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Self-designing networks and structural influences on safety

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Developing a theory on the relation between organizational design and safety in temporary organizations that operate in a dynamic environment

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Chapter One: Introduction

"It was like the Wild West out there… (…)
We may have had countless near misses…"

Captain, Royal Netherlands Army

1.1 Introduction

The Army Captain quoted above was a commanding officer of a unit that operated with Unmanned Aerial Vehicles, or UAVs, within Task Force Uruzgan (TFU) during a mission of the Dutch military in Afghanistan between 2006 and 2010. His quote reveals that his unit may have experienced countless near misses with other, friendly, flying units during its operations in Afghanistan's Uruzgan province. The possibility of countless near misses between UAVs and other units within Task Force Uruzgan suggests that -at least for UAV operations- safety was problematic within TFU.

Safety, or the absence of hazard, risk or injury (cf. Ale, 2009), seems to be a peculiar topic to discuss in a context such as the Uruzgan mission because a military mission area is dangerous and unsafe by nature. It can be argued, however, that the quote above suggests that disturbances within the military organization itself may make inherently dangerous and unsafe military work even more complicated.

Recent research has shown that due to nature of military task force design, work in these task forces is fundamentally different compared to the training situation at home (Kramer, De Waard & De Graaff, 2012). De Waard and Kramer (2008) point out that Dutch military Task Forces are deployed by "mixing and matching" different "building blocks" from the Dutch defense organization into a temporary task force. This "mixing and matching" design strategy results in a temporary organization that has little resemblance to the way the units in the Task Force are organized at home. In analyzing a particular case within Task Force Uruzgan, Kramer et al. (2012) indicated that soldiers needed to invest major effort in finding out with whom to cooperate. As a result, operators were constantly shaping and re-shaping configurations of units to find suitable organizational configurations to conduct missions (Kramer et al., *ibid.*). Such findings are not unique for TFU. Previous research has found similar design issues and accompanying "bottom-up" processes within

Dutch UNPROFOR[1] and SFOR[2] (see: Vogelaar et al., 1996; Kramer, 2007). These task forces were also designed by using a "mixing and matching" design strategy (see: Kramer, *ibid.*). Moreover, Kramer (2004; 2007) highlighted that the "mixing and matching" way of designing expeditionary organizations out of static military parent organizations impeded flexibility of expeditionary operations.

Apparently, "mixing and matching" units into a temporary expeditionary organization from several military parent organizations results in a task force with an organizational skeleton (cf. Weick, 2004, p. 48) that needs extensive fine-tuning and hinders flexibility during operations. Relating these findings to the quote presented at the beginning of this chapter, poses the question whether the possible near misses that the Army Captain experienced can be related to design characteristics of the Task Force. Furthermore, "mixing and matching" design strategies similar to that of the Dutch military can also be found outside the military context. Modig (2007), for example, highlights that assembling temporary organizations from one or more "stationary", parent organizations is a commonly used design strategy to cope with the challenges of the contemporary business environment. As such, it seems worthwhile to investigate whether the way these organizations are designed, influences their ability to operate safely.

Therefore, this thesis aims to investigate the relationship between organizational design and safety within, what will be referred to in the remainder of this thesis as, "expeditionary organizations". To clarify the concept of "expeditionary organizations", this introductory chapter will firstly continue with introducing this concept in greater detail. Secondly, more attention is focused on the concepts of safety and risk under uncertain and sometimes dangerous environmental conditions. In the third paragraph of this chapter it is argued why safety theories that pay attention to organizational influences, seem to be insensitive to the influence of organizational design on safety in expeditionary organizations. In paragraph four, the research goal and research strategy of this thesis are explicated. In paragraph five, the research steps followed in this thesis are outlined. In paragraph six the research model and research questions are explicated. Lastly, in paragraph seven, the outline of this thesis is sketched.

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[1] UNPROFOR: United Nations Protection Force, for Former Yugoslavia

[2] SFOR: Stability Force, for Former Yugoslavia

1.2 Expeditionary organizations, safety and risk

1.2.1 Expeditionary organizations and dynamic complexity

As argued above, expeditionary organizational forms can be found both within and outside of the military context. With regard to military expeditionary organizations, military operations of most Western countries changed substantially after the Cold War came to an end. Post cold war military tasks and roles became much more diverse compared to "traditional" tasks that focused on defense of national (and allied) territory. Nowadays, most Western military organizations conduct varying missions such as peace keeping, peace enforcing and reconstruction (or state building) activities (e.g., Edmunds, 2006). In order to carry out such a wide range of missions, many Western military organizations are confronted with an organizational design challenge (e.g, Bonin & Crisco, 2004; Kramer & De Waard, 2007; Bloch, 2000). This challenge centers on the question: how can a coherent organization carry out such a variety of missions? De Waard & Kramer (2010, p. 72) point out that to deal with this challenge: "*many military organizations try to develop the capacity to generate different organizational configurations, while at the same time they try to retain the advantages of relatively fixed structures and functionalities*". From an American perspective, Snook (2000, p. 33) highlights a similar design challenge and points out that: "*Task Forces are designed by taking basic unit building blocks and assembling them along hierarchical lines consistent with the demands of the mission and time-honored military traditions of command and control*". De Waard and Kramer (2008, p. 539) argue that the Dutch military follows a similar design strategy in which the different parent organizations (Army, Navy, Air Force and Military Police) are used as a "tool box" for building temporary expeditionary organizations.

Furthermore, as was highlighted above, a temporary "mixing and matching" design strategy seems to be used more broadly. To describe different forms of temporary organizations Modig (2007) employs a model that is based on the works of Galbraith (1994). This model, as depicted below, describes temporary organizations based on their relationship with static (or stable) parent organizations.

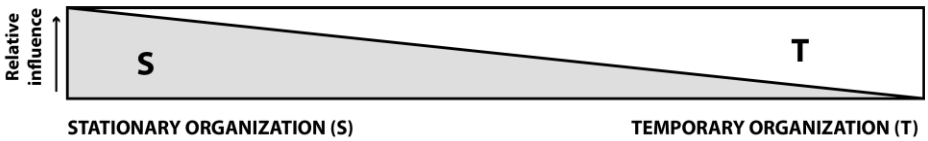

Figure 1: A model on temporary organizations (Source: Modig (2007))

At the left end of the model, parent organizations are stable and elements of these parent organizations are used as building blocks to assemble temporary organizations. At the right end of the model, "pure" temporary organizations are located. This means that elements of these temporary organizations do not originate from stable parent organizations. Instead these organizations are assembled of independent professionals that are hired for a particular project only. The design strategy that resembles the strategy of the military is located at the left end of the model because stable parent organizations are used as a platform for selecting building blocks from which temporary organizations are built. Some examples of this particular organizational design strategy outside the military context can be found in (mega) project organizations in construction, offshore (e.g., Flyvbjerg, Bruzelius & Rothengatter, 2003) and crisis response organizations (e.g., Boin, 2009). Such temporary organizations all seem to be "mixed and matched" out of one or more stable parent organizations in order to conduct a specific temporary task.

Although more organizations seem to use a similar design strategy for designing temporary organizations, it can be argued that "civil" expeditionary organizations are confronted with a different type of operating environment than military expeditionary task forces. After all, these temporary organizations are mostly not confronted with opposing forces that react with weapons to the actions of the temporary organization. However, it can be argued that civil expeditionary organizations are confronted with an operating environment that shares characteristics with the military, expeditionary, environment. Eric Trist highlighted in 1980 that organizations in the 20th century are confronted with what he calls the "turbulent field". This means that large numbers of large organizations are pursuing different goals, that a "communications revolution" reduces response time and increases information overload and that traditional regulatory mechanisms are unable to cope with the consequences (Trist, 1980, p. 116). It can hence be argued that Trist's definition of a turbulent field refers to an environment that has become increasingly uncertain, ambiguous and reactive. So, although "civil" expeditionary organizations are, mostly, not operating in an environment that is as hostile and dangerous as the operating environment military expeditionary organizations face, they certainly encounter some degree of uncertainty, ambiguity and reactiveness. For example, it is well known that temporary building organizations are confronted with fierce financial and time pressure within what can be called a "hyper competitive" environment (see for example: Flyvbjerg et al., 2003).

As such, it can be argued that in a more general sense "mixed and matched" temporary organizations are confronted with uncertainty, ambiguity and reactiveness in their environment. Kramer (2007) employs the term *dynamic complexity* to capture the combination of uncertainty, ambiguity and reactiveness. Consequently, the term "expeditionary organizations" will be used to refer to temporary organizations that are "mixed and matched" from building blocks that originate from one or more stable parent organizations and operate under dynamically complex conditions. It should be noted that the term dynamic complexity is used to refer to characteristics of the operating environment at the level of the expeditionary organization. Of course, parent organizations can also be confronted with complexity. It may even be argued that the strategy to form expeditionary organizations can be seen as a way for static parent organizations to cope with such uncertainty at the level of the parent organization(s). This issue will, however, be addressed later on in this thesis, in the Chapters Five and Six.

1.2.2 Enactment, risk and self-organization

A dynamically complex environment confronts expeditionary organizations with a particular kind of challenge which has implications for ways in which these organization can operate safely. In a dynamically complex environment, reactive third parties are present that respond, sometimes in a hostile way, to actions that the expeditionary organization undertakes. This means that in such contexts, expeditionary organizations cannot wait behind closed fences to figure out what needs to be done. They have to act in order to discover "what is going on". Weick (1979) refers to this phenomenon as "*enactment*". By means of enactment, organizations gradually build an understanding of their environment while acting. Therefore, in a dynamic complex environment, reaching absolute certainty is impossible as the environment changes continuously. As such, Weick (1979, p. 6) states that organizations eventually develop a "workable level of certainty" of their operating environment. For safety, or the absence of hazard, risk or injury (cf. Ale, 2009), this implies that attaining absolute safety is impossible as expeditionary organizations are confronted with fundamental environmental uncertainty. This has consequences for the way expeditionary organizations can deal with risk and develop safety of their operations.

Risk is traditionally defined as the product of the probability that a harmful event occurs and the consequences that the event may cause (Ale, 2009). This means that getting insight into risk in a traditional manner relies on quantification of harmful events and their related consequences. Quantitative methods for safety and risk are therefore well known and abundant (see for example: Aven, 2016). Quantification however, relies on (some form of) stability. That is to say, harmful events and their consequences can only be quantified if they occur more than once. In a dynamic complex operating environment however, stability is absent. Instead, organizations in these contexts, such as expeditionary organizations, have to deal with absolute uncertainty and the ever presence of unpredictable environmental risks.

Literature that acknowledges such a position on uncertainty and risk is growing. Some examples can be found in the work of Grote (2012), Hollnagel (2012) and Dekker (2005). Following this avenue in safety literature, it is highlighted that safety while faced with fundamental environmental uncertainty is not attained by simply following rules and procedures (see also: Dekker, 2005). Instead, safety is developed by means of self-organization and adaptation of employees conducting "normal work" (cf. Dekker, 2005) at the operational level of the organization (e.g., Dekker, Cilliers & Hofmeyr, 2011).

The above places attaining safety in expeditionary organizations in a different perspective compared to the traditional quantitative approach to risk and safety. That is to say, under dynamic complex environmental conditions, safety becomes a process that is constantly under pressure and has to be developed continuously. Therefore, getting insight into the relationship between organizational design and safety in expeditionary organizations points to investigating how a "mixed and matched" design influences self-organization and adaptation of employees conducting "normal work" at the operational level of the organization. In the next section a preliminary reflection on safety theory is presented that questions whether present theories that address organizational influences on safety are able to do so. It should be noted that the section below is not to be understood as an exhaustive reflection on organizational safety theory, this thesis will direct more attention to a critical theoretical reflection in Chapter Two. Nevertheless, by means of this preliminary reflection, issues in organizational safety theory, with regard to its ability to study the relationship between organizational design and safety in expeditionary organizations, can be highlighted.

1.3 Organizational safety theory and expeditionary organizations

Within the field of safety related theories, substantial attention has been focused on moving away from a so-called "human error" approaches on safety to approaches that address organizational influences on safety (e.g., Dekker, 2005; Reason, 2000). This means that theory development has moved from either a predominantly technical or psychologically oriented human-factors approach, to the inclusion of organizational factors such as safety culture (e.g., Guldenmund, 2000; Dekker, 2012) and management influences (e.g., Reason, *ibid.*). However, it is questioned whether such theories, which theorize on organizational influences on safety, are suitable for gaining insight into the relationship between organizational design and safety in expeditionary organizations. These doubts are fueled by

Andrew Hale's notion that safety management theory is predominantly "bureaucratic" (Hale, 2003) by which he means that safety management theory is mainly developed in and for large stable and static organizations. In line with Hale's notion, Dekker (2014) highlights the "bureaucratization of safety", which in his perspective means that attaining safety within organizations has become increasingly about rules, standardization and accountability.

Confronted with the characteristics of safety in expeditionary organizations presented above, a main problem seems to arise with regard to the applicability of organizational safety theory to expeditionary organizations. That is to say, a conceptualization of safety that emphasizes standardization does not seem to match the emphasis on self-organization and adaptation that was regarded as important to safety in expeditionary organizations. Hence, it is unlikely that organizational safety theory with underlying bureaucratic assumptions is suitable for a study on safety in expeditionary organizations.

In addition, recent studies have highlighted the importance of particular types of rules for safety within organizations (e.g., Hale & Borys, 2013). Hale and Borys, for example, point out that safety within organizations does not benefit from rules that restrict operators' autonomy and repress violations. However, it can be argued that a perspective that looks at the relation between safety and particular rules has a limited view of the relation between an organization's design and safety. That is to say, focusing only on the influence of rules seem to disregard influences of the underlying organizational "skeleton" (cf. Weick, 2004). This can be regarded as problematic for gaining insight into the relation between organizational design and safety in expeditionary organization, because the underdeveloped nature of this "skeleton" seemed to have a substantial influence on work in expeditionary organizations as was shown in the introduction section of this chapter. It can hence be argued that conceptualizations of organizational design that focus mostly on rules, disregard aspects of organizational design that may be of substantial influence on safety within expeditionary organizations. Hence, such approaches are unsuitable as a starting point for a study on the relationship between organizational design and safety in expeditionary organizations. As a result of this first and preliminary reflection on organizational safety theory, developing theory that fosters *understanding* the influence of organizational design on safety within expeditionary organizations seems a fruitful contribution to organizational safety theory. Therefore, the next section defines the research goal of this thesis.

1.4 Research goal and research strategy

Based on the preceding sections, the following research goal for this thesis is formulated:

Developing theory on the relation between organizational design and safety within expeditionary organizations by:

1. **Studying the relationship between organizational design and safety in specific expeditionary organizations and;**
2. **Generalizing these findings to expeditionary organizations in general**

In order to attain this goal, the next section explicates what characteristics a theory on the relationship between organizational design and safety in expeditionary organizations should have in order to address to the issues highlighted in the introduction.

1.4.1 The nature of the theory to be developed

As pointed out above, the main purpose of the theory to be developed in this thesis is *understanding* the relationship between organizational design and safety in expeditionary organizations. This, at the one hand, demands that the theory possesses certain characteristics. On the other hand, it limits the contents of the theory in a particular way.

Firstly, the theory that is developed in this thesis should be applicable to a family of expeditionary organizations. That is to say, the sections above not only placed emphasis on military expeditionary organizations but also highlighted the broader relevance of this organizational form. This implies that this thesis aims to develop a particular type of knowledge. Van Strien (1986; 1997) defines three distinct epistemological levels of knowledge generalization, which he quite straightforwardly named level A, B and C. Level A knowledge consists of abstract, ontological, assumptions within a particular research discipline. Level B knowledge represents problem-oriented knowledge. Level C knowledge represents context-specific knowledge. A theory on the influence of organizational design on safety within a family of expeditionary organizations is located at Van Strien's level B, that of problem-oriented knowledge. That is to say, such a theory is oriented towards a specific problem that a family of organizations seems to have, but at the same time aims to be more general than context specific knowledge.

Although the type of theory this thesis is aimed at is located at Van Strien's level B, this does not mean that the other levels of knowledge generalization are irrelevant. On the contrary, both level A and C are addressed extensively in the course of this thesis. For example, the more abstract ontological points on dealing with uncertainty and dynamic complexity outlined in preceding sections of this chapter can be defined as level A knowledge. Furthermore, context specific arguments that relate to specific expeditionary organizations such as Task Force Uruzgan, outlined in the introduction section of this chapter, are located at Van Strien's level C.

Secondly, Morse (1997a, p. 174) points out that a theory that fosters deep understanding of a particular phenomenon should possess both *explanatory* and *predictive* characteristics. With regard to explanatory characteristics, this means that within the theory developed in this thesis, particular mechanisms, or relationships between concepts, have to be unraveled. For the problem this thesis is aimed, this implies that specific characteristics of organizational design of expeditionary organizations have to be related to particular safety outcomes. With regard to its predictive characteristics, the theory developed in this thesis has to provide mechanisms between concepts that should be observed in all expeditionary contexts.

Regarding the limits of the theory to be developed, it should be emphasized that the theory described in this section does not aim to be a prescriptive organizational design or safety management theory. This means that it is not attempted in this thesis to create a theory on redesigning expeditionary organizations to operate more safely. However, it can be argued that before any redesign theory can be constructed, diagnostic knowledge has to be developed. In this sense, the work presented in this thesis can be interpreted as a necessary and inevitable step that has to be taken before any prescriptive theory can be constructed.

1.4.2 Research strategy: using the "geographical map" and "compass" metaphor

As was highlighted above, this thesis aims to develop a theory on the relationship between organizational design and safety in expeditionary organizations at Van Strien's level B. Therefore, a particular research strategy is chosen that adopts research approaches suggested by Christis (1998, p. 25) and Kuipers, Van Amelsvoort & Kramer (2010).

Christis (*ibid.*) employs the analogy of a geographical map to highlight that including all possible theoretical perspectives would lead to a study that is overly complex. As a metaphor, he states that geographical map can never reflect the area that it aims to map in full detail. Otherwise the map would become too big, complex and impractical to use. Therefore, during a map-making process, choices are made what to include in the map and what to leave out in order to make it useful for everyday navigation. By using this metaphor, this thesis will develop a "map" on the relationship between organizational design and safety in expeditionary organizations. By using such a principle of selectivity, complexity is reduced because it seems unrealistic to develop a theory on *all* aspects that influence safety within expeditionary organizations.

It was highlighted in the preceding sections that for the particular topic this study is interested in, no ready-made "map" seems to be available because existing organizational safety theory does not seem to take essential characteristics of expeditionary organizations and safety into account. Although such a map does not seem to be available, it is argued that some aspects of theory in organization science can be used to construct a map on the relation between organizational design and safety in expeditionary organizations. Within organization science, and the so-called Integral Organizational Renewal (IOR) approach in particular, the influence of an organization's structural design on its ability to cope with a dynamic environment is well defined (e.g., De Sitter, 1994; Kuipers et al., 2010; Van Eijnatten & Van der Zwaan, 1998). IOR, sometimes referred to as the Lowlands' Sociotechnical Design Theory (STSL; Van Amelsvoort, 2016)[3], is originating from a wider tradition in organization science, that of Socio-Technical Systems Design (STSD), which has its roots in works by Emery and Trist (see for example: Trist & Bamforth, 1951; Emery & Thorsrud, 1964). Within the different streams of STSD, the relationship between all kinds of organizational design aspects and outcomes such as flexibility, efficiency, innovation and worker's commitment is a central topic (see: Van Eijnatten, 1994).

IOR's premises are hence employed as a conceptual "compass" (cf. Kuipers et al., 2010, p. 281) that is used to develop a map on the relation between organizational design and safety in expeditionary organizational contexts. Applying IOR as a "compass" as part of the research strategy within this thesis means that the premises of IOR are used reflexively to guide the research process in investigating and mapping the relationship between organizational design and safety in expeditionary organizations. As such, it can be argued that IOR concepts are employed *heuristically* (cf. Richardson & Kramer, 2006) in the different studies of this thesis.

[3] In this thesis, the pros and cons of the different traditions within STSD are not discussed in detail. The interested reader is referred to Van Eijnatten (1994) or Kuipers, Van Amelsvoort & Kramer (2010).

1.5 Research steps

In this section, the analytical steps that are followed in this thesis are explicated[4]. In the first research step, the characteristics of expeditionary organizations and safety in a dynamic complex environment explicated in section 1.2, are used to review organizational safety theory. This is done because the preliminary reflection described in this chapter only presented some indications for a theoretical gap in organizational safety theory. It therefore has to be determined in detail what gap in safety theory can be identified. That is to say, as the research goal of this thesis is to develop level B theory, it has to be examined in detail to what extent frequently used theories that theorize on organizational influences cannot be used to get insight into the relation between organizational design and safety in expeditionary organizations. To determine this, four frequently used organizational safety theories are reviewed: Safety Management Systems-theory (Hale, Heming, Carthey & Kirwan, 1997), resilience engineering theory (e.g., Hollnagel, 2012), Normal Accidents Theory (Perrow, 1999) and High Reliability Theory (e.g., Weick & Sutcliffe, 2007).

In the second research step, and by using IOR as a conceptual “compass”, it is explored what aspects of organizational design influenced safety in an expeditionary organization. Such an exploration seems necessary to get a first and detailed understanding of the ways in which organizational design impacts safety in the context of an expeditionary operation. The exploration is carried out on the operations of a military expeditionary organization. More in particular the exploration focuses on the operations of the UAV unit of which the Army Captain, who was quoted at the beginning of this chapter, was a commanding officer. His UAV unit is the Royal Netherlands Army’s 107th Aerial Systems battery (107 ASBt). 107 ASBt conducted three expeditionary missions within Task Force Uruzgan (TFU) between August 2006 and May 2009. During the deployment of TFU, 107 ASBt was the only unit within the Dutch Army that operated with Unmanned Aerial Vehicles. This unit was chosen as a starting point for this thesis because both 107 ASBt and TFU were mixed and matched out of different building blocks from one or more stable military parent organizations. Therefore, studying this unit enables exploring the influence of expeditionary organizational design of both the UAV unit itself and Task Force Uruzgan on the ability of 107 ASBt’s operators to develop safety within the Task Force, against the background of the dynamically complex mission area in Uruzgan.

