FACULTEIT ECONOMIE EN BEDRIJFSKUNDE

UNIVERSITY OF GHENT

FACULTY OF ECONOMICS AND BUSINESS ADMINISTRATION

YEAR 2014-2015

The Impact of Lean on the Problem-Solving Behaviour of Nurses

Dissertation filed in order to obtain the degree of Master of Science in Applied Economics: Business Engineering

Simon Van Beveren

under the instructions of

Prof. dr. Paul Gemmel

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NEDERLANDSTALIGE SAMENVATTING

In deze masterproef werd de impact van de Lean filosofie op de probleemaanpak van verpleegkundigen onderzocht. Deze probleemaanpak werd uitgesplitst in twee overkoepelende gedragingen, het zogenaamde first-order en second-order problem-solving. First-order problem-solving heeft als typische kenmerk dat er getracht wordt om problemen op korte termijn te verhelpen zodat een bepaalde taak zo vlug mogelijk vervolledigd kan worden. Men gaat dan over tot het "blussen van een brandje" en men voelt zich bevredigd door het feit dat het probleem verholpen kon worden op eigen houtje. Desalniettemin wordt er geen verdere actie ondernomen om te zorgen dat het probleem zich niet meer stelt in de toekomst. Dit is juist waar second-order problem-solving over handelt. In plaats van enkel het probleem op korte termijn te verhelpen, onderneemt men verdere acties zodat de kans verkleint dat het probleem nog kan voorkomen in de toekomst. In de literatuur werd een model geïdentificeerd dat de variabelen voor een verhoogde graad van second-order problem-solving beschrijft. Dit model van Tucker en Edmondson dateert reeds van het jaar 2002 en daarom werden verwijzingen gecontroleerd om na te gaan of er geen recentere versies ontdekt konden worden. Op het moment dat deze zoekopdracht negatief bleek, werd systematisch de impact van de Lean filosofie op elk van de variabelen onderzocht door literatuur te raadplegen die handelt over Lean, verplegers en de specifieke variabelen van het model. Hieruit werd een propositie opgesteld, luidend dat er verwacht wordt dat een hoge mate van "Lean maturiteit" leidt tot een hogere graad van second-order problem-solving.

In het empirische luik van deze masterproef werd een quasi-experiment opgesteld binnen vier diensten verspreid over twee ziekenhuizen. Per ziekenhuis werd er telkens een dienst opgenomen met een hoge graad van ervaring in de Lean filosofie en een dienst waar Lean niet geïmplementeerd is of in elk geval minder succesvol. De eerste dienst heeft de functie van experimentele groep terwijl de dienst met lagere maturiteit opgenomen wordt als controlegroep. De resultaten gaven een indicatie dat de propositie klopt, maar deze bekrachtiging gold slechts in één van de twee ziekenhuizen. Daarom werd onderzocht waar het verschil aan te wijten kan zijn. Als verklaring werd vooropgesteld dat het ene ziekenhuis opteert voor een organisatie-overkoepelende implementatie van Lean waar het topmanagement duidelijk het geloof in de filosofie uitdraagt. In het andere ziekenhuis werd de keuze voor Lean ingegeven door het management van de specifieke dienst en geldt er dus geen overkoepelende aanpak. Ook focust het eerstgenoemde ziekenhuis meer op de Lean-cultuur dan het tweede, waar de tools van Lean voorop staan. Persoonlijkheidskenmerken van verpleegkundigen werden geacht geen impact te hebben op de resultaten maar door een beperkt aantal respondenten kon hier geen indicatie over gegeven worden.

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This dissertation would not have been possible without the help of several individuals who deserve my sincere gratitude.

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My family, moreover, receives an honourable mention. My parents, first of all, gave me the possibility to initiate this academic education. They were always willing to help or listen when an issue arose and their confidence in my possibilities boosted me to strive for the best results. Also my brother and my sister deserve my gratitude for their support and optimism.

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To all of you,

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ABBREVIATIONS

UHA	University Hospital of Antwerp
UHG	University Hospital of Ghent
CAQDAS	Computer Assisted Qualitative Data Analysis Software
CIP	Continuous Improvement Process
CSE	Customer-Service Empowerment
CEO	Chief Executive Officer
CNO	Chief Nursing Officer
FTE	Fulltime-Equivalent
i.e.	id est, meaning: that is
IH	Inpatient clinic of Heart surgery
IO	Inpatient clinic of Orthopaedics
ISBARR	Introduction, Situation, Background, Assessment, Recommendation and Readback
MBI-HSS	Maslach Burnout Inventory-Human Services Survey
NHS	National Health Service
NWI-R	Revised Nursing Work Index
OD	Outpatient clinic of Dermatology
OG	Outpatient clinic of General Internal Disorders
PSE	Problem-Solving empowerment
PW	Productive Ward
SRE	Service-Recovery Empowerment
TPS	Toyota Production System

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FIGURES

CHARTS

1. INTRODUCTION

The choice for this research topic was not a spur of the moment. During my third year in university, I became aware of the Lean culture in the course “Productiebeleid” taught by em. prof. dr. Luc Chalmet. During his class I learned the basic principles of the Toyota Production System and I was immediately interested. The principles of Lean which are both very simple to understand and very complex to implement, were studied more in detail during “Advanced Production Management”, taught by prof. dr. Tarik Aouam and “Total Quality Management”, taught by prof. dr. Dries Goossens. During these classes, my interest for Lean and its replications on the performance of firms grew even further.

Above that, I have always been interested in the healthcare industry. Consequently, when I noticed the subject of this dissertation on the list provided by prof. dr. Paul Gemmel, I immediately applied since the topic united both my curiosity for Lean and healthcare. The subject, which was originally named “Lean and Service in Hospitals: Two Sides of the Same Coin”, was narrowed after an initial literature review to “The Impact of Lean and the Problem-Solving Behaviour of Nurses”. This was done as this topic carried the mutual interest of both me and prof. dr. Paul Gemmel. On top of that, direct literature concerning the impact of the Lean philosophy on the problem-solving behaviour of nurses was scarce. That is why, I was very motivated to start investigating this subject with the eye on contributing to scientific literature.

2. LITERATURE REVIEW

2.1. PROBLEM-SOLVING IN NURSING

2.1.1. PROBLEMS AND ERRORS

An introduction into the vocabulary that is used in this dissertation is needed to completely understand the meaning of several expressions. Firstly, terms as problems and problem-solving are used frequently and are core concepts of this study. Therefore, they have to be defined in a meticulous way. A search in WordNet 3.1 provided three definitions of the expression "problem". These definitions can be aggregated into one single statement that is applicable in the light of this study.

"A problem is a state or a source of difficulty that needs to be resolved."

This description is very generic and needs to be refined with the eye on thoroughly understanding the concept. A refinement can be found in the problem definition of Tucker and Edmondson (2003).

"A problem is defined as a disruption in a worker's ability to execute a prescribed task because either: something the worker needs is unavailable in the time, location, condition, or quantity desired and, hence, the task cannot be executed as planned; or something is present that should not be, interfering with the designated task." (Tucker&Edmondson, 2003, p. 57)

The same authors provided five broad types of organisational nurse problems which are listed in the subsequent table.

Table 1 Broad Types of Organisational Problems

Missing or incorrect information
Missing or broken equipment
Waiting for a human or equipment resource
Missing or incorrect supplies
Simultaneous demands on the workers time

Source: Adapted from Tucker and Edmondson (2003, p. 58)

Table 1 provides the insight that the focus of this study is on organisational problems that nurses have to face, rather than on medical problems. As will be described below, nurses will approach these two umbrella categories of problems in a completely different way, i.e. a deductive and an

inductive one. To conclude this, a thorough understanding of both medical and organisational problem-solving is required.

Medical problem-solving is described by Round (2000) and Taylor (2000) and is a synonym for clinical reasoning, clinical decision-making and diagnostic reasoning. It is defined as *"the cognitive process that is necessary to evaluate and manage a patient's medical problem"* (Round, 2000, p. 109). This problem is therefore focused on the underlying causes of a certain disease or disorder and what treatment has to be prescribed. Several theoretical approaches have been studied for over 30 years and they have their roots in a number of different perspectives like psychology, clinical psychology, clinical practice and clinical education (Round, 2000). Examples of theories of clinical reasoning are decision- and information processing theory (Round, 2000; Taylor, 2000). The conclusion of these theories in combination with the examination of the theory of critical thinking of nursing (Martin, 2002) is that when solving medical problems, an inductive reasoning process is followed and therefore subjective experience carries more weight than reason (Martin, 2002; Round, 2000; Taylor, 2000). Round (2000) states that hypotheses about the problem are generated in the early clinical decision-making phases and that there is a rapid turnaround from collecting data and information to hypothesis testing. The information that is collected after the process of hypothesis generation will always be a function of this set of hypotheses. As a result, the procedure of clinical reasoning is a process of inductive decision-making rather than one of deductive reasoning as in the nursing process itself (Round, 2000). This nursing process of caring is described as a collection of goal-oriented methods and principles that provide a framework to the execution of nursing tasks (Round, 2000). This is very similar for organisational problem-solving in which hospital management creates an environment in which organisational problems of nurses are guided by a set of principles and methods (Tucker&Edmondson, 2002, 2003). Consequently, organisational problem-solving is approached in a more deductive way, guided by theory and principles. Examples of methods for organisational problem-solving in a healthcare setting are provided by Mazur, Chen and Prescott (2008) and Sobek and Jimmerson (2004, 2006).

An implication of the contrast between medical and organisational problem-solving is that the result of medical problem-solving is heavily and positively influenced by experience and age (Martin, 2002; Round, 2000; Taylor, 2000), while the result of the latter one is not (Mazur&Chen, 2009; Tucker&Edmondson, 2002, 2003; Young, Corsun, &Shinnar, 2004). The enhancement of organisational problem-solving is rather the responsibility of management that has to come up with decent methods and guidance for helping workers to solve and to prevent problems (Mazur&Chen, 2009; Tucker&Edmondson, 2002, 2003; Young, Corsun, &Shinnar, 2004).

On top of the distinction between medical and organisational problems, a second distinction has to be made regarding two types of process failures, i.e. problems and errors. A search in WordNet 3.1 offered a statement that is applicable in the light of this study.

"An error is a wrong action, attributable to bad judgement, ignorance or inattention."

Another definition of an error can be found in the following declaration:

"An error is the execution of a task that is either unnecessary or incorrectly carried out and that could have been avoided with appropriate distribution of pre-existing information." (Tucker&Edmondson, 2003, p. 56)

Together with problems, errors form the pre-mentioned process failures in the front-lines of hospital care delivery. Errors and their reporting and prevention in healthcare are widely discussed (Chiang, Lin, Hsu, &Ma, 2010; *IOM Report, 1999*; Mazur&Chen, 2009; Throckmorton&Etchegaray, 2007) although it has to be noted that the difference between problems and errors sometimes disappears and is rather vague. The delivery of the right medication to the right patient is a typical example of how errors can cause problems and how the two types of process failures are intertwined. When wrong medicines are distributed to nurses who have to provide these to patients, an error is made by the distributor. The nurses then face problems, which can be categorised under the fourth type of problems listed in Table 1, missing or incorrect supplies.

An important distinction between problems and errors, however, arises in the responsibility of handling and preventing the specific process failures. In the case of problems, workers can take action due to their intense awareness of them. On the other hand, in case of errors, the ultimate responsibility lies in the area of management that has to redesign work systems in ways that make errors less likely to occur (Tucker&Edmondson, 2003). Subsequently, workers can contribute to the prevention of problems rather than to the prevention of errors because the latter process failure is more often attributed to characteristics of the process and the work system. Nevertheless, the role of management cannot be neglected in facilitating the problem-solving effort (Mazur&Chen, 2009; Spear, 2005; Tucker&Edmondson, 2002, 2003; Young, Corsun, &Shinnar, 2004).

2.1.2. First- and Second-Order Problem-Solving

2.1.2.1. Definitions and Motivations for First-Order Problem-Solving

In research on quality improvement there is a distinction between two types of responses to organisational problems. These responses find their roots in the notion of organisational learning. Organisational learning can be divided into two approaches, a "behaviourist" and a "cognitive" one (Gond&Herrbach, 2006). The former approach views organisational learning as an adaptive competence resulting from the environment. The organisation is viewed as a goal-driven, adaptive system that has to reach certain target levels (Gond&Herrbach, 2006). Solutions to cope with certain problems are obtained from a set of pre-existing routines and these routines are not changed. This can be denoted as the first-order problem-solving response of organisational learning (Gond&Herrbach, 2006). The cognitive approach, nevertheless, focuses on an in-depth questioning of current work practices and theories in order to discover root causes of problems in organisations. This matches with the second-order problem-solving effort (Gond&Herrbach, 2006) which is the second response to organisational problems. It is by applying second-order problem-solving that real improvements in organisational learning can be obtained (Tucker&Edmondson, 2003).

The first response to organisational problems, denoted as first-order problem-solving, is a short-term answer and only "patches" problems (Tucker&Edmondson, 2003). This way, the immediate problem is solved but the underlying conditions, which created the problem, remain unaffected (Tucker&Edmondson, 2002, 2003; Young, Corsun, &Shinnar, 2004). This means that a quick workaround is applied to one of the five broad types of organisational problems in Table 1, without influencing the probability of recurrence. The term workaround is used frequently in healthcare literature (Debono, Greenfield, Black, &Braithwaite, 2010; Rathert, Williams, Lawrence, &Halbesleben, 2012; Vogelsmeier, Halbesleben, &Scott-Cawiezel, 2008). Workarounds are defined as *''work patterns an individual or a group of individuals create to accomplish a crucial work goal within a system of dysfunctional work processes that prohibits the accomplishment of that goal or makes it difficult''* (Debono, Greenfield, Black, &Braithwaite, 2010, p. 3). For maintaining the clarity of this study, the word "workaround" is used as a synonym for first-order problem-solving behaviour. First-order problem-solving is also known as reactive action, routine action, single-loop learning (Tucker&Edmondson, 2002) and fire-fighting (Young, Corsun, &Shinnar, 2004).

Second-order problem-solving, on the other hand, goes further and attempts to change the system so that the process failures do not reappear (Tucker&Edmondson, 2002). This type of problem-solving is also called preventive control, learning action and double-loop learning and it is displayed by three major actions: communication about exceptions, effort to find and remove underlying

causes of problems and experimentation (Tucker&Edmondson, 2002). A list of more detailed actions concerning second-order problem-solving is provided in the subsequent table. It has to be noted, however, that the two problem-solving responses are very often used together, meaning that they both can be applied to a single organisational problem. For example in a service organisation, it is perfectly possible that a first-order problem-solving approach precedes a second-order problem-solving one in order to continue customer service. Especially, in the healthcare setting, it is expected that first-order problem-solving behaviour will precede second-order problem-solving behaviour since in many cases, the patient will not be able to wait for the promised care and therefore, a quick workaround is desired (Tucker&Edmondson, 2002, 2003). However, after this action, second-order problem-solving behaviour might still occur.

Table 2 Actions of Second-Order Problem-Solving

Communicating to the person or department responsible for the problem
Bringing the problem to the attention of the manager or the head nurse
Sharing ideas about the cause of the situation and how to prevent recurrence with someone in a position to implement changes
Implement changes
Verify that changes have the desired effect

Source: Adapted from Tucker and Edmondson (2003, p. 61)

The short-term fix, resulting from a first-order problem-solving approach, enables nurses to continue caring for patients but does not grasp the opportunity to enhance organisational learning (Tucker&Edmondson, 2003). Although, first-order problem-solving in itself seems very successful in terms of cost to the nurse and the hospital, it is counterproductive given the fact that communication about problems is isolated (Tucker&Edmondson, 2003). Learning opportunities do not emerge when workers rarely inform the person responsible for a specific problem (Tucker&Edmondson, 2003).

Again, the medication distribution error which leads into an organisational problem at the front-lines of health care delivery, forms an excellent example. When the distribution error is detected, a nurse can easily pick up the right medication in a manner that the time lost is minimised. The nurse might feel gratified when figuring out a way to circumvent a problem, enabling him or her to continue patient care. On top of that nurses perceive working around problems as part of their jobs (Tucker&Edmondson, 2003). However, no action is undertaken to prevent the medication distribution error from recurrence and even worse, the rapid fix might lead to new problems

elsewhere since medication shortages may occur due to a lack of communication (Mazur&Chen, 2009; Tucker&Edmondson, 2003; Young, Corsun, &Shinnar, 2004). The resulting emergence of new problems is clearly described in the following statement.

*"By failing to focus on root causes and their solution, fire-fighters ensure that there will always be another fire to fight." (*Young, Corsun, &Shinnar, 2004, p. 28)

Young, Corsun and Shinnar (2004) describe this as a cascading effect resulting from the fire-fighting effort and Mazur and Chen (2009) call this the "snow-ball" effect. Also, in solely applying first-order problem-solving, considerable precious time is spent on tasks and rework. This can be considered as pure waste in comparison to a state in which things are done right the first time (Tucker&Edmondson, 2003).

Tucker and Edmondson (2003) discovered two implicit strategies for the profession of nursing, which are called rules-of-thumb. They cause the emergence of the rapid fixing effort without probing into what caused the obstacle to occur. On top of this, Young, Corsun and Shinnar (2004) advocate the widespread use of solely patching the symptoms of the problem to the organisation's problem-solving culture.

"Rule-of-thumb 1: When you encounter a problem, do what it takes to continue the patient-care, no more, no less." (Tucker&Edmondson, 2003, p. 61)

"Rule-of-thumb 2: When necessary for continuity of patient care, ask for help from people who are socially close rather than from those who are best equipped to correct the problem." (Tucker&Edmondson, 2003, p. 61)

The latter rule-of-thumb is in line with previous findings of Tucker and Edmondson (2002), implying that when an obstacle is encountered, communication about the problem is most likely addressed to peers rather than to people who can actually solve and prevent the problem from recurrence. In the light of this finding, Young, Corsun and Shinnar (2004) state that when the number of stressful encounters for front-line service workers is increased, these employees avoid interacting with irate management. This is a dimension of coping known as limitation (Young, Corsun, &Shinnar, 2004). The former rule-of-thumb, however, is also described by Young, Corsun and Shinnar (2004). They state that the focus on customer problems is at the heart of service organisations, in which the customer comes first, and is perceived as more important in comparison to solving organisational problems (Young, Corsun, &Shinnar, 2004).

In line with *"Rule-of-thumb 1"* and the fact that nurses perceive an important part of their jobs as handling with obstacles (Tucker&Edmondson, 2003), organisations often hold successful fire-fighters up as true heroes (Young, Corsun, &Shinnar, 2004). Tucker and Edmondson (2003) describe this as individual vigilance, i.e. "*the industry norm that encourages nurses and other health care professionals to take personal responsibility to solve problems as they arise"* (Tucker&Edmondson, 2003, p. 63). This norm is explicitly present and highly developed in healthcare organisations. Consequently, barriers to organisational improvement are created and independence is stimulated (Tucker&Edmondson, 2003). The culture of the organisation has to be adapted in a way that first-order problem-solving is not the final step in the problem-solving effort. For example, changes have to be made regarding reward systems (Tucker&Edmondson, 2002; Young, Corsun, &Shinnar, 2004) in a way that fire-fighters are no longer celebrated.

Another important motivation for the emergence of first-order problem-solving is the way nursing units are designed. These units are designed to maximise individual unit efficiency since nursing labour is rather expensive and in short supply (Tucker&Edmondson, 2003). The workload in hospitals is therefore very high and slack resources to resolve underlying causes of problems are unavailable (Tucker&Edmondson, 2003). Consequently, nurses do not have time to thoroughly investigate root causes and are pushed into the direction of first-order problem-solving.

Furthermore, the notion of empowerment has a dark side on second-order problem-solving. This might seem rather counter-intuitive given the fact that front-line workers are in the perfect position to handle root causes of problems and, if empowered, they have the authority to do this. As mentioned above, this perfect position to solve problems results from the deep consciousness of organisational problems nurses can develop (Tucker&Edmondson, 2003). Although empowerment of workers and nurses has been proven as a solution for quality and productivity problems, the removal of managers and other support leave nurses on their own to resolve problems. Managers are more likely to possess the status and power necessary to resolve problems which cross organisational boundaries and they appear to have a broader perspective on them. Consequently, by applying an extensive empowerment strategy without managerial support, the chances of a thorough root cause removal are diminished (Tucker&Edmondson, 2003).

Young, Corsun and Shinnar (2004) investigated this concept of empowerment and they came up with three different types varying in their impact on future first-order problem-solving. The first type of empowerment is described as service-recovery empowerment (SRE) and is only activated when a failure in service delivery occurs. The worker or nurse is then allowed to work around the process failure with a quick fix in a way that the service process is able to continue. Consequently, decreases

in customer retention and satisfaction will be countered, which is very important in the competitive market place. However, SRE is likely to have a direct effect on future first-order problem-solving since root causes of organisational problems are unaffected (Young, Corsun, &Shinnar, 2004). Customer-service empowerment (CSE), on the other hand, entails the possibility of offering services to customers on a proactive, not a reactive basis (Young, Corsun, &Shinnar, 2004). In contrast with SRE, CSE is not triggered by a process failure and it is therefore unlikely that future first-order problem-solving will result from this type of empowerment (Young, Corsun, &Shinnar, 2004). The last possible type introduced by Young, Corsun and Shinnar (2004) is problem-solving empowerment (PSE) which is the opportunity for nurses to solve organisational problems and their root causes. This appears to result in powerful long-term benefits (Mazur&Chen, 2009; Spear, 2005; Tucker&Edmondson, 2002, 2003; Young, Corsun, &Shinnar, 2004).

In addition, Hayes (1981) also underlines the importance of the national culture of a country. He contrasted US and Japanese managers and resulted that:

"American managers actually enjoy crises; they often get their greatest personal satisfaction, the most recognition, and their biggest rewards from solving crises. Crises are part of what makes work fun. To Japanese managers, however, a crisis is evidence of failure. Their objective is disruption-free, error-free operation that does not require dramatic fixes." (Hayes, 1981, p. 61)

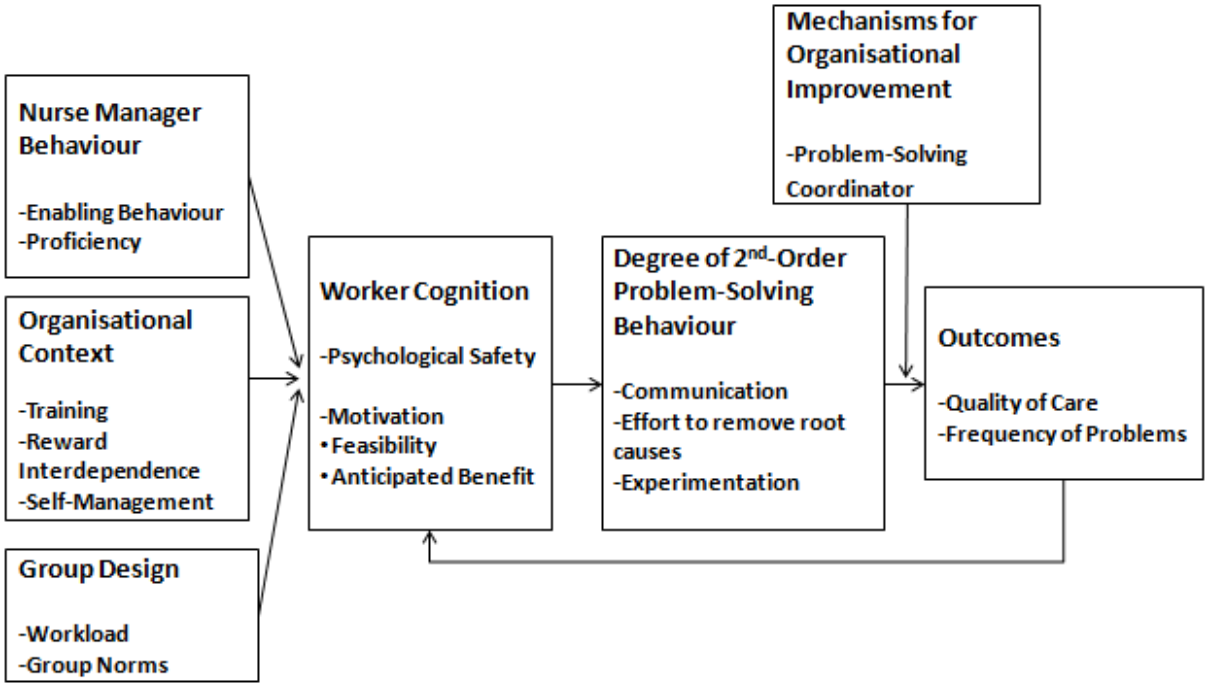
If these beliefs exist in the heads of managers, they will certainly have an impact on the beliefs of workers, or more specifically nurses, since it is the job of managers to translate organisational culture into a practical conversion on the work floor (Emiliani, 2003). This is in line with the findings of Young, Corsun and Shinnar (2004) who state that problem-solving has to be a primary concern for management and that employees have to be encouraged to participate in a process that exceeds fixing the short-term problem.

2.1.2.2. Model of Nurse Second-Order Problem-Solving Behaviour

In the previous paragraph, motivations for the application of first-order problem-solving for front-line nurses were explored. In the light of this study, however, the variables that lead to the action of root cause removal have to be identified to further improve organisational learning. Literature (Mazur&Chen, 2009; Spear, 2005; Tucker&Edmondson, 2002, 2003; Young, Corsun, &Shinnar, 2004) provided several insights into the underlying variables of second-order problem-solving. However, the bulk of these variables can be found in the Model of Nurse Second-Order Problem-Solving of Tucker and Edmondson (2002). This model will serve as a basis for the research model of this study and is depicted in the following figure. It is important that the variables of this model are meticulously defined in order to fully understand the underlying drivers of second-order problem-

solving. Since the model and other concepts related to second-order problem-solving are mainly based on the work of Tucker and Edmondson, which dates from the years 2002 and 2003, all citations were checked in order to make sure that no extensions exist which are more recent and more useful regarding the topic of this dissertation. The 2002 model was cited 17 times but the model itself was never adapted. The work dating from 2003, however, has 507 Google Scholar Citations after the first quarter of 2015. A browse through these citations and the reading of several abstracts convinced the researcher that the information is still up to date and applicable in the light of this study.

Figure 1 Model of Nurse Second-Order Problem-Solving



Source: Adapted from Tucker and Edmondson (2002, p. 90)

In their 2002 empirical research, Tucker and Edmondson found out that the nurses they shadowed faced an average of one problem per hour. Problems or exceptions can therefore be seen as an unavoidable part of nursing and are considered as routine. Dealing with these problems, as mentioned above, is therefore perceived as an essential part of the nursing profession (Tucker&Edmondson, 2002, 2003). In the case of difficulties, workers tend to stick to routines, even it is very straightforward that change is needed (Tucker&Edmondson, 2002). Tucker and Edmondson (2002) built on this line of thinking to claim that organisational routines, rather than sporadic individual efforts, are essential to develop capabilities in second-order problem-solving. Little differences were observed between individual nurse aspirations or abilities to develop the systems in which they worked. Instead Tucker and Edmondson (2002) identified differences in how well nurse

environments supported improvement activities. These differences lead to the supportive conditions for second-order problem-solving behaviour in the model. The conditions can be split up in three different managerial levers: nurse manager behaviour, organisational context and group design, each with their own sub dimensions (Tucker&Edmondson, 2002).

Managerial Levers

1. *Nurse Manager Behaviour*

In the road to the second-order problem-solving behaviour of nurses, nurse manager behaviour is a crucial enabler (Mazur, Chen, &Prescott, 2008; Mazur&Chen, 2009; Spear, 2005; Tucker&Edmondson, 2002, 2003). As mentioned earlier, Young, Corsun and Shinnar (2004) stated that problem-solving has to monitored closely by management. Employees have to be encouraged by inspiring leaders to participate in a process that exceeds fixing the short-term problem (Mazur&Chen, 2009; Spear, 2005; Tucker&Edmondson, 2002, 2003). In their research, Tucker and Edmondson (2002) experienced an elevated second-order problem-solving behaviour in hospitals where nurse managers were strongly present on the work floor or when there was a designated, available individual to provide direction and support to nurses. The latter reason resulted in higher levels of assistance and coaching to nurses when problems were encountered and is called “enabling behaviour”. The former cause of elevated second-order problem-solving is presented as “proficiency”. This implies the fact that managers are physically present on the nursing floor, they have time to resolve problems and have a status of improving conditions (Tucker&Edmondson, 2002).

2. *Organisational Context*

Organisational context is the second supportive condition for second-order problem-solving behaviour. In their research, Tucker and Edmondson (2002) found that “training”, “reward interdependence” and “self-management” are connected with effective improvement efforts and that is why these three variables form the construct of organisational context. First of all, training on problem-solving techniques is important because it can elevate perceived and actual competencies of nurses. It can also help in creating a culture that values never-ending improvement activities (Tucker&Edmondson, 2002). Inadequate training is commonly accepted as one of the major hurdles of effective organisational improvement. A reason of this poor training is that efforts are mostly aimed at managerial and support personnel rather than on nurses or doctors who are occupied in the front-lines where problems appear on the surface (Tucker&Edmondson, 2002).

