providing information that stimulates cognitive and affective feeling in individuals and direct their focus toward creative solutions (Malik et al., 2015). By extrinsic motivation triggered by frequent rewards from the organization employees will acknowledge that creativity is needed and perceive support from the organization to come up with and champion creative ideas (Chen et al., 2012). Thus, literature offers both positive and negative views regarding the effect of extrinsic motivation on creativity. As stated, Frey et al. (2010) found that both extrinsic and intrinsic motivation positively influences crowdsourcing activities. Amabile (1983) argues that extrinsic motivation could induce creativity, but leads to less creativity compared with intrinsic motivation. Therefore, it is expected that individuals' extrinsic motivation does have a positive influence on idea quality, but not as strong as the influence of individuals intrinsic motivation on idea quality.

*Hypothesis 3: Individuals' extrinsic motivation has a positive influence on output quality, in an internal crowdsourcing context.*

*How does the interaction between individuals' work motivation and cognitive flexibility influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

As stated, Perry-Smith and Mannucci (2017) consider cognitive flexibility as crucial for the idea generation phase. In his research, Harris (2013) found a positive relation between cognitive flexibility and the creative performance of poem writers. Harris (2013) questions whether the underlying factor influencing creative performance is individuals' intrinsic motivation, instead of cognitive flexibility. Ryan and Deci (2005) argue with their self-determination theory that individuals' intrinsic motivation positively influences cognitive flexibility. Intrinsic motivation arises from the individuals' positive reaction to the task itself, such as interest, involvement, curiosity, or positive challenge (Amabile, 1996). Intrinsic motivation facilitates individuals' self-determination due to the higher levels of perceived autonomy. Literature suggests that autonomous functioning individuals are more productive and engaged regarding a task, resulting in a higher intrinsic motivation (Deci, 1971), creativity (Amabile, 1983), cognitive flexibility (Deci & Ryan, 1985) and performance (Baard, Deci & Ryan, 1998). In line with this argumentation, McGraw and McCullers (1979) found a positive relationship between intrinsic motivation and cognitive flexibility, suggesting that intrinsic motivated students who are intrinsically motivated are more capable of shifting between paradigms of thought. In addition, (Kehr, 2004) argued that intrinsically motivated employees are more likely to translate their motivation into higher levels of effort and are more engaged to regarding a task, resulting into higher levels of performance, particularly on tasks requiring creativity, cognitive flexibility and conceptual understanding. As stated, Lazarus (1991) argues that motivation underlies cognition, because motivation provides the incentive necessary for activation of a cognitive process (Carver & Scheier, 1998), implying that without motivation, individuals' would have no reason to act. Motivation provides individuals with the incentive to conduct a task, whereas intrinsic motivation is suggested to positive influence the performance on tasks requiring cognitive flexibility such as idea generation. Buettner (2015) proposed that the effect of individuals' motivational behaviour in crowdsourcing activities does not significantly differ from individuals' general motivational behaviour. Based on these findings, it is expected that individuals' intrinsic motivation will have a positive influence on cognitive flexibility in an internal crowdsourcing context.

*Hypothesis 4: Individuals' intrinsic motivation has a positive influence on cognitive flexibility in an internal crowdsourcing context.*

In contrast to intrinsic motivation, Ryan and Deci (2005) suggest that individuals' extrinsic motivation negatively influences cognitive flexibility. Intrinsic motivation facilitates individuals' self-determination due to the higher levels of perceived autonomy, whereas extrinsic motivation diminishes one's autonomy and therefore individuals' will feel less self-determination. The less perceived autonomy negatively influences individuals' performance, since autonomous functioning individuals are more productive and engaged regarding a task, resulting in a higher intrinsic motivation (Deci, 1971), creativity (Amabile, 1983), cognitive flexibility (Deci & Ryan, 1985) and performance (Baard, Deci & Ryan, 1998). In line with this argumentation, McGraw and McCullers (1979) found that extrinsic motivation facilitates lower levels of cognitive flexibility compared to intrinsic motivation. Students who were focused on receiving a reward for completing a task were less capable of shifting paradigms of thought while conducting the task. McGraw and Fiala (1982) emphasize that extrinsic motivation potentially leads to early cognitive disengagement; implying that the individual loses interest, which negatively influences one's cognitive flexibility. Grolnick and Ryan (1985) extended this conclusion by examining the negative results of extrinsic motivation on cognitive flexibility in a conceptual learning setting. Their findings suggest that individuals' are less capable of using and training their cognitive flexible processing skills when extrinsically motivated. Recall, Lazarus (1991) argues that motivation underlies cognition, because motivation provides the incentive necessary for activation of a cognitive process (Carver & Scheier, 1998). Thus in order to activate cognitive processes individuals' has to be activated by a form of motivation. Recall that Buettner (2015) proposed that the effect of individuals' motivational behaviour in crowdsourcing activities does not significantly differ from individuals' general motivational behaviour. Based on these findings, it is expected that individuals' extrinsic motivation will have a negative influence on cognitive flexibility in an internal crowdsourcing context.

*Hypothesis 5: Individuals' extrinsic motivation has a negative influence on cognitive flexibility in an internal crowdsourcing context.*

*How does the interaction between individuals' intrinsic and extrinsic motivation influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?*

Self-determination theory emphasizes that extrinsic motivators have a negative influence on intrinsic motivation (Ryan & Deci, 1985), thus, following the line of reasoning of Amabile

(1983), extrinsic motivators must negatively influence creativity. Motivation Crowding Theory underlines this reasoning, arguing that individuals could feel less motivated because of the changed relationship with the organization. Contrasting, General Interest Theory suggests that extrinsic motivators positively influence individuals' intrinsic motivation, arguing that a specific extrinsic motivator gives an individual the control and autonomy to refuse the task, making the individuals more self-determined, and therefore the individual would perceive more intrinsic motivation when accepting the task. Job Characteristic Theory emphasizes that intrinsic motivation is retrieved solely through task-specific features. Amabile (1997) argues that the interaction between intrinsic and extrinsic motivation may vary per context. Here, the initial level of intrinsic motivation, the type of extrinsic motivation and the timing of the extrinsic motivator could be aspects that influence creativity. As can be seen, there is a long lasting discussion in the literature regarding the effect of extrinsic motivation on intrinsic motivation, where proponents of extrinsic rewards emphasize the potential added value, and the opponents highlight the subtractive nature of extrinsic motivation (Deci & Ryan, 2008). Kohn (1999) conducted two experiments and found that extrinsic motivators reduce intrinsic motivation, because of the quality and lasting commitment in intrinsic motivation cannot be matched. Extrinsic motivated individuals believe the task is too difficult to conduct without extrinsic motivator, focus on the reward instead of the task and therefore devalue the task (Kohn, 1999). These factors reduce individuals' intrinsic motivation. Deci (1971) came to the same conclusion, arguing that *'if a person is engaged in some activity for reasons of intrinsic motivation, and if he begins to receive the external reward, money, for performing the activity, the degree to which he is intrinsically motivated to perform the activity decreases'* (Deci, 1971, p. 108). So research regarding the effect on the interaction between individuals intrinsic and extrinsic motivation in a crowdsourcing context has not been conducted. In line with the self-determination theory, it is expected that the presence of individuals' extrinsic motivational orientation will decrease the perceived importance of the individual regarding the task, as well as individuals' self-determined behaviour, and therefore decreases the effect of individuals' intrinsic motivation on output quality in crowdsourcing ideation activities.

*Hypothesis 6: Individuals' extrinsic motivation will negatively influence the effect of individuals' intrinsic motivation on output quality, in an internal crowdsourcing context.*

## **2.9: Conceptual Model**

Based on the literature review, the sub-questions and the developed hypotheses, the following conceptual model is created.

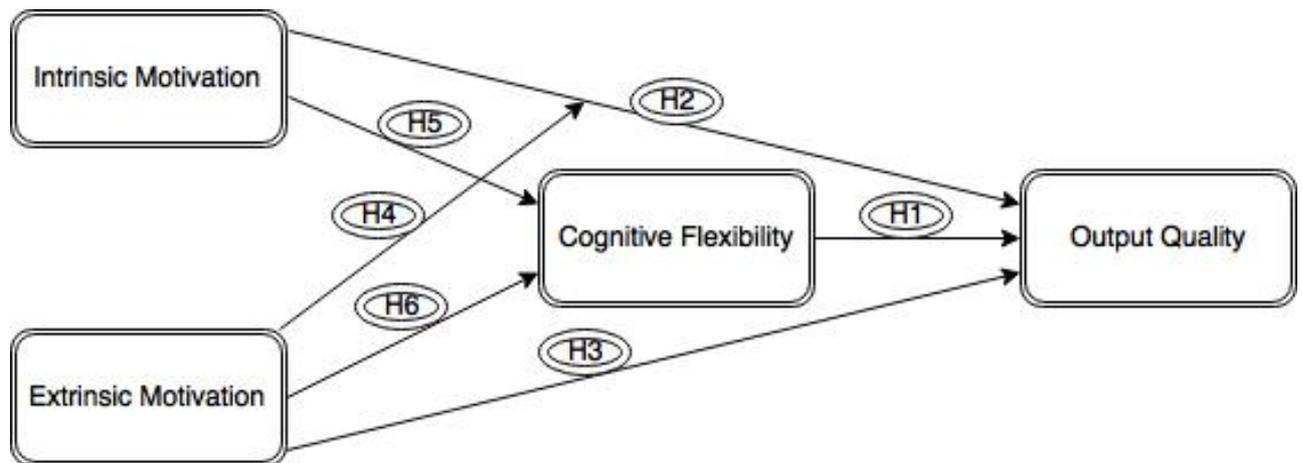


Figure 6: conceptual model

### 3. Methodology

To answer the research question and investigate the hypotheses, data is collected at Philips Open Innovation platform. A non-disclosure agreement was signed in order to gain access to the information of contributors, the contributions as well as the evaluation of the contributions. More information concerning Philips can be found in appendix A. The Open Innovation platform is an internal crowdsourcing platform concerned with idea generation. Moderators submit challenges on the platform, wherefore Philips employees are invited to contribute their ideas, or to evaluate other employees' contributions. A full description of the research context as well as the Open Innovation platform can be found in appendix A and B. This chapter will further examine the research strategy, how empirical data is collected, and which statistical method is used to test the hypotheses.