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[4] As these different steps require different methodologies, this section lacks detailed methodological descriptions. Instead, the different studies outlined in the chapters of this thesis have their own methodological section.

In step three, the main goal is to detail the relation between organizational design and safety for expeditionary organizations in general. This is a crucial step in developing a theory on organizational design and safety in expeditionary organizations at van Strien's level B. To do so, a second case study is conducted within Task Force Uruzgan, which firstly aims to generalize the results of the explorative case study within 107 ASBt to the organizational level of TFU. After that, by means of analytical generalization (cf. Yin, 2003, p. 32-33)[5], hypotheses are formulated on the influence of organizational design on safety for expeditionary organizations in general.

In step four, it is attempted to verify the hypotheses developed in the previous step by means of studying two other expeditionary cases: a case on the Dutch military contribution to SFIR[6] in Iraq and a case on the Dutch national crisis response organization that was initiated after the crash with flight MH17. In this way, it can be investigated whether analytically developed hypotheses on influences of organizational design on safety within expeditionary organizations can indeed be generalized to expeditionary organizations in general. This is a necessary step in developing theory at Van Strien's level B that has applicability to the family of expeditionary organization this thesis aimed on.

Subsequently in step five, the level B theory on the influence of organizational design on safety in expeditionary organizations is constructed. In this step, a conceptual model is developed that explicates the explanatory and predictive mechanisms between organizational design and safety in expeditionary organizations.

1.6 Research model and central research questions

This section will present the research model that is used to attain the goal of this thesis. The model is built out of the steps presented in the previous section and subsequently enables to derive central research questions. In this thesis, each of these research questions will be addressed and answered in separate studies.

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[5] In contrast to most quantitative social research that aims to generalize results by means of statistical generalization, qualitative social research can (partly) rely on analytical generalization instead of statistical generalization for achieving external validity. Analytic generalization is done by means of argument building, which means that it needs to be elaborated why and to what extent findings are relevant for other (expeditionary) organizational contexts. To attain external validity however, also replication has to be employed (Yin, 2003). This is done in the fourth research step.

[6] International Stabilization Force

The research model presented in this section is developed by using a procedure proposed by Verschuren and Doorewaard (2004). Their method is chosen because it offers a systematic procedure for developing research questions that are all aimed at attaining an overarching research goal. In this method, a distinction is made between the particular perspective used (in Dutch: "optiek") and the object of study. In the previous section, different perspectives and objects of study were highlighted. For example, it was highlighted in the first research step that "characteristics of expeditionary organizations and safety in a dynamically complex environment" (the perspective, or "optiek") will be used to study four frequently used organizational safety theories (the object). Confronting these two (visualized by two headed arrows in the model), opens up the possibility to formulate a research question. As such, based on Figure 2, the following research questions can be formulated:

1 What gap in organizational safety theory can be identified?
2 What aspects of organizational design influenced safety of 107 Aerial Systems battery within Task Force Uruzgan?
3 What hypotheses on the relation between organizational design and safety can be formulated for expeditionary organizations?
4 Can hypotheses on the relation between organizational design and safety in expeditionary organizations be verified by studying other expeditionary organizations?
5 What theory on the relationship between organizational design and safety in expeditionary organizations can be constructed?

In the next section, it is pointed out in which chapter and study each of the research questions will be addressed in this thesis.

1.7 Structure of this thesis

This thesis consists of seven chapters. This first chapter focused on introducing the main subject, research premises, research goal and the research questions of the study. In the second chapter the first study is presented that is aimed at a theoretical review in which four frequently employed organizational safety theories will be analyzed to detail a theoretical gap. The third chapter will focus on exploring the influence of organizational design on safety for 107 Aerial Systems battery its operations within Task Force Uruzgan. The fourth chapter will then conduct a second case study within Task Force Uruzgan to derive hypotheses on the influence of organizational design on safety in expeditionary organizations. After that, the fifth chapter aims to verify these hypotheses by means of confronting the findings of Chapter Four with two existing cases from other expeditionary organizational contexts. The sixth chapter will construct the content of the theory on organizational design and safety in expeditionary organizations. Finally, the seventh chapter entails a discussion to reflect on the pros and cons of the research carried out in this thesis.

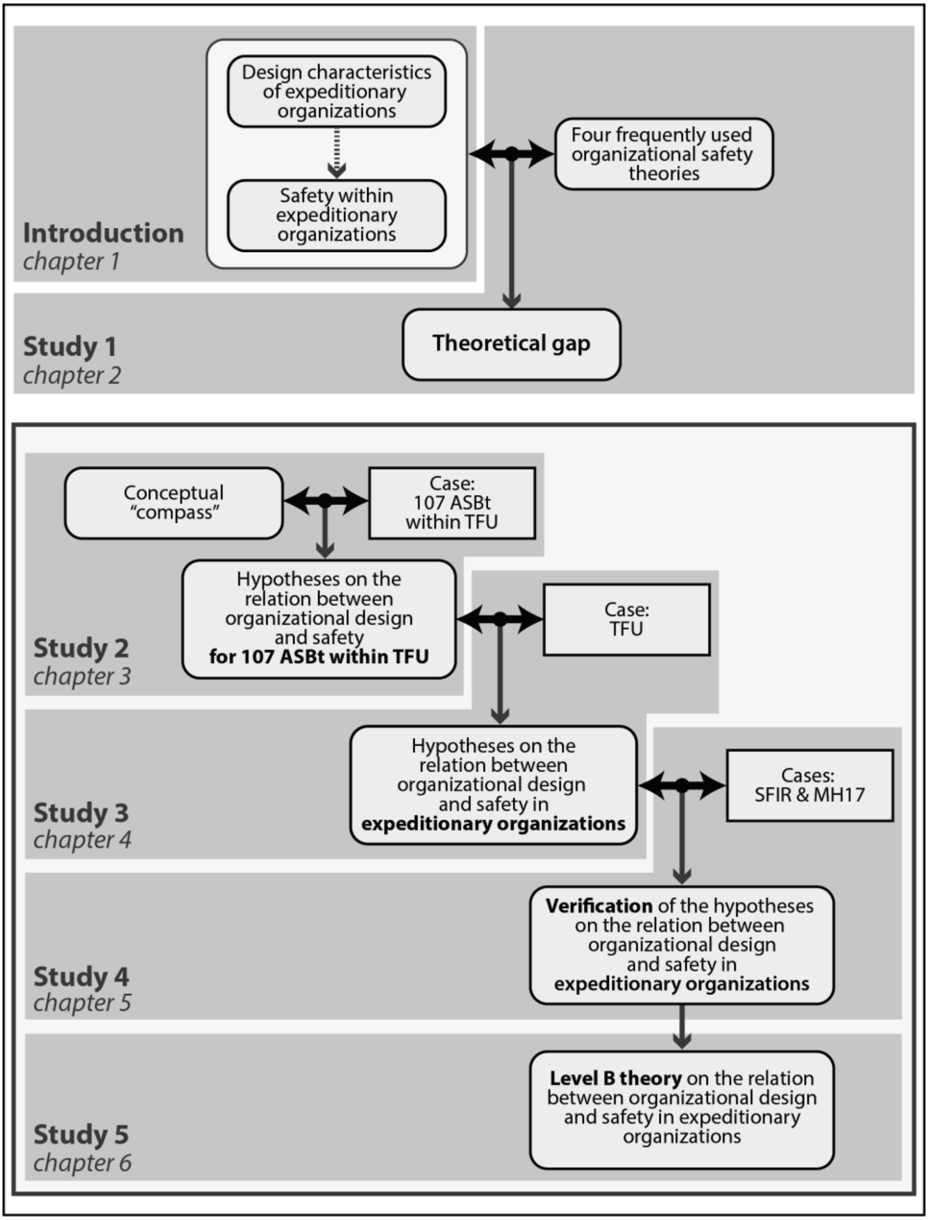

Figure 2: Research model of this thesis

ASBt=Aerial Systems battery; TFU=Task Force Uruzgan; SFIR= international Stabilization Force in Iraq; and MH17=Malaysia Airlines Flight MH17

Chapter Two: A review of four frequently used organizational safety theories[7]

2.1 Introduction

In this chapter, the first study of this thesis is presented. This chapter is therefore guided by the first research question, which is:

What gap in organizational safety theory can be identified?

The preliminary reflection in the previous chapter seemed to indicate that organizational safety theory is not able to get a deeper understanding of the relation between organizational design and safety in expeditionary organizations. Also, this reflection seemed to point to rather bureaucratic stances on the relationship between organizational design and safety present in organizational safety theory. These observations may indicate a gap in organizational safety theory with regard to its ability to develop an understanding of the relation between organizational design and safety in expeditionary organizations. However, quite obviously, in the previous chapter only indications of such a gap were highlighted.

This chapter will therefore examine whether these indications indeed point to a more substantial gap in organizational safety theory. To do so, four frequently used organizational safety theories are analyzed on their ability to get deeper insight into the relationship between organizational design and safety in expeditionary organizations. The four theories reviewed are: safety management systems theory (e.g., Hale et al., 1997), resilience engineering theory (e.g., Hollnagel, 2012), Normal Accidents Theory (NAT; Perrow, 1999) and High Reliability Theory (HRT; e.g., Weick & Sutcliffe, 2007).

One could argue that an analysis on the way in which these theories are able to gain a deeper understanding on expeditionary organizational design and safety can be done by directly confronting these theories with the characteristics of expeditionary organizations and safety described in section one and two of Chapter One. However, Reiman and Rollenhagen (2011) argue that safety theory suffers from assumptions that are often employed implicitly.

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[7] Parts of this chapter were published as: Moorkamp, M., Kramer, E.H., Van Gulijk, C. & Ale, B.J.M. (2014a). Safety management theory and the expeditionary organization: a critical theoretical reflection, *Safety Science*, 69, 71-81.

As a consequence, establishing whether organizational safety theories are able to get a deeper understanding of the relation between organizational design and safety in expeditionary organizations becomes difficult. Therefore, an analytical framework is constructed that is able to explicate assumptions on ways these theories address the relation between organizational design and the ability of an organization to operate safely. After these assumptions are explicated, it can be analyzed whether these theories are suitable for getting a deeper understanding of the relation between expeditionary organizational design and safety.

Including an analytical framework into the research approach of this chapter, however, complicates the research model for study one. Therefore, parts of the research model presented in Chapter One have to be changed. Based on the research model presented in Chapter One, the analytical steps followed in this chapter are guided by the following research model.

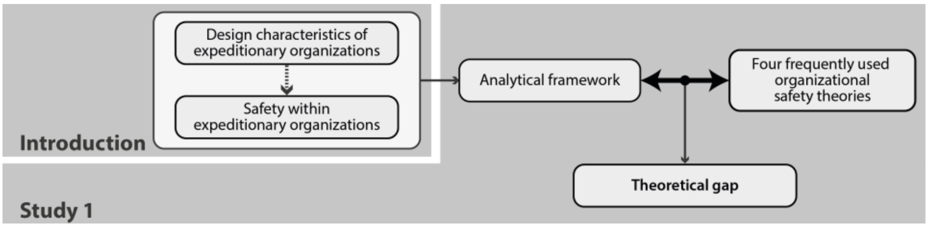

Figure 3: Research model of Study 1

As such in this chapter, firstly, the analytical framework is constructed. Secondly, four frequently used organizational safety theories are explicated. Thirdly, the analytical framework is confronted with these theories to explicate assumptions on the relation between organizational design and safety and elaborate on their suitability to gain a deeper understanding of the relation between organizational design and safety in expeditionary organizations. Finally, conclusions are drawn on the ability of these four theories to address the relationship between organizational design and safety in expeditionary organizational contexts. The next section addresses the development of the analytical framework.

2.2 Analytical framework

The analytical framework that is used to explicate assumptions on the relation between organizational design and safety in the analysis of this chapter is mainly built on a categorization of systems theory[8] made by Blom (1997). His categorization is used because he explicates three fundamentally different paradigms on how "systems" may deal with and control (i.e. reduce) environmental uncertainty. Both safety theory and organizational design theory seem to have roots in systems theory (e.g., Grote, 2012; Kuipers et al., 2010). It can hence be argued that constructing an analytical framework based on systems theory may be able to link the two theoretical streams to each other and hence enables explicating assumptions on the relationship between organizational design and safety present within organizational safety theories. This subsequently makes it possible to analyze whether organizational safety theories can be used to get a deeper understanding of the particular relationship between organizational design and safety that is suitable for studying expeditionary organizations. It should be noted that, in Van Strien's (1986) terms, systems theory is located at level A of knowledge generalization, the level of abstract ontological assumptions, whereas organizational theories and safety theories are located at level B, the level of problem oriented theory. This chapter therefore aims to link these levels of knowledge generalization. In the next section, Blom's rather abstract categorization is detailed.

2.2.1 A categorization of systems theory and paradigms on organizational design and dealing with uncertainty

Before Blom's categorization can be presented, first an understanding of what a "system" is needs to be explicated. According to Rapoport (in: Kramer, 2007, p. 63) crucial to understanding system is that a system is:

- Something consisting of a set of elements
- Among which relationships are specified so that
- Deductions are possible from such relations to others or from the relations among the elements to the behavior or history of the system.

In his categorization of systems theory, Blom distinguishes between classic, open and self-referential paradigms in systems theory. By means of this categorization Blom develops three fundamentally different perspectives on how characteristics of relationships between elements, the "inside" of a system, enable the system to deal with the environment, its "outside". It is emphasized that employing systems theory does not imply that an

[8] In the remainder of this chapter the term "systems theory" will be employed to refer to General Systems Theory (cf. Boulding, 1956).

organization "is" a system. Instead, systems theory is employed because it is regarded useful to understand an organization as a system in order to get more insight into its behavior and challenges (cf. Kramer, 2004, p. 69).

In this section, Blom's paradigms are linked to organizational theory in order to develop three fundamentally different perspectives on the role that organizational design can play in dealing with environmental uncertainty. The link with organizational theory in the analytical framework is made because this shows what forms explicit assumptions on organizational design may take. This opens up the road for detecting what assumptions the selected organizational safety theories have on the relation between organizational design and safety. Subsequently, it can be established whether these organizational safety theories are suitable for tapping into the relation between organizational design and safety in expeditionary organizations. Both inferences are detailed in the analysis of this chapter[9].

2.2.1.1 Classic systems theory and organizational design

A classic systems perspective acknowledges an environment, however, the relationship between the environment and the system is considered as static. This enables to define the relationships between elements entirely based on norms formulated inside the system by means of following a top-down "normative order" that defines what is relevant to the system and what is not. This implicates that the system is oriented towards internal stability, predictability and compliance to a prescribed "code" (Blom, 1997, p. 14). Consequently, the system is inflexible to any *change* in the operational environment. Dealing with environmental uncertainty in classic systems theory can be interpreted as making sure that the "normative order" within the system is maintained. This means that deviations due to environmental variation have to be removed so that the criteria for stable interaction between the elements within the system can be upheld. These premises of classic systems theory can be found in traditional bureaucratic organizational design theory, in which design is aimed controlling interactions by means of "top-down" procedures and creating maximum opportunity for predictability (Morgan, 2006, p. 11-32). As such, often in such designs it is witnessed that "control" is achieved by designing organizations with a maximum division of

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[9] It should be noted that within both systems theory and organization science, major differences exist in for example, definitions on what "elements" are and what "structure" is. To some extent, this will be explicated in the sections below. However, the main goal of the section below is not to contribute to these discussions on the definitions of "structure" or "elements" but to present fundamental differences in major streams of theorizing within organization science on the relation between the "inside" of an organization, its design in abstract terms, and its ability to deal with, or adapt to, environmental dynamics.

labor and numerous control loops to keep behavior of the organization's primary process within "top down" defined criteria.

2.2.1.2 Open systems theory and organizational design

In contrast to the classic systems perspective, the open systems approach, developed by Von Bertalanffy and many others, defines a system as a set of elements that interact with each other *and* with the environment. In other words, the relationship between system and environment is theorized as dynamic and interactive. Within open systems theory the central focus is on maximal adaptation of the system to a *changing* environment. Blom and Haas (1996) point out that open systems theory assumes that sensing changes in an environment and making subsequent changes within the system is not problematic. This means that open systems theory assumes that change can be sensed and recorded successfully, so that the system can perform the necessary adaptations accordingly. Hence, the system is expected to change along with environmental cues. Consequently, dealing with environmental uncertainty in open systems theory can be interpreted as attaining absolute flexibility.

Open systems perspectives on organizational design are characterized by concepts such as "contingency" and "best fit" (e.g., Schreyögg, 1980; Morgan, 2006, p. 39-65). Donaldson (2006) points out that within the contingency approach, the set of relationships between organizational actors, that according to him can be called the organization's structure, should vary along with variation of "contingency factors". He (*ibid.*, p. 51) points out that a premise of the contingency approach is that: "*its sees structure that is optimal as varying according to certain factors* (…). *Thus, the optimal structure is contingent upon these factors*". Such contingency factors are (cf. Donaldson, *ibid.*): strategy, size, task uncertainty and technology. Hence, Donaldson highlights that within such contingency approaches the "best way" of designing organizations depends on contingency factors.

According to Schreyögg (1980, p. 308), the "open system" contingency approach can be summarized by the following three principles:

1) There is only one "best answer" to deal with a specific contextual situation. This means that within given situations there is no choice among alternative structural arrangements.
2) The environment is considered as a given, which means that the organization has no possibility of influencing or controlling its environmental situation.
3) The organization has to achieve a certain level of economic performance in order to survive. The criteria against which its performance is assessed are defined externally, which means that level and criteria are out of control for the organization.

Morgan formulates critique to the "open systems" approach to organizational design. He states (2006, p. 74) that: "*it can be misleading to suggest that organizations need to "adapt" (…) this tends to make organizations and their members dependent on forces operating in an external world*". It can therefore be argued that dealing with environmental uncertainty is somewhat more challenging than hypothesized by an open system perspective. Blom's (1997) third systems-theoretical perspective addresses this issue.

2.2.1.3 Self-referential systems theory and organizational design

The self-referential systems perspective (see for example: Luhmann, 1990; Maturana, 1980) advocates that the relationship between system and environment is not as straightforward as is assumed by "open" systems theory. Blom (1997) emphasizes that self-referential systems theory does not assume openness. Instead, it reintroduces the idea of a system's "closedness" (Kramer, 2004). This closedness within self-referential systems theory points to the realization of "circularity": the system's structure influences its adaptive capacities and survivable qualities. That is to say, the nature of the relationships between elements, that can be called the structure of the system, largely influences whether the system can "reproduce" itself in such a way that survivability of the system in its environment is attained (see also: Achterbergh & Vriens, 2010). In this sense, systems adapt *in reference* to themselves. Heylighen and Joslyn argue that the principle of circularity is one of the cornerstones of self-referential systems thinking because it points out that: "*circularity*, (…), *can help us to understand fundamental phenomena, such as self-organization, goal-directedness, identity, and life, in a way that had escaped Newtonian science*" (2001, p. 9).

The circular relationship between the system's structure and its adaptive capacities is highlighted by the concept *emergence*. Emergence acknowledges how specific survivable patterns of relationships, or interactions, can emerge out of indeterminate relationships ("chaos") (e.g., Waldrop, 1992). The concept of emergence and the principle of circularity highlight the intertwined relationship between self-organization and system structures within a self-referential systems perspective.

Within organization science, contributions that can be interpreted as possessing self-referential characteristics, hence theorize on characteristics of the "inside" of an organization that influence self-organization of employees in such a way that it impacts adaptability and survivability against the background of an environment. As a consequence, a major difference between organizational design theories that can be interpreted as having "self-referential" properties and an "open systems" perspective on organizational design, is that "self-referential" contributions elaborate on ways in which the organizational skeleton, or "inside" of an organization influences self-organizing abilities of employees, given that it has to deal with a particular environment.

For example, Morgan (2006, p. 95-105) employs the metaphor of the holography to point to the notion that labor divided in a "holographic" (i.e. recursive) way facilitates the organization's survivability in a dynamic environment. Similar self-referential ideas can be found in socio-technical systems design (STSD) and IOR in particular. De Sitter (1994) for example, points out that grouping and coupling activities in a particular way facilitates the ability of operators to deal with disturbances and improves flexibility at the organizational level.

Summing up, from a self-referential systems perspective, dealing with environmental uncertainty can be interpreted as "bounded", or selective (cf. Blom & Haas, 1996), adaptation. A self-referential perspective on organizational design hence acknowledges that organizational design both enables and restricts the organization's options to adapt to environmental demands, due to the influences of design characteristics on self-organizing abilities of employees.

2.2.1.4 A systems theory perspective on organizational design and safety in expeditionary organizations

A self-referential systems perspective and accompanying assumptions on the relation between organizational design, adaptation and self-organization seems to suit the goal of this thesis best. That is to say, this thesis is interested in finding out in what way organizational design of expeditionary organizations influences safety, understood as a gradual process that emphasizes self-organization.

As such, it can be argued that organizational safety theories that enable getting a deeper understanding on the relationship between organizational design and safety in expeditionary organizations, have to address the "circular" relationship between characteristics of organizational design and the ability to adapt in a dynamic environment. This emphasizes that such theories have to possess either an implicit or explicit self-referential systems perspective in which the relation between organizational design and the ability of employees to develop safety, against the background of a dynamic environment, is addressed explicitly.

The questions subsequently addressed in the next sections therefore are: 1) to what extent can assumptions on organizational design and safety be found in the four frequently used organizational safety theories, and 2) do they enable understanding the relationship between organizational design and safety in expeditionary organizations? For reasons of overview, in the 3x2 matrix below, the relationships between systems-theoretical premises and assumptions on the role of an organization's design on the ability to adapt to environmental uncertainty are explicated.

