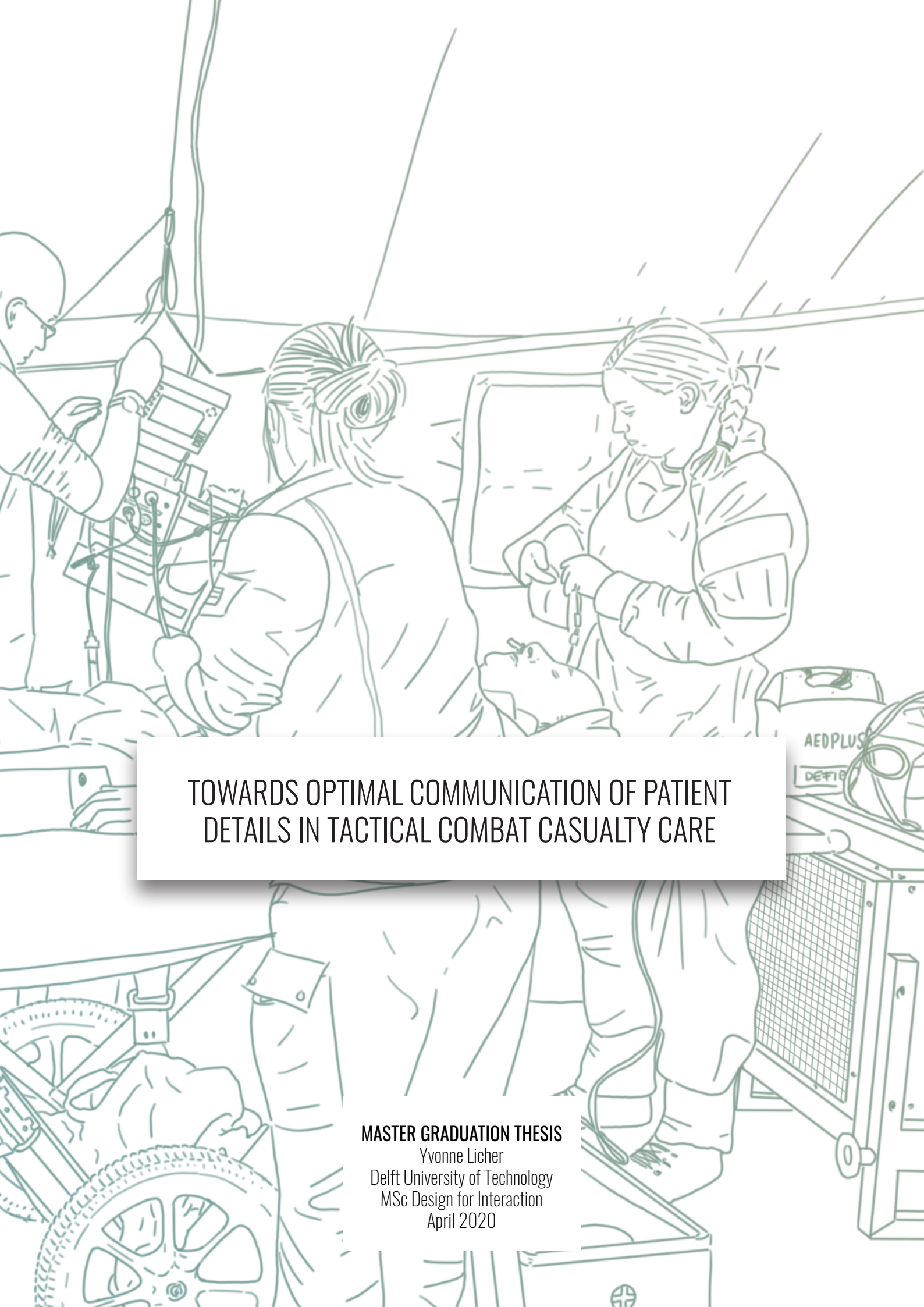

TOWARDS OPTIMAL COMMUNICATION OF PATIENT DETAILS IN TACTICAL COMBAT CASUALTY CARE

MASTER GRADUATION THESIS

Yvonne Licher
Delft University of Technology
MSc Design for Interaction
April 2020

COLOPHON

Master thesis
Delft, April 2020

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TOWARDS OPTIMAL COMMUNICATION OF PATIENT DETAILS IN TACTICAL COMBAT CASUALTY CARE

"Eripiendo Victoriae Prosum"

“While helping, I serve the victory”

Predicate of the Regiment Geneeskundige Troepen

ACKNOWLEDGEMENTS

Before you lies the final deliverable of my graduation for the master Design for Interaction at Delft University of Technology and the company Offroad Apps. Over the past seven months, I have explored the world of the Royal Netherlands Army, which I found exciting and intriguing. I am grateful to have been given this opportunity, as this has broadened my view on and made me passionate about this particular topic. Although the largest part of graduation was fun, it was tough sometimes as well. I could not have done this project without the support of a large group of people.

Thank you, Marieke, for supporting me with project-related, but also personal challenges and for being tough when I needed it.

Thank you, Jeroen, for being critical throughout the whole project and for being so enthusiastic about the topic.

Thank you, Vera, for sharing your passion for meaningful design with me. It has definitely sparked over to me. I have gained a lot of knowledge in a short time and valued your insights and opinions. I am also grateful for all the trips you took me on. I will never forget my first encounter with the context: It was ‘bloody’ fun. And then the personal conversations we had, where you shared your own experiences and tried to understand me as well. You have been a great mentor, thank you for that.

Thank you Nils and Titus from Offroad Apps for the fun lunches, long car drives, and good conversations. You taught me that, in your professional life, you should follow your interests and do things that make you happy. It was a pleasure to be part of the office.

Of course, a thank you to all the people from the Royal Netherlands Army, who have dedicated valuable time to help me understand the context and provide me with valuable insights for my project.

Thank you, mom and dad, my family, for being supportive all the way through and providing a safe haven at moments I needed it. And my sister, Evelien, for reading and correcting this thesis as a finishing touch.

To my dear friends and colleagues, who I could always talk to about my project, about all the ups and downs. And for the advice and support they have given me throughout the project. A special shout out to Noor, with whom I have had countless coffee dates to talk (and rant) about graduation. I hope we will continue this during your graduation.

And most important, thank you Adriaan, for always being there for me, for being my pillar of strength. I cannot be grateful enough.

Lastly, I want to thank you, the reader, for going through this report. I hope you will enjoy reading it.

Yvonne Licher

EXECUTIVE SUMMARY

Due to the increase of political friction and terrorist attacks, the Netherlands Ministry of Defence (MinDef) is preparing its armed forces for combat situations. If these occur, a large number of victims is expected in a short amount of time, which puts pressure on the military medical chain. As it is crucial to treat patients as early as possible, low resource medical treatment facilities (Role 1 MTFs) are placed near the battlefield. Heavily wounded soldiers are transported to this facility, where they are stabilised in order to survive transportation to a facility with more resources.

Due to the Role 1 MTF's critical function, it is of importance that the communication of patient details is optimal, as it improves the patient flow and survival rate. Currently, the communication of patient details causes a delay in the treatment process. This graduation project aimed for the improvement of patient detail communication by providing insight into the current communication process and formulating a vision for future innovation.

By performing different research activities, such as observations and interviews, an understanding of the Role 1 MTF and the used communication methods was developed. This resulted in an overview of communication problems that affect the efficiency of care and are experienced as frustrating. The key influence of these frustrations was the lack of situational awareness (SA), which became the focus of this project. To summarise the research findings, a journey map was made.

The journey map provides an overview of the events that take place within the Role 1 MTF, the communication activities, the workload, and the cognitive load as it is perceived by the general military physician (AMA). It was decided to focus on the AMA, as this person has the role of commander and has to makes the medical decisions.

Design opportunities could be identified from the journey map and were used as a starting point for ideation. The ideation resulted in several design ideas, which were evaluated on their desirability and credibility. The insights obtained from this evaluation were used to formulate a future vision, which was visualised in a vision map (figure 1).

The future vision describes three innovation horizons to increase SA and improve the communication of patient details in the Role 1 MTF. The first horizon describes how process innovation could be achieved in the short term. The second horizon proposes the adaptation of available technology, which can be implemented within 15 years. The third horizon describes disruptive innovation for the far future, where the Role 1 MTF will become obsolete.

In the end, this graduation project provided a tool to evaluate the communication of patient details in the Role 1 MTF and a vision for future innovation. These tools are the outcome of user-centered research, which makes them of value for the MinDef and can support future innovation for the Role 1 MTF.

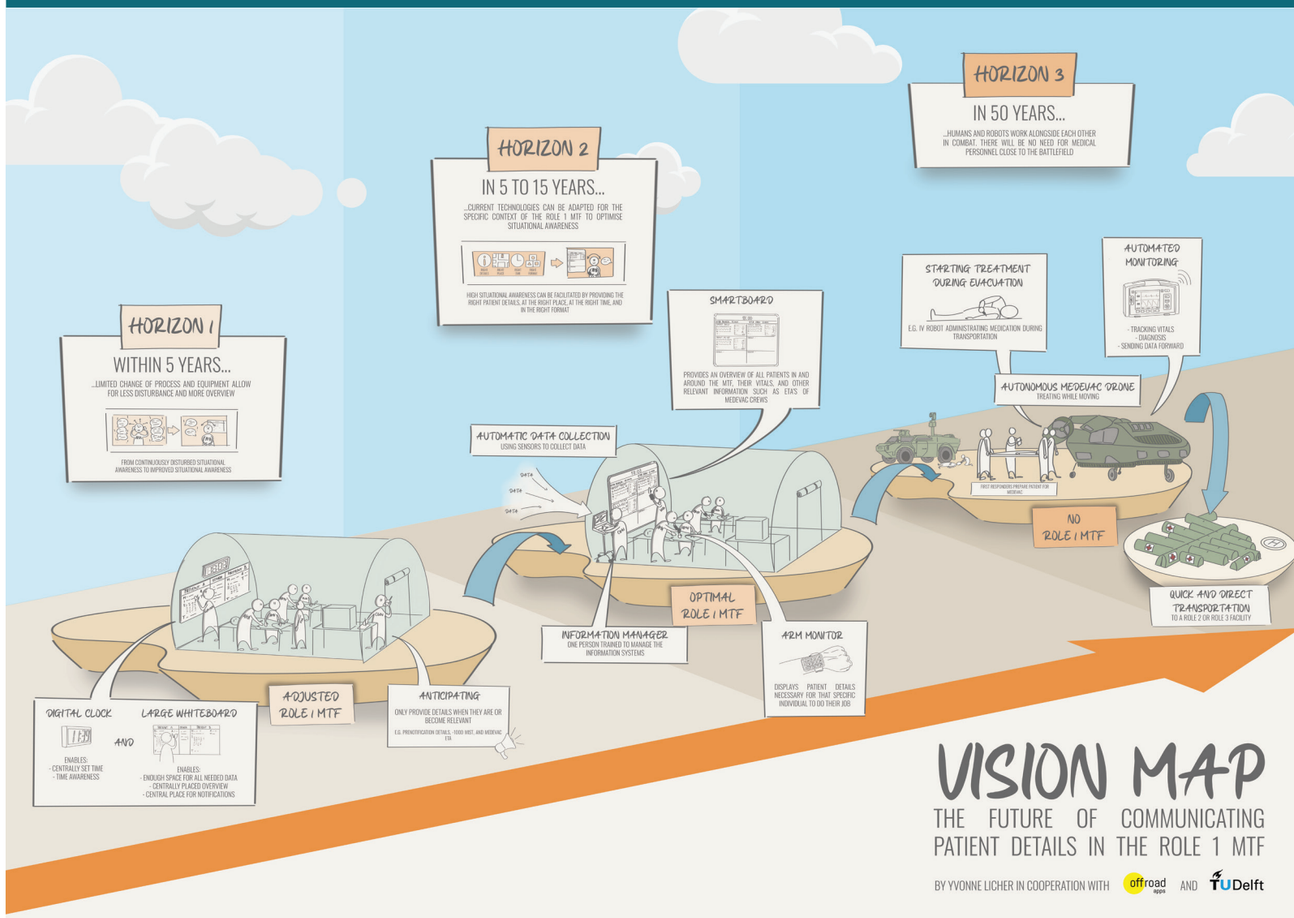

Figure 1: The vision map that was made to visualise the future vision for the Ministry of Defence.

GLOSSARY

A

Aeromedevac Medical evacuation by helicopter between Role 0 and Role 3

AI Artificial Intelligence

AMA General Military Physician

AMV General Military Nurse

ATLS Advanced Trauma Life Support

B

BG Battle Group

Boxer Armoured vehicle for wounded transportation between Role 0 and 1

C

CGN Combat Life Saver

D

DGOTC The Defence Healthcare Education and Training Centre

DIS Defence Industry Strategy

DST Digital Smart Tag

E

ELIAS Essential Landbased Information Application and Services

EPD Electronic Patients File

ER Emergency Room

ETA Estimated Time of Arrival

J

JIVC Joint Information Provision Command

M

MASCAL Mass Casualty Situation

Med C2 Medical Command and Control

Medivac Medical Evacuation

Min1000 Notification that the Boxer is less than 1000 metres away

MinDef The Netherlands Ministy of Defence

MIST (AT) Medical report on the status and performed treatment of a patient

MTF Medical Treatment Facility

N

NTP National Technology Project

P

PECC Patient Evacuation Communication Cell

POI Point of Injury

R

Role 0 to 4 The medical chain from basic to advanced medical care

S

SA Situational Awareness

Smart Tag Paper tag for the documentation of the MIST and treatment on the battlefield

Stratevac Medical evacuation by airplane to role 4 in The Netherlands

T

TCCC Tactical Combat Casualty Care

The Army The Royal Netherlands Army

V

VIG Caretaker Individual Health

VOSS Improved Operational Soldier System

Z

ZAU Non-armoured ambulance for wounded transportation

ZHKH Self-care and buddy aid

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1.0
INTRODUCTION

This report is the final deliverable of my graduation project about optimising the communication of patient details in Tactical Combat Casualty Care (TCCC). Together with Offroad Apps BV, a small Delft-based start-up, and the Royal Netherlands Army (hereafter called: the Army), I identified that there is a lot to improve when it comes to this topic. A specific part of the Army's medical chain was researched to provide focus on my graduation project: the Role 1 Medical Treatment Facility (Role 1 MTF).

Chapter 1.1 elaborates on the value of this project, after which the company it was performed for is described in Chapter 1.2. My motivations and ambitions are described in Chapters 1.3 and 1.4, whereafter the project approach and reading guide for this report are presented.

1.1 The value of this project

In the last decades, the increase of political friction and terrorist attacks have made governmental institutions focus on the preparation for threatening situations. Currently, the Netherlands Ministry of Defence (MinDef) is training its armed forces to act on so-called Article 5 situations, which are stated by the North Atlantic Treaty Organization (NATO) (2019) as follows:

"The Parties agree that an armed attack against one or more of them in Europe or North America shall be considered an attack against them all and consequently they agree that, if such an armed attack occurs, each of them, in exercise of the right of individual or collective self-defence recognised by Article 51 of the Charter of the United Nations, will assist the Party or Parties so attacked by taking forthwith, individually and in concert with the other Parties, such action as it deems necessary, including the use of armed force, to restore and maintain the security of the North Atlantic area."

Next to these types of situations, the Dutch armed forces also contribute to the international fight against terrorist organisation ISIS (Ministerie van Defensie, 2019i). Overall, it is not unrealistic that the Dutch troops are deployed to dangerous areas in the (near) future.

Both an Article 5 situation and the deployment to dangerous areas can result in dealing with mass casualty situations (MASCALs). The World Health Organization (WHO) (2007, p.9) defines a MASCAL as *"an event which generates more patients at one time than locally available resources can manage using routine procedures. It requires exceptional emergency arrangements and additional or extraordinary assistance."*

A MASCAL will put high pressure on the military medical chain: A large number of victims has to move through this complex medical system in a short amount of time. The quick movement of patients through this system is not purely done to save all individual casualties, but also to increase the overall survival rate. In general, the rule is that the earlier a patient is treated, the more chance there is for survival (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2016, p. 17).

Looking at the Army, the medical chain consists of several facilities, which range from having few resources to having surgical capacity. At every stage of this chain, it is of importance to provide the medical professionals with a patient's medical details to provide the best care.

In general, we can say that the low resource facilities, called Role 1 MTFs, are closest to the front line, which makes that heavily wounded people are transported there to be stabilised and then continued to be transported to a facility with more resources. Due to its critical function, it is of importance that the communication of patient details in the Role 1 MTF is optimal. This can improve the patient flow and survival rate. Currently, the communication of patient details creates a delay in the treatment process. Therefore, this project focuses on providing the MinDef with a journey map of the current way of communicating patient details and a future vision for the Role 1 MTF. These tools can help them look critically at their processes and assist for future innovation.

As the Army has not operated in combat operations in the past ten years, and thus high-risk situations were not expected, the Role 1 MTFs were not deployed in these years. However, due to the current tensions on political, but also terroristic domains, the Army is training its personnel for worst-case scenarios, such as the Article 5 situation. This project, therefore, focuses on the training situations.

1.2 Offroad Apps

When looking for a graduation project, I came in contact with Offroad Apps BV. Offroad Apps is a Delft-based start-up, which is specialised in making software for wearables and mobile devices. The company specifically focuses on providing quick and clear insight into the situation for professionals working in highly demanding circumstances. This is done by connecting wireless sensors to mobile devices using a sensor platform called PulseIQ. On this platform, sensor data is transformed realtime to provide the insights.

Currently, the main focus for Offroad Apps is the coordination of the VitalsIQ project (figure 2). This project is executed for the Royal Netherlands Army, and its primary goal is to provide the Army with a demonstrator to support first responders in a pre-hospital trauma care situation. The project will be explained further in Section 6.1.2.

Together with Vera Pijl, the product manager, this graduation assignment was shaped. After tagging along to a user test and playing a lotus victim, I was left intrigued by the Army experience and the type of people that was dealt with. By combining my interests and Offroad's vision, we decided that my project would focus on the next step in the medical chain: the Role 1 MTF.

The project brief that was set up and used as a starting point for this graduation project can be found in appendix A.

Figure 2: A soldier using the VitalsIQ demonstrator made by Offroad Apps (Offroad Apps BV, 2019b)

Figure 3: Soldiers of the Dutch Royal Army (400 GNK) carrying a wounded soldier at a training (Reservisten Specifieke Deskundigheid 400 GNK, 2019)

1.3 Motivation

A graduation project is not just any project: It is a project that you can mould and shape to your liking. Three main reasons motivated me to take on this specific graduation challenge.

From a young age, I have been interested in everything medical: the biological side, the procedures, and the instrumentation. To this day, I am drawn to this subject, but from another point of view: that of the designer. Doing a medisign specialisation, I gained knowledge of designing for and with patients and caregivers.

1. Intrinsic motivation for caregiver centred design: Currently, I feel that there is still a lack of focus on designing for and with caregivers, which I came to find one of the most rewarding things to do. I have a real passion for this subject. Moreover, it is something I would like to focus on after my graduation and continue to do professionally.

Over the past years, my design projects have enabled me to design for many different target groups and environments. This, however, is a whole new experience.

2. An exciting and challenging environment: Doing a project for Offroad Apps gives me the chance to get to know the intriguing world of the Royal Netherlands Army, a setting not many students are confronted with. This is a very different challenge than all others, due to the strict policies, protocols, and circumstances you have to take into account. This comes with its advantages and disadvantages, which motivates me to find different approaches for communication and evaluation during this project.

Lastly, a significant motivator was the fact that this project could contribute to future innovations in the Army, but also for Offroad Apps.

3. Making an impact in the real world: For my graduation, I wanted to work together with a company, as it was likely that my work would be of value for them and for the MinDef. Next to that, I wanted to show the MinDef what context analysis from a designer's perspective can add to their way of working. Sharing my design knowledge could be of great value for them.

1.4 Personal ambitions

At the start of this project, I stated four personal learning ambitions (LA) I wanted to focus on during graduation.

During my bachelor and master, I came to notice how much I like doing qualitative research and how valuable it can be for the development of a project.

LA1. Grow in doing qualitative research: Doing this project, I wanted to become better in performing qualitative analysis, maybe even use new approaches of context mapping, and translate the results to a meaningful future vision. I wanted to emphasize on this part of the project, as I think it is essential to find a good way to communicate and do context research with the user group for this project. They have a specific way of interacting with an outsider like me, as there is little time for activities like this and they like every minute to be spent well. A second reason is that I want to continue doing qualitative research after graduation.

During different courses, it also became clear how valuable expert interviews can be. They can help to gain insights and inspiration on specific topics and help you see something from a different point of view, which is needed as a designer.

LA2. Talking to experts: Therefore, I wanted to incorporate talking with experts from the context of this project, but also from other disciplines that might be interesting during my graduation.

In the past years, I have already grown a lot in terms of communicating my projects: I try to use more visuals and back down with the text where possible. However, I still find it hard to find balance.

LA3. Improve my visualisation skills: During my graduation, I wanted to get the balance right and communicate efficiently what I have done. This also includes getting better in making visuals and creating a suitable report style.

The final ambition I stated is all about working on my own. This has been an ongoing topic for me, as I struggled with this in the past.

LA4. Be and stay confident in managing and performing my project: During this project, I wanted to be and remain confident in managing and performing my project. Although I have had several negative experiences, I knew I could do it.

During graduation, I have worked on these four learning ambitions. At the end of the report, in Chapter 9.4, I reflect on them.

1.5 Project approach

During this project, I used the Double Diamond model from the Design Council (2019) as a lead for my process. The model describes two consecutive diamonds that each represent a divergent phase, where issues are explored more widely or deeply, and a convergent phase, where focused action is taken. The four phases that can be distinguished are: discover, define, develop, and deliver.

Figure 4 shows an overview of the Double Diamond model and the design activities that were performed during this project. However, it must be noted that the design process is never linear. It is an iterative process, as can be seen by the arrows between the phases and the diamonds.

Discover
The discover phase is all about getting an understanding of the stated problem by talking to people from the context and, if possible, placing yourself in the context. In this project, interviews and a workshop were held with the target group, and observations of the context were performed. Chapters 2, 3, 4.2, 4.3, and 5 describe the discover activities.

Define
The knowledge gathered in the discover phase leads to insights into the problem and its context. In the define phase, these insights are used to come to a design brief, where a specific design goal is stated. A journey map is presented as well and functions as an overview of the insights and as a tool for the MinDef. In this report, the define phase comes back in Chapters 4 and 5.

Develop
In the develop phase, focus lies on finding different solutions for the design goal. During this phase, several ideation methods were used, such as a creative session and a comparison with the civil context, to come to several rough design solutions. Chapter 6 describes these activities.

Deliver
During the last phase, deliver, the focus lies on evaluating different solutions and providing conclusions and recommendations. In this project, the design solutions were evaluated through an open conversation with experienced educators of the target group, after which a future vision is presented for the MinDef. In the end, recommendations are discussed for both the MinDef and Offroad Apps. The deliver phase is represented in Chapters 7, 8, and 9.

1.6 Reading guide

To convey the most important messages, one important reading tool is introduced.

Throughout the report, insight boxes can be found, where meaningful insights will be stated. The boxes will look like the ones below.

These boxes show meaningful insights

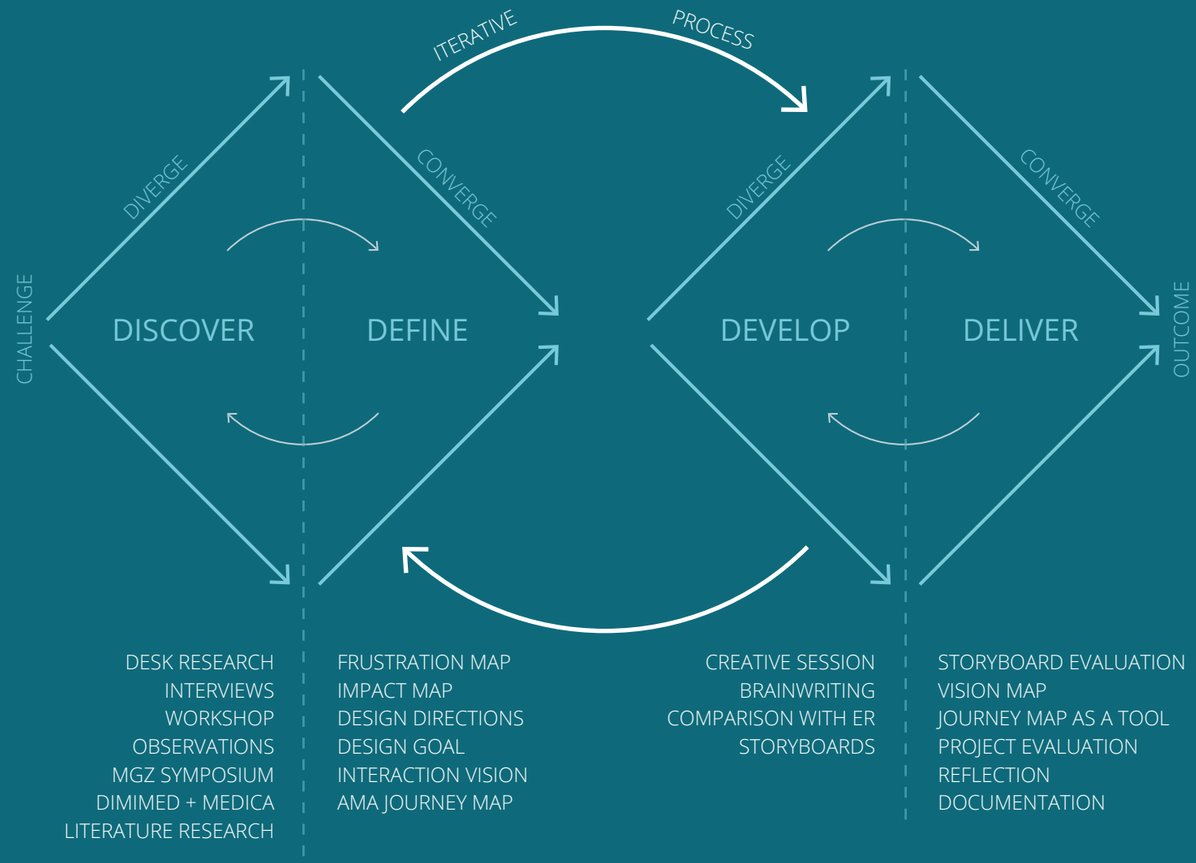


Figure 4: The Double Diamond model and the design activities that were performed in each phase of the model

2.0

THE MILITARY HEALTHCARE CONTEXT

As a start for this graduation project, general knowledge about the military healthcare context was needed. This information was mostly gathered by extracting knowledge from the Army's information bulletins and talking with people who know the context very well. The guide and notes from an interview with an AMA trainer that provided a lot of knowledge for this chapter can be found in appendix B.

Chapter 2.1 presents the general structure of the Army and the military medical chain. This provides insight into the complexity of an operation from the medical side. Chapter 2.2 will go into more detail about the Role 1 MTF and its different aspects, such as the facility and the personnel. The chapter concludes with the most important lessons learned from this immersion.

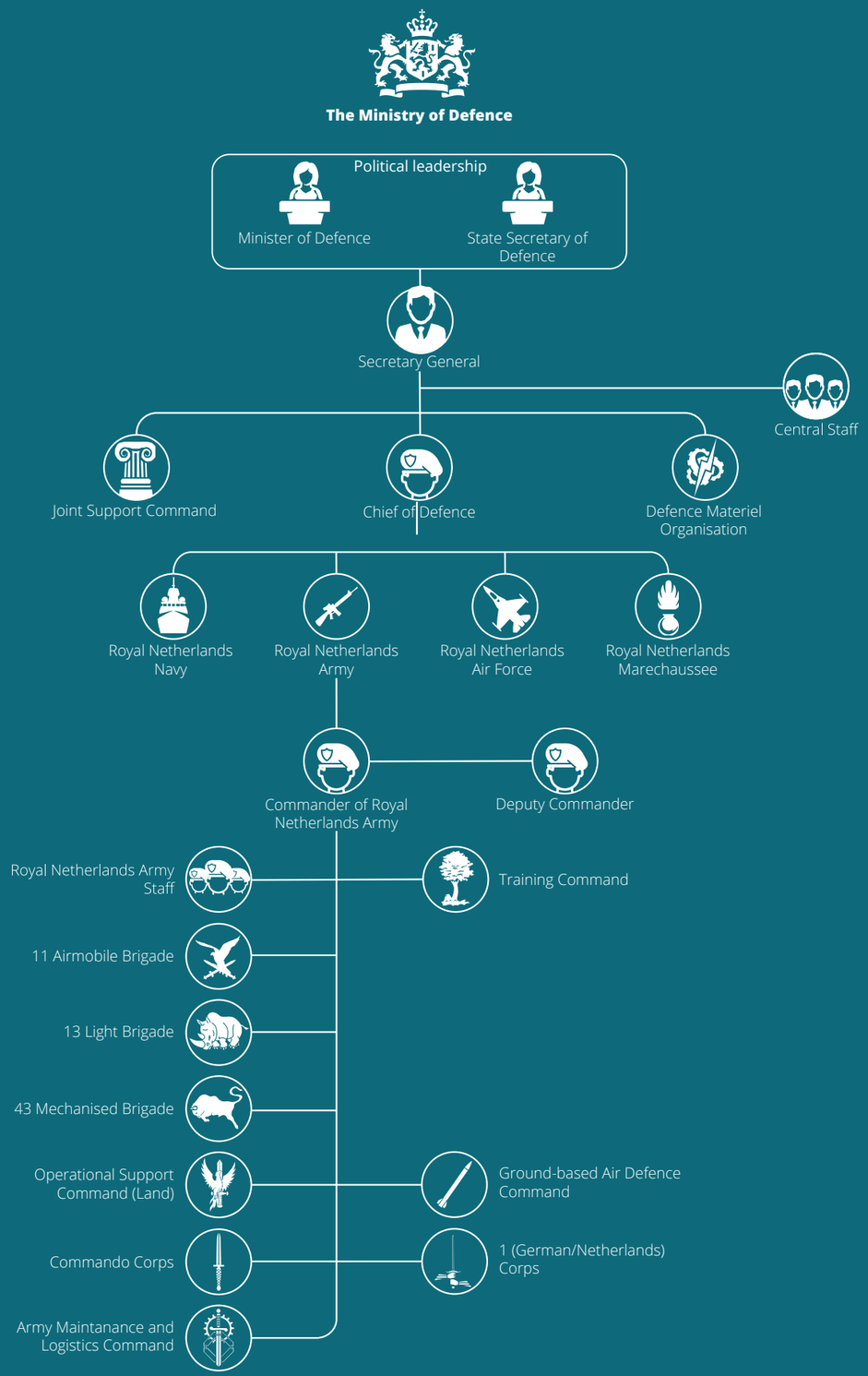


Figure 5: An organisational overview of the Netherlands Ministry of Defence and the Royal Netherlands Army

2.1 The Royal Netherlands Army

The MinDef is one of the largest employers of the Netherlands. The organisation protects what we cherish as a nation: peace, freedom, and security (Ministerie van Defensie, 2019c). This is done both within and outside of our country's borders. The main tasks of the MinDef are protecting our territory and that of allies, promoting the (international) legal order and stability, and providing assistance in the event of disaster and crises (Ministerie van Defensie, 2019e).

With around 22.000 employees, the Army is the largest armed force of the MinDef (Ministerie van Defensie, 2019b). As this project will provide a future vision for people within this organisation, it is of importance to gain a rich understanding of the (general) context in which they operate. This chapter provides an overview of the structure and organisation of the Army, as well as an overview of the relevant parts of the medical chain.

2.1.1 Structure and organisation

The Army is one of the four armed forces of the defence organisation. Within the Netherlands, the Army's responsibility is to defend Dutch territory (physically and digitally) and respond to crises and incidents. When operating abroad, tasks can include defending the territory of NATO Allies, contributing to peacekeeping, and providing humanitarian aid (Ministerie van Defensie, 2019a). Current missions abroad include Iraq, Afghanistan, Lithuania, Somalia, Bahrain, and the Gaza Strip (Ministerie van Defensie, 2019d).

Figure 5 provides an overview of the organisational structure of the MinDef and the Army. The Army consists of several units and has a core of three brigades: the 11 Airmobile Brigade, the 13 Light Brigade, and the 43 Mechanised Brigade. Each brigade has a specific way of operating.

The 11 Airmobile Brigade is a light infantry combat unit which is rapidly deployable. They can move around on foot, in light vehicles, and by helicopter and transport aircraft. The latter makes that they are deployable worldwide within seven to twenty days and can operate over long distances (Ministerie van Defensie, 2019f).

The 13 Light Brigade can be deployed for combat and peace missions, but also with natural disasters worldwide. Their light and fast (armoured) vehicles make that they are operational over a larger distance and are highly adaptable. Their fighting and reconnaissance vehicles ensure their operation on any terrain (Ministerie van Defensie, 2014, 2019g).

The 43 Mechanised Brigade operates similar to the 13 Light Brigade. The difference is that they have a core of heavy armoured (tracked) vehicles, such as battle tanks, which makes them less adaptable (Ministerie van Defensie, 2019h).

2.1.2 The medical chain

In 1869 the Medical Troops Regiment (Regiment Geneeskundige Troepen) was founded in reaction to the lack of coordinated medical care in the battlefield (Regiment Geneeskundige Troepen, 2019) and *"to maintain and preserve battle readiness of the armed forces"* (Komen, 2018a). The regiment provides medical support to all elements of the Army. The 400 Medical Battalion, part of the Operational Support Command (Land), has the responsibility for the deployment of (mobile) field hospitals.

Furthermore, each brigade has an integrated medical battalion, which is responsible for the Role 1 facilities of their brigade (Komen, 2018a). Military healthcare is aimed at monitoring, promoting and, if necessary, restoring the health of the soldiers (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 7). The size and composition of a medical unit are, in addition to the mission characteristics, adapted to the size and task of the units that are deployed (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 8). Nowadays, action is taken almost exclusively in collaboration with other armed forces (joint and combined). As a result, (international) partners are more dependent on each other in the implementation of operational healthcare (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 11).

