

FACTORS INFLUENCING THE TENDENCY TO IMPROVISE IN OFFSHORE MAINTENANCE WORK

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ABSTRACT

This thesis extends previous work on improvisation in operational environments by asking if the tendency to improvise among maintenance technicians, working on a remote location in a centralized organization, is influenced by circumstantial factors. The factors of interest in this study are the accessibility of help from the centralized organization and the perceived degree of centralization.

This thesis presents research results from a quantitative study of offshore maintenance technicians working for a large, cross border, energy provider with the objective of establishing correlation between the tendency to improvise and the defined circumstantial factors.

The results support the argument that the tendency to improvise correlates negatively with the accessibility of help. A significant negative correlation was also found between the tendency to improvise and the perceived degree of centralization, although this was in contradiction with the initial hypothesis. Due to the nature of the research, no causality between the variables could be established.

The thesis highlights that offshore maintenance technicians understand and recognize the moment that the pre-established plans or procedures are not applicable at the situation encountered. The results of the research furthermore support the conclusion that the current reliance on centralized approaches to increase the (perceived) availability of help are based on unrealistic expectations towards the effectiveness of these procedures.

The thesis concludes by recommending that future research should focus on the distinction between unassisted problem solving, within the practitioners boundaries of competence and experience, and actual improvisation as a way to deal with unexpected events.

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INTRODUCTION

In June 2013, on an offshore gas production platform in the Netherlands, maintenance work was carried out on a shell and tube type heat exchanger. Upon completion of the work, a hydrostatic pressure test was performed to confirm the integrity of the system. The test was unsuccessful and no buildup of water pressure in the heat exchanger was observed. The maintenance team adapted to the unexpected situation through improvisation, formulating and implementing coping strategies in real time.

The improvised response resulted in an attempt to confirm the assumption that the tube bundle was leaking. Thereto, the head of the heat exchanger was disconnected from the shell to visually confirm the leakage while pressure was applied to the shell side of the heat exchanger. The test pressure, in combination with the large internal surface area of the tube bundle flange, created a large force. Because of this force, and the fact that the bundle was not secured to the shell of the heat exchanger, the bundle traveled unexpectedly out of the shell at high velocity. This resulted in the death of two maintenance workers and the injury of a third worker.

An investigation team was put together to find facts and the sequence of events related to the incident, determining underlying causes and to recommend actions. Upon completion of the investigation, the all-too-familiar conclusion was drawn that existing procedures were not adequately applied. When confronted with the unanticipated situation, the maintenance workers had not, as the procedures describe, halted the work and engaged in a structured review of the changes and their possible impact.

Underlying this thesis is the idea that there are three distinct scenarios in which field maintenance work can be conducted. The first one is where the plans and procedures cover the eventualities that occur during the execution of the work. The practitioner is able to finish the work without assistance, or with assistance from direct colleagues only, and in accordance with the plan and applicable procedures.

The second way is where eventualities occur that render plan or procedures insufficient to complete the work. The practitioner seeks help in a formalized way to overcome the issue at hand. Help seeking in a formalized way means that the question how to proceed is brought back to the originators of the plan or procedures. By doing this, the required alternative is risk assessed with the same competence and system knowledge that was deployed in the initial preparation process.

The third way is, again, where eventualities occur that require a solution that deviates from the existing plan or procedures. This time, the practitioner does not seek help but improvises the solution. Such improvisation may, or may not, be a deliberate choice.

The characteristic of an improvised solution is that no formal risk assessment process is conducted. In many industries, improvisation is perceived as a risk because the safety implications of the improvised way of working are not formally assessed and the competence and system knowledge that is deployed during improvisation may be insufficient to come to a safe solution. It is therefore, from a safety perspective, interesting to look into the specific factors that influence the likelihood of improvisation during maintenance execution.

CENTRAL CONSTRUCTS & PROBLEM STATEMENT

The scientific literature on improvisation lists numerous factors that may influence (increase) the likelihood of improvisation at the work place, to name just a few: under-specification of plans and procedures, urgency of work, uncertainty of outcomes, motivational factors, the cost of seeking formal help (in terms of energy, social status, or self-image), as well as the accessibility and trustworthiness of the source of formal help. The literature section of this thesis will discuss these factors in more depth.

In this thesis, I focus on two factors that may correlate with the likelihood of improvisation and which are particularly prevalent and visible in the offshore industry. These factors are (1) the centralization of planning and work preparation, and (2) the perceived availability of help in the formalized line. The reason for choosing these factors is the way they are connected. Centralization of work planning and preparation are driven by efficiency (Antonsen, Skarholt, & Ringstad, 2012) but may result in a reduction of competence and system knowledge on the work floor. To assist the practitioners in dealing with unexpected events, a procedure for formalized help seeking is issued. However, if both factors influence the likelihood of improvisation the remedy, the formalized help seeking procedure, may not be always adequate. Based on the literature's prediction that these two factors influence the likelihood of improvisation at work, this thesis seeks to gain further insight into the relation between these variables by posing the following two hypotheses:

H1: The, perceived, accessibility of help correlates negatively with the likelihood of improvisation in the workplace.

H2: The perceived centralization of work preparation and planning correlates with the likelihood of improvisation in the workplace.

This means that there are three main constructs in my thesis work that require further elaboration, namely the likelihood of improvisation, the centralization of work preparation and planning, and the accessibility of help.

The first main construct is the likelihood of improvisation in the workplace. In this thesis, improvisation is defined as “an adaptive response to unexpected or unanticipated situations that are outside the boundaries of what an organization has prepared for” (Trotter, Salmon, & Lenne, 2013, p. 476). The likelihood of improvisation is, as a construct, one minus the sum of the likelihood of formalized help seeking and the probability that the work can be performed according to plan and procedures; that is, the likelihood of improvised work = $1 - \Sigma$ (likelihood of work with formalized help + probability that work goes according to plan). The likelihood of improvisation is the dependent variable in my research and refers to the probability that work is conducted in a way that is not prescribed in plans and procedures and where no formalized help is sought.

The second main construct, and the first one of the contextual factors, is the centralization of work preparation and planning. This construct is regarded an independent factor in my research. Centralization of work preparation and planning is a result of one of the key assumptions of safety management, namely, that the circumstances that produce major accidents can, to some extent at least, be identified, predicted and controlled (Petersen, 1978). “Thus, planning in advance is a key strategy utilized to maintain a sufficient level of control over the way work processes are executed. Traditionally, this is done by means of safety policies, work requirements and standard operating procedures” (Antonsen et al., 2012, p. 2001). Work preparation, in this context, is taken to mean the process of ordering materials and deciding upon the applicable work routines, techniques and procedures to complete a given task. Planning concerns the decision when, how (to a certain extent), and by whom, the given task shall be performed.

Centralization of work preparation and planning implies that the number of tasks and the level of responsibility for the practitioners are reduced and that cooperation between the practitioners and the formal support functions is therefore frequently required to deal with unexpected events.

The third main construct, the second one of the contextual factors, is the accessibility of help, whether or not affected by geographical dispersion.

The accessibility of help is taken to mean the availability of the personnel that is involved in the work preparation and planning to the practitioners at the worksite that conduct the planned work. For example, maintenance work may be conducted 24/7 but the centralized support organization may work normal weeks. Support may, or may not, be consigned during off duty hours. Geographical dispersion, in this context, means that practitioners and planners are separated physically by distance.

LITERATURE REVIEW

INTRODUCTION

High Reliability Theory and Resilience Engineering view accidents as resulting from the same processes that normally produce success (Dekker, 2006). Researchers in these domains claim that people with various goals, limited resources, and in the context of uncertain and changing circumstances have to have the ability to anticipate, respond, and flexibly adjust to safely manage their work in dynamic conditions (Colman, Kahle, & Henriqson, 2013). When it is not possible to completely specify performance in complex systems then, as a direct consequence, adaptations are unavoidably approximate as well. This phenomenon is known as performance variability. Resilience Engineering claims that performance variability is necessary to ensure the functioning of an organization but can also jeopardize system safety when it combines in an unanticipated and undesired manner (Hollnagel, 2009; Grøtan, Størseth, Rø, & Skjerve, 2008).

Just like other operators in today's socio-technical systems (Dekker, 2003), maintenance workers perform their tasks in a context of limited resources and multiple goals and pressures. In the company where the afore described incident occurred, as in many others within the same industry (Dekker, 2011), it is generally accepted that plans and procedures are underspecified by nature. As it is not possible to anticipate or prepare for every possible variation of events within a system, sooner or later workers will be confronted with an unanticipated or unprepared for disruption. Reiman (2011) argues that "maintenance work is by its very nature variable and requires variability also in human performance" (p. 341).

Technicians, in general, are interested in technical problems and take pride in being able to cope with them (Orr, 1996). Research has demonstrated that mechanics, working in the aircraft industry, perceive their "success as a result of their evolved skills at adapting, inventing, compromising and improvising in the face of local pressures" (Dekker, 2003, p. 234). In this light, the maintenance

workers' decision to improvise was not in accordance with applicable procedures but may well have been in line with operational reality.