Secondly, reward interdependence forms a next variable of the organisational context-construct. Reward systems that are aimed at the functioning of more substantial groups can stimulate

supportive behaviour towards second-order problem-solving (Tucker&Edmondson, 2002). Examples of positive reward systems in a healthcare system comprise task teams with representation over functional departments and an organisational environment that values outcomes at a higher level more than individual performance outcomes (Tucker&Edmondson, 2002). This supportive, cooperative behaviour for solving problems is specifically important in a healthcare environment since the workers in these organisations are highly dependent on the outcomes and performance of other workers (Tucker&Edmondson, 2002).

The last underlying variable of organisational context is self-management which is denoted as *"the group level analogy to autonomy"* (Tucker&Edmondson, 2002, p. 99). Autonomy itself is defined as *"the amount of job-related independence, initiative, and freedom either permitted or required in daily work activities"* (Tucker&Edmondson, 2002, p. 99). It has been given much attention in academic literature because of the perceived effects of higher nurse satisfaction and productivity gains (Tucker&Edmondson, 2002) but can also have negative consequences in its form of higher empowerment (Young, Corsun, &Shinnar, 2004). These latter outcomes are already described above and need no further explanation. The positive effect of self-management is that motivation of workers is boosted by their ability to make decisions on their own behalf (Tucker&Edmondson, 2002).

3. Group design

The last supportive lever is the group design which can be split into two aspects, "workload" and "group norms". As described earlier, workloads in hospitals are a major issue because little spare time is available for improvement activities when workloads are heavy (Tucker&Edmondson, 2002). Time has to be made available to pursue these second-order problem-solving activities but this will always remain a disputable recommendation given the ever increasing efficiency concerns.

Secondly, behavioural norms regarding improvement and communication efforts varies between group members and members from other groups (Tucker&Edmondson, 2002). On top of this, there is a dissimilarity in behavioural norms between different hospital units (Tucker&Edmondson, 2002). From their empirical research, these researchers concluded that it is harder for nurses to communicate to members of other groups than to their peers. This can also be found in their work published in 2003. The solution for this divergence in group norms can be provided by planning meetings on a regular basis. Consequently, communication about exceptions is enhanced and behaviour towards second-order problem-solving is prompted.

Nurse Cognition

The three supportive conditions, also denoted as managerial levers, influence the degree of second-order problem-solving through the mediator of nurse cognition. Two core cognitions were identified by Tucker and Edmondson (2002), psychological safety and motivation. The latter cognition questions the premise of nurses being fully motivated to display second-order problem-solving, while the former one describes the nurse perception of work conditions to be interpersonally and psychologically safe. This psychological safety has an impact on involving in delicate improvement activities, which will be explained subsequently (Tucker&Edmondson, 2002).

1. Psychological Safety

The notion of psychological safety of nurses is an important aspect in reporting medical failures (Chiang, Lin, Hsu, &Ma, 2010; *IOM Report, 1999*; Mazur&Chen, 2009; Throckmorton&Etchegaray, 2007). On top of this, it is widely discussed in literature as illustrated by the work of Edmondson (1999) and Nembhard and Edmondson (2006).

The reasons why a psychological safe work context is of major importance for engaging in second-order problem-solving can be found in the fact that this form of problem-solving very often requires exposing human errors and shortcomings (Tucker&Edmondson, 2002). In a lot of cases this will have negative consequences on the "whistleblower" who raises the issue. On top of this, nurses have low organisational power, resulting in the frequently observed event of discovering errors made by individuals with higher power. In psychological unsafe environments this will result in a situation in which first-order problem-solving efforts prevails without any second-order problem-solving attempts. A second motive for the importance of a psychologically safe environment can be found in the fact that the reputation of the person, who raises the concern, will be unaffected. Once more, this state will lead to enhanced second-order problem-solving.

Only when the condition of psychological safety is fulfilled, nurses can illustrate the ideal behaviours or characteristics that result in second-order problem-solving. The characteristics of the ideal second-order problem-solving employee are listed in the following table.

Table 3 Ideal Employee Behaviours Leading to Second-Order Problem-Solving

Complaining to managers and others about the situation.
Making a fuss about mistakes of colleagues instead of quietly correcting other's errors.
Acknowledging own mistakes and being a self-aware individual.
Questioning rather than automatically accepting current practices.

Source: Adapted from Tucker and Edmondson (2003, p.68)

2. Motivation

In this context, motivation is defined as *"the determination to pursue activities intended to lead to root cause removal over alternative responses"* (Tucker&Edmondson, 2002, p. 100). Yet again, two components of this variable are identified, i.e. feasibility and anticipated benefit. Firstly, feasibility is the worker's faith that processes and resources needed to overcome a certain exception are present (Tucker&Edmondson, 2002). More specific, these resources and processes include time to invest in second-order problem-solving, mechanisms for communicating across unit and hierarchical boundaries, and access to a support person who can simplify the solving and implementation effort (Tucker&Edmondson, 2002). Secondly, nurses must believe that the possible benefits will outperform the personal costs of engaging in the removal of the root causes. If this is the case, motivation will be enhanced. These benefits originate from reduced encounters with a specific exception, which leads to reduced frustration, less wasted time and on top of this even a reduction in negative patient effects (Tucker&Edmondson, 2002).

Degree of Second-Order Problem-Solving Behaviour

As mentioned above, the three managerial levers lead to a higher degree of second-order problem-solving through the mediating variable of worker cognition. The three behaviours connected with a higher degree of second-order problem-solving were already described in its explanation and include "communication", "effort to remove root causes" and "experimentation". A list of more detailed actions concerning a higher degree of second-order problem-solving were displayed in Table 2.

Outcomes

The two performance outcomes of the model are "the possibility to reduce the frequency of problems over time" and "quality of care". Firstly, first-order problem-solving behaviour is expected to have no impact on the occurrence of future exceptions because no action is undertaken to prevent their recurrence (Tucker&Edmondson, 2002). Second-order problem-solving, in contrast, is expected to prevent the reappearance of similar problems. Consequently, over time, the frequency of exceptions is reduced.

Secondly, “quality of care” will be improved by a successful endeavour of second-order problem-solving. The basis for this outcome lies in the fact that delays in patient care or the number of inconvenienced patients will be reduced when root causes of problems are removed and exceptions are prevented from recurrence (Tucker&Edmondson, 2002).

On top of this, Tucker and Edmondson (2002) suggest the existence of a virtuous circle, depicted in the model by the arrow originating from the performance outcomes and going to worker cognition. This indicates a dynamic relationship between the outcomes and second-order problem-solving behaviour. The latter enhances performance, which in turn motivates future second-order problem-solving behaviour (Tucker&Edmondson, 2002).

Mechanisms for Organisational Improvement

Putting effort and showing willingness to engage in second-order problem-solving, however, is not sufficient to really assure root cause removal (Tucker&Edmondson, 2002). Tucker and Edmondson (2002) suggest that real improvements in root cause removal are obtained by the moderating variable of a problem-solving coordinator, which is a mechanism for organisational improvement. The definition of a problem-solving coordinator is displayed by the following statement.

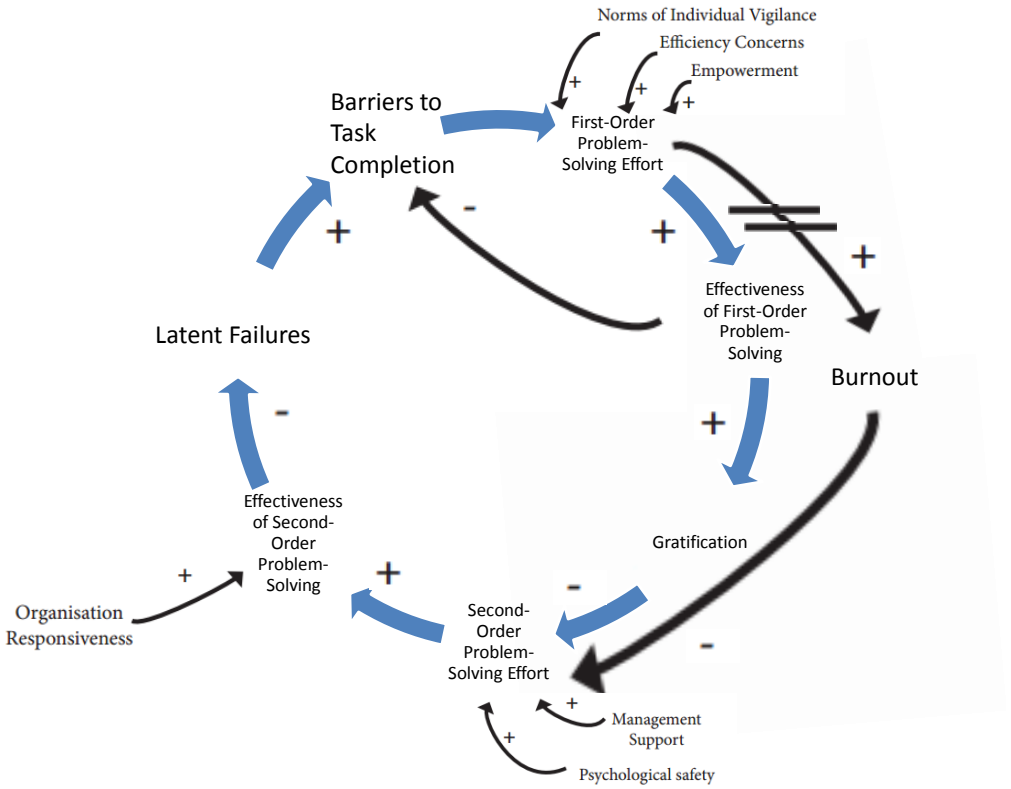
“A problem-solving coordinator is a person in a formal role at the work group level who is given the slack time and responsibility for communicating about problems across organisational boundaries, investigating for root causes, and implementing countermeasures.” (Tucker&Edmondson, 2002, p. 104)

This coordinator is also called “task coordinator”, “integrator”, and “organisational liaison” (Tucker&Edmondson, 2002). The problem-solving coordinator has to possess enough power and credibility to influence the activities of other work groups when change is desired. A major issue concerning second-order problem-solving efforts of nurses is that they do not have the required status within organisations, as described earlier (Tucker&Edmondson, 2002, 2003). On top of this, the pre-mentioned interdependent nature of various groups implies that coordination is of major importance (Tucker&Edmondson, 2002). Therefore, it is argued that *“a formal role is important in the nursing context because it allows the slack time, organisational status, and system focus necessary for negotiating improvement activities across functional boundaries”* (Tucker&Edmondson, 2002, p. 103).

2.1.2.3. The Balancing Loop of Problem-Solving Behaviour

In order to fully understand the dynamics of problem-solving behaviour, a schematic representation of the causal relationships between the pre-described constructs of first-order and second-order problem-solving is displayed in the following figure. The balancing loop is, yet again, adapted from the work of Tucker and Edmondson (2003, p. 65), who created this loop in an attempt to translate their 2002 model in managerial terms.

Figure 2 Balancing Loop of Problem-Solving Behaviour



Source: Adapted from Tucker and Edmondson (2003, p. 65)

The characteristics of the symbols used in the loop become clear when understanding the following illustration. If the loop is entered at the left side of the figure, latent or hidden failures increase barriers to task completion. The increase is indicated by a plus sign. These barriers, in combination with the three most important motivations for fire-fighting, lead to an increase in the first-order problem-solving effort as described earlier. When this effort is successful, the barriers to the completion of the task are removed and the nurse feels gratified. This feeling of gratification originates from the problem-solving culture in the organisation (Mazur&Chen, 2009; Spear, 2005; Tucker&Edmondson, 2002, 2003; Young, Corsun, &Shinnar, 2004). This example seems to promote first-order problem-solving. The nurse is able to continue the job and even feels delighted by working around the problem. However, latent failures are not removed and even worse, over time the nurse

could face a burnout resulting from frustration and exhaustion originating from too many organisational problems (Tucker&Edmondson, 2003). This time lag is indicated by two slash marks between first-order problem-solving and burnout. Obviously, this burnout will not lead to an increase in the effort put in second-order problem-solving (Tucker&Edmondson, 2003).

The explanation of the remainder of the loop is very straightforward given the description of the model of nurse second-order problem-solving behaviour (Tucker&Edmondson, 2002). However, a final remark has to be made concerning the influence of organisation responsiveness. Tucker and Edmondson (2003) describe this as the degree to which the organisation is responsive to efforts for root cause removal. If real changes have to be made, it is important that managers and others in the organisation respond to initiatives by pursuing and stimulating them (Tucker&Edmondson, 2003). This role is accomplished by the problem-solving coordinator in the model of second-order problem-solving (Tucker&Edmondson, 2002). Only this way, second-order problem-solving will be effective and latent failures will decrease.

2.2. LEAN AND SECOND-ORDER PROBLEM-SOLVING

The goal of this study is to investigate whether the Lean philosophy has an impact on the problem-solving behaviour of nurses. Therefore, an understanding of Lean is required without providing an endless list of its tools and practices. This would be out of the scope of this dissertation and would not bring any added value. An extra section, however, has to be devoted on Lean in healthcare since the application of Lean in this specific service environment is perceived as promising (Bahensky, Roe, &Bolton, 2005; Ben-Tovim et al., 2008; Dickson et al., 2009; Fillingham, 2007; Jimmerson, Weber, &Sobek, 2004; Kimsey, 2010; Manos, Sattler, &Alukal, 2006; Mazzocato, Savage, Brommels, Aronsson, &Thor, 2010; Mazzocato et al., 2012; Sirio et al., 2003) but also has its difficulties (Bahensky, Roe, &Bolton, 2005; Burgess&Radnor, 2012; Young&McClean, 2007). Finally, after these sections, the impact of Lean on the variables of the model of second-order problem-solving behaviour is investigated by making use of an extensive literature review.

2.2.1. ORIGIN AND PHILOSOPHY

The Lean production system finds its roots in the automotive industry during the 1980's. US car manufacturers were losing market shares to, predominantly, Japanese automakers who were able to manufacture cars with fewer defects and at higher customer satisfaction. Nevertheless, costs of these manufacturers were lower than the costs of the US manufacturers even when the former ones had to deal with shipping costs and tariffs (Jimmerson, Weber, &Sobek, 2004). The US manufacturers believed that the advantages in quality and costs were established through highly mechanised

factories, finely regulated to defect-free production, and on top of this an excess of meticulous inspectors to ensure quality output (Jimmerson, Weber, &Sobek, 2004). However, this was not the case. Instead, researchers like Womack, Jones and Roos (1990) described the success of an entirely new and different system of production. This system was able to manufacture goods with higher quality at half the cost in half the time of traditional manufacturing methods (Jimmerson, Weber, &Sobek, 2004). Consequently, the term "Lean manufacturing" was born. Although, Lean manufacturing is often perceived as a Japanese phenomenon, the system itself was invented by a single company: Toyota Motor Company. Other Japanese manufacturers, however, noticed the success of the Toyota Production System and were able to copy the essentials more rapidly than American companies (Jimmerson, Weber, &Sobek, 2004). This is why the system was perceived as Japanese.

After the description of the origin of Lean, it is time to obtain a basic understanding of the system since a detailed description of every tool and principle is not within the scope of this study. An overarching definition of the Lean concept is provided in the following statement obtained from Imre, Jenei and Losonci (2011).

"Lean is an integrated socio-technical system whose main objective is to efficiently satisfy customer needs by continuously striving for customer value, continuous flow and waste elimination in processes." (Imre, Jenei, &Losonci, 2011, p. 2)

Firstly, this definition reveals the predominant focus of the system which is on customer needs and value by rearranging work processes. Both the customer and the worker are told to benefit from this approach (Imre, Jenei and Losonci, 2011; Jimmerson, Weber, &Sobek, 2004; Spear&Bowen, 1999). Secondly, Lean is an integrated system meaning that an overarching approach is preferred over the application of a single tool. Only this way, real improvements can be made concerning the pre-mentioned objectives. On top of this, it is a social system denoting that people are at the core of the system. This also means that the organisational culture and the principles of the organisation have to be adapted in order to change the way of thinking, and consequently working (Doss&Orr, 2007; Imre, Jenei, &Losonci, 2011; Spear&Bowen, 1999). A definition of organisational culture is provided below.

"The organisational culture is a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems." (Schein, 1992, p. 12)

The Lean culture has extensively been described by Imre, Jenei and Losonci (2011) and Spear and Bowen (1999). Since a very broad description of Lean is out of the scope of this research, it is chosen not to provide all characteristics of the culture itself. However, the following table provides an overview of the Lean features that are related to second-order problem-solving (Tucker&Edmondson, 2002, 2003), which is the core of this study. This relatedness will be described more meticulously in later sections.

Table 4 Features of the Lean Culture Connected with Second-Order Problem-Solving

Continuous improvement	Employee development	Responsibility
Scientific experiment	Long-term thinking	Innovative spirit
Two ways, open communication channels	Process-thinking in decision-making and problem-solving	Regular information and knowledge sharing
Respect	Rewarding guidance	Finding root causes
Personal involvement	Tolerating failures	Employee suggestions
Cooperation	Discussions	Self-critique
Conflict acceptance	Employee involvement	Support

Source: Adapted from Imre, Jenei and Losonci (2011, p. 4)

The Lean manufacturing system is also described as a technical system, implying that it makes use of an extensive set of tools (Ballé&Régnier, 2007; Dickson, et al., 2009; Kimsey, 2010; Manos, Sattler, &Alukal, 2006; Mazur, Chen, &Prescott, 2008; Sobek&Jimmerson, 2004, 2006). However, a Lean environment cannot be created by tools and practices alone. In the light of this, Spear and Bowen (1999) state that *"Toyota uses the practices and tools merely as temporary responses to specific problems that will serve until a better approach is found or conditions change"* (Spear&Bowen, 1999, p. 10). Sustainable improvements will only be made if the organisational culture is changed and the Lean principles are accepted. Dombrowski and Mielke (2013) state that tools and methods are very important but they cannot achieve any results in itself. The biggest challenge is the change in behaviour and mindset of employees and leaders. If this is accomplished, it will result in a new way of thinking in which tools are constantly adapted to fit the ever changing needs and problems of the organisation (Ballé&Régnier, 2007). Examples of Lean tools are provided by Manos, Sattler and Alukal (2006) and Graban (2012). These include 5S workplace organisation, visual workplace systems, layout rearrangements, standardised work, point of use storage, batch size production, cellular and flow concepts, quick changeover, teams and teamwork, poka-yoke, pull systems and kanban, self-

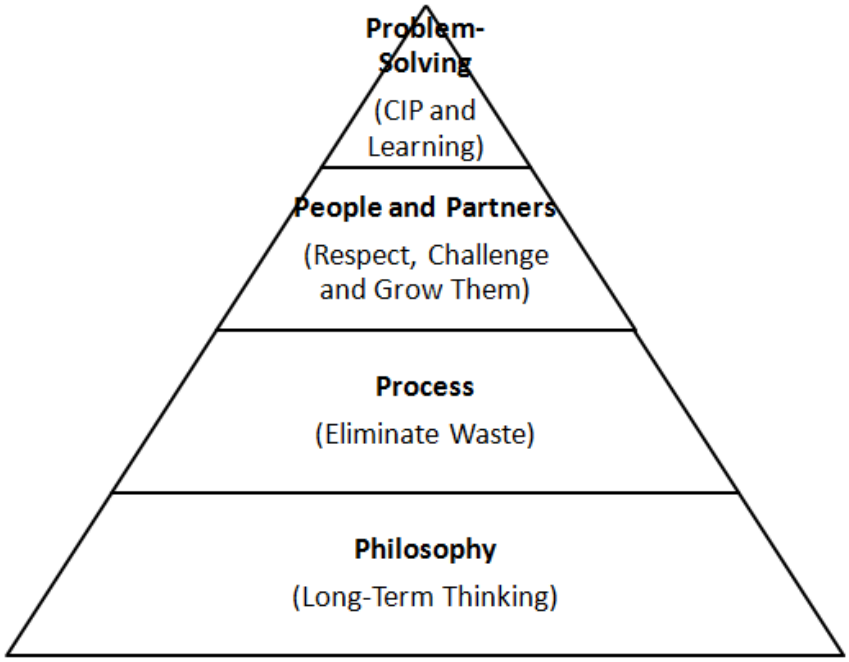
inspection, autonomation, just-in-time (JIT), total productive maintenance (TPM), value stream mapping (VSM) and change management.

The previous definition of Lean by Imre, Jenei and Losonci (2011) is closely related to the five principles of Lean implementation that were initially described by Womack and Jones in 1996. These principles are utilised by Burgess and Radnor (2012, p. 595) and Poksinksa (2010, p. 9) and are listed below. They will help giving a more clear indication of the true meaning of Lean.

1) Identify value from the perspective of the customer.
2) Identify the value stream for each product and challenge all the wasted steps.
3) Make value flow continuously, without interruptions.
4) Let the customer pull value from the producer.
5) Pursue perfection.

The real focus of this study, however, is on the impact of the Lean philosophy on problem-solving. With the eye on this objective, a last designation of the scope of the Lean production system is applicable. Liker's 4P model identifies four appropriate characteristics of Lean: philosophy, process, people and partners, as well as problem-solving (Dombrowski&Mielke, 2013; Liker, 2004). The main part of the organisations has focused on the process and the discontinuous elimination of waste, neglecting the other three P's of Lean. This is described as toolbox Lean (Dombrowski&Mielke, 2013). However, the real aim of Lean, according the 4P model, is to continuously improve every process every day. This way, a continuous improvement process (CIP) is achieved. Employees cannot do this alone, they have to be supported by inspiring leaders, training and enough time to engage in problem-solving efforts. This is depicted in the following figure.

Figure 3 4P Model of Lean Production System



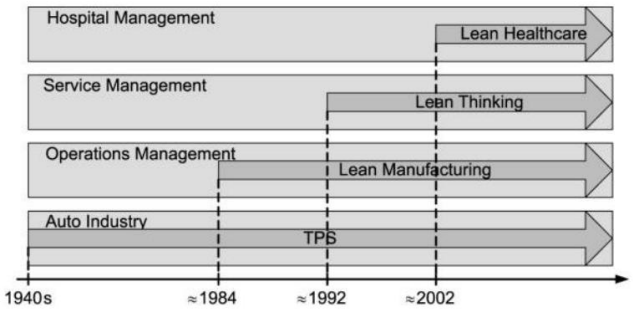
Source: Adapted from Dombrowski and Mielke (2013, p. 570)

2.2.2. LEAN IN HEALTHCARE

2.2.2.1. Motivations for Implementing Lean

Lean eventually broadened its borders as other manufacturing sectors than the automotive industry adopted the philosophy in their factories (Graban, 2012). On top of this, the Lean system was no longer purely seen as a factory system, it was also perceived as a complete business organisation, involving all aspects of bringing a product to the market (Graban, 2012). Consequently, every type of organisation could benefit from the Lean approach because every firm has to deal with quality issues, customer satisfaction and cash flow. The evolution of the implementation of Lean in different businesses is depicted in the following figure.

Figure 4 Evolution of Lean in Different Sectors



Source: Adapted from de Souza (2009, p. 123), originally created by Laursen (2003)

The reason why the Lean methodology was applied in healthcare stems from the difficulties the sector faces. These include increasing costs, increasing waiting times, inefficient use of resources, complex regulatory environments, rising error rates, labour shortages and the aging baby boomer population (Graban, 2012; Jimmerson, Weber, &Sobek, 2004; Mazzocato et al., 2012; Sobek&Jimmerson, 2004, 2006). Consequently, there is a risk that customer and personnel satisfaction suffers from the pre-mentioned healthcare challenges (Burgess&Radnor, 2012) and even worse, patient mortality could increase (Mazzocato et al., 2012).

In overcoming these difficulties, Poksinska (2010) states that the Lean methodology does not focus on extensive reorganisation requiring major investments. On the contrary, Lean gives healthcare an alternative methodology for achieving improvements within the framework of existing processes (Poksinska, 2010). This is particularly an asset because in this way, continuity of care is maximised and the satisfaction of employees, who are often change resistant (Graban, 2012; Poksinska, 2010), is maintained. In overcoming the final opposition to change, three enablers are identified by Poksinska (2010) in her literature review. Firstly, commitment and participation of healthcare employees in the improvement process is vital. Secondly, training and the gift of responsibility to workers is crucial in their development. Finally and of great importance, support from managers at all levels is a factor that can make or break the Lean implementation effort. In line with these enablers, Dickson et al. (2009) state that in an improvement process, management has to take a subordinate role. It is the empowered employee that has to identify problems and implement his or her own solutions with support from all managerial layers.

When the three main enablers are adapted such that the Lean implementation effort has the biggest chance to survive, the wastes in healthcare can be approached. These wastes are core to the Lean methodology and are most of the time summarised in seven or eight conditions which have to be defeated. The wastes can also be translated into the hospital setting, which shows that the same Lean principles from manufacturing can be used in the healthcare environment. Fillingham (2007, p. 236) identifies seven wastes in a hospital setting, Graban (2012, p. 37-44) and Manos, Sattler and Alukal (2006, p. 24-25) add an extra waste denoted as underutilised staff or waste of talent. A list of the wastes identified in hospitals is provided in the following table.

Table 5 Wastes in Hospitals

Waste	Example
Transport	Movement of patients and equipment
Inventory	Unneeded stocks and supplies
Motion	Movement of staff and information
Waiting	Delays in diagnosis and treatment
Overproduction	Unnecessary tests
Over Processing	Doing more than required, resulting in stressed, overworked staff
Defects	Medication errors, infections
Underutilising staff	Silo-mentality, not using knowledge of teams

Source: Adapted from Fillingham (2007, p. 236), Graban (2012, p. 37-44), and Manos, Sattler and Alukal (2006, p.24-25)

Other factors in the light of the question if Lean is applicable in healthcare come from Manos, Sattler and Alukal (2006) who state that the Lean methodology is certainly appropriate in a hospital setting because the key factors in what works and what does not, are the managerial processes, which are comparable for all businesses. Spear (2005), on top of this, notes that few industries are better equipped to obtain the skills and knowledge desired to improve processes that cross the boundaries of their disciplines. Hospitals are populated by people who are smart, dedicated and well-intentioned and these employees have proven many times that they possess the capacity to learn completely new ways of thinking (Spear, 2005).

Poksinska (2010) identified the outcomes of Lean implementation in two broad areas. The first one reports positively about the performance of the healthcare system. Examples of performance measures include overall time patients spent on care, reduced number of errors and incidents, increased patient satisfaction (Bahensky, Roe, &Bolton, 2005; Ben-Tovim et al., 2008; Kimsey, 2010; Mazzocato, Savage, Brommels, Aronsson, &Thor; Sirio et al., 2003). The other outcome, however, relates to the development of employees and the work environment and is described by Ballé and Régnier (2007), Ben-Tovim et al. (2008), Dickson et al. (2009), Fillingham (2007), Jimmerson, Weber and Sobek (2004), Manos, Sattler and Alukal (2006), and Kimsey (2010).

2.2.2.2. Challenges in Implementing Lean

Although this all seems very promising, several factors are responsible for the fact that Lean in the hospital setting is still at an early stage of development (Mazzocato et al., 2012). First of all, Lean will be hard to implement in almost every company since it is built on tacit knowledge (Jimmerson, Weber, &Sobek, 2004; Spear&Bowen, 1999). This means that it is connected to the culture of the organisation, it is not written down and it is very hard to articulate the true meaning of it (Jimmerson, Weber, &Sobek, 2004). In the light of this, many healthcare practitioners state that the adoption of Lean is counter-cultural (Fillingham, 2007; Poksinska, 2010). They state that they are definitely not a Japanese car manufacturer (Chalmet, 2013; Fillingham, 2007; Poksinska, 2010) and consequently, their organisational settings differ. However when the principles of Lean are taught, employees will understand that a great amount of waste exists in the hospital's processes and that applying Lean could offer potential benefits (Poksinska, 2010). Nevertheless, the scale and complexity of healthcare sets it apart from other sectors (Spear, 2005; Young&McClean, 2008). Spear (2005) supports the notion that many problems are due to the current organisation's complexity, which creates many opportunities for ambiguities. These can be described in terms of how an individual's job should be performed and how the work of many persons should be successfully coordinated into an integrated whole (Spear, 2005). On top of this, healthcare workers very often react to these ambiguities in terms of workarounds which enable them to continue serving the immediate patient needs (Spear, 2005). This notion has a clear connection with the next section which includes the problem-solving behaviour of nurses in a Lean environment.

Another potential difficulty in the implementation of Lean is the way healthcare is organised within hospitals. The only person who sees the complete patient trip through the hospital is the patient herself or himself (Poksinska, 2010). Graban (2012), Poksinska (2010) and Young and McClean (2008) describe this as the silo-mentality of healthcare. In a system like this, it is possible that a patient spends hours in a hospital without receiving any care or other value-adding activities (Poksinska, 2010). In order to apply Lean thinking and obtain the desired cross-functional changes, these departmental silos have to be broken down (Poksinska, 2010). Therefore, a holistic approach is required to attain the best results across the complete organisation.