Table 1: 3x2 matrix on the relation between systems theory and organizational design

		Reducing environmental uncertainty by:	Organizational design assumptions for dealing with environmental uncertainty:
Level A systems-theoretical premises	**Classic**	Creating and maintaining stability and predictability	Top-down design of control loops
	Open	"Absolute" adaptation	Aimed at maximum variation and adaptability
	Self-referential	Bounded or selective adaptation	Aspects of design influence "self-organization"

2.3 Four frequently used organizational safety theories

In this section, four frequently used organizational safety theories are explicated: Safety Management Systems theory (Hale et al., 1997), resilience engineering theory (e.g., Hollnagel, Woods & Leveson, 2006; Hollnagel, 2012), Normal Accidents Theory (Perrow, 1999) and High Reliability Theory (e.g., Weick & Sutcliffe, 2007).

2.3.1 Safety Management Systems theory

Safety Management Systems (SMS) theory developed by Hale et al (Hale et al., 1997; Hale, 2003) is widely employed as the basis of many safety management systems. For example, Lin (2011, p. 14) points out that Hale's SMS theory is used to construct so-called "Dutch models" on safety management. In SMS-theory, safety issues are regarded as resulting from deviations that have to be removed in order to ensure predictable, stable and safe organizational behavior. In their 1997 publication, Hale, et al argue that the concept of deviation from a desired standard or ideal situation is well known in safety and that: "*Deviations can be seen as undesired outputs arising from problems with inputs, controls and/or resources*." (1997, p. 128). In his 2003 article, Hale sums up what components should constitute a "good" SMS (Hale, 2003, p. 187-189):

- A clear understanding of the company's primary production processes and all their ancillaries, with all the scenarios leading to significant harm. […] Task and job safety analysis must be rooted in a functional analysis of the processes so that the deviations in the flow of those processes, which can lead to accidents, can be traced to their origins and linked to barriers.

- A life cycle approach to safety management, considering how all the system elements are designed, purchased, constructed, installed, used, maintained, modified, and disposed of.
- A problem-solving cycle identifying, controlling, and monitoring these scenarios at three levels: people in direct control of the risk, procedures and plans and a structure and policy level that at intervals reviews the current operation of the SMS and makes structural improvements to it.
- Feedback and monitoring loops ensuring assessment against performance indicators at each of the three levels.
- Systems at the middle level, linked to the staff and line functions of the company, delivering the crucial resources and controls to safety-critical tasks at the lower level.

To model an organizational safety management system, Hale et al (1997) employ In 't Veld's Structured Analysis and Design Technique (SADT; 2002). The SADT technique is used to visualize every process step in the production cycle of a particular product and study a particular activity with regard to its inputs, outputs, resources and controls. This method enables one to determine where deviations in inputs and resources threaten the safe and stable output of a particular activity so that these deviations can be reduced in order to ensure safety. In the words of Hale et al: "*The logic of the modeling is that the inputs must be necessary and sufficient to produce the outputs, given the resources and the control criteria*" (1997, p. 126). Summing up, the SMS developed by Hale et al aims to attain safety by reducing deviations. It aims to do so by generating safe criteria and scenarios for inputs, outputs and resources. Based on these criteria, the SMS is able to steer the behavior of particular activities back to stable and, presumably, safe behavior by means of the implementation of barriers.

2.3.2 Resilience engineering theory

Resilience engineering theory aims to account for the problem that quite often work situations seem to be dynamic and that aiming for a stable "steady state" may not be the best way to ensure safety in such dynamic situations. Although Rasmussen (e.g.: 1994; 1997) did not label his own work as "resilience engineering theory", it can be argued that he was one of the first theorists who addressed the influence of operational dynamics on safety as a reaction to the, then, dominant "human error" approach. Moreover, resilience-engineering theory seems to be building on Rasmussen's theoretical premises, such as in the work of one of the main contributors to resilience engineering theory, Erik Hollnagel (e.g.: Hollnagel, 2004; 2012).

In his 1997 article, Rasmussen pointed to the effects of "dynamic" operational conditions on managing safety. He stated that: "*Control of activities and their safety by the classic prescriptive command-and-control approach deriving rules of conduct top-down may be effective in a stable society where instruction and work tools at all levels can be based on task analysis. In the present dynamic situation, this approach is inadequate and a fundamentally different view on system modeling is required*" (1997, p. 185). In the same paper, Rasmussen proposes that: "*safety in the direct interaction with the work environment must be based on an identification of the boundary of safe performance by analysis of the work system, and the criteria that drive the continuous adaptive modification of behavior.*" (1997, p. 206). In line with Rasmussen, Woods (in: Hollnagel, Woods & Leveson, 2006, p. 22) states: "*Resilience then concerns the ability to recognize and adapt to handle unanticipated perturbations that call into question the model of competence, and demand a shift of processes, strategies and coordination*". These quotes highlight that instead of reducing deviations in order to ensure stability, resilience-engineering theory acknowledges that it might be impossible to remove all uncertainty in many organizational settings. Consequently, resilience engineering emphasizes that organizations should cope with this uncertainty and consequently focuses on how an organization might adapt safely.

A recent development within resilience engineering is the concept "functional resonance" and the accompanying Functional Resonance Analysis Method (FRAM; e.g., Hollnagel, 2012; Hollnagel & Goteman 2004). FRAM aims to understand and analyze the influence of organizational dynamics on safe performance and incorporates such an understanding into an organizational safety management method. For understanding "functional resonance" and FRAM, the underlying concepts "intractability" and "emergence" are central. According to Hollnagel, large socio-technical systems are (partly) intractable. This means that: "[…] *the conditions of work are underspecified, in principle as well as in practice. To the latter must be added the fact that resources materials, manpower, information and especially time usually are limited and sometimes insufficient*" (Hollnagel, 2012, p. 24). So, while Hale et al aim for a detailed description of the production process of an organization, the concept of intractability points to the issue that such efforts will always come up short. Therefore, according to Hollnagel, understanding the influence of dynamics on safety should start with looking at "emerging" relationships at the operational level that come into existence in doing everyday work (2012, p. 25). To get insight into these emerging relationships, he proposes to define a system on the basis of "functions" instead of "structures". Hollnagel writes: "*Systems are usually defined with reference to their structure, that* *is, in terms of their parts and how they are connected or put together. (…). It is, however, entirely possible to define a system in a different way, namely in terms of how it functions rather than in terms of what the components are and how they are put together. From this perspective, a system is a set of coupled or mutually dependent functions.*" (2012, p. 6). According to Hollnagel, safety issues may arise as a result of emergence because the performance of functions is subject to variability that originates from the: "*approximate adjustments of people, individually and collectively and of organizations that are the basis of everyday functioning*" (2012, p. 29). Consequently, in a system of interdependent functions "[…] *the functions may interact or combine so that a specific function is incorrectly performed or even missed*" (Hollnagel & Goteman, 2004). This is referred to as "resonance". To identify potential sources for resonance and prevent safety consequences from emerging, Hollnagel (2012, p. 36) proposes to:

- Identify functions that are required for everyday work to succeed
- Characterize the variability of these functions
- Look at a specific state and determine how functions may become coupled
- Propose ways to manage the possible occurrences of performance variability

To describe functions and visualize their interaction, Hollnagel proposes a hexagonal representation in which the performance of each function is specified in six characteristics (2012, p. 46). In addition to the inputs, outputs, controls and resources that Hale et al (1997) specified for analyzing a particular activity, Hollnagel proposes to add the notion of "time" and "necessary preconditions" to the analysis of functions because any function is in some sense governed by time and almost all functions need "something that has to exist" before the function can be carried out (2012, p. 46). Although Hollnagel deliberately omits SADT's use of arrows because it would refer to something "prescribed", the hexagonal representation has some resemblance to the SADT method Hale et al (1997) employed to model their SMS. Hollnagel explicitly points to the notion that the hexagonal model is to be used to both visualize the functions themselves and the interaction between functions as the organization adjusts to a particular situation.

Summing up, resilience engineering aims to account for the constantly changing nature of dynamic operational conditions. Managing safety, from the perspective of resilience engineering, is not about removing deviations on the basis of pre-defined safety criteria. Instead resilience engineering theory intents to get insight into the organization's adaptation process to dynamic operational situations. FRAM aims to do so by highlighting the concepts of "intractability" and "emergence", defining the organization in terms of "functions" instead of “structures” and consequently identifying resonating functions in order to propose ways to manage performance variability of these functions.

2.3.3 Normal Accidents Theory

In the aftermath of a major incident at the nuclear power plant of Three Mile Island, Charles Perrow developed his Normal Accidents Theory (NAT; 1999). The major premise of NAT is that accidents in particular organizations are inevitable. Due to their design, such organizations will eventually experience a serious accident without any major technical failure or human error. Instead, small failures eventually add up to failure of the entire system.

Before detailing the specific characteristics of organizations that, according to NAT, run particular high risks on a “normal accident”, Perrow (1999, p. 65-66) distinguishes different “system levels” within the organization: a part, a unit and a sub-system. Parts refer to single parts such as a particular valve. A unit refers to a “functional collection of parts” such as a steam generator. Subsequently, a sub-system refers to a cluster of units such as the cooling system of a nuclear power plant. The entire “system” (i.e. a nuclear power plant) is then comprised of several sub-systems. Consequently, he distinguishes between an incident and an accident. An incident refers to the failure of a part or unit, an accident to the failure of a sub-system or the disruption of the entire system. After that, he defines two types of accidents: component failure accidents and system accidents. Component failure accidents “*involve one or more component failures (part, unit, sub-system) that are linked in an unanticipated sequence*” (Perrow, 1999, p. 70). System accidents “*involve the unanticipated interaction of multiple failures*” (*ibid.*).

Central in Perrow’s theory are the concepts *coupling* and *interaction.* Coupling refers to the degree of interdependence between elements[10]. When the operations of one element requires the output of another element as its input, these elements are tightly coupled. When these elements are loosely coupled, they do not rely on each other’s in or output in order to function properly, as a result they can operate independently from each other. With regard to interaction, Perrow distinguishes linear and complex interaction. Linear interaction between organizational elements occurs when elements interact exactly as designed. Complex interaction occurs when unexpected interactions between elements take place.

According to Perrow, a combination of tight coupling and complex interaction in any organization is a recipe for disaster. That is to say, such organizations are confronted with

[10] Deliberately the word “element” is used here because, along NAT, it may refer to a part, unit or sub-system.

incompatible control demands. At the one hand, Perrow argues that tight coupling requires centralized control because local insight into the dependencies between the elements of the system is limited. Complex interaction, on the other hand, requires decentralized control because operators may have the best understanding of the specifics of the system's elements and can solve disturbances before interactions become complex at the central level. The figure below shows the map in which Perrow classifies particular organizations along the concepts coupling and interaction (1999, p. 96).

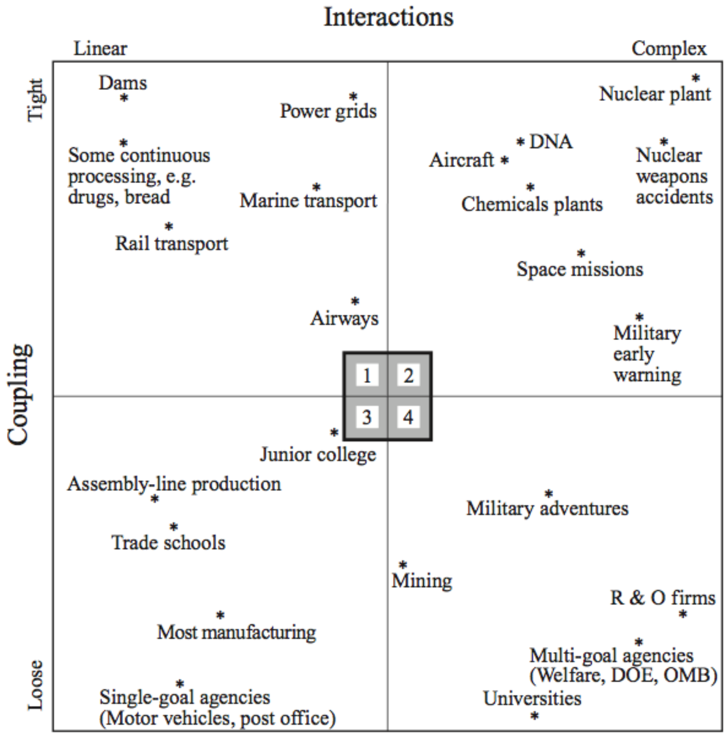

Figure 4: Coupling versus interaction[11]

Because to Perrow the control problem in tightly coupled and complex interacting organizations is fundamentally unsolvable, these organizations run the inevitable risk of a system accident. He employed the phrase "normal accident" because, to Perrow, a system accident is a "normal" consequence of the way these particular organizations are designed.

[11] Source: Perrow, 1999, p. 96

2.3.4 High Reliability Theory

According to Sagan, high reliability theorists focus on hazardous organizations that have achieved nearly error free operations through "intelligent organizational design and management" (1993, p. 14). Extensive research into the daily operations of, amongst other organizations, aircraft carriers has resulted in the identification of strategies and processes that are believed to produce impressive safety records (Sagan, 1993, p. 15). High Reliability Theory (HRT), also referred to High Reliability Organizing (HRO; e.g., LaPorte & Consolini 1991; LaPorte & Rochlin, 1994; Roberts, 1993; Weick & Sutcliffe, 2007) can be interpreted as being developed as a "reaction" to NAT. That is to say, high reliability theorists point to interactive processes between operators that are thought to be able to overcome the dangers of tight coupling and complex interaction pointed out by NAT. Early HRT theorizing identified redundancy, decentralization and "conceptual slack" as such reliability enhancing strategies (cf. Rijpma, 1997).

Firstly, with regard to redundancy Rochlin, LaPorte and Roberts (1987) pointed out that, on aircraft carriers, a particular kind of redundancy was present: decision/management redundancy[12], which ensured that critical decisions are timely and correct. As much safety-critical information is spread constantly through the organization in order to "assure that any critical element that is out of place will be discovered or noticed by *someone* before it causes a problem" (Rochlin et al, 1987; italics in original). Also, decision/management redundancy entails the creation of "shadow units" that can take over the tasks of other units immediately, if necessary (Rochlin et al, *ibid*). A second strategy is decentralization of authority. Next to an organization that possesses redundancy, high reliability theorists stress the relevance of decentralization (Rijpma, 1997). Sagan (1993, p. 22) argues that operators must have considerable decision-making authority concerning safety issues. Rijpma points out that: "*this is done in order to solve problems as they emerge*" (1997, p. 17). Decentralization is often associated with a "culture of reliability". As Rijpma (*ibid.)* points out such a culture: "*imbues members of the organization with clear operational goals, decision premises and assumptions. It gives them the competence and autonomy to respond to complex interactions, once these reach the surface, and correct them before tightly-coupled processes are set in motion which might* lead *to disaster*". Thirdly, Rijpma (1997) points to Schulman's notion of "conceptual slack". According to Schulman (1993): "*Conceptual slack is a divergence in analytical perspectives among members of an organization over theories, models,*

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[12] Rochlin et al (1987) also stressed the importance of technical and supply redundancy for high reliable operations. Only decision/management redundancy is highlighted above because technical and supply redundancy are not directly relating to aspects of organizational design.

or causal assumptions pertaining to its technology or production processes". Hence, by deliberately creating discussion and reflection conceptual slack is thought to create a certain "buffer" in the actions of operators in order to improve safety.

More recent theorizing in HRT can be interpreted as building on the work of Weick and Sutcliffe (2007). Weick and Sutcliffe highlight that dealing with the unexpected is influenced by existing "expectations" that create "blind spots" within the organization. Such expectations are based on existing "roles, routines and strategies" (Weick and Sutcliffe, 2007, p. 23). Expectations hinder dealing with the unexpected because they encourage searching for confirmation while filtering out evidence that does not confirm our expectations. Weick and Sutcliffe propose the concept of mindfulness to overcome these problems and deal with the unexpected successfully. They define mindfullness as: "*a rich awareness of discriminatory detail"* and continue: "*By that we mean that when people act, they are aware of context, of ways in which details differ, and of deviations from their expectations.*"

Weick and Sutcliffe subsequently argue that highly reliable organizations possess a "mindful infrastructure" in order to deal with the "unexpected". According to Weick and Sutcliffe (2007, p. 18), such a mindful infrastructure enables organizations to: "*organize themselves in such a way that they are better able to notice the unexpected and halt its development. If they have difficulty halting the development of the unexpected they focus on containing it. And if the unexpected breaks through the containment, they focus on resilience and swift restoration of system functioning.*". Weick and Sutcliffe subsequently advocate five principles that enable organizations to develop a mindful infrastructure and deal with the unexpected successfully and safely. These five principles are divided into three principles of anticipation and two principles of containment (Weick and Sutcliffe, 2007, p. 45- 82). Anticipation, according to Weick and Sutcliffe, deals with the ability to sense small disparities and stop the development of undesired events. Containment, according to Weick and Sutcliffe, refers to abilities "to prevent unwanted outcomes after an unexpected event has occurred" (2007, p. 65). Their three principles of anticipation are: preoccupation with failure, reluctance to simplify and sensitivity to operations. Their principles of containment are: commitment to resilience and deference to expertise. Preoccupation with failure entails practices that are aimed to spot so-called "weak signals". Even when operations are taking place within pre-determined safety margins "*missteps, missing resources, miscommunications or mistakes have to be found and put right before they can turn into a tragic flaw*" (2007, p. 47). Reluctance to simplify refers to the ability to scrutinize existing expectations, labels and categories in order to prevent deviations to propagate through the organization unnoticed (2007, p. 53- 58). Sensitivity to operations "*is about work itself, about seeing what we are actually doing regardless of what we were supposed to do based on intentions, designs and plans*" (2007, p. 59). After an unexpected event has happened, Weick and Sutcliffe quote Wildavsky in defining "commitment to resilience" and state: "*The mode of resilience is based on the assumption that unexpected trouble is ubiquitous and unpredictable; and thus accurate advance information on how to get out of it is short in supply. To learn from error and to implement learning through fast negative feedback, which dampens oscillations are at the forefront of operating resiliently.*" (2007, p. 69). Resilience, according to Weick and Sutcliffe, has three components: "*the ability to absorb strain and preserve functioning despite the presence of adversity*", "*An ability to recover or bounce back from untoward events"* and "*an ability to learn and grow from previous episodes*" (2007, p. 71). The fifth principle, deference to expertise, refers to the ability to "migrate decisions both up and down" in order to ensure that early warning signs are noticed and acted upon (2007, p. 74). As Weick and Sutcliffe highlight, this poses challenges to hierarchy within the organization. Therefore, as they point out, a "mindful culture" loosens hierarchy in favor of expertise, which is mostly located at the operational level. They also stress, that "expertise" is a relational concept: "*expertise is an assemblage of knowledge, experience, learning and institutions that is seldom embodied in a single individual*".

2.4 Analysis

The analysis presented in this section will confront the four organizational safety theories with the analytical framework in order to investigate and explicate how these theories theorize on the relationship between organizational design and safety. This is done to subsequently establish whether these theories can be used to get a deeper understanding of the relationship between organizational design and safety in expeditionary organizations. The next section starts with the analysis of safety management systems theory.

2.4.1 Analyzing safety management systems theory

The main goal of the Hale et al.'s SMS is to improve safety by developing a detailed description of the organization's primary process, determining safety boundaries/ criteria for activities and adjusting deviations in such a way that behavior of the activity remains within pre-determined safety criteria. In the analytical framework, it was pointed out that a classic systems interpretation of organizational design assumes that "control" can be achieved by implementing "top-down" defined procedures. The premises that the Hale et al. SMS has on establishing safety, can therefore be interpreted along these "classic" remarks. That is to say, the relationship between organizational design and safety implicitly found in the Hale et al. SMS points to the assumption that safety can be created by creating stability and predictability. These premises of the SMS seem exemplary of Dekker's notion of the "bureaucratization of safety" because "control" by creating stability and predictability was interpreted as exemplary for bureaucratic design premises. It is argued by means of the arguments below that an explanation for these assumptions on the relationship between organizational design and safety, which seems to be underlying the Hale et al. SMS, can be found in implicit and explicit traces of "classic" systems theory.

Firstly, implicit traces of classic systems theory can be found in the choice to focus on mapping activities by means of an adoption of In 't Veld's SADT technique. In 't Veld's technique is based on the so-called "steady state model" (see also: In 't Veld, 2002) of organizational control, which is aimed at minimizing influences of (environmental) variation on inputs and outputs of an organization's transformation, or primary, process and detecting, evaluating and adjusting variation within a particular transformation process. Subsequently, In 't Veld's steady state model attempts to keep behavior of activities within the primary process between, top-down, specified criteria. In the analytical framework, it was explicated that classic systems theory aims to deal with uncertainty by imposing an internally formulated normative idea about how elements should interact, onto the relationships within the system in order to maintain internal stability and predictability. Hence, the use of In 't Veld's methods can be interpreted as possessing traces of a "classic systems" perspective. Furthermore, the definition of risks as "deviations" in the Hale et al SMS can be regarded as a second implicit application of classic systems theory. That is to say, the SMS is aimed at removing these deviations to comply with prescribed safety criteria. This highlights that the Hale et al SMS intents to achieve safety within the organization by ensuring internal predictability and closing the primary process for environmental uncertainty and change. Furthermore, the Hale et al SMS seems to be built on the somewhat "utopian" premise that when all activities are behaving along the pre-defined criteria a perfect or "safe" state of the organization can be achieved. Hence, due to such implicit traces of classic systems theory and accompanying rather bureaucratic assumptions on the relationship between organizational design and safety, applying the Hale et al. SMS to gain a deeper understanding of the relationship between organizational design and safety seems problematic. Firstly, the assumption that safety can be achieved by aiming for predictability and stability are in contrast to the premises of developing safety in a dynamically complex environment. Secondly, linking safety problems to aspects of organizational design seems impossible by using the Hale et al. SMS. In line with In 't Veld's steady state model, the SMS seems to treat the way the "transformation process" is designed as a given. Hence, the SMS is unable to relate design of a transformation process to safety outcomes. As such, it is argued that the Hale et al. SMS cannot be used for getting a deeper understanding of the relationship between organizational design and safety in expeditionary organizations.