To counter this reality, and reduce the probability of an incident taking place, there are two fundamental approaches to controlling performance variability. "The first builds on restricting and constraining human behavior through rules and procedures, the second builds on the strengths, competence and motivation of the personnel" (Reiman, 2011, p. 341). High Reliability organizations and adopters of the Resilience Engineering philosophy favor the second option. These concepts share the notion that "to respond adequately in a situation which involves improvisation, the employees should have available - and effectively master - a set of response options, which allow flexible intervention" (Grøtan et al., 2008, p. 6). Dekker (2003) supports this view and argues that practitioners should develop skills to judge when and how to adapt.

Although the second notion is gaining momentum, the notion that not following procedures can lead to unsafe situations is persistent. To control the uncertainty that may result from improvisation, the company in which the incident with the heat exchanger took place, just like many others, had introduced a procedure that is generally known as 'Management of Change' (MoC). MoC has its origin in Process Safety management and is a procedure that is used to ensure that changes associated with equipment, operations, procedures, materials or design that may affect the safety of personnel, environment or equipment are evaluated and managed, through a formal process of risk assessment, to ensure that risks remain at an acceptable level. In many companies, including the company of the aforementioned incident, the definition of a change that is to be managed through the MoC procedure is described in detail. According to this definition, changes to approved operational plans and changes to started activities in operations typically require an MoC process.

This rigorous application of the MoC process creates a circular logic. If plans and procedures are underspecified by nature, and all changes to plans and activities shall be subjected to MoC, then all activities shall be subjected to MoC. In practice, obviously, this is not the case. Individuals and organizations continuously adapt to deal with variability and unanticipated events (Hollnagel, 2012). These adaptations often involve improvisation and activities that "lie outside the prescribed boundaries, yet remain within the limits of what would be judged as acceptable practice by people sharing comparable skills" (Reason, 1997, p. 51).

It seems that the industry hinges between two extremes. Resilience Engineering and High Reliability theory propagate the positive potential of variability in human performance and perceive improvisation as a means to safer operations

(Woods & Hollnagel, 2006). On the other hand there is the continuous urge to control and to regulate all activities that seems incompatible with the construct of improvisation. The underlying notion is that “performance results from meticulously planned actions and uncertainty-avoidance strategies. Thus, organizations often develop routines that yield activities and solutions learned from past experience” (Magni, Proserpio, Hoegl, & Provera, 2009, p. 1045).

This thesis will not argue for either of these views. As both are well-supported notions, the literature reviewed in the remainder of this section focuses on the question of how one can distinguish between a situation that may benefit from improvisation and one that requires formalized help seeking, for example in the form of the MoC process. The aim of this literature review is to assess what is known about improvisation in an operational environment and to find if there is any support for the notion that centralization of planning and work preparation or the accessibility of help may influence improvisation.

IMPROVISATION

Improvisation as a construct has been widely researched. There are a great variety of definitions for the idea, summed up by Piña e Cunha et al. (1999, p. 96) as “the conception of action as it unfolds, by an organization and/or its members, drawing on available material, cognitive, affective and social resources”. Trotter et al. (2013, p. 476) add a definition of improvisation as an adaptive response to unexpected or unanticipated situations that are outside the boundaries of what an organization has prepared for. It is a strategy used only when faced with situations for which no procedure exist, or where circumstances prevent known procedures from being deployed.

These two definitions combined describe rather accurately what took place when the maintenance workers were confronted with the unprepared-for failure of the hydrostatic pressure test. However, where Piña e Cunha et al. (1999) perceive improvisation as one of the possible emerging responses to an unprepared for situation, Trotter et al. (2013) perceive improvisation as a deliberate strategy that can be optimized.

Improvisation as a deliberate strategy is not an uncommon notion and is widely researched (Weick, 1998; Mendonca, Cunha, Kaivo-oja, & Ruff, 2004). Arshad and Hughes (2009, p. 178) argue that there is a “deficiency in prior empirical research on the link between reasoning and improvisation”. They examined organizational improvisation, although their field of study was strategic planning rather than operations. Their findings suggest that “improvisation is not an accident or an outcome of recklessness but rather a rational and deliberate decision” (Arshad & Hughes, 2009, p. 182). In jazz music and other performing

arts improvisation is often deliberate. In addition, there is the field of Resilience Engineering (Ranking, 2013; Reiman, 2011) where improvisation is regarded as a tool that can deliberately be deployed to deal with variability.

It is hard, however, to argue that improvisation in an operational setting is always the result of a conscious decision – a deliberate ‘strategy’ or ‘tool’. Klein (2003), argues that a large percentage of decisions in loosely structured, time pressured situations have automatic response or intuitive actions. Klein’s (2003) research was performed in a more operational setting (emergency services and armed forces), which seems a better fit to an offshore operations environment. Weick (1998), in his paper on organizational improvisation, expresses doubts on whether the decision to improvise is always rational, locally or otherwise. Weick (1998, p. 551) describes improvisation as “a mixture of the pre-composed and the spontaneous, just as organizational action mixes together some proportion of control with innovation”.

Literature in the field of behavioral science confirms the notion that unconscious influences play a significant role in decision making (Newell & Shanks, 2014). There are strong indicators that when a practitioner is confronted with a novel or challenging situation, consciousness immediately takes control over the decision process (Bernacer, Balderas, Martinez-Valbuena, Pastor, & Murillo, 2014). Even when improvisation would be regarded a habit, in relation to the claim that all plans and procedures are underspecified, Bernacer et al. (2014) argue that the capacity to consciously intervene at any time is not lost. Helzer and Dunning (2014) do not dispute this conclusion but add that the current research fails to appreciate how context influences the weight of decision cues. This leaves practitioners “with some recognition of how they arrived at their ultimate decision, but not necessarily why the decision unfolded as it did” (Helzer & Dunning, 2014, p. 31).

It is outside the scope of this thesis to conclude whether the decision to improvise is the result of (locally) rational or intuitive reasoning processes, or even both. It is not necessary to make this distinction in order to hypothesize that certain variables may correlate with improvisation. The literature divides these variables into factors that influence the likelihood for improvisation and factors that influence the quality of improvisation processes. The latter factors are interesting from a practical perspective because they can be instrumental in controlling the risk level that is associated with improvisation. The factors that influence the likelihood of improvisation are those that determine the choice, deliberate or not, for improvisation as a coping strategy, which is the central topic of this thesis. It is in this phase that the choice between improvisation and more formal approaches is made.

THE QUALITY OF IMPROVISATION

Starting with the factors that influence the quality of the improvisation process, Weick (1998) draws on the comparison of organizational improvisation with improvisation in jazz and concludes that improvisation can be improved by improving memory because “improving memory is to gain retrospective access to a greater range of resources” (Weick, 1998, p. 547). Weick’s argument is supported by other researchers (Trotter et al., 2013; Magni et al., 2009) that confirm that organizational memory, fluid communication, and procedural knowledge have a relation to the quality of the improvisation. However, Trotter et al. (2013) conclude that further research is required and that there is currently no coherent model of factors that influence the effectiveness of improvisation in safety critical situations.

Improvisation is viewed from the perspective of problem solving in the article written by Mendonca and Wallace (2007). The setting is emergency management where the need to respond quickly to non-routine events leaves no time for help seeking. Mendonca and Wallace (2007) review articles on the cognitive processes in improvisation with the intention to explore if these results can be applied to improvisation in emergency management. The paper discusses how procedural knowledge influences improvisation in emergency management settings and thereby confirms the findings of Weick (1998) and Trotter et al. (2013) that increased competence, knowledge, and communication positively influence the quality of improvisation.

Other research indicates that geographical distribution does affect troubleshooting in an offshore setting (Lauche & Bayerl, 2011). It was observed that “while offshore staff members are able to detect and react to unexpected events, they often lack the engineering expertise to solve complex problems” (Lauche & Bayerl, 2011, p. 180). A similar result is observed by Antonsen et al. (2012), who write that centralization of work preparation and planning can lead to a loss of system knowledge with offshore workers.

This form of reduced context specific knowledge may negatively affect safety critical decisions. Weick and Sutcliffe (2007) share the view of Mendonca and Wallace (2007) when they conclude that the capacity to deal with unexpected events is largely depending on the practitioners’ level of system knowledge and experience. If centralization of work preparation and planning reduces knowledge levels offshore then this is likely to impact the quality of improvisation. This conclusion is confirmed by Antonsen et al. (2012) who corroborate the idea that centralization may reduce improvisational skills. This, however, does not necessarily imply that centralization reduces people’s tendency to improvise.

THE LIKELIHOOD OF IMPROVISATION

During discussions in the aftermath of the incident with the heat exchanger, the question was raised if contextual factors may have influenced the decision to improvise. Offshore maintenance work is governed by central planning and the strict separation of work preparation (onshore) and execution (offshore). If improvisation can be defined as the concurrent manifestation of planning and execution then centralization of planning aims at “increasing the temporal and spatial distance between the planning and execution of operations” (Antonsen et al., 2012, p. 2007).