#### 3.1 Research strategy

This paragraph will further describe the data collection process. As stated, the goal of this research is to examine how individuals' work motivation and cognitive flexibility influences the quality of ideas generated in a crowdsourcing context. Quantitative research is often used to examine characteristics of individuals or groups en the relationships between these characteristics (Vennix, 2011). In contrast, qualitative research is used to describe a specific situation or phenomena in more detail to obtain specific information (Vennix, 2011).

Therefore, quantitative research suits best the goal of this research. The main instruments

used for data gathering in quantitative research are surveys. A survey is an empirical tool that aims to collect information about characteristics of units, with the purpose of describing characteristics and/or find relations between the characteristics (Vennix, 2011). Typically, questionnaires are used to gather this data. The research population consists of individuals or groups who possess the characteristics that are the basis of the variables, which are being examined (Vennix, 2011). For this research the research population will be the contributors of the Open Innovation platform. Thus, the population consists of individuals who participated in internal crowdsourcing activities and submitted on this platform in terms of an idea or solution. More information concerning the Open Innovation platform can be found in appendix B. The contributors of the Open Innovation platform are dispersed around the world. Therefore, a web-questionnaire is used, since it is a fast and inexpensive way to reach a large proportion of the research population. The questionnaire is sent by email through the crowdsourcing system to every individual who contributed to the platform. Furthermore, archival data is retrieved from the crowdsourcing system. This data includes contributions submitted, evaluations of these contributions, as well as demographic information.

## **3.2 Operationalization**

This paragraph will elaborate on the variables used to investigate the research questions. The independent variables are intrinsic motivation, extrinsic motivation and cognitive flexibility; the dependent variable is idea quality. Validated scales from previous research are used to measure the independent constructs. Intrinsic motivation and extrinsic motivation are measured based on the Work Preference Index (WPI) designed by Amabile et al. (1994). Cognitive flexibility will be measured using the Cognitive Flexibility Scale designed by Martin and Rubin (1995). Next paragraphs will further explain these scales, as well as operationalize the independent and dependent variables.

### **3.2.1 Independent variables**

As stated, the constructs of intrinsic and extrinsic motivation are measured using the Work Preference Inventory. The Work Preference Inventory is a questionnaire designed to measure the degree to which individuals perceive themselves to be extrinsically and intrinsically motivated toward a task or job. The questionnaire designed by Amabile et al. (1994) measures two forms of intrinsic motivation: pleasure and challenge, as well as two forms of extrinsic motivation: outward and the desire to receive compensation. Pleasure is present when activities are conducted for fun or enjoyment, including intrinsic task interest. Challenge involves desire to improve skills, to learn, intellectual interest or curiosity. Outward

involves motivation generated by the orientation toward recognition of others. Desire to receive compensation is based on monetary compensation. The questionnaire consists of 30 items, scored on a 6 point Likert scale.

The Cognitive Flexibility Scale (CFS) created by Martin and Rubin (1995) evaluates a person's awareness that different situations or options that take place or can occur. This awareness refers to individuals' cognitive capacity to be aware of different options, acting flexible towards the situations, to be able to control behavior and to provide an appropriate response to the situations. The scale consists of 12 items, scored on a 6 point Likert scale. An overview of the independent variables, their definitions and the items used to measure the constructs can be found in appendix D.

### **3.2.2 Dependent variable**

The dependent variable output quality is constructed based on archival data, retrieved from the Open Innovation Platform pilot. As Cooper (1990) emphasized success is interpreted differently because of the different perspectives on success. Therefore, scores and evaluation from individuals' who will be using the output is used for the construct of output quality, as suggested by Girotra et al. (2010). The information is based on evaluation of the user of the contribution. The evaluation consists on internal rating of several indicators of quality, in line with Cooper & Kleinschmidt (1995) whom suggested using multiple-criteria scales.

Three internal indicators of quality are used. Technical feasibility is concerned with the possibilities of the organization to meet the technical needs of the idea. Commercial opportunity is concerned with the potential commercial value of the idea. And lastly, potential for intellectual property represents a score to what extent the evaluator perceives the idea as unique in contrast to existing products or services. Every score is evaluated based on a 1 to 5 Likert scale, where 1 represents the highest score and 5 represents the lowest score.

### **3.3 Statistical method**

The statistical method relating to the research question, measures of variables and conceptual model are partial least squares structural equation modeling (PLS-SEM). Structural equation modeling (SEM) is a multivariate analysis technique which allows testing multiple hypothesized relationships between dependent and independent variables, or in

other words, the estimation of separate regression equations simultaneously (Hair et al., 2016). SEM allows incorporating latent variables and assesses the quality of measurement scales used for the construct of variables. Thus, it combines the aspects of regression and factors analysis. Hair et al. (2016) argues that 'SEM is particularly useful when one dependent variable becomes an independent variable in subsequent dependence relationships' (p. 617). For this research, cognitive flexibility is both an independent and dependent variable through the several hypotheses. The advantage of partial least squares (PLS) is that it can handle relative small sample sizes while still maintaining great statistical power (Hair et al., 2016), where the rule of thumb the sample size should be ten times larger than the largest predictor. Since this study has a sample size of 42, which is considered relatively low, using the partial least squares method helps maintaining statistical power. PLS-SEM consists of an outer and an inner model, also called the measurement and structural model. The measurement model illustrates the relationship between indicators and constructs, where the structural model illustrates the relationship between constructs (Hair et al., 2016). Furthermore, a distinction is made between reflective and formative constructs. Reflective constructs are based on theory and imply that the construct explains the indicators; in this research the reflective constructs are cognitive flexibility, intrinsic motivation and extrinsic motivation. Formative are, in contrast, based on the assumption that the indicators explain the construct. In other words, causality lies from the indicators to the construct. In this study, output quality is the only formative construct. The reliability and validation of formative and reflective constructs will be further discussed in chapter 4.2.

### **3.4 Research Ethics**

During the gathering and analysis of the data the research ethics have been treated with care. This implies that the gathered data has not been distributed with or among third parties, including the confidential data like e-mail addresses, names or personal information. This has been done in order to ensure respondents anonymity. Furthermore, the research has been open to the public in order to control for the results, also the contact information of the researcher has been enclosed to ensure respondents have the opportunity to respond to the results, ask for the information or implications of the researcher in case of displeasure, correspondent with the researcher to find adequate measures. Also the information provided by Philips Open Innovation platform has been treated with caution and has been following the agreements as stated in the non-disclosure agreement. These measures were taken in order to provide anonymity, transparency and discreetness according to the standards of the research ethics.

## 4. Analyses

### 4.1 Sample

The dataset of this research contains the result of 59 respondents. 17 respondents were deleted from the original dataset since these respondents did not contribute in terms of an idea. As a result, 42 measures were used for data analysis. 85.7% of the respondents were male and 14.3% were female. The age of most respondents is between 31 and 40 years old, namely 42.9%. Furthermore, 50% of the respondents finished a master degree, where 31% specified 'other' consisting mainly from PHD degrees. A total of 200 contributions were made to the platform, therefore 42 measures results in a response rate of 21%. The sample specifics are shown in table 1, the Spss output can be found in Appendix F.

<b>Gender</b>	<b>N</b>	<b>% of total</b>
Male	36	85.7
Female	6	14.3
<b>Age</b>		
21 – 30	2	4.8
31 – 40	18	42.9
41 – 50	13	31.0
51 – 60	7	16.7
61 or older	2	4.8
<b>Education Level</b>		
Secondary	1	2.4
Bachelor of applied science	4	9.5
University bachelor	2	7.1
Master degree	21	50.0
'Other'	13	31.0

Table 1: sample specifics

### 4.2 Reliability and Validity

As stated, partial least squares modeling is used as analysis technique to examine the hypothesized relationships. The analysis was performed using the software SmartsPLS. When creating the measurement model, SmartPLS distinguishes formative and reflective variables. For this study, all independent variables are reflective, since causality is directed from construct to measure. This implies that the construct explains the items. For example, ones intrinsic motivation explains his or her score on the items for intrinsic motivation. The

construct of output quality is formative, thus the items explain the construct. The quality of the output is constructed from the commercial potential, uniqueness and feasibility of a specific idea. For the evaluation of the criteria, different standards are set for reflective and formative variables. In table 2 the evaluation criteria for reflective variables are given. The settings for the PLS algorithm were configured as recommend by Hair et al. (2016), with all settings on default throughout the whole analysis (Weighting scheme: path; maximum iterations: 300; stop criterion ( $10^{-x/7}$ )).

	<b>Test</b>	<b>Rule of thumb</b>	<b>Reference</b>
Internal consistency reliability	Cronbach's alpha ( $\alpha$ )	Ideal: $\alpha > .85$ Sufficient: $\alpha > .60$	Field, 2013
Indicator reliability	Squared standardized outer loadings	Outer loadings $\geq .70$ Remove between .40 and .70 if it leads to increased $\alpha$ or AVE	Hair & Hult, 2016
Convergent validity	Average variance extracted (AVE)	AVE $\geq .50$	Hair & Hult, 2016
Discriminant validity	Fornell-Larcker criterion matrix	Each construct's AVE should be higher than its squared correlation with any other construct	Hair & Hult, 2016
	Cross-loadings matrix	Each indicator shall load highest on its associated construct	Hair & Hult, 2016
	Heterotrait-Monotrait ratios	HTMT $< 0.90$	Henseler, Ringle & Sarstedt, 2015

Table 2: Evaluation criteria

Convergent validity is achieved on measure and construct level, by respectively the indicator reliability in the form of outer loadings and the Average Variance Extracted (AVE).