2.4.2 Analyzing resilience engineering theory

In contrast to keeping organizational behavior between predetermined boundaries and closing the organization to environmental change, Rasmussen (1997) pointed out that safety management of organizations with "dynamic" operations should not be based on traditional assumptions of "command and control". Instead, safety management, according to Rasmussen, should be based on: "*an identification of the boundary of safe performance by analysis of the work system, and the criteria that drive the continuous adaptive modification of behavior*". To cope with, or manage, such dynamics and "become resilient", Woods argued that the organization needs to: "*adapt to handle unanticipated perturbations that call into question the model of competence, and demand a shift of processes, strategies and coordination*" (2012, p. 22). In this sense, it can be argued that the relationship between design and safety that seems to be present in resilience engineering theory, is that organizations should "move along" with environmental demands. This can be interpreted as a straightforward assumption from an "open systems" perspective on the relation between organizational design and adaptation. That is to say, open systems theory emphasized that to adapt to a changing environment and cope with environmental uncertainty, the relationships between elements within the system have to vary along with environmental change.

Some "self-referential" traces of explicit attention for the influence of the "inside" of the organization on safety can be found too in the works of Woods and Hollnagel. That is to say, Woods points to the influence of "processes, strategies and coordination" on adaptability and safety. Also, Hollnagel's concept of functional resonance seems have a particular interpretation of the relation between characteristics of the inside of an organization on safety. In terms of Hollnagel, interacting functions hinder each other in their outcome, they "resonate". FRAM consequently, proposes ways to reduce "functional resonance" within the organization. In this sense, resilience engineering theory seems to address particular influences of organizational design on safety outcomes, in which several aspects of the "inside" of the organization are related to adaptability and safety. However, applicability of these definitions to expeditionary organizations is questioned. That is to say, in the previous chapter it was pointed out that design in expeditionary organizations was characterized by underspecification of the underlying organizational "skeleton", or the absence of a coherent organizational design, which seems to point to a different problem than the influence of existing rules and procedures and resonating "functions". So, although FRAM and resilience engineering addresses some influences of organizational design on safety, it seems to be unable to get a deeper understanding of the relationship between organizational design and safety in expeditionary organizations. By means of the arguments presented below, is argued that problems with the applicability of FRAM are mainly due to an inconsistent systems-theoretical foundation that guides Hollnagel's deliberate choice to turn away from "structure" in favor of "functions".

Firstly, Hollnagel justifies his choice for functions over structure by arguing that a focus on functions enables one to study what the system "does", instead of what it "is". In a 2004 case study on the application of FRAM to operations of a navigation instrument for flight operations, Hollnagel and Goteman write: "[…] *structure, however, represents the normative organization of functions, when everything goes according to plan. Since it is unrealistic to assume that this will always be the case, it is preferable to use a representation that makes it possible to account for how events may develop in reality*." Later on, they point out that an assumption in this particular case study is that: "*the steady-state performance of the underlying air navigation infrastructure and operational structure is assumed to be acceptable as it is*". It is argued that these quotes reveal two, somewhat related, things 1) FRAM has rather implicit classic assumptions on the concept of organizational structure that results in 2) the inability of FRAM to relate design of organizational structures to safety outcomes.

To highlight the first point, a classic systems perspective on organizational design interpreted organizational structure as something "static", created and controlled by a "normative order" in order to maintain a "steady state" within the organization. In their 2004 case study, Hollnagel and Goteman explicitly point out that in their interpretation, structure refers to the "normative organization of functions", which clearly points to the notion that for Hollnagel, structure is something fixed and prescribed. This seems to point to "classic" assumptions from systems theory present in FRAM. So, where FRAM at the one hand seems to be using some aspects of self-referential systems theory, assumptions on the relation between organizational structures and safety has rather implicit classic foundations.

Secondly, and probably due to this inconsistent mix of explicit and implicit assumptions from systems theory, Hollnagel's argues that "when things do not go according to plan" organizational structures become irrelevant. This seems to be in contrast with the experiences of operating in an expeditionary organization, that were highlighted in Chapter One. Quite obviously, in military expeditionary organizations, things rarely go as planned. Instead of becoming less relevant, organizational structures seem to become *more* relevant during expeditionary operations. That is to say, a case study by Kramer (2007) showed that military work in an expeditionary organization was to a large degree characterized by shaping and reshaping configuration of units.

Moreover, Hollnagel specifically turns to "functions" instead of "structure" because to his interpretation, interactions between functions have "emergent" properties. However, his theorizing seems to have no account for the central concept of "circularity" within self-referential systems theory. That is to say, it was argued that the central premise of self-referential thinking is that interactions between elements within the system are influenced by system structures. Interactions between functions in FRAM, however, are not described in reference to any characteristics of structure because Hollnagel deliberately chooses to strikes any form of "structure" from the equation. As such, Hollnagel fails to theorize on the influence of an organization's "inside" on emergence, survivability and eventually, safety.

In addition, Hollnagel's concept of "emergence" does not seem to refer to the emergence of "order" out of "chaos", as it is defined within complexity science (e.g., Kelly, 1994; Waldrop, 1992). In Hollnagel's terms, the process of emergence can go either way, resulting in either adaptability or in an accident. In terms of self-referential systems theory however, an accident cannot be defined as "emerging" because it does not refer to any survivable state of the system. A safety issue, such as an accident or near miss, may therefore only be interpreted as a symptom of a system with characteristics of problematic survivability that fails to cope with environmental uncertainty.

Summing up, resilience engineering theory and FRAM addressed some aspects of the relation between organizational design and safety. However, it was pointed out that the aspects that were addressed did not match the characteristics of expeditionary organizations that were pointed out in Chapter One. For FRAM, this could be related to an inconsistent application of concepts from systems theory. Therefore, resilience engineering and FRAM cannot be applied to getting a deeper understanding of the relationship between organizational design and safety in expeditionary organizations.

2.4.3 Analyzing Normal Accidents Theory

In contrast to safety management systems theory, resilience-engineering theory and FRAM, Normal Accidents Theory (NAT) seems to explicitly relate organizational structural design characteristics to safety outcomes at the organizational level. Perrow's concepts of "coupling" and "interaction" address characteristics of the way elements (parts, sub-units and units) within the organization are connected to each other in a particular structural design. Furthermore, he addresses how a combination of tight coupling and complex interaction is a recipe for disaster. In this sense, Perrow's theory clearly relates aspects of organizational design to safety outcomes. As such, his theory shows implicit traces of a self-referential systems foundation. That is to say, he addresses how particular characteristics of the organizational "inside" influence the ability of the organization to operate safely. In this way Perrow seems to account for the concept of "circularity", which was regarded as the cornerstone of self-referential systems thinking by Heylighen and Joslyn (2001).

However, it is argued that despite the explicit relation between structure and safety and apparent traces from "self-referential" systems thinking, NAT is not worked out in such a way that enables it to provide suitable ingredients for getting a deeper understanding on the influence of organizational design on safety in expeditionary organizations. It is argued so for two reasons. Firstly, originating from the Three Mile Island nuclear power facility, NAT's concepts of coupling and interaction seem be tailored to describe characteristics of an already existing organizational design. That is to say, his conceptualization of mainly point to parts, units and sub-systems that are relating to each other in a particular existing configuration. Subsequently it can be argued that the concepts that he developed to describe the relation between aspects of design and safety outcomes are only suitable for analyzing organizations in which relationships between parts, units and sub-systems are already specified. The result of previous research in expeditionary organizations however, indicated that within expeditionary organizations design is underdeveloped. Hence, it can be argued that NAT does not match this essential characteristic of expeditionary organizations and hence cannot be applied to get a deeper understanding of the relationship between organizational design and safety in expeditionary organizations. Secondly, NAT seems to be unable to theorize on the influence of design characteristics on safety in dynamically complex contexts. For Perrow, complexity does not seem to relate to uncertainty, ambiguity and reactiveness of an organization's environment. Instead, it seems to point to "noise" that in combination with a tightly coupled and complex technological design results in internal complexity within the organization. Internal complexity and environmental complexity are, however, not the same thing. As such, NAT is regarded as unsuitable for getting an understanding of the relationship between organizational design and safety in expeditionary organizations.

2.4.4 Analyzing High Reliability Theory

Within HRT multiple aspects of organizational design are addressed in relation to adaptability, self-organization and safety. For example, Weick and Sutcliffe (2007) point out that anticipation strategies of operators are influenced by procedures that can create "blind spots" in their ability to cope with unexpected events. Also, Sagan (1993) pointed out that early developments of HRT were aimed at achieving nearly error free operations through "intelligent organizational design and management". In this sense, it can be interpreted that HRT has a "self-referential" perspective on the organization. However, despite such attention for the relationship between aspects of design and safety, it is argued that HRT does not enable getting a deeper understanding of the relationship between organizational design and safety in expeditionary organizations, because it seems unable to relate the nature of the organizational "skeleton" to safety.

To support this statement, three concepts from the early and later developments in HRT are reflected upon. Firstly, Rochlin et al (1987) pointed to "management redundancy", which they defined as fast and timely information sharing and the creation of "shadow units" that are able to relieve other units of tasks in order to ensure continuity of operations. However, Rochlin et al. do not address the underlying organizational "skeleton" in their lessons for improving coordination and communication. Improving coordination and communication without addressing the underlying configuration of units, may consequently result in treating symptoms of an ill-designed organization. That is to say, Kramer et al (2007; 2012) mainly relate problems in cooperation to underspecification in expeditionary organizations. Hence, improving coordination and communication in expeditionary organizations may be able to do something about the problems that expeditionary organizations face during operations, but it does not address the underlying design problem that seems to cause these issues in the first place.

Furthermore, the creation of shadow units may have worked to improve reliability of operations aboard aircraft carriers, however, when organizational design, of these units is not addressed, using the concept of "shadow units" may end up providing provide "redundancy in parts" instead of "redundancy in functions". That is to say, creating shadow units that can replace other units one-on-one, seems to refer to redundancy in parts. Regarding redundancy in parts, Streeter (1991, p. 169) points out that: "*systems designed on the principle of redundancy in parts are organized and can be reorganized but do not have the ability to self-organize*". This may limit the applicability of the "shadow unit" concept to expeditionary organizations, as self-organization was regarded as relevant for developing safety in expeditionary organizations.

Secondly, Rijpma (1997) pointed to local autonomy of workers and decentralization of authority as an important pillar of HRT. However, it is well known that local autonomy is determined by the nature of the organizational skeleton, or the way labor is divided within an organization (see for example: Mintzberg, 1980). Maximum division of labor, for example, results in workstations with little autonomy. Hence implementing Rijpma's advice without addressing the nature of the underlying organizational skeleton may result in advising to increase autonomy in organizations in which a lack of local autonomy is structurally determined.

Thirdly, the concept of "mindful infrastructure" (Weick & Stutcliffe, 2007) from the later developments of HRT is addressed. Weick and Sutcliffe point out that in highly reliable organizations, people organize themselves in ways that improve the ability of the organization to cope with uncertainty. They pointed to three principles of anticipation and two principles of containment that foster this self-organizing process and result in the creation of mindful infrastructures within the organization. The concept of mindful infrastructure, however, does not account for the influence of design of the organizational "skeleton" on repertoires of activity and routines of operators. This may be due to Weick's (e.g., 1979) definition of "structures" which is quite different from the definition employed in organizational design theory. Organization science however, points out that the way labor is divided is a main source of such activity repertoires and routines (see for example: Kuipers et al., 2010). Hence, the organization's design can be interpreted as an important source for "blind spots" and which may subsequently influence the ability to develop mindful infrastructures, which is neglected by HRT.

As a result of this analysis it can be argued that, although both early and later developments of HRT explicitly relate some aspects of organizational design to safety and reliability, which points to explicit traces of a "self-referential" perspective on the organization and its ability to adapt, HRT fails to incorporate design of the underlying organizational skeleton into its concepts and theorize on its relation with safety against the background of a dynamic complex operating area. This renders HRT unsuitable as a perspective that can be used to get a deeper understanding of the relationship between organizational design and safety in expeditionary organizations.

2.5 Conclusion

This chapter has reviewed four frequently employed organizational safety theories to get more insight into a gap in safety management theory. The analysis has shown that, although some aspects of organizational design were explicitly related to safety, all four theories were unsuitable as a starting point for research on the relationship between organizational design and safety in expeditionary organizations. Some of these issues were attributed to inconsistent and implicit application of concepts from systems theory, for example in the case of FRAM. The next chapter will therefore start with taking a first step in "filling" this gap by using Integral Organizational Renewal-theory, introduced in Chapter One, as a conceptual “compass” in studying ways in which organizational design influenced safety in expeditionary organizations for 107 ASBt’s operations within Task Force Uruzgan.

Chapter Three: Exploring the influence of organizational design on safety in an expeditionary organization[13]

3.1 Introduction

In the previous chapter, a "gap" in organizational safety theory was identified. It turned out that the four frequently used theories could not be used for getting a deeper understanding of the relationship between organizational design and safety in expeditionary organizations. Hence, this chapter takes the first step in attempting to "fill" this gap. Therefore, this chapter aims at answering the second research question, which is:

> **What aspects of organizational design influenced safety of 107 Aerial Systems battery within Task Force Uruzgan?**

In the first chapter a main argument was given for why the operations of 107 Aerial Systems battery (107 ASBt) within Task Force Uruzgan were taken as a starting point for developing a theory on organizational design and safety in expeditionary organizations. Studying 107 ASBt enables exploring the relationship between organizational design of both the unit itself and TFU on the ability to develop safety in a dynamic complex mission area. This was regarded as necessary to get a first and detailed understanding of the relationship between organizational design and safety in expeditionary organizations.

The goal of this chapter, as visualized in Figure 5, is therefore to study 107 ASBt's operations within TFU by means of the conceptual "compass" introduced in the Chapter One. In order to do so, this chapter is divided into several sections. Firstly, the content of the "conceptual compass" is described in detail. Secondly, background information on 107 ASBt and Task Force Uruzgan is presented. Thirdly, the methodology that is employed in this

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[13] Parts of this chapter were published as: Moorkamp, M., Wybo, J.L. & Kramer, E.H. (2016). Pioneering with UAVs at the battlefield: The influence of organizational design on self-organization and the emergence of safety. *Safety Science.* DOI:10.1016/j.ssci.2015.09.029 and Moorkamp, M., Kramer, E. H., Gulijk van, C., & Ale, B. J. M. (2014a). Safety Management within Task Force Uruzgan: a report on working with Unmanned Aerial Vehicles. In R. D. J. M. Steenbergen, P. H. A. J. M. Van Gelder, S. Miraglia & A. C. W. M. Vrouwenvelder (Eds.), *Safety, Reliability and Risk Analysis: Beyond the Horizon*. Boca Raton, FL: CRC Press.

chapter is formulated. Fourthly, the results of this chapter are presented. Fifthly, the analysis is explicated. Finally, this chapter concludes with a discussion.

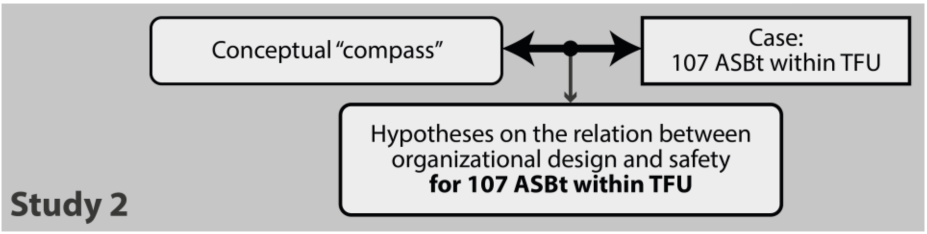

Figure 5: Research model of Study 2
ASBt=Aerial Systems battery; TFU=Task Force Uruzgan.

3.2 Conceptual "compass": IOR's main premises

As stated in Chapter One, the conceptual compass used will be based on the main premises of Dutch/ Lowlands Sociotechnical Design Theory or Integral Organizational Renewal (IOR). Therefore, in this section the main premises of IOR are introduced, which are largely built on the works of De Sitter (e.g., 1994; De Sitter, Den Hertog & Dankbaar, 1997). As a central starting point, De Sitter defines the organization as a social interaction network. He highlights that an organization's structural design, or *the way activities are grouped and coupled to workstations in relation to the flow of orders*[14], influences the nature of social interactions in such a way that it both indirectly and directly impacts the ability of an organization to operate with as few disturbances as possible.

Firstly, the way activities are grouped and coupled to workstations determines the degree to which employees can solve problems at their own workstation, i.e. that they have "internal control capacity" or that they have to pass it on to other workstations in the interaction network and use "external control capacity". Control capacity[15], or autonomy of employees at the operational level in classic organizational science jargon (cf. Van Eijnatten & Van der Zwaan, 1998), is needed to respond to disturbances and environmental challenges and develop controllability, is hence structurally determined. As such, by impacting control capacity, the organization's structural design has indirect influences on the way an

[14] This definition is literally translated from Dutch to English, based on De Sitter (1994).
[15] IOR employs the concept of "control capacity" to refer to operator's options to deal with problems themselves (internal control capacity) or pass them on to another department/ workstation (external control capacity).

organization can deal with disturbances. Secondly, the way activities are grouped and coupled to workstations impacts the social interaction network in such a way that it directly impacts the amount of disturbances. For example, De Sitter (1994) highlights that classic bureaucratic organizations, in which activities are often grouped and coupled at (many) specialist workstations, *structural complexity* exists. Structural complexity refers to a complex and incomprehensible web of interactions between workstations that directly results in problems such as production delays and miscommunication.

According to IOR, seven[16] "design parameters" (cf. De Sitter et al., 1997) can be used to relate the way activities are grouped and coupled to workstations to consequences for control capacity and structural complexity. The higher a particular organization "scores" on the parameters presented below, the more workstations will be confronted with limited control capacity and crippling structural complexity.

1. Functional concentration: the degree to which, in relation to the flow of orders, specialist activities are grouped and coupled at specialist workstations.
2. Division between performance, preparing and supporting activities.
3. Splitting performance activities into smaller parts.
4. Division between performance and controlling activities.
5. Control specialization: splitting control activities over parts of the process (i.e. each specialist workstation its own manager).
6. Control differentiation: splitting control activities per separate domain such as quality, safety, finance and Human Resources.
7. Division of control activities: different control workstations for measuring, evaluating and adjusting activities.

In defining organizational structure, IOR and De Sitter distinguish between a *production structure* and a *control structure*. The production structure refers to the way performance activities such as preparing, supporting and operational activities are grouped and coupled in relation to the flow of orders of the organization's primary process. The first four parameters presented above can be used for characterizing an organization's production structure. Control structure, refers to the way different control activities, such as measuring, evaluating and adjusting, are grouped and coupled to controlling workstation (i.e. design of control

[16] In recent developments of IOR written in Dutch, see for example Kuipers et al. (2010), eight parameters are used to characterize the production and control structure within an organization. However, the seven parameters presented in this section are adopted from an English article by De Sitter et al. (1997) and possess enough detail that suffice the purposes of this section of the thesis.

loops). The fifth, sixth and seventh parameter described above can be used to characterize the control structure within an organization. De Sitter (1994) argues that the way performance activities are grouped and coupled to workstations within an organization's production structure accounts for the lion's share of the influence of organizational design on the nature of the organizational interaction network and the accompanying relation with the amount of disturbances and ability of operators to deal with disturbances. Therefore, it depends largely on characteristics of the production structure whether individual efforts of employees will eventually result in an organization that is able to operate with as few disturbances as possible. De Sitter refers to this ability of an organization as an organization's controllability.

At first sight IOR seems to address key characteristics of expeditionary organizations that were highlighted in Chapter One. That is to say, it seems to relate a definition on organizational design explicitly to aspects of self-organization and adaptation of employees at the operational level and outcomes at the level of the organization. This may lead one to conclude that IOR concepts can be applied one-on-one to get an understanding of the relationship between organizational design and safety in expeditionary organizations. However, IOR is not a theory about safety nor is it a theory tailored to expeditionary organizations. For the following reasons, this limits the applicability of IOR to develop an understanding of the relation between organizational design and safety in expeditionary organizations.

Firstly, although safety problems may be interpreted as a particular type of controllability issue, IOR does not explicitly theorize on the relationship between organizational design and safety outcomes at the organizational level. Instead, as highlighted briefly above, it theorizes on the relationship between organizational design and controllability. Controllability, according to De Sitter, refers the ability of an organization to operate with flexibility, innovation and quality of work for operators with as few disturbances as possible against the background of its environment. Secondly, De Sitter (1994) highlights explicitly that IOR is aimed at standard bureaucratic organizations that he refers to as "Mainstream-Holland Inc [17] ". Although expeditionary organizations are "mixed and matched" from stable, and probably often bureaucratic, parent organizations, Chapter One highlighted that the organizational skeleton of military expeditionary organizations was characterized by under-specification and needed extensive shaping, reshaping and fine-tuning during operations. This implies that a fixed, or stable, organizational structure is absent in expeditionary organizations. This is in contrast to bureaucracies, in which the organizational

[17] This term is literally translated from the De Sitter's Dutch phrase "Doorsnee-Nederland B.V.".

skeleton is rigid and stable. As such, IOR concepts cannot be used one-on-one for a study that is aimed at getting insight into the relation between organizational design and safety in expeditionary organizations. This underlines the relevance of using IOR heuristically, as a conceptual compass, instead of applying IOR "top-down" to develop a "map" on organizational design and safety in expeditionary organizations. A methodology, that employs the concepts of IOR in a heuristic fashion is outlined in section four of this chapter.

3.3 Background information

This section presents background information on both the unit of study in this chapter, the Dutch Army's 107th Aerial Systems Battery, and Task Force Uruzgan. Firstly, background information is given on 107 Aerial Systems Battery. Secondly, more information is presented on Task Force Uruzgan.

3.3.1 107 Aerial Systems Battery

Within the Royal Netherlands Army, 107 ASBt is a unit of about 100 employees that operates with Unmanned Aerial Vehicles. From 1996 until 2010, they operated with Sagem's Sperwer-UAV. A Sperwer is a so-called Short Range Tactical UAV. This means that the UAV is able to gather tactical information with a maximum range of approximately 90 kilometers from its base station. For gathering such information, the Sperwer is equipped with a camera that is can record both at daytime and at night. The camera can only record in black and white. The Sperwer UAV does not have any weapons. Depending on the local circumstances, it is able to operate at a maximum height of 15000 feet. The Sperwer UAV is 3,5 meters in length and has a wingspan of 4,1 meters. It is propelled by a two-stroke petrol engine and is capable of carrying fuel for a four-hour flight. Next to the UAVs, a Sperwer "system" consists of a Ground Control Centre (GCC), a Ground Data Terminal (GDT) and a launching platform (LANS). During the operations of 107 ASBt in Uruzgan, a Report and Analysis Centre (RAC) was also part of the Sperwer "system".