The close international cooperations make that future changes in the Dutch military healthcare practice and communication systems should connect to the practice and communication systems of other (allied) countries.

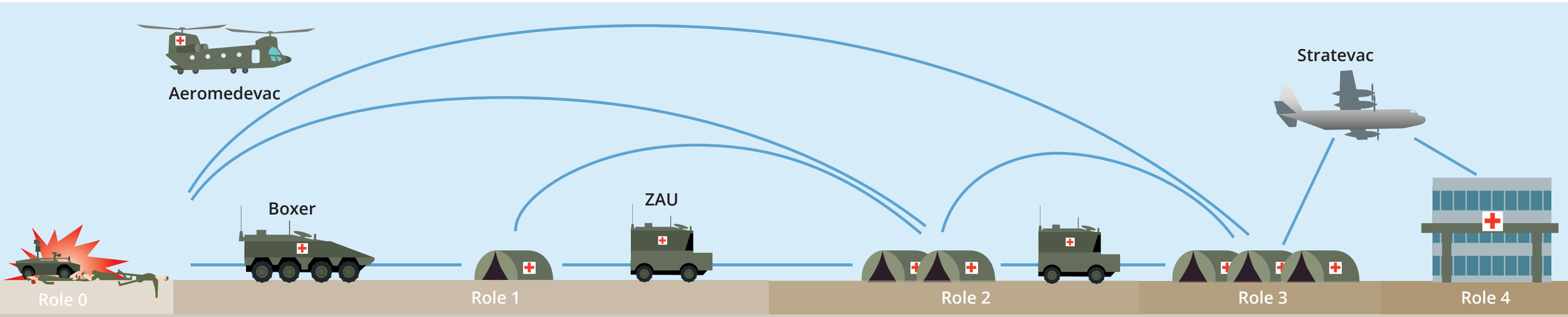
Recently conducted military missions have made it clear that we must be able to provide medical support for multiple and strongly different operations in a short amount of time. The operational health care system has a diversity of resources at its disposal to facilitate this. Medical staff must be prepared for rapidly changing situations. (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 11)

The Roles and their capabilities

The Army's medical chain is built up out of five tiers: Role 0 to 4. These Roles represent the different levels of care that can be provided. Below, in figure 6, a description of each Role is given alongside a visualisation of the chain.

The minimum capabilities of each Role are in principle intrinsic to each higher Role. This means that a Role 3 facility can carry out Role 1 and Role 2 functions. (NATO Standardization Office [NSO], 2015)

Figure 6: An overview of the military medical chain with its Roles and their functions



Role 0

Role 0 is the origin of the casualty, also called the Point of Injury (POI). Here, if possible, soldiers give first aid to themselves and their comrades, also called ZHKH (Zelfhulp Kameradenhulp). This can include care by a Combat Life Saver (CGN), who has had additional medical education and training in comparison to a regular soldier. Role 0 is the entrance of the medical chain. (NSO, 2015; Koninklijke Landmacht, 2014)

Role 1

The three elements forming Role 1 are the Role 1 MTFs, wounded transport groups, and wounded removal groups. The allocation of these elements can vary and is dependent on the assignment, composition, and disposition of the units to be supported. The medical care in this Role mostly includes advanced trauma life support (ATLS), stabilisation, and transportation to a higher treatment level (NSO, 2015). If the Role 1 personnel is not operational in the field, they provide the Forward Operating Base (a military base that supports the operation) with primary healthcare (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 15).

Role 2

There are two levels of Role 2 MTFs: Basic (2B) and Enhanced (2E).
A Role 2B MTF has surgical capacity and is capable of doing life and limb saving operations. This Role is meant to give heavily wounded victims a higher chance of survival. After treatment, the patient has to be transported to a Role 2E or Role 3 facility, as there is no capacity for long-term care. Due to its relatively small size, a Role 2B MTF is easy to deploy.
The Role 2E MTF can provide initial surgery to perform life, limb, and eye saving operations. The nature and size of the facility make that it has an extensive deployment time. For further treatment, patients are transported to a Role 3 facility or are evacuated to Role 4. (NSO, 2015)

Role 3

In a Role 3 MTF, primary surgery can be performed, and additional options for diagnosis and highly specialised treatment are available. Due to its large size, the Army will only contribute to a Role 3 in a multinational context. (NSO, 2015)

Role 4

A Role 4 facility receives patients from the area of operation to give them final hospitalisation and treatment by providing specialist care and rehabilitation. This is done in the home country. In the Netherlands, the Role 4 facilities are the Centraal Militair Hospitaal and the Militair Revalidatie Centrum.

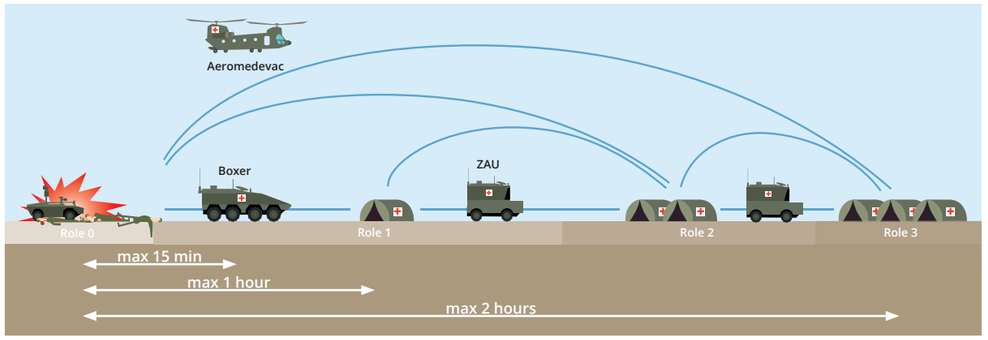


Figure 7: The application of the Dutch 15'-1-2 Timeline

Medevac

A patient does not have to go through all Roles. Depending on the injuries and capacity of the facilities, a patient can skip (a) Role(s). Patient transportation, also called medevac (medical evacuation), is done either through land or air.
On land, ambulances perform patient transportation. For transport between Role 0 and 1, specialised armoured ambulances, also known as Boxers, are used. These ensure safe transportation through the field. Between the remaining Roles, standard ambulances are used, also known as ZAUs (ziekenauto's).
When patient transportation between Role 0 and 3 is performed through the air, it is called aeromedevac. This is done by helicopter.
If patients have to be evacuated to a Role 4 facility, of which the Dutch one is stationed in Utrecht, it is done by aeroplane. This is called a stratevac.

The way of transportation is also dependent on the timeline for medical treatment. As the NATO states, *"Clinical evidence shows that the risk of death or permanent impairment is significantly reduced if injured or wounded personnel are treated as soon as possible after injury or wounding"* (NSO, 2015). In reaction to this, the NATO provides the so-called 10'-1-2 Timeline. This timeline consists of:

"a. *Enhanced first aid. Immediate life saving measures applied by personnel trained in tactical combat casualty care. Bleeding and airway control for the most severely injured casualties is to be achieved within 10 minutes of wounding.*
b. *Damage control resuscitation. Measures commenced by emergency medical personnel within 1 hour of wounding.*
c. *Damage control surgery. Depending on the specific and individual requirement the aim is to be able to provide damage control surgery (DCS) within 1 hour, but no later than 2 hours of wounding.*" (NSO, 2015)

The Dutch Army applies the same guideline, only the enhanced first aid is prolonged to 15 minutes, due to the ZHKH soldiers can perform. This makes that the Dutch Army has a 15'-1-2 Timeline (figure 7).

Time is crucial for the chance of survival of the wounded. All time that can be saved can contribute to the chances of survival.

When deciding on the way of transportation, it is thus essential to take into consideration the distance to the medical facilities and the severity of the injuries. The time, however, is not replaceable with an actual distance criterion due to the changing conditions of the terrain and infrastructure of the operating area in which the Medical Service has to be deployed (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 21).

The medical actors

Throughout the medical chain, medically trained personnel is available. The degree of medical training can range from basic to very advanced. Figure 8 provides an overview of the competence and authority levels that can be distinguished within the medical chain. From the base to the top, the military personnel has increasing authority for performing medical procedures and having responsibility for the supervision of lower trained staff. (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 16)

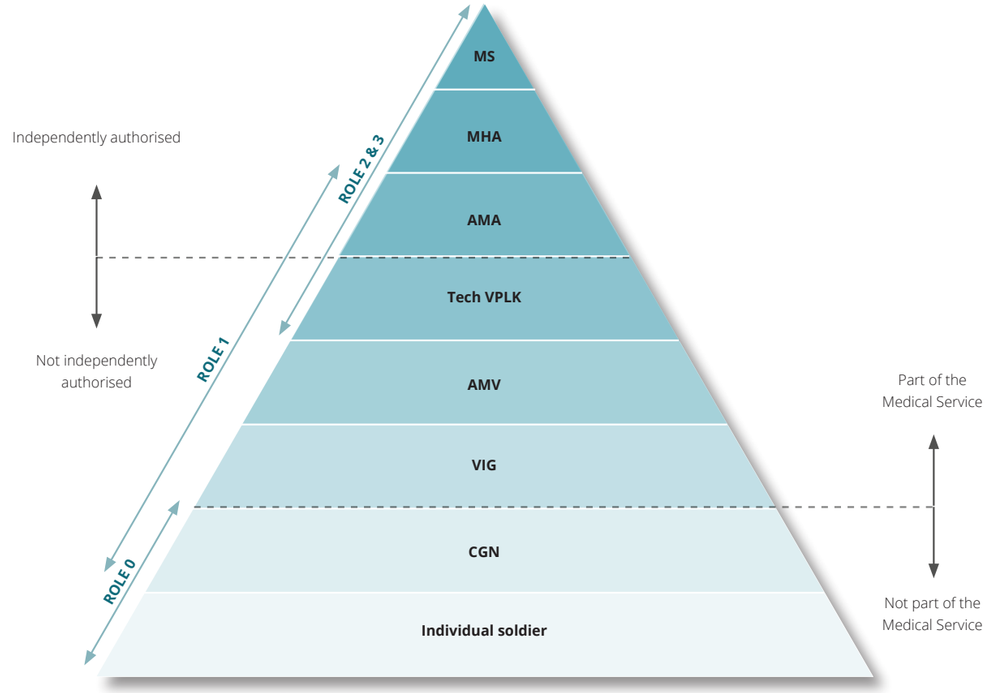


Figure 8: The competence and authority level pyramid shows who can be present in each part of the medical chain in a mission abroad

The pyramid also makes clear that there are officials who are not part of the Medical Service, but who can perform (limited) medical procedures: the individual soldiers, who can perform first aid by ZHKH, and the CGN, who can perform specific medical procedures in addition to ZHKH.

Next, there are the people who are part of the Medical Service but who are not independently authorised, following the BIG Act (Individual Healthcare Professions Act).
The Caretaker Individual Health (VIG) supports and assists doctors and nurses. Other tasks can be material maintenance, security, and camouflage (Werken bij Defensie, 2019). Then there are the General Military Nurses (AMVers) and Technical Nurses (Tech VPLK). The difference between them is that a Technical Nurse is a specialised official: They have experience being Intensive Care Unit (ICU) nurses or Emergency Room (ER) nurses in the civil setting, which means they have more experience with trauma care. AMVers and Tech VPLKs often operate under the direction of a doctor, but also have the authority to perform specific medical procedures on their own. (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 16)
Lastly, at the top of the pyramid, there are independently authorised professionals.
The General Military Physician (AMA) has had education on many different medical fields: They know things from general medicine to ATLS. This makes them multi-functional.
A Military General Practitioner (MHA) can be in function at the Dutch barracks, but can also be deployed for a mission. He or she will then mostly have the role of a general practitioner for the soldiers on base and can help with larger flows of wounded people.
On top of the pyramid is the Medical Specialist (MS), often a surgeon. Their speciality can vary from cardiovascular to orthopaedic, and even neurosurgery. An MS will mostly work for the Army when they are deployed for a mission, where they work in one of the (field) hospitals to operate on the wounded.

Figure 9: A Boxer with the red cross sign (Ministerie van Defensie, 2019j)

2.1.3 Safety

Due to the nature of the healthcare system, it is essential to keep in mind the tactical situation. This is to ensure the safety of the personnel, the wounded, and the facilities, but also to ensure the continuity of care. The medical and tactical situations are thus always closely interlinked.

Two significant factors for safety are flexibility and mobility. The rapidly changing circumstances in which the medical duties are performed demand a high degree of flexibility and determine the group of medical facilities to be deployed (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 18). Also, to adequately support a moving battle, the movements of the manoeuvre should be followed. This makes the frequent movement of MTFs necessary and mostly applies to Role 1 and Role 2B facilities as they are closest to the front line (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2015, p. 18).

The Geneva Conventions

In principle, medical personnel is protected by the Geneva Conventions. All countries in the world signed these conventions, which apply in times of armed conflict. These conventions state rules to protect those who are no longer or not taking part in the hostilities. This includes wounded people (men, women, and children) from both friendly and hostile parties, medical personnel, and medical facilities. (Rode Kruis, 2019)

In order to be recognised as personnel and material that is protected by the Geneva Conventions, they have to be able to be identified as such. This is done with the well-known red cross (or red half moon or red cristal) on a white surface (figure 9). However, it should always be kept in mind that hostile parties do not always respect the conventions. It is therefore important to consider masking the red cross or camouflaging the facilities when the situation asks for it. Medical personnel is also allowed to protect themselves and their patients against hostility. In this case, they retain protection by the Geneva Conventions (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2016, p. 21).

2.1.4 Communication

The three brigades and their medical components are heavily reliable on their communication networks. In order for them to communicate, mobile and transportable equipment are needed to be able to set up radio and data networks quickly. These networks are necessary to ensure smooth operations. Three main requirements have to be taken into account in terms of communication: the reliability, ease of connectivity, and security (Komen, 2018a).

All units, tactical and medical, have to be able to rely on their communication equipment at all times and in all conditions. As the equipment is often used in challenging conditions, such as the desert or tropical areas, they have to be able to withstand these conditions. The more complex a network becomes to endure these situations, the more likely they are to fail.

Communication equipment must be able to withstand the most extreme conditions.

The security might be the most essential part of the communication. During an operation, hostile forces might want to intercept the messages of your troops to track your movements. It is thus important that the networks are protected against hacking. Additionally, it is important to keep into account that each form of communication, either through data traffic or radio, can be pinpointed by the enemy and make friendly troops vulnerable. Radio silence is a way of ensuring the troops and their movements, but it inhibits the possibility of communicating.

Security is crucial to take into account when developing communication equipment in order to protect friendly troops.

Figure 10: The Raptor system (Nijhuis, 2017)

2.1.5 The Army's future vision

The world around us is changing rapidly, and the Army knows that this will have consequences for them too. For example, technological developments will change the way land operations are performed. To play a decisive role in the future, the Army must thus keep up with the changes. This is not only to ensure development for the battlefield but also to deal with the scarcity of personnel. According to the Koninklijke Landmacht (2018), *"this means increasing integration of humans and technology, greater investments in technologically advanced systems and quicker integration of technological applications in concepts of operations."*

Currently, the Army is working together with many different parties to keep up with technological changes. Through innovation projects on different scales, the Army involves Dutch companies and start-ups, such as Offroad Apps, to come up with (technical) solutions for both medical and tactical application.

One of the most talked-about developments is the Raptor: a digital assistant which presents a soldier with a digital overview of the field of operation and the location of his platoon members (blue forces). This Raptor (figure 10) is incorporated in the VOSS (Verbeterd Operationeel Soldaat Systeem), a system consisting of a smart vest and backpacks. (Twigt, 2017)

2.2 The Role 1 MTF

This chapter focuses on the practicalities of the Role 1 MTF context. As mentioned in Section 2.1.2, a Role 1 consists of three elements (a Role 1 MTF, wounded transport groups, and wounded removal groups) and has two functions: being a healthcare centre at the military base and supporting troops in the battlefield. As the latter situation is the focus of this project, from now on, when the Role 1 MTF is mentioned, we talk about that specific situation.

First, the positioning of a Role 1 MTF is discussed, after which the medical team and resources are elaborated on. Then, the facility will be described, and the different communication channels are explained. Lastly, it is explained how a patient moves through the Role 1.

2.2.1 Positioning

A Role 1 MTF is the entry point of the operational healthcare system, which means that it must be as close as possible to the units to be supported. The circumstances in which the MTF has to operate can be dangerous and challenging due to the short distance from the battlefield and the surroundings in which the military operation takes place. In principle, it can be deployed anywhere: from a busy city centre to the desert.

A Battle Group (BG) can work with four units in the field simultaneously. These units can vary in speciality (mechanised, airmobile, etc.) and have their own way of operating. As the operational health care system has to support these different teams under any circumstances, there are different factors that need to be taken into account when making decisions on how many and what type of Role 1 facilities are sent into the field. Factors include the expected amount of casualties, the geographical distribution, the task of the supported units, and the type of units. (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2016, p. 10). Figure 11 shows an example of a configuration of the medical chain, in which two Role 1 MTFs are placed behind the front line. Figure 12 shows an example of the structure and medical capacity of Role 1 MTFs for the 13 Light Brigade. They have one MTF available for each platoon.

The general rule is that a Role 1 MTF has to be able to receive wounded people, treat them, and make them ready for transportation within 30 minutes after arrival on location (Kennis- en Trainingscentrum Geneeskundige Dienst KL, 2016, p. 8). This means that its personnel has to keep track of the movements of the BGs, conduct orders for their own movement, and have to react quickly when the situation asks for it.

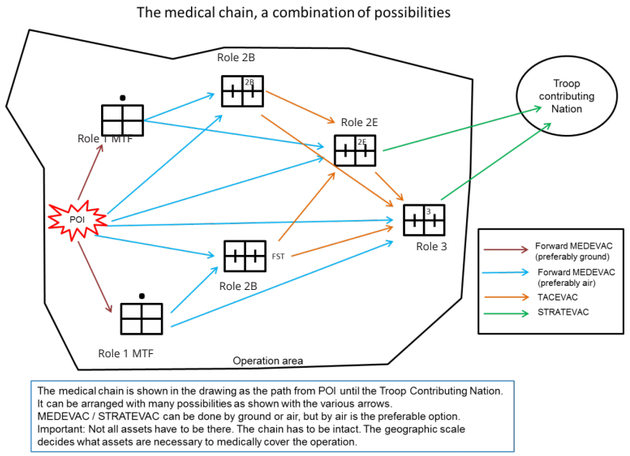


Figure 11: An example of the configuration of the military medical chain, as well as the different possibilities it provides (Schrijer, 2016)

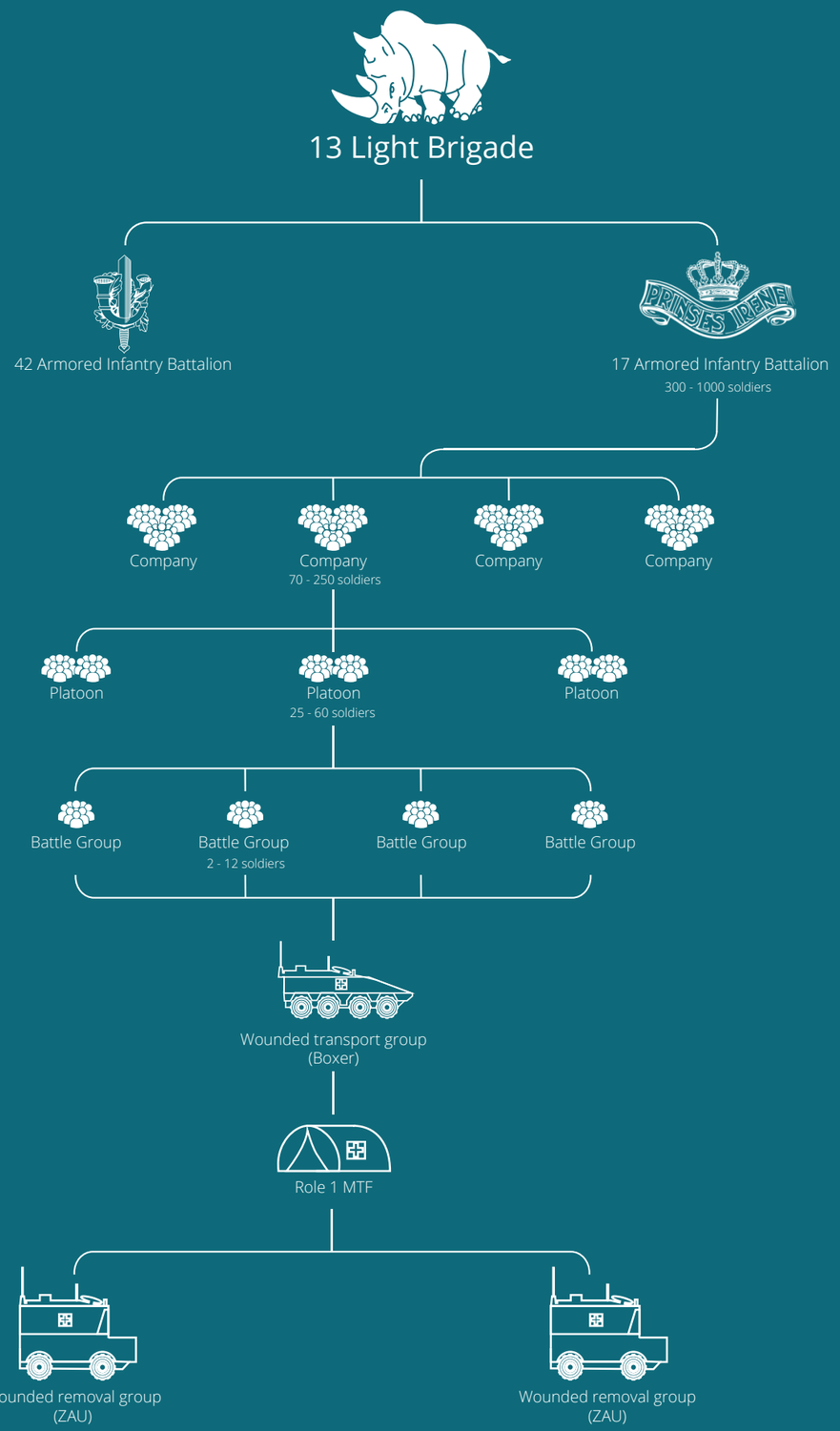


Figure 12: The MTF capacity of the 13 Light Brigade. The Brigade consists of two battalions, that consist of four companies each. Each company consists of three platoons, which on themselves consist of four Battle Groups. Each platoon has an integrated Role 1, composed of one Boxer, one MTF, and two or three ZAUs

2.2.2 The medical team

The medical team of a Role 1 MTF consists of five or seven people, depending on the nature of their deployment (figure 13). The 11 Airmobile Brigade has five people available because they have to be lightweight in order to be transported with helicopters. The medical team of the 13 Light Brigade and the 43 Mechanised Brigade both consist of seven people.

In the MTF, the AMA is the medical commander: he or she decides which patients will be treated or have to be transported the next Role because they are not critical enough. The AMA has the authority to decide on the treatments and instructs other team members. Along with that comes the responsibility for the actions of the team.
Additionally, there are 2 AMVs available, who have the authority to perform specific medical procedures on their own. One of them, the Senior AMV, acts as the tactical commander and has the responsibility for all tactical decisions within the MTF.
Then there are two VIGs, who support the AMA and AMVs with their tasks. They cannot operate on their own but are given orders to follow.

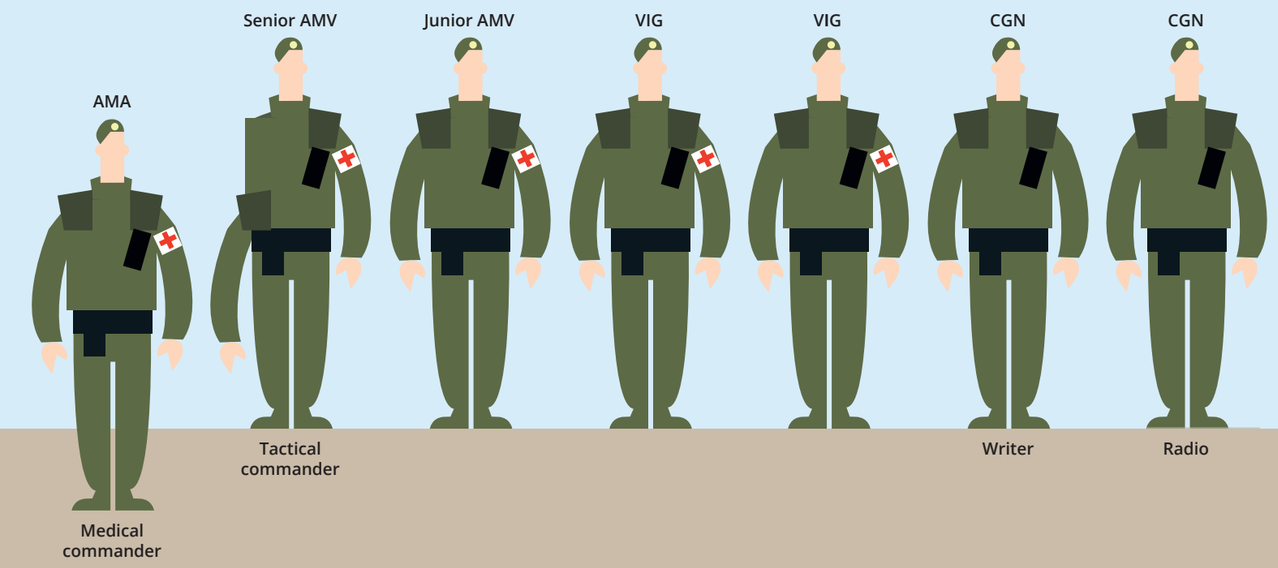
Only the 13 and 43 Brigades have two CGNs. These CGNs have the responsibility of either writing or taking charge of the radio communication. If they are available in between executing their primary task, they can help with patient treatment. In the 11 Brigade, other team members, often the VIGs, will take on these tasks.

Seven people sounds like a large medical team, but their extra individual tasks have to be kept in mind as well. This is even more the case for a team of five people.

2.2.3 Resources

The MTF has two dedicated treatment beds available. The general rule is that each bed has a subteam of an AMV and a VIG, and the AMA is dividing his attention between the beds.
A Role 1 MTF does not have a wide range of equipment available due to its high mobility. All resources should be able to be transported within the vehicle that is sent into the field.

Figure 13: The medical team of a Role 1 MTF



The Role 1 MTF teams of the 13 and 43 Brigade are sent into the operating area with two large trucks and a smaller one (figure 14). Each large truck has a trailer: one with a water tank and one with a mobile power generator. Finally, there are two tents: one treatment tent and one minimal care holding tent. This latter tent has a holding capacity for less severely wounded patients. This tent is put up in a more static form of operating, as it takes more time to deploy and break down the MTF with this addition.
The 11 Airmobile Brigade has two smaller trucks and two trailers with a tent which can be transported underneath a helicopter. However, it takes two flights to transport the entire MTF to the location, and they have fewer resources available, such as water.

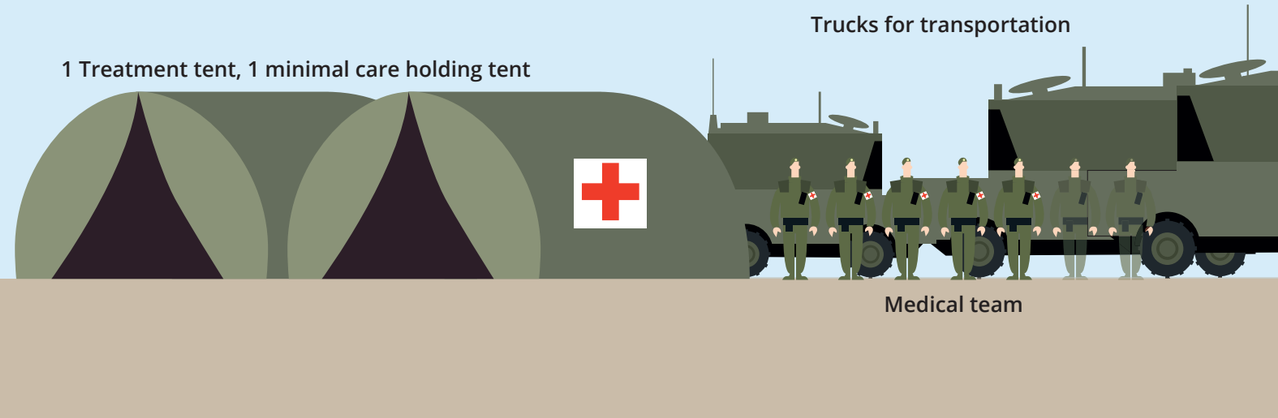
In terms of medical equipment, the Role 1 MTF's resources will not go beyond what a first responder in the field will have in their emergency kit. The only difference is that there is more of that same equipment on hand and that a portable patient monitor is available. There is also a power unit available, which ensures that this monitor will work for several hours.

It is not the extra equipment that makes a Role 1 MTF a necessary place for stabilisation, it is the knowledge and extra set of hands that do the work.

If medical equipment is running low, the MTF is restocked by a Role 2 facility. The Role 1 MTF can restock the Boxer and the Role 0 if needed.

The communication equipment consists of the radio that is in the trucks. This is the communication line through which commands from higher entities are received and where medical details about patients are provided. In order to use the radio in the tent, the car has to be put directly next to the tent, so the radio unit can be placed inside the tent using extension cables. This is not ideal. However, it is the best option to be able to hear all communication and not miss important information.

Figure 14: An overview of the vehicles and tents of a Role 1 MTF from the 13 and 43 Brigade



2.2.4 The facility

The MTF itself is not very large: the whole team operates in a space of roughly four by six meters. The treatment of patients and making them ready for transportation is mainly done within this small area.

On the right, in figure 15, several images show what the treatment tent can look like. Throughout several observations, I have seen different configurations of the facility, but they always had the same elements to work with. The medical teams themselves can decide how to use the space, it often comes down to having one open entrance to the treatment tent, one bed on the left side and one on the right side, and a desk with medical equipment at the back of the tent (figure 16).

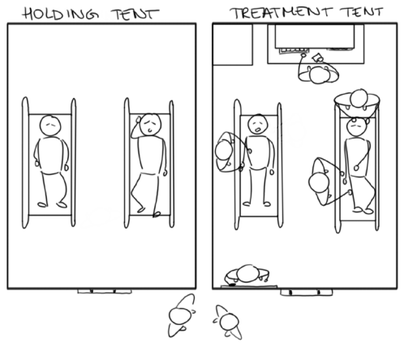


Figure 16: A top view of the treatment and holding tent

On the sides of the tent, and sometimes through the tent, chords are placed to suspend equipment from, such as a monitor and IV bags. Depending on the team's way of working, they also have one or two small whiteboards available in the tent. Additionally, if circumstances demand it, a heating element is placed in a corner of the tent. This takes up a space of roughly one square meter but it is highly necessary to maintain the temperature within the tent on a steady 37 degrees Celsius. This is done to prevent patients from suffering from hypothermia.

2.2.5 Communication

In a Role 1 MTF, there are three types of communication: tactical communication, medical command and control (MedC2), and medical communication. The first two are mostly done through radio, as this is the only way to communicate between different layers of operation.

Tactical communication is about the movement of the facility. The MTF should be able to follow the units on the ground, but should also keep into account that the front line can move towards the facility when it is deployed. This is done by following information and orders that come in through the radio.
MedC2 is all about the transport of patients: Who is transported where and with what type of transportation? These decisions are made by the Patient Evacuation Communication Cell (PECC), which is the highest level of authority for these commands. A Role 1 MTF has to ask the PECC for medevac of a specific patient. This process is explained later on.
Medical communication is about the number of casualties, the priorities, and the medical status of patients. Medical communication is present between different layers of the operation, but mainly within the MTF itself.

This project mainly focuses the medical communication used in the Role 1 MTF, although it must be said that all three types of communication are intertwined.

Figure 15: An impression of a Role 1 MTF (own images) ▶
Top left: The left side within a Role 1 MTF at the MGZ symposium
Top right: A desk with medical equipment at a training in Marnewaard
Center: An impression of the limited space available when treating a patient
Bottom left: A heating element in the corner of the tent
Bottom right: The right side within a Role 1 MTF at the MGZ symposium

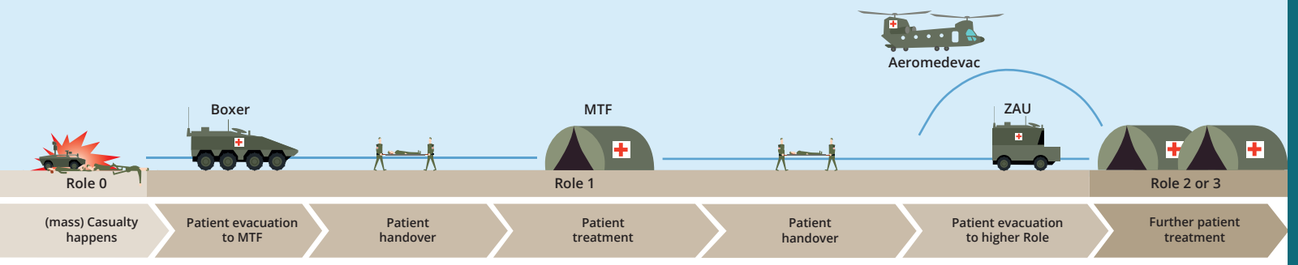


Figure 17: An overview of the patient journey from the POI to a Role 2 or 3 facility

2.2.6 Patient movements

When a casualty happens, patients are transported through the medical chain. This can include the Role 1 MTF. Figure 17 provides a schematic overview of patient movements between the POI and Role 2 or 3.

First, a CGN gives ZHKH or initial treatment to the wounded at the POI. The patients are gathered in a so-called 'wounded nest' to keep them as safe as possible from combat and the elements. Here, the person with the best medical knowledge performs initial triage. From this wounded nest, a Boxer picks up patients. It has an AMV on board to continue treatment and monitoring during transportation.

When arriving at the Role 1 MTF, the AMV will hand the patients over to the MTF's medical team, preferably at the Boxer. Here, the AMA will assess the state of the patients and decide which patients can stay, and which ones have to be transported to a higher Role. In principle, a Role 1 MTF only accepts so-called T1 and T2 patients, who are severely wounded but have a chance of survival. Figure 18 shows a short summary of the triage levels, and appendix C explains the triage system in more detail.