Convergent validity refers to the extent to which a measure correlates positively with alternative measures of the same construct (Hair et al., 2016). The results of the first PLS algorithm calculation can be found in appendix G. As can be seen, the outer loadings of several constructs are below the threshold value of .40 (Hair et al., 2016). This indicates a lack of indicator reliability, since the shared variance between construct and indicator is lower than the variance of the measurement error. The AVE score of extrinsic motivation, intrinsic motivation and cognitive flexibility are lower than the threshold value of .5, respectively .378,

294 and 356. All three independent variables do not meet the convergent validity indicators. AVE can be improved by deleting items that score low on outer loadings (Hair et al., 2016). The evaluation criteria for indicator reliability and convergent validity indicate a need for model modification. The items with a outer loading beneath the threshold value ( $<.40$ ) were stepwise deleted. This resulted in deletion six items (CF8, EM\_OUT3, EM\_OUT5, IM\_EN5, IM\_EN9, IM\_EN10).

The results of this modification can be found in appendix H. After modification, indicator reliability was fulfilled, since all outer loadings have a value of at least 0.4. Convergent validity was not fulfilled since the AVE scores of the construct where below threshold value ( $<.50$ ). The option of deleting more items was ignored because of the negative effect on R2, as well as the theoretical foundation of the used scales. The used scales (Work preference index, Amabile, 1994; Cognitive flexibility scale, Martin and Rubin, 1995) are well-examined scales that give confidence that the measures correlate as well as provide a valid indication of the constructs. A potential explanation is the relative low sample size, since a bigger sample size accounts for higher shared variance between measure and construct, which positively influences AVE.

Cronbach's alpha indicates the internal consistency reliability for cognitive flexibility, intrinsic and extrinsic motivation. A minimum value of 0.7 is required for Cronbach's alpha to be considered acceptable. As table 3 shows this requirement is fulfilled for all constructs. After removing the items, Heterotrait-Monotrait ratios of correlations did not validate the critical value of .90, cross-loadings did not exceed the indicator's loadings on its associated construct and each construct's AVE in the Fornell-Larcker matrix was not higher than its squared correlation with any other construct. Thus, the evaluation criteria for discriminant validity are fulfilled. Despite violating the evaluation criteria of convergent validity, the measurement model was considered acceptable for evaluation of the structural model.

Construct	AVE	Cronbach's alpha
Intrinsic motivation	.355	.832
Extrinsic motivation	.412	.913
Cognitive flexibility	.367	.833

Table 3: Internal consistency and Convergent validity

As stated, the dependent variable output quality is constructed as a formative variable, which possesses different evaluation criteria when comparing to reflective variables. According to Hair et al. (2016) formative construct should have a VIF value lower than five. Also the outer

weights should be significant with the construct. Table 4 illustrates the output as generated in the analysis. The VIF values are all beneath five. As can be seen in appendix I, all items are significant on the construct. Thus the evaluation criteria for output quality are fulfilled.

Item	VIF
Cognitive flexibility	1.684
Intrinsic motivation	1.285
Extrinsic motivation	1.436

Table 4: VIF values

Figure 6 illustrates the structural model used for analysis, including the items, dependent and independent variables, as well as the moderating effect of extrinsic motivation on the relation between intrinsic motivation and output quality.

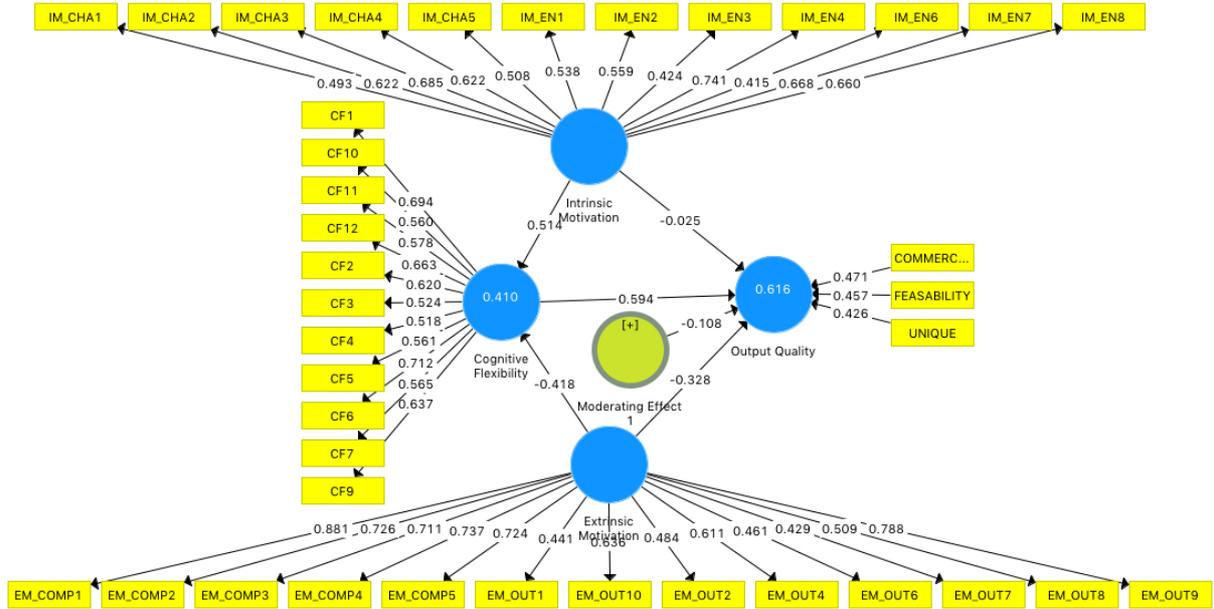


Figure 6: Structural model PLS

### 4.3 Descriptives

Table 5 summarizes the descriptive statistics of each construct, including the means, standard deviations and correlations. The correlation coefficient indicates that there is a strong correlation between cognitive flexibility and output quality (0.720). Intrinsic motivation also has a positive relation with output quality (0.288), in contrast to extrinsic motivation (-0.549). Furthermore, there is a positive relation between cognitive flexibility and intrinsic

motivation (0.488), where extrinsic motivation correlates negatively with cognitive flexibility (-0.386).

	CF	EM	IM	OQ
CF	1.000			
EM	-0.386	1.000		
IM	0.488	0.047	1.000	
OQ	0.720	-0.549	0.283	1.000
Mean	4.717	3.599	4.722	2.818
Std. dev.	.444	.609	.437	.557

Table 5: Descriptives and correlation matrix

#### 4.4 Partial least squares modeling

As stated in chapter 3.6, the convergent validity of the measurement model has insufficient AVE score. Thus, the weakness of the convergent validity should be kept in mind during the analysis, and will be further discussed in chapter 5. For evaluating the structural model R2 is used. R2 is a measure that indicates the level of prediction the independent variables have on the dependent variable (Hair et al., 2016). Figure 6 illustrates the inner model, where the R2 scores can be found in the construct points. As can be seen, cognitive flexibility has a R2 score of 0.410, and output quality has an R2 score of 0.605. This indicates that respectively 0.410 and 0.605 of the variance of these constructs is explained by the independent variables.

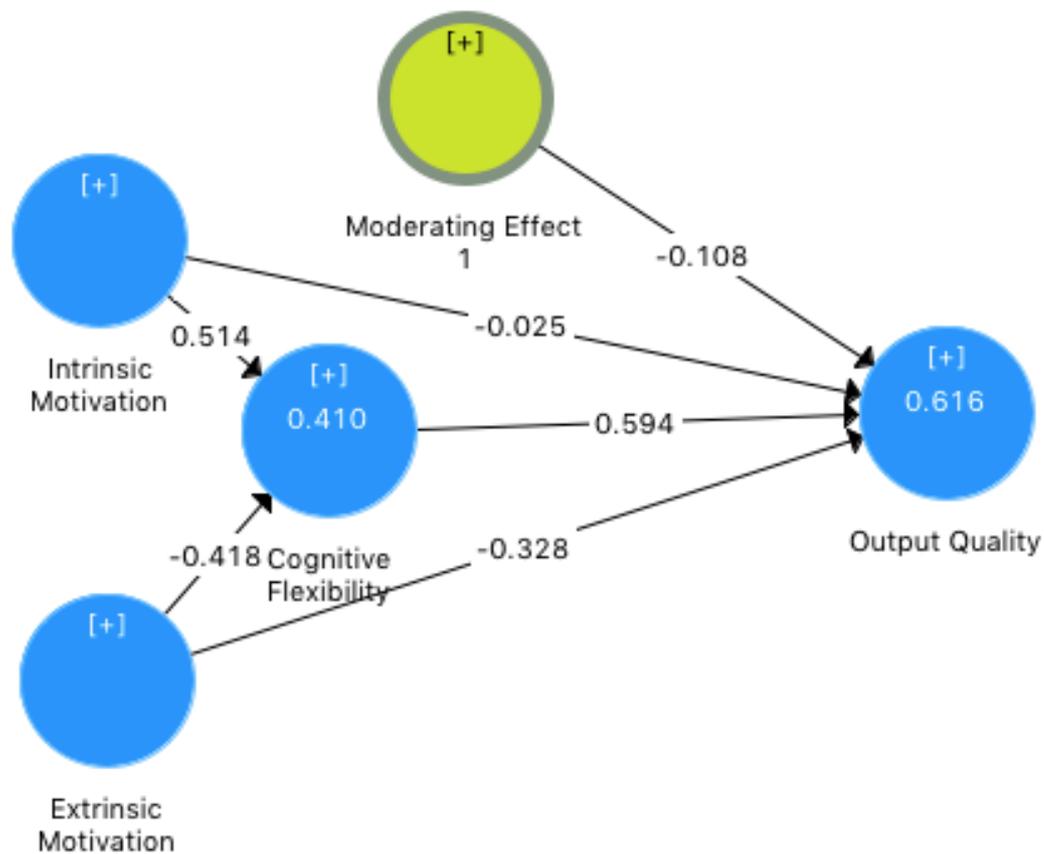


Figure 7: Inner model PLS

In order to determine significance of relationships, PLS uses bootstrapping. Bootstrapping is a method where the data is resampled. From the bootstrapping results, the t-value is used to determine significance (Hair et al., 2016). Appendix L provides the output as generated by SmartPLS. As can be seen, there is a significant positive relation between cognitive flexibility and output quality ( $\beta = 0.594$ ,  $p < 0.05$ ). Thus, hypothesis 1 is supported. Hypothesis two and three focused on the relationship between individuals' work motivation and output quality. Hypothesis 2 argued a positive relationship between intrinsic motivation and output quality. It was found that there was a minor positive relationship, but it was not significant ( $\beta = 0.003$ ,  $p > 0.05$ ), therefore hypothesis 2 is not supported. For hypothesis 3, evidence was found that there is a negative relation between extrinsic motivation and output quality ( $\beta = -0.328$ ,  $p < 0.05$ ), resulting in accepting the third hypothesis. Hypothesis four and five were aimed at explaining the relationship between individuals' work motivation and cognitive flexibility. In line with hypothesis 4, a positive relationship between intrinsic motivation and cognitive flexibility was found ( $\beta = 0.514$ ,  $p < 0.05$ ). Also hypothesis 5 was supported, since extrinsic motivation had a negative influence on cognitive flexibility ( $\beta = -0.418$ ,  $p < 0.05$ ).