In the sequence of getting a Sperwer UAV in the air, the required activities are depicted schematically in Figure 6 (see also: Moorkamp, Kramer, Van Gulijk & Ale, 2014b). These activities refer to internal activities within the unit and are independent of the organizational configuration in which 107 ASBt is located. To be able to fly with an UAV, the UAV has to be maintained according to strict aviation rules. These rules determine how a particular maintenance job is carried by the maintenance crew, from bolting a particular bolt onto the aircraft to using a specified type of glue. Next, the assembly crew prepares the aircraft for flight by filling the aircraft with fuel and carrying out pre-flight checks. After that, the aircraft is put on a launching device, with the size of a large truck, and the launching crew has -among other things- to make sure the aircraft is launched with a certain velocity. After that, the operating crew in the Ground Control Centre navigates the aircraft during its operations. When the assignment is complete, the UAV lands by using its parachute and airbags. The transport crew then moves to the recovery site to bring the UAV back to the base. When returning from a particular assignment, post-flight checks determine whether the aircraft has to go to maintenance or only needs preparation for the next launch and flight.

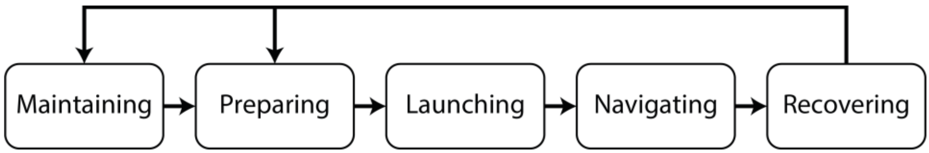

Figure 6: Activities 107 ASBt

Within the Dutch Army, 107 ASBt[18] has a particular place and role. The unit was formed in 1998, and was meant for reconnaissance tasks for the Army's artillery. From 2006, 107 ASBt was part of the Army's Intelligence Surveillance Target Acquisition and Reconnaissance (ISTAR) battalion. The main task of 107 ASBt within the ISTAR battalion was to provide the battalion with "single source" intelligence information. This information was combined with information from other "sources" such as reconnaissance units and electronic warfare to meet the needs from brigade and/ or army corps staff (Royal Netherlands Army, 2002; 2003). In 2006, 107 ASBt was organized by allocating Sperwer systems in three separate platoons (see: Figure 7), which were supported by a logistics and maintenance platoon.

[18] 107 ASBt was named 101 Remotely Piloted Vehicle Battery until 2011. In this chapter, the unit will be referred to as 107 ASBt.

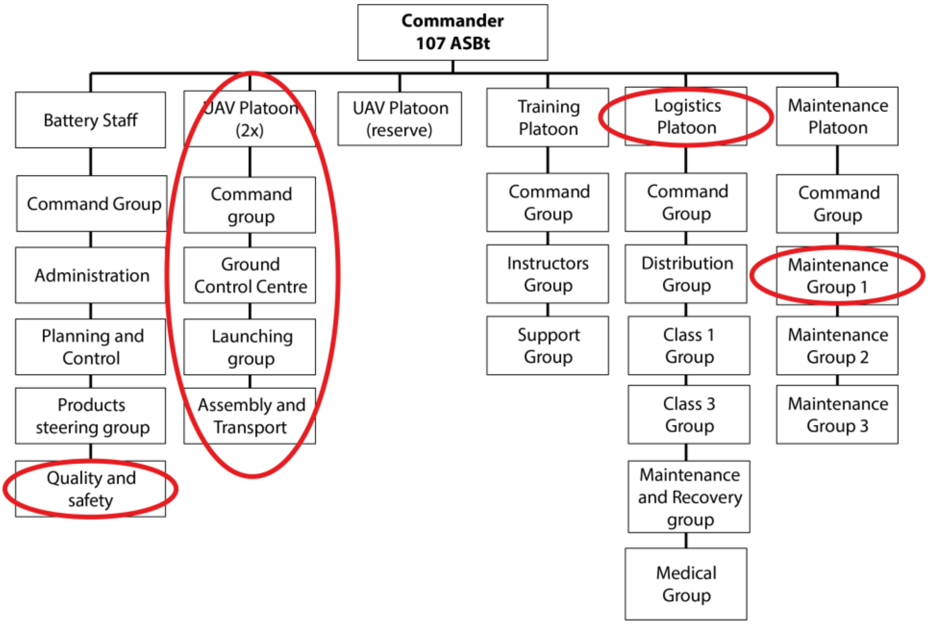

Figure 7: Layout 107 ASBt until 2008

From 2008 on, a number of reorganizations have taken place within the Army, ISTAR and 107 ASBt. Within ISTAR, or Joint ISTAR Command (JISTARC) as it is called today, the concept of the "ISTAR-module" was introduced in 2007. This meant that ISTAR was expected to be able to provide two simultaneously operating expeditionary missions with an ISTAR module that comprised all main intelligence "sources", including UAVs. For 107 ASBt this meant that the unit needed to be able to deliver two operational UAV detachments (Royal Netherlands Army, 2007).

In 2008, reorganization within 107 ASBt transformed the unit from an organization structured by platoons into an organization structured in "green and blue" parts (see: Figure 8). This reorganization was based on directions from the Dutch military aviation authority (MLA; Royal Netherlands Army, 2007) and International Civil Aviation Organization-guidelines (ICAO, 2006). The "blue" parts of the unit are related to flying activities whereas the "green" parts are not related to flying activities of the unit.

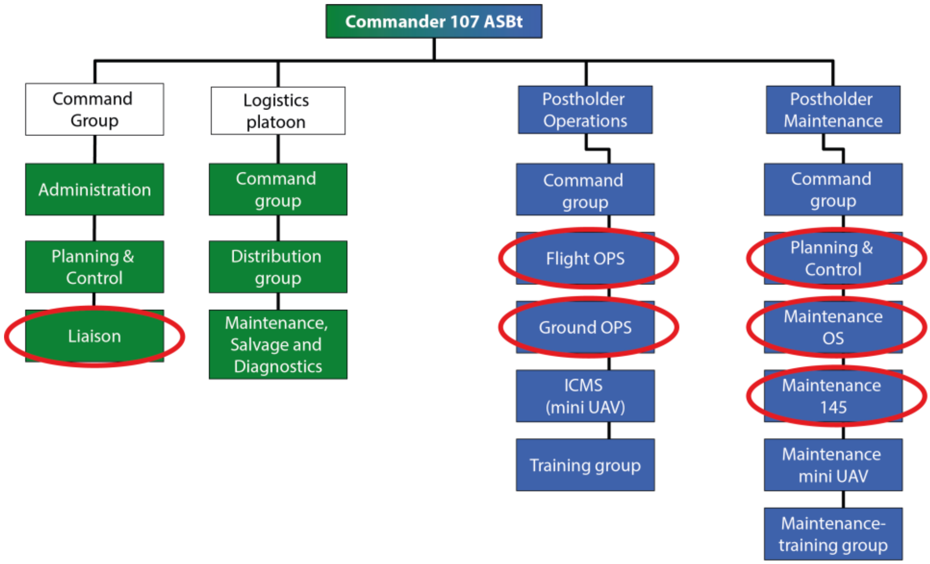

Figure 8: 107 ASBt after reorganization in 2008

In the new organization "Flight OPS" refers to the crew that navigates the UAV in the Ground Control Centre and "Ground OPS" refers to the launching crew. With regard to maintenance, "Maintenance OS" refers to the crew that prepares the UAV for flight, recovers and transports the UAV. "Maintenance 145" refers to "regular" maintenance activities. 107 ASBt mostly trains at the artillery training grounds, located in 't Harde, The Netherlands and at the NATO training facilities in Bergen-Hohne in Germany. The airspace in which the Sperwer UAV trained was, and is, closed for other air traffic.

From 2006 until 2010, 107 ASBt contributed three times to Task Force Uruzgan. For each mission, 107 ASBt needed to assemble detachments from their organization in the Netherlands. This meant that they had to select specific parts in the Dutch organization and assemble them into an "expeditionary" 107-organization (see: Figure 8). The red-circled parts of 107 ASBt in Figure 7 and 8 show the sub-units that were selected from the 107 "parent" organization before and after the reorganization

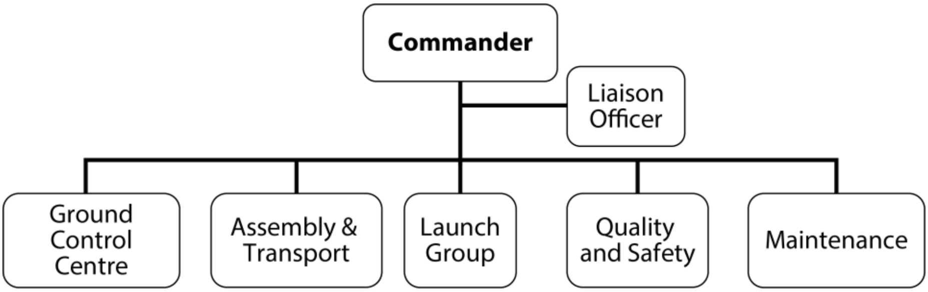

Figure 9: 107 ASBt in Uruzgan

3.3.2 Task Force Uruzgan

Between 2006 and 2010, Task Force Uruzgan (TFU) was a military expeditionary organization that was responsible for reconstruction and security duties in Afghanistan's Uruzgan province (see: Figure 10[19]). TFU contributed to NATO's ISAF[20] forces and was part of ISAF's Regional Command South (RC-South). The Task Force was mainly built up from elements originating from the Royal Netherlands Army and consisted of two main parts: a Battle Group (BG) for security tasks and a Provincial Reconstruction Team (PRT) for reconstruction tasks. Units of TFU were located at two camps: "Camp Holland" in Tarin Kowt and "Camp Hadrian" in Deh Rawood. Of these two camps, Camp Holland was the largest and housed the majority of the units and the Operations Room (TFU-OPS).

Figure 10: Map of Afghanistan

Within the Army, the way in which the parent organization is designed did not match the requirements of the Uruzgan mission. This means that the Army needed to "handpick" several elements from the parent organization and "glue" them together to form TFU. The units that were selected from the Army and assembled into TFU-1 are shown between the dotted lines in Figure 11.

[19] Source: www.lahistoriaconmapas.com

[20] ISAF: International Security Assistance Force.

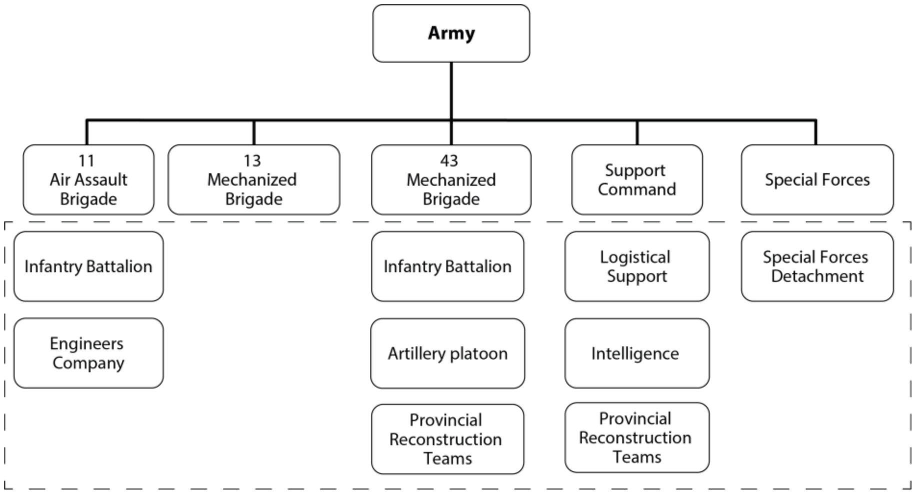

Figure 11: Army units in TFU-1

Also, several units from the Royal Netherlands Air Force were selected to operate in Uruzgan. Although some units were stationed at the same location as TFU's Army units, at Camp Holland, these units were not part of TFU's operational command. Air Force units were operationally commanded by NATO's "regional command south" (RC-South) in Kandahar. The units that were selected from the Air Force to conduct operations in Uruzgan are presented in Figure 12[21]. Within TFU, the Air Force's F16's and Apaches mainly provided intelligence and fire support for Army units on the ground. Chinook helicopters were mainly used for transport proposes.

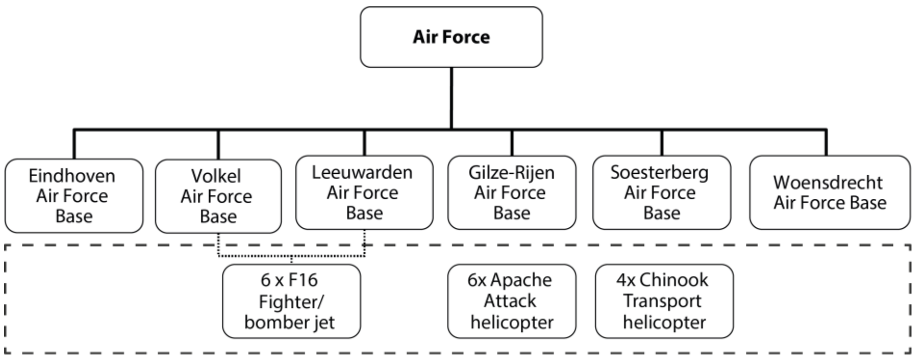

Figure 12: Air Force units in Uruzgan

[21] Soesterberg Air Force Base was closed in 2008. In 2006 however, it was still operational and provided operations in Uruzgan with Chinook transport helicopters.

The units that were selected from the different parent organizations were "mixed and matched" into Task Force Uruzgan. The layout of TFU-1 is schematically presented below. Because 107 ASBt was assigned to the ISTAR detachment within TFU, this detachment is presented with some more detail. Within TFU, the infantry battalions and the artillery platoon were grouped in the so-called "Battle Group". Provincial reconstruction teams (PRTs) are units that do not exist as such within the Army parent organization. During the deployment of TFU, PRT tasks were conducted by several different units of the Army combined with specialists from the Army's reserve forces that are organized under to the Army's support command in the parent organization. The dotted lines in Figure 13 indicate that TFU-staff had limited command and control over units from the Air Force, the Military Police and Special Forces.

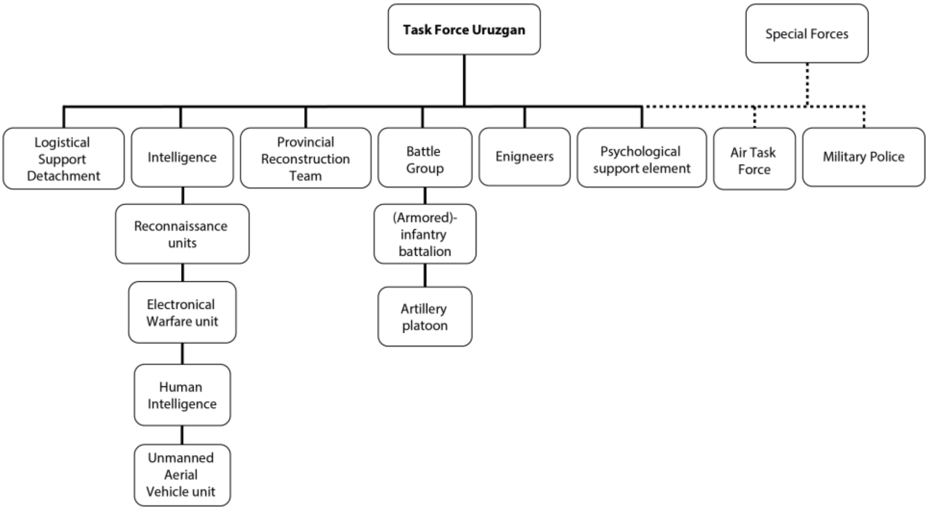

Figure 13: Organizational layout of TFU-1

3.4 Methodology

In this section, it is firstly described how the relationship between organizational design and safety is operationalized in order to be studied in a particular organizational context such as that of 107 ASBt within TFU. After that, the units studied and the way data was collected is explicated. Thirdly, the analytical approach that is used is detailed. Fourthly, issues of reliability and validity are described.

3.4.1 Operationalization by means of a particular "normal work" approach

To explore the influence of organizational design on safety for 107 ASBt within TFU, the concepts "organizational design" and "safety", and their relationship have to be operationalized. That is to say, the relationship between these concepts cannot be studied right away because these concepts are located as Van Strien's level B of knowledge generalization. As such, a translation to level C has to be made in order to be able to study these concepts in the context of 107 ASBt's operations within TFU. To make this translation, it is argued that a particular understanding of everyday operations, or "normal work" (cf. Dekker, 2005) of 107 ASBt's operators, is necessary. As was highlighted in Chapter One, safety in dynamic complex contexts is mainly achieved by means of self-organization and adaptation by interacting employees at the operational level. Adaptation and self-organization as such takes place during operations of employees at the operational level, which implies that capturing "normal work" of employees and the way they solve all kinds of safety issues is able to shed light on self-organization and adaptation in relation to safety. Besides that, Dekker points out that, while developing safety operators find themselves on the crossroads between the dynamics of the environment and the organizational context in which they work (cf. Dekker, 2005). This means that while developing safety in a dynamically complex environment, they also have to deal with aspects of the organizational context. Organizational design can quite obviously be interpreted as a substantial part of this organizational context, as was also highlighted in Chapter One. However, in order to get insight into the influences of this part of the organizational context on self-organization and adaptation of employees, a particular approach has to be taken because one cannot directly observe how operators dealt with "the way activities were grouped and coupled to workstations in relation to the flow of orders" while developing safety against the background of a dynamically complex environment. It is argued that these influences of organizational design have to be analytically reconstructed from influences that the organizational interaction network has on self-organization. That is to say, in the previous chapter, by means of the premises of IOR, it was pointed out that organizational design influenced the ability of the organization to deal with disturbances both *directly* and *indirectly* by its effects on the nature of the organizational interaction network. These effects manifest itself in the amount of disturbances operators experience and the way the ability to solve disturbances was impacted by control capacity. Hence, by getting insight into the work of operators and the influences they experience from the interaction network in which they are located while developing safety, enables relating aspects of this interaction network to the amount and type of safety problems they experienced and the way they could solve safety issues. Subsequently, these influences from the organizational interaction network can be related to the way activities were grouped and coupled to workstations in order to analytically reconstruct the relationship between organizational design and safety.

As such, to be able to unravel influences of organizational design on safety within expeditionary organizations, firstly, insight needs to be created in the influence the organizational interaction network has on the kind of safety problems operators experience and the way they attempted to deal with safety related problems during operations. Secondly, the influence of the interaction network needs to be connected to the way activities are grouped and coupled within the organization in order to reconstruct the influence of organizational design on safety[22]. As such, an analytical strategy is applied that Kramer (2007) refers to as "*analytical abduction*", in which existing theoretical concepts are combined with case study data in order to construct inferences. This approach enables to relate premises on organizational design, explicated in the paragraph on the conceptual compass, to experiences on the influence of the organizational interaction network on the type and amount of safety problems and the ability that operators have to solve safety related problems.

3.4.2 Research strategy: units studied.

In the introduction of this chapter, and also in Chapter One, it was argued that 107 ASBt's operations within TFU were a good starting point for an exploration on the relationship between organizational design and safety in expeditionary organizations because both 107 ASBt and TFU were "mixed and matched" out of stable parent organizations and operated in the dynamically complex mission area. As such, studying 107 ASBt's operations within TFU enabled exploring the relationship between both their design and TFU's design on safety of their operations.

At the one hand, to explore the relationship between 107 ASBt's organizational design on safety for 107 ASBt's operations within TFU, the relation between the interactions within 107 ASBt and safety issues have to be studied. On the other hand, exploring the relationship between TFU's design and safety from the perspective of 107 ASBt, interactions between 107 ASBt and TFU's units and its consequences for safety have to be explored. Hence, design of this study can be defined as a single case "embedded" case study design (cf. Yin, 2003, p. 39-41), because a single case within TFU, with multiple embedded units, is studied. A single-case approach has implications for external validity of claims made, because

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[22] Note here that the concept "safety" is defined at the organizational level. Dealing with safety issues is defined at the level of individual operators.

interactions within TFU are studied from the perspective of one unit only. These issues with regard to external validity are described in more detail in the last paragraph of this section.

3.4.3 Data collection

To collect the type of data that is needed to explore the relationship between organizational design and safety of 107 ASBt's operations within TFU, a qualitative study was conducted in which 13 in-depth interviews were conducted with employees of all sub-units of 107 ASBt who served one or multiple times in Uruzgan from 2006 until 2009. The main reason to conduct a qualitative study, instead of a quantitative study, is that according to Strauss and Corbin (1990), a qualitative case study methodology is especially suitable for studying phenomena that are highly contextualized. Expeditionary operations in a dynamically complex operating environment can be defined as such a highly-contextualized phenomenon. Also, qualitative research has the ability to reconstruct interactions between individuals and the way these interactions shape the way individuals give meaning to a particular situation (e.g., Blumer, 1986), which is relevant for attempting to get insight into the way the interaction network influenced the amount of safety issues and the ability of operators to solve safety related problems.