Centralization implies that the number of tasks and the level of responsibility for the offshore crew are reduced. Cooperation between the onshore- and offshore functions is therefore frequently required to deal with unexpected events but the onshore support function is not always easily accessible at night and in the weekends. It is not unthinkable that maintenance workers perceive the physical separation as a constraint in the process of formalized help seeking (such as through the MoC procedure).

The scientific literature points to a number of factors that influence the likelihood of practitioners engaging in improvisation. Whether improvisation is the result of a conscious decision or an intuitive process, the literature reveals some common factors that influence the incidence of improvisation. First of all there must be a situation that is not covered by existing plans or procedures. The dynamism and uncertainty of the situation create a number of constraints including a lack of information (applicable procedures) and a lack of time to acquire new information and to process it (Chelariu, Johnston, & Young, 2002). Resource constraints and making do with available resources are also seen as key predictors of improvisation (Chelariu et al., 2002). This does not mean that improvisation only occurs in emergency situations. Magni et al. (2009, p. 1045) observe that “improvised behaviors may occur even in the everyday working context when individuals face emergent but not necessarily dramatic situations”.

Aside from the perception of being deprived from resources and the feeling of being constrained in following the procedural path, the individuals, or teams, dealing with the situation perceive a sense of urgency (Gomes, Woods, Carvalho, Huber & Borges, 2009; Mendonca et al., 2004). Crossan, Cunha, Vera, and Cunha (2005) argue that there is a relation between urgency and uncertainty that provokes improvisation. When both urgency and uncertainty are low, organizations resort to planning in response to an unexpected event. However, when either- or both- factors are perceived as high, improvisation is encouraged.

Motivational factors may also stimulate improvisation. Maintenance workers take pride in their professionalism and expertise. Plans and procedures may be perceived as a threat to job motivation, meaningfulness of the work and the ability to carry out the daily work (Reiman, 2011). The result is that maintenance workers “seem to consider the capability for performance variability an integral aspect of professionalism” (Reiman, 2011, p. 351). Hollnagel (2009) argues that the knowledge of how to interpret, apply, and ignore procedures is considered a part of maintenance workers’ professionalism. Pettersen and Aase (2008) claim this behavior is a logical result of the drivers and constraints that are a part of the daily life of maintenance workers.

The implication of this is that maintenance workers may perceive improvisation as a normal solution to unexpected events, even when both urgency and uncertainty are deemed low. Leone (2010) states that researchers should focus more on the reasons that lead people to improvise, even in absence of urgency and resource constraints. “Specifically there is a need to disentangle some emerging unresolved issues dealing with the way improvisation unfolds as a creative process and in particular dealing with the way individuals conduct this process, breaking and recombining existing routines and knowledge” (Leone, 2010, p. 25).

Motivational factors that influence the likelihood of improvisation can also be found in the notion that help seeking, formal or otherwise, may come with a price. In this thesis, the formalized manner of seeking help from experts – for example through the Management of Change procedure - is theorized as the exact opposite of improvisation. A number of studies in the field of applied psychology have revealed that when confronted with complexity and uncertainty, individuals do not always seek out help. However, Hofmann, Lei and Grant (2009) claim that their findings reveal that practitioners are likely to seek help from experts, provided that they perceive them as accessible and trustworthy. Van der Rijt et al. (2013) confirm this claim and add that the accessibility of help is positively associated with the likelihood that help is sought. Borgatti and Cross (2003) even state that accessibility is vital. Thus, current literature suggests that improvisation may be more frequent in geographical dispersed locations where formalized help is not easily accessible.

Help seeking, as the inverse of (or alternative to) improvisation, is furthermore dependent upon the result of a cost-benefit evaluation, weighing the reduction of uncertainty against the risk of being perceived as incompetent or otherwise losing face. Other factors in the cost-benefit evaluation are the amounts of time and energy necessary to solicit assistance. On a more personal level help seeking may form a threat to the practitioners’ sense of self-efficacy and mastery

(Bamberger, 2009). This would suggest that there are practitioners for whom it is locally not rational to seek help, which may explain improvisation even in the absence of time constraints. On the other hand, formalized help seeking, such as in a MoC process, may overcome some of these social and personal costs because following the procedure could be perceived as professional conduct.

The latter would imply that cultural factors play a role as well. Workplace norms are known to influence the probability of improvisation. Magni et al. (2009) observe that a culture that supports diversity of skills and perspectives, and a preference for action, promotes improvisation. In a study conducted among nurses, Cioffi (2000) describes that practitioners sometimes lack confidence in their judgment if a situation actually meets the criteria for formalized help seeking. In an action driven culture, improvisation then seems an attractive alternative. Cultures that propagate openness and communication and praise the capacity to identify circumstances beyond the experience may facilitate the choice to seek help (Herrera & Hovden, 2008).

CONCLUSION FROM LITERATURE REVIEW: ADDRESSING THE KNOWLEDGE GAP

The literature review indicates that there is a lack of understanding of the influence of contextual factors on the tendency to improvise. Further exploration of the impact of situational factors beyond urgency and uncertainty is warranted (Mendonca & Wallace, 2007). Centralization of work planning and preparation, as a factor that reduces the capacity to improvise but increases the need for help seeking, and the perception of the ‘accessibility of expert help’, identified as a critical factor in any organization (van der Rijt et al., 2012), may play a larger role in remote locations where practitioners work with limited resources and often without 24/7 support from the central organization. Magni et al. (2009) specifically point to the lack of research regarding contextual variables, such as geographical dispersion. They state that further research should be conducted as geographical dispersion might affect individual improvisation.

An empirical study into the possible correlation of specific situational factors on the likelihood of improvisation in an operational setting can help fill the current knowledge gap. The implications of this work can be significant, both theoretically and practically. When a positive correlation can be established it may become necessary to review the way maintenance work is organized on remote (offshore) locations. The current reliance on the MoC procedure as a way to deal with unexpected events may create unrealistic expectations towards the effectiveness of these procedures.

If the MoC procedure would have been applied to the letter during the maintenance work of the heat exchanger, an updated, peer reviewed plan would

have been the result that may have reduced the probability of undesired consequences of the work. But the new plan, like all other plans, would not have specified all possible variations of reality. When safety results from people being skillful at judging when and how to adapt procedures to local circumstances, organizations should “develop ways that support people’s skill at judging when and how to adapt“ (Dekker, 2003, p. 235). Of even more importance is the understanding that the formal responsibility for the choices that are made, when faced with events that lie outside the boundaries of plans and procedures, ought to reside with the organization rather than the individual practitioner.

METHOD

The aim of the research is to find if a correlation can be established between the tendency to improvise when performing technical tasks and two specific contextual factors, namely the perceived availability of help and the perceived degree of centralization of planning and work preparation.

In the design of this study, the perceived availability of help and the perceived centralization of planning and work preparation are the independent variables. The likelihood of improvisation is the dependent variable.

As stated in the ‘Central Constructs & Problem Statement’ chapter of this thesis, the research project aims to test the following hypotheses:

H1: The, perceived, accessibility of help correlates negatively with the likelihood of improvisation in the workplace.

H2: The, perceived, centralization of work preparation and planning correlates with the likelihood of improvisation in the workplace.

DATA GATHERING AND ANALYSIS

Given the hypotheses, the ideal research population consists of maintenance workers that perform their work in an organization with centralized planning and work preparation in which a process of formal help seeking has been established and in a setting that is separated from their support organization. Offshore operations, with the clear separation of planning and execution and geographical distance between the practitioners and the support organization, provide a suitable environment for the desired empirical research. Within this environment, offshore technicians (operating technicians, mechanical

technicians, electricians, instrument technicians, riggers and fitters) form the target population.

In pitching the goal of this study, a large, cross border, energy provider perceived this research as potentially relevant to the industry. Therefore, access has been granted to their entire pool of offshore technicians in both their Dutch (around 200 technicians) and Norwegian affiliates (around 60 technicians) as well as to all relevant procedures, plans, documentation, etc.

Data was collected by means of a questionnaire, distributed through the Internet survey tool Survey Monkey (surveymonkey.com). The questionnaire consisted of a number of five-point Likert items that together combined into three Likert scale and established an ordinal score on both the independent- and the dependent variables. The score for every participant for each of the three variables, and thus for each of the three Likert scales, was established through calculation of the mean for the scores on the grouped survey questions.

The Likert scales in the questionnaire were each tested for reliability by means of Cronbach's Alpha. This test was used to determine how much the items on a scale are measuring the same underlying dimension and was run for each of the three Likert scales in the questionnaire. The results of this test indicate the level of consistency for the Likert scale but also allow for sensitivity tests to determine if the consistency can be improved by removing individual Likert items.

Next, the Spearman rank-order correlation was calculated for both hypotheses to provide a measure of the strength and direction of the association between the ordinal constructs. Spearman, unlike Pearson's correlation coefficient, does not require the relationship between the variables to be linear, nor does it require the variables to be measured on interval scales. Spearman's rank order correlation is therefore suitable for the ordinal variables that are produced by this research. Spearman's statistic provides a significance level for the hypothesis that correlation of the underlying distributions represented by the subjects' scores on the two variables is some value other than zero.