The sixth and final hypothesis was concerned with the moderation effect of extrinsic motivation on the relation between intrinsic motivation and output quality. It was suggested that extrinsic motivation would negatively influence this relationship. Though the path coefficient shows a negative relation, there were no significant results ( $\beta = -1.08$ ,  $p > 0.05$ ), thus hypothesis 6 is not supported. Table 6 gives an overview of the hypotheses, its proposed relation, and the relating path coefficient, t-statistic and p-value.

Hypothesis	Relationship	Path coefficient	T-statistic	P-value	Supported
H1	CF → OQ	0.594	3.479	0.001	Supported
H2	IM → OQ	0.003	0.105	0.916	Not-supported
H3	EM → OQ	-0.328	2.164	0.031	Supported
H4	IM → CF	0.514	2.543	0.011	Supported
H5	EM → CF	-0.418	3.793	0.000	Supported
H6	EM IM → CF	-.108	0.878	0.381	Not-supported

Table 6: Test of hypothesis

#### 4.5 Control variables

In order to create a more robust analysis, control variables were added to the initial model. This new model controls for the influence of age, gender, education and maturity on the dependent variables. Age was measured on a 5 point scale, with the groups: 21 to 30 years old, 31 to 40 years old, 41 to 50 years old and 50 or older. Gender was measured in the groups male, female or not specified. There were no records of not specified, thus this group was not integrated in the analyses. Education was measured on Primary education, Secondary education, Bachelor of applied science or equivalent, University bachelor or equivalent, Master or equivalent or other. Lastly, tenure is the amount of years an individual is active in the organization, which was measured in the groups 0 to 3 years, 4 to 6 years, 7 to 10 years or 10 years and older. The output can be found in appendix M. The control variables did not influence the main relationships in terms of significance. Furthermore there were no significant effects of the variables age, gender and education. Maturity had a significant relation with output quality ( $\beta = 0.55$ ,  $p < 0.05$ ), indicating that the time an individual is active in an organization influences the quality of his or her output. The sample size did not allow for multi-group analyses in order to confirm whether individuals who are active in the organization for a short or a long period tend to produce higher quality output.

Variable	Relation	Path coefficient	T-statistic	P-value
Age	CF	-0.079	0.533	0.594
	OQ	-0.235	1.781	0.075
Gender	CF	0.136	1.099	0.272
	OQ	-0.052	0.509	0.611
Education	CF	0.087	0.553	0.581
	OQ	0.101	0.950	0.343
Tenure	CF	0.127	0.757	0.449
	OQ	0.550	3.792	0.000

Table 7: Test of control variables

## 5. Conclusion

### 5.1 Conclusion

The main goal of this research was to obtain insights in the effect of individuals' work motivation and cognitive flexibility in crowdsourcing ideation activities on the quality of the generated output. Accordingly, the aim of this research was to provide an answer to the following research question: *'How does individual's work motivation and cognitive flexibility influence the success of crowdsourcing in the front-end stage of innovation in terms of output quality?'* In order to obtain these insights a study was conducted to examine the intrinsic motivation, extrinsic motivation and cognitive flexibility of contributors on the Philips Open Innovation platform, and the relation with the quality of their output. Table 8 presents a summary of all hypotheses.

Firstly, significant evidence was found that individuals' cognitive flexibility has a positive influence on output quality in an internal crowdsourcing context. This implies that individuals who are capable of flexible cognitive processing perform better in ideation in a crowdsourcing setting. This is in line with the argumentation of De Dreu, Baas and Nijstad (2008) and Perry-Smith and Mannucci (2015) who argued that cognitive flexibility facilitates better creative performance in tasks such as idea generation. As stated, Individuals' cognitive flexibility is the ease with which people can switch to a different approach or consider a different perspective, using broad and inclusive cognitive categories and holistic processing of information (Baas, 2013). The capability of switching between perspectives, cognitive categories and holistic processing of information facilitate higher quality of output in the idea generation phase.

Secondly, the effect of individuals' work motivation on output quality was examined. The analysis did not show significant evidence for a positive relation between intrinsic motivation

and output quality. This implies that individuals' who are intrinsic motivated do not produce higher quality output in a crowdsourcing for ideation context. This outcome contradicts with several studies, for example Ryan and Deci (2000) who argued that intrinsic motivation positively influences individuals' self-determination and task performance, through the higher amount of effort and dedication towards the task. From the analysis it can be concluded that individuals who are contributing for pleasure, enjoyment, out of interest, to learn or to be challenged do not produce significant higher quality results. Contrasting, significant evidence was found for the negative effect of extrinsic motivation on output quality. Implying that individuals who are contributing in order to gain monetary rewards, promotion, and recognition of superiors or status tend to produce output of lower quality. This is in line with the argumentation of Ryan and Deci (2000) that individuals who are extrinsically motivated perform less because of the controlling nature of incentives. Therefore, individuals tend to put in less effort or dedication regarding the task, resulting in lower quality output.

Thirdly, the effect of individuals' work motivation on cognitive flexibility was examined. Significant evidence was found for the negative effect of extrinsic motivation on cognitive flexibility. This is in line with prior research of McGraw and Fiala (1982) and Grolnick and Ryan (1985), in which the negative impact of extrinsic motivation on cognitive flexibility was found. Individuals' who exert an extrinsic motivational orientation tend to be less engaged with the task, resulting in lower engagement with the task, which negatively influences individuals' capability of switching to a different approach or consider a different perspective, using broad and inclusive cognitive categories and holistic processing of information while conducting the task. Significant evidence was also found for the positive effect of intrinsic motivation on cognitive flexibility. Individuals' who are intrinsic motivated tend to perform better at flexible cognitive processing. The findings do not indicate a significant effect of intrinsic motivation on output quality, but did find a strong significant effect of intrinsic motivation on cognitive flexibility. Since cognitive flexibility has a significant positive effect on output quality, it can be said that the relationship between intrinsic motivation and output quality is mediated by cognitive flexibility. Thus, the results indicate that individuals who are intrinsically motivated perform better on cognitive flexible processing capabilities, which results in higher creative performance.

Lastly, the moderating effect of extrinsic motivation on the relationship between intrinsic motivation and output quality was examined. No significant influence was found for the moderating effect of extrinsic motivation. This implies that no evidence was found that individuals' extrinsic motivational orientation does negatively interfere in the relation between individuals' intrinsic motivation and output quality. Ryan and Deci (1985) argued that if a

person is engaged in some activity for reasons of intrinsic motivation, and if this individual is focussed on receiving extrinsic rewards for this activity, the intrinsic motivation and their advantages tend to decrease. Though the relationship founded in this study was negative, since there were no significant results hypotheses six has to be rejected. Thus, it can be concluded that individuals' extrinsic motivational orientation does not negatively influence the effect of individuals' intrinsic motivational motives on output quality.

<b>Hypotheses</b>		<b>Accepted / Rejected</b>
<b>H1</b>	Individuals' cognitive flexibility will have a positive influence on output quality in an internal crowdsourcing context.	Accepted
<b>H2</b>	Individuals' intrinsic motivation has a positive influence on output quality in an internal crowdsourcing context.	Rejected
<b>H3</b>	Individuals' extrinsic motivation has a positive influence on output quality, in an internal crowdsourcing context.	Accepted
<b>H4</b>	Individuals' intrinsic motivation has a positive influence on cognitive flexibility in an internal crowdsourcing context.	Accepted
<b>H5</b>	Individuals' extrinsic motivation has a negative influence on cognitive flexibility in an internal crowdsourcing context.	Accepted
<b>H6</b>	Individuals' extrinsic motivation will negatively influence the effect of individuals' intrinsic motivation on output quality, in an internal crowdsourcing context.	Rejected

Table 8: Hypothesis supported

## 5.2 Discussion

The primary focus of this research was to develop a better understanding of the effect of individuals' work motivation and cognitive flexibility on output quality in a crowdsourcing for ideation context. The findings support that cognitive flexibility positively influences output quality. Also there were significant results for the negative effect of extrinsic motivation on output quality. Furthermore it was found that individuals' intrinsic motivation positively influences cognitive flexibility, in contrast to individuals' extrinsic motivation which negatively influences cognitive flexibility. In this chapter these findings will be discussed based on the current available literature.