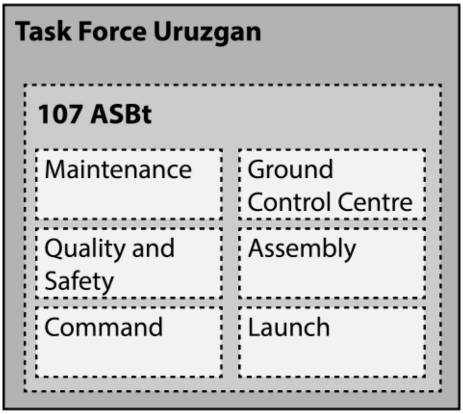

Figure 14: Case study design for Study 1

Subsequently, during the interviews, respondents were firstly asked about the kind of safety problems they experienced and the strategies with which they attempted to solve these problems in order to operate safely in the Uruzgan mission area. Next, during the interviews information was collected on the influence of organizational interaction network on these safety issues and on the ways operators tried to solve these problems. This meant that the interviewer(s) asked follow-up questions on relationships between departments of their own unit and relationships with other units within the Task Force and whether this resulted in safety problems or influenced the way they could solve safety issues. Interviews were conducted until no new influences of the interaction network within 107 ASBt and within TFU on safety were found. This results in a "saturated" (cf. Wester, 1987, p. 60) understanding of the way in which the nature of the interaction network within TFU and within their own unit influenced safety.

To be able to refer to 107 ASBt's operators in the remainder of this chapter, the employees that were interviewed were given a "code" along the sub-unit in which they worked. To ensure anonymity, these codes cannot be linked to individual operators. The codes that were used are presented in Table 2 below.

Table 2: Interview codes

Sub-unit	Code
Ground Control Centre	G
Maintenance	M
Assembly	A
Command	C
Launch	L
Quality and Safety	S

3.4.4 Data analysis

To explore the influence of organizational design on safety for 107 ASBt within TFU, the qualitative methodology of Wester and Peters (2004) is followed. Their methodology is followed because the four steps proposed to construct a *grounded theory* provide a systematic guideline to combine experiences of individuals with theoretical constructs. This is needed in this chapter to analytically reconstruct the influence of organizational design on safety from the way interaction networks impacted the amount and type of safety problems and the ability of operators to solve safety problems. In line with these remarks, and the specific "normal work" approach that is used, this chapter adopts the four phases proposed by Wester and Peters in a specific way, as detailed in the following steps.

Firstly, in the exploration phase, it is investigated what kind of safety problems 107 ASBt encountered and how they tried to solve these. Therefore, firstly, the safety issues 107 ASBt encountered were coded by means of "open coding" (cf. Boeije, 2005). Subsequently, "axial coding" was used to link problems with solutions in order to map strategies. The phrase: "dealing with…" was employed for grouping both problems and solutions in one category. The exploration phase resulted in a total of 45 different categories[23].

[23] Some might argue that an inherent, and reliability enhancing, part of analyzing qualitative data is to replicate coding by a second "coder". Such efforts are thought to establish "inter-rater reliability".

In the specification phase, the 45 categories of the exploration phase were re-examined with regard to the influence of the organizational interaction network, both within TFU and within 107 ASBt. Subsequently, it was investigated whether aspects of the interaction network could be associated either with the safety problems 107 ASBt experienced and/ or the way 107 ASBt's operators could solve problems in order to develop safety of their operations. After that, categories were grouped to form "central substantive concepts" (cf. Wester, 1987, p. 56-58). As a result, four central substantive "dealing with…" categories were developed that all characterized the influence of the organizational network on both the safety problems 107 ASBt experienced and the solutions they found to solve safety issues.

Subsequently, in the reduction phase, the categories developed in the previous phase are analyzed to construct influences organizational design of both 107 ASBt and TFU on safety of 107 ASBt's operations within TFU. This part of the analysis is aimed at making analytical statements by means of analytical abduction in which the "compass directions" are used to interpret the data and construct inferences by means of formulating propositions or hypotheses[24]. This part of the analysis can be interpreted as the core of the grounded theory developed in this chapter. Finally, in the integration phase, conclusions are drawn on the influence of structural design characteristics on safety of 107 ASBt within TFU.

3.4.5 Reliability and validity

In this section, aspects are highlighted that relate to the scientific quality of the study presented in this chapter. In doing so, this section relies on the works of Yin (2003), who elaborated extensively on characteristics of reliability and validity for case study research in general. His work is chosen because the characteristics of reliability and validity that he

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However, Morse (1997b) points out that duplicating coding is only suitable for structured or semi-structured interview techniques. For "open" interviews, it is impossible for a second "coder" to replicate the categories coded by the first coder. This is due to the gradual process of "open" interviews in which a better understanding of the phenomenon of interest is reached in the course of the entire interview process. In line with Morse her arguments, in this study it is not attempted to replicate coding of the categories by a second coder. Instead, a second interviewer was present during the first seven interviews presented in this study in order to ensure progress in understanding the phenomenon of interest during the interview process.

[24] In this chapter, the pros and cons of different analytical stances in qualitative research are not discussed in detail. The interested reader is referred to Richardson and Kramer (2006) and Kramer (2007) for an in-depth discussion on this topic.

defines are largely similar[25] to those selected for the grounded theory approach by Wester and Peters (2004, p. 129), but defined in a more detailed manner as compared to the methodological guidelines of Wester and Peters.

According to Yin, the issue of reliability is focused on minimizing errors and bias in a study so that it is possible to conduct the same case study all over again (2003, p. 37). In order to establish reliability, Yin (2003, p. 38) advises to document as many research steps as possible[26]. Therefore, in this study all interviews were recorded digitally by means of a voice recorder and subsequently transcribed word-for-word. After that, a case study database was developed in which all categories and accompanying pieces of text from were stored.

With regard to validity, Yin points to three types of validity: construct, internal and external validity (2003, p. 35-37). Construct validity, according to Yin, refers to the quality of measurements that are developed for studying relevant concepts. Yin points out that to meet the test of construct validity, a researcher must make sure to: "1) *Select specific types of changes that are to be studied*" and 2) "*Demonstrate that the selected measurements of these changes do indeed reflect the specific types of change that has been selected.*". To attain construct validity, this chapter has to show that changes in safety of 107 ASBt's operations within TFU can be attributed to operators' strategies that are influenced by characteristics of structural organizational design. In order to do so, a construct validity enhancing strategy that is proposed by Yin, is employed in this study (see: 2003, p. 34). In this study, a "chain of evidence is constructed". This means that one "must be able to move from one part of the case study to another, with clear cross-referencing to methodological procedures and to the resulting evidence" (Yin, 2003, p. 105). Consequently, constructing a chain of evidence applies to the interview transcripts, the case study database and the resulting case study report. With regard to such a case study report, the study that is reported in this chapter was part of an overarching research project on safety within Task Force Uruzgan (see: Moorkamp & Kramer, 2014). Consequently, the chain of evidence can be traced in the case study report on that research project.

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[25] A difference between Yin and Wester and Peters can be found in their definition of reliability. Where Yin points out that reliability of a study should ensure that the same study can be can conducted all over again, Wester and Peters (2004, p.129) point out that doing the exact same study over again might be impossible due to the fact that the study (for example interviewing respondents) has already been done. Instead they point out that reliability of a grounded theory study refers to the ability to trace research steps (in Dutch: navolgbaarheid).

[26] In adhering to this advice from Yin, it is argued that the possibility to trace research steps is made possible. Hence, complying with the argument made by Wester and Peters presented in the footnote above.

According to Yin, internal validity is relevant for research designs that aim to make causal inferences (2003, p. 36), which is the case in this chapter. This means that it has to be established that causal claims made, account for possible intervening variables. One strategy that can be followed in order to attain internal validity is "explanation building" (Yin, 2003, p. 120-122), which Yin describes as an iterative process for explaining phenomena. It is described as an iterative process because "*case study evidence is examined, theoretical positions are revised, and the evidence is examined once more from a new perspective*". The methodology of Wester and Peters (2004) that is used in this chapter for analyzing the data can be defined as incorporating such an iterative process for explanation building. The different analytic phases described above are characterized by constantly going back and forth between data and the concepts that were developed, to make sure that these concepts reflect the experiences of 107 ASBt adequately. Furthermore, in the analysis, possible intervening variables were sought explicitly. These are consequently reported in the integration phase of the study. Lastly, interviewees were all asked to review the interview transcript to ensure that the transcript is in concordance with interviewees' experiences.

External validity, according to Yin (2003, p. 37), deals with the problem whether results are generalizable beyond the actual case studied. The nature of this chapter is explorative and served to provide indications for the evaluation of 107 ASBt's safety management instruments carried out in the next chapter. This means that external validity of the findings in this chapter is limited. It should be emphasized, however, that the results of this chapter play a significant role in the fourth chapter of this thesis in which it is attempted to verify parts of the findings of this chapter by studying experiences of other units within TFU. Methodological aspects of this generalization are therefore addressed in Chapter Four.

3.5 Results

The results section is divided into four parts that represent the four "substantive concepts" developed in this chapter. Consequently, the results are presented until the specification phase. Quite interestingly, this research stage made clear that for 107 ASBt, the organizational interaction network within both TFU and their own unit had such a large influence on the amount of safety problems and the way they could solve safety issues that operating safely within TFU was inherently compromised. In the section below, these influences will be explicated.

3.5.1 Dealing with assignments

In section 3.3, it was highlighted that 107 ASBt was used to train relatively isolated from other (military) units. Consequently, they were not accustomed to the types and number of assignments they had to conduct within TFU. As a result, 107 ASBt's problem solving strategies were initially characterized by finding ways to discover what assignments they had to do and with whom they had to cooperate in order to contribute meaningfully and safely to TFU's operations. Due to the diversity of strategies associated with "dealing with assignments", this section is divided into four parts: dealing with new assignments, dealing with too many assignments, dealing with "re-tasks" and dealing with extension of the mission-period.

3.5.1.1 Dealing with new assignments

From the start of the first mission in Uruzgan in 2006, 107 ASBt needed to learn how to operate with configurations units within TFU. This meant that 107 ASBt had to discover what had to be done within ISTAR and TFU. Their activities at the beginning of their first mission in 2006 were therefore characterized by discovering how 107 ASBt could provide a safe and meaningful contribution to TFU's operations, as an employee of quality and safety explains (S-3):

> *The first questions* [from other units within TFU] *were: what can your unit do for me? So, the first things that had to be done were discovering possible partners, communicating a lot and thinking about the unit's PR...*

107 ASBt was not only unfamiliar with operating with other units within TFU, these units were also unfamiliar with operating with an UAV. Employees of 107 ASBt tried to improve

these units' knowledge on the possibilities and limitations of operating with a Sperwer-UAV by giving "sales pitches" within TFU, as an employee of quality and safety explains (S-2):

> *One of the myths about UAVs was that we can track IEDs*[27] (…) *But we can't, so we had to organize sales pitches on what can be done, and what cannot be done.*

Due to such sales pitches, other units learned to use the Sperwer UAV. During the first mission, the Sperwer was mostly used for mapping quala's (small villages), as another employee of quality and safety points out (S-3):

> *That was simply quala-watching: entrance, exits, mapping thickness of the walls. Fly a few circles around it and then to the next one…*

Despite the organization of sales pitches, learning to understand the possibilities and limitations of the Sperwer by other units within TFU was problematic. This resulted in assignments that could simply not be executed, as an operator from the Ground Control Centre explains (G-5):

> *People did not have the right understanding of the possibilities of the UAV, which frustrated us. We got assignments to look for a red car, while the Sperwer was only equipped with a black and white camera. Or we had to determine the depth of a river, which was simply impossible.*

These problems with regard to the possibilities and limitations of the Sperwer-UAV, also resulted in assignments that exceeded safety limitations of the UAV, as an employee of 107 ASBt's maintenance crew explicates (M-2):

> *We had to fly with heavy thunder. We explicitly told them that it was unsafe to fly with thunder both for the UAV and for the crew who had to elevate the UAV's radio tower. We could lose the airplane* (…). *The commander of TFU eventually ordered us to fly. We had to fly.*

An operator of the Ground Control Centre explains similar problems with regard to flying with dangerous weather conditions (G-5):

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[27] IED: Improvised Explosive Device (roadside bomb)

I told them that we had severe "icing" conditions and that we could not fly. Not that we did not want to, but the weather conditions were simply too unsafe. They just wanted us to fly; well then it becomes a safety problem.

For such occasions, the quality and safety department of 107 ASBt employed an interpretation of Operational Risk Management (ORM). A manager from the quality and safety department explains what ORM looked like for 107 ASBt (S-3):

When we are on an operational mission, we have an "escape" for any commanding officer: operational risk management. Sometimes the operational priorities of an assignment can be more important than its safety consequences. Then, safety rules may be violated if all potential risks are acknowledged. But, the most important thing of ORM is that you allocate authority where it should be, so that if something does go wrong the operator is not punished. Then, the commanding officer of the Task Force had to sign a document with which he assumed all responsibility for possible damages.

Due to the aforementioned problems and misunderstandings, the number of assignments declined during 107 ASBt's 2006 mission, as an operator from the Ground Control Centre explicates (G-5):

It remained to be a battle [between 107 ASBt and other TFU units]. *At a certain moment, the assignments declined and the UAVs were just standing there. Well, then they said: go and look at the qualas again.*

During the second and third mission of 107 ASBt within TFU in 2008 and 2009, the discovery process between 107 ASBt and the other units of TFU went faster because 107 ASBt's operators used their experience from the 2006 mission. However, although assignments were initially similar to the assignments in 2006, along the way, units within TFU began experimenting with the Sperwer UAV. Over time, the Sperwer was employed for a wide variety of assignments that ranged from guarding troops that had to rest overnight in the field, flying reconnaissance missions combined with Apache helicopters to deterring Taliban forces. An employee from 107 ASBt's assembly team explains "rest overnight" missions (A-3):

When ground troops were outside and had to stay in the field during the night it was discovered that when we flew above their campsite, the Taliban did not attack them.

The same employee describes that Taliban activity declined when the Sperwer was in the air (A-3):

They knew when we were in the air... Also, the Canadians told us that: when we were in the air, it was much quieter…

With regard to the combined reconnaissance missions with Apache helicopters, an employee of the maintenance crew explains that the Sperwer explored where Taliban-ambushes for ground troops were located so that Apache helicopters could be tasked to attack these ambushes (M-2):

We could see where Taliban ambushes were located, and we could advise ground troops to take a different route. Sometimes it was not possible to take an alternative route and then we flew low over these Taliban troops. They mostly disappeared after that because they knew that Apaches were coming quickly after us to terminate them…

Due to this increased demand for the Sperwer within TFU, 107 ASBt had to cope with an increasing number of assignments. Strategies for dealing with too many assignments are therefore detailed in the next section.

3.5.1.2 Dealing with too many assignments

An employee from the assembly team of 107 ASBt's explains that the number of assignments during the second and third mission in Uruzgan was much higher than planned (A-3):

Instead of doing four assignments in one week, they told us that we had to do seven… Our "asset" was discovered within TFU. They increasingly valued the capacities of the Sperwer.

The liaison officer (LSO) of 107 ASBt was an important link between 107 ASBt and the other units of TFU. During the second mission, other units regularly approached the LSO "horizontally". That is to say, these units "skipped" the formal ISTAR chain of command and made direct contact with 107 ASBt's LSO for assignments, as a commanding officer explains (C-2):

For example, they asked whether we could you fly over a particular location near Chora. Well we were going to Chora the day after, so we included that in our schedule…That was arranged horizontally…

A contributing factor to the dramatic increase in assignments during the second and third mission was the live stream of the Sperwer, which was shown on a TV screen in the Operations Room of TFU (TFU-OPS). To manage the increasing amount of assignments, 107 ASBt's LSO simply turned the TV-screen off, as a commanding officer describes (C-2):

Well, there was this TV screen with a live feed of the Sperwer's camera. When there was some action on the ground it became crowded with people very quickly. (…) A disadvantage of this is that these people are inclined to ask for a lot of things: fly over this…fly over that… And whether it is a Colonel or General, these people are not trained to give us assignments…(…) We then simply turned the TV-screen off, to limit the number of these assignments…

The number of assignments was associated with problems regarding 107 ASBt's personnel, as an operator of the Ground Control Centre explains (G-6):

At a certain point in time, they wanted to increase to two flights a day. (…) That results in problems because we planned our personnel to do one flight a day… So, we had personnel to do one flight a day.

Next to these problems related to personnel of the Ground Control Centre, the number of assignments resulted in maintenance problems, as an employee from the assembly crew explains (A-3):

We conducted much more flights than planned. That result in much more stress on the UAVs. The UAVs therefore required much more maintenance than planned. Also, spare parts were worn out much quicker (…) We were pushed to our limits…And at a given time the UAVs were simply used up…

Due to these maintenance issues, spare parts such as parachutes were used up as well. A problem with the parachutes of the Sperwer was that safety regulations prescribed that they should be washed after three flights. This seemed particularly relevant because of the amount of dust and sand in Uruzgan. However, due to the number of assignments, parachutes had to be "recycled" more than three times to meet the increased demand for the UAV, as an employee from maintenance explains (M-1):

> *We told them that the parachutes were getting too thick because of the sand. They had to be washed again in the Netherlands. They could be used two or three times and then they were used up… But I think they used ORM* [Operational Risk Management] *to fly with these parachutes anyway.… At a certain moment, we also had too few parachutes…*

The number of assignments clearly affected maintenance schedules. A maintenance manager explains that he dealt with these issues by restricting flight time of UAVs (M-2):

> *I dealt with these things by planning assignments differently. I told the LSO and the crew in the Ground Control station that some UAVs had time limits. The LSO consequently planned the assignments according to these limits until all spare parts arrived…*

This implicates that maintenance and operational sub-units within 107 ASBt had to align plans more frequently, as an employee of the assembly group explains (A-3):

> *Look, flying has priority. But it cannot be that maintenance lags behind when the amount of flights increases. Operators wanted to fly and fly and fly while they had no insight in whether the UAVs are maintained… (…) so that had to be coordinated.*

The "system expert" from 107 ASBt's assembly group was responsible for such coordination. Because the need to coordinate between operations and maintenance increased due to the increased number of flights and assignments, the system expert was put under increasing pressure and stress, as an employee from the assembly group describes (A-3)

> *At a certain moment, sweat was pouring from my back…because I had to coordinate maintenance and operations…I became a central player for the unit. I had to decide whether flying was possible. That resulted in increased pressure on the entire assembly group but also on me personally…I just tried to keep myself on my feet…*

Over time, some form of a pattern started to emerge with regard to the number of assignments. This provided some grip for maintenance, as the same employee from 107 ASBt's assembly group explains (A-3):

> *After some time, assignments became structured. Initially they planned that we would be flying in the morning or in the evening and that we had the Sunday off… Well most of the time we did three flights on Sunday and we had no assignments in the morning…So at a certain moment we knew that we should prepare the UAVs for the afternoon and Sundays…*

During a particular assignment, it often happened that the UAV was needed for ad-hoc situations such as "troops in contact" (TIC) when ground troops encountered Taliban fire. In such situations, the Sperwer was often "re-tasked" during flight. Dealing with re-tasks will be detailed in the next section.

3.5.1.3 Dealing with re-tasks

An operator of 107 ASBt's Ground Control Station describes that re-tasks were happening all the time during the 2008-2009 missions in Uruzgan (G-5):

> *Re-tasks were standard during every flight… From the moment we launched the UAV, it was just a matter of time before we were ordered to re-task (…) Most of the time this was due to "troops in contact", but it also happened when the Battle Group needed reconnaissance of a certain area…*

Another operator from 107 ASBt's Ground Control Station explains that the navigation equipment in the Ground Control Station was not suitable for such re-tasks and that re-tasking the UAV during a pre-programmed flight resulted in the inability to control the UAV during an emergency (G-1):

> *Re-tasking was dangerous because re-tasking the UAV meant that the pre-programmed flight plan had to be abandoned. The problem with the Sperwer was that it often lost its radio connection with the base. In such situations, I normally quickly selected the pre-programmed flight plan on the digital map. However, this could only be done when the UAV flew close to its original flight plan and was therefore impossible during re-tasks because the UAV was flying miles from its planned location. I could not select the flight*

plan on the digital map during signal loss because I had to scroll endlessly in the digital map to find the original flight plan.

Because of these issues, operators in the Ground Control Station tried to reduce the number of re-tasks, as a Ground Control Station operator describes (G-1):

It was hard to convince other people of the danger of re-tasks. When we said to the LSO that he should stop with ordering re-tasks he said: "well, it never goes wrong, right?". That's the difficulty with danger and risk, it goes right until the moment that it doesn't…

According to 107 ASBt's operators, after a while, the Sperwer UAV was regarded as an asset that could not be missed within TFU at the end of the second mission. Therefore, the second mission was extended for several months until May 2009. This period is regarded as the third mission in this chapter. Within 107 ASBt this period is also referred to as the "bonus detachment". The next section details how 107 ASBt dealt with extending the second mission.

3.5.1.4 Dealing with extension of the mission

Although 107 ASBt was pushed to, and over its limits during the second mission in Uruzgan, the mission was extended with four months. A commanding officer of 107 ASBt describes what this extension looked like (C-2):

In fact, we executed 2,5 missions in Uruzgan: the first in 2006 and 2007, the second in 2008 and 2009, and again in 2009. I was detachment commander in 2008 and we had planned that the mission would take 6 months. Everything was prepared for a six-month period. During the mission, it became clear that we were required to stay longer…

The extension resulted in personnel planning problems, as an operator of 107 ASBt's Ground Control Station describes (G-1):

As the mission duration became longer and longer we had two options: employees that were already in Uruzgan could serve longer or they had to assemble a new detachment to relieve us. But assembling a new detachment meant that everybody that ever served at

107 ASBt and now worked somewhere else in the Army had to be recalled to serve with us again.

Next to personnel planning problems, extending the mission had consequences for the planning and stock of spare parts, as a maintenance manager explains (M-2):

We never anticipated on this "bonus detachment". My predecessor heard of this extension only several days or maybe one week in advance and it was also unknown how long the extension would be! So, he tried to make a planning of spare parts as best as possible. When I relieved him, a lot of spare parts were coming in based on his planning. But I had to order a lot of extra spare parts as well. And some parts were not on stock in Holland or at the factory so we had to ground some UAVs.

An employee of the assembly group describes that, due to the extension and the number of assignments, 107 ASBt was operating on its limits (A-3):

We had planned to do a six-month mission, and extending that means that all equipment –not only UAV's but also ground equipment- has to operate longer in Uruzgan circumstances with heat and dust. That meant that we were confronted with the limits of what could be tolerated…

Next to discovering what kind of assignments had to be conducted within TFU, 107 ASBt's operators had to discover how to operate in airspace in which other airplanes were flying. Therefore, the nest section explicates how they dealt with these other airspace users.