The statistic computed for the Spearman rank-order correlation Coefficient is represented by the letter r , which is the correlation between the two variables in the underlying population. r can assume any value within the range of -1 to $+1$. The absolute value of r indicates the strength of the relationship between the two variables and the sign of r indicates the nature of the direction of the relationship. A positive sign indicates a direct relationship where a negative sign indicates an inverse relationship. It should be noted that the test cannot confirm causality between variables.

Finally, the significance of the correlation was calculated, which is a measure of how unlikely a given correlation coefficient is to occur given no relationship in the population. The lower the value of the calculated likelihood, the more significant the relationship between the constructs. Scientific convention (Sheskin, 2011, p. 60) has established that in order to declare a difference statistically significant, there can be no more than a 5% likelihood that the difference is due to chance.

The survey questions can be found in Appendix 1. The survey was made available in three languages, English, Dutch and Norwegian, to encourage participation.

RESEARCH ETHICS

In conducting this survey study, three basic issues in relation to ethics were considered. These are informed consent, the protection of confidentiality, and the ethical risk introduced by the unequal relationship between the researcher and the participants.

Informed consent means that both the organization supporting the survey, as well as the individual participants, must not be misled as to the nature and purpose of the research and must be provided with general information on the aim of the research, the amount of time and effort that will be required of the participants and how the resulting data will be used and stored. The survey, therefore, contained an introductory part, available in appendix 2, that provided the information required for the participants to subsequently confirm their informed consent. In the online invitation to participate in the survey study, the participants were given information regarding informed consent, and only after accepting the conditions were they able to participate.

Confidentiality concerning individuals was obtained by the anonymization of the data. The selected survey tool offers this possibility with the disadvantage that the possibility of follow-up interviews, whereby interview candidates are selected on the basis of specific results, was eliminated. This study used the anonymized data from the online survey tool.

The researcher and the research population are colleagues with an unequal relationship. Unequal relationships arise where one person or party is seen to have more power or agency in relation to the other. This introduces the risk that this relationship can result in participants feeling pressure to be involved in the research, and may affect their experience of the research itself. This risk is mitigated in this study through the use of an anonymous web-based survey

without direct interaction and voluntary participation. In addition, a clear distinction is made between the professional relationship and the research activity by stating in the introduction to the survey that the results shall be used in the context of a study at Lund University (see appendix 2).

RESULTS

From the 260 offshore maintenance technicians that were invited to participate in the study, a total of 156 questionnaires were returned which amounts to a response rate of 60%. 17 questionnaires were returned uncompleted. They were removed from the results, leaving 139 fully completed questionnaires.

The first construct, Likelihood of Improvisation, was measured by 6 questions (question number 3, 4, 5, 7, 8, and 9; see appendix 1) which were all answered 139 times (N = 139). To maximize the outcome of Cronbach’s Alpha, two questions (5 and 9) were omitted from the construct. Removing these questions improved the reliability of the scale from 0.441, which is indicative of an unacceptable internal consistency to a score of 0,732 which could no further be improved and indicates an acceptable internal consistency (Sheskin, 2011).

Table 1 shows the scoring frequencies, the mean, and standard deviation for the individual Likert Items and for the resulting construct.

	Question 3	Question 4	Question 7	Question 8	Likelihood
N	139	139	139	139	139
Mean	2,4317	2,6475	2,5683	2,9496	2,6493
Std. Deviation	0,70248	1,04162	0,9329	1,10548	0,7133

Figure 1 shows the frequency histograms for the Likert Scale Likelihood of Improvisation, per Likert item.

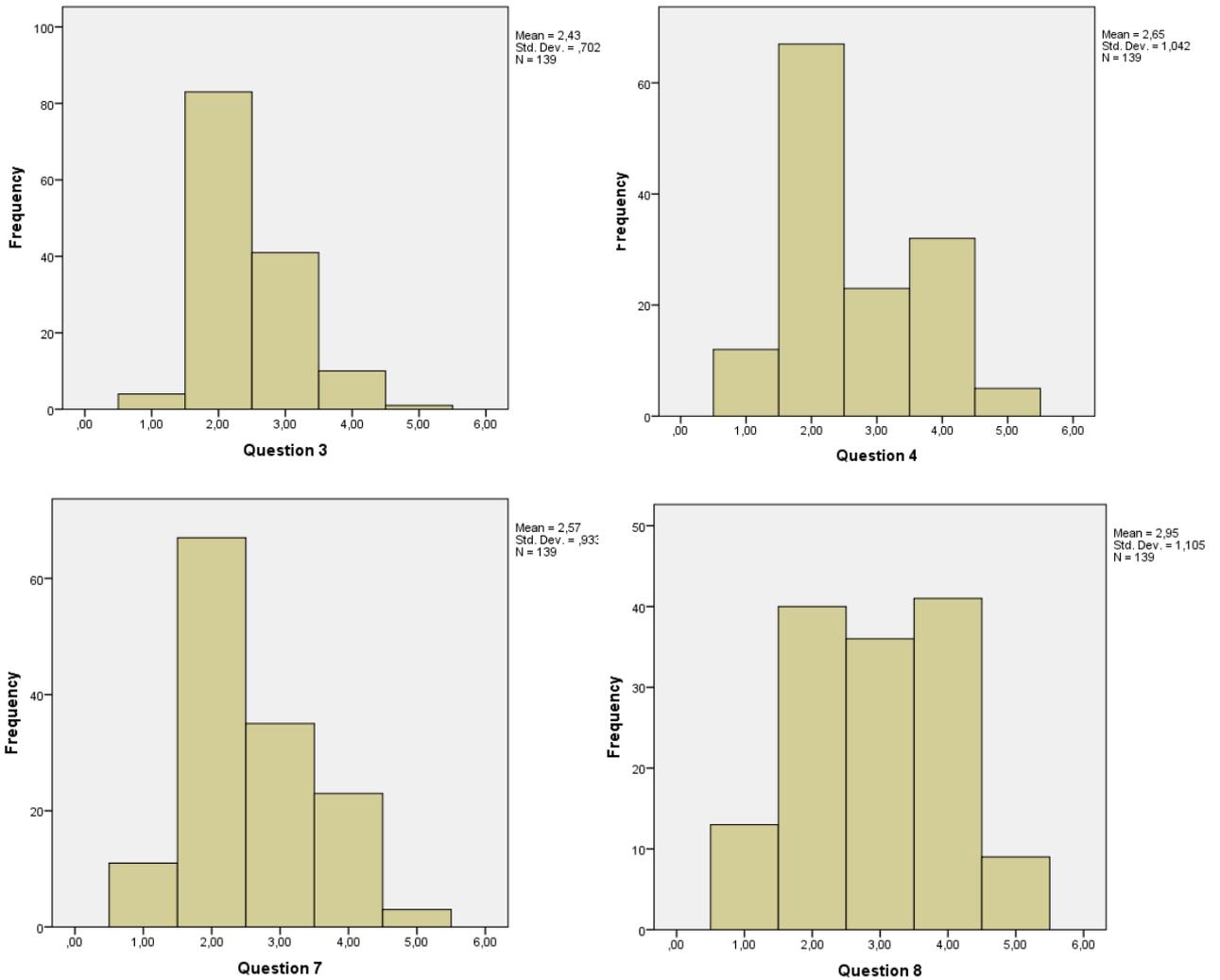


Figure 1 Frequency histograms Likert Scale Likelihood of Improvisation

The second construct, Accessibility of Help, was measured by 4 questions (number 11, 12, 13, and 14; see appendix 1) which were all answered 139 times (N = 139). To maximize the outcome of Cronbach's Alpha, one question (14) was omitted from the construct. Removing this question improved the reliability of the scale from 0,759, which is indicative of an acceptable internal consistency, to a score of 0,806. This score could no further be improved and indicates a good internal consistency (Sheskin, 2011).

Table 2 shows the scoring frequencies for the individual Likert Items and the mean and standard deviation for the resulting construct.

Table 2 Statistics Likert Scale Accessibility of Help

	Question 11	Question 12	Question 13	Accessibility
N	139	139	139	139
Mean	2,5899	3,0144	2,3597	2,6547
Std. Deviation	1,21472	1,17945	1,161	1,00595

Figure 2 shows the frequency histograms for the Likert Scale Accessibility of Help, per Likert item.