On top of this, many authors mention the indeterminate nature of the customer which is a barrier to Lean implementation (Burgess&Radnor, 2012; Poksinska, 2010; Young&McClean, 2008). The patient receives care but does not directly pay for the provided service. That is why caregivers, family members, decision-makers, local communities, taxpayers and even the government should also be considered as customers of healthcare (Burgess&Radnor, 2012; Poksinska, 2010). The real notion of

value has to be understood by defining the customers and their conflicting priorities, otherwise the Lean implementation process can be obstructed (Poksinska, 2010; Young&McClean, 2008).

The next factor that inhibits Lean implementation concerns the organisational structure of healthcare (Poksinska, 2010). Physicians typically are highly educated and are used to act independently. This is in contrast with the principles of Lean which requires group effort and good communication. These are skills that are traditionally not emphasised in the professional education of physicians (Poksinska, 2010).

Finally, the last factors that hinder Lean are a lack of time to be occupied with Lean initiatives (Fillingham, 2007) and a lack of other resources (Burgess&Radnor, 2012). Burgess and Radnor (2012) state that there is a lack of incentives to allocate resources. This is because in the minds of many, the Lean initiative is seen as a method to systematically reduce resources rather than a bright occasion to enhance advantageous service (Burgess&Radnor, 2012).

2.2.2.3. The Productive Ward Program

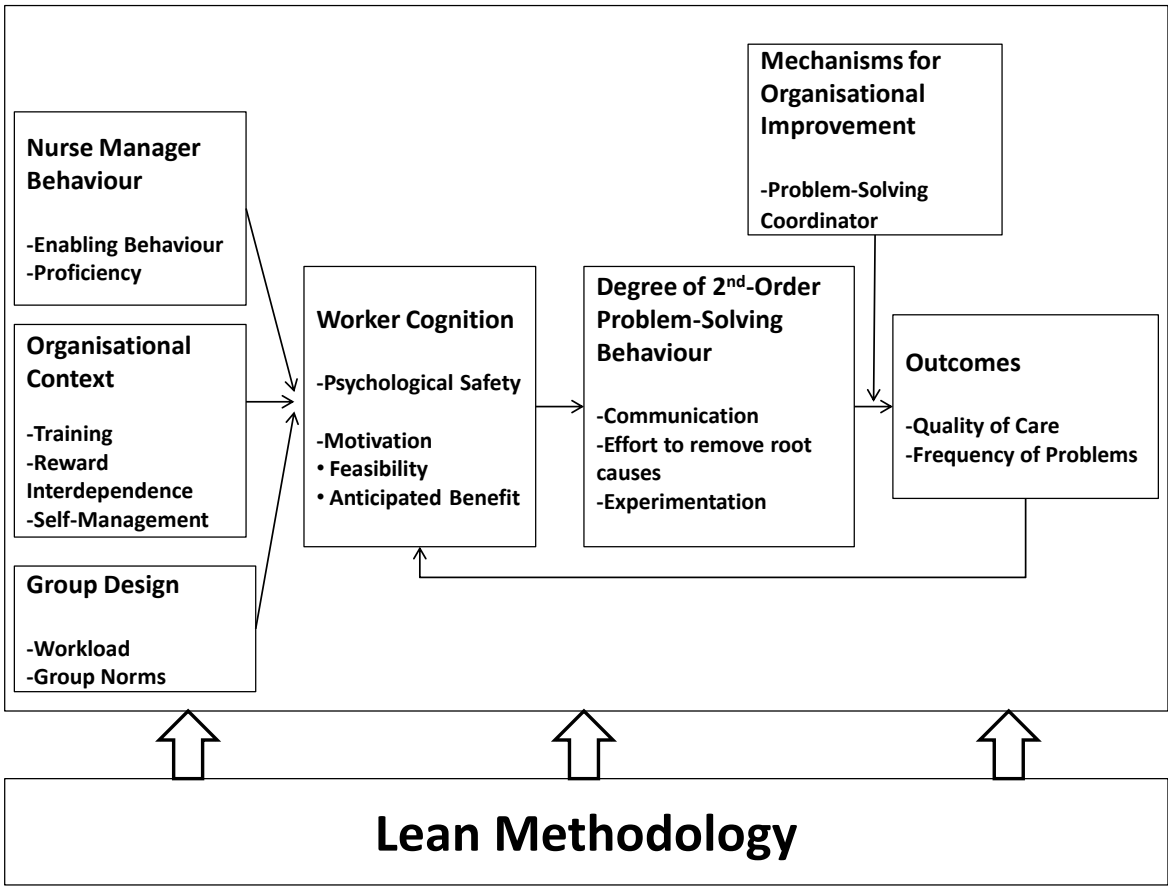
The Productive Ward (PW) is a quality improvement program developed by the National Health Service (NHS) Institute for Innovation and Improvement (Van Bogaert et al., 2014; Davis&Adams, 2012; White, Wells, &Butterworth, 2014; Wright&McSherry, 2013). It was launched in The United Kingdom in 2007 under the full name of *The Productive Ward-Releasing Time to Care*, which reveals the main goal of the program, i.e. leaving staff with more time to provide direct patient care (Van Bogaert et al., 2014). The modules of the program aim to augment the efficiency of healthcare working practices, leading to a state in which more time is available for staff to devote to patient care (Davis&Adams, 2012; White, Wells, &Butterworth, 2014; Wright&McSherry, 2013). However, two additional goals can be observed. The first one includes improving patient and staff experience, while the second one aims at physically reorganising the ward environment (White, Wells, &Butterworth, 2014; Wright&McSherry, 2013).

The PW program and the including modules are based on the improvement principles of the Lean philosophy (Van Bogaert et al., 2014; White, Wells, &Butterworth, 2014). It helps nursing staff in tackling previously neglected everyday issues with the eye on satisfying the pre-mentioned PW goals. In practice, the Lean principles and tools are used in order to re-evaluate patient and nurse processes. Consequently, it will be possible to identify and eliminate waste or those activities that add no value for the patient (White, Wells, &Butterworth, 2014). The Productive Ward Program is therefore a specific instance of a Lean-based healthcare environment in which Lean fulfils the role of the underlying PW philosophy.

2.2.3. LEAN AND THE MODEL OF NURSE SECOND-ORDER PROBLEM-SOLVING

As mentioned before, the real aim of this master thesis is to identify the impact of the Lean methodology on the degree of nurse second-order problem-solving behaviour. In this literature review this is done by investigating the impact of the Lean philosophy on the variables of the model of second-order problem-solving behaviour. The importance of second-order problem-solving or double-loop learning is emphasised by Burgess and Radnor (2012). According to them the necessity of double-loop learning is to *"raise the bar of service improvement in healthcare"* (Burgess&Radnor, 2012, p. 601). The research model is depicted in the following figure.

Figure 5 Research Model



Source: Adapted from Tucker and Edmondson (2002, p.90)

An extensive review concerning the literature of the Lean methodology and the profession of nursing was executed in order to identify these relationships. Generally, the quest for articles started with an investigation of LibHub, which is the search interface of e-articles available at Ghent University. Also several databases including PubMed, Web of Science and Google Scholar were consulted. Two

examples of queries are provided subsequently to display the procedure that was used in the search process.

Query to Search for Lean Nurse Manager Behaviour

((lean OR lean thinking OR Toyota Way OR Toyota production system OR Toyota DNA OR lean production OR lean method* OR lean principle*) AND (nurse* OR healthcare OR hospital) AND (((manager OR leader) AND proficiency) OR ((manager OR leader) AND competence) OR ((manager OR leader) AND competency) OR ((manager OR leader) AND prowess) OR ((manager OR leader) AND skill*) OR ((manager OR leader) AND expertise) OR ((manager OR leader) AND capability)))

Query to Search for Lean Organisational Context

(lean OR (lean AND thinking) OR (Toyota AND Way) OR (Toyota AND production AND system) OR (Toyota AND DNA) OR (lean AND production) OR (lean AND method*) OR (lean AND principle*)) AND (nurse*) AND (training OR (reward AND interdependence) OR (self AND management))

The complete search process resulted in the discovery of twenty-eight academic papers, books and case studies. The outcomes of this review will be presented in the different sections below.

2.2.3.1. Lean and the Managerial Levers

The relationship between Lean and the three managerial levers of second-order problem-solving behaviour will be discussed in this subsection. From the literature review, it became clear that the enablers, or levers, of an enhanced second-order problem-solving behaviour are in fact very similar to the enablers of a successful Lean implementation (Anand, Chhajed, &Delfin, 2012; Ballé&Régnier, 2007; Boyer, 1996; Emiliani, 2003; Graban, 2012; Jimmerson, Weber, &Sobek, 2004; Kimsey, 2010; Mazzocato et al., 2012; Losonci, Demeter, &Jenei, 2011; Pamfilie, Petcu, &Draghici, 2012; Poksinska, 2010). When the enablers or challenges for Lean are adapted in order to support the Lean culture, they will also improve the second-order problem-solving effort since the same underlying conditions are fulfilled. Consequently, in a successful Lean organisation, the three managerial levers for second-order problem-solving behaviour will be influenced.

For the first lever, nurse manager behaviour, literature concerning Lean leadership was consulted which stemmed mainly from the healthcare and nursing setting. To thoroughly understand the notions of leadership and Lean leadership, the following definitions are provided.

"Leadership is the capacity to influence others through a dynamic, reciprocal covenant aimed toward identifying and accomplishing collective purposes." (Doss&Orr, 2007, p. 2)

"Lean leadership is a methodical system for the sustainable implementation and continuous improvement of Lean production systems. It describes the cooperation of employees and leaders in their mutual striving for perfection. This includes the customer focus of all processes as well as the long-term development of employees and leaders." (Dombrowski&Mielke, 2013, p. 570)

The concept of Lean leadership is extremely important in the implementation of a successful Lean environment. It is perceived as the link between toolbox Lean and an organisation of Lean thinking in which learning and continuous improvement prevail (Dombrowski&Mielke, 2013). An important remark in the light of this, is that leadership can never be value-adding in itself. It is the nurse on the front-line who adds value and who is supported by a leader who sets up the required framework for an ideal value creation (Dombrowski&Mielke, 2013).

Emiliani (2003) compared the beliefs, behaviours and competencies of managers who were trained in the Lean management system in contrast to conventional management practices. In a Lean management system, changed underlying beliefs lead to adapted managerial behaviours which in turn lead to increased competencies of managers (Emiliani, 2003). Consequently, trust in the Lean system is in fact an important facilitator of the behaviours and competencies of managers. On top of this, faith in leadership, induced by enhanced Lean leader's competencies, will lead to higher commitment of workers to continuous improvement or Lean (Anand, Chhajed, &Delfin, 2012; Pamfilie, Petcu, &Draghici, 2012). A higher degree of trust in the skills of leaders, with on top of that a certain degree of self-management, will lead to proactive behaviours of front-line nurses in ameliorating work processes in a systematic way (Anand, Chhajed, &Delfin, 2012). Another study, performed by Losonci, Demeter and Jenei (2011), can be seen as an extension of the latter and implies that belief, commitment, work method and communication have a substantial direct impact on workers' perceptions of Lean transformations and the success of Lean itself. Yet again, given the similarity of the enabling conditions of a successful Lean implementation and the enablers of nurse second-order problem-solving, it can be concluded that successful Lean implementation will lead to the fulfilment of the enablers of second-order problem-solving. In other words, when management behaviour is adapted to fit the Lean methodology, this will also lead to the enabling behaviour for a higher degree of second-order problem-solving behaviour. Doss and Orr (2007) suggest nine leadership behaviours that are inherently connected to a successful Lean environment and to the variable of nurse manager behaviour in the model of nurse second-order problem-solving. The behaviours are listed in the following table which is slightly adapted in comparison to the original one in order to highlight the connection with the model of second-order problem-solving.

Table 6 Lean Leadership Behaviours

Teaches and engages workgroups to resolve problems
Respects people
Focuses on processes
Supports and recognises by being at the gemba (the work floor)
Leads by example
Deploys policy and objectives
Commits to standards
Has a long-term vision and principles
Supports the change process

Source: Adapted from Doss and Orr (2007, p. 4)

The second and third managerial lever, organisational context and group design, are also tightly connected to the principles of the Lean methodology. Training in a Lean nursing environment is essential because the successful execution of Lean relies deeply on the existence of well-trained nurses (Boyer, 1996; Graban, 2012; Spear&Bowen, 1999; Spear, 2005). Very often training is mainly focused on managers, neglecting the true potential of nurses who have the talents to engage in root cause problem-solving (Tucker&Edmondson, 2002). It is important that nurses, who are witnesses of process failures at the moments they occur, are trained in problem-solving techniques and tools in order to prevent their recurrence. Examples of these Lean tools focused on problem-solving are the A3 report (Graban, 2012; Sobek&Jimmerson, 2004, 2006) and the value stream map (Graban, 2012, Poksinska, 2010). Furthermore, the definition of Lean leadership mentions the concept of training in its declaration that long-term development is required with the eye on perfection (Dombrowski&Mielke, 2013).

The notion of reward interdependence is not widely discussed in literature concerning Lean in healthcare. However, it is undeniably connected with the design of groups and more specifically, with group norms. Cross-functional teams with a responsibility to overcome problems over different departments are used frequently in a Lean environment (Boyer, 1996; Emiliani, 2003; Graban, 2012; Imre, Jenei, &Losonci, 2011; Kimsey, 2010; Mazzocato et al. 2012; Poksinska, 2010). Consequently, problem-solving is decentralised and barriers between different departments, or the silo-mentality, is broken down (Boyer, 1996; Poksinska, 2010). Emiliani (2003) builds on this finding in his research on Lean leadership and states that *"cross-functional teams work together to identify and implement*

solutions, and the reward system supports teamwork rather than heroic individuals (Emiliani, 2003, p. 902)". Consequently, the Lean reward systems are focused on the performance of more extensive groups, who work over the boundaries of individual departments. This is in line with the enabling condition of reward interdependence.

Self-management, in contrast to reward interdependence, is in fact more widely discussed in the Lean literature. Although not all forms of empowerment are described as beneficial (Young, Corsun, &Shinnar, 2004) it is an undeniable aspect of the Lean methodology in the road to nurse second-order problem-solving (Ballé&Régnier, 2007; Graban, 2012; Kimsey, 2010; Mazzocato et al., 2012). Self-management in the nursing profession leads to an improved understanding and control of own practices (Ballé&Régnier, 2007). As a result, it contributes to an increase in the number of nurse problem-solving suggestions (Mazzocato et al., 2012). This is done by the translation of the improvement principles to fit the local context of a problem (Mazzocato et al., 2012).

Since nursing units are designed to maximise individual efficiency, the workload in hospitals is very high and spare time to resolve underlying causes of problems is missing (Tucker&Edmondson, 2003). In Lean healthcare, however, time intended for process improvements is deliberately made available (Graban, 2012). This can be seen as a self-reinforcing cycle in which time, allocated to problem-solving, results in the removal of waste (Graban, 2012). Consequently, rework for example will decrease and time available for process improvement will increase.

2.2.3.2. Lean and Worker Cognition

The variable of worker cognition is at the core of the Lean methodology (Anand, Chhajed, &Delfin, 2012; Emiliani, 2003; Graban 2012; Jimmerson, Weber, &Sobek, 2004). Establishing psychological safety in a Lean environment concerns the creation of a no-blame work context (Emiliani, 2003; Graban, 2012) in which information flows without interruption and consequently, continuous improvement is achieved (Emiliani, 2003). In other words: *"We have to shift from naming, blaming, and shaming employees to an environment in which we learn from errors, using knowledge gained to prevent future errors"* (Graban, 2012, p. 112). Although Edwards Deming's ideas implied that 94% of all errors are caused by faulty systems, healthcare practitioners continue to blame individuals, which leads to the practice of punishing or even firing them rather than improving the system (Graban, 2012). Lean management, however, is not a layoff program if it is practiced appropriately (Emiliani, 2003).

The enthusiasm and motivation of employees for making improvements is elevated by the Lean philosophy because changes concerning the work practices are made as close in time and person as possible (Jimmerson, Weber, &Sobek, 2004). Imposed changes, without interference of employees,

are very often resisted. Jimmerson, Weber and Sobek (2004), however, found that in a Lean management system, in which workers are able to take part in a redesign process affecting their own work, motivation to solve problems is increased. On top of this, in their empirical study of commitment to Lean, Anand, Chhajed and Delfin (2012) state that workers will enthusiastically contribute to improvement projects when the benefits of their additional efforts are comprehensible in advance and the efforts are feasible within the allocated time and resources. Yet again, motivation will be augmented due to nurses' beliefs that improvement activities will have a positive effect on their own ability to do their jobs (Anand, Chhajed, &Delfin, 2012).

2.2.3.3. Lean and the Degree of Second-Order Problem-Solving

The way Lean influences the degree of second-order problem-solving is described by its impact on the communication about underlying causes, the effort to remove these causes and the way experiments are conducted to test proposed solutions. First of all, through increased worker cognition in the Lean healthcare setting, communication about problems will be enhanced (Graban, 2012; Mazzocato et al., 2012). For example, the A3 problem-solving method based on the Lean principles enables objective communication about interdepartmental organisational problems (Jimmerson, Weber, &Sobek, 2004). Furthermore, the effort to remove the underlying causes is enhanced by the Lean methodology and also results from the elevated worker motivation and the psychological safe environment as mentioned above (Ballé&Régnier, 2007; Graban, 2012; Jimmerson, Weber, &Sobek, 2004; Kimsey, 2010; Mazzocato et al., 2012; Sirio et al., 2003; Spear, 2005). However, experimentation in Lean problem-solving is not discussed yet and needs further explanation. In Lean organisations, people at all levels are taught to become experimentalists (Spear, 2005). Through simulation or experiments, workers constantly figure out how to test ideas as rapidly and economically as possible (Spear&Bowen, 1999; Spear, 2005). This is done by formulating hypotheses according to a scientific method which teaches people how to improve, rather than expecting them to learn only from individual experience (Jimmerson, Weber, &Sobek, 2004; Spear&Bowen, 1999). This way, root causes of problems are addressed in a structured way, leading to the best results.

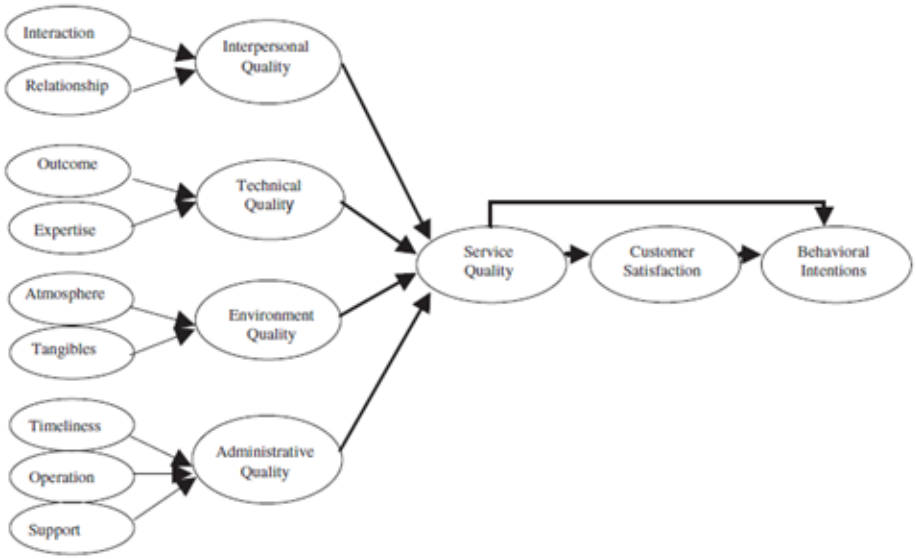
2.2.3.4. Lean and the Outcomes of the Model

Mazur, Chen and Prescott (2008) investigated the use of organised documentation in the process improvement exercise and concluded that this was perceived as very helpful in the road to root cause removal. Pure brainstorming via visualisation, on the other hand, did not contribute to the individual's abilities in understanding and solving underlying causes of problems (Mazur, Chen, &Prescott, 2008). Lean directly reduces the frequency of organisational problems through the

application of the organised A3 problem-solving tool (Jimmerson, Weber, &Sobek, 2004; Kimsey, 2010; Sobek&Jimmerson, 2004, 2006).

On top of this, Lean is expected to result in higher quality of care (Graban, 2012). For describing this quality, the hierarchical model of health service quality developed by Dagger, Sweeney and Johnson (2007) provides an excellent overview of the underlying aspects. This model proposes that service quality perceptions are composed of four main dimensions, i.e. interpersonal quality, technical quality, environment quality and administrative quality, each with their own subdimensions (Dagger, Sweeney, &Johnson, 2007). The model is provided in the following figure.

Figure 6 Model of Health Service Quality



Source: Adapted from Dagger, Sweeney and Johnson (2007, p. 131)

To become aware of the impact of the Lean methodology on service quality, the relationship of Lean and the underlying subdimensions has to be investigated. First of all, expertise will be affected since in the Lean methodology training is crucial (Boyer, 1996; Graban, 2012; Spear&Bowen, 1999; Spear, 2005). Consequently, employees at a hospital will carry out their tasks more proficiently leading to an increase in the technical quality dimension (Dagger, Sweeney, &Johnson, 2007).

Secondly, the timeliness of care will be induced positively. Spear (2005) investigated this and found that, through the implementation of Lean and the resulting elimination of ambiguity and workarounds, several quality measures were improved which mainly comprised a reduce in waiting times of patients in the treatment process. A last distinctive influence of the Lean methodology in comparison to other management philosophies concerns the subdimension of operation. In the Lean methodology, the silo-mentality is broken down (Boyer, 1996; Poksinska, 2010) which facilitates

cross-functional teamwork and implies an enhanced perception of service quality by patients (Dagger, Sweeney, &Johnson, 2007). On top of this, the Lean methodology addresses errors and problems at the roots of their existence (Ballé&Régnier, 2007; Graban, 2012; Jimmerson, Weber, &Sobek, 2004; Kimsey, 2010; Mazzocato et al., 2012; Sirio et al., 2003; Spear, 2005), yet again leading to an enhanced operation of the hospital. These last two subdimensions of timeliness and operation are translated to an improvement in service quality through the dimension of administrative quality (Dagger, Sweeney, &Johnson, 2007).

2.2.3.5. Lean and the Problem-Solving Coordinator

As mentioned earlier, in Lean it is the responsibility of the Lean leader to support and guide nurses towards successful second-order problem-solving (Dombrowski&Mielke, 2013). Jimmerson, Weber and Sobek (2004) concluded that nursing units experienced greater difficulties working without a dedicated resource, i.e. a coach, to react to problems and to coordinate the problem solution. According to Liker and Rother (2015), Morrey, Pasquire and Dainty (2013), Rother (2010) and Chalmet (2013), Lean will only be successful when there is a certain automatism in striving for continuous improvement. Two forms of the so-called "kata", which is the Japanese word for "shape" and is derived from martial arts (Chalmet, 2013), can be identified. On the one hand, kaizen-kata implies the automatism of all employees to solve problems thoroughly and voluntary (Chalmet, 2013). This is related to the degree of second-order problem-solving. However, these voluntary actions will only appear when there is an ongoing automatism of leaders in guiding employees towards problem-solving. This is called kaizen coaching-kata and it means that leaders have to be visible on the gemba, i.e. the work-floor (Chalmet, 2013). This was already discussed in the *"Lean and the Managerial Levers"*-section. On top of this, a leader has to be become some kind of mentor who helps employees in growing problem-solving skills (Chalmet, 2013). He or she has to be a real problem-solving coordinator who supports employees in tackling problems on a more individual basis.

Spear (2005), however, notes that much of the Lean achievement in preventing workarounds can be attributed to a coordinator who is not necessarily a member of the management team. By giving problem-solving responsibilities to a central person who is hierarchically close to the nurses, the process failures were reported more frequently (Spear, 2005). After the reporting of the problem, this problem-solving coordinator and the whistleblower have to work closely together in order to assure the right process changes occur (Spear, 2005). The coach, however, needs to be trained thoroughly in problem-solving techniques and tools that take into account the characteristics of a particular work environment (Spear, 2005). Only this way optimal and feasible resolutions can be proposed.

3. PROPOSITION GENERATION

In the literature review it became apparent that hospitals, and healthcare organisations in general, are becoming increasingly interested in applying the principles of the Lean philosophy. This implementation can have several benefits such as a reduction in the overall time a patient spends on care, a reduction in the number of errors and incidents, an increase in patient satisfaction and many more. On top of this, by consulting literature concerning the relationship of the Lean philosophy and the variables of the model of second-order problem-solving behaviour, it is expected that Lean has an impact on the degree of second-order problem-solving behaviour and the resulting outcomes of the model. The variables of the model, which is created by Tucker and Edmondson in 2002, are widely discussed in literature concerning Lean healthcare and there it is stated that several of these variables are essential for the successful implementation of a Lean culture. Consequently, in a successful Lean healthcare environment, these enablers will be present. Since these conditions for a successful implementation are similar to the enablers for second-order problem-solving, it is expected that the Lean philosophy will lead to a higher degree of second-order problem-solving behaviour of nurses. This leads to the following proposition for investigation in the empirical part of this study:

In a successful Lean environment, hence in an environment in which the maturity of Lean implementation projects reaches high levels, second-order problem-solving behaviours displayed by nurses who face organisational problems will be more frequently observed than second-order problem-solving behaviours performed by nurses employed in environments in which Lean has lower levels of maturity.

By comparing several departments in different hospitals with a distinction in the maturity of Lean implementation programs, this will be studied. However, the impact of Lean on the outcomes of the model, i.e. “quality of care” and “frequency of problems”, was not investigated and falls out of the scope of the empirical research. Also, the topic of the problem-solving coordinator is neglected. Hence, the empirical part of the study solely focuses on the possibility of an elevated frequency of second-order problem-solving behaviour in departments in which Lean is more strongly present.

4. EMPIRICAL RESEARCH

4.1. GOAL AND MISSION OF THE EMPIRICAL STUDY

As mentioned above, the goal of this dissertation is investigating the impact of the Lean philosophy on the problem-solving behaviour of nurses. Literature expects that Lean will augment the degree of second-order problem-solving of nurses, leading to a state in which problems less frequently occur and quality of care is improved. By performing a quasi-experimental research in two Flemish University Hospitals, the above proposition was investigated. Within each hospital two departments with a varying degree of Lean maturity could be identified. By selecting one department with low Lean maturity and one department with high Lean maturity in each of the two hospitals, an experiment could be carried out which investigated the problem-solving behaviour of the respondents. The behaviour of nurses who work in departments with high Lean maturity was compared to the behaviour of nurses who operate in departments with low Lean maturity. The low maturity units therefore serve as control groups, while the high maturity departments are considered as treatment groups since they have received more successful Lean implementation programs. According to the proposition that the maturity of Lean implementation enhances second-order problem-solving behaviour, it was expected that in departments with higher Lean maturity second-order problem-solving behaviour could be observed more frequently than in departments with lower Lean maturity.

This experiment, however, could not meet all the requirements of a true experiment. That is why it was chosen to carry out a quasi-experiment that relaxes several obstacles imposed by this research topic. More explanation about these design choices will be provided in subsequent sections.

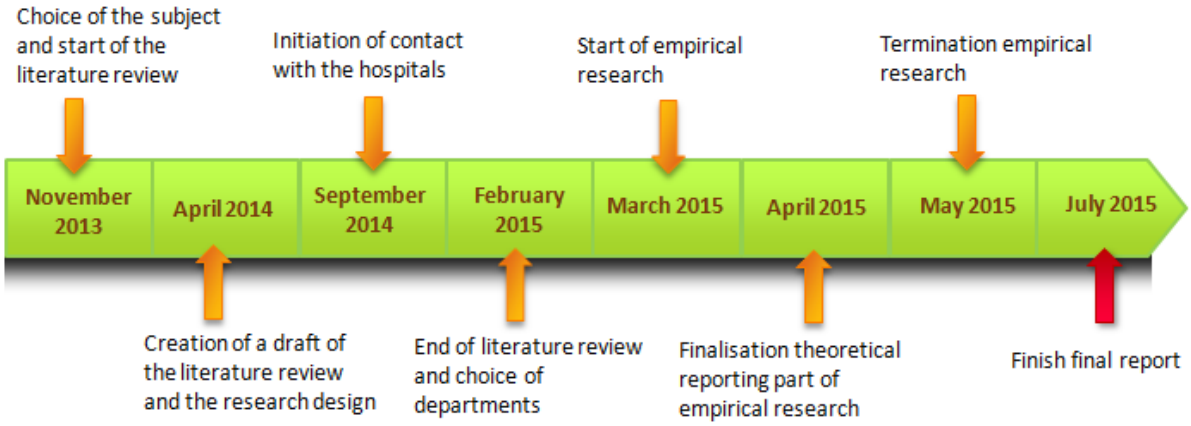
The mission of this study, however, is to provide healthcare practitioners with clear understanding of the problem-solving behaviour of nurses and the role of the Lean philosophy in this process. By sharing the findings of this study, management of the two University Hospitals, and potentially of other healthcare units too, could be provided with new and in-depth insights regarding the true value of the Lean philosophy in improving problem-solving of their workforce. On the other hand, this research can serve as the groundwork for a more extensive empirical research in which the findings of this study could be verified.