3.5.2 Dealing with other airspace users

As was highlighted in section three of this chapter, 107 ASBt mainly trained isolated from other air space users. This training situation was significantly different from the situation in Uruzgan. The airspace in Uruzgan was crowded with flying assets from Task Force Uruzgan itself, the Australian Army and other airplanes, such as commercial Russian transport helicopters and American medical evacuation flights. An operator from 107 ASbt's Ground Control Centre describes that dealing with other airspace users in the airspace over Uruzgan was "one big surprise" for 107 ASBt. In particular, he mentions that, in Uruzgan, 107 ASBt had to deal with rules and procedures for avoiding collision ("deconfliction") for the first time (G-6):

We always assumed that we would operate on our "post stamp"[28]*, and that we always operate in restricted airspace that we own. We were not used to operate with other airspace users (…) and in Uruzgan we encountered things that we had not anticipated. To be honest, it was one big surprise over there… (…) We had to invent everything on the spot… (…) That was the first time that we had to deal with deconfliction…*

Dealing with airspace users is divided into four sections: dealing with airspace users within the area of the air traffic control tower, dealing with airspace users outside the area of the air traffic control tower and dealing with airspace users during ad-hoc operations.

3.5.2.1 Dealing with airspace users within the area of the air traffic control tower

The air traffic control tower of Tarin Kowt airfield ("TK-tower") was one of the most important players with regard to deconfliction in Uruzgan, as it controlled a circle of about 10 kilometers around Camp Holland. This, imaginary circle, was divided in to "cake-wedges". An employee from the quality and safety department explains how he tried to familiarize himself with the rules and procedures of the air control tower ("TK-Tower") (S-3):

The control tower was an important player…manned by Air Force employees…they had been there from day one. On a regular basis, they had a tower meeting (…) and at a certain moment you learn with whom you have to coordinate, like: "this is the liaison officer from the Australian Army, how do you do…" And the Dutch Air Force was stationed one door further… (…) nobody told us what to do…we had to discover everything ourselves

Learning to deal with the rules and procedures of TK-tower while operating resulted in problematic interaction between 107 ASBt and TK-tower. This was highlighted by an incident in which a Sperwer-UAV was launched while other air traffic was still approaching Camp Holland's airstrip. As an operator from 107 ASBt's Ground Control Centre explains, this incident resulted from misunderstanding in communication between 107 ASBt and TK-tower (G-1):

We were used to announce our launch by saying: "launch within ten minutes". TK-tower, however, thought that we were launching over exactly ten minutes…So they

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[28] This is how employees refer to their training area in 't Harde, the Netherlands.

thought that there was time for another airplane to land, whereas we decided to launch the UAV after five minutes…

After this incident, an employee from the quality and safety department of 107 ASBt decided to inform TK-tower on the UAV's launching procedure, as an operator from the Ground Control Centre describes (G-6):

After that he[29] *decided that we had to show each other our ways of working. Why some things are important to us and why some things are important to them. Tower personnel changed every eight weeks, and every time they changed we were introduced again. That was how we solved that with TK-tower. After a couple of times that went smooth…*

Another issue in dealing with TK-tower that 107 ASBt's operators had to cope with was that some aircrafts did not notify TK-tower of their approach. Also, during the first mission TK-tower had no directive role and was only able to provide non-binding advice due to legal restrictions in Uruzgan, as an operator of 107 ASBt's Ground Control Centre explains (G-1):

Sometimes we experienced that some aircrafts did not work with TK-tower at all. That we were landing and Afghan or Russian airplanes did not care about anything… TK-tower tried to arrange everything but they had no directive role, they could not hold people accountable when the rules were not obeyed.

Most of the time, however, the Sperwer was deployed outside the circle that was controlled by TK-tower. Outside this circle, other rules and regulations applied, that also had to be discovered by employees of 107 ASBt. Dealing with airspace users outside the circle controlled by TK-tower is detailed in the next section.

3.5.2.2 Dealing with airspace users outside the area of the air traffic control tower

Although the airspace outside the circle controlled by the air traffic control tower was designated as "uncontrolled airspace", the units within TFU employed several methods of "deconfliction"[30] to avoid conflicts and collision. Coordination between airspace users took

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[29] The interviewee refers to the already mentioned employee from 107 ASBt's quality and safety department.

[30] The rules and procedures that were employed to avoid conflicts and collision in the air, are referred to as "deconfliction measures".

mainly place within TFU's operations room. Within 107 ASBt the liaison officer (LSO) was responsible for coordinating with other units within TFU. During UAV flights, the liaison officer was seated in the TFU-OPS. Consequently, the LSO was a key player in discovering how things worked within TFU, as a commanding officer of 107 ASBt states (C-2):

> *While I was busy building our camp, the LSO went to the OPS-room and just asked: "how do things work around here?". And they explained it to him. He was also introduced to the Task Force Air Management Element* [TAME]. *He just made his own deals with everybody and constructed a couple of scenarios for particular operations. That is how agreements were made…*

The Task Force Air Management Element (TAME) was important for the coordination and planning of TFU's flying assets outside the circle that was controlled by TK-tower. All flying assets within TFU had a representative who took seating in TAME and agreements were made on where and when operations took place. By means of TAME, however, it was not possible to reserve actual airspace. Airspace had to be requested at the Combined Air Operations Centre in Bahrain (CAOC). This was done by means of requesting pieces of air space, "keypads", through a computer program based on the instant messaging program mIRC, as the same commanding officer explains (C-2):

> *Before launching, airspace had to be requested. In TAME, no airspace is assigned… There was a mIRC computer in the TFU OPS-room on which all messages for Regional Command South*[31] *were shown. On that computer, I also requested air space by typing "skyview airspace request" …And then I requested "keypads". They had put a raster over Uruzgan that divided the province in squares. I picked the particular keypads that we needed for an operation and chose a particular altitude. Those keypads were then reserved at that particular altitude. We also had to post our VHF frequency, so that other aircraft could contact us directly when they had fly through our airspace…*

Due to the nature of assignments, deconflicting the operations of the Sperwer-UAV with other flying assets of TFU by means of TAME and keypads, however, was associated with problems because the airspace that was requested was by the Sperwer crew was very large, as a commanding officer describes (C-2):

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[31] Regional Command South was located in Kandahar and responsible for the south of Afghanistan, including Uruzgan.

We requested keypads that were several kilometers wide. And we mostly requested a space of eight by four keypads. It was impossible for other aircraft to know in which particular keypad we were at a certain point in time.

As a result, deconfliction between aircraft outside the circle controlled by TK-tower relied mostly on local coordination by means of the VHF radio and "see and avoid", which are commonly used deconfliction methods for "regular" military aircraft. The Sperwer, however was not able to participate in these methods. With regard to "see and avoid" an operator of 107 ASBt's Ground Control Centre explains that the Sperwer-UAV was blind with regard to other aircraft in the airspace (G-1):

We were flying blind…I mean, the Sperwer does not have any eyes…We had a camera but that camera looks to the ground…

In addition, most of the time the Sperwer-UAV operated outside the range of 107 ASBt's VHF radio that was located in the Ground Control Centre. It was therefore impossible for other aircraft to make contact with the Sperwer, as a commanding officer explains (C-2):

We flew on a particular altitude that was reserved for us only, and when other aircraft wanted to use that altitude they had to contact us by radio…But they could not reach us…The Sperwer was able to operate at a distance of 90 kilometers from the base, but the range of our VHF radio was much smaller. So, when we operated in Chora, for example, we did not know whether Apaches were also flying there…

Consequently, deconflicting with other aircraft outside the circle controlled by TK-tower was impossible for 107 ASBt. The same commanding officer of 107 ASBt states that the area outside TK-tower's circle looked like the "Wild West" (C-2):

Outside (TK-tower's circle) *it was the Wild West…We could not reach other aircraft. For example, we could not inform Apaches on our location… we were unable to contact anyone…*

These problems with regard to deconflicting outside TK-tower's circle had consequences for safety, which is highlighted by a near miss between the Sperwer and two Dutch Apache helicopters, as a commanding officer explains (C-2):

> *We may have had countless near misses…An Apache pilot thought that he had a near-miss with a French Mirage fighter jet…But at that time there were no French in that area. When they looked into that incident they found out that it was us…*

This section explicated how 107 ASBt dealt with other aircraft outside TK-tower's circle during flights that were scheduled. The next section will explicate how they dealt with other aircraft during ad-hoc operations and re-tasks.

3.5.2.3 Dealing with air space users during ad-hoc operations and re-tasks

As was highlighted above, the Sperwer was often re-tasked during an ad-hoc event such as "troops in contact". During such ad-hoc events, many flying assets were directed to the same location to assist ground troops, which also that predefined plans of deconfliction needed to be abandoned. Deconflicting these assets during such ad-hoc operations was done by means of mutual communication in the Operations Room of Task Force Uruzgan (TFU-OPS). As is shown schematically in Figure 15, some units of TFU had their own section within TFU-OPS. A watch officer monitored ongoing operations ("Current").

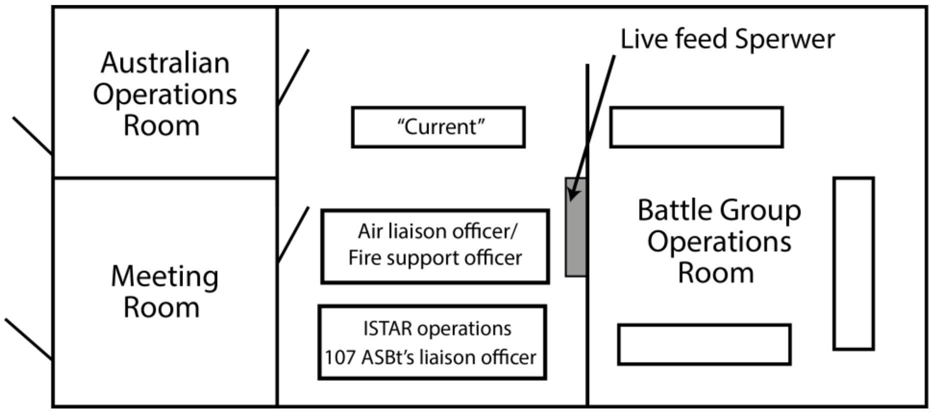

Figure 15: Schematic layout Operations Room of Task Force Uruzgan 2008

For deconfliction between the Sperwer and other air space users within TFU during ad-hoc operations, not only 107 ASBt's liaison officer (LSO) was seated in the TFU-OPS. An air liaison officer (ALO) was the representative for the assets of the Dutch Air Force such as

Apaches and F16's. A fire support officer (FSO) was the representative for the Battle Group[32]. Although the Battle Group was an Army unit, the Battle Group was an important airspace user as they operated with artillery[33]. The Dutch Air Force had a separate OPS-room at Camp Holland. Within the Air Force OPS-Room a Ground Liaison Officer (GLO) represented the Army. Also, an Australian detachment was part of TFU, they had a separate room within TFU-OPS, as is shown in the Figure above.

During ad-hoc operations, a "Forward Air Controller" (FAC-er) managed the air space around these operations. Mostly a FAC-er closed the air space above ground operations for all non-essential aircraft by means of declaring a "Restricted Operations Zone" (ROZ). A commanding officer explains how he dealt with this seemingly complicated deconfliction process between flying units during ad-hoc operations (C-2):

> *When we had a re-task in an area that was not deconflicted beforehand, we arranged that on the spot. Then I went to the fire support officer and asked: "are you shooting over there? "is there a ROZ"? Then I went to the ALO…and so I talked with all the important people...*

Although the Sperwer was directed to a ROZ many times to assist ground troops, there was no direct communication between the operator of the Sperwer in the Ground Control Centre and the FAC-er, as an operator explicates (G-6):

> *When we were tasked to assist troops in contact, the Apaches were mostly also there. But when F16 or F-18 fighter jets arrived we were almost always removed from the ROZ. That was all dealt with by the LSO. I never had direct contact with a FAC-er.*

A commanding officer explains that one of the main reasons that the Sperwer operator could not communicate with a FAC-er was that both the operator of the Sperwer and the FAC-er would become overloaded with information (C-2):

> *When we were sent to such operations, I talked with the fire support officer and he then contacted the FAC-er. (…) It is good to have a couple of layers because a FAC-er does*

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[32] The Battle Group mostly consisted of an Army infantry battalion and an Army artillery platoon. During the Uruzgan mission however, Battle Groups were also assembled from Marine units.

[33] Artillery units are able to shoot with grenades over distances of approximately 20 kilometers and consequently use significant pieces of air space during their operations.

not want to listen to eight radios (…) and otherwise everybody would also start bothering the Sperwer operator…

3.5.3 Dealing with units at Camp Holland

At the start of both missions, 107 ASBt had to build its camp in order to start operations. To do so, 107 ASBt had to work together with other units at Camp Holland such as the Engineers and Logistics. Dealing with units at Camp Holland is divided into two sections: dealing with units at Camp Holland at the beginning of both missions and dealing with constantly changing units at Camp Holland.

3.5.3.1 Dealing with units at Camp Holland at the beginning of both missions

At the beginning of the first mission 107 ASBt had to negotiate quite firmly to obtain a suitable place for deployment at Camp Holland, as an operator of 107 ASBt Ground Control Station describes (G-5):

Our place was hard earned by …[34]. He fought really hard for that spot… And it was only dust and sand…

However, the place at Camp Holland at which the Sperwer's launching device was located crossed the landing strip of Tarin Kowt airfield during launches of the UAV, as is schematically presented in Figure 16.

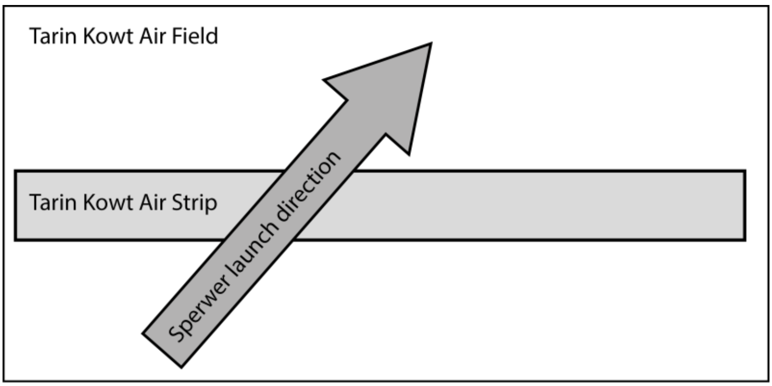

Figure 16: Schematic representation of Sperwer launches at Tarin Kowt airfield

[34] The name is omitted to respect anonymity.

Consequently, 107 ASBt was confronted with landing and departing aircraft at every launch of the Sperwer. An operator of 107 ASBt Ground Control Station describes this launching situation (G-5):

> *We could only launch in one direction... (…) and we could not launch in the opposite direction because then we would be launching over Camp Holland's barracks. We were launching over the landing strip, which was not helpful…*

Not only the place of the launching device was associated with problems. The launching device was also placed next to a so-called HESCO-wall, a big wall that was built to protect Camp Holland from enemy fire (see: Figure 17). This wall prevented the crew from having sight on the launching direction and incoming air traffic. Also, on the other side of the HESCO-wall was a road for military vehicles.

Figure 17: Sperwer launching installation[35]

To deal with incoming air traffic and traffic on the road next to the HESCO-wall, it was decided to put the Ground Safety Officer who was in charge of safety of ground operations of 107 ASBt, such as launching, on the HESCO-wall. In this way, he could be on the lookout for any problems during launching, as an operator of 107 ASBt's Ground Control Station explains (G-6):

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[35] Source: Dutch Defense press (http://www.dutchdefencepress.com/sperwer-withdrawn-from-royal-netherlands-army-service/).

He kept an eye on air traffic and other things… We could not see that because we were launching over the HESCO-wall, so we put somebody up there. When he spotted any air traffic, the flight was aborted.

An employee from 107 ASBt's quality and safety department acknowledges these tasks for the ground safety officer (S-2):

My main task was to monitor the surroundings, to look for any aircraft, personnel or cars… When that happened, I aborted the launch and made sure that the incoming aircraft could land safely… (…) We experienced once that the UAV had a technical problem and dove into the airstrip after launch… When there would have been a helicopter flying there, we would have had a serious problem.

During the startup phase of 107 ASBt's first mission within TFU, the unit had to improvise at Camp Holland. Next to dealing with the launching location, maintenance of the Sperwer's parachutes was also characterized by improvisation, as an employee from 107 ASBt's quality and safety department describes (S-2):

When we arrived in Uruzgan, we had no water, no electricity and the location was problematic. We also discovered that our parachute-drying tower, which was 24 meters high, could not be placed at Camp Holland, and then we had to improvise. This had consequences…we lost electric power a couple of times and we also had shortage of water[36]*… (…) In order to comply with safety rules and regulations we have to attain the right conditions…Eventually we succeeded, but I doubt whether we operated optimally…*

The same employee from 107 ASBt's quality and safety department points out that the startup phase of the second mission resembled the startup phase of the first mission, but that it was easier for 107 ASBt to cope with units at Camp Holland because they had learnt from previous experiences (S-2):

[36] The Sperwer's parachutes had to be dried under specific atmospheric conditions, which required a certain humidity level. Water was needed to reach the required level of humidity.

> *The problems started all over again… They had not anticipated on our arrival again… But it was easier for us because we had done it before… (…) We had to put a lot of effort in it…*

During 107 ASBt's missions, TFU's units at Camp Holland changed frequently. How 107 ASBt dealt with constantly changing TFU-personnel is explicated in the next section.

3.5.3.2 Dealing with "rotating" units at Camp Holland

Dealing with units at Camp Holland was complicated by the frequency in which units within TFU were relieved and replaced by "new" units from the Netherlands. Within the Dutch defense organization, the process of relieving and replacing units is also referred to as "rotation". An employee from 107 ASBt's Ground Control Station explains that every time the Battle Group "rotated", 107 ASBt was confronted with a "new" Battle Group that had to learn to work with an UAV all over again (G-5):

> *We invited the new Battle Group and showed them everything all over again…How we worked and what we could and could not do…*

To deal with rotations, the units that were relieved tried to transfer as much knowledge as possible to the new units in a period of one or two weeks. This process of transferring knowledge is referred to as a "HOTO" (hand-over-take-over). An operator from 107 ASBt's Ground Control Centre describes, however, that the HOTO process of TK-tower were not sufficient to transfer al details of working with a Sperwer-UAV (G-1):

> *These HOTO's were not sufficient to learn everything about operating with a Sperwer. So, we knew that personnel of TK-tower changed every eight weeks. Then, we used to visit new TK-tower personnel to check up on any problems.*

TFU's Battle Group had a similar HOTO-process. However, when asked whether these HOTO's were sufficient to transfer all knowledge on operating with a Sperwer, an employee from 107 ASBt maintenance crew answers that this was not the case (M-2):

> *No, HOTO's are incredibly busy. There are twice as many people on the camp and they are constantly deliberating on how to do this and that…And the people that are leaving have their minds already set at going home…*

"Rotating" was associated with safety issues because new units and employees within TFU had to learn to operate with the limitations and possibilities of a Sperwer-UAV all over again, as a commanding officer of 107 ASBt explains (C-2):

> *One of the issues was that a new commander did not understand our safety limitations. (…) One such as safety rule is that our landing zone had to be free of any obstacles. And the new commander decided that it would be convenient to build a new watchtower in that area… then we cannot fly anymore…And also, he decided to place iron markers along a road in our landing zone... then we cannot fly anymore either because when a UAV hits those markers during landing, it's total-loss…*

On this particular issue, it was decided to start an "ORM-procedure". The same commanding officer explains this procedure on this particular issue (C-2):

> *We were already airborne when we heard that they had put iron markers in our landing zone. Then we had to start an ORM-procedure really quick. We had to weigh the risks of landing outside the camp risking that Taliban fighters would capture the UAV or risking substantial damage to the UAV by landing between the markers. Eventually the TFU-commander had to decide because that responsibility is above my pay grade. Losing the UAV would have cost us one million Euros.*

Operating in Uruzgan also meant that 107 ASBt had to deal with environmental circumstances regarding the weather and the landscape. These circumstances differed substantially when compared to their training circumstances. Strategies that concern dealing with such circumstances are reported in the next section.

3.5.4 Dealing with environmental circumstances in Uruzgan[37]

Environmental circumstances in Uruzgan differed substantially from 107 ASBt's training circumstances. For example, temperatures in Uruzgan ware much higher during the summer and the landscape in Uruzgan was characterized by mountains and a sandy and dusty soil.

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[37] Note that the term "environmental" employed in this section, refers to atmospheric conditions and characteristics of the Uruzgan landscape. This is not to be confused with the term dynamic complex "environment" as it is used in section two of this chapter. The latter refers to the degree of environmental variation, that is to say the degree in which tasks and goals that an organization has to conduct in its operating environment, varies.

This section is divided into two sections: dealing with environmental circumstances during take-off and flight and dealing with environmental circumstances during landing.

3.5.4.1 Dealing with environmental circumstances during take-off and flight

Camp Holland was located at a height of approximately 1300 meters. This meant that the air density was much lower when compared to 107 ASBt's training conditions. The difference in air density had a significant effect on the way the Sperwer was launched, as an employee from 107 ASBt's maintenance crew explains (M-2):

> *Here* [in the Netherlands] *we have an air density of 1013 at sea level. Over there we had an air density of 890 hecto Pascal. We had to adjust our launching speed because lower air density decreases lift of the UAV. Also, we the maximum altitude of the UAV was lower over there…*

The lower air density resulted in problems at the begin of the first mission that had to be solved to launch the UAV safely, as another employee of the maintenance crew describes (M-1):

> *Operators were not familiar with the difference in air pressure…it was a learning process (…) At the beginning we saw that the UAV descended after launch… it just dropped…*

Along the way, a solution for this specific problem was found. An employee of 107 ASBt's maintenance crew explains that solving this problem involved considering many parameters (M-2):

> *One can solve that by making the UAV lighter, increasing the launching pressure and increasing the amount of RPM's of the Sperwer's engine. The launching pressure could only be increased until 9,8 bar and making the UAV lighter by reducing the amount of fuel has implications for the range…*

Mountains characterize the Uruzgan landscape, which is rather different than the landscape in which 107 ASBt used to train. Flying in this landscape resulted in problems with regard to the connection of the Ground Control Station with the Sperwer. When the Sperwer flew behind mountains, the connection with the Ground Control Station was lost. An employee from 107 ASBt's maintenance crew (M-1) explains that navigators were not familiar with this problem at the beginning. To prevent faulty maintenance orders due to these problems, he decided to coach the crew in the Ground Control Centre on the effects of mountains on the Sperwer's signal.