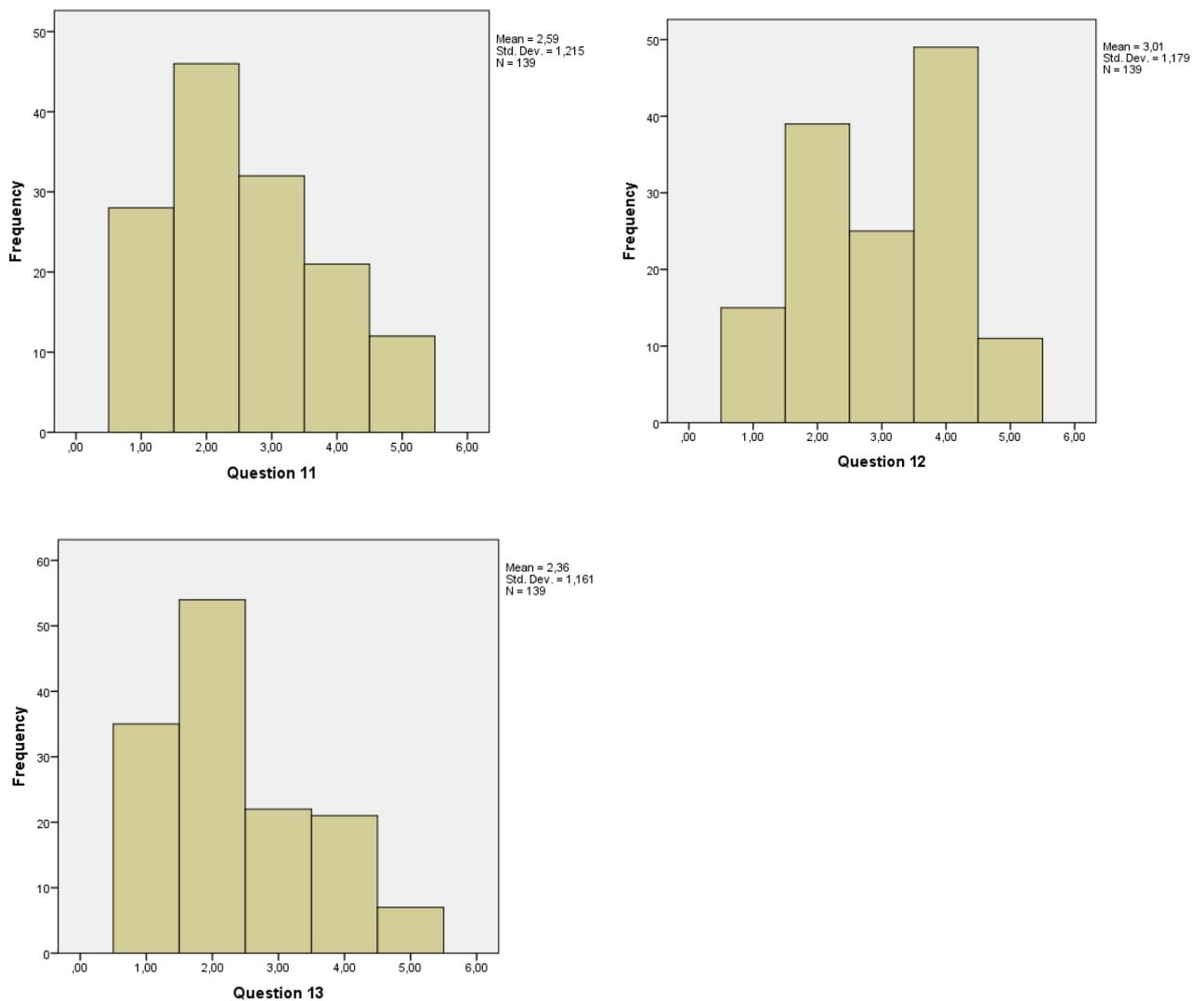


Figure 2 Frequency histograms Likert Scale Accessibility of Help

The third construct, Centralization of Work Preparation and Planning, was measured by 5 questions (number 15, 16, 17, 18, and 19; see appendix 1) which were all answered 139 times (N = 139). To maximize the outcome of

Cronbach's Alpha, two questions were omitted from the construct (17 and 19). Removing these questions improved the reliability of the scale from 0.632, which is indicative of a questionable internal consistency, to a score of 0,703 which indicates an acceptable internal consistency (Sheskin, 2011). The score could have been marginally improved, to 0.729, by removing question 18 but since this would have left the internal consistency in the acceptable range it was decided to maintain this question as a part of the Likert scale.

Table 3 shows the scoring frequencies for the individual Likert Items and the mean and standard deviation for the resulting construct.

Table 3 Statistics Likert Scale Centralization

	Question 15	Question 16	Question 18	Centralization
N	139	139	139	139
Mean	3,1439	3,2302	3,3094	3,2278
Std. Deviation	1,19517	1,09886	1,09577	,89554

Figure 3 shows the frequency histograms for the Likert Scale Centralization, per Likert item.

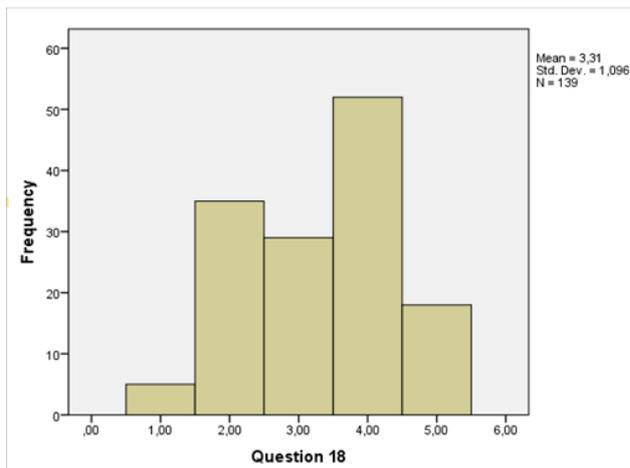
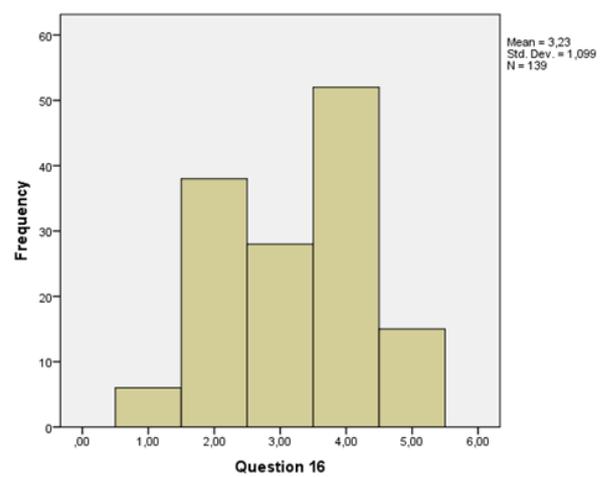
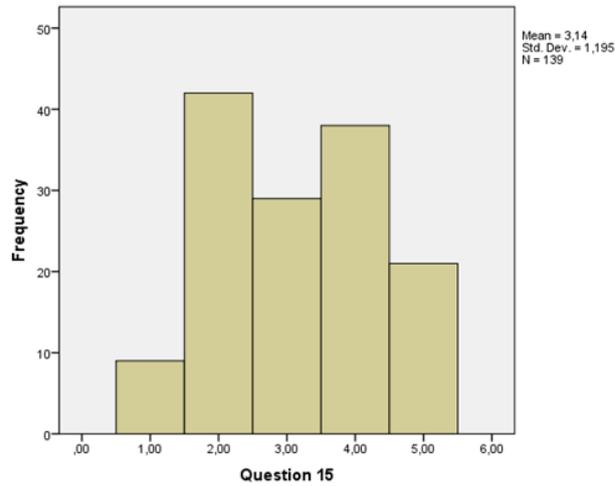


Figure 3 Frequency histogram Likert Scale Centralization

HYPOTHESES

A Spearman's rank-order correlation was run to assess the relationship between Accessibility of Help, Centralization of Work Preparation and Planning, and the Likelihood of Improvisation in order to test the hypotheses. Table 4 shows the results of the correlation test.

Table 4 Correlations

Spearman's rho		Accessibility	Centralization	Likelihood
Accessibility	Correlation Coefficient	1,000	,007	-,220**
	Sig. (2-tailed)		,937	,009
	N	139	139	139
Centralization	Correlation Coefficient	,007	1,000	-,207*
	Sig. (2-tailed)	,937		,015
	N	139	139	139
Likelihood	Correlation Coefficient	-,220**	-,207*	1,000
	Sig. (2-tailed)	,009	,015	
	N	139	139	139

** Correlation is significant at the 0,01 level (2-tailed)

* Correlation is significant at the 0,05 level (2-tailed)

The first hypothesis states that the, perceived, accessibility of help correlates negatively with the likelihood of improvisation in the workplace. The analysis demonstrates a weak negative correlation between Accessibility of Help and the Likelihood of Improvisation, $r_s = -.220$. The correlation is significant at the 0.01 level and the results of this survey thus confirm the first hypothesis.

The second hypothesis states that the centralization of work preparation and planning correlates with the likelihood of improvisation in the workplace. The analysis demonstrated a weak negative correlation between Centralization of Work Preparation and Planning and the Likelihood of Improvisation, $r_s = -.207$. The correlation is significant at the 0.05 level and the results of this survey thus confirm that there is a significant correlation between the two constructs although the correlation is negative rather than positive as predicted in the second hypothesis.

No significant correlation was found between the two independent variables Accessibility of help and Centralization of work planning, $r_s = .007$. The lack of correlation between these variables indicates that these variables are two entirely independent constructs. As such, but only to a small extend, the lack of correlation can be taken as evidence for the construct validity of these constructs and their underlying questions.