4.2. METHODOLOGY

4.2.1. DIFFERENT RESEARCH STAGES

In this dissertation, roughly three different research stages can be identified which were overlapping at several points in time. The first one, the literature review, was the most time-consuming part since theory building was essential in fully understanding the different concepts of this study. A second stage, identified as the empirical research, comprises the design of the quasi-experiment and the questionnaire in order to obtain sufficient data to perform a thorough analysis. This analysis is part of the last stage of this study. In order to display the findings, a lot of effort was put in the creation of a reliable report, which is also part of the third stage. A schematic overview of the milestones of this dissertation is provided in the following figure.

Figure 7 Timeline of the Research



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4.2.2. QUASI-EXPERIMENTAL RESEARCH

4.2.2.1. Motivations Concerning Research Choices

In the empirical research of this dissertation, a quasi-experiment was set up that made use of qualitative data for analysis. These data were collected by means of an electronic questionnaire filled out by common nurses at different departments. The head nurses and several care givers without a full nursing diploma are therefore excluded from this study. Qualitative research is flexible, open and systematic (Duits, 2011) and makes it possible to preserve and analyse answers in their original form without losing any content (Chesebro&Borisoff, 2007). Consequently, responses are not directly subject to numerical or other formal conversions and they take the form of words rather than

numbers (Chesebro&Borisoff, 2007). More about the collection of this qualitative data and the analysis is provided in subsequent sections.

As mentioned above, it was chosen to conduct a quasi-experiment for this study. Experimental research makes it possible to draw causal interference, which is the identification of the cause and effect of certain actions (Cook&Campbell, 1979; De Pelsmacker&Van Kenhove, 2010; Grant&Wall, 2009). Experiments are defined as a research design in which independent or treatment variables are manipulated in order to determine the effect on dependent variables (De Pelsmacker&Van Kenhove, 2010). This is performed in such a way that the influence of extraneous variables are eliminated (De Pelsmacker&Van Kenhove, 2010).

However, not all experimental designs are applicable in determining causal relationships. That is why a true experiment has three conditions. The first one comprises the need for a thoughtful design of the research (De Pelsmacker&Van Kenhove, 2010). The second condition, on the other hand, states the need for the controlled measurement of phenomena within different groups of subjects (De Pelsmacker&Van Kenhove, 2010). The last condition demands the controlled and random assignment of subjects to different experimental groups (De Pelsmacker&Van Kenhove, 2010). Grant and Wall (2009) state that a violation of the third condition is an evident consequence of the reality of life in organisations, i.e. hospitals. After all, a lot of organisational decisions affect different groups of people, making it difficult to avoid management-selection and site-level differences as alternative explanations for the resulting effects (Grant&Wall, 2009). On top of the difficulty to randomly assign subjects to experimental groups, Grant and Wall (2009) note that in organisations the experimenter may lack control over key variables. They state that *"even when variables of interest can be manipulated, organisations do not hold still, making it difficult for researchers to isolate key causal factors and rule out alternative explanations for differences observed"* (Grant&Wall, 2009, p. 654).

The aforementioned obstacles to set up a true experiment can be handled by creating a quasi- or natural experiment (De Pelsmacker&Van Kenhove, 2010; Grant&Wall, 2009; Gribbons&Herman, 1997). This form of experimental design was first introduced by Campbell and Stanley (1966). By using this design, many benefits of the true experiment, such as high internal validity, are maintained (Campbell&Stanley, 1966). On top of this, the relaxation of the obligation for random assignment of subjects and the controlled manipulation of all independent variables is brought about (Grant&Wall, 2009).

Also, since the events and problems in a department of a hospital cannot be imitated in a laboratory, it was chosen to create a qualitative questionnaire in which scenarios of problems are described as similar as possible to their occurrence in the natural setting. This, in combination with the two

aforementioned obstacles, resulted in the choice of setting up a quasi-experiment for this study. The imitation of the natural context enhances the external validity (De Pelsmacker&Van Kenhove, 2010), resulting in the fact that quasi-experiments may offer a stronger combination of both internal and external validity (Grant&Wall, 2009). More information about the questionnaire and validity aspects will be provided in subsequent sections and the attachments.

4.2.2.2. Research Design

Internal and External Validity

For the realisation of the quasi-experiment, two Flemish University Hospitals were contacted in which each time two departments had to be selected. However, the design of the quasi-experiment is an important lever for elevating both internal and external validity (Morgan, Gliner, &Harmon, 2000). Internal validity is highly associated with experimental and quasi-experimental research because it assesses the causality of certain variables (Yin, 2014). It is therefore of major importance in explanation building. External validity, on the other hand, implies the possibility to generalise certain findings (Yin, 2014). The start of acceptance of theoretical propositions is only possible if the study is replicated in several environments and identical results are obtained (Yin, 2014).

For the research design, in one hospital it was chosen to study two outpatient clinics that are situated in the same medical sector, i.e. metabolic and cardiovascular disorders. The use of the terminology of medical sectors is specific to this university hospital. In general, it can be seen as a covering division that includes several departments and that has a single chairman and care manager. By this design choice, internal validity is increased since the two departments are equal in terms of sector management and they are both outpatient clinics, resulting in more similar work practices and the exclusion of possible unidentified confounding factors. In the second hospital, however, it was chosen to investigate two inpatient clinics for the same reason of internal validity. Consequently, several extraneous variables are excluded in the comparison of the departments within each hospital (Morgan, Gliner, &Harmon, 2000).

As mentioned before, it is only possible to generalise findings at a certain level by extending the research to two or more hospitals (Yin, 2014). On top of this, by selecting outpatient clinics in one hospital and inpatient clinics in the other one, external validity is increased even more. However, full statistical generalisation will never be possible since the sample of hospitals and departments is not big enough and subjects of the sample are not randomly chosen nor representative for the whole population (Yin, 2014). Therefore, high external validity is very hard to obtain in this study.

A remark concerning the use of outpatient clinics at one hospital and inpatient clinics at the second one is required. It is expected that the differences between outpatient and inpatient clinics do not

influence the probability of facing second-order problem-solving behaviour. This assumption could be made by talking to the CNO of one hospital (personal communication, 15 April 2015) and the care manager of the second hospital (personal communication, 20 March 2015).

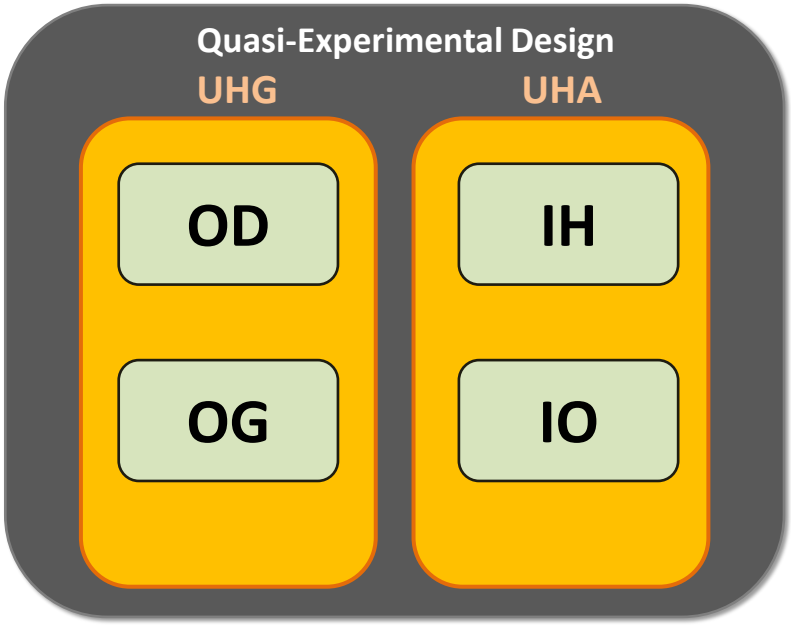
Varying Degree of Lean Maturity

With the eye on investigating the impact of the Lean philosophy on the problem-solving behaviour of nurses, two departments that varied in terms of Lean maturity were selected in each hospital. The aforementioned proposition stated that it was expected that in departments with higher Lean maturity, second-order problem-solving behaviour would be more prevalent than in departments with lower or no Lean maturity. In the design research, the latter cohort, which is the one with low maturity, serves as a control group while the former one is identified as the experimental group. More about the specifics of the different departments in the empirical research will be provided in later sections. The following figure, however, already displays the graphical representation of the quasi-experimental design. The two yellow boxes represent the university hospitals in which each time, two departments are displayed in light-green. For reasons of clarity, the abbreviations are explained subsequently in order to enhance the readability of the experimental design. These abbreviations will be used throughout this dissertation, although sometimes it is preferred to use the complete notations.

As already stated, two University Hospitals were incorporated in this study. The first one is the **U**niversity **H**ospital of **G**hent (UHG) and the second one is the **U**niversity **H**ospital of **A**ntwerp (UHA). Within the University Hospital of Ghent, two departments were selected, respectively the **O**utpatient clinic of **D**ermatology (OD) and the **O**utpatient clinic of **G**eneral Internal Disorders (OG). In the University Hospital of Antwerp, on the other hand, two inpatient clinics were chosen. These are the **I**npatient clinic of **H**eart surgery (IH) and the **I**npatient clinic of **O**rthopaedics (IO).

In the graphical representation, each time, the upper department box represents the unit which has higher Lean maturity. Consequently, it becomes clear that there is one treatment group per hospital, respectively OD and IH, in combination with one control group, respectively OG and IO. The treatment groups have been provided with an extensive implementation of the Lean philosophy while the control groups received no or less effective Lean training. How this was determined will be discussed in the *"Preparation and Data Collection"*-section.

Figure 8 Graphical Representation of the Research Design



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4.2.2.3. Preparation and Data Collection

Theoretical Triangulation

This study started with an in-depth literature review with the eye on building new theoretical insights concerning Lean and the problem-solving behaviour of nurses. During this literature review, as many evidence as possible was consulted regarding the impact of the Lean philosophy on the variables of the model of second-order problem-solving. This process is known as triangulation and more specific, theoretical triangulation (Bryman, 2004). Triangulation in itself is defined as *"the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings"* (Bryman, 2004, p. 1142). Consequently, in this study, theoretical triangulation is the creation of a new theoretical framework which is based on the synthesis of the model of second-order problem-solving and the implications of the Lean philosophy. The results of this process were provided in the literature review and is schematically represented by the research model.

Departmental Choices

During the literature process, the two University Hospitals were already contacted. Both the University Hospitals of Ghent and Antwerp could be convinced of the interesting topic after an introductory conversation.

The primary goal within each hospital was to select two departments that deviated in terms of Lean maturity. In the University Hospital of Ghent, the choice for department OD was obvious since this unit is widely known for its Lean implementation projects (Van Goubergen&Lambert, 2012). The selection of unit OG was based on the fact that this department has no experience in Lean projects, this makes it the ideal department to serve as a control group.

For selecting two departments in the University Hospital of Antwerp, a different approach was needed since in this hospital, an organisation-wide Productive Ward program was implemented which has the Lean philosophy as its foundation. In the evaluation of nurse practice environments, this hospital selected measures that assessed nurse perceptions, burnout, quality of care, and job outcomes (Van Bogaert et al., 2014). These instruments were called the NWI-R, the Revised Nursing Work Index, and the MBI-HSS, the Maslach Burnout Inventory-Human Services Survey. On top of this, an additional instrument was developed that assessed how nurses evaluated the degree of implementation of the PW program (Van Bogaert et al., 2014). This 5-item measure is composed out of the following topics: (1) the involvement of the nurses working in the PW environment; (2) the development of the required skills to work with various methodologies of the program; (3) the knowledge of the PW methodologies; (4) the intention to work further with PW methodologies; and (5) the support of the hospital board towards the program (Van Bogaert et al., 2014). Van Bogaert et al. (2014) found out that in departments with higher scores on the degree of PW implementation, i.e. with higher Lean maturity, scores on items of the NWI-R and MBI-HSS were higher too.

Based on low versus high scores on the degree of implementation of the PW program, the two inpatient clinics could be selected for this study. A low score means that a certain department has not managed to systematically implement the PW program and the underlying Lean philosophy. A high score, however, implies the opposite. Department IH therefore has higher Lean maturity within the University Hospital of Antwerp in comparison with unit IO. More information about the four different departments in this study will be provided in the *"Results"*-section.

Questionnaire

With the eye on the collection of data, which is a very important link in the chain of evidence (Yin, 2014), an electronic Qualtrics-questionnaire was developed. The main part of this survey consisted of five scenarios which are related to the five broad types of nurse problems observed by Tucker and Edmondson (2003). For reasons of clearness, these types of problems are again displayed in the subsequent table, which is identical to Table 1.

Table 7 Broad types of Organisational Problems

Missing or incorrect information
Missing or broken equipment
Waiting for a human or equipment resource
Missing or incorrect supplies
Simultaneous demands on the workers time

As can be observed in this table, four of the five types of nurse problems (1) missing or incorrect information; (2) missing or broken equipment; (3) waiting for a human or equipment resource; and (4) missing or incorrect supplies; consist of a certain duality that was avoided in creating the scenarios. Consequently, nine different scenarios had to be created in order to overcome this issue.

The aim of the problem scenarios was to obtain information about the actions undertaken by nurses when problems arose. That is why it was asked to write down a step-wise list of actions when facing a certain organisational problem. However, since the questions posed to the nurses were open-ended, it would require considerable effort to fill out the questionnaire containing nine problem scenarios. Also, it was expected that answers to scenarios that were placed at the end of the questionnaire would be less detailed. A possible solution to this issue is randomising the order of the questions with the eye on levelling out this phenomenon. However, this was not beneficial since it was the intent of the researcher to have detailed answers on all the problem scenarios. That is why two different questionnaires were created in which each time only one of the two instances of a type of problem was incorporated. The fifth type of problem, in which no ambiguity could be observed, was then incorporated in both the questionnaires. Consequently, two versions of the questionnaire were created, named version A en version B. In order to safeguard validity of the empirical research, it was asked to the head nurses to distribute the questionnaires randomly to the respondents in their department. By doing this, it was attempted to randomly approximate a fifty-fifty distribution of the surveys to the respondents within a department.

In addition, the chance of winning a financial compensation of fifteen Euros was promised to nurses who filled out the entire questionnaire in detail. Since no external budget was available and the researcher was very keen on obtaining detailed answers, it was decided that the money had to come from own resources. Consequently, no more than one nurse per hospital was able to win the financial reward and only in case of answering the questions in extensive detail.

However, the process of creating a high-quality questionnaire was not finished yet. According to Yin (2014), construct validity entails the development of operational measures for investigating different concepts. Critics declare that a bad set of operational measures is responsible for subjective interpretation by the researcher (Yin, 2014). By contacting an acquainted nurse, the nine broad types of problems were translated in more specific scenarios. This was done to lower the level of abstraction and consequently to enlarge the touch of the interviewees with the organisational problems. This improved construct validity of the study. To ameliorate construct validity even more, the scenarios were discussed with the care manager of the sector of metabolic and cardiovascular disorders in the University Hospital of Ghent and the CNO of the University Hospital of Antwerp. Also three doctoral assistants of the department of innovation, entrepreneurship and service management were contacted. Two of these assistants had a nursing background, which provided the questionnaire with even better scenarios through a pilot study. The third assistant, however, was very helpful in fine-tuning the methodological style of the scenarios.

On top of the answers to the problem scenarios, several additional information was obtained from the respondents in order to distinguish them in terms of sex, age, nurse experience and full-time equivalents. Although organisational problems are expected to be solved in a deductive way (Round, 2000; Tucker&Edmondson, 2002, 2003), these nurse characteristics can be investigated for a possible impact on the degree of second-order problem-solving behaviour. In addition, comparison of differences over the departments of these characteristics became possible in order to identify possible extraneous variables with the eye on maintaining internal validity. These relevant nurse characteristics and the subcategories were selected on the basis of interviews with a care manager and two head nurses of one hospital and the CNO of the second hospital. Consequently, a meaningful set of personal data was obtained. The exhaustive set of characteristics and the subcategories, made to classify nurses within a certain characteristic, can be found in the questionnaire in the attachments.

At the end of the survey, two final questions were asked. The first one verified the awareness of respondents of the Lean implementation in their department. The second question investigated nurse perceptions of the problem-solving contribution of the Lean philosophy. These questions are called the awareness and the contribution question. The questions were meant to have a certain control over construct validity. It would, for example, be bizarre that in a department with high Lean maturity and a high degree of second-order problem-solving, a specific nurse would not have known the Lean philosophy in any of its forms. If, however, a nurse knew that Lean was implemented at the department but did not believe that the philosophy was accountable for the effect on problem-solving behaviour, additional question marks about the appropriateness of the questionnaire may

have risen. In these cases, it could have been possible that the survey did not measure the impact of Lean maturity on second-order problem-solving behaviour.

The complete questionnaire is displayed in the attachments for the sake of ensuring the reliability of this research. Accordingly, the same procedures can be followed by future researchers and identical outcomes and conclusions can be obtained (Yin, 2014). Consequently, faults and biases are minimised in the replication of the study (Yin, 2014).

4.2.2.4. Limitations of the Empirical Research

As in almost every study, this dissertation faces some limitations. The first two restrictions are about the fact that the questionnaire was only filled out by nurses at two University Hospitals that are geographically close to each other. These limitations certainly have an effect on the ability to generalise empirical research findings, i.e. the external validity. In the light of this, Grant and Wall (2009) state that a vast challenge of all quasi-experiments is *"to strike a delicate balance between attending to context-specific phenomena and testing generalisable hypotheses"* (Grant&Wall, 2009, p. 673).

The fact that only hospitals in Flanders were incorporated could result in the disregard of several other factors such as, for example, the specific problem-solving culture of a geographic area. It could be true that organisational problems are solved differently in, for instance, the French speaking part of Belgium in comparison to the Dutch speaking part. Also only university hospitals were incorporated. Since it is possible that problems are handled differently in hospitals that are not connected to universities, this design choice may have an impact on external validity too.

Another limitation of the research design is about the internal validity of the study. Random assignment and the manipulation of the independent variable is never fully under the experimenter's control. Consequently, in order to protect internal validity, it is particularly important for researchers to design quasi-experiments cautiously (Grant&Wall, 2009). As mentioned earlier, this was attempted by making the different design choices. However, it is very hard to suppress all extraneous variables that could affect causality. Ideally, researchers should use multiple control groups and pre-test/post-test time-series measurements designs to rule out, or minimise, the impact of validity threats (Cook&Campbell, 1979; De Pelsmacker&Van Kenhove, 2010). In this dissertation, no pre-test was performed that could have proven the impact of the Lean philosophy over time and that could have eliminated alternative explanations. On top of this, per hospital only one control group was used in order to limit the workload on the researcher. A final limitation relating to internal validity concerns the fact that no statistical tests could be conducted in order to investigate the significance of the differences in occurrences of second-order problem-solving behaviour over departments. In

this study, the occurrences of second-order problem-solving behaviour per department are counted and are compared to the occurrences in the other unit. Consequently, this dissertation only gives an indication of a possible causality between Lean and a higher degree of second-order problem-solving behaviour.

A fourth limitation of the research design entails the possibility that the answers of the respondents are guided by normative behaviour. Consequently, a certain deviation between actual and detected behaviour may exist. In literature, this limitation is often denoted as the Hawthorne-effect (Mazur, Chen, &Prescott, 2008). Although this effect is stronger in case of direct observation (Mazur, Chen, &Prescott, 2008), it is said to influence behaviour of respondents towards higher levels of positive perceived behaviour. Therefore, respondents were told that no good or bad answers to the problem scenarios existed. Also, they were never informed about the real goal of the study, which is about the impact of Lean on the degree of second-order problem-solving behaviour. The only thing respondents knew was that the study is about the impact of the Lean philosophy on how they approach problems but the actual behaviours of a second-order problem-solver were never brought to their attention.

On top of that, an additional limitation of the empirical research comes from the fact that only one method for gathering data is used, i.e. the electronic questionnaire. Methodological triangulation, which refers to the use of more than one method with the eye on gathering data (Bryman, 2004), is not fulfilled in this research. Also, all data was gathered by only one researcher which refers to the notion of not satisfying investor triangulation (Bryman, 2004).

4.2.3. Qualitative Content Analysis

4.2.3.1. Definitions and Approach

For the analysis of the data, qualitative content analysis was utilised which is a widely used research technique applied in a variety of research areas (Hsieh&Shannon, 2005). In recent years, also the healthcare industry became a frequent user of this method (Bradley, Curry, &Devers, 2007; Hsieh&Shannon, 2005). It is an ideal technique for understanding phenomena within their context, revealing links among concepts and behaviours, and generating and refining theory (Bradley, Curry, &Devers, 2007; Miles&Huberman, 1994; Patton, 2002). Consequently, the goal of the method is to provide more extensive knowledge and understanding of the phenomenon under study (Hsieh&Shannon, 2005). An example of the use of qualitative content analysis in healthcare is illustrated in the work of Bradley and Nolan (2007).

The analysis technique is defined as: *"A research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns."* (Hsieh&Shannon, 2005, p. 1278)

Accordingly, the method is used to analyse text data. However, this type of data can be obtained in several forms. This becomes clear in the following statement:

"Text data might be in verbal, print, or electronic form and might have been obtained from narrative responses, open-ended survey questions, interviews, focus groups, observations, or print media such as articles, books, or manuals." (Hsieh&Shannon, 2005, p. 1278)

As reported by Bradley, Curry and Devers (2007) there cannot be one uniform approach to the use of qualitative content analysis. However, Hsieh and Shannon (2005, p. 1285) conclude that in all procedures seven classic steps can be identified, containing: *"creating the research questions to be answered, choosing the sample to be analysed, identifying the categories which to be applied, outlining the coding process and the coder training, implementing the coding process, determining trustworthiness, and analysing the results of the coding process"*.

An additional certainty is that qualitative content analysis will be an iterative never-ending process starting in the initial phases of the study (Bradley, Curry, &Devers, 2007). Depending on the goal of the research, the same authors concluded that there are several approaches of content analysis. These are especially applicable for the use in the healthcare setting and have different types of results (Bradley, Curry, &Devers, 2007).

The first type of result relates to the generation of taxonomies. These are "*formal systems for classifying multifaceted, complex phenomena according to a set of common conceptual domains and dimensions"* (Bradley, Curry, &Devers, 2007, p. 1761). The main purpose of a taxonomy is to enhance clearness in defining and comparing complex phenomena (Bradley, Curry, &Devers, 2007). Hsieh and Shannon (2005) describe the approach leading to this type of result as "Conventional Content Analysis". It is therefore usually applied on describing phenomena on which limited theory or research literature exists (Hsieh&Shannon, 2005).

The second type of result, however, is the creation of a theme. *"Themes are recurrent, unifying concepts or statements about the subject of inquiry"* (Bradley, Curry, &Devers, 2007, p. 1761). Their major purpose is to embody behaviours or beliefs of individual participants by analysing insights from the data (Bradley, Curry, &Devers, 2007). The enabling content approach is described as the "Summative Content Analysis" and starts with identifying and quantifying certain content in the text in order to understand the contextual use of certain words (Hsieh&Shannon, 2005). This is an

attempt to explore usage (Hsieh&Shannon, 2005). However, a normal summative approach goes further than merely counting words or content and also includes latent content analysis, i.e. discovering underlying meanings of words or the content (Hsieh&Shannon, 2005).

The last type of result deals with the building or extension of a certain theory, which is *"the set of general propositions that help explain, predict, and interpret events or phenomena of interest"* (Bradley, Curry, &Devers, 2007, p. 1761). The reason for identifying theories is to recognise probable levers in order to influence particular outcomes or to steer further examination of hypotheses derived from a certain theory (Bradley, Curry, &Devers, 2007). Consequently, it is key in understanding potential causal links (Bradley, Curry, &Devers, 2007). According to Hsieh and Shannon (2005), the approach which produces this type of result is called the "Directed Content analysis". However, sometimes it is denoted as the deductive use of theory in content analysis (Hsieh&Shannon, 2005). The motivation for this method is that existing theory sometimes is unfinished or would profit from further explanation (Hsieh&Shannon, 2005). The aim of a directed approach is therefore *"to validate or extend conceptually a theoretical framework or theory"* (Hsieh&Shannon, 2005, p. 1281). Nevertheless, the directed approach faces some challenges. Hsieh and Shannon (2005) state that researchers will analyse the content with an informed, but strong bias since theory has already been formulated in the past. By being blinded to the contextual aspects of the phenomenon resulting from an overemphasis on the theory, researchers will not investigate all different viewpoints (Hsieh&Shannon, 2005). Therefore, investigators might be more likely to find proof that is supportive rather than non-supportive of a theory (Hsieh&Shannon, 2005). To achieve unbiased results with high validity, a test and audit process can be used (Hsieh&Shannon, 2005).

The phenomena of Lean and second-order problem-solving behaviour of nurses are investigated in this dissertation. These phenomena are already clearly defined and further explanation regarding these concepts are no longer needed. Consequently, conventional content analysis would be of no use. However, it is the aim of the study to build further insights regarding the theory of Lean and the degree of second-order problem-solving. Therefore, a directed content analysis is required. Theory concerning Lean and its impact on the variables of the model of second-order problem-solving has already been built in the literature review. The validation of this theory will be investigated in the empirical study by means of analysing and comparing the occurrences of a theme, i.e. second-order problem-solving behaviour, across several departments. As a result, this second-order problem-solving behaviour is seen as a recurrent, unifying concept. Therefore some, but not the complete set of aspects, of the summative approach to content analysis are also applicable.

The notion of second-order problem-solving behaviour is a very broad concept and embodies several specific underlying activities. Consequently, it is required to structure the data obtained from the questionnaire and to search for these activities. This will be done by coding the information which was provided by the respondents.

4.2.3.2. Coding of Content

The basic aim of the coding process in content analysis is to classify big quantities of text into much fewer categories (Hsieh&Shannon, 2005; Lofland, Snow, Anderson, &Lofland, 2006). Therefore, a coding scheme is used which is a device including the processes and rules of data analysis (Hsieh&Shannon, 2005). These are systematic, logical and scientific and contribute to the trustworthiness or the validity of the study (Hsieh&Shannon, 2005).

Coding itself is defined numerous times (Bradley, Curry, &Devers, 2007; Lofland, Snow, Anderson, &Lofland, 2006; Miles&Huberman, 1994; Saldana, 2008). For the reason of simplicity, the definition of Saldana (2008, p. 8) is provided:

"To codify is to arrange things in a systematic order, to make something part of a system or classification, to categorise. When codes are applied and reapplied to qualitative data, you are codifying – a process that permits data to be segregated, grouped, regrouped and re-linked in order to consolidate meaning and explanation."

The coding process enables a more extensive data analysis, resulting in thoroughly meeting the goals of the research (Saldana, 2008). A code itself is displayed as a "tag" or a "label", attached to pieces of text of varying size (Miles&Huberman, 1994). These can be words, phrases, sentences or whole paragraphs. Apart from the qualitative content analysis approach, a well-crafted and comprehensive coding structure will always promote the quality of the resulting data analysis (Miles&Huberman, 1994).

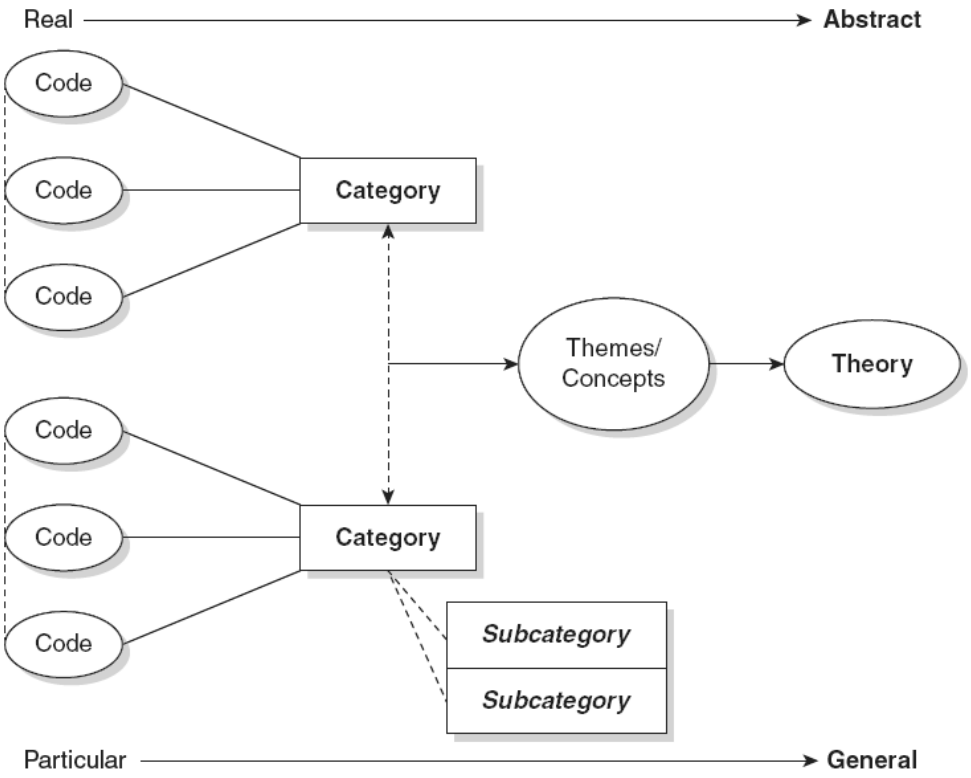
Three conditions concerning codes have to be fulfilled, however. First they have to be valid, meaning that they should correctly mirror what is being researched (Miles&Huberman, 1994). On top of this, codes have to be mutually exclusive. No overlap between two codes may occur, implying that all codes should be distinct (Miles&Huberman, 1994). Finally, exhaustiveness is required meaning that all relevant data should fit into a certain code (Miles&Huberman, 1994).