TRIAGE #	CLASSIFICATION MEANING
T1	Immediate treatment
T2	Delayed treatment
T3	Minimal treatment
T4	Expectant treatment
DEAD	Dead

Figure 18: Triage classifications

The AMA has the authority to accept or decline any patient at the MTF. An exception to the acceptance and declining of patients can be a MASCAL situation, where a large number of patients has to go through the system. In this case, it may be necessary to take on more patients than preferred.

From the Role 1 MTF, attempts will be made to transport all T1 classified patients with aeromedevac to a Role 2 or 3 MTF. T2 and T3 classified patients are mostly transported by land with a ZAU to Role 2 or 3. If no aeromedevac is available, this is also the case for T1 patients. When a patient is picked up, a a handover is done between the MTF's AMA and the ZAU or helicopter's AMV.

Theoretically, a Role 1 MTF can handle a 60 patients per 24 hours (Glasbergen, 2019, Appendix B).

2.3 Conclusions

This chapter described the Army and its medical components. It is now clear that the Army consists of three brigades that are supported by the Medical Troops Regiment, which provides them with a medical chain. This chain is aimed at monitoring, promoting, and restoring the health of soldiers.

The tiers of the medical chain have increasing capabilities: Where the Role 0, or POI, has almost no medical resources and personnel with basic medical education, the Role 4 has a large variety of medical resources and staff that is higher medically educated. However, the lower Roles are of great importance as these are closest to the POI. By providing medical care as soon as possible, the risk of death is significantly reduced. This shows that time is one of the most critical elements in the treatment of patients.

What also became apparent in this chapter is the fact that safety is of great importance. Due to the nature of the healthcare system, it is crucial to keep the tactical situation in mind to ensure the safety of the personnel, the injured, and the facilities. The lower Roles have to adapt to rapidly changing circumstances and have to be able to move when necessary.

Another major factor to take into account is communication. All units, tactical and medical, have to be able to rely on their communication equipment at all times and in all conditions. Here, the security of the communication mechanisms is key in staying safe.

The specific context for this project was also described in this chapter: the Role 1 MTF. This is a crucial element of the Army's medical chain, as this facility ensures that patients are provided with medical treatment in time. The MTF is placed directly behind the front line and has to act quickly when a casualty happens. With a team of 5 to 7 medically trained people, they treat and stabilise T1 and T2 patients for them to be transported to a higher Role. All this happens in a small facility with limited medical resources.

The Army wants to keep up with technological developments. By integrating humans and technology, investing in technology, and integrating technological applications in concepts of operation. Looking at the focus of this project, this can be of great value for the Role 1 MTF.

3.0

THE COMMUNICATION OF PATIENT DETAILS

Now that the general military healthcare context is clear and the specific context of the Role 1 MTF is described, the second important part of this project is introduced: the communication of patient details. By doing a workshop with AMAs, observing two different medical training moments, and talking to other context experts, insights were gathered on the way patient details are currently being communicated within the Role 1 MTF.

Chapter 3.1 starts with a description of what communication of patient details entails and the theory behind it. After that, the stakeholders of the communication of patient details in the Role 1 MTF are described in Chapter 3.2. Then, the current communication methods that are used by the Army and the frustrations that come with them are explained in Chapter 3.3. That same chapter is concluded with some additional findings and design directions. Chapter 3.4 elaborates on the current way the Army maps their processes, after which the chapter ends with a conclusion on the learnings from practice and literature.

3.1 Communication of patient details between medical professionals

Desk research has been performed to understand what communication of patient details entails. The focus of this research was to gain a deeper understanding of the way patient details are generally communicated between medical professions. First, a definition of communication in healthcare is provided, after which communication systems is described. Then, different communication media are discussed, as well as the risks of insufficient communication. The chapter is ended with a brief conclusion.

3.1.1 Communication in healthcare

As Vermeir et al. (2015) describe, *"effective and efficient communication is crucial in healthcare"*. Wani, AlGhassab, Alsalmi, Uzair Ul Haq, and Wani (2018) back this up by stating that *"communication and collaboration is essential for a medical team in order to minimize errors in the treatment of patients and to provide best results"*.

But how can we define the communication of information in healthcare? Coiera (2006) describes that we can view all information that is exchanged in healthcare as forming a 'space': the communication space. He describes the communication space as *"that portion of the total information transactions that involves interpersonal interaction"*. This can entail all types of transactions, such as face-to-face conversations and written communication. The communication space can become very complex, even within small teams, as *"the number of different conversations that could take place at one time is determined by the number of individuals who may have to communicate"* (Coiera, 2006; Lang & Dickie, 1978). To provide an example: Within a group of three individuals, three conversations can take place between any two individuals. In a group of five individuals, this already increases to ten (figure 19). This shows how many different information transactions can take place within a group of people and that this increases rapidly with an increasing number of individuals.

3.1.2 Communication systems

The communication of information in healthcare is done through so-called communication systems. Coiera (2006) defines communication systems as *"the formal or informal structures organisations use to support their communication needs"*. Communication structures consist of multiple elements, which will be described next. The explanations are based on Coiera (2006).

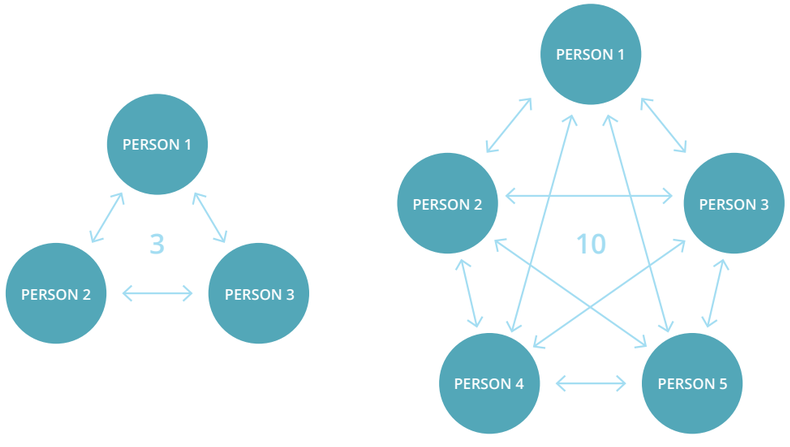


Figure 19: An example of the amount of information transactions that can take place in groups of different sizes (after Lang & Dickie, 1978)

Communication channel
A communication channel entails a method of conveying a message. Examples are a face-to-face conversation, a medical record, or a telephone conversation. Each channel has attributes, such as noise and capacity, that determine how suitable they are for different tasks.
There are two different ways of communication to be distinguished for communication channels: synchronous and asynchronous communication. With synchronous communication, like a telephone conversation, two parties can communicate across a channel at the same time. Synchronous communication is often interruptive as an immediate responce is required. This form of communication can therefore have a negative impact on the individuals participating in it. This is often the case when they experience a high cognitive load. Asynchronous communication, such as an e-mail, only allows one-way communication, which means that no simultaneous discussions can take place. This is often a preferred way of communicating with busy individuals, as it is not that interruptive.

Type of message
To achieve a specific task, messages are structured. This is done by using available resources to meet the needs of the receiver.
Informal messages can vary in structure, for example e-mail and voice messages.
Formal messages have fixed structures. Examples are lab results and alerts generated by a computer.

Communication policies
Communication systems are influenced by security policies that are put in place by the users of the systems and depend on the working environment. This can result in communication systems not being used to their full potential.

Agents
Agents are people that are involved in information specific transactions and have a communication role. An example is a ward clerk at a medical unit, who can function as a barrier to prevent unnecessary interruption such as phonecalls. Communication systems can be specifically structured around these agents in order to reduce the interruption of other staff, such as doctors.

Communication services
A communication system can provide different communication services. E.g. a telephone line can provide for voice messages, but can also be used to send fax messages. These are two completely different services that can be provided by one communication system.

Communication device
A communication service can be provided by a variety of devices. Each device is used with a different situation in mind. Currently, wearables, such as smartwatches, are rising in popularity to become the latest innovative communication devices, as they are often small and easy to take with you. As innovations are happening rapidly in the field of communication services, other devices are introduced into the market at a rapid pace.

Interaction mode
The usefulness of communication systems is mainly dependent on the way interaction is designed. Where some interactions are designed to be responded to immediately, such as a phone's ringtone, others are designed to be less interruptive, such as an e-mail. However, asynchronous services can also be designed to have an interruptive interaction mode. An example is the notification sound you hear when an e-mail comes in.

Security protocol
As we are talking about communication in healthcare, patient confidentiality must be taken into account as well. It should not be possible for unauthorised people to access medical records. Examples of measures that can prevent unauthorised access are encrypting messages or providing a secured environment which only authorised individuals can enter.

When designing a communication system, it is vital to take all abovementioned elements into account as well as the context in which the communication system will be used. If inappropriate decisions are made, it can cause the whole communication system to underperform.

When designing a communication system it is of great importance to take into account the setting and context it will be used in, in order for it to work efficiently.

3.1.3 Different media

Next to carefully selecting the appropriate elements for the setting, it is also of importance to take into account the different media that are used by the communication systems. For example, while some communication systems are designed to carry data, others may be designed for face-to-face communication. It is usually context-dependent which medium is chosen over another medium (Caldwell, Uang, & Taha, 1995). This means that the characteristics of a specific task, the environment in which it occurs, and the amount of information that the medium can endure all seem to affect human performance in relation to a communication task (Rice, 1992).

Let us look at the example of face-to-face communication. Face-to-face communication is often the preferred way of communicating. All involved individuals can hear what is being said and body language and facial expressions help to convey the message. However, written communication may be a better option in certain situations, as this can be traced and consulted by third parties. (Vermeir et al., 2015)

3.1.4 Risks

Within the healthcare domain, communication of information must be conducted effectively and efficiently. If done poorly, it can have terrible consequences.

The complexity of interactions, as described in Section 3.1.1, can put a heavy load on the communication process. This can cause miscommunication and thus be a source of morbidity and mortality (Coiera, 2006). Wilson et al. (1995) described how, of 14.000 in-hospital deaths, the lead cause was determined as communication errors. This was twice as frequent as errors that were made due to inadequate clinical skills.

Another risk factor is the number of interruptions. These interruptions can be caused by a lot of things and cause a healthcare worker to suspend their active task in order for them to deal with the interruption. Afterwards, they have to get back to their original task again. As Coiera (2006) describes, *"suspending tasks and then returning to them imposes a cognitive load, and may result in tasks being forgotten, or left incomplete"*. This has an impact on the time that is spent and on the efficiency of working.

Lastly, Vermeir et al. (2015) describe that *"poor communication leads to additional workload as it decreases confidence in decisions"*. It is crucial to be fully and correctly informed before making any decisions about the treatment of a patient, as this could otherwise result in errors.

3.1.5 Conclusions

Looking at the subject of the communication of patient details between medical professionals, it is clear that any miscommunication can have serious consequences. There are many different factors to take into account, such as the channel that is being used to transfer a message, the type of message that is conveyed, and the number of people taking part in the communication system. By making sure that the elements of a communication system are carefully selected for the setting and context they are used in, risks can be reduced, and adverse events prevented.

Figure 20: A hospital nurse communicating by filling in a patient chart (Foto Garage AG, 2020) ▶

About
The AMA is a broadly medically educated doctor and is the commander of the Role 1 MTF.

Roles and responsibilities
As medical commander of the Role 1 MTF, the AMA is responsible for the patients and the actions of his medical team. If possible, all medical decisions are made or authorised by the AMA. The AMA switches between the two beds in the treatment tent and helps to treat the patients.

About
An AMV is a nurse that can perform many different medical procedures. Although AMVs operate under the direction of an AMA, they are allowed to perform procedures on their own if the situation asks for it.

Roles and responsibilities
There are two AMVs in the Role 1 MTF: a senior and a junior AMV. Each AMV forms a team with a VIG. As a team, they treat and monitor one patient. If the AMA is busy with another patient and there is no time, the AMV has the mandate to decide on the treatment. The senior AMV is also responsible for all tactical decisions and orders that are made.

About
A VIG is a caregiver that can perform basic medical procedures. Within the Role 1 MTF he cannot operate on their own, but an AMA or AMV will give orders.

Roles and responsibilities
The VIG forms a team together with the AMV: together, they take care of one patient. The main task of the VIG is to assist the AMV with their tasks and to perform procedures when ordered to. He also helps to monitor the patient.

About
The writer CGN has had primary medical education. The only difference with a regular soldier is that a writer has had a few weeks of extra training in addition to ZHKH.

Roles and responsibilities
Within the Role 1 MTF, the writer is responsible for administration concerning the patients: their vitals, the treatments and medication that have been given, and keeping track and trace documents for the MTF. In addition, the writer can help with patients if time allows it.

About
The radio CGN has had the same (medical) training as the writer CGN.

Roles and responsibilities
The radio CGN is responsible for maintaining radio contact with the medical commander. When orders or messages come in, he will notify the rest of the team, and when ordered, he sends out requests for medevac. If time allows it, he can also help with patients.

3.2 Stakeholders

Various stakeholders are involved with the communication of patient details within the Role 1 MTF. Besides the Role 1 MTF medical team, other parties rely on the communication of patient details as well. Examples are the patient himself and the medical personnel of the transport and removal groups. These two pages describe each of the stakeholders that were identified. The medical team is presented on the left, and the additional stakeholders are presented below.

Note: To improve readability, individuals are referred to as 'he'; however, it can also be read as 'she'.

The communication of patient details is not only crucial for the people within the facility, but also for people at a greater distance from the MTF.

The Boxer AMV is the person that is responsible for communicating patient details from the POI up to the Role 1 MTF. He communicates this with the whole MTF team if possible.

The AMV from the ZAU is the person that receives all patient details from the AMA or AMV from the Role 1 MTF during the second handover. He will transfer this to the next Role.

The medical commander is the person that does the patient detail communication between the lower Roles, the higher Roles, the PECC, and the Role 1 MTF. All orders and requests for the Role 1 MTF go through this person.

Medevac must be requested from the PECC. The PECC can arrange and order medevac for each patient to all roles. The Role 1 MTF cannot directly get in contact with the PECC; this must be done through the medical commander.

One of the most important stakeholders is, of course, the patient: All patient detail communication is about and for this person to increase the chances of survival.

More indirect stakeholder are the patient's family. It has a significant impact on them if communication is done wrong, as this can directly impact their loved one.

3.3 Patient detail communication in the Role 1 MTF

To improve the current communication of patient details in the Role 1 MTF, in-depth knowledge about the current situation is needed. This knowledge was gathered by performing a communication mapping workshop with AMAs and by observing two different medical training moments. Section 3.3.1 elaborates on the results of the workshop, which resulted in an overview of the current ways of communicating patient details. In Section 3.3.2, the frustrations that were described during the workshop are mapped and discussed, after which an impact map is introduced. Additional findings from observations and talks with AMAs and AMVs are provided in Section 3.3.4, after which Section 3.3.5 describes interesting design directions that could be identified.

3.3.1 Current methods

To gain insights into the current methods of interaction, a communication mapping workshop was organised at the Generaal-majoor De Ruyter van Steveninckkazerne in Oirschot. The workshop was done together with three AMAs from the 13 Light Brigade and M. Goos, a consultant on medical information provision at the Joint Information Provision Command (JIVC) who was interested in this project. The goal of this workshop was to map the current methods of communication within a Role 1 MTF and to find out what frustrations they evoke.

During the workshop, the AMAs mapped the current way of communicating from the moment the first patient details are provided until the moment they are passed on to the next part of the chain. This was done using mapping tools that were specifically made for this session (figure 21). In appendix D and E, the complete workshop plan and the unredacted results are provided.

Figure 21: A selection of the mapping tools used during the communication mapping workshop (own image)

During the workshop, it became clear that patient details are communicated in many different ways to, in, and from a Role 1 MTF. Figure 22 provides a map of all the current communication methods that were described in the workshop. The map also provides the other types of communication that are used, the people that are communicating, the location in which the communication takes place, the content of each communication method, and if it is a direct or indirect line of communication.

As can be seen, there are many different ways of communicating patient details: through radio, on paper, on a whiteboard, and by using speech. These methods all contribute to the complex system of communication. To understand the map, each communication stage and its method(s) will shortly be described in order of appearance.

POI

When a (mass) casualty happens, a soldier on the ground will contact his medical commander through radio. He provides notification of the incident and the estimated amount of casualties, and requests for the evacuation of the wounded. This is done in the format of a 9-LINER, a standard message consisting of nine lines of information. An example of a 9-LINER can be found in appendix F. The radio communication goes directly to the medical commander: MTF personnel listens to this radio communication in order to know that a casualty has taken place. They will wait for instructions to set up the MTF.

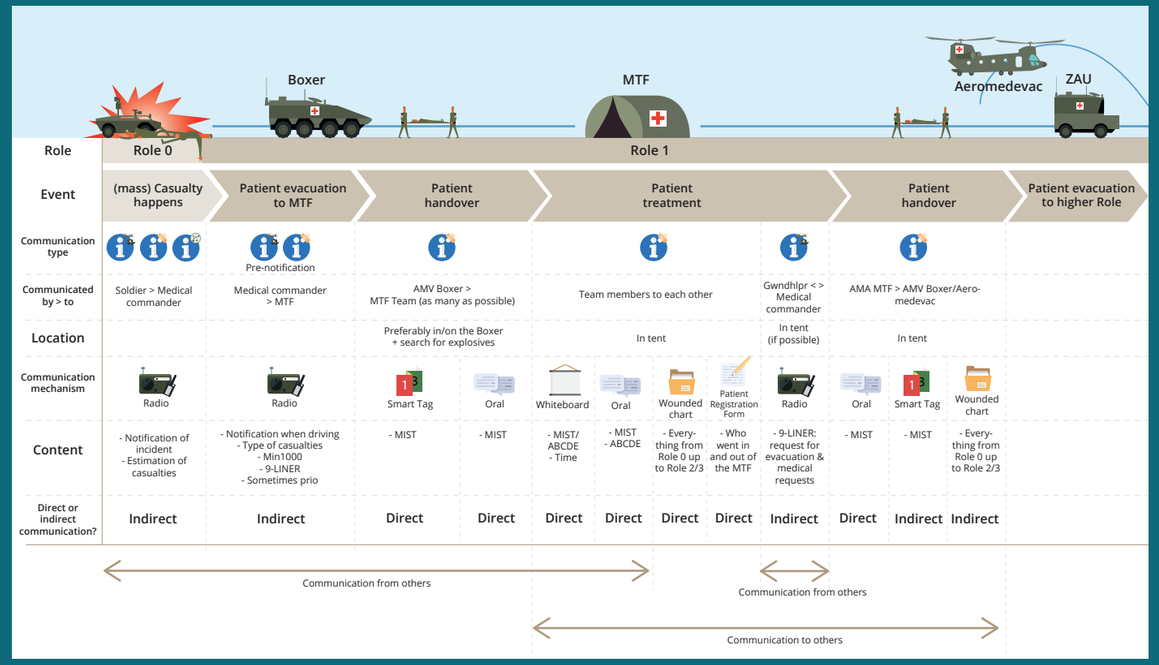


Figure 22: An overview of the outcome of the communication mapping workshop

Figure 23: Role 1 MTF personnel communicating via the Smart Tag (Komen, 2018b)

Boxer

After patients are picked up by a Boxer, its personnel communicates this to the medical commander, who then relays this to the MTF. This communication is all done through radio. The information coming from the Boxer is often limited. The only things the MTF personnel is sure of, is when the Boxer is leaving the POI and when it is less than 1000 meters away from the MTF (min1000). Additional information might be the type of casualties and priorities. A 9-LINER is rarely put through.

The amount of patient details communicated before the patients enters the MTF is very limited.

Patient handover Boxer

When patients are brought in, the MTF team will most often go outside for the patient handover. This gives the AMA a chance to assess the patients on the severity of their injuries and to search them for possible explosives.

The handover is done using two communication methods: an oral handover and a paper chart filled in at the POI, also known as the Smart Tag (figure 23 and 24). In the Army, a fixed format is used for effective communication about the medical status of a patient. This fixed format is called the MIST (or MIST AT), which described the Mechanism of impact, Injuries, vital Signs, and Treatment given. Both the oral handover and the Smart Tag use this MIST format. A more elaborate explanation of the MIST can be found in appendix G. When a patient is handed over, the Smart Tag is handed over as well.

The MIST format is key for patient detail communication.

Treatment inside the MTF

When a patient enters the MTF, his vitals are written down on a whiteboard. This whiteboard is either centrally placed in the MTF or on the side of the tent where the patient will be treated. This way, every team member can see what is written down. Each time vitals are measured, they are said out loud, after which the writer adds them to the whiteboard. The team itself can decide on the whiteboard's format. Most teams use the MIST as a basis, with emphasis on the vital signs (figure 25).

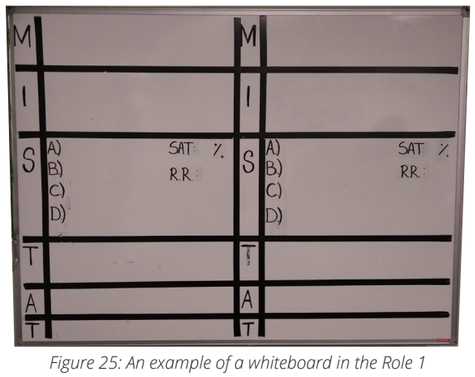


Figure 25: An example of a whiteboard in the Role 1 MTF at the Military Healthcare Symposium (own image)

Whatever is written on the whiteboard, must also be noted in a patient file. This file has a fixed format and with each patient, a new file is started. This patient file is meant to report everything that is measured and all the treatments that are

Figure 24: An example of a used Smart Tag (own image)

given, to be used later on in the chain. An example of the patient file is provided in appendix H.

Next to the written forms of communication, the team also talks to each other a lot: Together, they assess and treat the patient. Whenever an order is given to perform a procedure, this order is repeated by the person that has to perform it. This is called 'team talk', which ensures no mistakes are made.

Last but not least, the writer also has to keep a track and trace document to see which patients entered and left the facility throughout the day. This is track and trace is done on the so-called patient registration form. This form is necessary in the case that any issues arise later on in the chain, to see who performed treatment on the patient and if they acted accordingly. It is meant as a way of protecting the MTF personnel as well.

Within the MTF, there are many different communication methods to be distinguished, of which most are in written form.

It is of great importance to be able to trace back which caregiver performed what treatment.

Request for medevac

Most patients need quick medevac to higher Roles in order to survive. Therefore, it is essential that medevac is requested by the MTF as soon as possible. This is done via radio, with a 9-LINER, by the radio CGN. This request goes out to the medical commander, who then has to put it through to the PECC, which makes the decisions on medevac. The MTF thus has to wait until the medical commander confirms that the medevac is put in motion.

Patient handover ZAU or helicopter

When medevac arrives, in the form of a ZAU or helicopter, the AMA hands the patient(s) over to the AMV from that team. This is done orally, again in the form of a MIST. Also, the Smart Tag and patient file are handed over to ensure all recorded data stays with the patient.

Figure 27: The results of an afternoon spent analysing statement cards (own image)

Figure 26: An example of a statement card

Category	
Paraphrase	**Goed getimede afvoer is essentieel voor de doorstroom van het systeem**
Quote	Tijd is je vijand. Een patiënt behandelen kost niet zoveel tijd, maar ze moeten gewoon door. Het gebeurt heel makkelijk dat je systeem verstopt raakt als je afvoer naar achter niet goed is.
Participant(s)	3

3.3.2 Frustrations

Next to gaining insights into the practicalities of communicating patient information, the workshop with AMAs was also used to gain insight into the negative aspects of the patient detail communication methods currently used in the Role 1 MTF. This was done by using 'statement cards', an analysis method often used for the design research method 'contextmapping'. Sanders & Stappers (2012, p.224) explain that using statement cards can *"help to make interpretation and pattern finding steps explicit."*

All statement cards have an identical format with four fields: a quote, a paraphrase, the participant(s) who stated it, and the category in which that statement card is placed. Figure 26 shows an example of a statement card.

The analysis was started by preparing a verbatim transcription of the audio recording of the workshop, after which I selected the parts that were relevant to my research or were interesting otherwise, e.g. frequently made statements.

All selected fragments were individually put into the quote fields of the statement cards, after which they were all paraphrased separately. In the end, 48 statement cards were made. Examples of paraphrases that were made are: "medical information is not always the most important information to be communicated", "writing down patient data manually is a time consuming and unhandy task", and "patient details coming in through the radio can be misleading".

The statement cards were printed and cut to make it easy to cluster them while still being able to read what was on the cards. Spontaneous clustering was used, placing one card at a time onto a big whiteboard, and names were assigned to each cluster. This process took about half a day. The result can be seen in figure 27.

The analysis resulted in 20 categories, which could be divided into eight main themes. Figure 28 on the right shows an overview of the themes with their accompanying categories. Figure 29 shows how they relate to one another.

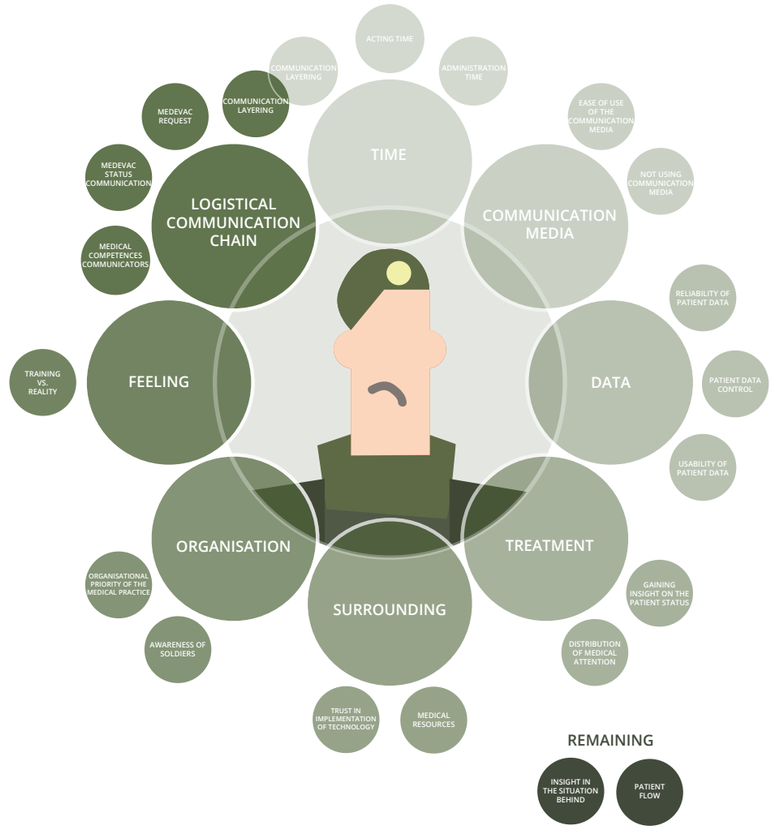


Figure 28: The 'frustration map' that resulted from the statement card analysis

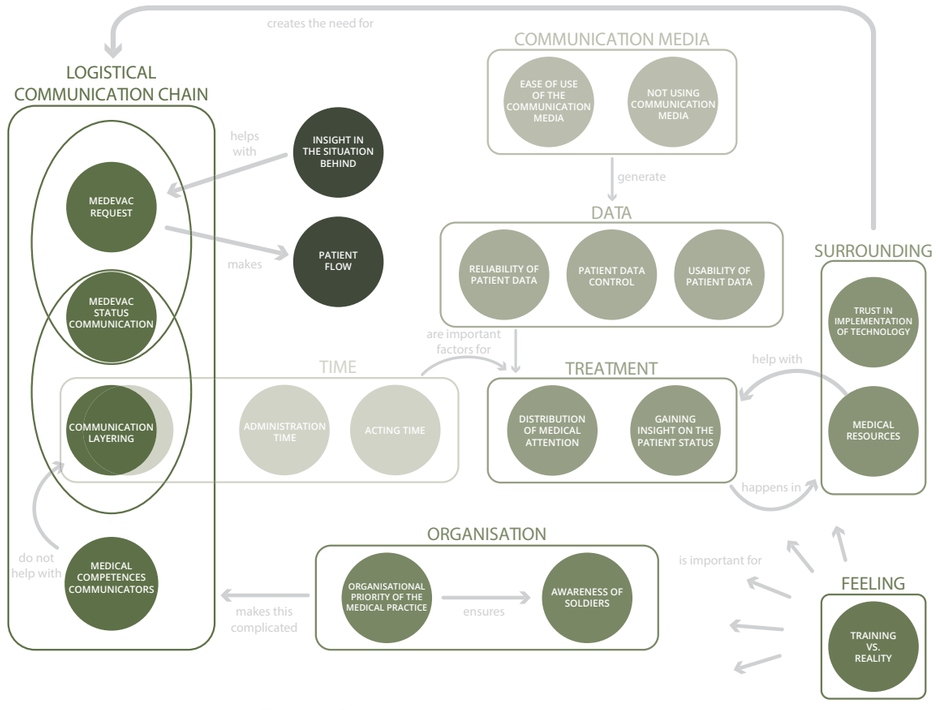


Figure 29: The frustration themes in relation to each other

The statement card analysis revealed eight main themes that caused frustration for the AMAs. In order to understand the themes and their categories, each will be explained briefly.

The logistical communication chain
The Army's communication chain consists of many layers (figure 30). Having these layers causes a delay in almost every case. For example, when an AMA requests for medevac, a 9-LINER has to go through the medical commander, who puts it through to the PECC, after which the answer has to be communicated back as well. As every minute counts in this first stage of treatment this can be very frustrating, as the answer is not always communicated back directly and the AMA does not know what the status of the medevac request is. This makes it hard to start adequate preparation.

The current communication through radio about medevac often leaves AMAs in the dark about its status.

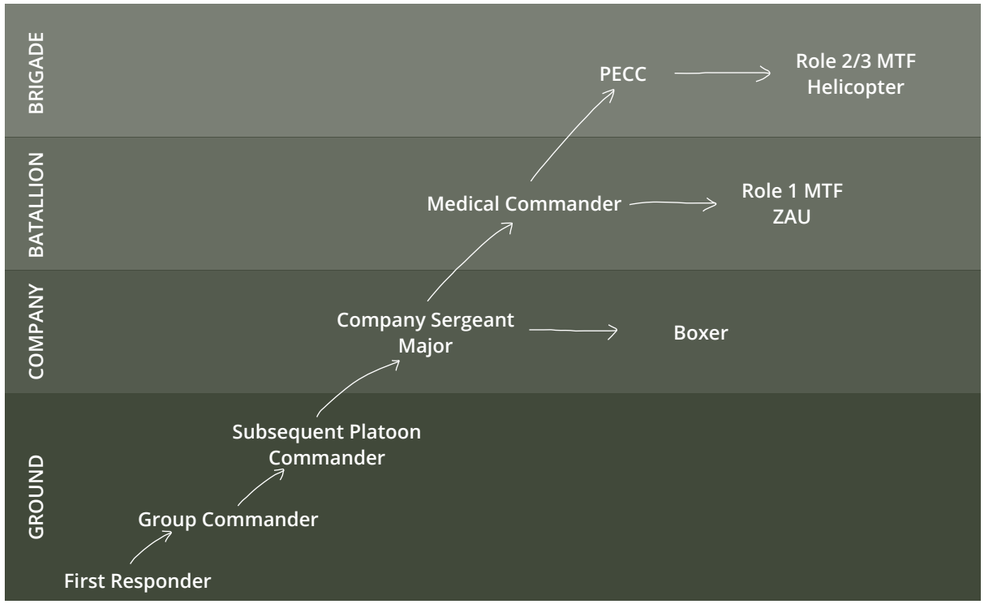


Figure 30: The different layers of communication in an operation

Next to this, the medical commander, who is the central intermediary between the MTF and the ground or the PECC, is not necessarily medically educated. This can cause loss of information, as the commander might not interpret the messages and their urgency correctly. Overall, this can have consequences for the MTF and the patient.

Time
As said earlier, time is a major factor when treating a patient. There is only a small time window to start and perform treatment due to the often bad state patients are in when they enter the MTF. Most decisions and actions need to happen as fast as possible; thus, everything that takes valuable time is interruptive. E.g. taking a patient out of the Boxer to assess him and having to put him back in because the injuries are not severe enough to keep him at the Role 1 MTF. Also, double administration takes valuable time, and thus manpower, which could be used to assist with treating a patient.

Communication media
Some of the current methods of communicating patient details are not easy to execute or to use. The Smart Tag is one method that causes frustration, as the layout is too detailed for noting down initial MIST data. Due to the circumstances in the field, data is often unreadable and scattered across the Smart Tag, instead of in the boxes that are dedicated for that information. An example of this was presented in figure 24. This results in the Smart Tag not being used in a Role 1 MTF, as time is of great importance and cannot be wasted on deciphering information. The whiteboard is another source of frustration as data is wiped from it when there is no space left for new values. The first measurements are not displayed anymore, which makes it difficult to identify a trend in the change of the patient's vital signs.

Data
An illegible Smart Tag can cause patient data to become unreliable and therefore unusable. If there is any uncertainty about the data that the Smart Tag provides, the data cannot be used. This is why the AMAs prefer oral handovers, as they have control over that action and can ask for clarification if necessary.

The AMAs value the feeling of being in control of the communication, as this makes sure that any uncertainties can be filtered out.

Then there is the reliability of patient data. The small amount of information that is provided through the radio can be misleading: It can make someone think in one direction, and in the end, it turns out the situation is completely different. Information from the radio is also not very reliable if several patients are announced: The chances are high that details about different patients are mixed up. This is why the information is listened to, but with reservation. An accurate assessment cannot be made without seeing the patient.

Information from the field can ever be fully trusted, as it is often incomplete or incorrect.

Treatment
As the small amount of information that is provided through the radio has to be listened to with reservation, it is hard to gain insight into the current status of a patient. The most important information a doctor can get is seeing the trend of the vital signs: is a patient doing better or worse than before? Also, in most cases, no medical history is provided, as soldiers do not always carry their Smart Tag around with their medical history.