DISCUSSION & INTERPRETATION OF THE SURVEY RESULTS

HYPOTHESES

The results of the survey provide a number of insights. A statistically significant negative correlation was established between the tendency to improvise and the perceived availability of help. This finding, meaning that the less help is perceived to be available, the more the target population is inclined to improvise, confirms the initial hypothesis that assumes this correlation. The finding also supports the literature that suggests this relation (Magni et al., 2009; Van der Rijt et al., 2013; Borgatti & Cross, 2003). In short, the perceived availability of help is thus one of the circumstantial factors that relates to the tendency to improvise.

The second hypothesis states that the centralization of work preparation and planning correlates with the likelihood of improvisation in the workplace. The results of the survey present a statistically significant negative correlation between these constructs meaning that the lower the perceived degree of centralization, the higher the tendency to improvise.

The original hypothesis assumed a positive correlation, meaning that a high perceived degree of centralization would provoke a higher tendency to improvise.

In searching to understand this reversed correlation it was noted that the response to the questions that form the Centralization construct, see figure 4, demonstrate that the target population does not perceive centralization uniformly. Around 50% of the respondents acknowledge the concept of centralization whereas around 30% of the population does not experience that work planning and preparation is centralized. It seems that the target population, despite the formal work processes stating otherwise, still experiences a degree of autonomy regarding planning and work preparation.



Figure 4 Degree of Centralization targeting questions

One explanation for the reversed correlation may be that in a perceived decentralized organization, where technicians regard themselves at least partially responsible for work planning and operation, improvisation may be the logical option to deal with situations that fall outside one's own plan. Another view is that in an organization with a high perceived degree of centralization, the organization has apparently proven successful to establish the concept. It would consequently be more obvious to the technicians that a problem during the execution of the work should be brought to the attention of the centralized support organization. As such, sheer compliance would prevent improvisation.

As stated, the negative correlation between the degree of centralization of planning and work preparation and the tendency to improvise is in some ways understandable albeit in contradiction to hypothesis 2. That said, the understanding springs from maintaining hypothesis 2 and adjusting for specific assumptions, such as that the target population did not behave according to the expectations that were evoked by the written processes and procedures. The issue here is that because of the anonymous survey responses, no qualitative follow up interviews were conducted as a part of this research. Targeted interviews would have been instrumental in understanding the different perceptions of centralization concept. This could be a consequence of a not

successfully introduced work process but it could also be based on the respondents' experience of the factual division of tasks in the organization.

Any which way, the insight that can be derived from the survey results is that a rather large discrepancy exists between workflow as described in the processes and workflow as experienced by the target population. Further research into this situation is warranted, not only from an efficiency point-of-view but more so to decrease the risk that work is not risk assessed according to the formal internal standards.

ACCESSIBILITY OF HELP

The response to the survey questions that are addressing the perceived accessibility of help, see figure 5, shows that a rather large part of the target population is of the opinion that help is not always readily available.

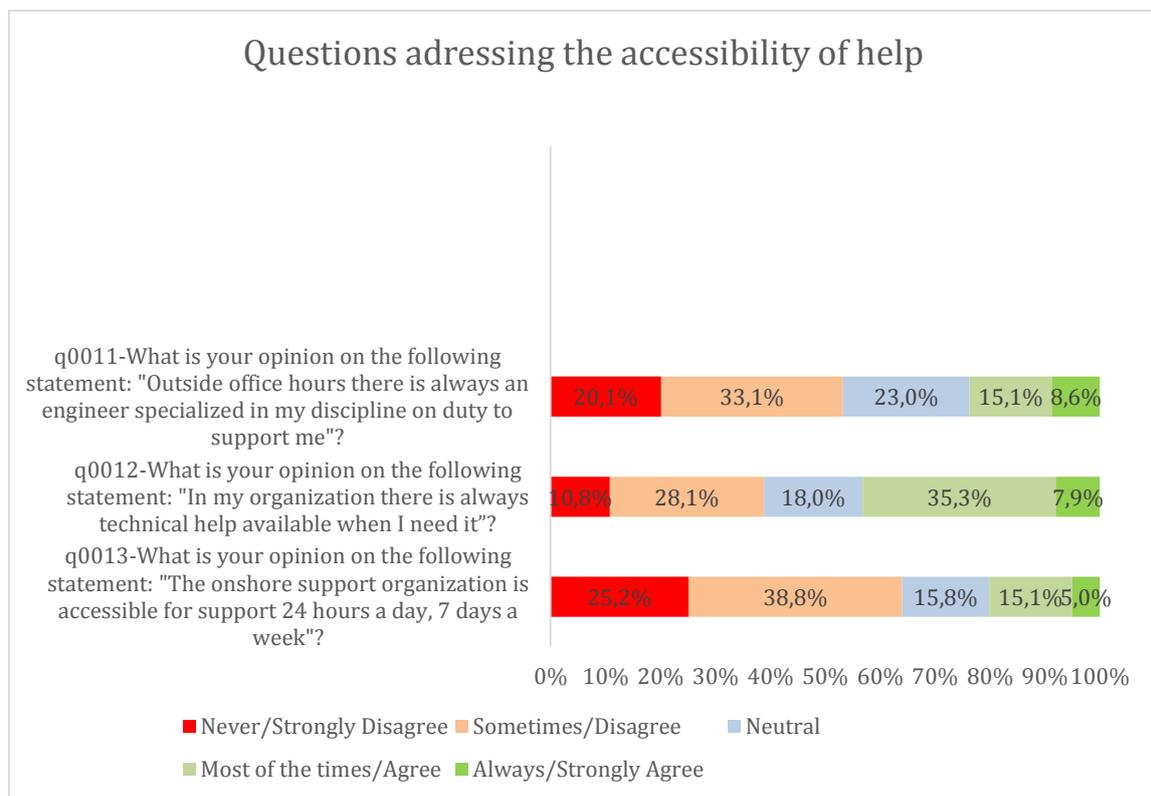


Figure 5 Questions addressing the Accessibility of Help

In the organization where the survey was conducted there is not always a specialized engineer on duty. It is interesting to see from the response to question 11, see figure 5, that this limited availability of discipline engineers is perceived rather differently throughout the target population. A possible explanation for this effect may be insufficient information regarding the duty

schedule. Another explanation may be the experience that the individual respondents have in contacting the relevant duty engineer outside office hours. The response to question 12, see figure 7, suggests that some of the respondents feel confident they can find technical help when needed, even in the absence of formal on-duty support.

LIKELIHOOD OF IMPROVISATION

One of the main conclusions that can be derived from the survey is that improvisation is a routine way to deal with unexpected situations. The responses to the survey questions that are addressing the likelihood of improvisation, see figure 6, show that a majority of the target population has experienced situations in which pre-established plans and procedures were not applicable and around 90% of the target population solves this situation at least sometimes through improvisation.

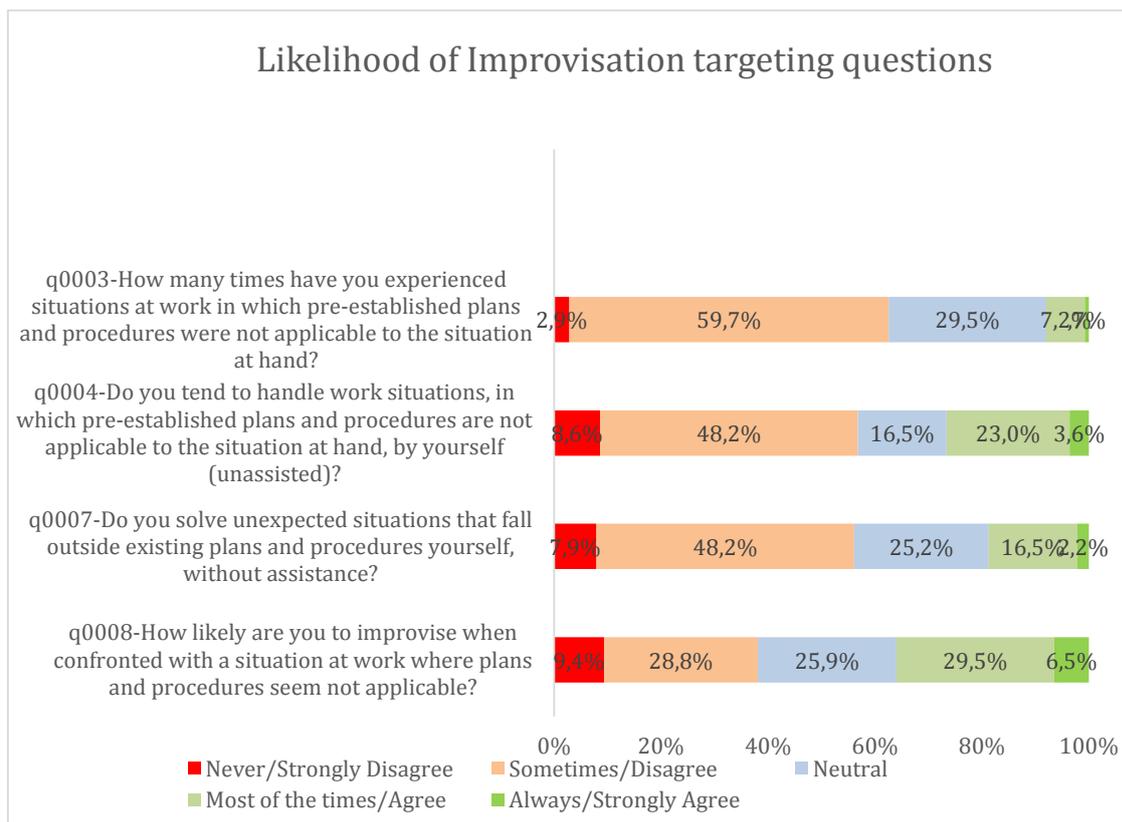


Figure 6 Likelihood of Improvisation targeting questions

Since there is a correlation between the likelihood of improvisation and the accessibility of help it can be argued that an MoC procedure, as a formalized way to access help, could contribute to the reduction of improvisation.