As a directed content analysis is preferred for this dissertation, deductive coding is appropriate. In this coding process, codes are defined before and during data analysis, which is in contrast with the conventional content analysis (Hsieh&Shannon, 2005). There, codes are solely defined during data analysis (Hsieh&Shannon, 2005). According to Lofland, Snow, Anderson and Lofland (2006) deductive

analysis starts with theoretically derived hypotheses and then proceeds to confirm or falsify them via data which were obtained from respondents. The deductive approach starts with an organising framework for the codes, derived from theoretical propositions (Bradley, Curry, &Devers, 2007). After the data are obtained, a review of the content will be executed in order to allocate data parts to the predefined categories, themes and codes (Bradley, Curry, &Devers, 2007). Inductive coding, on the other hand, is based on developing a set of codes from the ground up, i.e. from scratch. That is why it is frequently denoted as "Grounded Theory", emphasising that the investigator gets soaked in the data so that rooted meanings and relationships can appear (Patton, 2002). In this approach, data are evaluated line by line and as a concept becomes visible, a code is assigned (Hsieh&Shannon, 2005).

From its definition it can be derived that coding is a method that enables researchers to organise and group similarly coded data into categories because they share some characteristics (Saldana, 2008). In this study, for example, responses of nurses to problems were coded. These responses could be allocated to more general problem-solving actions which formed categories. Categories can be seen as sub-dimensions of the broader concepts of first -and second-order problem-solving behaviour, which were identified as themes. Analysis of the occurrence of these themes can therefore help in building or investigating theory concerning the impact of the Lean philosophy on the second-order problem-solving behaviour of nurses. For reasons of clarity, a general codes-to-theory model is provided subsequently. This model makes sure that the hierarchical nature of themes, categories and codes becomes apparent. More information about the data analysis choices in this study will be provided subsequently.

Figure 9 A Streamlined Codes-to-Theory Model for Qualitative Inquiry



Source: Adapted from Saldana (2008, p. 12)

Since this study is situated in a service environment, it is expected that very often, first-order problem-solving and second-order problem-solving will be used in a consecutive way with the eye on resolving the same organisational problem (Tucker&Edmondson, 2002, 2003). This means that, in a healthcare environment, first-order problem-solving is always expected to precede second-order problem-solving behaviour (Tucker&Edmondson, 2002, 2003) because it is avoided that a patient will have to wait for the promised care. In the data analysis, it was therefore supposed that first-order problem-solving would always occur when nurses faced organisational problems. Consequently, only behaviours related to the main concept of this study, i.e. second-order problem-solving, were coded. This forms the only theme of the Codes-to-Theory model of this study. Second-order problem-solving behaviour is subsequently split in several more specific problem-solving behaviours, which form the different categories. These were obtained from the following table which is identical to Table 2. Next, the categories were coded in order to discover the specific actions of the nurses in second-order problem-solving. By applying this coding approach, i.e. starting from the theoretical model and gradually refining the level of detail, it is attempted to fulfil the above conditions for coding which were defined by Miles and Huberman (1994).

Table 8 Actions of Second-Order Problem-Solving

Communicating to the person or department responsible for the problem
Bringing the problem to the manager's attention
Sharing ideas about the cause of the situation and how to prevent recurrence with someone in a position to implement changes
Implement changes
Verify that changes have the desired effect

The data analysis was performed by making use of Computer Assisted Qualitative Data Analysis Software, i.e. CAQDAS. The specific program that was used is NVivo 10. For analysing the text data a framework, i.e. a code tree, was created in this software program. Since text data were obtained from written responses to an electronic questionnaire, no transcription of answers was needed in this study. This implies that no adjustments were needed before the data analysis could start.

4.3. RESULTS AND DISCUSSION

In the following part, the results of the empirical research will be displayed and discussed. Each section will start with a general description of the specific hospital and its departments of interest. Also the different Lean implementation programs will be discussed. Firstly, however, the methods that are used to analyse the results will be explained below.

4.3.1. ANALYSIS

4.3.1.1. Correction for Enabling Comparison

In this study, the occurrence of several second-order problem-solving behaviours in a certain department is investigated and compared with the other department of interest within the same hospital. Later on, variations across hospitals are investigated.

To correct variations of second-order problem-solving behaviour resulting from differences in the number of respondents per department, the observed number of second-order problem-solving behaviour is divided by the number of scenarios filled out in a specific department. Only this way comparison over different departments becomes possible. Initially, it was intended to divide the total occurrences of a specific second-order problem-solving behaviour by the number of respondents per department but since there was a certain dropout and consequently, certain problem scenarios remained unsolved, this method was not applicable. After the occurrences of second-order problem-solving behaviour of a specific department were divided by the number of scenarios of that

department, a factor was found which was multiplied by 100. This was done with the eye on augmenting the comprehensibility of the results. For example, if after the two corrections a number of X occurrences was found, this means that on 100 problem scenarios the second-order problem-solving behaviour will occur X times.

Since Tucker and Edmondson (2002, 2003) do not make any differences in their broad types of organisational problems regarding the probability of facing second-order problem-solving behaviour, the above X-value can be seen as the probability for facing a specific second-order problem-solving behaviour when any problem arises. Therefore when such a problem arises and if this reasoning is followed, there is X% chance that the problem will be resolved while making use of the second-order problem-solving behaviour. However, since one problem can cause several different second-order problem-solving responses and sometimes, the same response is displayed multiple times for addressing the same problem, the reasoning of making use of probabilities is not followed in this study. This would result in ambiguous conclusions although the difference in meaning is rather small. Nevertheless, in this study it is initially assumed that every problem scenario has an equal chance to be approached by a random second-order problem-solving behaviour. Afterwards, this assumption will be relaxed and consequently, it will be investigated which scenarios are more sensitive to evoke certain second-order problem-solving behaviours.

The aim of this study is to give an indication about the impact of Lean on the degree of second-order problem-solving. As mentioned above this is done per hospital by comparing the occurrences of second-order problem-solving behaviour over two departments with a varying Lean maturity. According to the proposition of this dissertation, it is expected that the department with a higher degree of Lean maturity will face an elevated number of second-order problem-solving behaviours. For the comparison process, it is chosen to solely evaluate the occurrences of second-order problem-solving behaviour in a descriptive way. This means that no statistical tests could be applied to express the significance of differences in the number of second-order problem-solving behaviour. Also, since per hospital only two departments were investigated, it would be meaningless to use a self-made comparison metric based on diverse measures of dispersion. This means that a comparison standard based on for instance the standard deviation would be meaningless.

For reasons of clearness, the method for enabling the comparison of second-order problem-solving behaviours over different departments, and eventually hospitals, is repeated here. First a factor is created by dividing the occurrences of a second-order problem-solving behaviour by the total number of scenarios which were filled out in a specific department. When this factor is multiplied by

100, the estimated frequency of a second-order problem-solving behaviour is obtained when 100 problems are encountered in that department.

4.3.1.2. Labelling of the Participants

Throughout the following parts, several nurse quotes will be displayed in order to make the coding process more transparent and with the eye on highlighting critical problem-solving behaviours. For the labelling of the participants, a label which consists of two characters is created. The first character stems from the first letter of the department under study, respectively D for dermatology, G for general internal disorders, H for heart surgery and O for orthopaedics. The second character, on the other hand, stems from the chronological order of respondents within a certain department. For example, D3 denotes the third respondent of the outpatient department of dermatology while O9 is meant to represent the ninth respondent of the Inpatient Clinic of Orthopaedics.

4.3.2. THE UNIVERSITY HOSPITAL OF ANTWERP

On a yearly basis, the University Hospital of Antwerp treats 500.000 patients. In providing this care, it is occupied with nearly 600 beds and it employs 2.800 employees. In 2007, the chief executive officer (CEO) and the chief nursing officer (CNO) decided to alter the hospital organisation from traditional hierarchical and departmental to one that is flat and interdisciplinary (Van Bogaert et al., 2014). This transformation process included the implementation of firstly a flat organization in which unit-based decision-making reigned (Van Bogaert et al., 2014). In this decision-making unit, it was attempted to incur sufficient nurses in the organisational committee with the eye on tapping into their knowledge of organisational problems and other issues. Secondly, the transformation process included the emergence of a participate management style incorporating sufficient feedback from nurses and the attendance of observable and accessible nursing leaders (Van Bogaert et al., 2014). Thirdly, the process was meant to create positive interdisciplinary relations with mutual respect among all disciplines (Van Bogaert et al., 2014).

On top of the hospital transformation process in 2007, the Productive Ward Program was initiated in 2012 in several departments. This Lean-based improvement program was already discussed in the literature review. Since the program is similar for the two departments under study, the general implementation process is discussed here. The subsequent information was obtained from a project employee occupied with implementing the Productive Ward.

The implementation process in both the departments under study is structured as follows. After an introductory phase in which general preparations are required, a kick-off meeting was organised in which the CNO, the head of the department, the project team, the head nurse, nurses and some

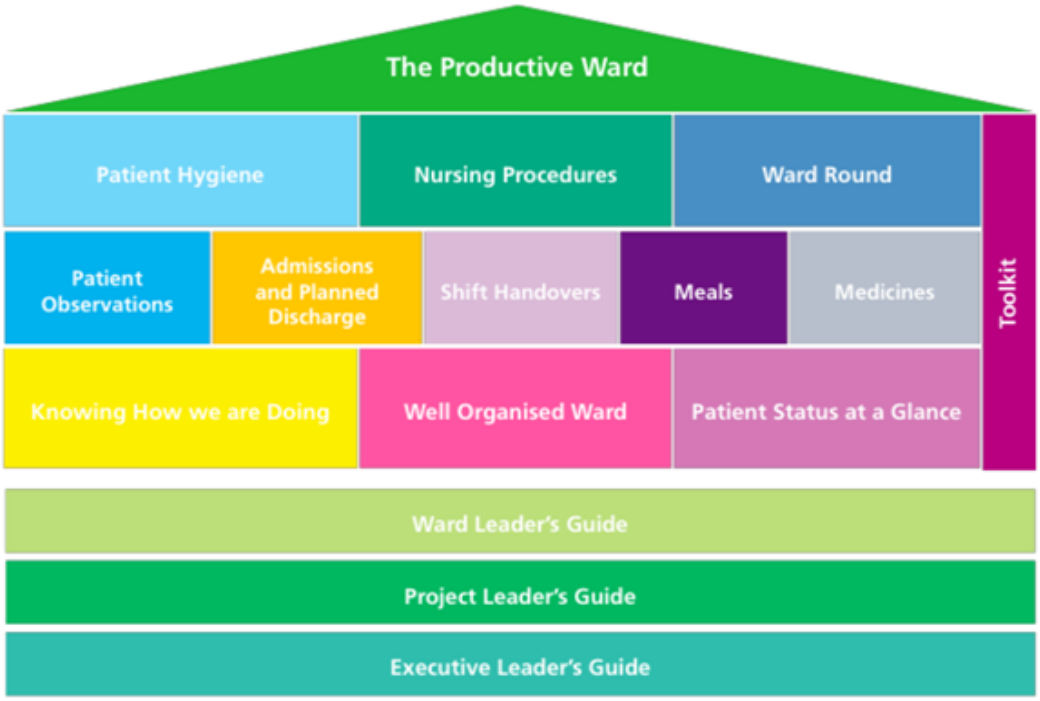
physicians were present. In this meeting, the PW program was explained to the attendants. Also a draft of the future vision of the department was attempted to be created. The second step of the PW program included the start of foundation module 1. This module is called “knowing how we are doing” and it is focused on evaluating the work practices of the department. This module has three different pillars. The first one is about measuring the outputs of a specific department. The second pillar is then intended on visualising these performance indicators, such that everyone becomes aware of them. Finally, the third pillar of foundation module 1 is focused on organising weekly team meetings in which performances of the department are discussed and in which possible improvements are proposed. On top of these three pillars, registration of activities and actual time to care is measured in foundation module 1.

Foundation module 2, i.e. the third step of the program, is focused on improving the organisation of the department. That is why it is called, “well-organised ward”. The module includes the simplification of the work environment and the implementation of 5S, process mapping and a spaghetti diagram. As mentioned earlier, these are tools or variations of the pre-mentioned tools of the Lean methodology. Foundation module 3 is the fourth step of the program. It is called “patient status at a glance” and it is intended on visualising and structuring relevant patient information at very short notice.

Finally, the fifth step of the program includes the start of one or several process modules. This choice is dependent on the needs of the specific department. At the University Hospital of Antwerp, eight process modules were identified, i.e. patient observations, admission and discharge management, shift handover, meals, medications, patient hygiene, nursing procedures and ward rounds.

A schematic representation of the complete PW program is depicted in the following figure. As can be noticed, the foundations of the figure include three guides intended on leader’s behaviour. This behaviour is perceived as very important in the complete PW program. The other modules are provided in a hierarchical way. Only by accomplishing the ones that are needed for a specific department, a successful PW implementation will be possible.

Figure 10 The Productive Ward Modules



Source: NHS Institute for Innovation and Improvement (2007-2008)

A final remark about the work practices of the University Hospital of Antwerp concerns the way errors, problems and other incidents are registered. If an error occurs which results in an incident or a near-miss, nurses are demanded to use the safety management system, i.e. "UZA Meldt" or in English: "UHA Reports". Errors are detected and analysed in a systematic way, so that it becomes possible to follow an improvement process. Consequently, the aim of the safety management system is to facilitate learning in the organisation. In practice, every unintentional event that caused, could cause or will cause damage to patients has to be reported. Given the magnitude and the seriousness of the error, the improvement process will be performed by an empowered team or by management.

Organisational problems, on the other hand, are not meant to be reported by the safety management system. In the University Hospital of Antwerp, it is assumed that these types of process failures will follow the hierarchical line. This means that when a organisational problem is faced on the work floor, a nurse will report it to a head nurse. Vice versa, the head nurse will report the organisational problem to a member of the management and so on. This way, it is believed that root causes of the organisational problem will be removed and organisational learning is brought about.

4.3.2.1. The Inpatient Clinic of Heart Surgery

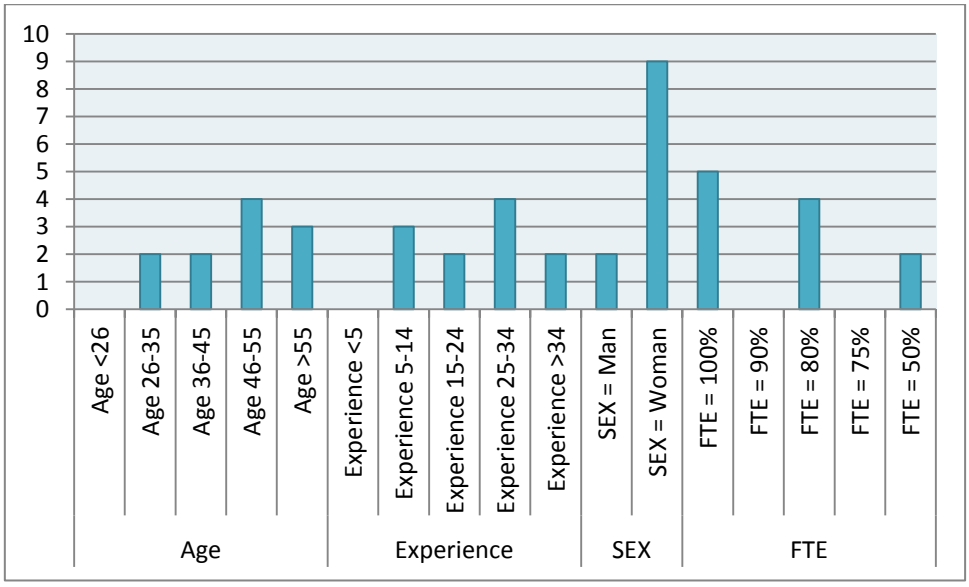
The implementation of the PW program at the Inpatient Clinic of Heart Surgery started in March 2012 and was extremely successful given the very high score on Lean maturity. Currently, the inpatient clinic employs 29 nurses.

Results

In this master thesis, 11 out of the 29 nurses who are employed at IH were questioned in a time span of almost two months. Initially, this response rate was very low and consequently, the CNO himself urged the collaboration of the nurses. This led to a total response of 50 completed scenarios.

Average age and experience were respectively 47,3 and 24 years, implying that the questioned nurses were rather experienced in their profession. The average fulltime-equivalent was 84% and 9 of the respondents at the Inpatient Clinic of Heart Surgery were women, while 2 of them were male. A graphical representation of the characteristics of the respondents is depicted in the following bar chart which counts the number of nurses within a certain subcategory. Remark that the sum of the respondents within each category, which consists of several subcategories, equals 11.

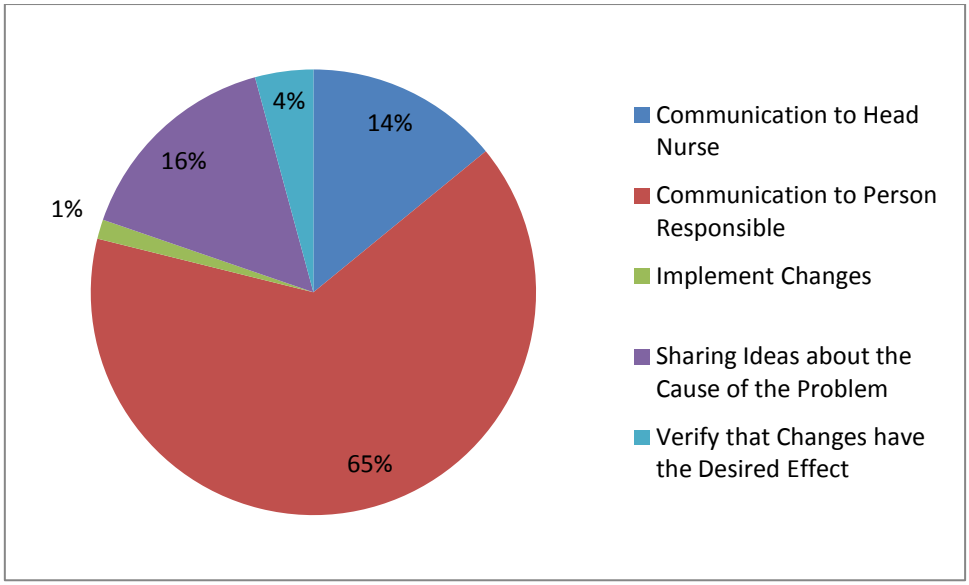
Chart 1 Characteristics Respondents at IH



The relative distribution of the specific second-order problem-solving behaviours is displayed in the following pie chart. As can be seen, “Communication to the Person Responsible” is the determining behaviour with 65%. This means that 65% of all second-order problem-solving responses were coded as “Communication to the Person Responsible”. “Sharing Ideas about the Cause of the Problem” and “Communication to the Head Nurse” account for respectively 16% and 14%, while “Verify that

Changes have the Desired Effect" and "Implement Changes" explain 4% and 1% of the second-order problem-solving behaviours.

Chart 2 Relative Distribution of Behaviours at IH



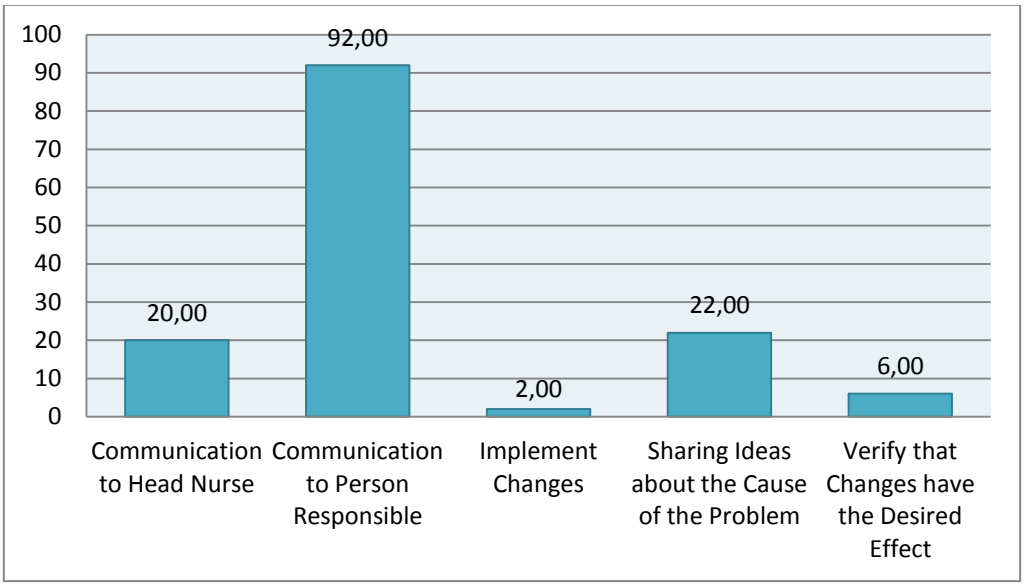
The following table displays the absolute number of the different second-order problem-solving behaviours.

Table 9 Absolute Number of Second-Order Problem-Solving Behaviours at IH

Second-Order Problem-Solving Behaviour	Absolute Number
Communication to Head Nurse	10
Communication to the Person Responsible	46
Implement Changes	1
Sharing Ideas about the Cause of the Problem	11
Verify that Changes have the Desired Effect	3
Total	**71**

As can be seen, second-order problem-solving behaviour was observed 71 times at this department on a total of 50 problem scenarios. On a total of 100 problem scenarios, it is therefore expected that 142 second-order problem-solving responses will be detected. When in addition the individual problem-solving behaviours are corrected for the number of scenarios, the following results as indicated by the understanding chart can be obtained. The expected number of occurrences on 100 problem scenarios is indicated on top of each second-order problem-solving behaviour. It can be noted that these sum up to 142.

Chart 3 Second-Order Problem-Solving Occurrences at IH



A few remarkable quotes are included here with the eye on making the coding process more transparent and in order to give additional information on how problems are approached at this department.

In resolving the problem of wrongly delivered supplies, H5 provided a beautiful example of both first and second-order problem-solving.

"First of all, I search for a solution in order to continue my job. I do this by borrowing supplies from a neighbouring department. Later when I finished the task, I call the responsible of the central services department and I ask to correct the wrongly delivered supplies. When I notice that the issue keeps reoccurring, I contact the head nurse in order to prevent the problem in the future."

It can be seen that H5 firstly tries to circumvent the problem by borrowing the supplies. Afterwards, however, additional actions are undertaken in order to prevent the issue in the future. This is done by "Communication to the Person Responsible" and by "Communication to the Head Nurse".

In some scenarios, nurses went a step further and tried to more actively contribute to the prevention of problems. "Sharing Ideas about the Cause of the Problem" can be seen as a more progressive second-order problem-solving response. This behaviour was brought about by H1, H2, H3, H5 and H6. Although "Sharing Ideas about the Cause of the Problem" was observed in resolving different problem scenarios, it was mostly noticed when a nurse had to deal with incorrect or missing patient information. A frequently detected response to this problem included the use of the ISBARR mnemonic, which usually stands for Introduction, Situation, Background, Assessment, Recommendation and Readback and is used to arrange the safe transfer of patient information. In

the light of “Sharing Ideas about the Cause of the Problem”, the background and the assessment step provide a clear understanding on the origins of the communication problem and by the recommendation step, it is made sure that these causes are well communicated (Aldrich et al., 2009). Although the ISBARR response was also coded as “Communication to the Person Responsible”, it transcends this conservative behaviour by the search and communication of the causes. However, the ISBARR technique does not imply that changes are implemented and verified by nurses themselves, that is why no other codes were applicable.

Other instances of “Sharing Ideas about the Cause of the Problem” originated mostly from missing or defect equipment and missing or wrongly delivered supplies. H3, H5 and H6 all solved one or more of these issues with the following response. Note that this is only part of the problem-solving response since first-order problem-solving was observed firstly.

“..., Further, I will track the origin of the problem. When I do found this root cause, I will communicate it to the head nurse or at the weekly PW meeting”.

One clear example of “Verify that Changes have the Desired Effect” is provided by H2 who stated that:

“After I try to come up with an initial response myself, I contact the responsible department which has to find a solution that makes the recurrence of the problem impossible. Afterwards, I always check if the proposed solution has the desired effect.”

The least frequent response at IH was “Implement Changes” with only one response, displayed by H6 for resolving the problem of a missing piece of equipment. After displaying the first-order problem-solving behaviour, H6 contacted the head nurse. Additionally H6 stated:

“If I notice that the same problem recurs frequently, I try to come up with some sort of new procedure for placing the item. Most of the time this is done at the weekly PW meeting, in collaboration with my colleagues.”

Awareness-Contribution Matrix

As mentioned earlier, the awareness of the Lean philosophy and the belief in contributing to the removal of organisational problems was checked. The results are displayed in the following table, which is called the awareness-contribution matrix. The table displays the number of respondents who answered a certain combination of answers to the two final questions. An additional category, named “unassigned”, had to be created since not all respondents managed to complete the questionnaire. From the settings of the questionnaire it was made sure that a respondent who did

not fill out the awareness question, could never fill out the contribution question. Therefore, when the awareness question was left blank, the contribution question was never displayed and was as well coded as unassigned.

Table 10 Awareness-Contribution Matrix IH

Lean		Contribution		
		Unassigned	Yes	No
Awareness	Unassigned	1	0	0
	Yes	0	10	0
	No	0	0	0

From the table it can be seen that all respondents who filled out both the awareness and contribution question believe that Lean has an impact on the prevention on the recurrence of organisational problems.

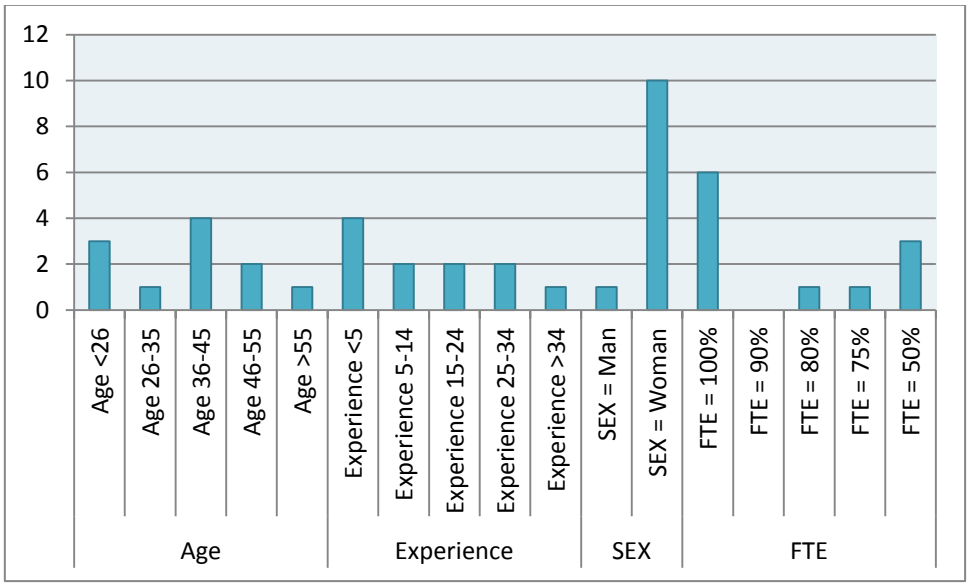
4.3.2.2. The Inpatient Clinic of Orthopaedics

The implementation of the PW program at this department started a year later than that of the Inpatient Clinic of Heart Surgery. Consequently, the program was initiated in March 2013. As mentioned above, the Inpatient Clinic of Orthopaedics, which employs 19 nurses, was implemented in this study given its lower score on Lean maturity relative to the Inpatient Clinic of Heart Surgery.