Amabile (1983) articulated in her componential model of creativity the traits of individuals that facilitate creative outcomes. Intrinsic motivation, domain relevant skills and cognitive processes, were seen as within-individual that influences creativity. The findings of this study indicate that cognitive processes, namely cognitive flexibility, indeed positively influences creativity, in terms of generating high quality ideas. This is in line with the findings of several authors (Colins and Koechlin, 2012; Barbey et al., 2013; Dietrich, 2004) who claim that creative achievement does not solely depend on a single cognitive process, but is achieved by individuals' ability to adjust his or her thinking and adapt to new situations. The dual pathway model of creativity articulated by De Dreu, Baas and Nijstad (2008), argued that cognitive flexibility leads to original ideas because it facilitates finding new connections among knowledge and ideas (Nijstad et al., 2010), is supported by the findings of this study. Also the suggestion of Perry-Smith and Mannucci (2015) that cognitive flexibility is a crucial need for the idea generation phase is supported. It can be concluded that individuals who show high levels of cognitive flexible processing produce higher quality output in a crowdsourcing for ideation setting.

In line with the self-determination theory of Ryan and Deci (2000), significant results were found for a negative effect of extrinsic motivation on output quality. This implies that individuals who have an extrinsic motivational orientation tend to perform worse on creative tasks such as idea generation. Several studies (Malik et al., 2015; Byran & Khazanchi, 2012; Chen et al., 2012) suggested that extrinsic motivators may activate individuals by providing an incentive for action, provide information that stimulates cognitive and affective feeling and direct their focus towards creative solutions, and therefore have a positive effect on creativity. Ryan and Deci (1985) argued that when individuals possess an extrinsic motivational orientation, they tend to perform worse because of the reduced autonomy in their action. The individual performs the task because of the potential reward, and therefore has less focus on the task itself. Furthermore, significant evidence was found for the negative effect of extrinsic

motivation on cognitive flexibility. This finding is in line with previous research (McGraw & McCullers, 1979; McGraw & Fiala, 1982; Grolnick & Ryan, 1985) suggesting that individuals who are focused on receiving a reward for completing a task were less capable of shifting paradigms of thought while conducting the task. Thus, providing an extrinsic motivator in a crowdsourcing context potentially attracts individuals who tend to produce lower quality output.

The hypothesis that Individuals' intrinsic motivation positively influences output quality in an internal crowdsourcing context for idea generation was not supported. Literature (Amabile, 1983; Deci and Ryan, 1985) viewed intrinsic motivation as a facilitator for creative outcomes. Recall that 'creativity is seen as the production of novel, appropriate ideas in any realm of human activity from various aspects of life or occupation' (Amabile, 1997, p.40). In his study, Harris (2013) found a positive effect between cognitive flexibility and creative performance, and questioned if the underlying factor could be intrinsic motivation. This study did not find a significant result of intrinsic motivation on output quality, but did find a strong effect of intrinsic motivation on cognitive flexibility. Since cognitive flexibility has a significant positive effect on output quality, it can be said that the relationship between intrinsic motivation and output quality is mediated by cognitive flexibility. Lazarus (1991) argued that motivation underlies cognition, because motivation provides the incentive necessary for activation of a cognitive process (Carver & Scheier, 1998). Thus intrinsic motivation provides an incentive for activation of flexible cognitive processes. Amabile (2012) argued that '*people are most creative when they feel motivated primarily by the interest, enjoyment, satisfaction, and challenge of the work itself*' (p.3). Ryan and Deci (2005) also articulated in their self-determination theory that intrinsic motivation has a positive effect on individuals' work performance, cognitive flexibility. When comparing both studies with the results of this study, individuals who are motivated by interest, enjoyment, satisfaction and challenge of the work itself achieve higher levels of cognitive flexibility, which results in more creative outcomes. This mediating effect of cognitive flexibility on the relationship between intrinsic motivation and output quality has not been articulated in the literature, therefore, could be an interesting direction for future research.

Literature contains contrasting perspectives regarding the effect of extrinsic motivation on intrinsic motivational characteristics. Ryan and Deci (1985) argued that extrinsic motivators have a detrimental effect on intrinsic motivation because of the controlling nature of extrinsic motivational orientation. Contrasting, Eisenberger, Pierce and Cameron (1999) suggested that extrinsic motivation could activate individuals, as well as provide individuals with the option to conduct the task, which results in a higher perceived

autonomy. No significant evidence was found that individuals' extrinsic motivation negatively influences the effect of individuals' intrinsic motivation on output quality. This implies that the negative effect of extrinsic motivation is not supported, contrasting the views of Ryan and Deci (1985).

### **5.3 Theoretical implications**

This research adds to the body of knowledge regarding the effect of intrinsic motivation, extrinsic motivation and cognitive flexibility on creative tasks such as idea generation in a crowdsourcing context. Firstly, this study confirms that cognitive flexibility has a positive effect on creative tasks as idea generation. Thereby adding additional evidence to the dual pathway model of creativity, articulated by De Dreu, Baas and Nijstad (2008), obtained in a crowdsourcing context. This finding also supports the need for cognitive flexibility in the idea generation phase, made by Perry-Smith and Mannucci (2015). Furthermore, it was found that intrinsic motivation does positively influence cognitive flexibility, in contrast with extrinsic motivation, which has a negative effect on cognitive flexibility. These findings add empirical evidence to the claims made by Ryan and Deci (1985) in their self-determination theory. However, no significant evidence was found that intrinsic motivation positively affects output quality in ideation activities conducted through a crowdsourcing platform. In this study was found that this relation was mediated by cognitive flexibility. This mediation effect is not investigated in the self-determination theory, and therefore adds new insights in the relation between intrinsic motivation and creativity. Amabile (1983) also championed intrinsic motivation as a key need for creativity, where this study indicates that the positive effect of intrinsic motivation is exerted through cognitive flexibility. Therefore, more insights in the mechanisms influencing creativity are offered through this study. Lastly, no significant evidence was found for the interaction effect between intrinsic motivation and extrinsic motivation. Therefore no further insights regarding the continuing discussion among several authors (Eisenberger, Pierce & Cameron, 1999; Ryan & Deci, 1985; Frey & Jegen, 2001) regarding the interaction effect of intrinsic and extrinsic motivation can be obtained through this study.

## **5.4 Managerial implications**

The results of this research provide a number of important implications for managers who conduct ideation through a crowdsourcing platform. First of all it is shown that individuals who possess high levels of cognitive flexibility generate higher level output in terms of ideas and solutions. Therefore managers should try to attract individuals who possess this cognitive capability. For example, when inviting individuals to contribute, managers could test their cognitive flexibility through gamification. Here, individuals who show high levels of cognitive flexibility could be invited to participate in crowdsourcing contests that require high creative solutions. Furthermore extrinsic motivational orientation has a negative influence on output quality in a crowdsourcing context. Thus providing incentives such as monetary rewards, status or public recognition will attract individuals who produce lower quality output. Managers should avoid offering these rewards, and instead present the crowdsourcing challenges in such a manner that individuals' intrinsic motivation is triggered. In contrast with studies that concluded that extrinsic rewards are the main reason for participation (Kaufmann, Schulze & Veit 2011), this study reveals that the contribution of participants who are extrinsic motivated are of lesser quality. By reviewing the needed output and adjusting the motivational incentive to this, managers can build a more effective and efficient crowdsourcing process, attracting the right individuals to contribute to a particular challenge.

## **5.5 Limitations and future research**

This section will discuss the limitations of this research, as well as address several interesting directions for further research. First of all, the evaluation criterion for convergent validity was not met. Convergent validity refers to the extent to which a measure correlates positively with alternative measures of the same construct (Hair et al., 2016). A potential explanation is the relative low sample size, since a bigger sample size accounts for higher shared variance between measure and construct, which positively influences the average variance extracted. Due to theoretical considerations, it was chosen not to delete more measures in order to obtain a higher average variance extracted. The used scales (Work preference index, Amabile, 1994; Cognitive flexibility scale, Martin and Rubin, 1995) are well-examined scales that give confidence that the measures correlate as well as provide a valid indication of the constructs. As indicated, the relative low sample size induced problems with the statistical verification of convergent validity. The low sample size is due to the small research population, which contained solely 200 potential respondents. Therefore, 42 measures provide a good reflection of the total population, but is relative little for statistical analysis. The sample size contained mainly male respondents between the age of 31 and

50, which could affect the results. Future researchers are advised to take a larger sample size into consideration in order to further validate the results of this study.

Another limitation is the specific crowd used in this research, namely the internal crowd of Philips employees. Although the employees varied from educational background and division, all are active in a highly creative environment, implying that these individuals are more in touch with creativity work on a daily basis. Therefore, the external validity and the generalizability of the findings might be questioned. Also the output quality data was based on subjective evaluation criteria, rated by individuals whom uploaded the crowdsourcing contest. Thus professionals who tend to use the contributions in order to create or improve current products and services evaluated the output. This leads to a potential bias in the evaluation. In order to validate the results and generate more generalizable results, it is advised to conduct this study in different crowdsourcing platforms, in different industries or in different organizations, based on a set of uniform indicators for evaluation to ensure a proper comparison between platforms can be made.

Another limitation is the high order of constructs used in this thesis. An interesting direction for future research might be to incorporate different incentives for motivation into the study. Recall that extrinsic motivation is activated by external incentives, such as direct or indirect monetary compensation, or recognition by others (Ryan & Deci, 1985). Intrinsic motivation refers to doing something on the merit of pleasure or fulfillment that is initiated without obvious external incentives (Ryan & Deci, 1985). This study indicates the effect of extrinsic and intrinsic motivation on both cognitive flexibility and output quality, but because of the measurement no insights about the underlying incentives for intrinsic or extrinsic motivation can be articulated. Future research could incorporate different extrinsic incentives, as well as intrinsic motivations in the analysis. Incorporating different incentives offers the possibility to generate deeper knowledge regarding the relationship between motivation and output quality in a crowdsourcing ideation setting, and might also provide managers with more insights on how to design their crowdsourcing for ideation challenges.