Another difficult aspect of an AMAs role is that they always have to divide their attention. If there are only two patients, the AMA can rely on its team to ensure treatment is performed. However, in a MASCAL situation, a second tent can be set up, which means there are suddenly more patients to keep an eye on. To keep an overview, one of the CGNs or VIGs is given the task to keep an eye on these patients, which means manpower is lost. This can include the loss of a dedicated writer or radio communicator. For the AMA, it is stressful to have to choose between keeping an overview of all patients and treating a critical patient well.

Surrounding
Due to the nature of its deployment, a Role 1 MTF has a low amount of medical resources. This can make it frustrating not be able to help a patient: there is only so much that can be done with the available resources. Moreover, the available equipment does not always function as it should. This makes the trust in the implementation of technology in this setting very minimal.

Organisation
There is also noticeable friction between the organisational priority of the tactical aspects of an operation and the importance of the medical aspect. This is, for instance, noticeable in the communication: tactical information has priority, followed by medical information. If the radio lines are too busy, the medical facilities have to wait.

Then there is the lack of focus on the importance of certain communication methods. The Smart Tag is an example, as not many soldiers take a Smart Tag with them into the field. Their commanders should generate this awareness.

Training versus reality
Although the medical teams train a lot, not every aspect is practiced. For instance, the AMAs could not immediately recall the method to request for a restock of medical equipment from the next Role. Also, not all medical procedures are being trained, such as intubation. If the real situation requires this procedure, not all AMAs would feel confident performing it. Another crucial procedure that is never trained is 'jumping'. This means that the front line is moving towards the MTF and the whole facility has to move away from it in order to stay safe.

Taking all this into account, the AMAs do not know how they would react in a real situation, as they have never been in that situation before. Everything they do is training, so they do not know how their emotions would come into play. This could be a significant distraction from the communication of patient data, as their emotions would occupy their mind. This could lead to the AMA not thinking clearly and therefore not communicate clearly as a result

Even though training is done frequently, AMAs are unsure of their reaction to a MASCAL in real life.

Remaining categories
Lastly, two remaining categories did not fit within the eight identified themes.

Firstly, the AMAs found it frustrating that they do not have any insight into the situation that is going on in the Roles behind them. A medevac is requested, and patients are sent to the next Role, no questions asked. However, in a previous training it has happened that patients were evacuated to a higher Role while there was no capacity to receive patients. In that specific training five patients 'died' because of this decision. An AMA has the authority to keep a patient in the Role 1 MTF if there is the capacity to do so. Having insight into the situation behind could help make this decision in order to keep a patient alive.

The last category is patient flow. It is essential to have good patient flow, as there is only a certain amount of capacity. The AMAs noticed it is very stressful when patients keep coming to the Role 1 MTF, but no patients are leaving to higher Roles. A well-timed medevac is a crucial factor in making this happen.

3.3.3 Impact
In order to find focus for this project, the frustration categories were used to make an 'impact map' (figure 31). This map shows each of the frustration categories and their impact on other categories. An example is the arrow going from 'medical competences communicators' (bottom left) to 'communication layering': If the medical commander were to be medically educated, there would be an improvement in the communication layering, as there would be less 'noise' in the communication chain.
Each of the arrows represents impact, which means that the more arrows are facing away from a category, the more impact a change in this category will have on others.

In the end, six frustration categories were identified that can have a significant impact on the communication of patient details in the Role 1 MTF when improved: patient data control, ease of use of the communication media, insight into the situation behind, medevac status communication, communication layering, and organisational priority of the medical practice.

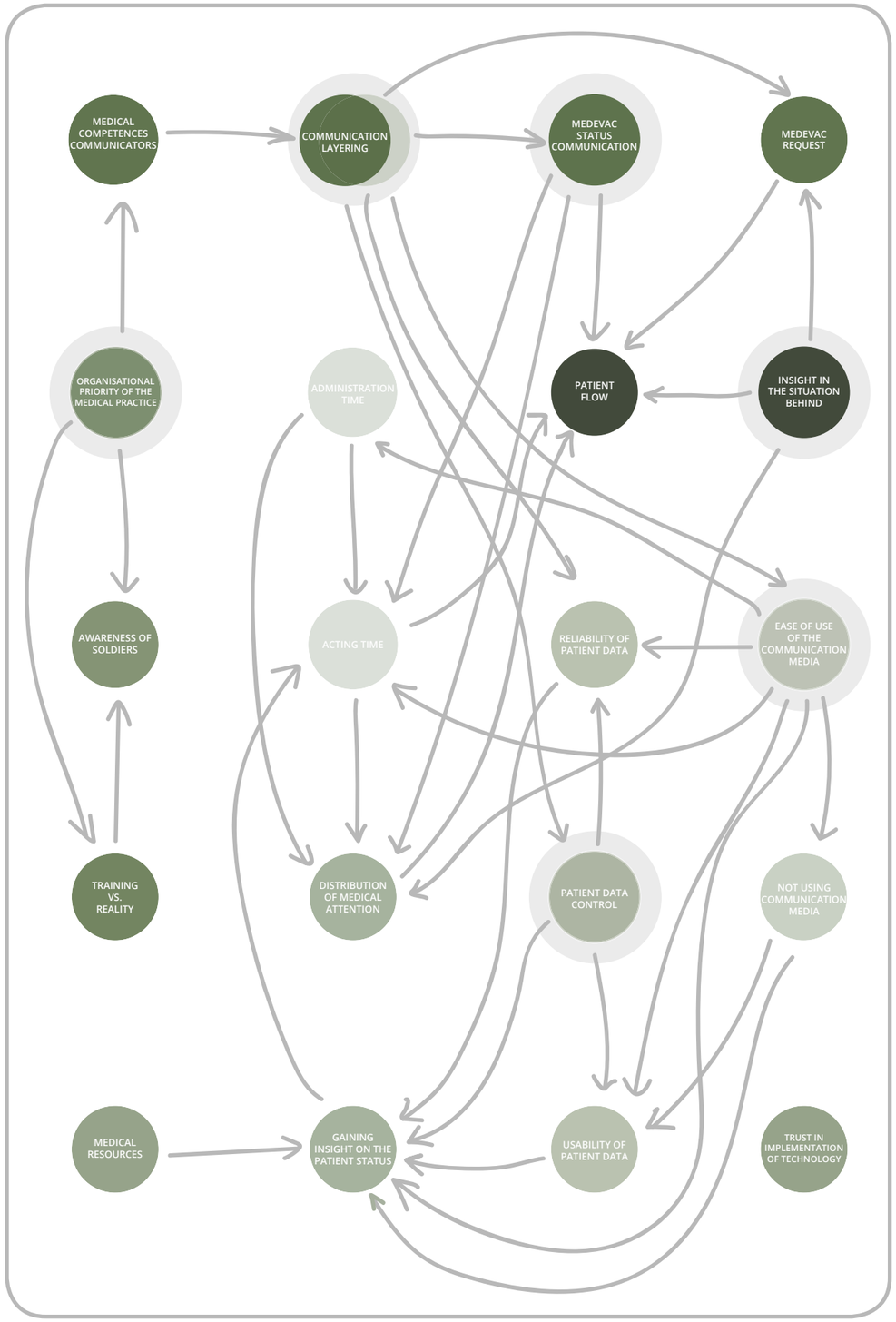


Figure 31: The impact map

3.3.4 Additional findings

Besides the workshop with AMAs, three other research activities were performed. The Military Healthcare Symposium was visited (figure 32) and observations were done at two different medical training opportunities. The first observation was done at the Medic Diamond, a training for Role 2B facilities. Although the facility itself is not very comparable to the Role 1 MTF, it did provide useful insights into the way of communicating patient details, as this aspect does not differ a lot between both situations. The second training that was visited was a medical training in Marnewaard, where Role 1 facilities from the Netherlands, Belgium, and Luxembourg were training in the civil setting. During all activities, new insights were gathered in addition to those acquired in the workshop.

The cohesion of information

As was already mentioned, information from the field is often limited. It is rarely the case that the MTF team is provided with a clear and complete MIST. Next to the game of 'Chinese whispers' through the radio, where information is lost, information is also lost at earlier stages due to first responders not being able to communicate with medical terminology as well as people with a more solid medical education.

Another form of loss of information is losing the physical data, such as the Smart Tag. During one of the observations, a Smart Tag fell on the ground. This was left unnoticed and had an impact later on, when the patient was being transported to the next Role.

All these 'errors' add up, which makes that there is no cohesion of patient details.

Cognitive overload

Another important observation was that it seemed as if there were times where too much information was provided at once. During these moments, several things happened.

Firstly, during the treatment of a patient, a new MIST was called out to the MTF personnel. This was done by the radio CGN, who asked for attention and just started shouting the MIST. This caused much distraction but was also essential for the MTF personnel to hear.

Then, everyone tried to listen and started to write on a piece of paper or their glove. It seemed as if they did this in order to make sure that they did not forget or lose this information.
Within ten minutes, five different MIST calls were announced, each time by yelling it through the tent. Some of them even concerned the same patient. During the fifth one, the AMA looked frustrated and yelled: *"Aaaah, hold on! I am not getting anything!"* It was too much information to process at once.

This course of actions made it very clear that a lot of patient details have to be remembered in an already stressful and busy situation.

Cognitive overload is caused by the many different sets of information that have to be processed in a short amount of time.

AMV

When talking to an AMV at the training in Marnewaard, it was mentioned that the role of the AMV should not be underestimated. When an AMA is occupied with a patient and cannot assist with the treatment of another patient or the handover of a new patient, the AMV has the responsibility to make decisions and act. This means that the AMV has to know just as much as the AMA in terms of patient details in order to act at all times. This is an important aspect to take into account for the development of this project, as it was assumed that the AMA was the single user that had to be kept in mind.

Although the AMA takes most decisions, AMVs are just as important for the communication of patient details.

Maintaining overview

What was also discussed with AMAs and AMVs, was the fact that it is hard to maintain an overview of all patients and their details. During training, a MASCAL was practised, and a Role 1 MTF had six patients to take care of. There was no time to set up another tent, and due to the cold weather, they decided to put four patients in their vehicles. However, it was hard to remember who was placed where and what medical information belonged to whom.

Information is not provided at the right time

An AMV mentioned that it is often the case that information is shared that is not yet relevant. An example of this is the MIST announcement from the field. If provided, the details cannot be used until the patients are in the MTF and, as mentioned before, the information is often not very reliable. Also, treatment is being performed on patients that are already in the MTF while the MIST announcements are made. This means that the medical team has their hands full and will often not do anything with the patient details they are provided with. However, they do have to remember them for the handover later on.

Observations provided additional and valuable insights into patient detail communication.

Figure 32: The Role 1 MTF at the Military Healthcare Symposium (own image)

3.3.5 Design directions

Taking into account the findings from all previously mentioned research activities and my personal interests, three main design directions were identified (figure 33). Each design direction could improve the communication of patient details in a Role 1 MTF if changes are made in that specific domain. However, it must be said that the directions are related to each other, as they shape the context as a whole. This section explains each of the design directions briefly

Improving the layering of communication
One of the most significant frustrations is the current layered structure where patient details need to be communicated to other entities within the medical chain. Having a layered radio structure causes several inconveniencies, which can have a substantial effect on the Role 1 MTF.

The first factor that has an impact is the noise that is created by the layering of the radio communication system. It causes the message to go back and forth between several parties. Even the slightest change to the message can have an impact on the treatment trajectory of a patient if, for instance, the urgency of the injuries does not come across. The AMAs from the workshop compared it to a game of 'Chinese whispers'.

The second factor is the delay the layering of communication causes. Due to the lack of a direct communication line, an MTF often has to wait a long time for a message to reach them, e.g. a confirmation whether or not a medevac is coming. This impacts the way the MTF personnel prioritises, prepares, and treats their patients.

Making sure that higher entities, such as the PECC, can directly contact a Role 1 MTF or can see what the factual situation in a Role 1 MTF is can help reduce the noise and time spent communicating drastically. Direct contact would provide the MTF personnel with more time to act, rather than losing time worrying when crucial information will come in

Make training more realistic
As was identified in the communication mapping workshop, AMAs have a hard time with envisioning how they would personally react in a real-life (MASCAL) situation. This is mostly because many of the current AMAs have not yet been deployed. Although the AMAs often have working experience in a civil setting, such as a hospital, the injuries that are most common in the battlefield are not often seen in these settings. In most cases, the injuries AMAs would encounter in the field are much more gruesome. Another fact is that the civil setting and the Role 1 MTF differ a lot in terms of resources. The Role 1 MTF is very primitive in comparison to an ER, for example, which results in limited options to treat and stabilise patients. In a Role 1 MTF AMAs will be faced with the need to think quickly on their feet in hectic situations, in order to find creative ways to make due with what they have available to them.

Besides the fact that the working environment is different from the the ones AMAs are familiar with, training is also not reflective of real-life situations. During both training moments, it was observed that the lotus victims sometimes have a hard time acting according to their injuries.

Figure 33: The three design directions that were identified

Also, in between acting, they have to provide their medical data by telling it. This does not help with reenacting the real situation.

During a visit to DiMiMed (the International Conference on Disaster and Military Medicine) in Düsseldorf, Thomas Gebhardt from the Bundeswehr University of Munich presented a serious game approach for TCCC. This training was developed in order to train medical personnel in the field, such as CGNs. By using virtual reality (VR) to train medical treatment on the battlefield, the personnel is already performing these medical actions in a more realistic setting. This can help to make the training feel more realistic.

For this design direction, things like mixed reality could be interesting to consider, as this can combine the real-life setting with real-life victims. This combination could provide the MTF personnel with a better sense of what the real situation would look like. Ultimately, this can help the personnel with anticipating on what to expect and being able to be more focused on the communication aspect.

Improving situational awareness
The final design direction I found interesting to include is the improvement of situational awareness (SA) for the AMA and AMV. Many of the identified frustrations and issues address not having insight into the full situation.

First and foremost, there is a considerable lack of information, such as patient details from the field, the current status of the patients in holding, and the status of medevac requests. This makes that AMAs and AMVs cannot anticipate as well as they want to. As a result, they may not take certain decisions as they are not informed thorougly enough. This can eventually result in a negative outcome for the patient. The fact that there is no direct control over this data is very frustrating for the AMA and AMVs.

Secondly, some communication media are a source of frustration due to the way they are designed, such as the Smart Tag. Often, the information cannot be used due to the data being illegible. Within the tent, communication media like the whiteboard are also not optimally designed, as there is not much space available for data. This sometimes results in erasing earlier measured values to make room for new data

Lastly, if the information is available, there is often a lot of it. All this data has to be processed in a short amount of time. Due to the lack of appropriate communication media, this can cause a cognitive overload for the AMA and AMVs, which can have a negative influence on the treatment process.

By providing patient details in an appropriate format and by providing more insights into the situation outside of the treatment tent, SA can be improved. This can have a positive influence on the state of mind of the AMA and AMVs, and therefore make the chance of adverse events for the patient smaller.

3.4 Current process mapping tools in the Army

As I have stated in the introduction, I wanted to provide the MinDef, and thus the Army, with a journey map of the current communication of patient details. The main reason for this is that I wanted to experience and learn to make a journey map, as journey maps are a widely used method to show what a user experiences and feels within a specific timeframe and during certain events. The second reason that made me decide to make a journey map was to show the MinDef what tools like these can do for their organisation. By using these types of tools within their organisation, different kinds of processes can be structured and made visual, which allows them to identify undesired aspects in their processes.

From the materials that were studied, the Army does not seem to excel in evaluating their processes. Many materials display and explain how a process should be executed; however, there are no materials to help and evaluate them. M. Goos, the consultant on medical information provision at the JIVC, explained that this indeed the case. He explained that most process evaluation is done through oral evaluation and reporting.
At the Defense Healthcare Education and Training Centre (DGOTC), it is common to frequently evaluate during training by discussing what went well and what needed improvement. Sometimes a short report is made, but this is not always the case.
At the JIVC, so-called 'kernteams' are composed to draw lessons from an exercise or a test. These lessons are then reported textually.

Knowing all this, it can be concluded that the MinDef could benefit from tools that help to structure and visualise their processes. Using them can help to identify process aspects that need improvement.

The Army does not have many process evaluation tools available.

3.5 Conclusions

This chapter provided insights on the communication of patient details. It became clear that is is crucial to know the specifics of the context when developing or selecting new communication systems for a healthcare setting. This will support the selection of appropriate elements of the communication system. Doing this will help to prevent miscommunication and the occurence of adverse clinical events as much as possible. It will also help to lower the stress on the involved individuals.

From research, it is also clear that the communication of patient details is not only of great value for the medical team within the MTF and for the patient. Other parties in the medical chain, such as the ZAU AMV, the medical commander, and the PECC, depend on patient details as well. The faster and more accurate these details are communicated, the quicker (and maybe even better) a patient can be treated.

By doing a workshop with AMAs, observing two medical training moments, and talking Role 1 MTF personnel at different events, current communication methods for patient details could be identified, such as radio, the Smart Tag, a whiteboard, and a patient file. The research activities also lead to insights into the frustrations that were pointed out by the AMAs and AMVs. All these insights were gathered and analysed, after which three main design directions could be identified: improving the layering of communication, making training more realistic, and improving situational awareness.

Lastly, it was found that the MinDef does not use appropriate tools for analysing processes such as the communication of patient details. It is therefore chosen to provide the MinDef with a journey map, as this design tool can show them the value of such tools for mapping their processes and identifying issues and opportunities.

Figure 34: An impression of the AMA workshop in Oirschot (own image) ▶

4.0

DESIGN BRIEF

The previous chapters have provided insights into the context and the issues and frustrations that come with communicating patient details within that context. This chapter describes the design brief, which includes the chosen design direction, additional literature, and the design goal for this project.

The final design direction is presented in Chapter 4.1, after which more theory about patient details is provided in Chapter 4.2. Then, additional literature is given in Chapter 4.3. The design goal for this project is stated in Chapter 4.4., after which a design vision is described in Chapter 4.5. The chapter ends with a brief conclusion.

4.1 Chosen design direction

Now that the first research phase is completed, a focus for this graduation project has to be chosen. Section 3.3.5 presented three design directions: improving the layering of communication, making training more realistic, and improving SA. The design direction that was chosen as the focus for this project is the improvement of SA within the Role 1 MTF. This focus was chosen for several reasons.

The first reason to go forward with this design direction is the fact that it immediately sparked my interest immediately. Sometimes I, myself, have some issues with external stimuli going on. I can not imagine how hard it must be when an AMA has to perform medical procedures under a tremendous amount of pressure, and at the same time has to be fully aware of all the information that is shared. The topic of SA thus intrigues me a lot.

Another reason is that this topic can be of added value to Offroad Apps' future development of the VitalsIQ project. This system is now specifically developed for the first responders in the field, but what happens with the gathered patient details further on in the chain? By focusing on SA in the Role 1 MTF, the insights gathered can be directly used to develop the system with this context in mind as well.

Lastly, I feel that this is the domain where the most profit can be gained in terms of patient treatment efficiency. Having a great training tool with mixed reality that can improve the readiness of the caregiver and having a more direct communication system along the chain can decrease the delays and noise in the system. However, it does not decrease the amount of information an AMA or AMV has to process. By tackling this aspect first, the stress of an AMA or AMV can be reduced, which helps with thinking more clearly, deciding more carefully, and treating more efficiently.

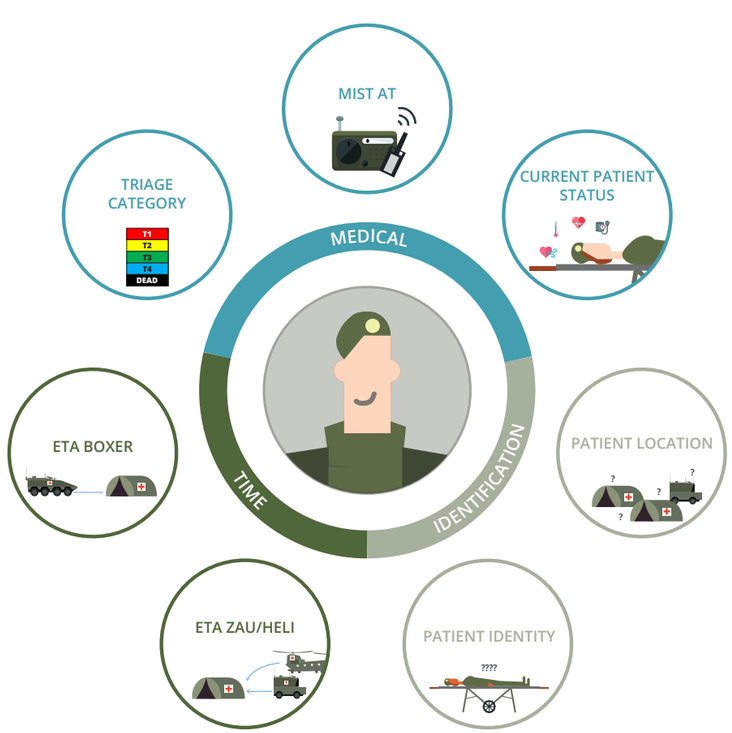


Figure 35: The different types of patient details

4.2 Understanding patient details

Now that the design direction is clear, it is of importance to understand the types of patient details that are important for the Role 1 MTF. Up until now, the different methods of conveying these details have been discussed. In order for the AMA and AMVs to provide efficient medical care to a patient, different types of information are needed. As can be seen in figure 35, this information can be split into three categories: medical, time, and identification. This chapter will briefly describe each category and the types of patient details it contains.

4.2.1 Medical-related details

The medical category includes patient details that tell the MTF team something about the medical state of the patients. Three types of details can be distinguished in this category: the triage category, the MIST AT, and the current patient status.

Triage category

The order of treating patients is based on the triage category that is assigned to them. A T1 patient is more critically injured than a T2 patient, which means that the T1 patient will be treated first. In some situations, it can be the case that the MTF has a patient that is a T4, which means he is so heavily injured that chances of survival are unlikely. In MASCAL situations, this person has a lower priority than a T1 patient, as the latter has a higher chance of survival. It can thus be said that the triage category helps AMAs and AMVs to decide which patients to treat next. However, this does not mean that the T4 patient is disregarded. He will receive palliative care in the meantime.

MIST AT

As was already discussed in Section 3.3.1, the MIST is a fixed format which provides a summary of a patient's status. This format is used on the radio and during patient handovers. This summary provides the MTF personnel with details on what caused the injuries and what treatment has already been provided. Treatment can be continued using this information.

Current patient status

The most important medical information that is needed to treat a patient effectively is the current status of the patient. Information about the status from 20 minutes ago can provide insight into the course of the symptoms, but if the symptoms occur right in this minute, they have to be dealt with immediately. The current patient status not only involves what can be seen from a patient, but also their primary vitals signs: temperature, blood pressure, heart rate, respiratory rate, and oxygen saturation.

4.2.2 Time-related details

The time category consists of two types of information that are crucial for maintaining a good patient flow in the MTF: the ETA of the wounded transport groups and the wounded removal groups.

ETA Boxer

Having a small team and only two treatment spots make it essential to use time efficiently. Knowing the estimated time of arrival (ETA) of the Boxer can help MTF personnel to prepare for the handover, without losing valuable time waiting. This ETA is currently provided in the format of a min1000 message, which means that the Boxer is 1 kilometre away and will arrive in a short time.

ETA ZAU/heli

The same goes for the ETA of the ZAU or helicopter. In order to prepare a patient for transport without having to wait, it is important to know the ETA of the ZAU or helicopter that picks up the patient. If the wounded removal group arrives later than expected, the medical team of the Role 1 has to wait and cannot treat the patient effectively in the meantime due to the patient being wrapped and strapped for transport.

Figure 36: A lotus patient at a training with a Smart Tag on her wrist (Van Rijt, 2018)

4.2.3 Identification-related details

The final category concerns patient identification. This can be seen in two ways: the identification of the patient and the patient's location.

Patient identity

A crucial part of treatment is knowing which patient is which. When treating a colleague, it is often known who it is, and additional medical records are sometimes known, such as allergies and age. These help to provide proper treatment. If this information is not available, and the patient is unknown, treatment is given in the hope it does not affect the patient negatively.

Patient location

In case of a MASCAL, the MTF has to provide care to a large number of patients in a short amount of time. Because there are only two beds available in the treatment tent, other patients have to be placed elsewhere. Ideally, they are placed in the holding tent, the holding. However, the situation could be that patients have to be placed outside or in vehicles, as there is no second holding tent availabe or due to the large number of patients. In that case, it is crucial to keep track of the patients' whereabouts: Which patient is placed where? It is also of great importance to keep the patient's details, such as measured vitals and treatments administered, with the correct patient at all times, as a mix-up of patients can result in adverse clinical events. An example of how patient details are currently recorded is the Smart Tag, which is put around the patient's wrist with an elastic band (figure 36).

4.3 Understanding situational awareness

As this project now focuses on SA, additional theory is needed in order to understand the term. This chapter will go more into depth on the topic of SA and how we can use today's knowledge of this topic to improve patient detail communication by increasing the SA in the Role 1 MTF.

4.3.1 The theory

The rapid development of information technologies in the past decades causes us to live in the so-called 'information age'. The amount of information being generated and continuously presented is enormous. Although this has its benefits, it most certainly has its disadvantages: Tons of data are being produced, which makes it hard to find the information that is needed. As Endsley, Bolte, and Jones (2003) state, *"It is becoming widely recognized that more data does not equal more information"*.

Situational awareness or SA is defined by Endsley (1988) as *"the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future"*. It means that you are aware of what goes on around you and that you understand what the information that is provided to you means to you right now and in the future. For SA, only those parts of the situation that are relevant for the current assignment are important. E.g., a doctor has to know all the symptoms of a patient in order to diagnose him; however, not every detail of the patient's full medical history is needed.

The three levels of situational awareness

SA is often used as the basis of decision making and performance, even though the different elements of SA can differ a lot between domains. The definition of SA can be broken down into three levels: the perception level, the comprehension level, and the projection level (Endsley et al., 2003). The full SA model is presented in figure 37, and the different levels are presented in figure 38 on the next page.

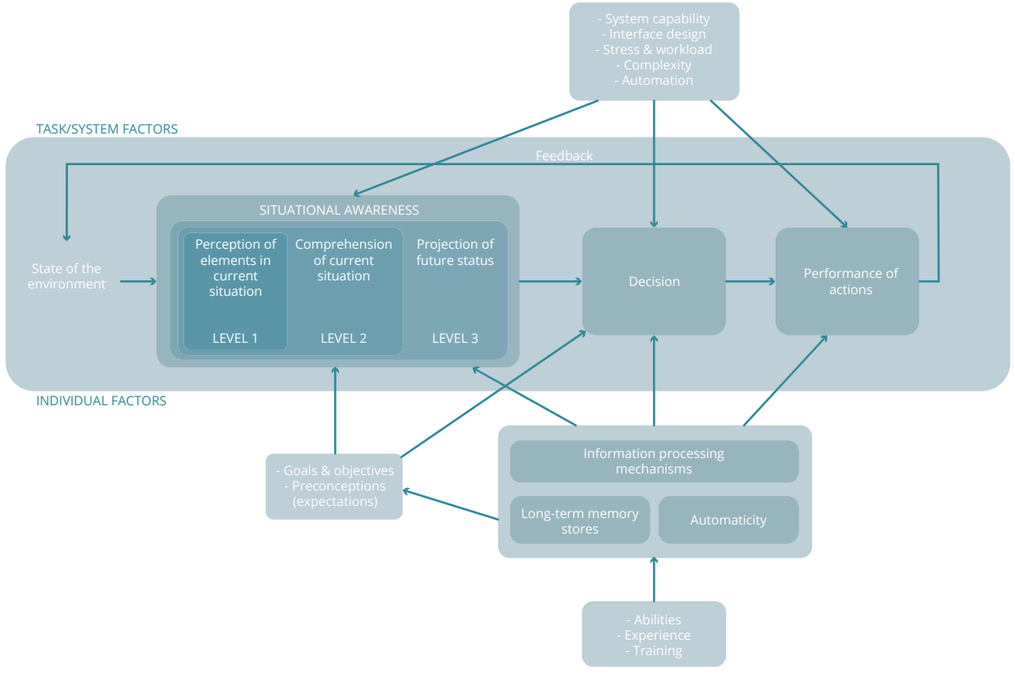


Figure 37: The model of situational awareness in dynamic decision making (based on Endsley, 1995)

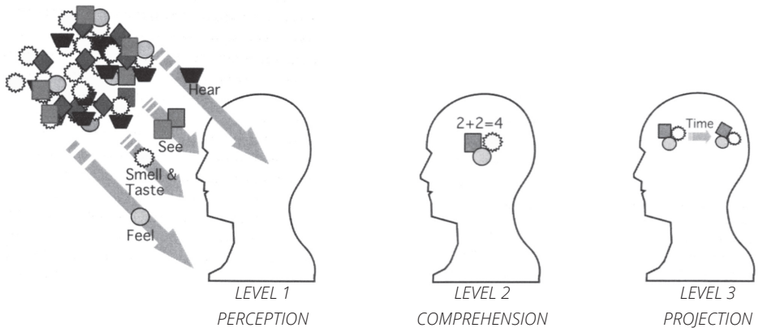


Figure 38: The different levels of situational awareness (Endsley et al., 2003)

Level 1: The perception layer is about perceiving information about relevant elements in the environment. These can be collected through different senses, such as visual, tactile, and auditory senses. Additionally, *"verbal and nonverbal communications with others form an additional information source that is drawn upon and contributes to Level 1 SA"* (Endsley et al., 2003). These different sources of information each have a different level of reliability.

Level 2: The comprehension layer is about understanding what the information that is perceived means in relation to relevant objectives and goals. Here, the individual synthesises the unconnected elements from the Level 1 SA and compares that information to his goal. Pieces of data are integrated to form information, which is then prioritised in terms of importance in relation to the goals.

Level 3: The projection layer is about being able to predict what the elements that are perceived and comprehended will do in the future. This level of SA can only be achieved when the individual has good Level 2 SA, and thus a good understanding of the situation and its dynamics. By continuously projecting the situation in the future, individuals can anticipate and be proactive, which can be mentally demanding of an individual. If not provided with the right mental resources, for instance, by being overloaded with irrelevant information, future projections may not be accurate.

Level 3 SA can only be reached when Level 1 and Level 2 SA are well developed.

Decision making and situational awareness

Each of the SA levels come with a level of uncertainty. These uncertainties come together in the decision making process: To what extend will the decision an individual makes produce the desired outcome? In order to make decisions, a certain level of confidence in the course of action is needed. Figure 39 shows the relationship between confidence and SA. If SA is good and there is high confidence in that particular SA, it is more likely that an individual will achieve a good outcome (Endsley & Jones, 1997; Christ, McKeever, & Huff, 1994).

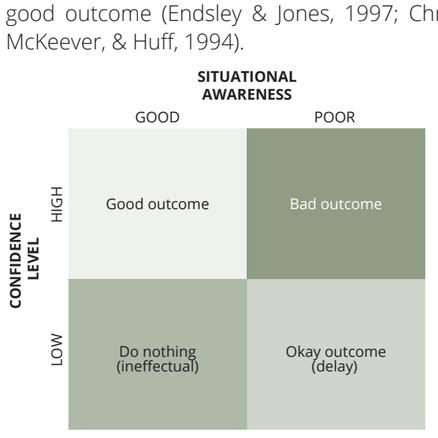


Figure 39: The relationship between confidence and SA (Bbd (based on Endsley & Jones, 1997)

However, if SA is equally good but the confidence of the individual in that SA is low, chances are high they will not act on it. This results in being ineffective. It is therefore essential to ensure that the individual can attribute confidence to that SA.

The confidence of an individual in their SA is an essential factor for the decision making process.

Team situational awareness

The Role 1 MTF team operates on an individual level, but on a team level as well. This makes so-called 'team SA' of importance. In order to understand team SA, we need to understand what a team is first. A team can be defined as *"a distinguishable set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal/ objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited life span of membership"* (Salas, Dickinson, Converse, & Tannenbaum, 1992). For teams to be successful, a high level of team SA is needed due to the interdependence between the goals and roles of each team member. The SA requirements of each team member, however, do show a degree of overlap (figure 40).

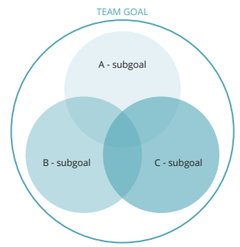


Figure 40: Looking at the goals and SA requirements of each team member, team SA can be defined (Endsley & Jones, 1997).

It must be said that team SA is not something the team as a whole can possess. Team SA can be defined as *"the degree to which every team member possesses the SA required for his or her responsibilities"* (Endsley, 1995). It is thus crucial that all members of the team have good individual SA in order for the team to perform well.

Optimal team SA can only be achieved if all team members have good individual SA.

Shared situational awareness

To ensure good team SA, 'shared SA' is of importance as well. Although the SA of individual team members should not be the same, as their objectives and goals are not the same, there is always a part of their individual SA that overlaps due to the team goal. Shared SA can thus be defined as *"the degree to which team members have the same SA on shared SA requirements"* (Endsley & Jones, 1997). This is shown in figure 40 as the overlapping parts between the circles. Without accurate shared SA, team operations will not be effective, which can result in poor team coordination and lacking individual SA.

The enemies of situational awareness

In the specific context of the Role 1 MTF, two major factors can influence SA.

The first factor that can limit SA are the challenging conditions that people operate in. Looking at the Role 1 MTF in the battlefield, stressors such as stress, anxiety, time pressure, and uncertainty can have a significant impact on the medical team´s SA. Next to these psychological stressors, physical stressors, such as high or low temperature and noise, can be of influence as well. Adverse effects of these stressors on SA can include the reduction of the working memory and the inefficient gathering of information (figure 41). This will make individuals more prone to errors.

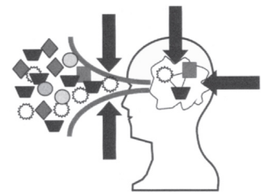


Figure 41: Stressors can cause inefficient gathering of information (Endsley et al., 2003)

The second factor that can limit SA is data overload. Rapid changes in data can create a need for information intake. The ability of the sensory and cognitive system of an individual is not able to keep up with that need, which results in the brain becoming a bottleneck (figure 42). There is only so much the human brain can process at a time. This data overload can be prevented by altering the rate at which information is presented and by providing it in the appropriate format. For example, graphics can be processed faster than streams of text.