Literature indicates that in a centralized organization, the ability to deal with unexpected events decreases in the part of the organization that is responsible for the execution of the work (Antonsen et al., 2012). This mechanism, from a risk reduction perspective, explains the desire to restrict autonomy at the work floor. Presuming that plans and procedures are underspecified by nature (Dekker, 2011), a centralized organization will have to make the planning and preparation competence available to the executive part of the organization to deal with unexpected events. The introduction of an MoC procedure is, in theory, a formalized method to make this support available to the technicians. Practitioners could initiate this process to understand how to proceed when confronted with unexpected events, thereby ensuring the deviation is handled with the same quality and levels of risk assessment as the initial plan.

The survey results, however, seem to demonstrate that the implementation of an MoC procedure is not perceived to increase the accessibility of help in this population. Figure 7 shows the scores on the questions in the survey that specifically targeted the opinions and the experience of the target population with the MoC procedure. The findings suggest that the target population is uncertain about the working of the MoC procedure. Results indicate also that the target population is inexperienced with the procedure. When looking at the results of the 5 survey questions that specifically mention the MoC procedure, it becomes apparent that the MoC procedure is underutilized. Question 10 indicates that 50 % of the target population never initiated an MoC procedure and question 9 indicates that a total of 43% of the target population is not likely to do so when confronted with an unexpected situation.

Question 6, 19 and 20, see figure 7, demonstrate that a rather large percentage of the target population chooses the neutral category when asked questions about the existence and usefulness of the MoC procedure. A neutral response could, apart from the reflection of subjects choosing the alternative that is closest to their position, also be an indication that the target population have insufficient knowledge of, or experience with, the subject to form a strong opinion. Sturgis, Roberts and Smith (2012) have found evidence that choosing a neutral response may be chosen in the absence of sufficient information.

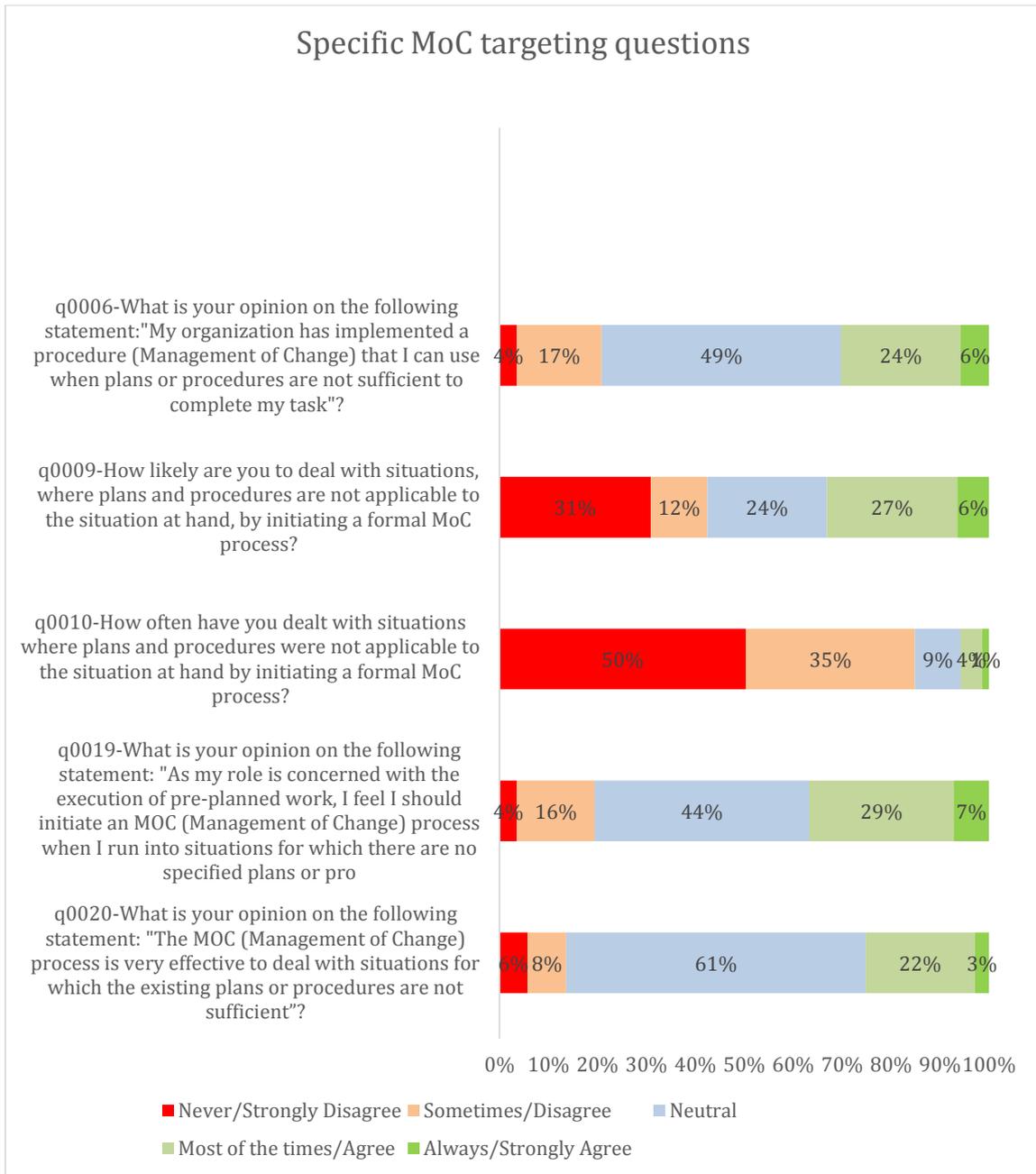


Figure 7 Specific MoC targeting questions

It can be argued that the questionnaire was not optimally designed in this respect and that either the neutral choice should not have been offered or the subject should have been accompanied of more information around the MoC process. Nevertheless, the response gives the impression that the MoC procedure is insufficiently known among the target population and that the target population lacks information as to how it functions. This is most clearly demonstrated by the answers to question 20 that seem to reflect a large degree of uncertainty concerning the effectiveness of the MoC procedure. Since the response to

question 10 suggests that this uncertainty is not based on experience with the procedure it is possible that the uncertainty springs from a lack of information. From an organizational point of view this is worrying because it would suggest that unexpected situations are regularly solved without formal risk assessment.

It is also worrying because the findings suggest there is a gap between desired behavior at the sharp end and actual behavior. As mentioned before, changes to approved operational plans, and changes to started activities in operations, require an MoC process in the organizations in which the target populations perform their work. The limited number of technicians that initiate an MoC process may signify to the onshore support organization that planning and work preparation is of sufficient quality. From the survey it seems that the situations that would warrant an MoC process are encountered much more often than actual processes are initiated.

The notion that informally risk assessed problem solving is presenting a risk to the organization is apparently not shared by the target population. A strong sense of mastery seemingly motivates technicians to solve unexpected events unassisted. The discrepancy between the answers to questions 4 and 7 (see appendix 1), inquiring about the tendency to solve problems unassisted, and question 8, which inquires directly about the likeliness to improvise, suggests that technicians may be reluctant to classify their behavior as improvisation.

This study offers the insight that offshore maintenance technicians do understand and recognize the moment that the pre-established plans or procedures are not applicable at the situation encountered. Since it is theorized that improvisation may not always be the result of a conscience decision it can be argued that not every instance of insufficient planning or work preparation by the centralized organization is recognized as such.

However, when asked, technicians almost unanimously reply that they have encountered such situations. Their response to these situations, when not classified as help seeking or inertness, is then regarded improvisation. This was also the underlying assumption in this research.

However, there are indications that practitioners differentiate between unassisted problem solving, within the boundaries of their competence and experience, and improvisation. It could be argued that, from the viewpoint of the centralized organization, this distinction is irrelevant since the ensuing action still lacks formal risk assessment. Still, the notion that not-formally risk assessed problem solving is presenting a risk to the organization is, according to the survey results, not shared by the target population.