Also, the specific scope of this research makes it difficult to generalize to results to different contexts. It could be interesting to examine the effect of different motivational orientation in the next stages of front-end innovation. Recall that several authors articulated front-end frameworks (Khurana & Rosenthal, 1988; Cooper, 1983; Perry-Smith & Mannucci, 2015; Kijkuit & Van den Ende 2007), with Cooper (1990) arguing that although the names of the stages differ, the frameworks contain several similarities. Potentially different motivational orientation yield higher results in terms of productivity or quality in the front-end innovation

per stage. Therefore, investigating the effect of motivational orientation of individuals per stage and the relation on their output quality, productivity, or innovativeness of output could potentially provide more insights in the mechanism of motivational orientation in the front-end innovation. Also expanding this research's perspective from individuals to teams could potentially add insights. West (1997) argued that team and individual creativity differs on various traits. Therefore, this research is not generalizable to idea generation conducted by teams.

Another interesting direction for future research might be to incorporate different cognitive processes into the analysis. For example, De Dreu, Baas and Nijstad (2008) articulate cognitive persistence in their dual pathway of creativity theory. Cognitive persistence refers to the extent to which an individual invests cognitive resources and systematically focuses attention and effort on the task at hand (Nijstad et al., 2010). Hereby, generating novel ideas is achieved through prolonged effort and systematic exploration of the problem, as well as incremental search processes (Baas, 2013). Thus, potentially cognitive persistence increases creative achievement. By incorporating cognitive persistence as a variable, a broader view on the relationship between cognitive processes and output quality in a crowdsourcing for ideation context.

Lastly, this study did not find a significant result of intrinsic motivation on output quality, but did find a strong effect of intrinsic motivation on cognitive flexibility. Since cognitive flexibility has a significant positive effect on output quality, it can be concluded that the relationship between intrinsic motivation and output quality is mediated by cognitive flexibility. This in line with Harris (2013) suggestion that the underlying factor which activates cognitive flexibility might be intrinsic motivation. Nevertheless, classic theories of Amabile (1983) or Ryan and Deci (1985) never reviewed the mediating effect of cognitive flexibility in the relationship of intrinsic motivation and output quality. When comparing both studies with the results of this study, individuals who are motivated by interest, enjoyment, satisfaction and challenge of the work itself achieve higher levels of cognitive flexibility, which results in more creative outcomes. This mediating effect of cognitive flexibility on the relationship between intrinsic motivation and output quality has not been articulated in the literature, therefore, could be an interesting direction for future research. To gain further insights as well as potentially specify their frameworks, more empirical research regarding this mediating effect should be conducted.

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## **7. Appendices**

### **Appendix A - Organizational Context**

Philips is a Dutch multinational, founded in 1891 in Eindhoven, and currently the global headquarters are located in Amsterdam. The organizations' initial growth was derived from the sales of light bulbs. Innovation has always been a key concern for Philips, which quickly diversified its products and entered different sectors in order to improve its viability.

Nowadays, the organization can be divided in two sectors: Philips Consumer Lifestyle and Philips Healthcare. Philips Lighting recently became a separate entity. Philips Corporate Technologies can be seen as a supportive unit, facilitating the needs of the other business units. Worldwide Philips has more than 180.000 employees; total revenue over the year 2016 was 24.5 billion, with a EBIT of 1.9 billion, and a 1.5 billion profit (Philips, 2016)

### **Appendix B – Philips Open Innovation Platform**

Philips Open Innovation Platform is an internal crowdsourcing initiative. It is designed to facilitate ideation among the internal crowd of Philips employees, based on front-end innovation challenges. The Open Innovation Platform is available for Philips employees, inviting them to make a contribution to the various challenges. The process can be divided into three stages, the challenge, ideation and the evaluation. A challenge consists of several stages, developed in a funnel pattern with a divergent initial stage, processing to a convergent stage in which initial contributions are filtered. In the first stage, participants are asked to think of solutions or ideas for specific challenges. The participants can submit their ideas on the platform, where other contributors can view the ideas, provide feedback, and evaluate the ideas on several performance indicators. Based on the evaluations certain ideas are progressed to the next stage in the funnel. Here, ideas are further developed, combined or specified by the contribution owner. After another round of evaluations is conducted one idea is appointed as the best idea for that specific challenge. The evaluations are conducted by a panel whom will be working with to ideas or solutions, and structured among structured evaluation criteria. Noteworthy is that no idea is deleted, and will always be saved on the platform for further inspiration, in line with Coopers (1990) views on ideation. The respondents are referred to as the crowd; employees of Philips dispersed all over the world whom voluntarily participate in crowdsourcing challenges in order to generate innovative ideas or solutions. Also external partners who were concerned with aspects of the specific

challenge were invited to contribute on the platform. End-users or customers were not, since the focus was on the idea generation and not implementation of products or services.

**Appendix C – Questionnaire Invitation**

Dear Sir/Madam,

First of all, thank you for your participation and contribution in the Open Innovation Platform. As a platform we are always looking for ways to further improve our crowdsourcing ideation activities. Therefore, we request your participation in a short survey, requiring approximately 5 to 10 minutes to finish. The results will be processed in an academic master thesis for the Radboud University in Nijmegen. All answers will be confidential, and used only for research purposes.

The goal of this survey is to find ways to motivate employees to participate and contribute to the platform, in order to obtain more ideas and foster creativity as well as innovation throughout the organization. With your contribution we hope to further develop the incentive system, as well as generate a broader view of cognitive aspects influencing ideation quality in a crowdsourcing context. Furthermore, general feedback is requested to integrate your views in our future initiatives.

We are looking forward to learn from your experiences,

Open Innovation platform

**Appendix D – Independent Variable Definition and Measures**

<p>Intrinsic Motivation (Amabile et al., 1994)</p> <p>‘Intrinsic motivation refers to doing something on the merit of pleasure or fulfillment that is initiated</p>	<p>Pleasure</p> <p>‘Activities which are conducted for fun or enjoyment, including intrinsic task interest</p>	<ul style="list-style-type: none"> <li>• I want my work to provide me with opportunities for increasing my knowledge and skills</li> <li>• Curiosity is the driving force behind much of what I do</li> <li>• I want to find out how good I really can be at my work</li> </ul>
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<p>without obvious external incentives'</p>		<ul style="list-style-type: none"> <li>• I prefer to figure out thing for myself</li> <li>• What matters most to me is enjoying what I do</li> <li>• It is important for me to have an outlet for self-expression</li> <li>• No matter what the outcome of a project is, I am satisfied If I feel I gained a new experience</li> <li>• I'm more comfortable when I can set my own goals</li> <li>• I enjoy doing work that is so absorbing that I forget about everything else</li> <li>• It is important to me to be able to do what I most enjoy</li> </ul>
	<p>Challenge</p> <p>'Individuals' desire to improve skills, to learn, intellectual interest or curiosity'</p>	<ul style="list-style-type: none"> <li>• I enjoy tackling problems that are completely new to me</li> <li>• I enjoy trying to solve complex problems</li> <li>• The more difficult the problem is, the more I enjoy trying to solve it</li> <li>• I prefer work I know I can do well over work that stretches my abilities (reverse coded)</li> <li>• I enjoy relative simple, straightforward tasks (reverse coded)</li> </ul>
<p>Extrinsic motivation (Amabile et al., (1994)</p> <p>'Extrinsic motivation is activated by external incentives, such as direct or indirect monetary compensation, or recognition by others'</p>	<p>Outward</p> <p>'Individuals' motivation generated by the orientation toward recognition of others'</p>	<ul style="list-style-type: none"> <li>• I am strongly motivated by recognition I can earn from other people</li> <li>• I want other people to find out how good I really can be at my work</li> <li>• To me, success means doing better than other people</li> <li>• I have to feel that I'm earning something for what I do</li> <li>• I believe there is no point in doing a good job if nobody else knows about it</li> <li>• I'm concerned about how other people are going to react to my ideas</li> </ul>

		<ul style="list-style-type: none"> <li>• I prefer working on projects with clearly specified procedures</li> <li>• I'm less concerned with what work I do than what I get for it</li> <li>• I am not that concerned about what other people think of my work (reverse coded)</li> <li>• I prefer to have someone setting clear goals for me in my work</li> </ul>
	<p>Compensation</p> <p>'Individuals' desire to receive monetary compensation'</p>	<ul style="list-style-type: none"> <li>• I am strongly motivated by the money I can earn</li> <li>• I am keenly aware of the career' goals I have for myself</li> <li>• I seldom think about salary and advancement (reverse coded)</li> <li>• I am keenly aware of the income goals I have for myself</li> <li>• As long as I can do what I enjoy, I'm not that concerned about what I exactly get paid (reverse coded)</li> </ul>
<p>Cognitive Flexibility (Martin &amp; Rubin, 1995)</p> <p>'Individuals' cognitive capacity to be aware of different options, acting flexible towards the situations, to be able to control behavior and to provide an appropriate response to the situations'</p>		<ul style="list-style-type: none"> <li>• I can communicate an idea in many different ways</li> <li>• I avoid new and unusual situations (reverse coded)</li> <li>• I feel that I never get to make decisions (reverse coded)</li> <li>• I can find workable solutions to seemingly unsolvable problems</li> <li>• I seldom have choices when deciding how to behave (reverse coded)</li> <li>• I am willing to work at creative solutions to problems</li> <li>• In any given situation, I am able to act appropriately</li> <li>• My behavior is a result of the conscious decisions that I make</li> <li>• I have many possible ways of behaving</li> </ul>

		<p>in any given situation</p> <ul style="list-style-type: none"> <li>• I have difficulty using my knowledge on a given topic in real life situations (reverse coded)</li> <li>• I am willing to listen and consider alternatives for handling a problem</li> <li>• I have the self-confidence that is necessary to try different ways of behaving</li> </ul>
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## Appendix E – Questionnaire

### *Introduction*

Dear Sir/Madam,

Thank you for your participation in this research! The goal of this survey is to find ways to motivate employees to participate and contribute to the platform, in order to obtain more ideas and foster creativity as well as innovation throughout the organization. The survey will require approximately 5 to 8 minutes to finish.