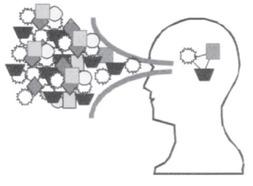


Figure 42: The brain becoming a bottleneck due to data overload (Endsley et al., 2003)

The conditions individuals work in and the rate at which data is provided can make or break good SA.

4.3.2 Improving communication of patient details

To increase the SA, and thus to improve the communication of patient details, several aspects must be taken into account during the design process. This paragraph discusses the three most crucial aspects.

Firstly, in order to obtain a sufficient Level 1 SA (perception), you have to ensure that the communication system obtains the necessary information and provides this in a way that enables the system user to process it quickly, while other information is competing for attention as well. Misplaced salience is an important factor here, as it can cause blockage of signals that are of higher priority. By assuring that there is no overuse of attention-drawing signals like lights, alarms, and buzzers, important information can stand out from other information streams without the chance of being ignored.
Secondly, time is a crucial factor for SA. As Endsley et al. (2003) describe, *"an often critical part of SA is understanding how much time is available until some event occurs or some action must be taken"*. It is thus of great importance to indicate specific information at the right time, in order for the individuals to know what to do or expect.
Lastly, it has to be taken into account that it is difficult to process different information simultaneously when it is presented in the same way, uses the same resources, or requires the same response mechanism (Endsley et al., 2003; Wickens, 1992). An individual has a limit on the number of elements he can pay attention to, which affects the amount of information he can process. This can form a bottleneck and thus has to be prevented.

4.3.3 Conclusions

To improve SA, a balance has to be found in providing the correct patient details at the right place, at the right time, and using the right way of presentation. It also has to be taken into account that the team has a shared main goal, but individuals within the team have their own goals and objectives as well. This means that not every individual within the team should should receive information the same way.

Figure 43: The whole team should have good SA in the MTF (Ministerie van Defensie, n.d.) ▶

4.4 Design goal

To provide a focus for the future vision that will be provided to the MinDef, a design goal was formulated. This design goal is the outcome of all previous research and encaptures what a possible future design should achieve. The formulated design goal is stated below (in blue). To understand what is meant with every element of this design goal, a short description is provided.

Increase situational awareness
By increasing SA I want to provide the AMAs and AMVs with more structure and clarity. This will help them to differentiate information and concentrate on important tasks.

AMA and AMVs
I chose to include both the AMA and the AMVs in this design goal, as the AMV is a crucial back-up when the AMA is available to perform tasks or make decisions.

A Role 1 MTF in the battlefield
At the beginning of this project, the decision was made to focus on the Role 1 MTF on the battlefield, as this situation is the one with the lowest number of resources available. If a design intervention can provide better SA in this context, it will likely help in higher resource settings as well.

A MASCAL situation
It is also chosen to specify the design goal for a MASCAL situation, as the flow of patients in this situation is highest. As mentioned above, if an intervention functions in a MASCAL situation, it will most likely also work with lower patient flow.

Improve the efficiency of care
The main goal of the improvement of patient detail communication is to make treatment more efficient. Efficiency can help to increase the chance of survival for patients. Therefore, in this context, efficiently means that care can be provided more quickly and with less uncertainty and distraction.

Ultimately, the design goal is about providing the AMA and AMVs with the right amount of information at the right place and at the right time. There is a fine balance between being provided with too little, enough, or too much information. The art is finding this fine line of 'enough' information.

"I want to increase situational awareness of the AMA and AMVs of a Role 1 MTF on the battle field in a MASCAL situation in order to improve the efficiency of care."

4.5 Design vision

As a tool for ideation, a design vision was formulated, which is shaped by an interaction vision. This interaction vision is dissected into two separate elements: design qualities and product qualities. These elements can help to provide solutions for the design goal.

4.5.1 Interaction vision

An interaction vision was constructed using the knowledge gathered during the research phase. This interaction vision consists of a metaphor, which can help understand a design problem by making a comparison with known situations. Casakin (2007) states that creative thinking can be enhanced by approaching a design project from another perspective. By using this interaction vision and breaking it into smaller interaction qualities and product qualities, it can be used as inspiration for creating different ideas with this same vision in mind.

While formulating the vision, two important components of the current experience of the AMAs and AMVs are acknowledged.

Firstly, every training that the Role 1 MTF team does is different. Moreover, every time that they are deployed will be different. Even though they train for years, and are familiar with the surroundings and the protocols, the situation will always provide a bit of uncertainty. The analogy thus takes this into account
Secondly, it was identified that having control over the provided data is of significant influence on the way information is processed. It also provides a better overview of the situation in the Role 1 MTF.

The interaction vision that was formulated can be seen in figure 44.

Figure 44: The interaction vision and an image that provides a representation of it (Mehegan, 2018)

"The interaction should feel like driving in your car, having to find your way to an address you vaguely know how to find, whith your navigation system helping you."

4.5.2 Interaction qualities

The interaction vision can be split into various elements. These elements, the interaction qualities, can form the basis for ideation, as they are desirable in the new situation. The interaction qualities that were identified are: supportive, intuitive, clear, and efficient. Below, each interaction quality is briefly described.

Supportive
Although you know the neighbourhood you have to travel to, you have no idea where the destination exactly is. Your navigation system provides you with the exact location and guides you to it, with both vocal and visual support. You can ignore the directions if you wish; however it will always be there to back you up.

Intuitive
Using the navigation system feels very natural and intuitive: You know what all the symbols and colours on the device mean. For example, you know that the blue line represents the best route towards your destination and that the time at the bottom indicates the time of arrival. Just by glancing at it every once in awhile, you know what to expect. The determined voice telling you to go left at the next intersection feels like a person sitting next to you and giving you directions. It feels familiar.

Clear
The navigation system provides all elements in an organised manner, which ensure that you instantly know where specific information can be found. There is just the right balance between having too much and too little information: The system only shows what is necessary and tells you what actions to take when needed.

Efficient
When driving to your destination, the navigation system provides you with the shortest route. When there is a lot of traffic, it will provide an alternative route in order to save time. This makes your trip more efficient and less hectic, as it will save you the trouble of a traffic jam.

4.5.3 Product qualities

Product qualities help to shape ideas and connect them to the interaction vision. In order to come up with ideas that convey the interaction qualities that were identified, the following product qualities were determined: familiar, structured, notable, adaptive.

Familiar
As the AMA and AMVs need to process a lot of data, it is of importance that a design intervention supports them in obtaining the correct information. This is done best if the information is provided in a format or with a means that is known to the user. Therefore, it should feel familiar, so that minor instruction is needed.

Structured
As some patient details are more important than others, design interventions should provide these in an organised way. This helps to distinguish more relevant information from less relevant information.

Noticeable
The design goal aims at lowering the cognitive overload; however, this does not mean that certain patient details should not be given at all. Moreover, they should be provided at the right time and in the right way. If the situation asks for it and details have to be communicated right away, a signal should be given to the user.

Adaptive
Because of the different degrees of importance of information, a design intervention should adapt to the situation. It should only provide details on the foreground when necessary. In all other cases, it should be provided in the background. This ensures that information that has high priority and relevancy stands out.

4.6 Conclusions

This chapter described the different elements of the design brief. The design direction that was selected for the continuation of this project, is to increase situational awareness (SA) in order to improve patient detail communication in the Role 1 MTF. Before formulating a design goal, additional knowledge about patient details and SA was gained.

There are seven types of patient details that can be distinguished, which can be divided into three categories: medical-related details, time-related details, and identification-related details. Each type of patient detail is of importance, as they support the AMA and AMVs to assess the situation. This enables anticipation and decision making.

Essential for keeping overview is SA. This is the specific act of being aware of the situation around you and understanding the impact of the information that is provided in this moment and in the future. SA consists of three levels, and with each level, a more complex and understanding SA is reached. In order to improve SA, the correct patient details should be provided at the right time, at the right place, using the right communication medium.

By combining the new knowledge with the knowledge gathered in the previous chapters, a design goal was formulated. The design goal focuses on the improvement of situational awareness for both the AMA and AMVs in the Role 1 MTF on the battlefield in a MASCAL situation. An interaction vision was created in order to support the ideation process.

Patient treatment

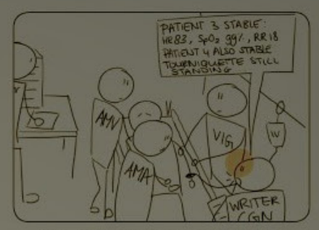
e placed in the the holding tent juries and current e.

The patients in the treatment tent each have a medical team (AMV + VIG) that treats them and the AMA switches between beds. First examination is performed.

The treatment of the patients is started and a request for medevac has to go out.

During treatment, each team uses team talk, where everyone repeats what is said in order to prevent mistakes from happening.

The radio CGN receives a MIST for 2 possible incoming patients and notifies this to the team by asking for attention and shouting the MISTs.



The team continues treating the patients. The writer sometimes notifies the AMA of the current status of the patients in the holding tent.

The AMA is called to the other bed for a consult on the treatment of that patient.

The radio CGN receives an update for the 2 possible incoming patients and notifies this to the team by asking for attention and shouting the updated MISTs.

Treat patients and prepare for new patients

d in the treatment tent

Are examined

Are treated and stabilised

ed in the holding tent

Are lying in the holding tent and being checked upon every couple of minutes

RADIO
Sends out a 9-LINER to ask for medevac for current T1 patients

RADIO
Receives MIST for 2 possible incoming patients

ORAL
Calls out MIST to the team

ART
ded chart
ient in the
nt tent

LISTEN
Listen to MIST

PAPER
Noting down the MIST

LISTEN
Continuously listens to measurements being called out by the primary medical team

WOUNDED CHART
Writes down all measured vitals and other details of both patients that are currently being treated when needed

WHITEBOARD

5.0

CURRENT AMA COMMUNICATION JOURNEY

As was explained in Chapter 3.4, it was decided to make a journey map. Now that the design goal is clear, the journey map was made with a focus on the experience of an AMA regarding the communication of patient details, SA, and cognitive load. The journey map has four functions: to learn the skill of journey mapping, to provide an overview of the research, to function as a starting point for ideation, and to provide an example of a process mapping and evaluation tool for the MinDef.

Chapter 5.1 will provide a detailed description of each part of the journey map and explains how to read it. Then, Chapter 5.2 describes what value this method can have for the MinDef. This chapter ends with a brief conclusion on the journey map.

5.1 Explanation

To provide an overview of the insights that were gathered during the research phase and to show the impact of cognitive overload on the AMA, a journey map was made (figure 45). This chapter will provide a detailed explanation of each element of the journey map, in order from top to bottom. The journey map is included as annex I on a larger scale. Annex II is a legend that explains the icons on the journey map.

As most of the participants that participated in the research for this project were AMAs, the dicision was made to focus the journey map on the experience of the AMA. The information gathered from AMVs was not elaborate enough to provide similar depth.

The focus was also put on cognitive overload, as this is the underlying cause of many of the AMA's frustrations, as seen in observations and identified in Section 4.3.1 as being overloaded with data. Moreover, cognitive overload is an important factor that contributes to poor SA.

It must also be mentioned that, during observations and interviews, I have come across different ways of operating by the MTF personnel. There are many ways to perform specific actions, and every team has their own preferences. An example is that the AMAs from the context mapping session do their handover in or nenxt to the Boxer, while I observed the team from the training in Marnewaard do the handover within the MTF. There is not one specific way of working, which makes it complicated to understand and explain the context fully. In order to convey the situation as well as possible, I have therefore chosen to describe only one way of operating for every part of the journey. However, it has to be kept in mind that other ways of operating are possible.

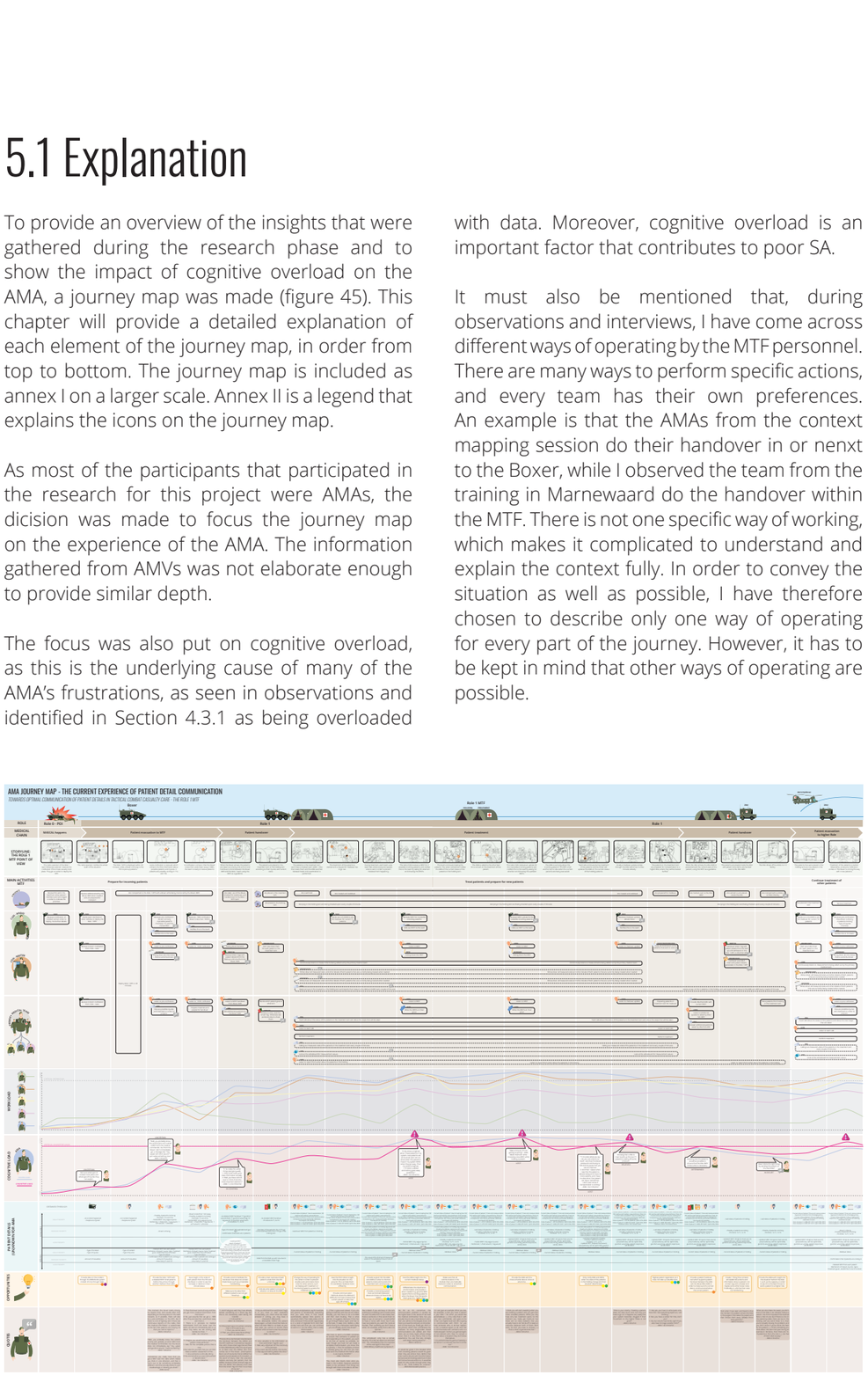


Figure 45: The AMA journey map on small scale

5.1.1 The story

The first layer of the journey map explains the story of the Role 1 MTF. As was mentioned in Chapter 4.4, the project focuses on a Role 1 MTF on the battlefield in a MASCAL situation. The journey map therefore describes this situation. It is told by using short texts and simple drawings to envision the situation (figure 46).

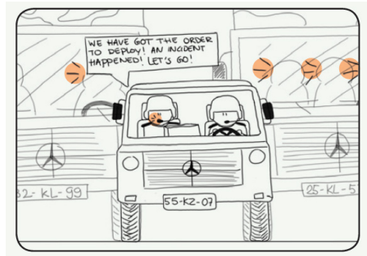


Figure 46: An example of a drawing used to tell the story

The story begins with the MTF team situated in their vehicles while a MASCAL is announced. The first patients are announced as well, and the MTF has to be set up. Four patients arrive at the MTF, of which two with triage category T1 and two with category T2. The T1 patients are placed in the treatment tent, and the T2s are placed in the holding tent.

During the treatment and monitoring of the four patients, two new patients are announced while there is no confirmation for the medevac of the current patients yet. Eventually, the first T1 patients are picked up by a ZAU and the patients from holding are treated, while the new patients are on their way.

The story captures several aspects of a MASCAL situation, such as the overflow of patients (in a 'normal' situation a Role 1 MTF would never receive four patients at a time) and the lack of clear information upfront about what kind of incident took place. It also includes different scenarios that were described by the AMAs in Oirschot as stressful, such as the status of medevac being unknown while new patients are coming in.

5.1.2 Patient care

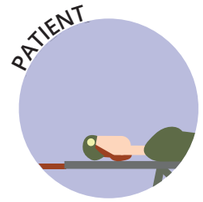


Figure 47: The patient logo used to indicate patient care actions

The next row in the journey map describes the actions that are taken to provide the patients with care. It shows what care a patient receives, when they are transported, and where they are placed. This information was added, as the topic of this thesis is about patient detail communication, which includes the whereabouts and treatment of patients.

5.1.3 Communication activities

Next, the communication activities of the MTF personnel are provided. For this section the MTF personnel was split into three entities: the radio CGN, the writer CGN, and the primary medical team. This was done to demonstrate how patient detail communication impacts these individual roles.

The radio CGN is responsible for all radio communication from and to the MTF. When important information is provided, he has to communicate this to the rest of the MTF team. This is a crucial role in the communication of patient details.

The details that are announced by the radio CGN have to be noted down. This is the main task for the writer CGN. The writer makes sure all details are noted and available for the team and the next Role. This is also done for patient details that are generated within the MTF, such as vital sign measurements and treatments performed. The writer is also responsible for the administration of all patients that go through the MTF.

The last communication activities that are described are those of the primary medical team (figure 48). This team consists of the AMA, AMVs, and VIGs. As was identified, the AMA and AMVs have to be aware of the patient details in particular. It can be seen on the journey map that the communication activities of this group sometimes consist of eight different actions.

Figure 48: An example of the communication activities of the primary medical team

5.1.4 Workload

To provide insight into the workload distribution within the team, a workload graph was added to the journey map.

The green line, which represents the workload of the radio CGN, immediately stands out. As the radio CGN is responsible for all incoming messages, his attention is on the radio at all times. This means that he cannot take on many other tasks. In the graph, peak moments can be identified when relevant radio communication is in process.

The workload graph of the VIG (pink) is relatively low in comparison to the writer, AMV, and AMA. This is due to the VIG not having the authority to make decisions or to perform procedures on their own. The AMV's workload is thus a bit higher, as he must take these decisions and perform the procedures together with the VIG.

As the writer has a very hectic job, he is placed relatively high on the workload graph (orange). The different types of details that have to be administrated, sometimes at the same time, can make the writer experience a critical workload.

The person at the top of the workload graph is the AMA (blue). As the AMA is responsible for the entire MTF and needs to have an overview of everything that is happening, the workload is very high.

It has to be mentioned that this graph is based on estimation, as there was no opportunity to talk with every team member during the research phase. The estimation was made by comparing the different tasks in terms of frequency and importance, and by taking the information learned from the research into account.

5.1.5 Cognitive load AMA

The next layer of the journey map provides insight into the cognitive load of the AMA. Again, it has to be said that the cognitive load graph is an estimation which is based on the information gathered previously.

The cognitive load is given in one graph together with the workload, in order to see if a relationship exists between them. It can be seen that these two factors are likely to be related, which means that if the workload is high, the cognitive load is high as well.

The second aspect that is highlighted is the fact that cognitive overload exists. When an overload is reached, the AMA has a hard time to take in, comprehend, and project information. However, these steps are necessary to obtain good SA. Cognitive overload mostly happens when too much data is provided at the same time (also called data overload, figure 49), relevant information is missing, or no control is given on the way of communication.

This aim is to lower this cognitive load to increase SA for the AMA. The same goes for the AMVs, even though their cognitive load will differ a bit from that of the AMA.

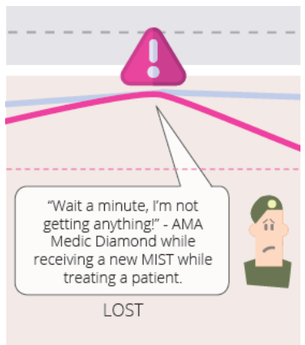


Figure 49: A moment of cognitive overload caused by data overload

5.1.6 Patient details

The layer following the AMA´s cognitive load describes the patient details that are familiar and unfamiliar to the AMA. This was done to provide insight into the different types of patient details that occupy the AMA. The patient details are ranked according to their priority, as the patient details vary in importance. At the top, the communication methods by which these details are obtained are displayed.

It can be seen that the volume of patient details is higher when patients are situated in the MTF. The reason for this is that there are more channels of communication to provide the details, as opposed to the limited radio communication upfront. This results in a significant lack of information before patients arrive at the MTF, which causes uncertainty for the medical team.

Lastly, missing information can be a cause of cognitive overload, as not having enough information can result in worrying and stress. These are two stressors that have a negative effect on SA.

5.1.7 Opportunities

Taking into account the formulated design goal and the findings of the research phase, different opportunities (figure 50) have been identified to serve as inspiration for the ideation phase. The second to last layer describes these opportunities.

The coloured dots at some of the opportunities have a meaning, which will be explained in Section 6.4.3.

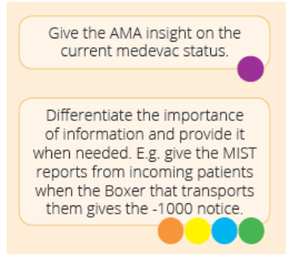


Figure 50: An example of two opportunities that were identified

5.1.8 Quotes

The final layer of the journey map contains relevant quotes from the different research activities (figure 51). These provide more insight on specific parts of the journey map, such as patient details that are missing or communication activities of specific team members within the MTF.

"Time is your enemy. Treating a patient does not take much time, but they just have to go on. It happens very easily that your system becomes clogged if their movement to the higher Roles is not good."
- AMA 3 Oirschot

Figure 51: An example of a quote provided in the final layer of the journey map

5.2 A tool for the Ministry of Defence

A goal for this project was to provide the MinDef with an example of a tool that can be used to map different processes and evaluate them. In order for the MinDef to see the value of the tool, I had to make sure it was structured and intuitive to read. Otherwise, the map will not be seen as a contribution, and the chances of using such a tool are low.
The journey map has a layered structure in order to lay out the context in a structured manner and to make the map easy to read and understand. With each layer, depth was added. By reading the journey layer by layer, people are gradually learning more about the context. If desired, they can go into full detail on specific parts by reading the quotes that are provided.

5.3 Conclusions

This chapter focused on the explanation of the AMA journey map. The journey map was made for several reasons: to learn the skill of journey mapping, to provide an overview of the research, to function as a starting point for ideation, and to provide an example of a process mapping and evaluation tool for the MinDef. The map focuses on the cognitive load of the AMA, which is often experienced as negative and is a crucial factor for the development of good SA.

By layering the journey map, varying degrees of depth are provided. From top to bottom, the map elaborates on the story, the people involved, the workload these people endure, and the cognitive load the AMA experiences. Then, known and unknown patient details are displayed, and identified design opportunities are provided, which will be used as a starting point for ideation. The final layer shows quotes from different research activities.

The different layers make the map structured and intuitive to read. This will increase the likeliness of the MinDef to be interested in a mapping and evaluation tool like this.

Figure 52: The journey map in progress ▶

6.0

IDEATION

The design goal stated in Chapter 4 provided a focus for ideation. By using the knowledge and insights that were gathered, different approaches were used to create solutions. The design ideas that result from this phase will be used to gather insights for the future design vision. This chapter explains these approaches and how they contributed to this phase.

Chapter 6.1 explains the current technology trends and developments that exist on the market, but also within the Defence organisation itself. In Chapter 6.2, the contribution of a creative session with students is elaborated on, after which Chapter 6.3 explains the learnings from a comparison with a similar context in the civil setting. Chapter 6.4 describes the final ideation session, after which the results of this phase are presented, and a conclusion is provided.

6.1 Current technology trends and developments

The current rate at which technology advances is very high. It is fuelled by the continuous exponential growth of computing power and progression in augmented intelligence. As the MinDef already envisions, technology will play a significant role in future military operations. Technology can also be used for the intent of this project by providing tools to help improve SA for personnel in the Role 1 MTF. Section 6.1.1 provides an overview of upcoming technologies that might be of interest for this subject, while Section 6.1.2 elaborates on innovation projects conducted and supported by the MinDef. The information was gathered by doing desk research, visiting the MEDICA fair in Düsseldorf (the largest medical fair in Europe), and by talking to innovation experts from the Army.

6.1.1 Relevant technology

By doing desk research into today's and tomorrow's technologies, an inventory of relevant technologies was made. A selection of the most interesting and relevant technologies is discussed below.

Computing Everywhere

A technology that can be of considerable value is Computing Everywhere. This technology entails computing being available at any time and any place. It is also flexible in the way that it can be used on any device in any format. Computing Everywhere has vast potential when supported by military mobile networks, as it could provide real-time decision support to soldiers. This technology can also be implemented in the military healthcare chain, in order to support medical personnel with decision making and by connecting different entities through the network. (NATO, 2018)

Predictive Analytics

Another interesting technology is Predictive Analytics. This technology can generate understanding of data and provide insights for the prediction of future states (NATO, 2018). It can thus help to improve Level 2 and 3 SA. By providing future designs for the Role 1 MTF with a technology that can do Predictive Analytics, decision support and early indicators for possible adverse events can be provided.

Mixed Reality

Mixed Reality is another technology that could have a positive influence on the future military healthcare system. By merging the real world with a virtual world, for instance through Augmented Reality, new environments can be created. In these environments, digital and physical objects coexist and can interact in real-time (NATO, 2018). An example of an innovation that uses this technology is the IVAS Soldier Touchpoint II (figure 53) from the US Army and Microsoft. Products like this can be of value to the medical team of the MTF, as it can increase SA and prevents the need to take their eyes off of a patient.

Sensor technology

For technologies such as Predictive Analysis and Mixed Reality, data input is needed to be able to provide it. This data can be collected by using sensor technology. Like many technologies, sensor technology is rapidly developing and can range from high tech to low tech and from being active to passive (NATO, 2018). By using sensor technology, caregivers in the military medical chain can shift their attention from measuring to treating. Sensors could be integrated into the soldier's equipment, for example, by providing soldiers in the field with health monitoring sensors. Many variants of these sensors were seen at the MEDICA fair, and predictions are that they will be used in soldier systems reasonably soon.

Wearables

Collecting and providing data can also be done through the use of wearables. Data about vital signs can easily be obtained by placing wearables with sensors on patients. However, it can also be useful to provide soldiers with wearables before going onto the battlefield. Examples of wearables that might be suitable are chest bands, patches, earpieces, and clothes. Additionally, wearables can be used to provide caretakers with patient details. Wearables that might be useful for this purpose are smartwatches, smart glasses, and smart belts.

Figure 53: The IVAS Soldier Touchpoint II (Bacon, 2020)

Artificial Intelligence
The last technology that could be of value is Artificial Intelligence (AI). AI can use generated data for analysis and decision making. Machines that use AI are capable of learning new heuristics and can enhance themselves. This technology could provide military medical personnel with decision support, as it can calculate the chances of specific adverse events by comparing previously obtained data.

Data gathering, data provision, and decision support are areas that need innovation. The discussed technologies can be of great use and could support the Role 1 MTF in many different ways.

6.1.2 Defence innovation

The MinDef is investing a lot in innovation. About 20 percent of the total budget is spent on innovations to help defend the country, support civil services, and to fight hostile parties (Ministerie van Defensie, 2018). Next to following technological trends and developments, the MinDef also innovates on itself. This is done by internal innovation teams, but also by working on innovation projects together with the industry. Appropriately, the slogan of the innovation strategy of the MinDef is 'Innovate faster together'.

National Technology Projects
The Defence Industry Strategy (DIS) describes the required knowledge areas and industrial capacities for Defence applications. As the Defence organisation cannot do all innovation on its own, companies can submit a proposal for a National Technology Project (NTP). NTPs stimulate the development of prototypes and demonstration of defence specific applications (Tweede Kamer der Staten-Generaal, 2019).

An example of an NTP in the healthcare domain is the VitalsIQ project from Offroad Apps that was mentioned in Chapter 1.2. This project shows how technology trends and developments are used to innovate for the technology needs in the Army's medical chain.

Using a system of wearable sensors and mobile devices, VitalsIQ can provide a first responder with real-time information about a patient's vital signs (figure 54) and can assist with patient triage and administration. This support is valuable, as time is of the essence in these situations, and the VitalsIQ application provides for quick monitoring and administration. The first responder can also connect several patients to a single device.

Besides the sensors and mobile devices, a Digital Smart Tag (DST) is part of the system. All generated data is stored on this device, which replaces the paper Smart Tag. For now, the intention is that every soldier will be equipped with a DST, which stores his or her details (such as name, age, and allergies), in advance. In case a casualty takes place, the first responder (and medical professionals further on in the chain) can access this information with their mobile device. The DST remains with the wounded soldier at all times in order to provide each medical professional with access to this data.

Currently, wearables that are used to provide data for the system are a pulse oximeter and an in-ear sensor. These wearables provide a good overview of the patient's vitals. In the future, Offroad Apps envisions the system to work with different configurations of sensors, as this creates flexibility for different scenarios.

Internal innovation projects
The Army's organisation contains many different innovation departments, which differ in size and specialise in a specific technology domain. One of these domains is focused on telecommunication. Telecommunication is about communicating at a distance, and this technology could be of value for the medical chain, as the current communication possibilities are limited.

To get a grasp of what is and will be possible in terms of telecommunication in the (near) future, I met with two innovation managers from the TEN/FOXTROT programme. This programme focuses on the replacement of all communication media in the tactical edge in the next 10 to 15 years. The goal of this meeting was to gain insight on the future of data communication over a longer distance, as this could help to provide the Role 1 MTF with patient details that are currently not provided and might be of value.

Currently, radio communication is the method that is used most in the tactical edge. The radio system is constructed like a rake; each person has only two channels to which the radio can

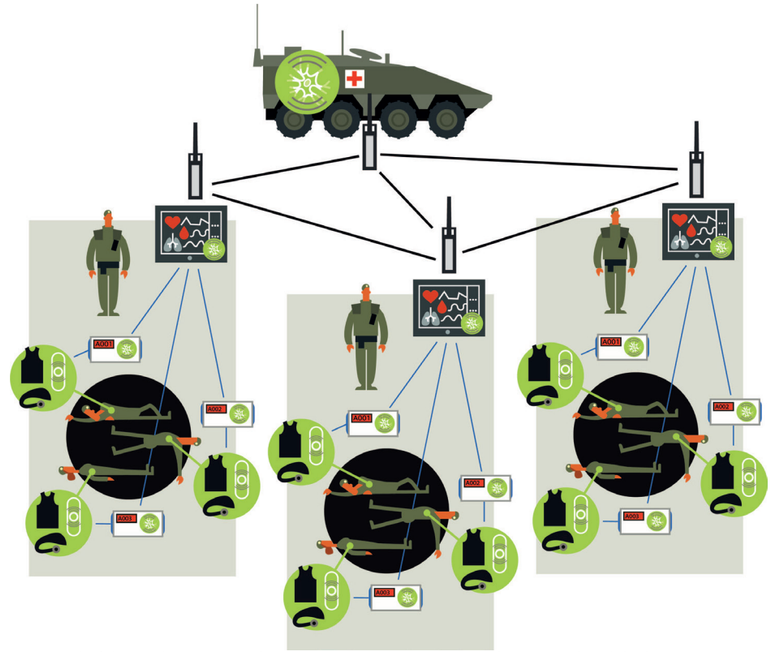


Figure 54: A visual of the VitalsIQ project, showing how sensors connect to the DST and mobile devices to provide medical professionals with an overview of the patients and their vital measurements (Offroad Apps BV, 2019a)

connect to a maximum of two channels, which makes that messages have to travel through different people in order to arrive at their destination. This makes direct contact from the battlefield to the PECC, for instance, impossible. The TEN/FOXTROT programme is aimed at building a 'flat radio' system, where all entities can communicate directly. This can reduce communication delays drastically. However, oral communication can still cause noise and unclarity between two individuals.

During the meeting, we brainstormed about ways to send data (vitals, images, etc.) from the POI or Boxer to the Role 1 MTF. We concluded that it would be difficult to send real-time data over a longer distance, as there is no continuous connection on the field. However, it would be possible to send small amounts of data (e.g. vitals) every couple of seconds instead of multiple times per second. This would be similar to the current way of Blue Force Tracking (the tracking of friendly troops), where GPS coordinates are sent forward every couple of seconds. The problem, however, is the communication method, as a radio or a smartphone from the VitalsIQ project is not suitable for sending data forward due to security reasons.

A possibility to enable sending data forward is the use of the current ELIAS system, which is integrated into all Army vehicles. ELIAS stands for Essential Landbased Information Application and Services, and is capable of sending data in addition to voice messages. This system is also highly secured by using encryption. Currently, sending data with ELIAS is not preferable as it has to be typed into the system manually. This takes valuable time. A solution would be to use a third system to function as a bridge between the data collection device (e.g. a smartphone from VitalsIQ) and the device through which it is sent forward (ELIAS). A system that could fulfil that function is the VOSS, as introduced in Section 2.1.5. The VOSS will be implemented in the near future and contains a separate radio system, VOSS radio, which can communicate digital data with ELIAS. In its turn, ELIAS can send patient data forward every couple of seconds, and make it available to the Role 1 MTF, for example.

Sending data forward to the Role 1 MTF is possible if the data collection system is integrated in the VOSS. VOSS radio can provide the data to ELIAS, which then sends it forward.