Results

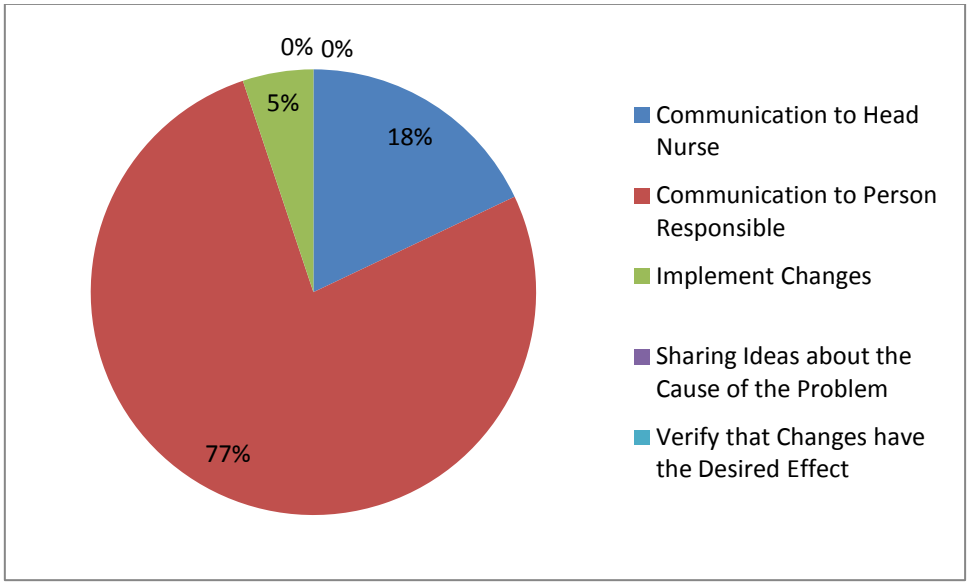
At IO, 11 out of a total of 19 were questioned. Once more, the CNO had to encourage the respondents in order to elevate the low response rate. This led to a total response of 37 completed scenarios. Average age and experience were respectively 38,64 and 13,83 years, which implies that the employees at this department are slightly younger and more inexperienced than at IH. The average fulltime-equivalent was 83% and 10 of the respondents were women, while 1 of them was a man. A graphical representation of the characteristics of the respondents is again depicted in the following bar chart.

Chart 4 Characteristics Respondents at IO



The relative distribution of the specific second-order problem-solving behaviours is displayed in the following pie chart. Again, "Communication to the Person Responsible" is the determining behaviour with 77%. "Communication to the Head Nurse" and "Implement Changes" account for respectively 18% and 5% of the second-order problem-solving behaviours. The other two responses, on the other hand, were never observed.

Chart 5 Relative Distribution of Behaviours at IO



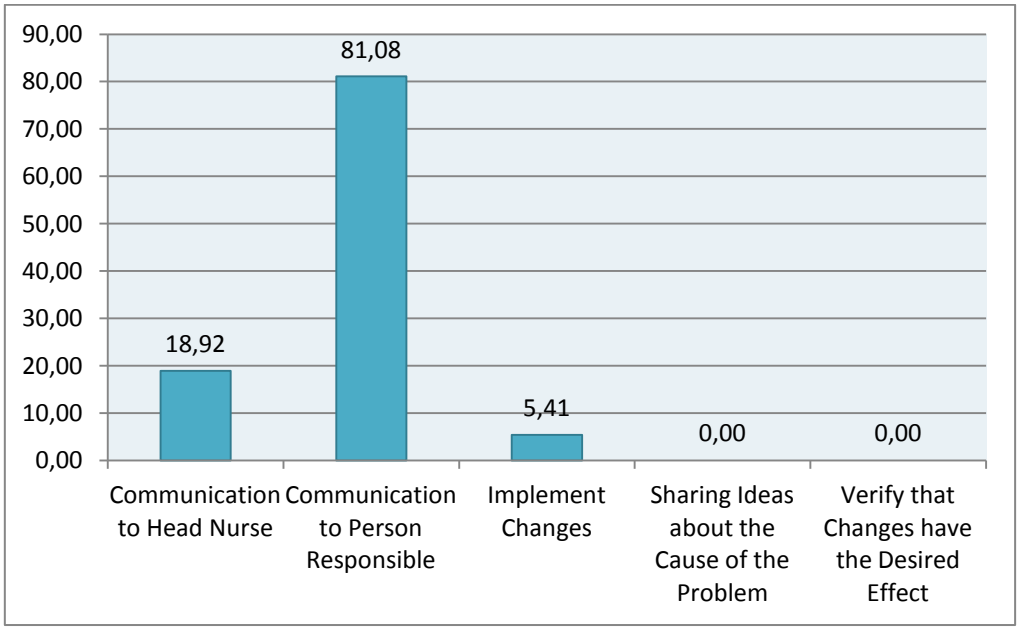
The following table displays the absolute number of the different second-order problem-solving behaviours.

Table 11 Absolute Number of Second-Order Problem-Solving Behaviours at IO

Second-Order Problem-Solving Behaviour	Absolute Number
Communication to Head Nurse	7
Communication to the Person Responsible	30
Implement Changes	2
Sharing Ideas about the Cause of the Problem	0
Verify that Changes have the Desired Effect	0
Total	**39**

As can be seen, second-order problem-solving behaviour was detected 39 times at this department. Taking into account that 37 problem scenarios were filled out, it is therefore expected that 105,41 second-order problem-solving responses will be observed on a total of 100 problem scenarios. When in addition the individual problem-solving behaviours are corrected for the number of scenarios, the following results, as indicated by the understanding chart, can be obtained. The expected number of occurrences on 100 problem scenarios is indicated on top of each second-order problem-solving behaviour.

Chart 6 Second-Order Problem-Solving Occurrences at IO



The behaviour of "Implement Changes" was observed two times by the same nurse, O5. The first instance was in response to the problem of a missing piece of equipment. The complete answer was:

"I start with searching for the equipment in all possible places. If no results are obtained, I interrogate my colleagues about a potential location. When the item is found eventually, I make sure that a note is attached with clear guidelines about the right place. This can be a new one if the old location proved to be suboptimal."

The behaviour of "Implement Changes" can be noticed in the response of attaching the note with a potential new location for the piece of equipment.

The second behaviour of "Implement Changes", also displayed by O5, was observed in response to the problem of wrongly delivered supplies. The solution to this problem noted:

"Firstly, I make sure that I can continue my job. Secondly, I call the responsible department and I ask for the right supplies to be delivered. Additionally, I intend to make clear arrangements in order to overcome this issue in the future. This can mostly be done by adapting the communication process."

The first component of this response is the part where first-order problem-solving can be noticed. Later, when the problem is solved and the job is finished, this nurse displays second-order problem-solving behaviour by "Communication to the Person Responsible" and "Implement Changes". This latter response of "Implement Changes" is demonstrated by the intention of O5 to make new, improved arrangements with the responsible department.

Awareness-Contribution Matrix

The results of the awareness-contribution matrix are displayed subsequently. 6 out of 7 nurses who filled out the two questions believed that Lean has a positive impact on the prevention of the recurrence of organisational problems. 1 nurse, on the other hand, does not attribute the prevention of organisational problems to Lean.

Table 12 Awareness-Contribution Matrix IO

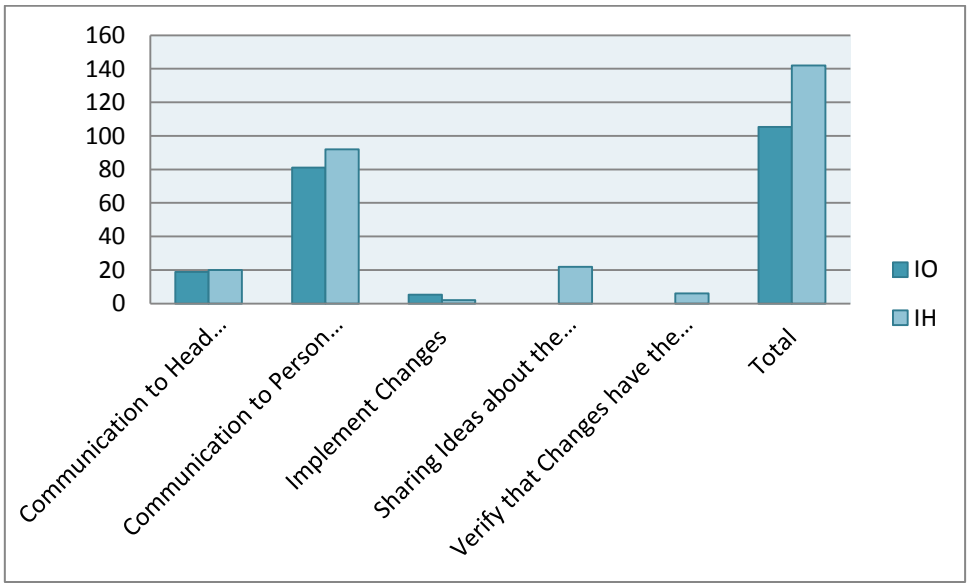
Lean		Contribution		
		Unassigned	Yes	No
Awareness	Unassigned	4	0	0
	Yes	0	6	1
	No	0	0	0

4.3.2.3. Cross-Departmental Analysis UHA

Since the Inpatient Clinic of Heart Surgery has the highest degree of Lean maturity, it is expected that second-order problem-solving behaviour occurs more frequently at this department. The results of

the cross-departmental analysis at the University Hospital of Antwerp are listed in the following bar chart. Again, the occurrences are corrected for the number of scenarios filled out by the respondents per department.

Chart 7 Cross-Departmental Analysis UHA



As can be seen, the Inpatient Clinic of Heart Surgery has a higher number of occurrences on the different second-order problem-solving behaviours, except on "Implement Changes". On 100 problem scenarios, a total of 142 second-order problem-solving responses will be detected for the Inpatient Clinic of Heart Surgery versus 105,41 for the Inpatient Clinic of Orthopaedics. This result seems to support the proposition that a higher Lean maturity leads to an elevated degree of second-order problem-solving behaviour. However, it has to be kept in mind that this result does not provide hard evidence about the significance of the differences since no statistical tests can be conducted. Nevertheless, it gives an indication of the impact of Lean on the degree of second-order problem-solving behaviour.

4.3.3. The University Hospital of Ghent

Since the University Hospital of Ghent has more than 3.000 patients per day and more than 6.000 employees, it is one of the biggest and most specialised hospitals in Flanders. With the eye on providing the appropriate care for its patients, the hospital is equipped with extensive facilities and more than 1.000 beds for both inpatient and outpatient clinics.

In contrast with the flat organisational structure of the University Hospital of Antwerp, the organisation of the University Hospital of Ghent is rather hierarchical. As mentioned earlier, the hospital is divided in sectors. In this study, the use of the terminology of medical sectors is specific for

the University Hospital of Ghent. In general, a sector can be seen as a covering division which includes several departments and which has a single chairman and care manager. The University Hospital of Ghent has 9 different sectors, which are displayed in the following table. The sector in which this study was conducted is indicated in bold.

Table 13 The Nine Sectors of the UHG

Administration and General Management	Corporate Supporting Sector
Musculoskeletal System	**Metabolic and Cardiovascular Disorders**
Critical Services	Head, Neck and Nervous System
Man, Woman Child	Clinical Supporting Sector
Blood, Respiration and Digestion	

Source: Anonymous, personal communication, 20 March 2015

The sector of Metabolic and Cardiovascular Disorders is subdivided in 8 separate departments. Each department has an accompanying outpatient clinic. In two of them, the Outpatient Clinic of Dermatology and the Outpatient Clinic of General Internal Disorders, the questionnaire was distributed. For reasons of completeness, the organisational chart of the sector is provided in the attachments. The departments under study are indicated in orange.

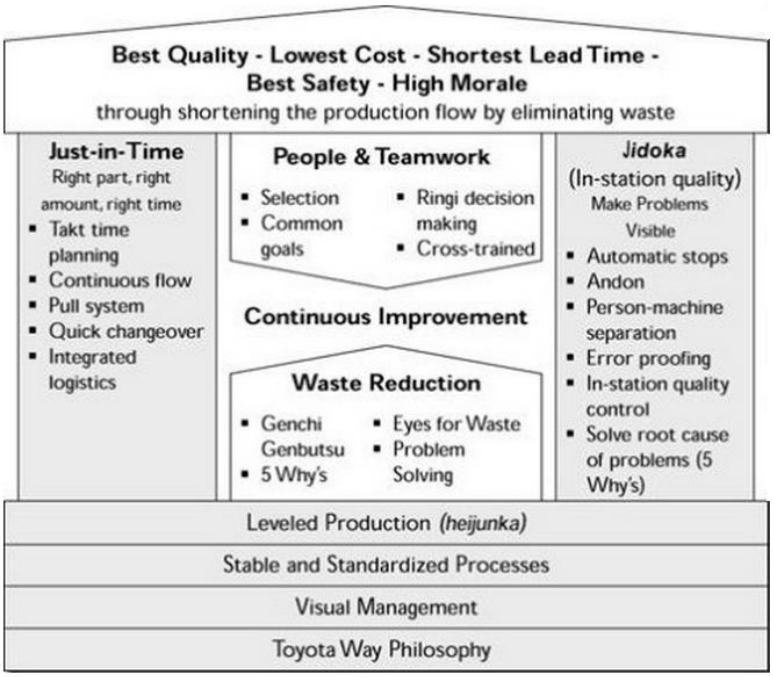
Similar to the situation in the University Hospital of Antwerp, a safety management system is put in place with the eye on facilitating the reporting of incidents and near-misses. In Ghent this system is called the "Incidents Reporting and Learning System", or in Dutch "Incidenten Meld -en Leersysteem". For some organisational problems, in contrast, the hospital uses an online platform, named "Faci-Link". The purpose of this platform is to report problems or to organise deliveries. Examples of these are problems with the infrastructure or the ordering of pillows. Other organisational problems are expected to follow the same hierarchical line as in the University Hospital of Antwerp.

4.3.3.1. The Outpatient Clinic of Dermatology

At the start of the year 2008, the department of dermatology was evolved into a national and international academic unit of great appearance (Lambert&Van Goubergen, 2012). However, operational processes faced some difficulties. These were twofold. Firstly, there were issues with long waiting times for consultations. Consequently, patients had to wait significant periods before an appointment could be held. Also, there were problems with the punctuality of the consultations and the transfer of the right information to the right patient at the right time (Lambert&Van Goubergen, 2012). Secondly, intellectual contributions and technical achievements of staff were very low.

As a result, the department chose to adopt the tools of the Lean philosophy. Guided by "The Toyota Production System House", displayed in the figure below, tools applicable for the hospital environment were identified in order to obtain exceptional outcomes (Lambert&Van Goubergen, 2012).

Figure 11 The Toyota Production System House



Source: Liker (2003)

The implementation of some of the Lean tools, which are connected to the Toyota Production System House, occurred in six different steps. The first step relates to the concept of value for the customer, i.e. the patient. This step resulted in a clear specification of value definitions and expectations of the patient, and a value stream. Also the eight types of wastes were identified and concrete objectives for improvements were determined (Lambert&Van Goubergen, 2012). For identifying wastes and objectives, it was very important that everyone at the department was involved. That is why a team was created, consisting of employees of all levels. This team included receptionists, nurses, assistants and also members of higher management. Important to notice is that a "no blame"-attitude was expected from the management and the other members since it was assumed that the process fails, rather than the individual (Lambert&Van Goubergen, 2012).

Starting at the second step of the implementation program, the difficulties and wastes in the value stream were addressed. In this step, one piece flow in the consultation value stream was implemented. This means that reports of physicians' examinations had to be finished immediately after a patient was checked (Lambert&Van Goubergen, 2012).

In the third step, load levelling in the consultation value stream was scrutinised. This action of load levelling is denoted as “heijunka” in the TPS House (Lambert&Van Goubergen, 2012). In addition, in the fourth step, additional difficulties in the value stream were considered by better matching capacity of demand. As a result, variability was reduced (Lambert&Van Goubergen, 2012). The fifth step, nevertheless, focused on eliminating waste and an increase of capacity by implementing standard work for specialists (Lambert&Van Goubergen, 2012). Finally, the sixth step included the implementation of visual management, A3-thinking, 5S and performance boards in order to support continuous improvement, which is in the centre of the TPS house. It has to be noted that at the time of publication of the work of Lambert and Van Goubergen (2012), the Lean implementation program was not finished yet. Only parts of the TPS House were implemented and since the implementation of Lean is a journey and not a project, additional actions were required. That is why, in the years after the publication, additional actions were undertaken to further implement the Lean tools (Anonymous, personal communication, 20 March 2015).

As can be derived from the above description of the Lean implementation program, the department of dermatology mainly focuses on the incorporation of Lean tools and not on its intellectual legacy. This was confirmed by the care manager of the sector of Metabolic and Cardiovascular Disorders who stated that Lean is seen as a toolbox (personal communication, 7 November 2014). Therefore, the Lean manufacturing system at the department emphasises the above mentioned technical system which was derived from the definition of Lean, implying that it makes use of an extensive set of tools rather than of its culture.

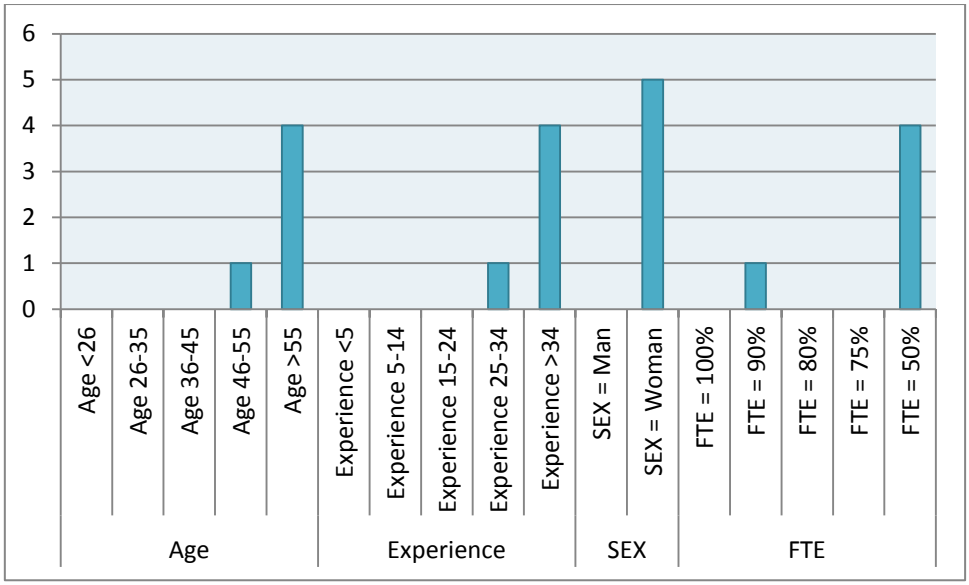
Organisational problem-solving at the Outpatient Clinic of Dermatology is, in contrast with the Outpatient Clinic of General Internal Disorders, not an individual responsibility. The problem-solving situation at OG is discussed further on. When problems arise at OD, they are discussed in short team meetings in which the problem is written on an improvement board. Possible solutions are proposed in group and responsibilities for preventing the cause of the problem are distributed. Also, a clear deadline is set, stating the allowed time allocated for solving the problem.

Results

In this study, 5 out of the 6 nurses who are employed at the department were questioned. Therefore, this set of respondents is quite representative for the total department. The respondents at OD were all women. Average age and experience were respectively 59,4 and 38 years, implying that the questioned nurses were very experienced in their profession. The average fulltime-equivalent is 58%, which is rather low and coincides with the aging nursing population at the department. A graphical representation of the characteristics of the respondents is depicted in the following bar chart which

counts the number of nurses within a certain subcategory. Remark that the sum of the respondents within each category, which consists of several subcategories, equals 5.

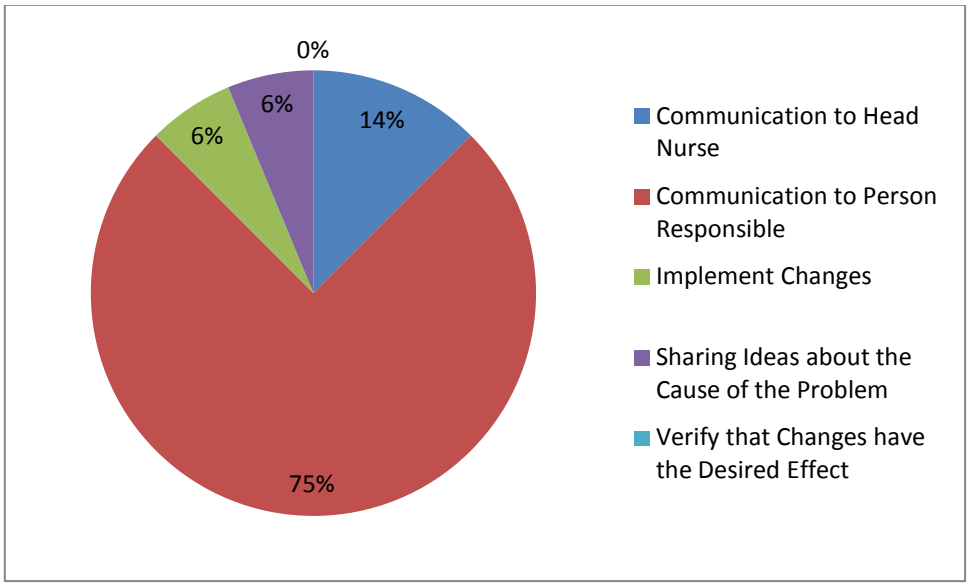
Chart 8 Characteristics Respondents at OD



From the 5 respondents, 3 managed to fill out the questionnaire completely implying that these 3 respondents solved 15 problem scenarios in total. 2 nurses on the other hand only filled out 4 problem scenarios meaning that the total number of problem scenarios at the department was augmented by 8, making it 23. The initial response at OD was very low. That is why the electronic questionnaire was printed on paper and consequently, the nurses could answer the problem scenarios by making use of their writing skills. Afterwards, these responses were collected by the researcher and introduced in the online Qualtrics-questionnaire. This process was rather time intensive but was absolutely necessary to overcome boundaries of nurses in filling out the electronic questionnaire. It is expected that this method does not influence the results of the study since the difference between electronically and manually filling out the questionnaire can be neglected.

The relative distribution of the specific second-order problem-solving behaviours is displayed in the following pie chart. As can be seen, “Communication to the Person Responsible” is the determining behaviour with 75% of all second-order problem-solving behaviours. “Communication to the Head Nurse” accounts for 13% and both the behaviours of “Implement Changes” and “Sharing Ideas about the Cause of the Problem” explains 6% of the second-order problem-solving behaviours. “Verify that Changes have the Desired Effect”, on the other hand, was never observed at the department.

Chart 9 Relative Distribution of Behaviours at OD



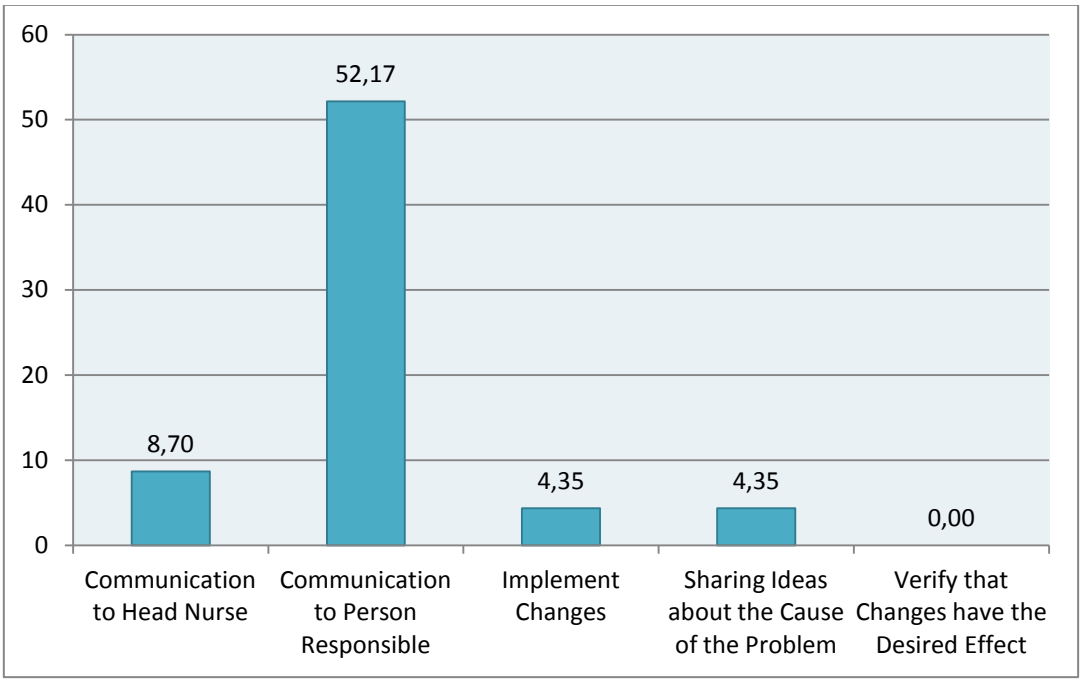
The following table displays the absolute number of the different second-order problem-solving behaviours.

Table 14 Absolute Number of Second-Order Problem-Solving Behaviours at OD

Second-Order Problem-Solving Behaviour	Absolute Number
Communication to Head Nurse	2
Communication to the Person Responsible	12
Implement Changes	1
Sharing Ideas about the Cause of the Problem	1
Verify that Changes have the Desired Effect	0
Total	**16**

As can be seen, second-order problem-solving behaviour was observed 16 times at this department on a total of 23 problem scenarios. On a total of 100 problem scenarios, it is therefore expected that 69,59 second-order problem-solving responses will be detected. When in addition the individual problem-solving behaviours are corrected for the number of scenarios, the following results as indicated by the understanding chart can be obtained. The expected number of occurrences on 100 problem scenarios is indicated on top of each second-order problem-solving behaviour. It can be noted that these sum up to 69,59.

Chart 10 Second-Order Problem-Solving Occurrences at OD



"Communication to the Person Responsible" is by far the most popular second-order problem-solving response, as stated above. D5 also tried to "Share Ideas about the Cause of the Problem" and to "Implement Changes" as she proposed to organise a meeting to discuss the origins of the problem in which some new arrangements in case of a missing piece of equipment could be made. "Verify that Changes have the Desired Effect" could not be observed at the Outpatient Clinic of Dermatology.

Awareness-Contribution Matrix

Again, the awareness of the Lean philosophy and the belief in contributing to the removal of organisational problems was checked. The results are displayed in the following table. It can be seen that all nurses know that the philosophy is implemented at their department. However, none of them believes that Lean has an impact on the recurrence of problems. This finding is very remarkable, especially when it is compared with the results of the University Hospital of Antwerp. A potential explanation may stem from the following remark of D2:

"We are indeed aware of the implementation of Lean. However, we are not familiar with its tools and principles. Lean is mostly aimed at the physicians at the department and they know very well how to use the different tools."

This quote may imply that the nurses at the department are not fully involved in the Lean implementation program and that they may lack knowledge about the true meaning of the philosophy. A quote of another nurse at the department appears to confirm this statement as D1

said that Lean is *"more or less"* implemented at the department of dermatology. This finding might prove that up till now, Lean did not yet find its way to the profession of nursing. Also, these discoveries may underpin the earlier remark which stated that Lean is mostly seen as a toolbox and not as a philosophy and a new way of thinking.

Table 15 Awareness-Contribution Matrix OD

Lean		Contribution		
		Unassigned	Yes	No
Awareness	Unassigned	0	0	0
	Yes	0	0	5
	No	0	0	0

4.3.3.2. The Outpatient Clinic of General Internal Disorders

At the Outpatient Clinic of General Internal Disorders no formal Lean tools or programs are implemented yet. This choice was based on a disbelief in the philosophy and its tools and principles. A quote obtained from the head nurse (personal communication, 20 March 2015) at OG proves this statement.

"As we nurses are knowledge workers, we cannot approach problems making use of standardised tools and guidelines. We need the freedom to make our own decisions and to solve problems in our own way. That is why I do not believe that the Lean tools will work in a hospital setting."

Consequently, if an organisational problem arises, managers and the head nurse expect that nurses will make use of their common sense. At the department, it is therefore explicitly communicated that logical thinking is valued.