With your contribution we hope to further develop the incentive system, as well as generate a broader view of cognitive aspects influencing ideation quality in a crowdsourcing context. Also, The results will be processed in an academic master thesis. Noteworthy, all information submitted will be treated confidentially and is used solely for research and improvement purposes.

### *Demographics*

The first section is used to obtain general demographic and socio-economic insights regarding who participated in the Open Innovation platform. All information will be treated confidential.

1. Did you contribute in the form of an idea or feedback in the Open Innovation platform?

- I contributed in terms of submitting an idea
- I contributed in terms of providing feedback on ideas
- I did not submit on the Open Innovation platform

2. What challenge did you participate in?

- Augmented Reality
- 3D Printing + Manufacturing
- Real-time Physiological Monitoring
- Image Guided Therapy

3. Which division did you work for at the time of your contribution to the Open Innovation platform?

4. What was your function at the time of your contribution to the Open Innovation platform?

5. What is your name?

7. What is the name of your contribution?

8. Which round did your contribution achieve?

- Did not progress to the next round
- Clustered into new idea
- Final round
- Winner

9. What is your gender?

- Male
- Female
- Not specified

10. What is your age?

- Younger than 21 years
- Between 21 and 30 years old
- Between 31 and 40 years old
- Between 41 and 50 years old

- Between 51 and 60 years old
- Older than 60 years

11. What is your educational background?

12. What level of education did you complete?

- Primary education
- Secondary education
- Bachelor of applied science or equivalent
- University bachelor or equivalent
- Master or equivalent
- Other .. (open question)

13. How long have you been working for Philips?

- 0 – 3 years
- 4 – 6 years
- 7 – 10 years
- Longer than 10 years

Section two is concerned with your motivation to participate in the ideation activities of the Open Innovation platform. Here, you have the option in a continuum from 1 to 6 to match your personal view regarding the specific statements. The statements are reflective, and propose several indicators for motivation.

*Option 1 implies the statement does in no manner apply to your personal motivation.*

*Option 2 implies the statement does not match your personal motivation, but you are less adverse from the statement than option 6.*

*Option 3 implies the statement does not correlate entirely with your personal motivation, but there are striking elements.*

*Option 4 implies the statement does correlate with your personal motivation, but there are missing elements.*

*Option 5 implies the statement does match your personal motivation, though less than option 6.*

*Option 6 implies the statement does absolutely match your personal motivation.*

### *Intrinsic Motivation – enjoyment*

- I want my work to provide me with opportunities for increasing my knowledge and skills
- Curiosity is the driving force behind much of what I do
- I want to find out how good I really can be at my work
- I prefer to figure out things for myself
- What matters most to me is enjoying what I do
- It is important for me to have an outlet for self-expression
- No matter what the outcome of a project is, I am satisfied if I feel I gained a new experience
- I'm more comfortable when I can set my own goals
- I enjoy doing work that is so absorbing that I forget about everything else
- It is important to me to be able to do what I most enjoy

### *Extrinsic Motivation – Outward*

- I am strongly motivated by recognition I can earn from other people
- I want other people to find out how good I really can be at my work
- To me, success means doing better than other people
- I have to feel that I'm earning something for what I do
- I believe there is no point in doing a good job if nobody else knows about it
- I'm concerned about how other people are going to react to my ideas
- I prefer working on project with clearly specified procedures
- I'm less concerned with what work I do than what I get for it
- I am not that concerned about what other people think of my work (reverse coded)
- I prefer to have someone set clear goals for me in my work

### *Extrinsic motivation – Compensation*

- I am strongly motivated by the money I can earn
- I am keenly aware of the career' goals I have for myself
- I Seldom think about salary and advancement (reverse coded)
- I am keenly aware of the income goals I have for myself
- As long as I can do what I enjoy, I'm not that concerned about exactly what I'm paid (reverse coded)

### *Intrinsic motivation – challenge*

- I enjoy tackling problems that are completely new to me
- I enjoy trying to solve complex problems
- The more difficult the problem is, the more I enjoy trying to solve it
- I prefer work I know I can do well over work that stretches my abilities (reverse coded)
- I enjoy relative simple, straightforward tasks (reverse coded)

### *Cognitive flexibility*

Section three is concerned with your cognitive processes. The following statements deal with your beliefs and feelings about your own behaviour. Read each statement and respond by selecting how much you agree or disagree with each statement. . Here, you also have the option in a continuum from 1 to 6 to match your personal view regarding the specific statements

*Option 1 implies that you absolutely disagree with the statement.*

*Option 2 implies that you disagree with the statement.*

*Option 3 implies that you somewhat disagree with the statement.*

*Option 4 implies that you somewhat agree with the statement.*

*Option 5 implies that you agree with the statement.*

*Option 6 implies that you absolutely agree with the statement.*

- I can communicate an idea in many different ways
- I avoid new and unusual situations (reverse coded)
- I feel like I never get to make decisions (reverse coded)
- I can find workable solutions to seemingly unsolvable problems
- I seldom have choices when deciding how to behave (reverse coded)
- I am willing to work at creative solutions to problems
- In any given situation, I am able to act appropriately
- My behavior is a result of conscious decisions that I make
- I have many possible ways of behaving in any given situation
- I have difficulty using my knowledge on a given topic in real life situations (reverse coded)

- I am willing to listen and consider alternatives for handling a problem
- I have the self-confidence necessary to try different ways of behaving

Section four has as goal to foster your experiences and opinion regarding to the Open Innovation Platform pilot. Crowdsourcing is combining knowledge of the several individuals through a platform in order to generate ideas or solutions for certain challenges, such as you experienced with the Open Innovation Platform.

How would you rate your experience with the Open Innovation Platform?

Score from 1 to 10

Do you think this kind of platform is suitable to foster innovation for an organization such as Philips?

Score from 1 to 10

Do you have any comments or constructive feedback regarding the Open Innovation Platform to further enhance future initiatives?

What is your email?

Thanks for your participation! Your contribution and feedback in improving our activities and for academic research is very appreciated.

## Appendix F – Sample Size

**What is your age?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 21 / 30	2	4,8	4,8	4,8

31 / 40	18	42,9	42,9	47,6
41 / 50	13	31,0	31,0	78,6
51 / 60	7	16,7	16,7	95,2
60 or older	2	4,8	4,8	100,0
Total	42	100,0	100,0	

**What level of education did you complete?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Secondary	1	2,4	2,4	2,4
Bachelor of applied science	4	9,5	9,5	11,9
Univeristy bachelor	3	7,1	7,1	19,0
Master	21	50,0	50,0	69,0
other	13	31,0	31,0	100,0
Total	42	100,0	100,0	

**What is your gender?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Male	36	85,7	85,7	85,7
Female	6	14,3	14,3	100,0
Total	42	100,0	100,0	

**Appendix G – Evaluation criteria reflective variables**

	<b>Cognitive Flexibility</b>	<b>Extrinsic Motivation</b>	<b>Intrinsic Motivation</b>	<b>Output Quality</b>
CF1	<b>0,699</b>			
CF10	<b>0,549</b>			
CF11	<b>0,577</b>			
CF12	<b>0,678</b>			
CF2	<b>0,615</b>			
CF3	<b>0,516</b>			
CF4	<b>0,509</b>			
CF5	<b>0,563</b>			
CF6	<b>0,706</b>			
CF7	<b>0,584</b>			
CF8	<b>0,472</b>			
CF9	<b>0,640</b>			
COMMERC_OPP				<b>0,796</b>
EM_COMP1		<b>0,866</b>		
EM_COMP2		<b>0,723</b>		
EM_COMP3		<b>0,709</b>		
EM_COMP4		<b>0,713</b>		
EM_COMP5		<b>0,696</b>		
EM_OUT1		<b>0,464</b>		
EM_OUT10		<b>0,622</b>		
EM_OUT2		<b>0,506</b>		
EM_OUT3		<b>0,407</b>		
EM_OUT4		<b>0,630</b>		
EM_OUT5		<b>0,423</b>		
EM_OUT6		<b>0,500</b>		
EM_OUT7		<b>0,423</b>		
EM_OUT8		<b>0,493</b>		
EM_OUT9		<b>0,789</b>		
FEASABILITY				<b>0,666</b>
IM_CHA1			<b>0,501</b>	

IM_CHA2			<b>0,607</b>	
IM_CHA3			<b>0,681</b>	
IM_CHA4			<b>0,607</b>	
IM_CHA5			<b>0,489</b>	
IM_EN1			<b>0,545</b>	
IM_EN10			<b>0,350</b>	
IM_EN2			<b>0,565</b>	
IM_EN3			<b>0,429</b>	
IM_EN4			<b>0,729</b>	
IM_EN5			<b>0,329</b>	
IM_EN6			<b>0,425</b>	
IM_EN7			<b>0,675</b>	
IM_EN8			<b>0,656</b>	
IM_EN9			<b>0,311</b>	
UNIQUE				<b>0,753</b>

Table 1: outer loadings

	Cognitive Flexibility	Extrinsic Motivation	Intrinsic Motivation	Output Quality
Cognitive Flexibility	0,597			
Extrinsic Motivation	-0,402	0,614		
Intrinsic Motivation	0,487	0,063	0,543	
Output Quality	0,707	-0,560	0,288	

Table 2: Fornell-Larcker criterion

	Cognitive Flexibility	Extrinsic Motivation	Intrinsic Motivation
Cognitive Flexibility			
Extrinsic Motivation	<b>0,536</b>		
Intrinsic Motivation	<b>0,519</b>	<b>0,443</b>	

Table 3: HTMT ratio

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Cognitive Flexibility	<b>0,837</b>	<b>0,841</b>	<b>0,867</b>	<b>0,356</b>

<b>Extrinsic Motivation</b>	<b>0,888</b>	<b>0,902</b>	<b>0,896</b>	<b>0,378</b>
<b>Intrinsic Motivation</b>	<b>0,852</b>	<b>0,833</b>	<b>0,855</b>	<b>0,294</b>
<b>Output Quality</b>		<b>1,000</b>		