6.2 Creative session

To keep a broad perspective in the ideation phase, a creative session was organised (figure 55). In a two-hour session, facilitated by a creative facilitation student, a group of design students focused on the following question: *How to clearly and quickly provide an AMA with patient information?*

After a quick group introduction and icebreaker activity linked to communication, an introduction about the context was provided in the format of a presentation and an immersion soundclip. After this, the students worked on a mind map where they wrote all perceived issues and thoughts that came to mind. The content of the mind map was used as input for creating How To's (Heijne & Van der Meer, 2019; Tassoul, 2009). These How To's were clustered to find overarching themes, which were then also formulated as How To's. Together, the students chose five How To's that they found inspiring and sparked ideas. These were then ideated upon, using Brainwriting as method (Heijne & Van der Meer, 2019; Tassoul, 2009). After this, all ideas were clustered spontaneously. Three clusters were then chosen and for each cluster a concept was created. At the end of the session, each concept was pitched.

The outcome of this session consists of a large number of ideas and interesting clusters. Examples of clusters that were identified are: 'sound with meaning', 'wearables to gather & display', and 'visualisation'. The individual ideas and clusters were used as inspiration for the final idea generation session, which will be elaborated upon in Chapter 6.4. All unredacted results of the creative session can be found in appendix I.

Figure 55: An impression of the creative session (own image) ▶

6.3 Comparing: the civil setting

Looking at the context, the Role 1 MTF functions in the same way an ER in a hospital does. A patient is brought in by an ambulance (similar to the Boxer) and is stabilised in the ER (similar to the Role 1 MTF function). After stabilisation, the patient is then sent to a more specialised unit where further diagnostics and surgery can be performed when needed (similar to the Role 2 or 3).

I was interested to see if there were more similarities between the military and civil context, and if I could learn anything from the way hospitals deal with the communication of patient details. I spoke to Nelleke Zeeman, an ER nurse at the Amsterdam UMC, location VU medical centre (VUmc).

The emergency room
The ER at the VUmc has 26 small treatment rooms and four so-called shock rooms (figure 56). Shock rooms are adapted for handling severe trauma patients. When severe trauma patients come in, an on-call team is paged to come and assist. This team can consist of surgeons, anesthesiologists, doctors, ER nurses, co-assistants, etc. Who has to show up is dependent on the severity of the trauma that comes in.

Similarities
As said earlier, the two contexts have a similar patient flow. Talking to Nelleke, I found out they also have similar ways of communicating patient details.

All patient detail communication between different teams has a format that is similar to the MIST: the SBAR. This SBAR describes the Situation, Background, Assessment, and Recommendations. Although it is a different format, it does contain almost the same information as a MIST, which is a bit more concise. The SBAR format ensures that essential information is conveyed quickly and clear. This is done through oral communication.

Just like the Role 1 MTF, the ER sometimes deals with a lack of information about a patient. The 'Meldkamer', an external control room for emergencies, provides all information they have received about the incident. Paramedics from the ambulance can provide additional information about the patient's vitals. However, it can still be the case that no information about the cause of the injuries or the patient's identity is known.

◀ *Figure 56: A shock room at the VUmc showing a patient monitor above the door and the administration monitor to the left of the door (Zeeman, 2019b)*

The patient handover is done in the shock room. When the whole team is ready, the paramedics hand over the patient by stating the SBAR. One ER team member notes this information down on a whiteboard, which is centrally placed in the room. This is to make sure that this information is available for everyone until the patient monitors are connected and an electronic patient file is available. This is similar to receiving the handover MIST and noting it down on the whiteboard in the MTF.

In the shock room, one person is in charge, or as we say: the medical commander. This can either be the surgeon, if surgical knowledge is required, or the anesthesiologist in most other cases.

Inspiration
The two contexts also show differences, most of which exist due to the high availability of technology in the civil setting. Despite these differences, it can be of inspiration for the military context.

The first difference is the fact that ambulances can have direct contact with the ER. They can provide updates on the patient's status and let the ER know their ETA. The ETA is of great importance, as the medical team has to be prepared in time to receive the patient. On the other hand, there is no time to wait for the ambulance and do nothing, as there are many other patients to treat. It is thus great that the ETA is known, almost to the minute.
Knowing the Boxer ETA could help the Role 1 MTF team to anticipate better on the incoming patients. This prevents them from spending time waiting instead of treating (other) patients.

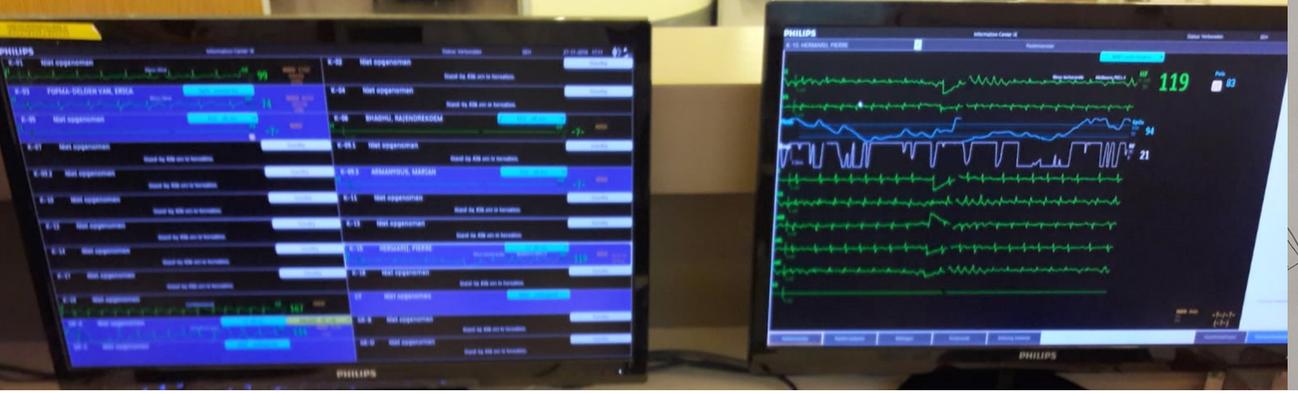


Figure 57: Patient monitoring screens at the main desk of the ER, with on the left an overview of all patients and on the right the vital signs of one patient (Zeeman, 2019a)

The second difference is that an electronic patients file (EPD) is opened as quickly as possible after the patient is handed over by the paramedics. If a patient's citizen service number (BSN) is known, they try to find an existing EPD. If it is unknown, or not available, a new EPD is made. During the treatment in the shock room, and in the stages after, all patient details are put in this EPD. In the shock room, all medical personnel has the authority to write in this file on an administration monitor. Often, the person who has time to do this takes on this task.
Having an EPD in the MTF could reduce administration time drastically. This would provide the writer with more time to help with patients. It can also reduce writing errors and illegibility, as writing by hand is not necessary anymore.

When an EPD is made in the ER, patient monitors can 'talk' to it: You can view and store all monitored vitals. The vitals can be viewed either in hard values or in graphs. These graphs can be displayed from every individual minute to whole days.
For the MTF, it can be of great value if measured vitals are stored automatically. Again, this reduces administration time drastically and can give valuable insights into the patients' status from the moment they were connected to a monitoring system.

To link a patient to their file in the ER, a wristband is used, which can also be placed elsewhere if needed. This wristband contains a QR code, a barcode, the patient number, the name, and date of birth. It ensures that the right EPD is opened whenever it is needed.
This method could also be used in an MTF to ensure the correct data comes up with the right patient. Currently, the Smart Tag is sometimes misplaced, which accounts for frustrating and dangerous situations.

The ER also makes use of three applications of screens to keep an overview of a patient's vital signs.
The shock room has two screens: one patient monitor, which is placed at the bed, and a copy of that screen placed on the other side of the room, as could be seen in figure 56. This way, every person in the room has an overview of the patient's vitals. When needed, a big door between two shock rooms can be opened. This way, personnel can also keep an eye on the vitals of a second patient by looking on that patient's screen.
In the hallway, just outside the shock rooms, two big screens provide an overview of all patients in the different shock rooms.
Also, the main desk of the ER has two screens that provide an overview of all regular rooms (figure 57). If patients are connected to a monitor, their vitals are displayed on the left screen. The second screen can provide a more detailed look into the vitals from one specific patient.
The Role 1 MTF could benefit from using a screen by displaying an overview of all patients at the MTF. With one look, AMAs and AMVs could be provided with the information they need.

In the end, the most apparent difference between the ER and the Role 1 MTF is that the communication of patient details in the ER is mostly done digitally. A similarity can be found in case of a power outage; if this occurs, the ER has to go back to basic and use paper.
For future design, it must be taken into account that the Role 1 MTF could lose its power source. This asks for a backup plan, which will most likely consist of pen and paper.

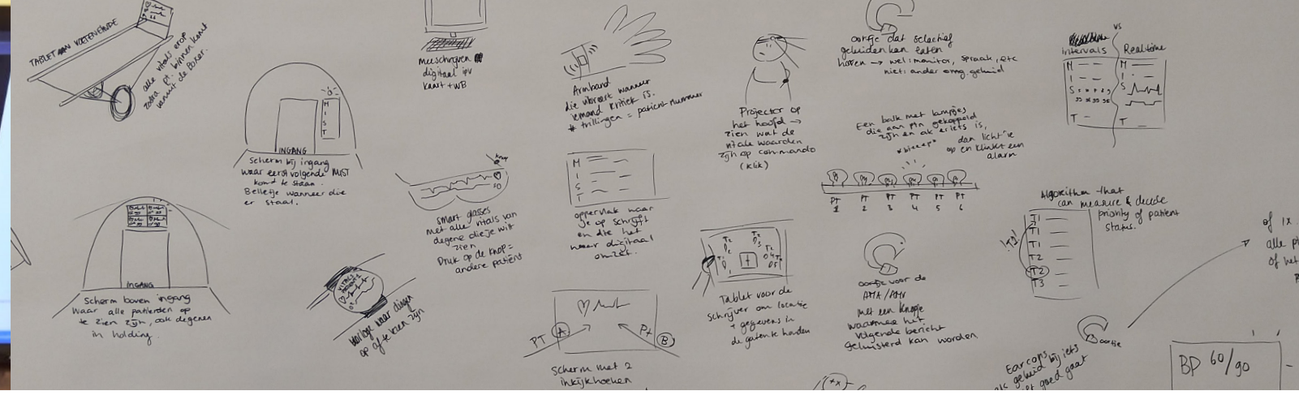


Figure 58: An impression of the idea generation (own image)

6.4 Idea generation

After doing explorative activities to get a broader view of the solution space, it was time to generate ideas by myself. This ideation step was intended to find solutions to the design goal formulated in Chapter 4.4. In this chapter, the process of this design activity and the outcome is discussed briefly.

Research question
As a design goal has been formulated, opportunities that allow for the improvement of SA have been identified, and design inspiration is gathered through different activities, it is now time to put all findings into design ideas.

The idea generation is aimed to provide solutions for the following question:

What design solutions can be provided to increase the situational awareness of the AMA and AMVs in order to prevent cognitive overload from happening?

Methodology
The idea generation was performed in three consecutive phases: diverging, synthesising, and converging.

In the diverging phase, different techniques, such as How To's and Brainwriting (Heijne & Van der Meer, 2019; Tassoul, 2009), were used to create as many ideas as possible that fulfil the design goal (figure 58). These ideas were not yet evaluated on their feasibility to obtain a broad spectrum of ideas. The ideas generated in this phase go from very logical and conservative, to out of the box and futuristic.

The synthesis phase was all about filtering ideas on their credibility. This was done by using the knowledge that was gathered during the first phase of the project, e.g. by talking to the target group.
In the last phase, the converging phase, the ideas that were left were iterated upon and combined to create different design ideas that fulfiled the design goal.

An impression of the idea generation can be found in appendix J.

Storyboards
The converging phase of the idea generation resulted in five different design ideas. Each of these ideas pinpoints (a) different problem(s) within the domain of SA and will help to gather insights for the future vision of the Role 1 MTF. The five ideas are presented on the next pages in the form of storyboards, together with a description of the problem they tackle and the intended goal of the design.

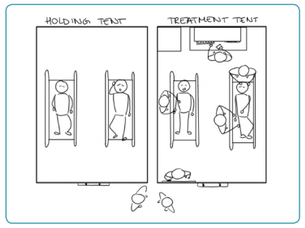
As the ideas are based on opportunities identified in the journey map, the journey map also displays what opportunities each idea was based on. The colours of the dots at the opportunities on the map correspond with the colours of the ideas on the following pages.

1. EAR PEACE

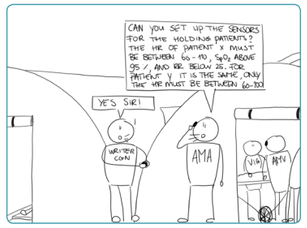
THE PROBLEM IS...
The AMA and AMVs don't know the current status of holding patients at all times. A team member runs back and forth, providing oral information on the patients' statuses, which is hard to remember.

THE GOAL IS TO...
Make the AMA and AMVs aware of the status of the patients in holding and provide this information in a non-intrusive way.

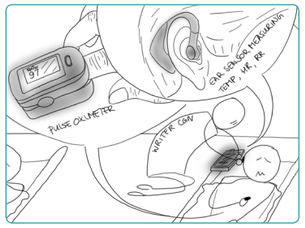
THE STORYLINE



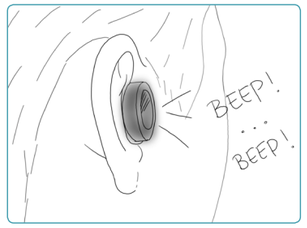
4 patients were brought in: 2x T1, 2x T2. The T2s are placed in the holding tent, the T1s in the treatment tent.



The AMA knows the T2 statuses from handover and what to keep an eye on. He asks the writer to set up the HOOR system and states the value ranges for all vitals.



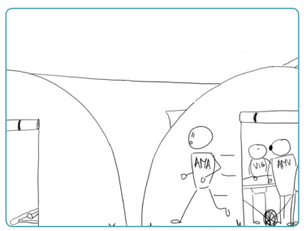
While the AMA is in the treatment tent, the writer sets up the HOOR system by applying sensors to the patients, connect them to the system, and state the range values in the monitoring tablet.



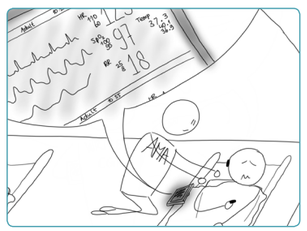
The AMA and AMVs are all wearing an ear piece from the HOOR system: it will notify them every minute that the patients in holding are doing well by sounding a firm but friendly beep for each patient.

While the patients are waiting in holding, the writer comes and checks on them every few minutes.

If the vitals of a patient in holding change beyond the set boundaries, an alarming sound is played, together with the patient trigram, which was added by the writer at setup.



The AMA or one of the AMVs can quickly respond and can go to the patient to see what is going on with the patient.



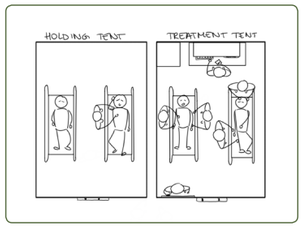
The monitoring tablet will show the course of the vitals of the patient to support further decision making and treatment.

2. AL.ARM

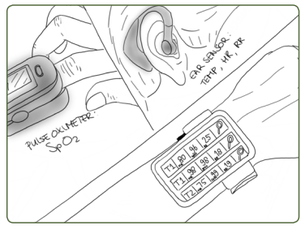
THE PROBLEM IS...
That it is hard for the AMA and AMVs to keep an overview of all the current patients at the MTF.

THE GOAL IS TO...
Provide an overview of all patients, together with visual support for the memory.

THE STORYLINE

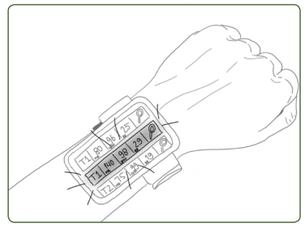


4 patients were brought in: 2x T1, 2x T2. The T2s are placed in the holding tent, the T1s in the treatment tent.

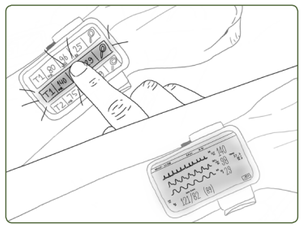


The AMA and AMVs all have an arm monitor that displays the vitals of all connected patients.

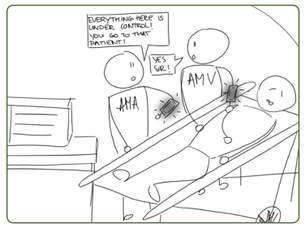
If a patient enters a critical state, this is notified by the monitor by heavy vibrations.



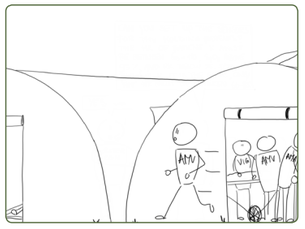
The vitals bar of the patient in question will start blinking to indicate which patient is critical.



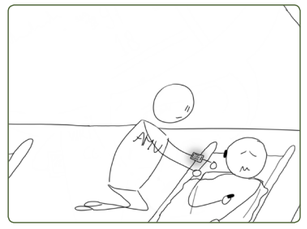
To see more detailed vitals, the AMA or AMV can click on the bar. A screen with more detailed vital signs will be displayed



Based on this information, the AMA and AMV can quickly decide if someone has to go an check on the patient.



In this case, the AMV will run over to the holding tent where the patient is placed.



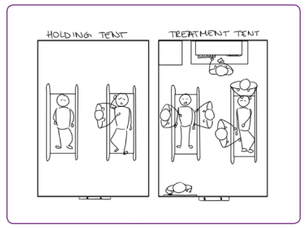
Here, an assessment can be done, after which can be decided what to to.

3. TRACKEVAC

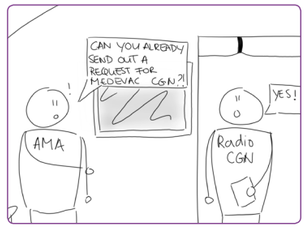
THE PROBLEM IS...
That the unknown status of medevac causes a lot of stress for the AMA and AMVs. This is even worse if more patients are announced while the MTF is already full.

THE GOAL IS TO...
Provide insight in the medevac status in order to reduce the stress of having too many unstable patients.

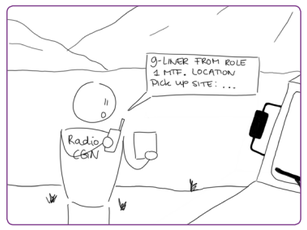
THE STORYLINE



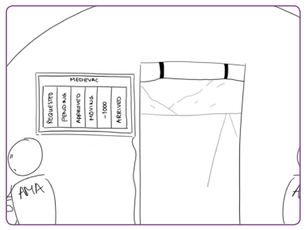
4 patients were brought in: 2x T1, 2x T2. The T2s are placed in the holding tent, the T1s in the treatment tent.



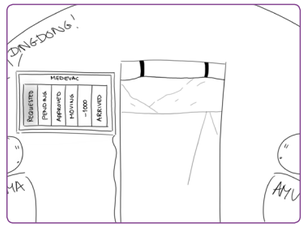
The AMA gives the order to request medevac for the T1 patients.



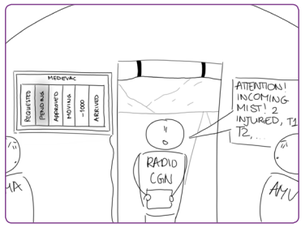
The Radio CGN sends out a 9-LINER to request for medevac.



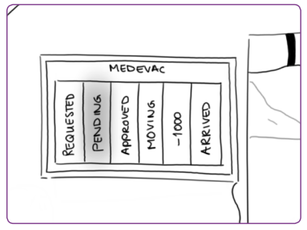
A screen is placed in the treatment tent, and is connected to the BMS system in the truck. This screen shows the different stages for medevac.



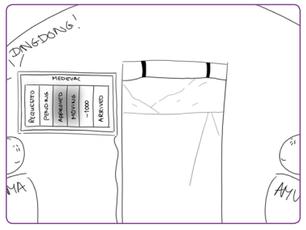
When the 9-LINER is send to the medical commander, this is immediately visible for the AMA and AMVs in the treatment tent. Additionally, a sound marks the next medevac stage.



In the meanwhile, 2 new patients are announced. The AMA and AMVs become nervous: the tent is already full and the medevac status is still at 'PENDING'.



If the status is not changing in the next three minutes, the Radio CGN will contact the medical commander again to ask what is taking so long. They need medevac ASAP.



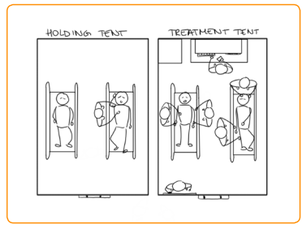
Luckily, the medevac status changes to 'APPROVED'and the screen indicates that they are already on their way.

4. CIRCLE

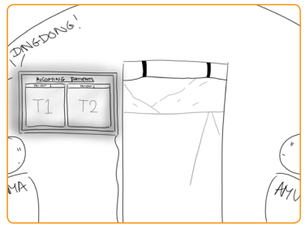
THE PROBLEM IS...
That a lot of information is provided continuously, but not all information is of importance at all times.

THE GOAL IS TO...
Provide information when it becomes relevant in order to focus on the treatment of the most critical patients in the MTF.

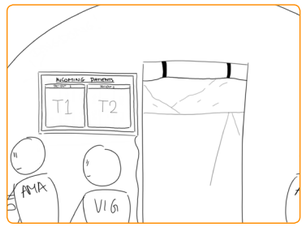
THE STORYLINE



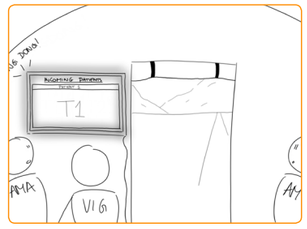
4 patients were brought in: 2x T1, 2x T2. The T2s are placed in the holding tent, the T1s in the treatment tent.



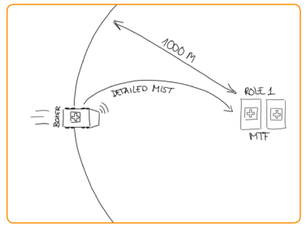
A notification for 2 possible incoming patients is made. A large touch screen is placed in the tent, which receives this information through BMS. When a notification comes in, a sound plays and only the priority is stated.



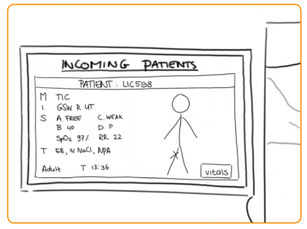
The MTF personnel keeps on treating their current patients. They are less distracted, because they don't have to keep track of the (incorrect) MIST details of the incoming patients.



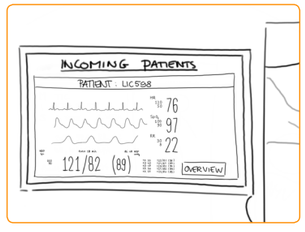
The information about incoming patients is only updated when the number of patients or their priority changes. This is indicated with sound. Here, the number of patients reduces to 1.



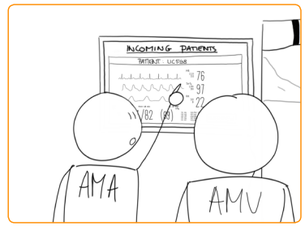
When the Boxer is close to the MTF (~1000), it enters a communication bubble: the detailed MIST is send forward to the MTF.



In the treatment tent, the detailed MIST for all incoming patients is shown on the touch screen. An alarm indicates that the Boxer is almost there.



If necessary, the progress of the vital values over time can be consulted for more in-depth information.



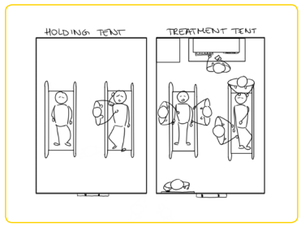
Using this system, the AMA and AMVs can quickly prepare for the handover by discussing the MISTs. This makes that they are well prepared and know what to expect.

5. AWAREGLASS

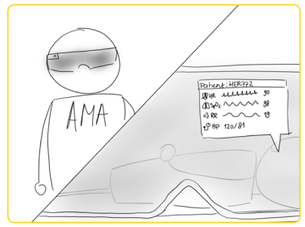
THE PROBLEM IS...
There is a lack of visual support of all different patient details. For the only visual support that is provided (Smart Tag, whiteboard, patient file) you have to take your eyes of the patient.

THE GOAL IS TO...
Provide visual support for the AMA and AMVs without them having to look away from their patient. Next to that, the AMA and AMVs are given the choice to show or withhold certain information.

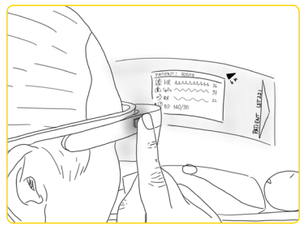
THE STORYLINE



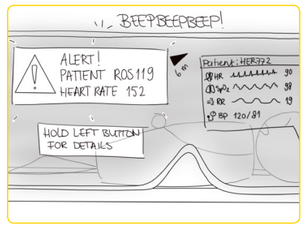
4 patients were brought in: 2x T1, 2x T2. The T2s are placed in the holding tent, the T1s in the treatment tent.



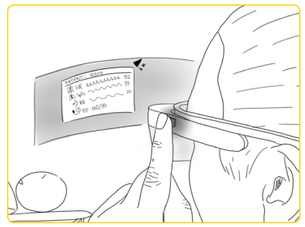
Each AMA and AMV wears smart glasses, which provide them with the vitals of the patient they are looking at.



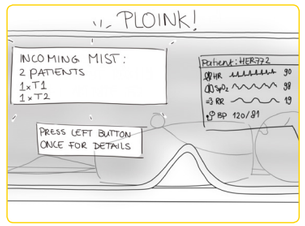
The AMA and AMVs can also 'toggle' between the patients' statusses by pressing the right side button on the glasses. Aditionally, an arrow shows where that specific patient is located relative to the AMA/AMV.



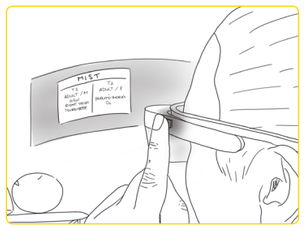
If a patient becomes critical, and its vitals drop or increase beyond set boundaries, a pop up is shown and a sound plays to indicate this to the AMA and AMVs.



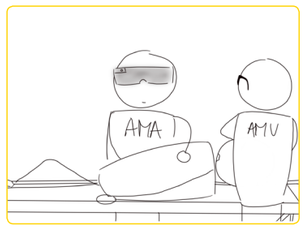
By doing what the pop up asks (hold left button) it will show the current patient status. It will also show a guiding arrow in order to direct the AMA and AMVs to the correct patient (in this case, to the right).



The glasses can also provide the AMA or AMV with the decision to show or withhold information, such as the incoming MISTs. If a new MIST arrives, a pop up shows and a sound plays.



By pressing the left button once, the AMA or AMV can now see the known details of the MIST that came in.



The glasses provide the AMA and AMVs with enough visual support to keep their mind on treating patients, and not on reminding all patient details that are provided continuously.

6.5 Conclusions

This chapter explained the ideation phase of this project and the different activities that were performed. Each of the activities contributed to the ideation, as they broadened the solution space.

When looking into current technology trends and developments, it became apparent that many different technologies could be of value when designing for the improvement of SA in the Role 1 MTF. Technologies such as Predictive Analytics and wearables can contribute to this by supporting data gathering, providing data, and making predictions for decision support. This helps to provide the correct patient details at the right time, at the right place, through the right communication medium, and thus improves SA.

While technologies are developing, the MinDef is innovating as well. The organisation has a large number of innovation departments, which focus on different domains. However, the MinDef does not have enough knowledge within the organisation to innovate in all areas. To overcome this problem, the MinDef devised NTPs. NTPs allow the industry to innovate together with the MinDef and stimulate the development of prototypes and demonstration of defence specific applications. In the end, examples from both types of Defence innovation provided elements that could be used in the idea generation.

A creative session with design students was held to keep a broad perspective and generate as many ideas as possible. By performing different activities, they produced a large number of ideas and inspiring clusters.

In addition to the creative session, a comparison with the ER was made to obtain inspiration. It became apparent that the ER and Role 1 MTF do not differ a lot in terms of function. However, the high availability of technology in the ER makes that the communication of patient details is done more effectively. Screens and digital patient files allow for better SA, and patient details can be displayed in any part of the hospital after leaving the ER.

In the idea generation session that was held, all previously gathered knowledge was taken into account. This resulted in a large number of ideas which were then selected, combined, and resulted in five design ideas, that were explained in storyboards.

In the end, the five design ideas will help to evaluate if the problems identified in the research phase are accurate, and if the designs provide solutions for the current situation. This will be helpful when creating the future vision for the communication of patient details in the Role 1 MTF.

7.0

IDEA EVALUATION

After creating five storyboards to explain the design ideas that resulted from the ideation phase, it was time to evaluate them with context experts. The knowledge gathered during this evaluation will be used to form a future vision for the communication of patient details in the Role 1 MTF.

Chapter 7.1 explains the goals of the idea evaluation, after which the activities and participants of the evaluation session are described in Chapter 7.2. Chapter 7.3 provides an overview of the insights that resulted from the evaluation and is followed by Chapter 7.4, which concludes the main learnings from this evaluation.

7.1 Goal

To evaluate the five design ideas that were introduced in Chapter 6.4, an evaluation session was held at the Korporaal Van Oudheusdenkazerne in Hilversum (figure 59). The session served three purposes.

The first goal was to confirm the findings from the research phase. Even though these findings were gathered by talking and interacting with AMAs and other people related to the context, there was still a chance that the interpretations were incorrect. During the session, different findings were discussed when evaluating the design ideas. It was likely that the participants would mention any discrepancies or misinterpretations.

The second goal of this evaluation was to evaluate the desirability and credibility of the design ideas. The insights that were gathered during the session will not be used for concept development in this project, but help to develop and fine-tune a future vision for the MinDef.

The last goal was to obtain insights on the experts' views on the future of the Role 1 MTF. As the participants were very familiar with the context, they could provide their view on and opinion about the future situation and the role that the MinDef could play in it.

Figure 59: An impression of the evaluation session with medical instructors from the DGOTC (Pijl, 2020a)

7.2 The session

After formulating the goals for the evaluation, the session had to be prepared. This chapter will explain how the session was built up and who participated in it. The full session plan can be found in appendix K.

Preparation

Due to the limited amount of time that was available for the evaluation, quick and effective session activities had to be prepared to ensure that enough insights could be obtained. The activities consisted of a short introduction of the graduation project and the design goal, an explanation of the design ideas, a prioritising activity, and a plenary discussion.

As this session would be used for the evaluation of the desirability and credibility of the design ideas, it was chosen not to use interactive artefacts, as the context is not directly accessible and valuable time would be put into simulating the environment. This would take away from the time for evaluation. Therefore, to gain insights on the impact of the concepts in the context, a form of interactive introspection was used to evaluate the concepts (Xue & Desmet, 2019). When providing the participants with an explanation, they are asked to imagine how it would affect the way of working. When preparing the session, it became evident that the storyboards were too elaborate to use for the explanation of the design ideas. It was decided to modify them and make them shorter to spare time explaining. The modified versions of the storyboards can be found in appendix L.

To obtain quick insights on the opinions of the individual participants on the design ideas, a prioritising activity was prepared. In this activity, participants are asked to rate the five ideas based on priority: Which idea do they want to implement tomorrow? And which idea has the least added value? The activity allows for individual reflection on the ideas and can facilitate the plenary discussion, as differences and similarities can easily be identified on a large piece of paper (figure 60).

For the discussion, a semi-structured format and open-ended questions were prepared (Wilson, 2014). This was done to ensure that all predefined questions could be answered, but also to provide flexibility for the discussion.

Participants

The evaluation session was held at one of the training facilities of the DGOTC, where the participants had their weekly meeting. In total, nine people participated in the session and provided their own opinions and insights based on their knowledge. The participants were medical instructors from the DGOTC, who educate and train medical personnel and have experience with deployment. Even though they might not have operated in a Role 1 MTF in the field, because this has not happened in the past decade, they have plenty of real-life and training experience. This made them representative of the user group as a whole.

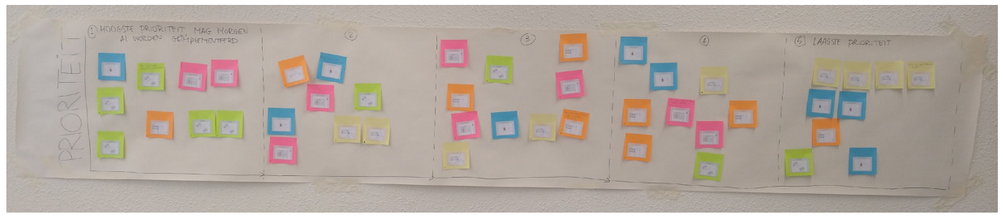


Figure 60: The results of the prioritsing activity (own image)

7.3 Insights

Overall, the evaluation session was very productive. Appendix M provides the unredacted results, consisting of the prioritising results, notes that were taken while discussing, and transcriptions of the relevant parts of the discussion at the end of the session. Different insights were obtained during this discussion by letting the participants explain why they prioritised the ideas in a specific way. Additionally, being able to see the differences in prioritisation on the wall encouraged an engaging conversation.

To distinguish the insights obtained by discussing specific ideas and by general discussion, the following two sections describe them separately.

7.3.1 Idea-related insights

The evaluation and discussion of the five design ideas lead to different insights. Most of them provide requirements for a future patient detail communication system. Figure 61 presents the insights that were gathered and the specific ideas that led to them. Below, the overarching insights gathered from the ideas are formulated:

- Having a large-scale overview of all patients at the MTF can provide the whole medical team with clear insight on the current situation and makes sure that it can be obtained at one glance.
- If personal communication devices become part of the patient detail communication system, they should be tailored to the specific role of each team member. This prevents them from obtaining irrelevant patient details, which add to their cognitive load.
- The elements of the patient detail communication system should not distract and hinder the user under any circumstances.
- By providing insight into time in a clear and relevant way, it can make the whole team more time conscious. This could improve anticipation, treatment, and patient flow.