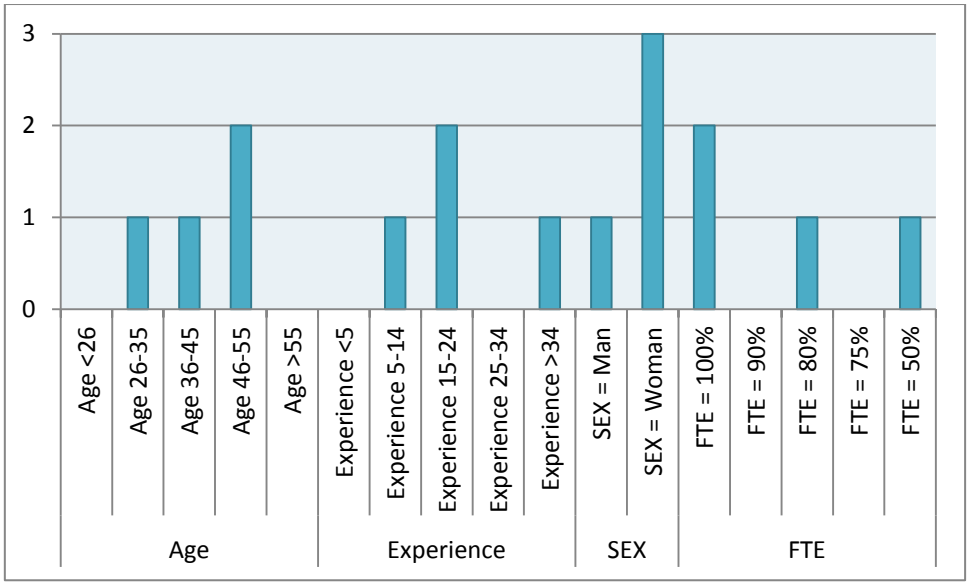
Results

Once more, nurses were hesitating to fill out the electronic questionnaire. That is why, the same method was applied as for OD and consequently, the questionnaire was printed on paper and manually filled out by the respondents.

At the Outpatient Clinic of General Internal Disorders, 4 out of the 6 nurses were questioned. 3 of them were women and average age and experience were respectively 43,75 and 20,75 years, implying that the questioned nurses were younger than at OD. The average fulltime-equivalent is 83%, which is higher than at OD. A graphical representation of the characteristics of the respondents

is depicted in the following bar chart which again counts the number of nurses within a certain subcategory.

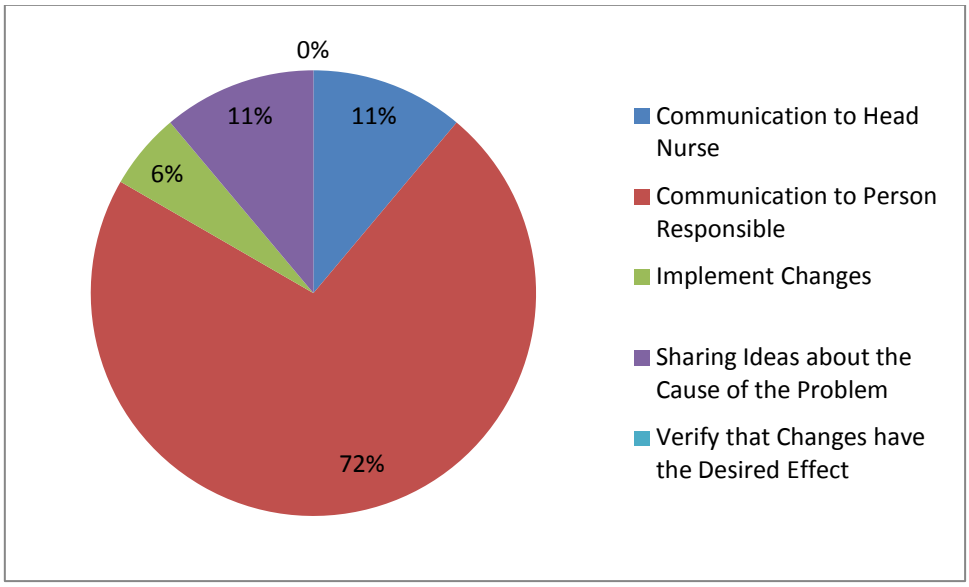
Chart 11 Characteristics Respondents at OG



From the 4 respondents, 3 managed to fill out the complete questionnaire implying that they solved 15 problem scenarios in total. 1 nurse on the other hand only filled out 4 problem scenarios, meaning that the total number of problem scenarios for analysis was 19.

The relative distribution of the specific second-order problem-solving behaviours is displayed in the following pie chart. As can be seen, “Communication to the Person Responsible” is again the determining behaviour with 72%. “Communication to the Head Nurse” and “Sharing Ideas about the Cause of the Problem” account for 11% of second-order problem-solving responses, while the behaviour of “Implement Changes” explains 6%. Once more “Verify that Changes have the Desired Effect” was never observed at the department.

Chart 12 Relative Distribution of Behaviours at OG



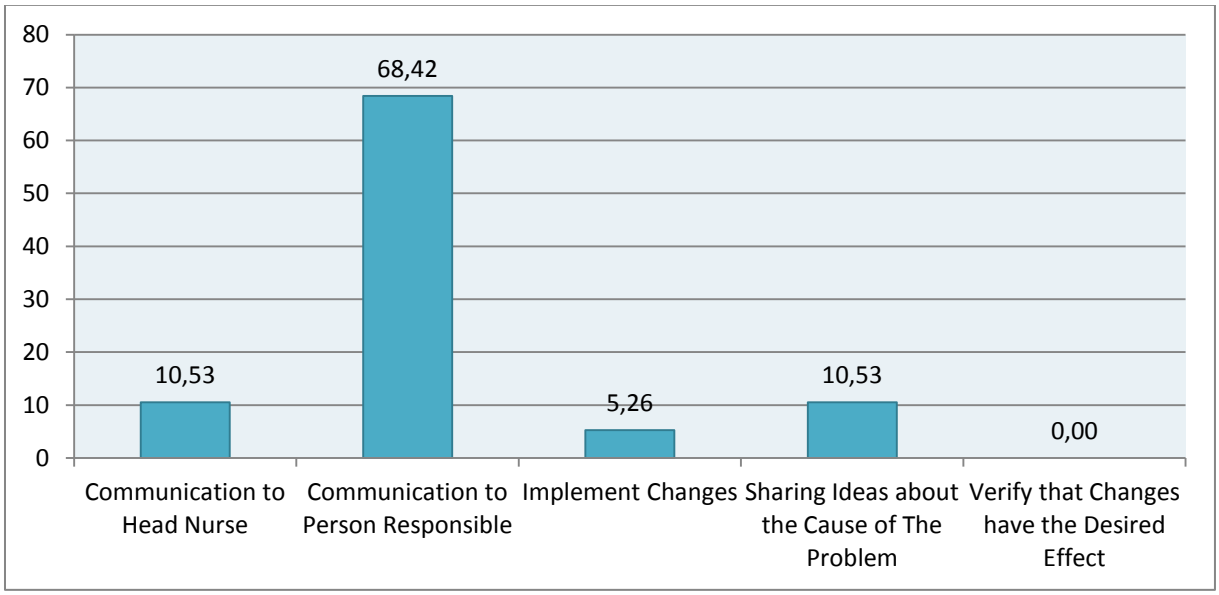
The following table displays the absolute number of the different second-order problem-solving behaviours.

Table 16 Absolute Number of Second-Order Problem-Solving Behaviours at OG

Second-Order Problem-Solving Behaviour	Absolute Number
Communication to Head Nurse	2
Communication to the Person Responsible	13
Implement Changes	1
Sharing Ideas about the Cause of the Problem	2
Verify that Changes have the Desired Effect	0
Total	**18**

As can be seen, second-order problem-solving behaviours were observed 18 times at this department on a total of 19 problem scenarios. On a total of 100 problem scenarios, it is therefore expected that 94,74 second-order problem-solving responses will be detected. When in addition the individual problem-solving behaviours are corrected for the number of scenarios, the following results can be obtained as indicated by the understanding chart.

Chart 13 Second-Order Problem-Solving Occurrences at OG



"Sharing Ideas about the Cause of the Problem" was displayed by two different nurses on two different problem scenarios. In the case of facing a lack of information for treating a patient, G3 answered:

"Firstly, I call the physician who is responsible for the missing information. Next I try to search for a cause of the miscommunication and when I do find this origin, I try to communicate it to the physicians with the eye on the prevention of recurrences."

The next instance of "Sharing Ideas about the Cause of the Problem" coincided with the responses of "Implement Changes" and "Communication to the Head Nurse". On the problem of missing a piece of equipment, G4 stated:

"Firstly, I will search for the missing piece of equipment. Later, however, I will talk with the head nurse and I will communicate the issue and the potential causes to my colleagues, ..."

The last part is an example of "Sharing Ideas about the Cause of the Problem". The quote was not finished yet, however and continued with a clear illustration of "Implement Changes":

"... I will also try to come up with a new procedure for placing the equipment in order to prevent this problem in the future".

Awareness-Contribution Matrix

Once more, the awareness of the Lean philosophy and the belief in contributing to the removal of organisational problems was checked. The results are displayed in the following table and are rather surprising since at OG no Lean tools were implemented. It can be seen that two of the nurses

answered that the philosophy is not implemented at their department, which is correct. However, the other two nurses believed that their department faced a Lean implementation program, while this was not the case. Although these nurses had no experience in Lean at their department, they believed that Lean has indeed an impact on the prevention of organisational problems. The researcher believes that this finding might be seen as some sort of noise or normative behaviour. It could be true that the nurses tried to find or guess the answer which they thought was most appropriate.

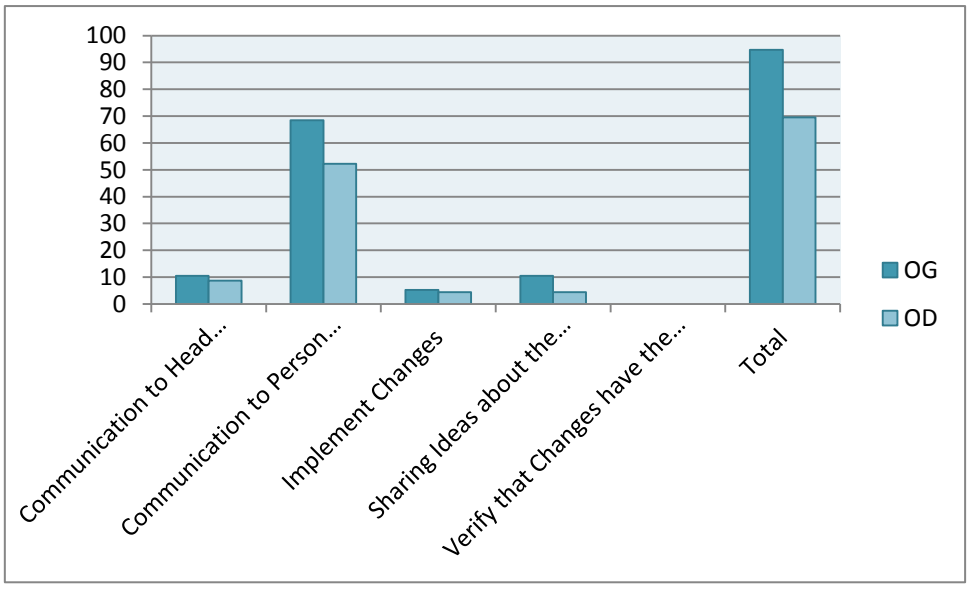
Table 17 Awareness-Contribution Matrix OG

Lean		Contribution		
		Unassigned	Yes	No
Awareness	Unassigned	0	0	0
	Yes	0	2	0
	No	2	0	0

4.3.3.3. Cross-Departmental Analysis UHG

The same approach as for the University Hospital of Antwerp was followed. This leads to the subsequent bar chart.

Chart 14 Cross-Departmental Analysis UHG



In contrast to the results of the University Hospital of Antwerp, the department with a higher degree of Lean maturity, which is the Outpatient Clinic of Dermatology, has an overall lower degree of second-order problem-solving behaviour. This finding, therefore, does not support the proposition of

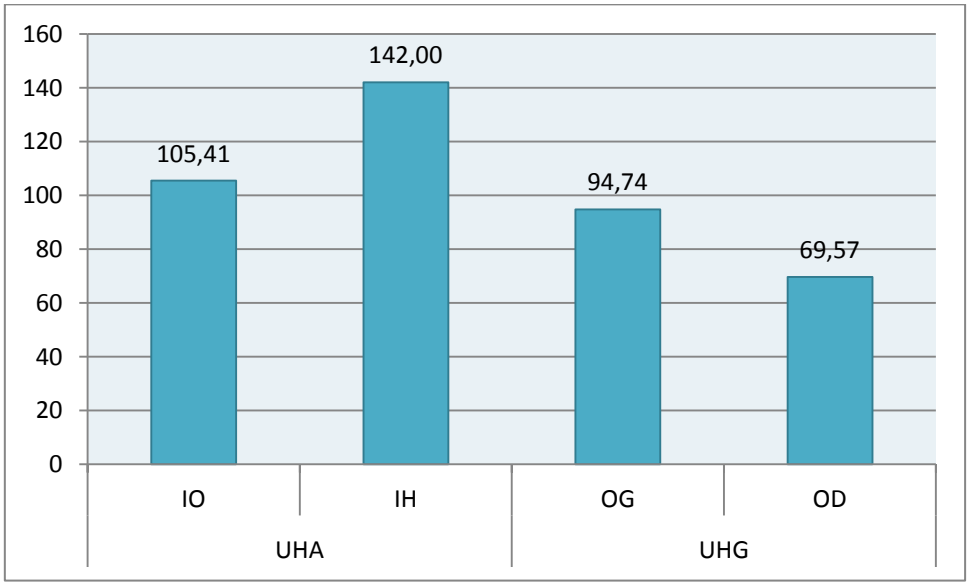
this study. On the contrary, it seems that the Outpatient Clinic of General Internal Disorders, which has no experience in Lean implementation programs and relies solely on the common sense of its nurses, evokes an elevated behaviour of second-order problem-solving. On a total of 100 problem scenarios, second-order problem-solving behaviour will be detected 94,74 times at the Outpatient Clinic of General Internal Disorders versus 69,57 times at the Outpatient Clinic of Dermatology. This finding is quite curious given the proposition that was derived after an extensive literature review and therefore has to be investigated by looking at other factors that may affect the degree of second-order problem-solving behaviour. Although it was expected that the characteristics of the respondents would not play a major role, they have to be analysed. In the literature review, it was concluded that organisational problem-solving is approached in a deductive way. Consequently, age, experience, FTE and sex are initially expected to have no effect on the degree of second-order problem-solving behaviour. In the following sections, this topic will be discussed in more extensive depth with the eye on coming up with an explanation for the findings at UHG. Also other factors that may have an impact will be investigated. These factors include for instance the way in which Lean was implemented at a specific department or hospital.

4.3.4. Cross-Hospital Analysis

4.3.4.1. Occurrences per Hospital and Department

In this section, the results of the two hospitals are compared in order to discover potential differences and their explanations. In the following bar chart the occurrences of second-order problem-solving behaviour per department are displayed.

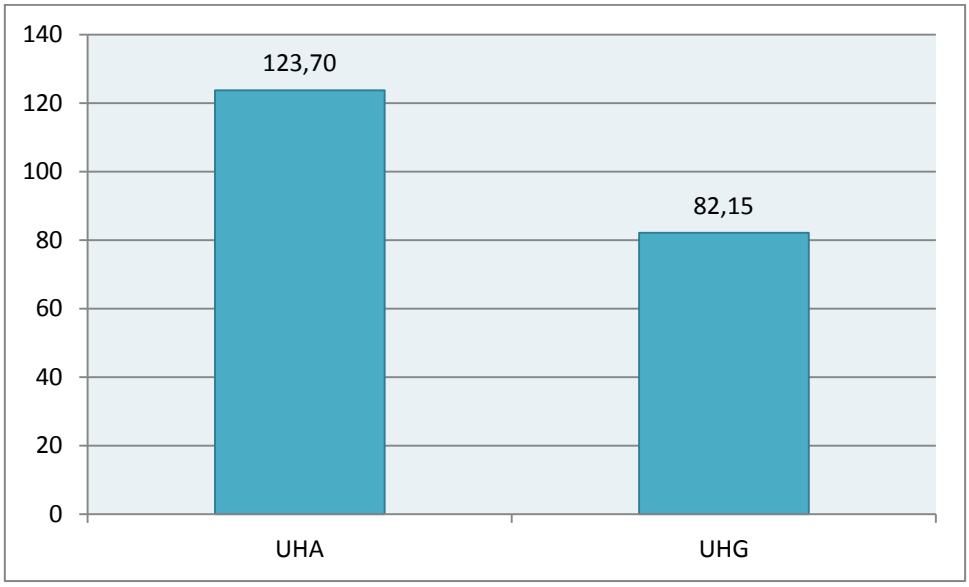
Chart 15 Occurrences per Department



The numbers in the bar chart are identical to previously displayed figures. The only difference here is that they are aggregated in order to facilitate cross-hospital analysis. It can be seen that second-order problem-solving occurrences at both departments at the University Hospital of Antwerp are higher than at the departments at the University Hospital of Ghent. This means that even the department with the lowest degree of occurrences at UHA, which is IO, has a higher degree of second-order problem-solving behaviour than the department with the highest degree of occurrences at UHG, which is OG.

This difference is even more clear if the occurrences per department are aggregated and a mean is calculated. The results are displayed in the subsequent bar chart.

Chart 16 Occurrences per Hospital



This bar chart can be understood as follows: the average department at UHA in this study causes 123,70 second-order problem-solving responses on 100 problem scenarios, while the average department at UHG in this study only causes 82,15 second-order problem-solving responses. This result implies that there is a potential difference between the two hospitals in second-order problem-solving behaviour. A possible explanation might be that there is a difference in problem-solving behaviour of nurses who work at outpatient clinics in comparison to nurses who work at inpatient clinics. However, as mentioned before, this is expected to have no considerable impact.

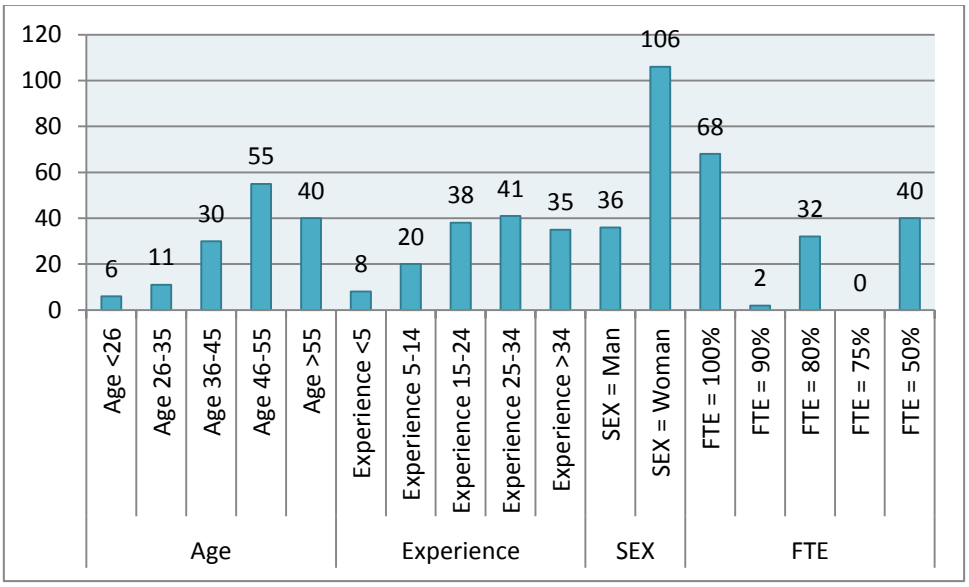
An additional, more promising explanation stems from the fact how Lean was implemented at the different hospitals. The University Hospital of Antwerp has chosen for an organisation-wide approach in which all departments have to undergo the PW implementation program at some point in time. Also, the hierarchical structure of the hospital was adapted in order to facilitate Lean

implementation. Consequently, top management supports a company-wide Lean implementation in which almost all employees are involved, even the nurses. In the University Hospital of Ghent, on the other hand, the Lean implementation at the Outpatient Clinic of Dermatology is a more stand-alone program in which top management is less involved. The initiative for a Lean implementation program was created by the departmental manager and no direct support is provided by top managers. This means that they are less actively involved in the implementation of the program than at the University Hospital of Antwerp. Also, as mentioned above, the program in Ghent is more focused on the Lean tools than on its intellectual legacy. This is in contrast with the PW program which tries to incorporate the core of the Lean principles in its different modules. Another big difference concerns the involvement of nurses in the Lean program. As could be derived from the quote of D2, the program is mostly aimed at the physicians of the department and consequently, the nurses are less familiar to the philosophy. This might be a reason why second-order problem-solving behaviour is observed less at OD than at OG and the departments of the University Hospital of Antwerp.

4.3.4.2. Occurrences per Nurse Characteristic

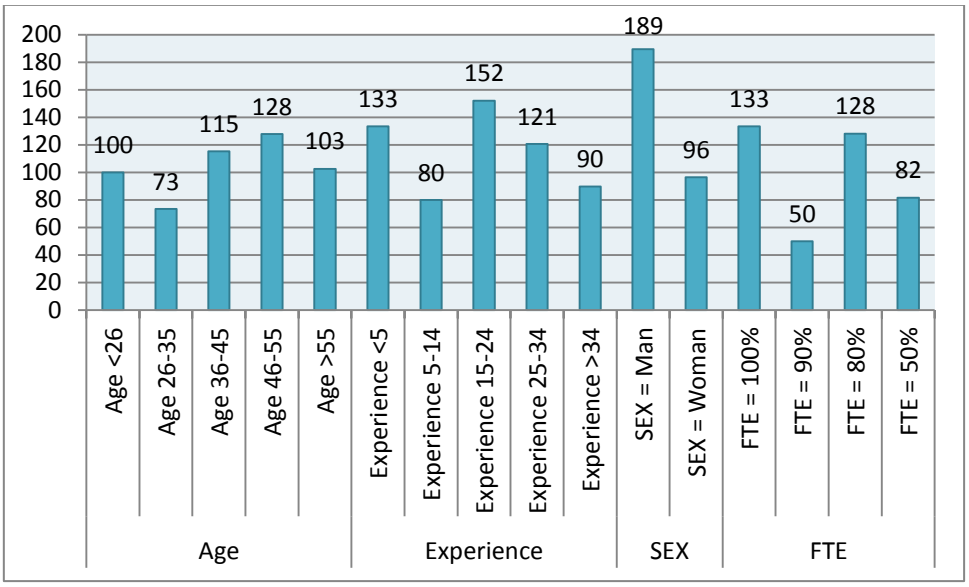
Although it was expected that nurse characteristics would not have an impact on the degree of second-order problem-solving, due to the probable deductive approach in solving organisational problems, this had to be investigated. The procedure that was applied is similar to the analysis that was performed above. First the number of second-order problem-solving occurrences was calculated per subcategory of a nurse characteristic. The results are displayed in the following bar chart. As can be seen, no respondents with an FTE of 75% were observed. Consequently, in the following calculations, this subcategory was deleted.

Chart 17 Occurrences per Subcategory



Again, the issue arose that the number of respondents in different subcategories were very dissimilar. Therefore, the same correction as was used above had to be made in order to facilitate the comparison of second-order problem-solving behaviour over different subcategories. The next bar chart displays the number of second-order problem-solving behaviours per subcategory and per 100 scenarios. It is repeated that the correction by the number of scenarios is obligatory since several respondents did not manage to complete the entire questionnaire and as a result, a division over the number of respondents per subcategory would imply a bias. Once more, for reasons of comprehensibility, a second correction was applied in order to find the number of occurrences on 100 scenarios. Consequently, the interpretation of the numbers below is as follows: on 100 problem scenarios, filled out by the respondents in a specific subcategory, X second-order problem-solving behaviours will be detected.

Chart 18 Occurrences per Subcategory on 100 Scenarios



Initially, it was intended to investigate patterns in the above bar chart in order to search for an indication of the impact of subcategories of nurse characteristics. However, the data above are highly biased since it originates from an aggregation of data of the four different departments. Both departments with high and low scores on the degree of second-order problem-solving behaviour are included. An example of the issue provides better insight. A nurse with an FTE of 90% was only observed at OD and given the fact that this department scores very bad on the number of second-order problem-solving occurrences, it would be wrong to conclude that nurses with an FTE of 90% evoke few second-order problem-solving responses. If, for example, the nurse with an FTE of 90% was observed in another department with a higher overall degree of second-order problem-solving behaviour, it would also be wrong to conclude that the higher the FTE, the higher the degree of second-order problem-solving behaviour. This problem could have been solved with a more extensive data set in which each subcategory is presented in a similar way at each department but, regrettably, this high number of respondents could not be obtained in this study.

A possible solution to the above issue was to split the analysis of the impact of nurse characteristics in several different analyses in order to circumvent possible biases. Consequently, the results of the different analyses could be compared. This division of analyses could be done by looking at the different departments individually or by aggregating departments with similar characteristics in terms of Lean implementation or results on the occurrences of second-order problem-solving behaviour. These corrections would have a positive impact on internal validity since extraneous variables are controlled. However, every decomposition of the original analysis would result in an even greater decline in the number of respondents per subcategory and consequently, the strength

of the examination would be very low since in most subcategories no or almost no respondents will be observed.

As a result, few or no indications can be given about the impact of nurse characteristics on the degree of second-order problem-solving behaviour since the set of respondents is too small and the characteristics of nurses within departments are very similar.

4.4. CONCLUSIONS

The proposition of this dissertation was given by the following statement:

In a successful Lean environment, hence in an environment in which the maturity of Lean implementation projects reaches high levels, second-order problem-solving behaviours displayed by nurses who face organisational problems will be more frequently observed than second-order problem-solving behaviours performed by nurses employed in environments in which Lean has lower levels of maturity.

The results of the empirical research seem to confirm this proposition but only in the University Hospital of Antwerp. In this hospital, a company-wide Productive Ward Program, based on Lean, was implemented in which top management clearly shows its belief in the philosophy. Also, everybody at the hospital is involved in Lean and feedback is frequently provided about the results of the application. However, differences exist over departments in the maturity and success of Lean implementations. This finding could be used to set up a research design in which the above proposition could be investigated. The outcomes of the questionnaire and the following analysis provide indications that the above proposition is valid since the department with a high Lean maturity had higher levels of second-order problem-solving behaviour. However, nothing can be said of the significance of the difference in the degree of second-order problem-solving behaviour since no statistical tests could be conducted with the collected data. The aim of this study was to give indications based on a qualitative research, not to provide hard evidence.

The University Hospital of Ghent successfully implemented the Lean tools at the department of dermatology but this application currently is not translated in a higher degree of second-order problem-solving behaviour by its nurses. In contrast, the Outpatient Clinic of General Internal Diseases, which was included in this study as a department without any experience in Lean programs, displayed more frequent second-order problem-solving behaviours. A possible explanation might be the stand-alone Lean implementation at the Outpatient Clinic of Dermatology. Consequently, the Lean culture is not developed throughout the complete hospital and this definitely has an impact on the belief of employees in the possibilities of Lean. They might experience Lean as a

methodology which causes a limitation of their independency and which causes an elevation of standardised work practices. Also, from the questionnaires at OD, it became clear that the implementation program is mostly aimed at physicians and not at nurses. This finding is in contrast with the guidelines of the Lean philosophy since it is widely known that everybody in the company should be involved in an implementation program. This is due to the fact that knowledge about work practices is very often scattered across the organisation and consequently, every employee holds a piece of it. A difference in Lean implementation over the two hospitals was therefore detected in this study and this might have an effect on the degree of second-order problem-solving.

As was derived from the literature review, nurse characteristics were expected to have no effect on the degree of second-order problem-solving. This was investigated by comparing the frequency of second-order problem-solving behaviours over different subcategories of characteristics. However, since the set of respondents was rather small, no valid conclusions could be made. It would be wrong to conclude that, for instance, men evoke more second-order problem-solving occurrences than women since most men worked in departments with a higher degree of second-order problem-solving. In order to make trustworthy conclusions about the influence of nurse characteristics, a bigger and more diverse set of respondents is needed per department.

5. FINAL REMARKS

5.1. LIMITATIONS

As mentioned in the above paragraphs, the number of respondents at the departments was rather low. On the one hand, this was due to the fact that few nurses are employed at the selected departments. This is mostly the case at the University Hospital of Ghent. On the other hand, nurses were not keen on cooperating. Therefore, the analysis of the results had to be delayed and, eventually, the collection of respondents had to be stopped since the head nurses and the management did not believe that any other reminders, sent to the nurses, would be successful. This small number of respondents causes problems for the trustworthiness of the results, especially in the analysis of the impact of nurse characteristics on the degree of second-order problem-solving.

The next limitation has an impact on the reliability of this dissertation. The nurses who contributed to this study were only questioned once. The results are therefore collected at a certain moment in time without any retest. As a result, nothing has been said on how consequent these nurses are in their problem-solving behaviour.