Table 4: Construct reliability and validity

#### Appendix H – Modified evaluation criteria reflective variables

	<b>Cognitive Flexibility</b>	<b>Extrinsic Motivation</b>	<b>Intrinsic Motivation</b>	<b>Output Quality</b>
<b>CF1</b>	<b>0,693</b>			
<b>CF10</b>	<b>0,561</b>			
<b>CF11</b>	<b>0,578</b>			
<b>CF12</b>	<b>0,662</b>			
<b>CF2</b>	<b>0,621</b>			
<b>CF3</b>	<b>0,524</b>			
<b>CF4</b>	<b>0,516</b>			
<b>CF5</b>	<b>0,562</b>			
<b>CF6</b>	<b>0,713</b>			
<b>CF7</b>	<b>0,562</b>			
<b>CF9</b>	<b>0,635</b>			
<b>COMMERC_OPP</b>				<b>0,800</b>
<b>EM_COMP1</b>		<b>0,880</b>		
<b>EM_COMP2</b>		<b>0,726</b>		
<b>EM_COMP3</b>		<b>0,711</b>		
<b>EM_COMP4</b>		<b>0,737</b>		
<b>EM_COMP5</b>		<b>0,724</b>		
<b>EM_OUT1</b>		<b>0,441</b>		
<b>EM_OUT10</b>		<b>0,637</b>		
<b>EM_OUT2</b>		<b>0,484</b>		
<b>EM_OUT4</b>		<b>0,611</b>		
<b>EM_OUT6</b>		<b>0,462</b>		
<b>EM_OUT7</b>		<b>0,429</b>		
<b>EM_OUT8</b>		<b>0,509</b>		
<b>EM_OUT9</b>		<b>0,788</b>		
<b>FEASABILITY</b>				<b>0,663</b>

IM_CHA1			<b>0,480</b>	
IM_CHA2			<b>0,602</b>	
IM_CHA3			<b>0,711</b>	
IM_CHA4			<b>0,640</b>	
IM_CHA5			<b>0,521</b>	
IM_EN1			<b>0,524</b>	
IM_EN2			<b>0,549</b>	
IM_EN3			<b>0,399</b>	
IM_EN4			<b>0,734</b>	
IM_EN7			<b>0,656</b>	
IM_EN8			<b>0,651</b>	
UNIQUE				<b>0,751</b>

Table 1: outerloadings

	Cognitive Flexibility	Extrinsic Motivation	Intrinsic Motivation	Output Quality
Cognitive Flexibility	0,606			
Extrinsic Motivation	-0,386	0,642		
Intrinsic Motivation	0,488	0,047	0,596	
Output Quality	0,720	-0,549	0,283	

Table 2: Fornell-Larcker criterion

	Cognitive Flexibility	Extrinsic Motivation	Intrinsic Motivation
Cognitive Flexibility			
Extrinsic Motivation	<b>0,526</b>		
Intrinsic Motivation	<b>0,545</b>	<b>0,377</b>	

Table 3: HTMT ratio

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Cognitive Flexibility	<b>0,828</b>	<b>0,832</b>	<b>0,863</b>	<b>0,367</b>
Extrinsic Motivation	<b>0,888</b>	<b>0,913</b>	<b>0,897</b>	<b>0,412</b>
Intrinsic Motivation	<b>0,835</b>	<b>0,833</b>	<b>0,855</b>	<b>0,355</b>
Output Quality		<b>1,000</b>		

Table 4: Construct reliability and validity

**Appendix I – Evaluation criteria formative variable**

<b>COMMERC_ OPP -&gt; Output Quality</b>	0,471	0,482	0,011	0,080	0,910
<b>FEASABILITY -&gt; Output Quality</b>	0,457	0,415	-0,042	0,063	0,835
<b>UNIQUE -&gt; Output Quality</b>	0,426	0,405	-0,020	0,025	0,790

Table 1: outer weights

	<b>Cognitiv e Flexibilit y</b>	<b>Extrinsic Motivatio n</b>	<b>Intrinsic Motivatio n</b>	<b>Output Qualit y</b>
<b>Cognitive Flexibility</b>				<b>1,684</b>
<b>Extrinsic Motivation</b>	<b>1,002</b>			<b>1,285</b>
<b>Intrinsic Motivation</b>	<b>1,002</b>			<b>1,436</b>
<b>Output Quality</b>				

Table 2: Collinearity statistic (VIF)

**Appendix J – Descriptive statistics**

	<b>Cognitiv e Flexibilit y</b>	<b>Extrinsic Motivatio n</b>	<b>Intrinsic Motivatio n</b>	<b>Output Qualit y</b>
<b>Cognitive Flexibility</b>	1,000			
<b>Extrinsic Motivation</b>	-0,386	1,000		
<b>Intrinsic Motivation</b>	0,488	0,047	1,000	
<b>Output Quality</b>	0,720	-0,549	0,283	1,000

Table 1: Variable correlations

## Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
IM	42	3,50	5,67	4,7222	,43736
EM	42	2,23	4,69	3,5989	,60867
CF	42	3,45	5,55	4,7165	,44409
OQ	42	1,67	4,00	2,8175	,55681
Valid N (listwise)	42				

Table 2: Mean and Standard deviation

## Appendix K – PLS Structural model

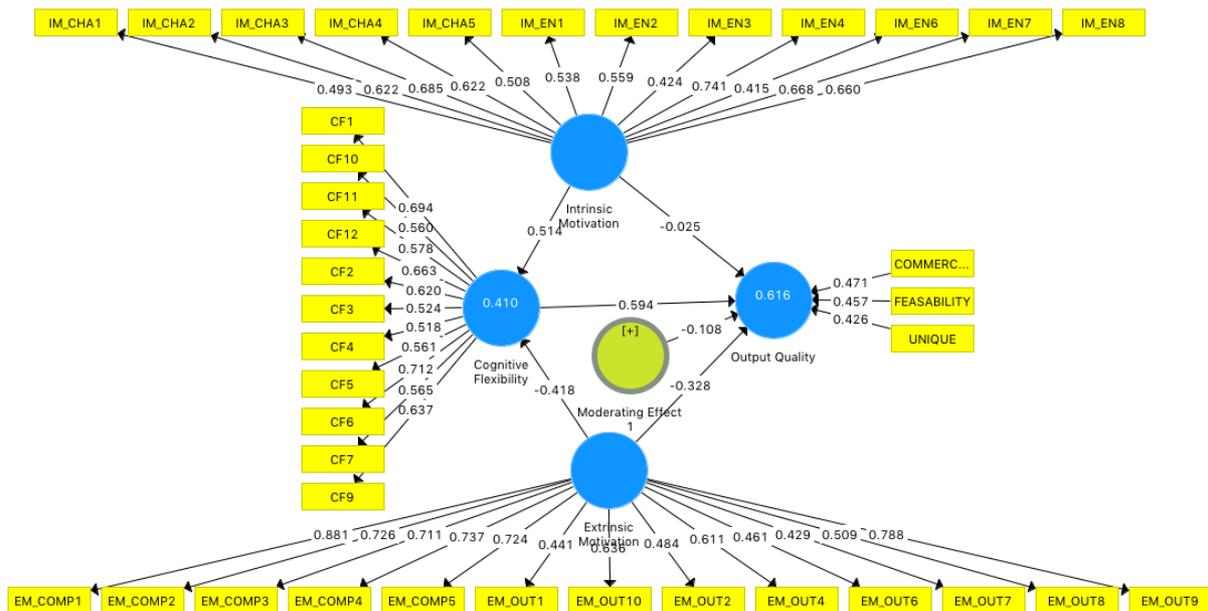


Figure 1: Structural model

## Appendix L – PLS output

	Original Sample (C)	Sample Mean (M)	Standard Deviation	T Statistics ( O/ST)	P Values
Cognitive Flexib...	0.410	0.511	0.110	3.738	0.000
Output Quality	0.616	0.708	0.081	7.585	0.000

Table 1: R2-value

	Original Sample (C)	Sample Mean (M)	Standard Deviation	T Statistics ( O/ST )	P Values
Cognitive Flexib...	0.594	0.610	0.171	3.479	0.001
Extrinsic Motiva...	-0.418	-0.409	0.110	3.793	0.000
Extrinsic Motiva...	-0.328	-0.291	0.152	2.164	0.031
Intrinsic Motivat...	0.514	0.506	0.202	2.543	0.011
Intrinsic Motivat...	-0.025	0.002	0.233	0.105	0.916
Moderating Effe...	-0.108	-0.040	0.123	0.878	0.381

Table 2: Path-coefficient, T-statistic and P-value from bootstrap.

## Appendix M – Control Variables

	Original Sample (C)	Sample Mean (M)	Standard Deviation	T Statistics ( O/ST )	P Values
Age -> Cognitiv...	-0.079	-0.076	0.149	0.533	0.594
Age -> Output...	-0.235	-0.224	0.132	1.781	0.075
Cognitive Flexib...	0.556	0.561	0.134	4.147	0.000
Educational Lev...	0.087	0.082	0.158	0.553	0.581
Educational Lev...	0.101	0.091	0.107	0.950	0.343
Extrinsic Motiva...	-0.425	-0.400	0.143	2.979	0.003
Extrinsic Motiva...	-0.316	-0.287	0.136	2.323	0.021
Gender -> Cogn...	0.136	0.119	0.124	1.099	0.272
Gender -> Outp...	-0.052	-0.063	0.101	0.509	0.611
Intrinsic Motivat...	0.471	0.464	0.200	2.356	0.019
Intrinsic Motivat...	-0.064	-0.046	0.152	0.418	0.676
Maturity -> Cog...	0.127	0.118	0.167	0.757	0.449
Maturity -> Out...	0.550	0.508	0.145	3.792	0.000
Moderating Effe...	-0.067	-0.037	0.115	0.585	0.559

Table 1: Path-coefficient, T-statistic and P-value with control variables

## APPENDIX P