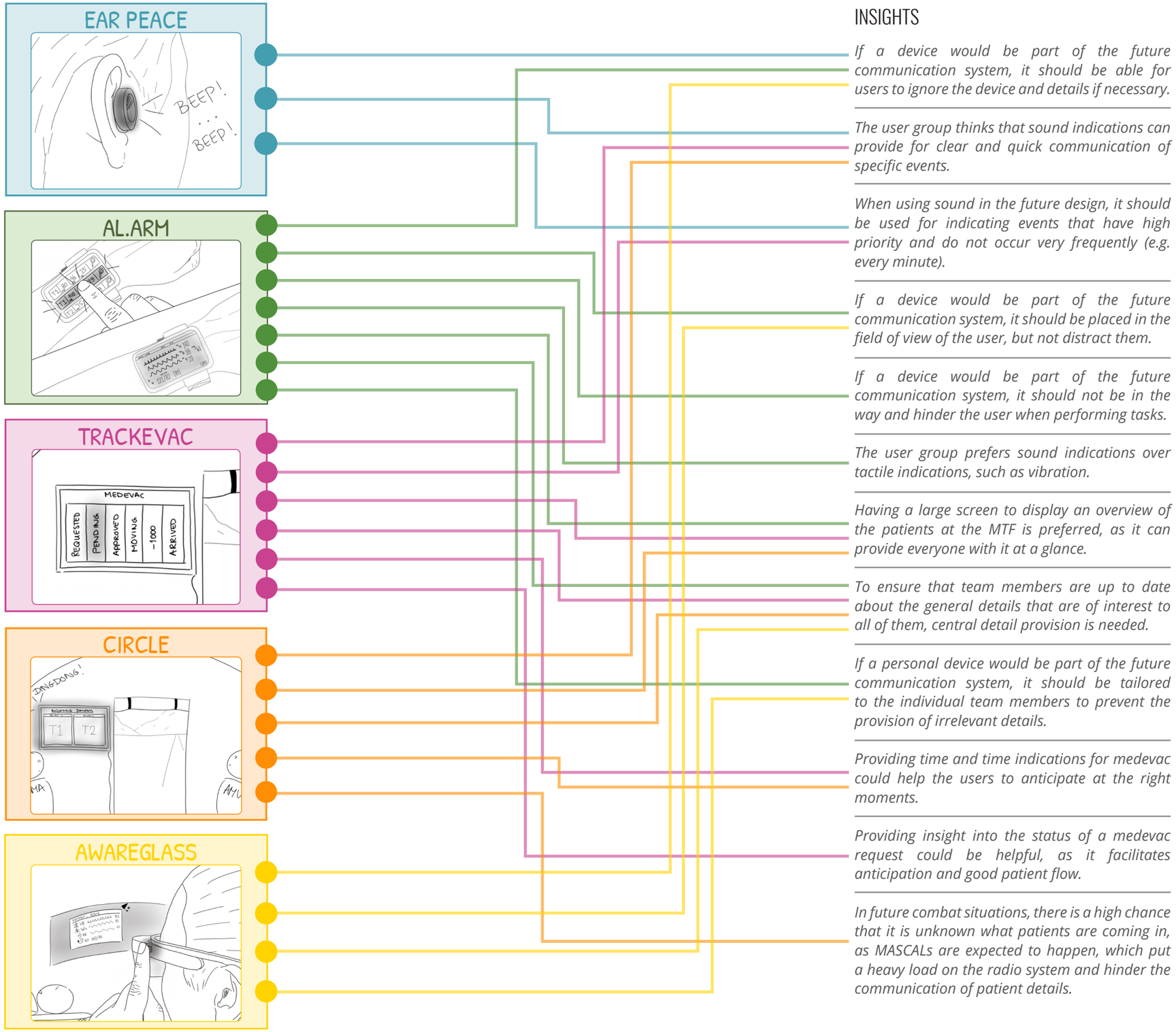


Figure 61: The connection between the ideas that were evaluated and the insights they provided ▶

7.3.2 General insights

Besides the insights gathered from discussing the specific ideas, other insights were gained as well. During the discussion and a round of additional questions, the participants reflected on the way of working in general, on the Defence organisation, and on the future of the Role 1 MTF. In this section, these insights are explained, as they were found to be essential elements for the future vision and recommendation for the MinDef.

Overview is key
The most important task for the AMA is to have an overview of the entire situation at all times. As was identified during the research phase, this is not always the case. By providing the AMA with a clear overview of all patients and their status, decision making can be supported and valuable time comprehending is saved.

Practice, practice, practice
If a new communication system is implemented in the future, all medical personnel be educated to work with it. If a system would be implemented without dedicated training, it is likely that it will not be used. A team should fully trust the system before they are comfortable to work with it in the field. This can only be achieved if they train and work with it extensively.

KISS
It is also essential that a new system should be KISS-proof: Keep It Simple, Stupid. In short, this means that the system should be made easy and intuitive enough to be understood by everyone that has to work with it. Of course, training is needed at the beginning, but the system should not make the work more difficult.

Logistical footprint
When developing a new communication system, it has to be kept in mind that it should not cause a large logistical footprint. Preferably, it provides more time for the treatment of patients than it currently does. However, if the system does require more logistical work, e.g. to provide tailored detail provision, it should be considered to assign that task to a specific team member and educate them for it. This can prevent AMAs and AMVs having to deal with logistics that distract them from their work.

A back-up plan
A comment that has been given on multiple occasions during this project is about system failure. If future communication systems are provided digitally, it has to be taken into account that either the system or the power supply could fail or be tampered with. It is of importance to provide a back-up plan, as patient detail communication has to be continued at all times.

Implementation of simple items
One of the most intriguing insights that were obtained is about the implementation of available and straightforward items that provide support to the MTF personnel. Apparently, it is challenging to get permission to add new items to the standard equipment that is used.

An example that was provided was that of the digital clock. Having a digital clock is essential to ensure that all team members are working with the same set time and to support them staying aware of it. However, even though there are thousands of digital clocks that could be purchased and added to the standard equipment, it has not been implemented yet. When asking about the reason behind it, no clear answer could be provided. They thought that the financial department that has to approve these requests does not have this high on their priority list.

Knowing that even simple requests are not approved easily makes it even more important to explain the need for and value of supporting equipment to the MinDef, as the Role 1 MTF might have a crucial function in the near future. This should be taken into account when planning for future developments and implementations.

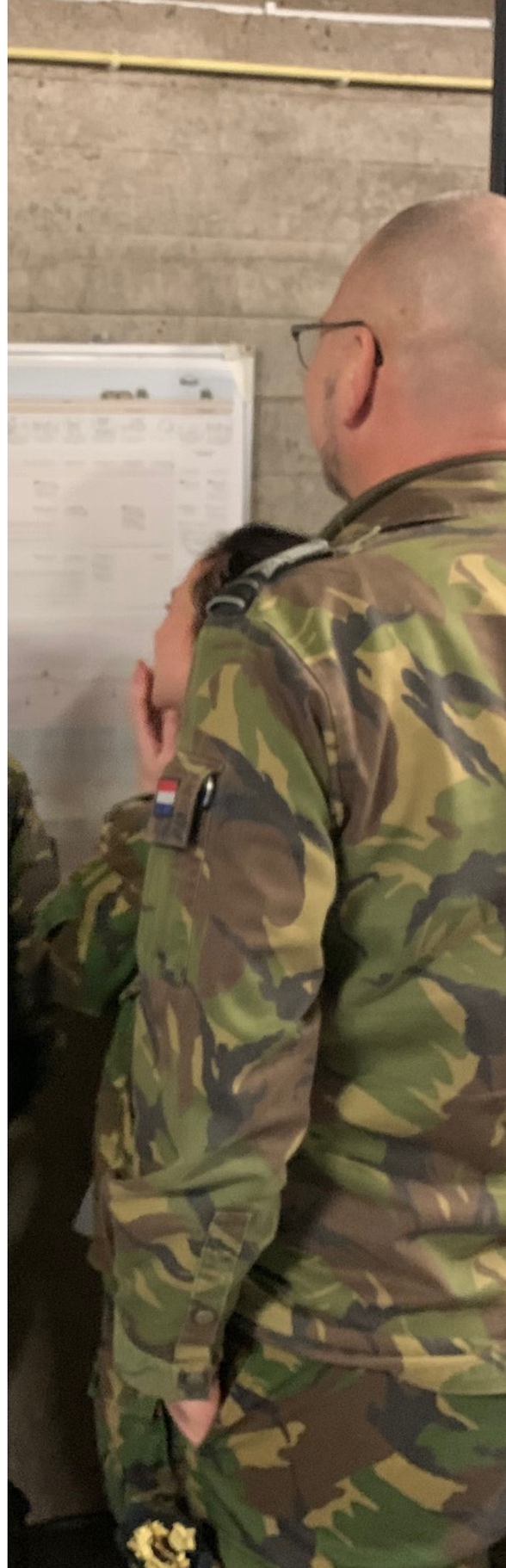
Thinking beyond the Role 1 MTF
During the session, an employee of the 400 Medical Battalion joined us to see how this project could be of interest for the Role 2 setting. She provided the insight that any system that is made should be suitable for use in other Roles as well, as it can provide continuity of patient treatment. By making small adaptions to the system's capabilities, it should be able to provide a system that supports the medical chain as a whole.

The Role 1 MTF's future
When asking what the Role 1 MTF would look like in 50 years, all medical instructors simultaneously said: *"It will not exist anymore!"* They think that, in 50 years, technology will be advanced enough to provide autonomous medevac solutions that can treat patients while transporting them to a higher Role. Currently, different companies are developing autonomous vehicles, such as drones and ground vehicles.

It is apparent that the need for supporting technologies is high and the MinDef has to act quickly in order to start using them in the near future, as the organisation takes a while to implement them. However, the session participants think that the first technologies could be implemented within ten years, as most of them already exist. The most essential is that the adaptations that have to be made in order for the technologies to be used in a military context. However, this must be possible within a reasonable amount of time. The medical instructors think that the use of such technologies can help to bridge the gap between the use of almost no technology at all and the Role 1 MTF not being necessary anymore.

Interaction vision
In Chapter 4.5, an interaction vision was formulated, which acted as a guide for ideation. Looking at the different insights that were obtained from this session, it seems that the interaction vision formulates the needs of the users well. However, refinement of this vision might be needed, as it was not yet tested with the user group. This could be a topic of research for the future.

Figure 62: Participants during the evaluation session (Pijl, 2020b) ▶

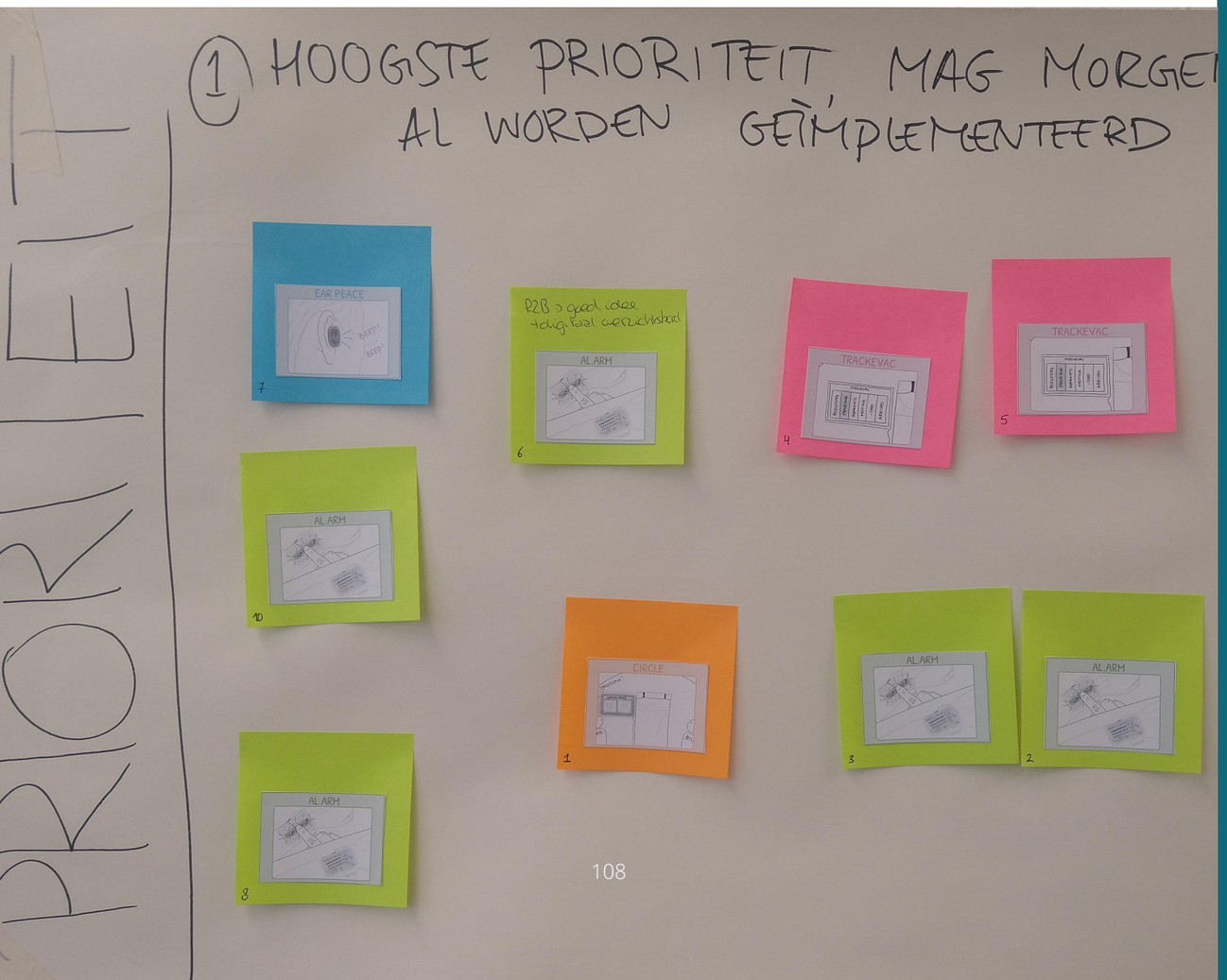


7.4 Journey map evaluation

In order to show the participants what I have been doing during this project and what results were obtained, I brought the AMA journey map to the session. At the end of the evaluation session, several participants stuck around and talked to me about the project and its value. I used this moment to show them the AMA journey map, as I did not have the opportunity to evaluate it with users before.

About six participants had a closer look at the journey map, as could be seen in figure 59. The people I spoke to were very enthusiastic, as the journey map is very different from evaluation methods they use currently. One of the medical instructors said the following: *"This is a discipline that we are missing within the Ministry of Defense. A while ago, we had a big tabletop practice. If we would have a tool like this to visualise how it went, it could lead to insights we did not see before."* Again, this shows that there is a lack of proper process evaluation tools that help to analyse processes and identify problematic areas. Often, the obvious problems are noticed right away; however, the underlying problems might not.

It was valuable to discuss the journey map with this group of people, as they confirmed both the need for evaluation tools and the effectiveness of it. In the end, one of the participants even asked me what software I used to make it, as she wanted to start practising with this herself.



7.5 Conclusions

This chapter presented the goals, setup, and results from the evaluation session that was held with medical instructors from the DGOTC in Hilversum. As these instructors had plenty of knowlegdge and experience between them, they could provide valuable insights about the needs for innovation in the Role 1 MTF.

The evaluation session had three goals: to confirm the findings from the research phase, to evaluate the desirability and credibility of the five design ideas, and to obtain insights on the participants' views on the future of the Role 1 MTF. The gathered insights provide elements for the development of a future vision for the communication of patient details in the Role 1 MTF.

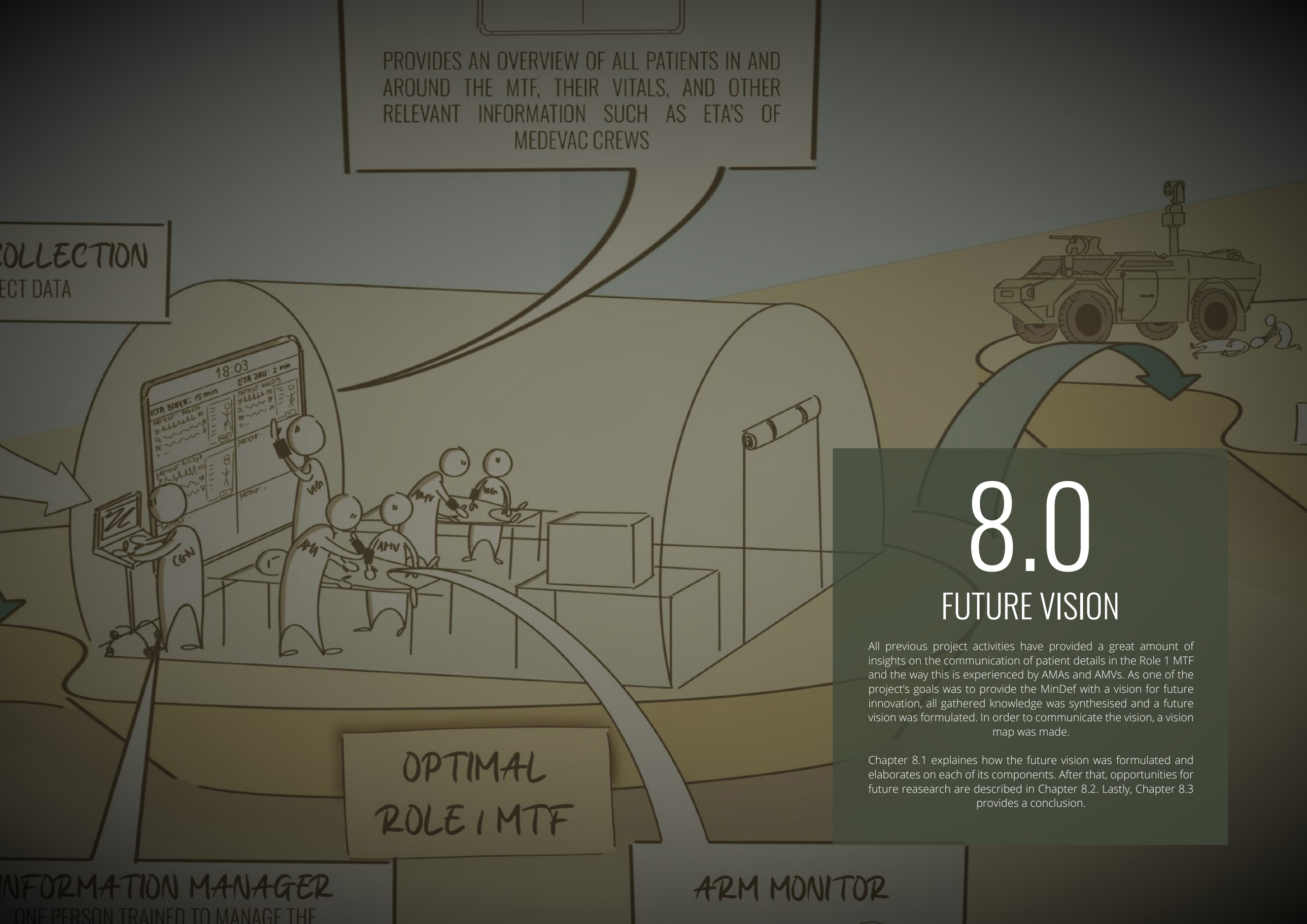
As the amount of time for the session was short, adequate activities were prepared to support a plenary discussion. By emphasising on the discussion, in-depth insights could be gathered in a short timeframe.

The evaluation session lead to different insights, which were either obtained by evaluating the proposed ideas, or by the discussion of general topics.
Overall, it was made clear that a future communication system should:
- save time doing irrelevant tasks, and provide more time for treatment;
- lower the cognitive load, by providing necessary and relevant patient details only;
- not distract users from treating patients;
- provide an overview of both the patients and the situation.

The conclusions of the general topics were the following:
- When implementing a new communication system, proper education is needed in order for the users to trust the system.
- If a communication system requires information management, one team member should be specifically educated to manage the information flows.
- There should always be a back-up plan.
- As it appears that the MinDef does not even fund relatively simple adjustments to the Role 1 MTF (and other medical entities), it must be made very clear to the organisation that the medical chain might play a crucial role in the near future. In order to be fully prepared for an Article 5 situation, change is necessary.
- In the far future, the Role 1 MTF will be replaced by autonomous medevac vehicles. This technology can provide for quick transportation to higher Roles and prevents the need for a Role 1 MTF near the battlefield.

At the end, the session also resulted in a short evaluation of the journey map. It confirmed the lack of proper process evaluation tools that help identify underlying issues and provide a clear overview. Overall, the participants were enthusiastic and could see the added value of using evaluation tools like the journey map.

◀ *Figure 63: A detail of the priority map that was made during the evaluation session in Hilversum (own image)*



8.0

FUTURE VISION

All previous project activities have provided a great amount of insights on the communication of patient details in the Role 1 MTF and the way this is experienced by AMAs and AMVs. As one of the project's goals was to provide the MinDef with a vision for future innovation, all gathered knowledge was synthesised and a future vision was formulated. In order to communicate the vision, a vision map was made.

Chapter 8.1 explaines how the future vision was formulated and elaborates on each of its components. After that, opportunities for future reasearch are described in Chapter 8.2. Lastly, Chapter 8.3 provides a conclusion.

8.1 The future vision

As was mentioned in the introduction of this report, the focus of this project was to provide the MinDef with tools that support process evaluation and future innovation in the field of communication of patient details in the Role 1 MTF. The journey map, presented in Chapter 5, was created to support process evaluation. To support the MinDef with future innovation, a future vision was formulated, which addresses both process and product innovation.

This chapter presents the future vision by elaborating on the framework that was used to structure it, the tool that was created to support it, and the three innovation phases it is constructed of.

8.1.1 The three horizons framework

To make sure that the future vision was formulated in a clear way and contained different phases for innovation, structure was needed. The structure of the vision is therefore loosely based on the three horizons framework from Baghai, Coley, & White (2000), which describes three phases to support company growth by innovation. Even though this project is not about company growth, the framework was used, as it provided guidance on the implementation of innovation at different levels.

The three horizon framework describes three consecutive phases, which represent the current situation, the transition phase, and the future. These phases are called 'horizons', as organisations work towards these situations. Figure 64 presents a schematic overview of the model.

The first horizon aims at process innovation. By adjusting current processes or implementing known and ready-to-use technologies, processes can be strengthened and risks are reduced. This improves overall efficiency.

The third horizon focuses on disruptive innovation for the far future. It includes technologies and solutions that are practically unknown to the industry and is about learning how to use these for a specific context. This type of innovation is called disruptive, as it can have a significant impact on an organisation.

The second horizon is the transition between the first and the third horizon, which goes beyond the scope of the first horizon and takes innovation for the far future into account. It makes use of solutions and technologies that are available but are not yet adjusted for the use in a specific organisation or industry. (Baghai, Coley, & White, 2000; Curry & Hodgson, 2008)

By implementing this structure into the future vision, three clear horizons for innovation could be described.

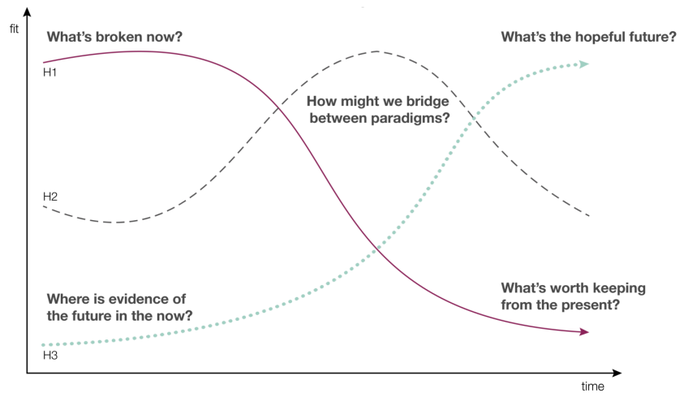


Figure 64: The three horizons model adapted from Curry and Hodgson (2008) (Dempsey, 2015)

8.1.2 Vision map

To present the future vision in a clear and structured way, it was decided to create a vision map. The vision map is a visual representation of the different innovation horizons that could be identified for the improvement of SA, and thus the communication of patient details, in the Role 1 MTF. Figure 65 presents the vision map on a small scale. It is also included in the deliverables as annex III on a larger scale.

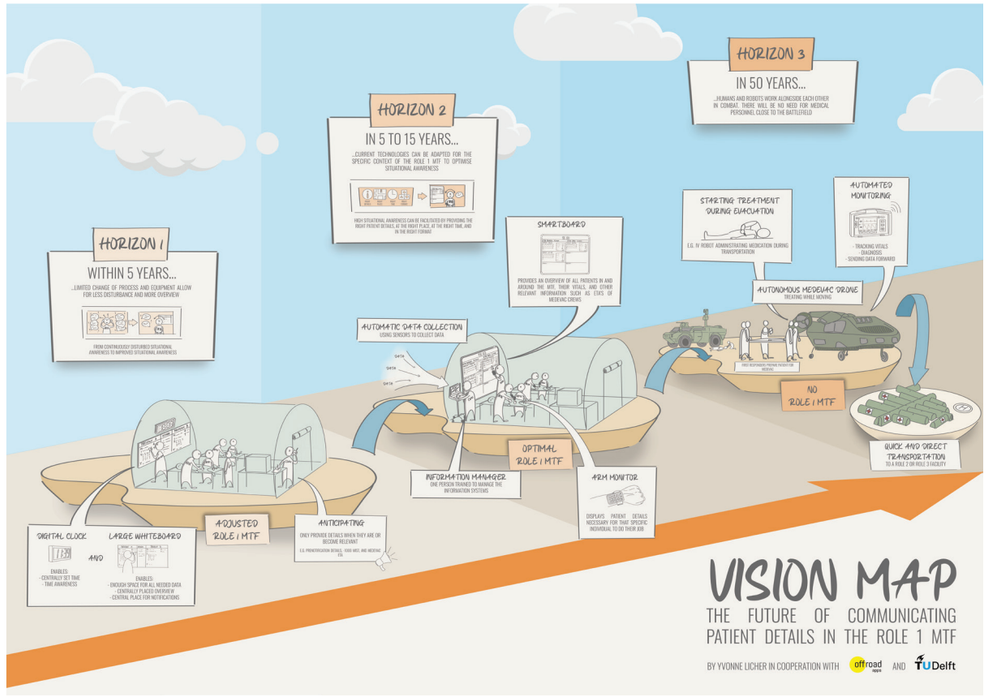


Figure 65: The vision map about the communication of patient details in the Role 1 MTF

8.1.3 Horizon 1

As explained in Section 8.1.1, the first horizon aims at process innovation in the short term. By implementing ready-to-use products and making simple changes to the communication process, already the AMA's and AMVs' cognitive load can be reduced. This will increase their SA.

In order to propose specific changes, the following question was asked: If you could implement any ready-to-use product or make any process change tomorrow, what would you do? Taking into account all gathered insight, three proposes for short term process innovation could be formulated. Figure 66 presents a visualisation of these proposes, which are explained next.

Equipment

For the implementation of available products that could facilitate an increase of SA in the short term, two products are proposed: a digital clock and a large whiteboard.

From the start of this project, it was clear that time is crucial for the survival and treatment of a patient. Besides treating a patient as quickly as possible, it is also crucial to keep track of time during specific treatments and for adequate preparation of the patient for medevac. Although all MTF personnel is equipped with a watch, it is difficult for them to stay aware of time. It is also not sure if all watches are set at the same time. The result is an increased risk of adverse medical events and a time being spent waiting for medevac.
Adding a large digital clock to the standard equipment of the MTF, and placing it centrally within the tent, enables central time provision and increases time awareness. As there are many digital clocks available on the market, the purchase should not cause any problems.

The second product that should be added to the MTF's standard equipment is a large whiteboard. Currently, one or two small whiteboards are used to keep track of patient details, such as the complete MIST and patient's vital signs. Due to the small size of the whiteboard(s), measured values often have to wiped away to make space for new ones. This results in an incomplete overview of the patient's status. By providing a large whiteboard (e.g. 90x180 cm) and placing it centrally within the tent, a complete overview of two patient statuses can be displayed. As it is centrally placed, these patient details can easily be obtained from both sides of the tent. Additionally, the whiteboard can be used as a central location to convey notifications, which will be explained shortly.

Process

In addition to the implementation of products, a process change is proposed. Currently, a large share of patient detail communication is done orally. As a result, the number of interruptions for the AMA and AMVs is high and their memory is filled with patient details to remember. This increases the cognitive load and makes it hard to focus. By changing the flow of information provision, the cognitive load can be reduced. To achieve this, the Radio CGN should only provide patient details when they become relevant for the AMA and AMVs.

An example is the prenotification from the Boxer. As was learned during observation, it is sometimes updated multiple times in a short period. After each update, the Radio CGN shouts the details through the tent. In the meanwhile, nothing is done with this information, as patients at the MTF have priority and adequate preparation for the incoming patients is not possible. By postponing the provision of these details until the Boxer announces the min1000, the CGN can provide the most recent details in one announcement. This is right in time before the new patients arrive and improves the general efficiency of care. To support cognition even more, the announcement can be written on a section of the whiteboard.

Conclusion

As described in Section 4.3.3, SA can be improved by providing the correct patient details at the right time, at the right place, using the right format. The changes proposed for horizon 1 are a simple means to support the provision of patient details at the right time and at the right location This strengthens the current process and reduces risks, which improves overall efficiency.

The implementation of the changes will be relatively inexpensive, as digital clocks and whiteboards are readily available and do not

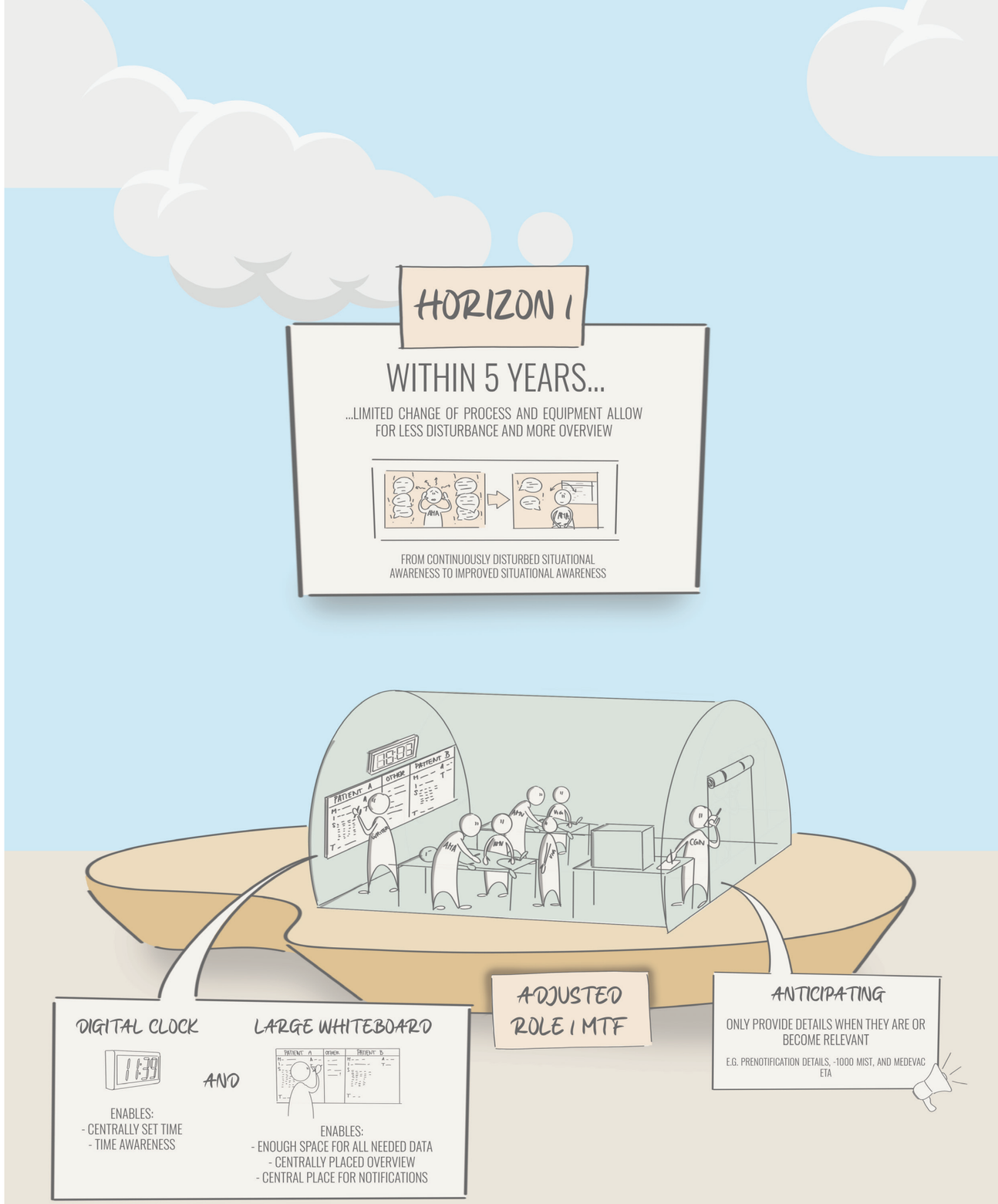


Figure 66: A visualisation of the first horizon

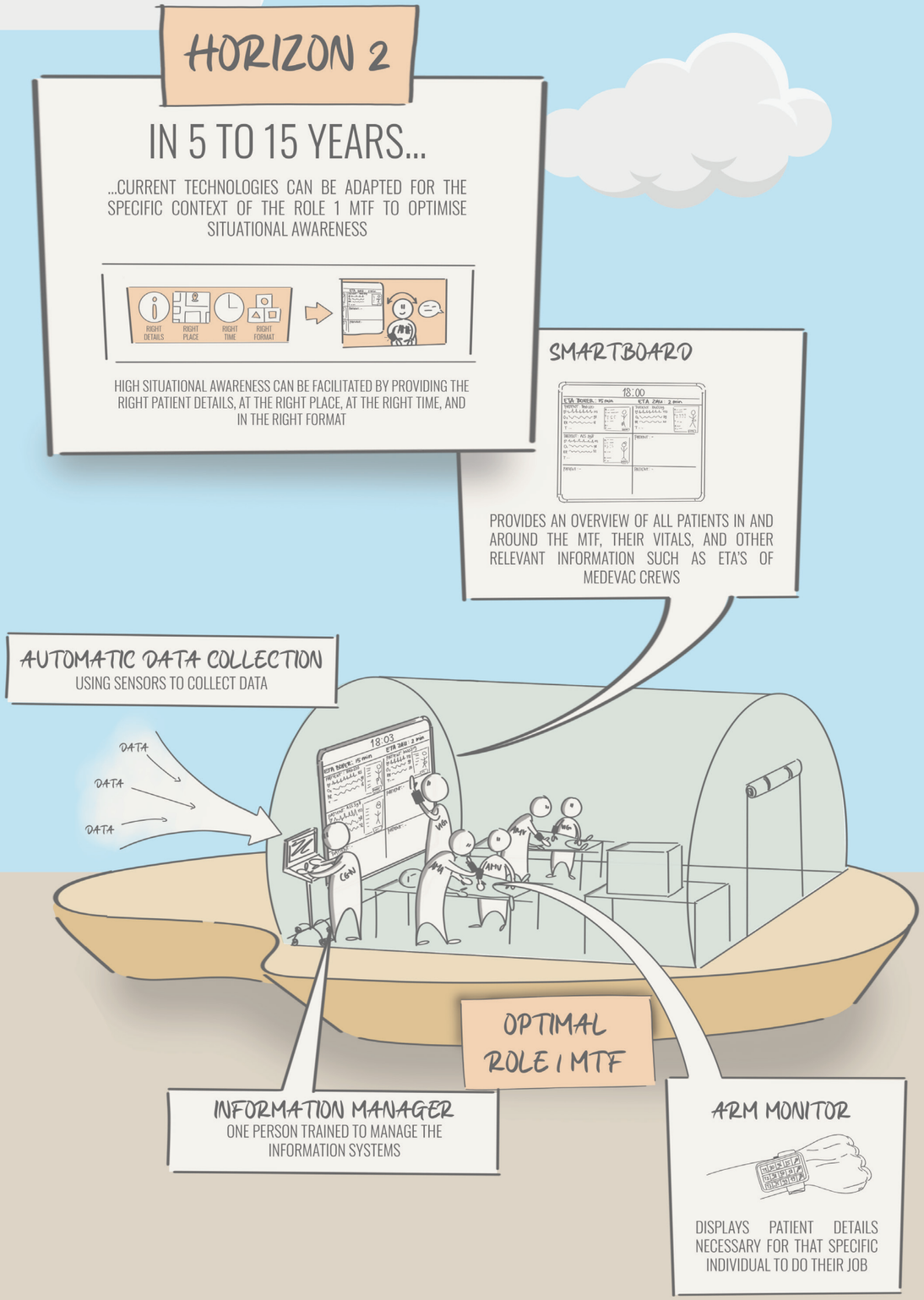


Figure 67: A visualisation of the second horizon

require complex technology. Besides, the implementation of process change is relatively low-cost, as it does not require new knowledge and requires little change in training.