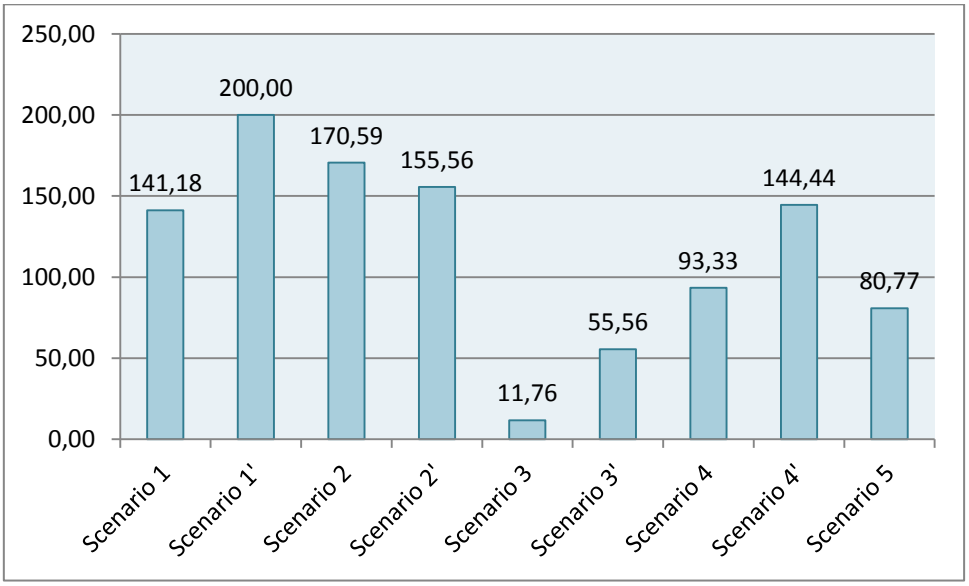
External validity of this study has to be seen as very low since only two hospitals were included. These hospitals were located very close to one another and therefore, national and cultural differences could not be investigated.

The last set of limitations have to deal with the questionnaire and the answers of the nurses to the problem scenarios in the questionnaire. Although the questionnaire was created with the assistance of a nurse and was tested by two academic assistants with a background in nursing and by managers or nurses at the two hospitals, several nurses did not want to answer a scenario since they perceived the problem as not applicable to their profession. This behaviour was observed three times by three different nurses. These unsolved problem scenarios were coded in NVivo as “Unanswered”.

The nurses of the University Hospital of Ghent refused to fill out the electronic questionnaire and this may result in a possible bias. There may exist a difference in the way questionnaires are filled in, whether this is done manually on paper or on a computer. Although this is not investigated further, it has to be kept in mind as a possible factor which causes the higher degree of second-order problem-solving behaviour at the University Hospital of Antwerp.

Finally, the assumption that every problem scenario has an equal chance for causing second-order problem-solving was investigated. The results of this analysis are displayed in the following bar chart.

Chart 19 Occurrences per Scenario



The above chart displays the number of second-order problem-solving occurrences that will be detected when 100 instances of a specific scenario will be solved by the set of respondents. For instance, when Scenario 1 is solved 100 times, this will lead to 141,18 second-order problem-solving occurrences. Scenario 3, which is the scenario in which the nurse has to wait for information or

equipment, causes very few second-order problem-solving behaviours. Looking at the variation in expected second-order problem-solving occurrences, there is an indication that the assumption, stating that every problem scenario has an equal chance for causing second-order problem-solving behaviour, does not hold. Consequently, the set of scenarios, displayed to individual respondents, has an impact on the problem-solving behaviour. Also, when looking at a more detailed analysis, it is concluded that some problem scenarios are more responsible for the occurrence of specific problem-solving behaviours than other scenarios. Scenario 1', for example, causes 30 occurrences of problem-solving behaviour "Communication to the Head Nurse" when it is displayed 100 times. Problem Scenario 1, on the other hand, only evokes 17,65 incidences. For reasons of conciseness, this analysis is included in the attachments.

5.2. RECOMMENDATIONS FOR FURTHER INVESTIGATION

With the eye on future research, it is important that several of the above limitations are approached. First of all, a bigger set of respondents will facilitate the analysis and its power. Also, it is required that more departments are included with a more extensive variety in its characteristics. Only this way, statistical generalisation might become possible and higher levels of external validity will be attained. To achieve this, a mathematical model will be needed which enables the measurement of the impact of several variables and their combinations.

In the selection of the departments, a standardised scale which measures Lean maturity should be used. As a result, the future researcher will not have to rely on the perception of the hospitals in determining the maturity of the departments. These can then be selected on a more objective basis and comparison over different hospitals will be facilitated. The scale may be based on the measure developed by the University Hospital of Antwerp. However, when using this measure, it has to be kept in mind that it was developed for the departments of a specific hospital. Therefore, the scale has to be adapted and standardised.

As was mentioned above, second-order problem-solving behaviour was dependent on specific problem scenarios. Therefore, new scenarios are needed which eliminate or reduce this finding. These scenarios have to be tested in order to ensure the independency with problem-solving behaviour. This pilot test will also make sure that nurses feel comfortable with the problem which is simulated, as was done in this study.

Additionally, in future research, nurses have to be encouraged to fill out the questionnaire in excessive detail. This study made use of vouchers to stimulate nurses but this was perceived as an inefficient method. The future investigator has to make sure that nurses are intrinsically motivated to

cooperate, only this way satisfying results will be attained. Furthermore the method for collecting data should be scrutinised. Other techniques, such as observation or interviewing, may be used to gather information that is more detailed.

A final remark concerns the application of the model of second-order problem-solving behaviour, developed by Tucker and Edmondson. In the empirical study, only parts of the model were investigated since “quality of care”, “frequency of problems” and the impact of the “problem-solving coordinator” were not measured. Further research could take these outcome variables into account with the eye on investigating the impact of Lean.

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ATTACHMENTS

1. QUESTIONNAIRE

In order to make sure that the study can be replicated by future investigators, the complete questionnaire is displayed subsequently. This survey was translated from Dutch to English in pursuance of making sure that a broader public can understand the provided questions and information.

Information about the Study

Dear Respondent

First of all, I would like to thank you for your collaboration. I expect that the questionnaire would not take more than 15 minutes.

After several introductory questions, you will be faced with five problem scenarios. It is essential that you define your problem-solution as meticulously as possible in a step-wise manner. Nevertheless, it is important to note that no bad or good approaches to the problems exist. It is only important that you make some effort in answering the questions as completely as possible. That is why, as an encouragement, I raffle a check of FNAC at a value of 15 euro per hospital. Your chances for winning this coupon are, however, not extremely small since only a limited number of respondents take part in this investigation.

Furthermore, I would like to mention that the results of this research will be processed anonymously. The hospital and your department will never obtain your answers and have approved this research. If you continue this survey, it means that you agree with the processing of your results.

Good luck and thanks!

Simon Van Beveren

General Questions

1. Do you wish to strive for the coupon of FNAC at the value of 15 euro? If this is the case, next you will have to provide your name since otherwise I cannot identify the winner afterwards. I repeat that the hospital and your department will never obtain your answers.
    - Yes
    - No

If answer "Yes" was chosen, the next question arose:

2. What is your name?

All following questions were displayed, no matter what answer was chosen in the coupon-question.

3. What is your sex?
    - Female
    - Male
4. What is your age?
5. How long do you already work as a nurse?
6. What is your full-time equivalent?
    - 100%
    - 80%
    - 75%
    - 50%
    - Other, namely ...
7. In which hospital are you employed?
    - The University Hospital of Ghent
    - The University Hospital of Antwerp
8. If Ghent was selected: At which department are you employed?
    - Outpatient clinic of dermatology
    - Outpatient clinic of general internal disorders
9. If Antwerp was selected: At which department are you employed?
    - Inpatient clinic of heart surgery
    - Inpatient clinic of orthopaedics

Problem Scenarios

The five subsequent scenarios include problems which you can face as a nurse. Try to imagine that you are in the real-life situation of encountering the problem. Afterwards, try to write down as detailed as possible what you would do in that case.

Version A

Scenario 1

A physician provides insufficient information with the eye on treating a patient. What are the different steps you undertake?

Scenario 2

You notice that the medical equipment you need is defect. What are the different steps you undertake? Equipment comprises for example: an electronic blood pressure measuring instrument, a bed, the patient administration system,...

Scenario 3

You know that medical equipment you need is currently used by a colleague. Accordingly, you need to wait. What are the different steps you undertake? Equipment again comprises for example: an electronic blood pressure measuring instrument, a bed, the patient administration system,...

Scenario 4

You notice that supplies, for example bedclothes or paper table-mats, are out of stock. Consequently, you face a lack of the needed supplies. What are the different steps you undertake? For reasons of clearness, these supplies are distributed by a central service. They will be replaced after usage and as a result, they are different from the pre-mentioned equipment.

Scenario 5

Two different physicians are demanding your services at the same time. Consequently, you are expected to be at two places at the same time. What are the different steps you undertake?

Version B

Scenario 1'

A physician provides wrong information with the eye on treating a patient. What are the different steps you undertake?

Scenario 2'

You notice that the medical equipment you need is missing. Consequently, you have to search for it. What are the different steps you undertake? Equipment comprises for example: an electronic blood pressure measuring instrument, a bed, the patient administration system,...

Scenario 3'

You need to support a physician in treating a patient but the physician has not arrived yet. Consequently, you need to wait. What are the different steps you undertake?

Scenario 4'

You notice that supplies, for example bedclothes or paper table-mats, are wrongly delivered. What are the different steps you undertake? For reasons of clearness, these supplies are distributed by a central service. They will be replaced after usage and as a result, they are different from the pre-mentioned equipment.

Scenario 5

Two different physicians are demanding your services at the same time. Consequently, you are expected to be at two places at the same time. What are the different steps you undertake?

Additional Questions

10. Is the Lean philosophy (sometimes described as the Productive Ward Program) implemented in your department?
    - Yes
    - No

If answer "Yes" was chosen, the next question arose:

11. Do you think that Lean contributes to the prevention of the above problems?
    - Yes
    - No

Ending Remarks

This is the end of the questionnaire. I hope no problems occurred. I would like to thank you again for your collaboration and I wish you a lot of luck in winning the FNAC-coupon. In case of curiosity regarding the outcomes of the study, you can always contact me at the following e-mail address: Simon.VanBeveren@Ugent.be.

Kind regards,

Simon Van Beveren

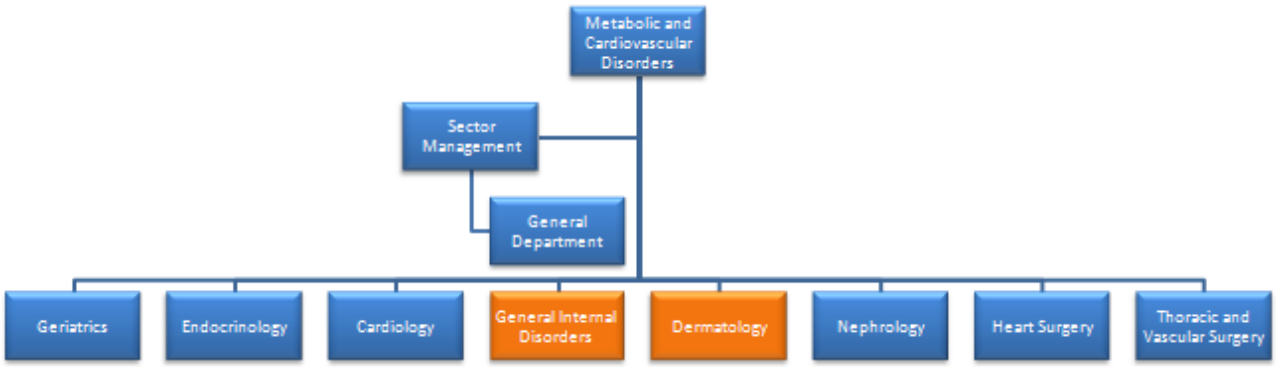
2. CODE TREE

Name	Sources	References
Respondents	31	31
Scenarios	28	129
Second-Order Problem-Solving Behaviour	28	144
Communication to Head Nurse	13	21
Communication to Person Responsible	28	101
Implement Changes	4	5
Sharing Ideas about the Cause of The Problem	8	14
Verify that Changes have the Desired Effect	1	3

This code tree displays the structure of the coding exercise. It also depicts the number of sources, i.e. respondents, and the number of references, i.e. the occurrences, that are connected to a specific node element. The nodes of “Respondents” and “Scenarios” were created in order to facilitate the extensive analysis of the results but have no important underlying connotation. It is therefore not needed to explain them in excessive detail.

3. Organisational Chart of Metabolic and Cardiovascular Disorders

Figure 12 Sector of Metabolic and Cardiovascular Disorders

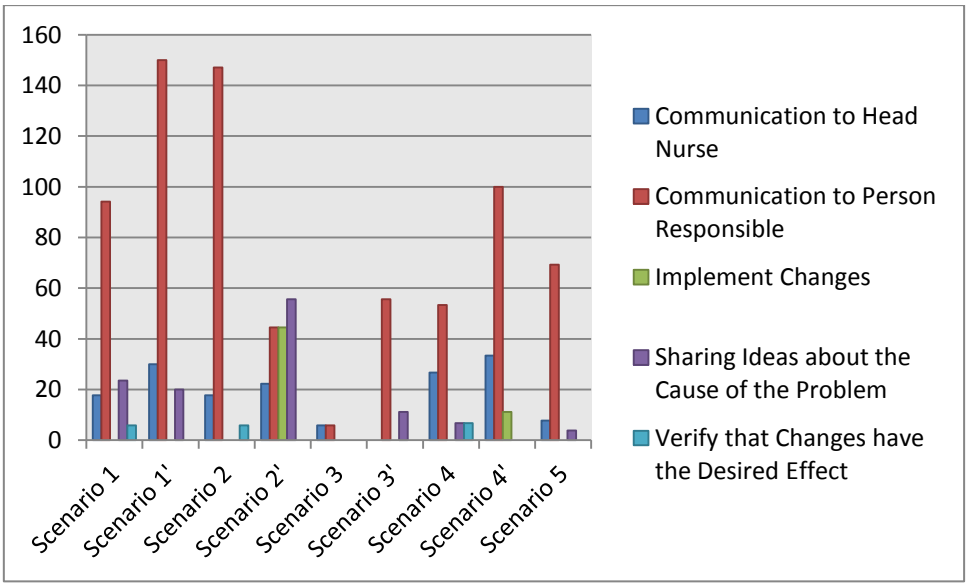


Source: Anonymous, personal communication, 20 March 2015

4. Problem-Solving Behaviour per Scenario

In this analysis, the same correction for the number of scenarios filled out by the respondents, is applied. The first bar chart gives an aggregated view on the specific problem-solving behaviours per 100 scenarios. It is repeated that it is simulated that each scenario is filled out 100 times by the set of respondents in this study.

Chart 20 Specific Second-Order Problem-Solving Occurrences per Scenario



Apparently, huge differences exist over the different scenarios and over the specific problem-solving behaviours. In the majority of the scenarios “Communication to the Person Responsible” is the most prevalent behaviour. Only in Scenario 2’, “Sharing Ideas about the Cause of the Problem” is detected more frequently.

For reasons of clearness, this aggregated bar chart is split per scenario. Since the meaning of the numbers can easily be derived from previous information, no further explanations will be given.

Chart 21 Scenario 1

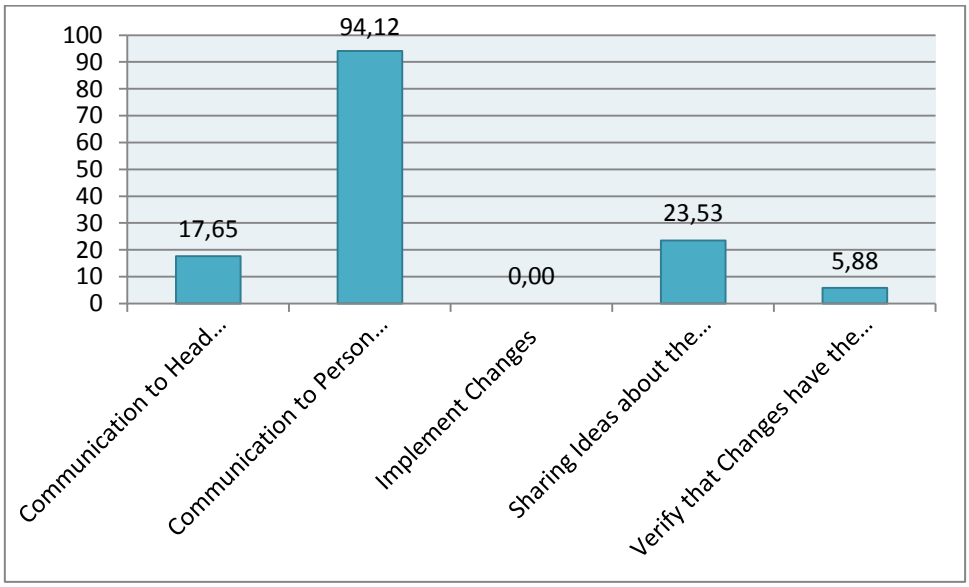


Chart 22 Scenario 1'

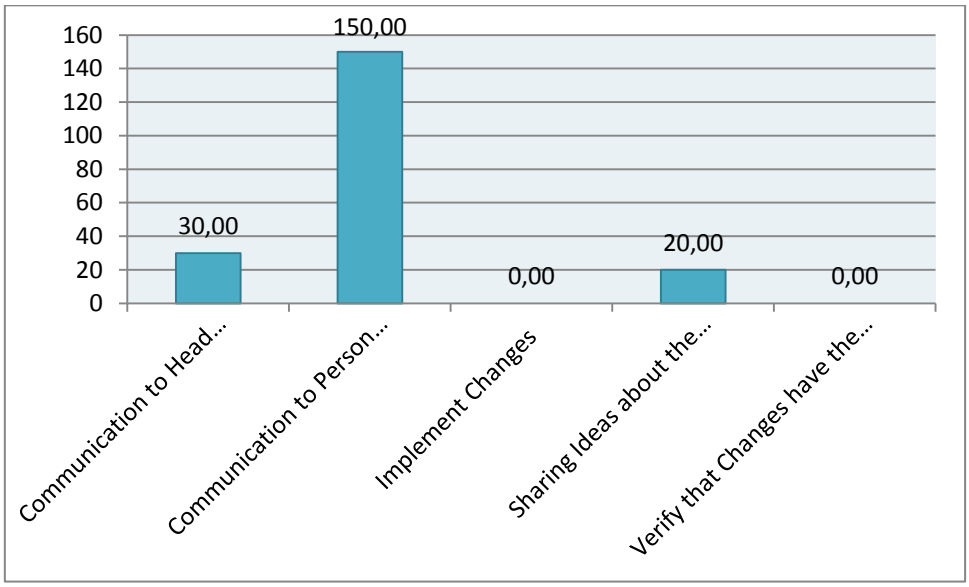


Chart 23 Scenario 2

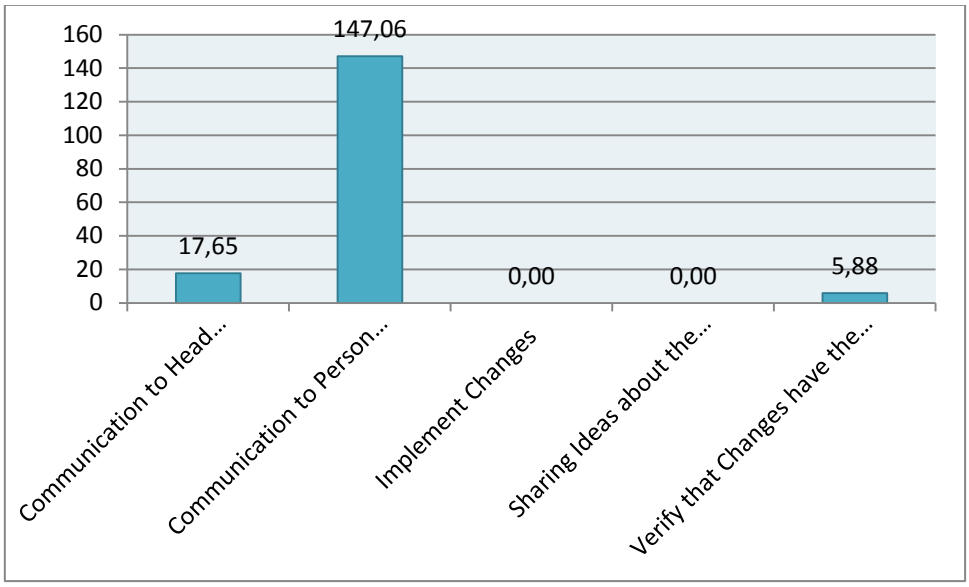


Chart 24 Scenario 2'

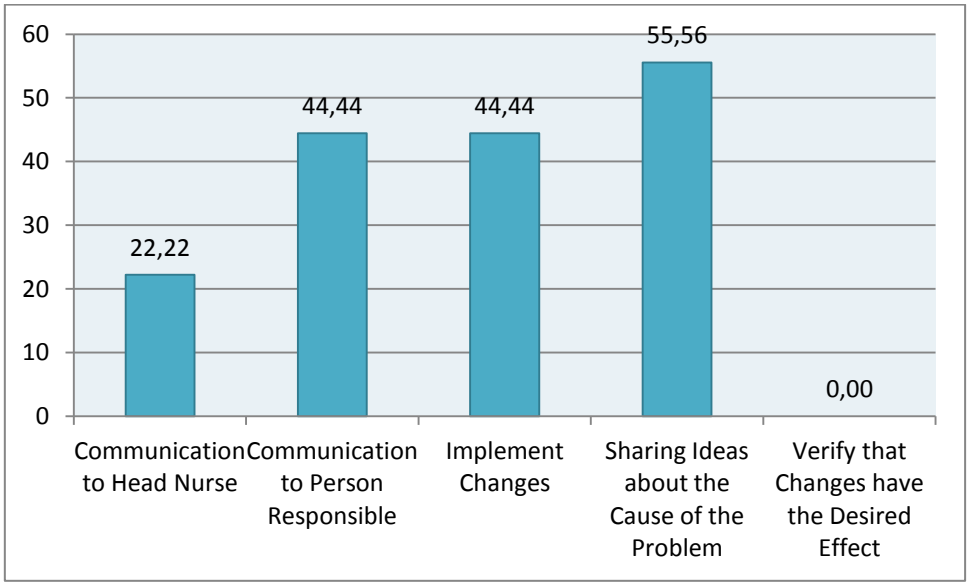


Chart 25 Scenario 3

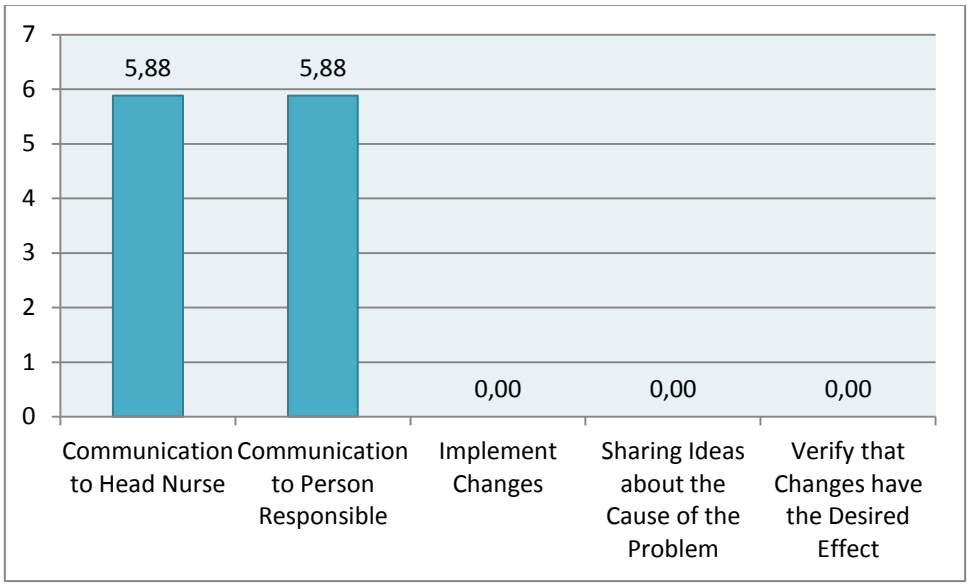


Chart 26 Scenario 3'

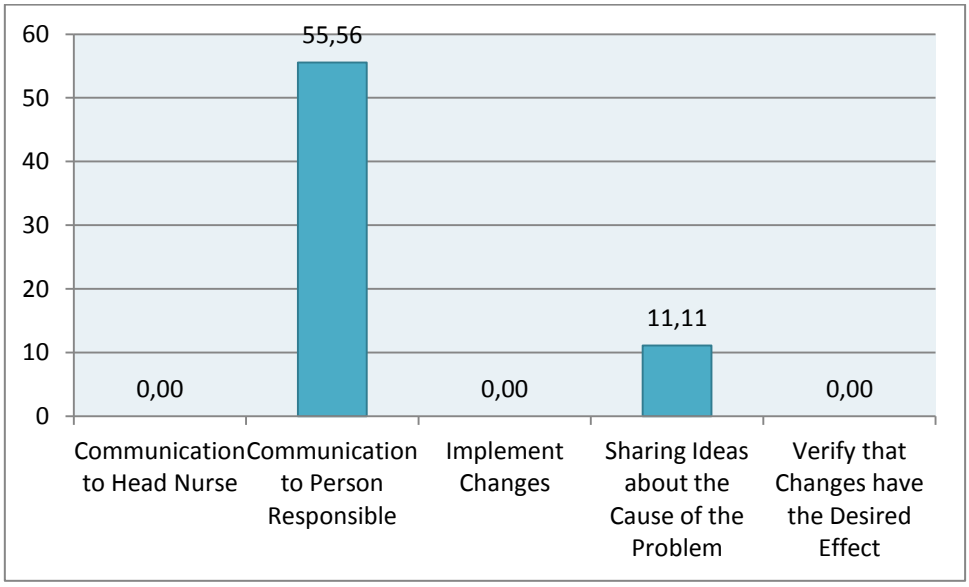


Chart 27 Scenario 4

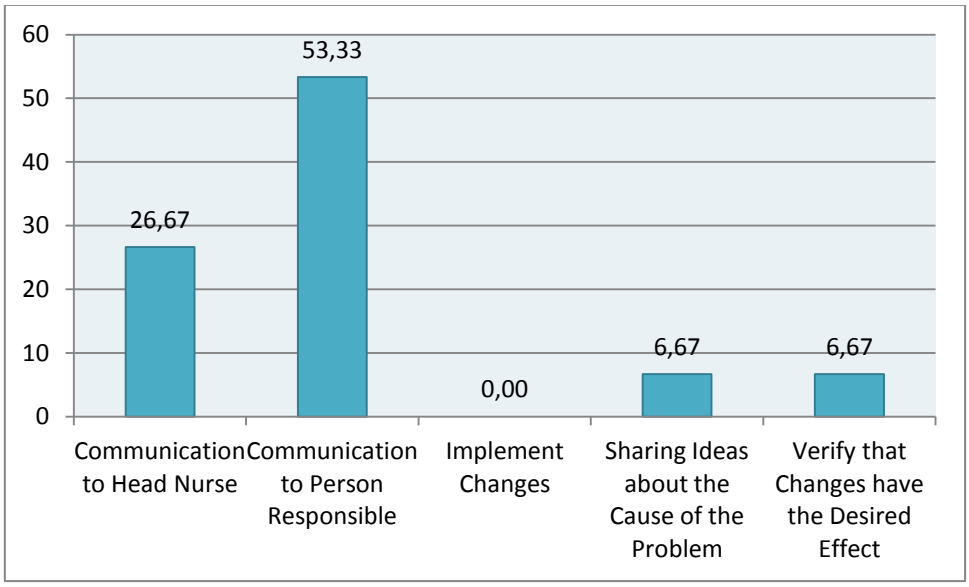


Chart 28 Scenario 4'

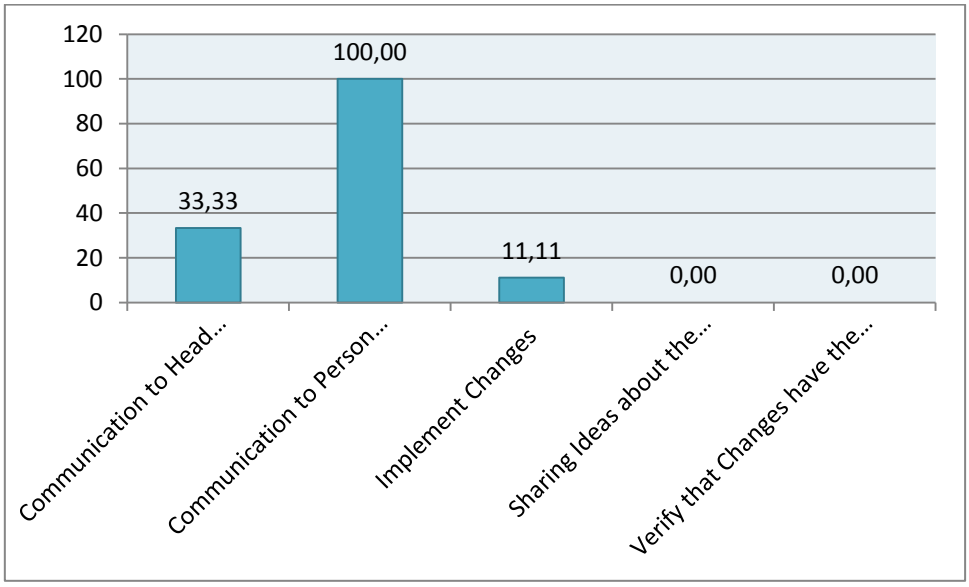


Chart 29 Scenario 5