CONCLUSION

The objective of this paper was to find if the tendency to improvise among maintenance technicians, working on a remote location in a centralized organization, is influenced by circumstantial factors. The factors this thesis focused on were (1) the perceived accessibility of help from the centralized organization and (2) the, perceived, degree of centralization. A negative correlation was established between the tendency to improvise and the perceived accessibility of help. When help is perceived less accessible, the tendency to solve unexpected problems through improvisation increases.

This study further found a negative correlation between the centralization of work preparation and planning and the likelihood of improvisation in the workplace. This means that the lower the, perceived, degree of centralization, the higher the tendency to improvise. This finding is contradictory to the hypothesis that assumed a positive correlation. No definite explanation for this effect could be learned from the research results and further research into this effect may help provide the required insights.

The design of the study created several limitations. The anonymized questionnaire omitted the possibility for follow up questions. As such, a correlation could be established but a causality between the variables could not be confirmed. Therefore, this study could not confirm if the circumstantial factors influenced the tendency to improvise because that specific phrasing suggests causality. It is also necessary to point out that improvisation, as a scientific construct, is sometimes criticized. It is said that research needs a clearer conceptualization and understanding of what improvisation means and how it unfolds in organizational contexts (Leone, 2010). Cornelissen (2006, p. 1580) describes how “processes of metaphorical imagination partake in theory construction” which may even be more tempting when the constructs offer “a very promising explanatory potential” (Leone, 2010, p. 1). The understandings gained throughout this research render the impression that ‘Tendency to Improvise’ may not have been the right construct. A deviation from predefined plans and procedures cannot, in the perception of the sharp end practitioners, automatically be labeled as improvisation. As long as the problem solving is within the domain of their competence and experience they do not feel that they are improvising. A better argument may have been that with centralization, not the tendency to improvise but the probability of *not formally risk assessed deviation* increases when help is not readily available.

The basic philosophy behind the concept of Management of Change is that the risk of deviation from the plan can only be managed centrally. Where this may be true for complex work, it seems that for everyday maintenance activities the

concept is not very successful. The fundamental issue in a centralized organization may well be the underestimation of the capabilities of the sharp end practitioners. With that, this research seems to support the findings of the literature study that maintenance workers consider the capability to deal with unexpected events an integral aspect of professionalism (Reiman, 2011; Hollnagel, 2009; Petterson & Aase, 2008). When the term “professionalism” encompasses the set of desired behaviors for any role, then there clearly exists a gap between the understanding of what constitutes professionalism in maintenance workers between the onshore- and offshore part of the organization. Consequently, it can be argued that the results of the research support the conclusion from the literature study that the current reliance on the MoC procedure as a way to deal with unexpected events apparently is based on unrealistic expectations towards the effectiveness of these procedures.

The findings from this research suggest that technicians clearly recognize the moment when plans and procedures are falling short. Meaningful further research could be aimed at understanding how technicians continue from this point and if, and how, they distinguish between unassisted problem solving and improvisation. Furthermore it would be useful to engage in a discussion on the necessity to formalize help seeking through a procedure. It is interesting to debate if a centralized organization would be able to deal with the requests at all if technicians would fully adhere to the procedure in all the instances they recognize that plans and procedures are underspecified.

The insights gained from this research, combined with practical work experienced in the target organization, has led to the impression that the MoC procedure seems most looked-for in the instances it was not used and an accident occurred. As such, the MoC procedure creates an illusion of control concerning the management of risk of activities that do not fit the existing plan and procedures. The research results indicate that these instances are numerous but MoC processes are seldom initiated. Whether that is important or not could be the subject of further research.

Finally, how could the industry proceed to increase control over situations that deviate from pre-defined plans and procedures? The answer may lie in that increased centralization requires increased collaboration. Technicians that have established a good working relationship with their discipline engineers will, in accordance with the literature (Hofman et al, 2009, Van der Rijt et al, 2013), find it easier to seek help. Allowing technicians insight and a voice in plans and work preparation processes and engaging in technical discussions will help build mutual trust. Rather than regarding the sharp end practitioners as the “hands” of the organization that need continuous guidance and control, increased interaction between the central planning function and the sharp end practitioners

may reduce the need for formal MoC, in favor of recognition of the competences and skills of the technicians and a shared understanding of the limits of these skills.

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APPENDIX 1 SURVEY QUESTIONS

The following questions appear in the survey;

1. *How many years of working experience do you have that are relevant for your current position? (General Question)*
Answer range: <2, 2-5, 6-10, 11-15, >15
2. *In which country do you perform most of your work? (General Question)*
Answer range: Germany, Netherlands, UK, Norway, Other
3. *How many times have you experienced situations at work in which pre-established plans and procedures were not applicable to the situation at hand? (Likelihood of improvisation)*
Answer range: (1) never – (2) sometimes – (3) regularly – (4) often – (5) always
4. *Do you tend to handle work situations, in which pre-established plans and procedures are not applicable to the situation at hand, by yourself (unassisted)? (Likelihood of improvisation)*
Answer range: (1) never – (2) sometimes – (3) regularly – (4) often – (5) always
5. *What is your opinion on the following statement: "A competent technician can solve most problems without onshore support"? (Likelihood of improvisation)*
Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree
6. *What is your opinion on the following statement: "My organization has implemented a procedure (Management of Change) that I can use when plans or procedures are not sufficient to complete my task"? (General Question)*
Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree
7. *Do you solve unexpected situations that fall outside existing plans and procedures yourself, without assistance? (Likelihood of improvisation)*
Answer range: (1) never – (2) sometimes – (3) regularly – (4) often – (5) always

8. *How likely are you to improvise when confronted with a situation at work where plans and procedures seem not applicable? (Likelihood of improvisation)*

Answer range: (1) I never improvise – (2) not very likely – (3) neutral – (4) likely – (5) very likely

9. *How likely are you to deal with situations, where plans and procedures are not applicable to the situation at hand, by initiating a formal MoC process? (Likelihood of improvisation)*

Answer range: (1) I never initiate an MOC process – (2) not very likely – (3) neutral – (4) likely – (5) very likely

10. *How often have you dealt with situations where plans and procedures were not applicable to the situation at hand by initiating a formal MoC process? (Base rate question – matching question 3)*

Answer range: (1) Never – (2) sometimes – (3) neutral – (4) most of the times – (5) always

11. *What is your opinion on the following statement: "Outside office hours there is always an engineer specialized in my discipline on duty to support me"? (Accessibility of help)*

Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree

12. *What is your opinion on the following statement: "In my organization there is always technical help available when I need it"? (Accessibility of help)*

Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree

13. *What is your opinion on the following statement: "The onshore support organization is accessible for support 24 hours a day, 7 days a week"? (Accessibility of help)*

Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree

14. *What is your opinion on the following statement: "When confronted with a situation where the pre-defined plan is not sufficient, I can always get help by initiating a Management of Change process"? (Accessibility of help)*

Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree

15. *What is your opinion on the following statement: "In my organization, planning of maintenance work is done by the onshore organization"? (Centralization of work preparation and planning)*
Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree
16. *What is your opinion on the following statement: "In my organization, work preparation for maintenance work is done by the onshore organization"? (Centralization of work preparation and planning)*
Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree
17. *What is your opinion on the following statement "In our organization there is a strict separation of planning and execution of maintenance work"? (Centralization of work preparation and planning)*
Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree
18. *What is your opinion on the following statement: "As my role is concerned with the execution of pre-planned work, I feel I should contact the onshore (planning) organization when I run into situations for which there are no specified plans or procedures"? (Centralization of work preparation and planning)*
Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree
19. *What is your opinion on the following statement: "As my role is concerned with the execution of pre-planned work, I feel I should initiate an MOC (Management of Change) process when I run into situations for which there are no specified plans or procedures"? (Centralization of work preparation and planning)*
Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree
20. *What is your opinion on the following statement: "The MOC (Management of Change) process is very effective to deal with situations for which the existing plans or procedures are not sufficient"? (General Question)*
Answer range: (1) Strongly disagree – (2) disagree – (3) neutral – (4) agree – (5) strongly agree

APPENDIX 2 INFORMED CONSENT STATEMENT

Dear Participant,

You have been invited to participate in a survey that is an essential part of research work concerning factors that influence the execution of maintenance work. The research is performed by Kick Sterkman (kick.sterkman@gdfsuezep.com) and governed by the University of Lund, Sweden, Faculty of Human Factors and System Safety.

The purpose of the research is to examine if a relation can be established between several circumstantial factors and the performance of maintenance. You have been selected as a participant in this survey because of your role in the organization and the relevance of your opinions and experience to this research. The survey consists of 20 questions and answering will require around 5 minutes of your time.

The identities of all participants will remain anonymous and will not even be known to the researcher.

Your participation in this research project is entirely voluntary. You may refuse to participate or withdraw from the research at any time.

The results of this research will form a part of a thesis. Upon completion of the thesis, the results of the survey and the conclusions will be made publically available.

In case further information is required please contact Kick Sterkman at kick.sterkman@gdfsuezep.com.

Your participation indicates that you have read this consent form and that you consent to participate in this research.

Thank you for supporting this research!