The relatively low expenses, high availability, and simplicity of the proposed changes make that implementation is possible within five years. However, it does require the MinDef to provide a budget and people for the purchase of products, time to change the process, and training.

8.1.4 Horizon 2

The second horizon functions as a bridge between rapid process innovation and disruptive innovation in the far future. Therefore, this horizon goes beyond the rapid implementations made in the first horizon and already takes into account what the far future requires.

In order to bridge the gap between the adjusted Role 1 MTF and the far future, the use of technology is needed. By adjusting available technologies for the military context, significant improvements can be made. The innovations in this horizon built further on the changes proposed in the first horizon and are visualised in figure 76.

Equipment

For the second horizon, it is proposed to implement a patient detail communication system, consisting of a smartboard, an arm monitor, a computer, and medical sensor technology.

Firstly, medical sensor technology can be used to obtain patients' vital measurements automatically. This technology is already used in the VitalsIQ system and is subject to rapid development. As measurements are automatically obtained, the AMA and AMVs have to spend less time measuring. This allows for more time to perform treatment. As this technology is a study on its own, no further research was performed on this subject.
Secondly, a computer is needed to gather the generated data and convert it into a useable format. Technologies like AI can be used to provide insight on the possible risks that exist for a patient in specific conditions and can provide decision support for the AMA and AMVs.

Thirdly, a smartboard can be used to display the generated details centrally. The idea is that this smartboard only provides patient details that concern the whole team, such as the arrival time of the Boxer and an overview of all patients at the MTF. Additionally, vital measurements can be displayed in real-time and in different formats, such as graphical and numerical, to show a clear overview of the course of a patient's status.

Lastly, a personal communication device should be implemented, which provides the user with patient details tailored to their role and tasks. By filtering out the patient details that are irrelevant for their task, interruptions can be prevented and cognitive load can be reduced. This device can be provided in the format of an arm monitor, as it allows for quick obtaining of information and hands-free working.

Process

As the proposed communication system is relatively complex, information management is needed. One team member should be dedicated to this task. For example, the Radio CGN can be educated to maintain and operate the digital information flows and provision of patient details. This way, the medical team can fully concentrate on the treatment and evacuation of patients.

Conclusion

A significant increase of SA in the Role MTF is possible if relevant technologies are adjusted to the military context. The proposed communication system can help to reduce the cognitive load of the AMA and AMVs by providing the correct patient details at the right place, at the right time, and in the right format.

The innovations could be implemented within roughly fifteen years, as the technologies are already developed, but require adjustments for military use. Additionally, time is needed for the education and training of medical personnel to ensure adequate preparation and trust in the system.

8.1.5 Horizon 3

The third horizon focuses on disruptive innovation for the far future and is presented in figure 68. As was learned during the evaluation session with medical instructors, it is almost certain that these disruptive innovations will result in the Role 1 MTF being obsolete.

Future combat

In the past decades, the implementation of technology has supported combat in different ways. For example, technologies like smart weapons and unmanned aerial systems help to reduce the risks for soldiers in the front line. The current 'information age' will provide more opportunities for innovation in the next decades, and will help to decrease the number of soldiers to deploy. It is thought that, eventually, robots will replace human soldiers on the battlefield. However, it is not likely that this will happen in the next 50 years, as technology is nowhere near good enough to have robots perform all tasks currently performed by humans. Instead, it is expected that soldiers and robots are going to work alongside each other and that robots will perform the most dangerous tasks. (Hooijdonk, 2019)

Autonomous medevac solutions

As the need for soldiers on the battlefield will still exist in this horizon, the need for medical support will remain so as well. During the evaluation session, it was explained that hope is placed on the development of autonomous medevac vehicles. The implementation of these vehicles can provide for two main changes.

Firstly, it is prevented that the medical staff has to operate near the battlefield. Instead, the medevac vehicle is flown or driven to the POI, where fellow soldiers prepare the patient and place him in the vehicle for transportation.

Secondly, the medevac vehicle can directly transport a patient to a higher Role with more medical capacity and capabilities. This provides for more efficient care, as proper treatment can be administered immediately.

Treatment during transportation

Besides transportation, a medevac vehicle can also facilitate treatment. For example, by implementing technologies such as an IV robot, medication can be administered while the vehicle is moving towards a medical facility. Although it might require minor preparation of the patient, e.g. by inserting an infusion catheter, it allows for treatment on the go.

Another essential feature to implement in an autonomous medevac vehicle is automated monitoring. Using medical sensor technology, as introduced in the previous section, real-time vitals measurements can be performed, and data can be sent forward to the medical facility. If technology is advanced enough, diagnosis can be made as well. By using monitoring technologies like this, medical personnel can is prepared for the patient and can start proper treatment at arrival.

Both treatment and monitoring during transportation contribute to the continuity and efficiency of care. Even though patient preparation may be needed, valuable time transporting can now be used to increase the patient's chances of survival.

Conclusion

In the far future, the Role 1 MTF will not be needed, as autonomous medevac solutions can provide for quick and direct transportation to higher Roles. By integrating technologies that can start treatment and monitor the patient during transport, the efficiency of care can be optimised.

Although it is uncertain how long it will take to develop and implement these technologies, the positive hope exists that the Role 1 MTF is replaced with a medevac solution in 50 years. Already, different organisations are starting developing and test autonomous vehicles and treatment solutions. It is merely a matter of time before these solutions are fully developed. However, the combination and implementation of these technologies the military context will provide serious challenges that need to be overcome

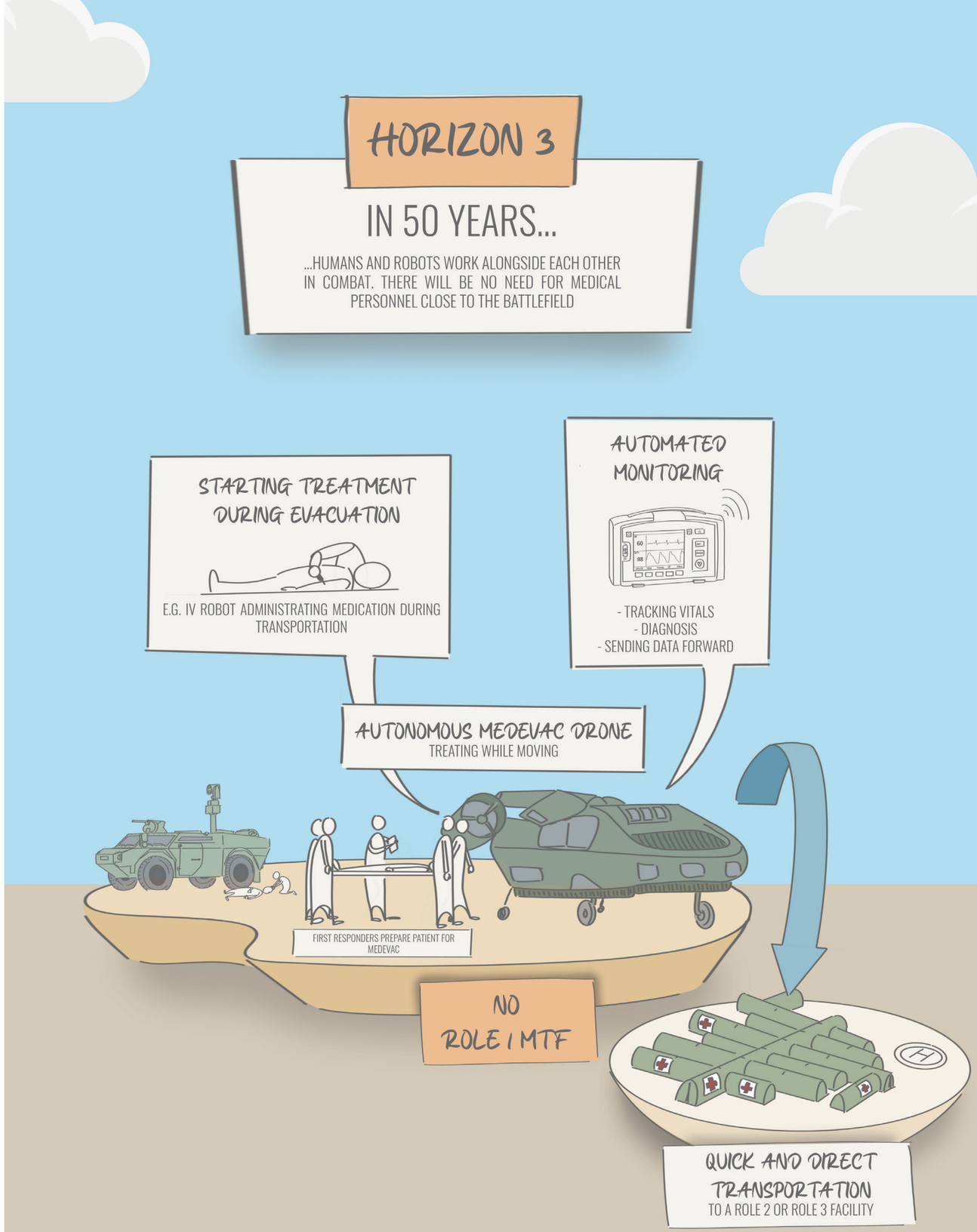


Figure 68: A visualisation of the third horizon

8.1.6 Evaluation

As the future vision for innovation is a response to the needs of the AMA and AMVs of the Role 1 MTF, evaluation with this user group was deemed necessary. Due to the circumstances, however, no time was available for an extensive evaluation. Fortunately, major Engelbert van Bevervoorde, head of the training centre of the DGOTC, found time for a short response.

It could be concluded that formulated vision is in line with the major's vision of the future. He, like many others, predicts that robots, drones, and Information Technology will be combined to support the armed forces. This will change the role of military (medical) personnel significantly. It was also mentioned that the timeframe for innovation was realistic, especially for the first horizon.

Although it is recommended to evaluate the future vision and the vision map more thoroughly with context experts, it can be said that it provides a realistic view of the paths for innovation.

8.2 Opportunities for future research

Besides the different innovation opportunities that are proposed, the future vision provides tools and reasons for the innovation of other products and communiation systems, such as VitalsIQ from Offroad Apps. Moreover, Offroad Apps can use the vision and vision map as a means for conversation with the MinDef about the future of military healthcare and the uncertainties that lie ahead. Already, these uncertainties lead to opportunities for future research:

- During the evaluation session with medical instructors, it was asked to imagine how different types of patient detail provision would affect the way of working. The insights that were obtained from this were used for the formulation of the future vision. As imagination is not the best means to base conclusions on, different communication methods have to be tested for each of the types of patient details. This should be done with (advanced) prototypes in order to obtain a conclusive outcome.

- Also, the optimal configuration of a Role MTF should be researched. By researching the effects of different configurations in multiple scenarios, critical components of the process can be identified and innovation for these components can be instigated.

- Another interesting topic for research is future combat. By researching how future combat may develop in the coming decades, the needs for future healthcare provision can be identified as well. These can be used as the foundation for military healthcare innovation in general.

- If tailored patient detail communication will be part of the Role 1 MTF communication system, research has to be done on the specific needs of each team member. This could be done by testing different information flows, where the type of patient details and the moments at which they are provided differs. The results can be used to tailor the information flows to each individual.

Research of the topics mentioned above can be of value for both the MinDef and Offroad Apps, as they are of interest to the future of military healthcare in general. Furthermore, it can support the definition or refinement of the innovation stategies of both organisations. Additionally, Offroad Apps can these research opportunities to define project briefs for (future) graduation projects, which can be of addition to the company's knowledge development.

8.3 Conclusions

This chapter described the future vision that was formulated to support the MinDef with future innovation for the communication of patient details in the Role 1 MTF. A vision map was made to visualise the future vision and function as a tool for Offroad Apps to start the conversation with the MinDef. Although the future vision was not evaluated extensively, it was perceived in line with the vision of members of the DGOTC.

The formulation of the future vision was based on the three horizons framework, which provided a structure for the implementation of innovation at different levels. As a result, three horizons for innovation could be described.
The first horizon described how process innovation could be achieved in the next five years. By providing patient details at the right time and by implementing simple products, such as a whiteboard and a digital clock, SA can already be improved.
The second horizon proposed the use of available technology by adapting it for use in the military context. The implementation of a dedicated patient detail communication system allows for tailored information provision and increases SA significantly. Although time for development and training is needed, implementation should be possible within roughly 15 years.
The third horizon described disruptive innovation for the far future, where autonomous medevac vehicles will replace the Role 1 MTF and the need for medical personnel near the frontline is limited. By starting patient treatment during transportation, the continuity and efficiency of care are increased. Additionally, patient details can be automatically monitored and send forward to ensure that the medical facility is prepared on the patient's arrival.

Besides the recommendations that are made for future innovation, oportunities for future research were identified, such as the future of combat, medical developments, and the optimal configuration of the Role 1 MTF.

In the end, the future vision is a means to start a conversation about the future of the Role 1 MTF regarding the communication of patient details. With this purpose, it can can be used by both the MinDef and Offroad Apps.

9.0

PROJECT EVALUATION

The final stage of the graduation process is to evaluate the entire graduation project on different aspects. First, general conclusions on the project are be presented in Chapter 9.1, after which the limitations will be elaborated on in Chapter 9.2. Recommendations for both the MinDef and Offroad Apps are given in Chapter 9.3. The report is concluded with a personal reflection.

9.1 General conclusions

This graduation project focused on the improvement of patient detail communication in the Role 1 MTF. It was explored how the Role 1 MTF currently works, how the communication of patient details can be optimised, and how the MinDef can take concrete steps towards successful innovation.

Different research activities were performed to create an understanding of the complex context of the Role MTF. By analysing the findings from activities, such as a workshop and observations, it was identified that the AMA and AMVs experience a lack of SA due to the current way of communicating patient details. This has serious implications for the efficiency of care. Additional research provided knowledge about SA and how it is influenced. It was found that, in order to improve SA, it is essential to provide the correct patient details at the right location, at the right time, using the right format.

As SA has a significant impact on the efficiency of care and the opportunity for improvement is large, the following design goal was formulated:

"I want to increase situational awareness of the AMA and AMVs of a Role 1 MTF on the battlefield in a MASCAL situation in order to improve the efficiency of care."

In addition to the design goal, an interaction vision was formulated to help understand the problem and function as an inspiration for ideation.

Before starting ideation, a journey map was made to provide a clear overview of the findings of the context research regarding SA. The journey map was focused on the AMA and showed how the current way of communicating patient details caused them to suffer from cognitive overload, which results in decreased SA. Additionally, the journey map identified opportunities for design.

By combining findings from different ideation activities with the interaction vision and the design opportunities identified by the journey map, five design ideas for the increase of SA were created. By evaluating the desirability and credibility of these ideas with context experts, additional insights for future innovation were obtained.

It was concluded that, if a patient detail communication system is developed, it should provide for:

- Central patient overview;
- tailored patient detail provision;
- non-invasive detail provision;
- use throughout the whole medical chain.

The evaluation also provided insight on the future of the Role 1 MTF. It is expected that, in the far future, medevac solutions will replace the function of the Role 1 MTF.

The insight gathered from the evaluation session formed the basis for the formulation of a future vision. This vision describes three innovation horizons to increase SA and improve the communication of patient details in the Role 1 MTF. Also, a vision map was made to visualise the future vision.
The first horizon described how process innovation could be achieved in the next five years by providing patient details at the right time and by implementing simple products, such as a whiteboard and a digital clock.
The second horizon proposed the use of available technology by adapting it for use in the military context. The implementation of a dedicated patient detail communication system allows for tailored information provision and overview. Implementation should be possible within roughly 15 years.
The third horizon described disruptive innovation for the far future, where autonomous medevac vehicles will replace the Role 1 MTF and the need for medical personnel near the frontline is limited. By starting patient treatment and monitoring during transportation, the continuity and efficiency of care are optimised. Although extensive time for development is needed, this level of innovation is expected to be implemented within 50 years.

In conclusion, this project provided two tools that can be used by both the MinDef and Offroad Apps. The journey map allows for process evaluation and supports the identification of underlying problems, while the future vision was built upon the opportunities identified by it and can serve as a means of conversation for future innovation. Additionally, the future vision provided opportunities for future research, which can be used by both organisations to refine their innovation strategy. However, the most important aspect is that the journey map and future vision portray the urgent need for change in the Role 1 MTF regarding the communication of patient details, as they are the result of experiences from the users themselves.

Figure 69: Dutch Role 1 personnel carrying a lotus victim at the Vigorous Warrior training in Romania (Zwaal, 2019)

9.2 Limitations

During this project, several limitations could be identified. Below, these limitations are discussed.

Availability target group
The limitation that impacted this project the most was the limited availability of the target group. As the Army has a lack of personnel, time for activities outside of the personnel's regular schedule is scarce. This resulted in having short meetings, which had to be prepared well in order to get the most out of them. Luckily, the people that I have met provided me with valuable insights in these short periods. Although the meetings were very fruitful, it would have been ideal to have a fixed group of people to consult at different moments of the project. This way, more engaging conversation would have been possible, and the evaluation of the results could have been more elaborate.

This limitation also had a positive side. By talking to different people, it was found that there are many different ways of working within the MTF. Each team has their own way of working, which only became clear hearing experiences from different people. Of course, this made the context more comlex, but it provided richness and understanding as well.

Idea evaluation
The evaluation of the five design ideas was subject to limitation due to limited availability as well. In order to evaluate them and obtain insights in a short amount of time, participants were asked to imagine the ideas and their interactions. Although this brought valuable insights by discussing their findings, the specific interaction elements could not be evaluated, as imagination is not the proper means for this. In order to obtain insights on the specific interaction elements, it is thus needed to test them through the use of prototypes.

Validation
To continue on the topic of evaluation, it should be mentioned that the low availability of context experts also resulted in minimal project validation, as time was too short to validate the journey map and future vision properly. Although the first impression employees of the DGOTC had of both tools was positive, they should be evaluated more thoroughly in order to validate their value.

The Role 1 MTF (in action)
Another limitation that was the result of low availability of people was that the first chance of seeing and experiencing the Role 1 MTF was two months after the start of this graduation project. Although the context was researched by reading the Army's information bulletins, conducting interviews, and doing a context workshop, it was difficult to fully understand how it worked without actually seeing it. Eventually, it contributed to the research phase being extensive.

Training versus reality
As mentioned in the introduction, this project was based on the training situation, as opposed to the real deployment of the Role 1 MTF in a combat situation. This made that all outcome is based on training situations, which are likely to differ a lot from the real-life experience. In addition, most people that contributed to this project have never experienced the deployment of a Role 1 MTF themselves. Although it is tried to make the training as real-life as possible, it will never be the same as a situation on the battlefield. It is therefore essential to keep developing better training materials, which can help to identify more opportunities for improvement of patient detail communication.

9.3 Recommendations

Now that the general conclusions and limitations are discussed, some final recommendations are made. These recommendations are split up into two categories. First, recommendations are made for the MinDef, and thus the Army, after which recommendations for Offroad Apps are made as well.

9.3.1 The Ministry of Defence

Even though this project was performed for Offroad Apps, it can be of great value for the MinDef as well, as this organisation has the resources to innovate on its own and support innovation from the industry. Several recommendations are made and explain below.

First and foremost, it is of the essence to make military healthcare provision, in general, a priority. During the evaluation session at the DGOTC, it appeared that the implementation of basic equipment was not possible. In order for the Role 1 MTF (and other Roles) to function properly and support the troops in combat, it is crucial to spent time, resources, and money on the improvement of military healthcare in general.

As mentioned in Chapter 8.2, research on combat in the far future is necessary, as this influences the future of the military healthcare provision as well. By formulating a vision for future combat and identifying the challenges and opportunities, the future vision for innovation for the Role 1 MTF can be refined.

As was identified in Chapter 3.3, training is not realistic enough. This contributes to the uncertainty of the medical personnel on how they would react if a real event took place. Although training is as close to reality as possible, they do not prepare the medical teams for deployment adequately. It is recommended to keep developing training and make them as real as possible. This could be done with technologies, such as VR and Mixed Reality. By making training as close to reality as possible, identification of patient detail communication issues become more refined, and innovation can be developed accordingly.

As it became clear that the Role 1 MTF is in need of improvements regarding the communication of patient details, it is of importance to investigate this need in other Roles as well. If changes are made to the communication process in the Role 1 MTF, it will have implications for both lower and higher Roles. By researching the needs regarding patient detail communication for each element of the medical chain, it can be ensured that systems or processes connect to each other, and the continuity of care is secured. The MinDef could use tools like the journey map to evaluate the current communication processes of each element in the medical chain and identify opportunities for change.

9.3.2 Offroad Apps

This project was performed for Offroad Apps with the intent to serve as a reference work for the future development of VitalsIQ. In general, the recommendations that are made for the MinDef can be considered for future development and innovation of VitalsIQ as well. If desired, steps can be taken in collaboration with the MinDef, as this reinforces the bond between and increases the knowledge of both organisations. An example of this could be the research into the effect of varying configurations of the Role 1 MTF in different scenarios. Here, Offroad Apps could provide the knowledge for proper testing and evaluation, and the MinDef could provide people and resources.

If VitalsIQ is expanded towards the Role 1 MTF, it can be expanded and developed to function as the patient detail communication system as proposed in horizon 2 of the future vision. If this is the case, and Offroad Apps will build further upon this project, different additional recommendations are made.

As the evaluation of specific design elements was not possible, different concepts should be tested by utilising prototypes. This way, design elements can be selected and developed for implementation into the VitalsIQ system.

Also, research has to be performed to identify the needs of each individual team member of the Role 1 MTF. By doing this, tailored detail provision can be supported.

If tailored detail provision is implemented, it is essential to manage and control these information flows, as they need to be traceable. It was proposed to educate a CGN on the specific task for information management. Therefore, it is recommended to research the possibilities for a proper managing system and education.

Finally, as it is almost certain that the future communication system will make use of technology, it is recommended to provide a back-up plan in case technology fails. As it is unwanted to go back to pen and paper, 'graceful degradation' is needed. Examples from the current project are the option for manual registration in the system in case of sensor failure, and the use of e-paper to display the last update of MIST on the DST, even if the batteries are exhausted.

Figure 70: The interface of VitalsIQ from Offroad Apps ▶ (Zwaal & Fréni, 2019)

9.4 Personal reflection

At the start of this project, I stated four personal learning ambitions. During the past few months, I have worked on them and learned a lot. I will briefly reflect on each of them, after which I discuss some additional learnings.

LA1. Grow in doing qualitative research

During this project, I have had the opportunity to conduct qualitative research on multiple occasions. I have enjoyed this a lot, as it provides for rich analysis and gives the user the chance to explain and comment in their own words. It also caused the sessions to be more lively and interactive, which resulted in valuable and fun days. The outcomes of the research will also be of value when communicating the results with the MinDef, as deliverables like the journey map show personal experiences and quotes from personnel. It can help the MinDef understand how presing the need for change in the Role 1 MTF is.

In general, I think that the DFI master has provided me with the tools to conduct qualitative research at an appropriate level. If I had doubts, I asked my supervisors and fellow designers for opinions and input. I think that I will continue to learn each time I conduct qualitative research, and I am curious what those future learnings will be.

LA2. Talking to experts

A large share of the knowledge gathered during this project was obtained by talking to experts. Both context experts and experts from other domains, such as the ER, were consulted.

As little literature was available about the Role 1 MTF, every minute spent with a context expert was valuable. During each conversation, I discovered new things and heard new terms. This made the project fun and inspiring, as it almost felt like a scavenger hunt. Still, to this day, I do not know everything about the Role 1 MTF.

The interviews and conversation with experts from other domains were also interesting, as they provided me with a view from another perspective and helped broaden the solution space. Even though my project was not always of added value to the expert's domain, they were interested in my project and were happy to provide insights from their point of view.

When starting this project, I thought that I would have difficulty approaching people to talk about this project. I thought they might not find it relevant. However, the opposite happened. Every single person I approached was interested and wanted to help. I think that the key is to be passionate about the topic and to explain how their knowledge could be of value.

Additionally, I have learned that events are great ways to meet and learn from experts as well. The Military Healthcare Symposium, for example, was a great opportunity to visit a Role 1 MTF tent and casually talk to AMAs and AMVs about my project. The visit to DiMiMed was valuable, as it was a great way to expand my general military knowledge.

LA3. Improve my visualisation skills

A significant ambition was to improve my visualisation skills during this project. I think I can say that I have become much better in visualising information and that I made some great visual deliverables. I started a bit wobbly, but after defining a dedicated style, it improved a lot. By adjusting existing visuals from Offroad Apps and combining these with the ones made on my own, I achieved a visual style that is functional and pleasing to look at. Although I sometimes struggled (Photoshop is not my friend), I am proud of the visuals I made.

LA4. Be and stay confident in managing and performing my project

During this project, I have had my ups and downs. There were weeks where I felt confident in what I was doing and weeks where confidence was nowhere to be found.
An example of the confident moments was the preparation of the AMA workshop. As it was planned sooner than expected, I had less time to prepare. By changing my planning and putting full focus on the reparation of the workshop, I managed to make all materials in time.
A moment where confidence was low, was the week after the evaluation session at the DGOTC. I wanted to process all insights that were gathered and formulate the future vision in only one week, as my Green Light meeting was coming up. This proved to be too ambitious, and I ended up panicking. When my supervisors identified this, I realised I had to take the time to let the insights sink in, which ended up being of great help.

While working on this ambition outside of graduation, I have learned that my doubts are not always valid. I have learned to stop comparing myself with others too much and thinking I am not doing well enough. In the future, I will implement my learnings on this subject and try to put that bad energy into positive energy.

Overall, I have enjoyed this project very much. The topic was 'alive', as I continued to learn new things and the people I have talked to were passionate. The visits to different events, training moments, and military barracks made the project unforgettable as well. Last but not least, I have enjoyed working at Offroad's office, as it helped to build a working routine and allowed for some fun times.

In conclusion: Despite the difficult moments, the results of this project are something to be proud of.

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Own photograph. (2019, December 11). Treating a patient in the Role 1 MTF. Role 1 training Marnewaard.

Chapter 4.0

Own photograph. (2019, November 29). Workshop results on a whiteboard. AMA Workshop Oirschot.

Chapter 5.0

Own image. (2020, February 12). A part of the current AMA journey map.

Chapter 6.0

Own photograph. (2019, December 3). An impression of the creative session held with design students. Creative session.

Chapter 7.0

Own photograph. (2020, Februari 12). Storyboards. Evaluation session Hilversum.

Chapter 8.0

Own image. (2020, April 9). A part of the vision map.

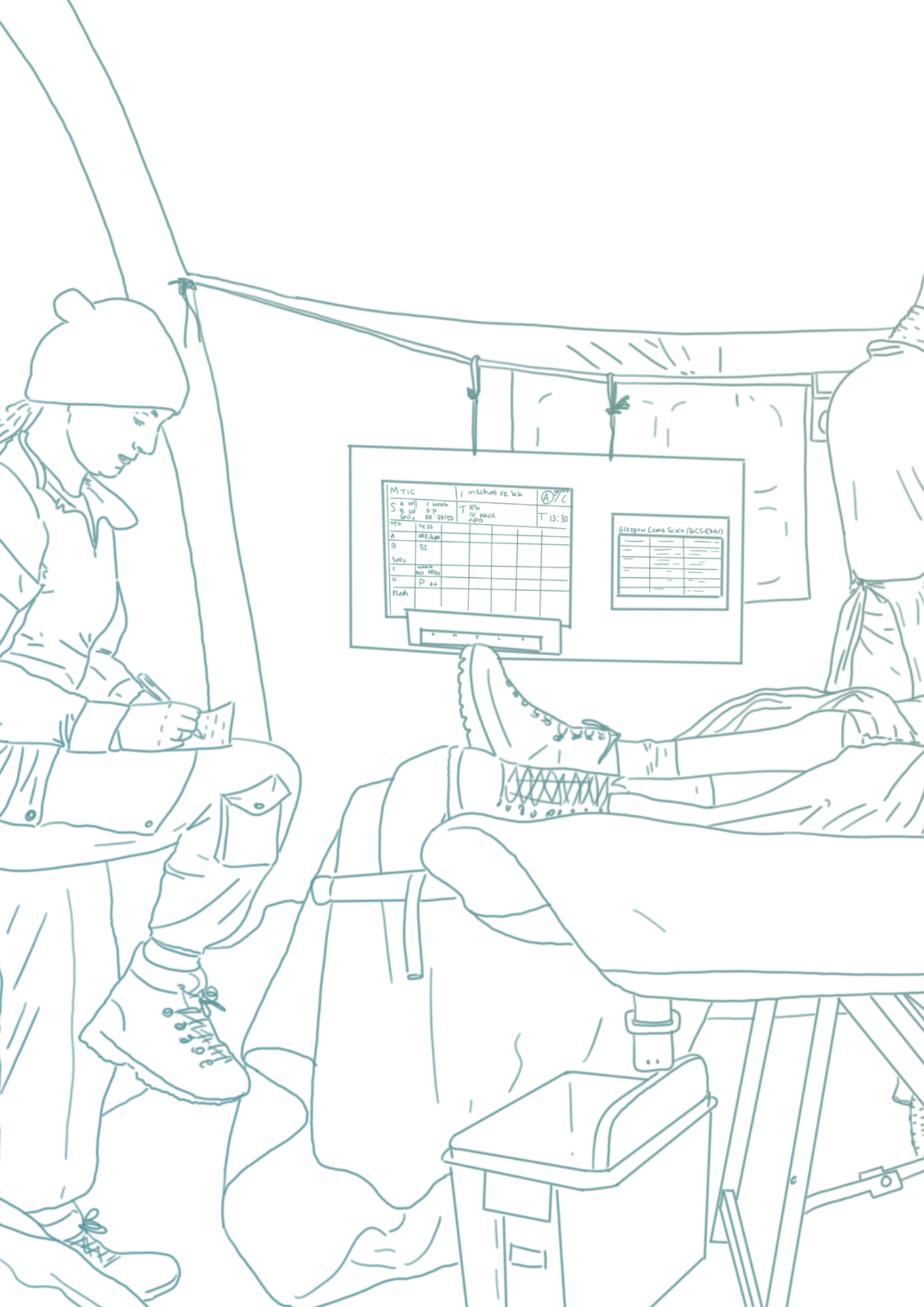
Chapter 9.0

Own photograph. (2019, December 10). A ZAU displayed between company booths. Military Healthcare Symposium.

"Verzin een list"

- Almost all military medical personnel

This is a saying that I heard multiple times during my graduation project. It describes that there are many protocols and rules everyone has to comply to, but if the situation asks for it, the rules will be bent in order to save and protect patients and personnel. This asks for a lot of creativity and flexibility in the moment. Sometimes it popped up in my head, and it inspired me to break loose ones in a while, if a situation asks for it or not.


MTIC
1 inschot re 'bb
A/C
S
A wtj
B 40
SpO2
C weak
DP
RR 70/50
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IV nacl
npo
T 13:30
Tijd
14 26
A
wtj/kgw
B
32
SpO2
C
weaks
MO 60/30
D
P ++
Meds
Glasgow Coma Scale (GCS-EMV)