> *It occurred that the operator had communication problems with the UAV, that the images of the Sperwer's camera were not transmitted properly. That could result in aborting the mission and writing a maintenance order to find that communication problem. But what we did was when the operator encountered a communication problem they called me. I looked over their shoulder and asked things like: where are you flying? Then I saw that they were flying behind a mountain… The navigator had also seen that but they do not understand that the communication link works on a line-of-sight principle. The aircraft must be in a direct line with our antennas. So, I told them to fly to the right…problem solved. And the operator will know about this problem in the future… In this way, I saved maintenance a lot of extra and unnecessary work.*

The same employee from 107 ASBt's maintenance crew (M-1) describes that such informal contacts were often established within the unit and that this way of working prevented a lot of unnecessary work and maintenance delays.

> *When they encountered a problem they first called the system expert*[38]*. And when he didn't understand the problem they called us. (…) In this way, we could catch up a lot of delays because many problems were prevented.*

Also during landing the Sperwer, 107 ASBt had to deal with local conditions. Strategies for dealing with such conditions during landing are explicated in the next section.

3.5.4.2 Dealing with environmental circumstances during landing

High temperatures in Uruzgan had consequences for landing the aircraft safely because high temperatures result in even lower air density. Landing during daytime consequently resulted in rough landings that caused substantial damage to the UAVs, as an employee from 107 ASBt's assembly crew explains (A-3):

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[38] The system expert was the technical expert of the Sperwer-UAV and part of 107 ASBt's assembly crew.

The UAVs came down pretty rough and that resulted in substantial damage…At a certain point in time there were not many UAVs left to fly with… An I told them that continuing flights during daytime would leave us with no UAVs left…

By trying to coordinate maintenance and operations, flights were planned in the morning or evening as much as possible. Aligning maintenance and operations, however, was not easy as the same employee from 107 ASBt's assembly crew describes (A-3):

In the beginning coordination was difficult. We wanted to proof ourselves because we are relatively new Army unit. And it took a while before I had convinced the LSO that he should not accept assignments during daytime because those flights resulted in serious damages…

Apart from high temperatures, characteristics of the Uruzgan landscape also resulted in problems during landing. Because of the rough and rocky soil, "belly pods"[39] were severely damaged. This caused maintenance problems as an employee from 107 ASBt's maintenance crew states (M-1):

We had a lot of damage…and therefore we could not keep up with the maintenance work. Then we decided to inspect the landing zone and we discovered that the zone was swamped with rocks…and there was even a large iron pole sticking out the ground…They did not look at that at al…

Dealing with these issues was also associated with internal tension and problems in the coordination between the subunits of 107 ASBt, as the same maintenance employee describes (M-1):

There was a giant iron pole in the middle of the landing zone sticking out the ground…Ground-OPS used that pole as a centering tool to build the landing zone… They did not pay any attention to the consequences… Things like that happened a lot…

During the second mission, it was eventually decided to relocate the landing zone, as an employee from 107 ASBt's maintenance crew explains (M-2):

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[39] "Belly pods" were located at the underside of the Sperwer and contained the UAV's camera.

We were repairing "belly pods" continuously (…) Eventually we decided to relocate the landing zone and we used the Engineer's salvage tank to even the ground and remove rocks. After that, things improved substantially.

As highlighted above, accumulating dust and sand was associated with problems with the Sperwer's parachutes. However, it took a while before this problem was discovered. Different parachute related activities, such as cleaning, folding and assembling, were divided over separate departments within 107 ASBt. At first sight, the parachute problems were attributed to human errors during the parachute-folding process and technical problems. Eventually they discovered that accumulating dust and sand caused the parachute problem. An employee from 107 ASBt's maintenance crew explains that this was discovered through establishing coordination between 107 ASBt's maintenance and assembly departments (M-1):

We did the first investigation on the parachute problem… And we saw that the parachute was stuck in the parachute bay. But at that time, we could not say whether that was due to human error or mechanical problems… Until we talked to the system expert and he said that they had problems putting the parachute into the UAV. Then I got the idea that the parachutes must have been too big to fit in the parachute bay… After the second crash, we were able to conclude that there must have been too much sand and dust in the parachutes… (…) They were simply too big.

3.6 Analysis

In this section, the results of the reduction and integration phase are presented. In the reduction phase, the results of the previous section are analyzed in order to develop hypotheses on the influence of organizational design on safety for 107 ASBt within TFU. In the integration phase, conclusions are drawn on the influence of structural design characteristics on the ability of operators of 107 ASBt to develop safety of their operations within TFU against the background of the dynamic complex Uruzgan environment. As such, this section presents the grounded theory that is developed in this chapter.

3.6.1 Reduction phase

In the previous section, it became clear that interacting with TFU's units was associated with numerous safety problems. Also, interactions within 107 ASBt itself can be interpreted as being problematic, as these were associated with safety issues too. Subsequently, 107 ASBt's operators developed strategies that were aimed at discovering, creating and shaping the interaction network both within their own unit and within TFU. It was also shown, however, that such efforts sometimes were initiated after incidents had already occurred. Also, it sometimes seemed impossible to change the interaction network in such a way to create safe operations within TFU.

Subsequently, by abductively combining the results with the "compass directions", this section firstly aims to reconstruct the relation between TFU's design on 107 ASBt's safety within TFU. After that, the relation between design of 107 ASBt itself and safety of their operations within TFU is detailed. In this reconstruction, as was pointed out above, analytical abduction (cf. Kramer, 2004) is used in which the results of the specification phase are combined with the "compass directions" in order to derive analytical statements on the relationship between organizational design and safety for 107 ASBt's operations within TFU.

3.6.1.1 The influence of structural characteristics of TFU

From the results outlined in the previous section, it can be firstly inferred that interaction between 107 ASBt and TFU's units was often characterized by missing integration between 107 ASBt and other units within TFU. This was highlighted in the section on dealing with assignments, dealing with air space users and dealing with units at Camp Holland. Such missing integration consisted of two parts. At the one hand, 107 ASBt seemed to be poorly integrated into the operations of TFU, as it was shown that both TFU's units and 107 ASBt's operators did not know, at the start of TFU's operations, what place the UAV could take within TFU's operations. On the other hand, such missing integration was witnessed in the absence of agreements, or rules, between 107 ASBt and TFU's units. Along the concepts outlined in the conceptual "compass" this would point to an organization in which both the production and control structure was characterized by *limited structural coupling* (cf. De Sitter, 1994, p. 79) between its workstations. That is to say, from the start of the mission, input-output relations between 107 ASBt and TFU's units, along with accompanying agreements or control mechanisms, seemed to be missing. As structural coupling between workstations (i.e. units) can be regarded as a basis of any organization, it can be questioned whether, from the perspective of 107 ASBt, TFU was an organization from the start of their operations.

Furthermore, it is argued that such limited structural coupling between 107 ASBt and TFU's other units can be related to the way TFU was "mixed and matched". As stated before, 107 ASBt was grouped with other Army and Air Force units in a large expeditionary configuration within TFU. This configuration differed substantially from the organizational configuration in which they were training in The Netherland. In their training situation, 107 ASBt conducted assignments alone, whereas within TFU the unit was planned to operate as an intelligence unit that was meant to be part of a broader primary process of TFU that operated within the Uruzgan environment. As a result, the first hypothesis is formulated as follows:

Hypothesis 1: From the perspective of 107 ASBt, using a "mixing and matching" strategy to design TFU resulted in an expeditionary organization that was characterized by missing structural coupling between units.

It was witnessed in the case description that due to such missing integration, safety incidents occurred. This was highlighted by assignments that were ordered during lightning and with icy conditions, which confronted 107 ASBt and the Sperwer-UAV with dangers, a near-miss with Apache helicopters and problems during take-off at Camp Hollands airstrip. It can be argued that, from the perspective of 107 ASBt such safety issues came into existence as a direct result of TFU's structural layout and *enactment* of TFU in its dynamic complex mission environment (cf. Weick, 1979). That is to say, at the one hand, from the perspective of 107 ASBt TFU's "mixed and matched" organizational design resulted in missing integration between 107 ASBt and other units. On the other hand, because TFU operated in a dynamically complex operating environment, the only way of discovering what needed to be done in that environment was by acting. This means that TFU's units cannot wait behind closed fences in order to find out what needs to be done and what rules to use in order to do so safely, they have to discover this along the way by acting in the environment. Due to enactment, it can be argued that there was simply not enough time for 107 ASBt's operators find out how to operate with other units within TFU. This resulted in operations with underdeveloped integration for critical interactions within TFU, which had safety consequences for both 107 ASBt and TFU. In this sense, it can be pointed out that although most strategies of 107 ASBt were not aimed at dealing with a dynamically complex environment, they were in this way confronted with the consequences of TFU's enactment in its operating environment.

Trying to explain these safety issues from an IOR perspective, however, seems to be challenging for the following reasons. Although safety incidents indeed seem to be directly associated with the way the expeditionary organizational structure was designed, they cannot be solely defined as a lack of control capacity or the result of structural complexity. Instead, from the perspective of 107 ASBt, the disturbances described above were related to the absence of structural coupling between workstations within TFU and TFU's enactment in its operating environment. The absence of structural coupling is not part of the seven "design parameters" described in the section on the conceptual compass. This difference between the results found in this chapter and the premises of IOR may be attributed to the observation, which was also made earlier in this chapter, that IOR is mainly built for "Mainstream Holland Inc." instead of expeditionary organizations. According to De Sitter (1994) Mainstream Holland Inc., is characterized by standard bureaucratic designs. Within such designs, coupling between workstations is already specified, which from the perspective of 107 ASBt is in contrast to expeditionary organizations in which coupling seems to be missing at the start of operations[40]. Nevertheless, based on the results of this chapter, the following hypothesis is formulated:

Hypothesis 2: A combination of missing structural coupling within TFU and TFU's enactment threatened safety of both 107 ASBt and TFU.

Due to missing structural coupling, strategies of 107 ASBt's operators were initially characterized by finding ways to discover what assignments they had to do, with whom they had to cooperate and what rules and procedure applied within TFU. Sometimes they initiated such strategies after safety incidents had already occurred. In order to get to know other units and to find out what assignments could be done, "sales pitches" were organized by some of 107 ASBt's operators for other TFU units and TFU commanders. Subsequently, agreements had to be developed with these other units on what kind of assignments could be done and what could not be done with a Sperwer-UAV. Such activities can be interpreted as creating meaningful interaction patterns, or structures (cf. Weick, 1979). Based on De Sitter's definition of structural coupling (1994, p. 79), 107 ASBt's activities can be interpreted as *creating* structural coupling within TFU's production structure. That is to say they were aimed at establishing input-output relationships and accompanying agreements between themselves and other TFU workstations. As structural coupling between units can be interpreted as the basis of any production structure, it can hence be interpreted that from the perspective of 107 ASBt, operators were trying to self-design the unit into TFU's production structure.

In contrast to their strategies for dealing with assignments, the strategies of 107 ASBt's operators for dealing with airspace users were not aimed at creating input-output relations. Instead, they were aimed at discovering, establishing and refining rules and

[40] This observation may pose an opportunity to contribute to IOR and Sociotechnical Systems Design theory. Therefore, this aspect is also addressed in the chapters later on in this thesis.

procedures for safety critical interactions, such as rules for "deconfliction" with other airplanes and procedures with TK-tower. Following De Sitter (1994), these strategies can be interpreted as attempts to integrate 107 ASBt into TFU's control structure. Yet, most airspace (safety related) rules and procedures within TFU were based on existing NATO procedures. Consequently, most discovery efforts of 107 ASBt for dealing with airspace users seemed directed towards exploring an "already explored terrain". Therefore, the second hypothesis is formulated as follows:

Hypothesis 3: "Normal work" of 107 ASBt's operators was mainly aimed at self-designing 107 ASBt into TFU's production and control structure.

Also, it can be argued that due to enactment, within TFU it was gradually discovered in what ways the Sperwer could be best employed in order to deal with the dynamic complex mission area in Uruzgan. This resulted in new and innovative ways to operate with the Sperwer UAV. For example, after some time the UAV was "tasked" for rest-overnight operations and assignments together with Apache helicopters. However, as a result, 107 ASBt had to operate in constantly changing configurations of other units within TFU with which integration turned out to be absent. Therefore, the fourth hypothesis is formulated as follows:

Hypothesis 4: Enactment of TFU in its environment and accompanying innovation of TFU's units with the Sperwer-UAV resulted in ongoing integration issues because of the changing configurations of units in which 107 ASBt operated.

Despite safety issues, 107 ASBt's operators reported that operating within TFU became less problematic after some time. In this sense, self-designing efforts of 107 ASBt's operators improved safety of UAV operations within TFU. These efforts of 107 ASBt's operators were, however, complicated by the frequency in which TFU's other units were relieved by "new" units from the Netherlands (i.e. "rotation"). These new units had to learn to operate with a Sperwer UAV all over again, for which the Hand-Over-Take-Over procedure seemed too short. This resulted in safety issues, which was for example illustrated by problems on the Sperwers landing zone that resulted from orders of a Task Force Commander. Hence, the fifth hypothesis is formulated:

Hypothesis 5: Self-designing efforts of 107 ASBt's operators were complicated by "rotation" of units within TFU, which resulted in safety threats.

Lastly, 107 ASBt's operators found out that existing (NATO) rules and procedures did not fit their operations, which resulted in safety issues that were unsolvable for 107 ASBt's operators. This was highlighted by the inability of the Sperwer UAV to participate in "see-and-avoid" and local deconfliction outside the area of TK-tower. Apparently, these rules and procedures did not fit the nature of UAV operations in Uruzgan. As a result, these aspects of TFU's control structure presented permanent safety threats to 107 ASBt's operations within TFU. Consequently, the sixth hypothesis is developed:

Hypothesis 6: Due to incompatible rules and procedures, 107 ASBt and TFU were confronted with permanent safety threats during UAV operations.

3.6.1.2 The influence of structural characteristics of 107 ASBt

In the results section it can found that, next to the substantial influence TFU's interaction network had on safety, the interaction network within 107 ASBt's could also be associated with safety issues.

During the 2008 and 2009 missions, TFU discovered that the Sperwer UAV was a valuable asset in its operations in Uruzgan. This, however, increased the number of assignments substantially. As was stated above, the increased number of assignments resulted in maintenance delays, shortage of spare parts, stress for individual operators and UAVs that were not fully operational. Especially shortage of spare parts combined with environmental circumstances in Uruzgan had safety consequences because parachutes needed to be "recycled" beyond their regular maintenance interval. This resulted in accumulation of sand and dust, which turned out to be detrimental for the Sperwer's ability to land without damage. Although the assembly department had experienced that it was difficult to put the parachutes into the UAVs and the maintenance department had discovered that dust and sand had accumulated in the parachutes, it took two accidents to relate these findings to antother. Therefore, it can be stated that interaction and coordination between the departments of 107 ASBt became problematic and this influenced the way operators within the unit could develop safety substantially. Similar internal problems can also be seen from the way departments of 107 ASBt interacted while creating a landing zone for the Sperwer on Uruzgan's rocky landscape. For example, 107 ASBt's Ground-OPS team was responsible for creating a landing zone. However, they did not seem to be aware of the requirements that were needed for a safe landing of Sperwers until maintenance employees decided to find out where substantial damages during landing came from. Although some may interpret these problems as a problem of communication within 107 ASBt, such lack of process oversight can be related to design of 107 ASBt's production structure.

De Sitter (1994; De Sitter et al., 1997) points out that grouping specific activities at specialist departments, which he refers to as functional concentration, has a negative effect on process oversight within these different specialized departments. Decreased process oversight, on its turn negatively influences the ability of operators to solve disturbances and create controllability at the organizational level. As can be seen in Figure 6 and 9, the different activities of 107 ASBt are all grouped at different specialist departments. Following De Sitter, therefore, 107 ASBt's production structure can be interpreted an example of a functionally concentrated production structure[41]. It can thus be argued that problematic process oversight can be attributed to functional concentration within the unit. For 107 ASBt, it can consequently be posed that dividing 107 ASBt's activities over different separate workstations had a negative effect on the ability of 107 ASBt's operators to develop safety. Hence, the seventh hypothesis is developed:

Hypothesis 7: Functional concentration within 107 ASBt hindered the ability of operators to develop safety of their operations within TFU.

107 ASBt's operators tried to deal with these issues by planning the UAVs differently, by recycling spare parts such as parachutes and by coordinating more intensively between operations and maintenance departments. Next to this, reshaping internal procedures was used as a strategy for dealing with changes in air density and temperatures, which were dangerous when launching the Sperwer. Following De Sitter's distinction between production and control, structure, these efforts can be interpreted as ad-hoc changes to 107 ASBt's control structure (i.e. redesign of 107 ASBt's control loops). It can be argued that in this way, 107 ASBt's operators tried to adapt the unit to operating within TFU and environmental circumstances in Uruzgan. In line with the preceding section, the eighth hypothesis can be formulated:

Hypothesis 8: "Normal work" within 107 ASBt partly consisted of redesigning control loops in an attempt to adapt their organization to demands of TFU and the Uruzgan environment.

In the next section, the results of the integration phase of this chapter are presented.

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[41] By using IOR's "design parameters", it can be argued that 107 ASBt's production structure is also characterized by a high degree of division between performance, preparing and supporting activities (parameter 2). It can be argued however, that such a division is a more detailed translation of "functional concentration". Hence, the term "functional concentration" is employed in the seventh hypothesis.

3.6.2 The integration phase

In this section, conclusions are drawn on the relation between organizational design and safety for 107 ASBt within TFU. A noteworthy result of the analysis is that organizational design of both TFU and 107 ASBt impacted safety substantially. Apparently from the beginning, TFU's design was characterized by missing structural coupling of 107 ASBt into TFU's production and control structure, which could be related to the way 107 ASBt was mixed and matched with other units within TFU. From the perspective of 107 ASBt, it can be stated that from the beginning of their operations within TFU, a coherent expeditionary organization seemed to be absent. Because of TFU's necessity to act in its operating environment, however, 107 ASBt had to conduct its operations within TFU with an underdeveloped organizational structure, which had safety consequences for both 107 ASBt and TFU. As a reaction, 107 ASBt's operators began to improvise and pioneer within TFU in order to self-design the unit into TFU. Along the way and due to their efforts to integrate 107 ASBt within TFU, 107 ASBt's operators reported that operating within TFU became less problematic. However, due to "rotation" and incompatible rules and procedures for deconfliction in the air some issues were unsolvable for 107 ASBt's operators, which resulted in permanent safety threats to TFU. In this way, it can be argued that TFU's design presented 107 ASBt with safety issues problem that, at least partly, could not be solved. This consequently resulted in safety issues at the level of TFU that could not be avoided.

Furthermore, related to influence of 107 ASBt's design on safety it was found that poor process oversight and associated safety issues could be related to high degrees of functional concentration within 107 ASBt. Apparently, the way 107 ASBt was designed did not match expeditionary demands, which resulted in safety threats. As a reaction, 107 ASBt's operators tried to adapt their organization to demands within TFU and Uruzgan by reshaping control loops. This eventually increased the ability of 107 ASBt to operate safely in Uruzgan. Nevertheless, this was more or less achieved after safety incidents had already occurred.

3.7 Conclusion

This chapter aimed to explore the relationship between organizational design and safety within TFU by taking a specific "normal work" approach and using a grounded theory methodology. It was found that safety of 107 ASBt's operations within TFU was significantly and in multiple ways impacted by design of the unit itself and that of TFU. The exploration carried out in this chapter has provided a first but detailed understanding of the relationship between organizational design and safety in an expeditionary organization. As was stated in Chapter One, the results of this chapter will be used develop and understanding of the relationship between organizational design and safety in expeditionary organizations that can be used for building the theory at which this thesis is aimed. This means that findings from the perspective of 107 ASBt have to be generalized to the level of TFU and validated for expeditionary organizations in general. This is done in Chapter Four and Five of this thesis.

Chapter Four: The influence of organizational design on safety within expeditionary organizations

4.1 Introduction

This chapter will present the third study of this thesis in which the third research question will be addressed. The third research question is:

> **What hypotheses on the relation between organizational design and safety can be formulated for expeditionary organizations?**

In the previous chapter, hypotheses were developed on the relationship between organizational design and safety for 107 ASBt's operations within Task Force Uruzgan. However, in order to "fill" the theoretical gap that was identified in Chapter Two, the "map" that is developed in the course of this thesis needs to get beyond the exploration stage. For this, an understanding of the relationship between organizational design and safety has to be developed for expeditionary organizations in general.

In Chapter Three of this thesis an exploration of the relationship between organizational design and safety in an expeditionary organization was carried out that showed a substantial relation between organizational design and safety at two organizational levels, that of 107 ASBt and that of TFU. However, a number of generalization issues arise in translating these results to the level of TFU and expeditionary organizations in general. That is to say, the study in Chapter Three was conducted only from the perspective of 107 ASBt. The particular influence of organizational design and safety found within the 107 ASBt case may, therefore, have been unique for them and not symptomatic for either Task Force Uruzgan or expeditionary organizations in general. It was already highlighted in Chapter Three that some characteristics of 107 ASBt made the unit unique within the Royal Netherlands Army. For example, the fact that 107 ASBt could not train with other units due to legal restrictions on the UAV, could have played a large role in their integration issues within TFU. Also, 107 ASBt was operating as a particular intelligence unit that, due to the unmanned nature of the UAV, did not directly engage in the dynamics of the Uruzgan operating environment. This might have had consequences for the type of safety problems that were found in Chapter Three. Hence, findings within 107 ASBt cannot be translated one-on-one to the level of TFU or expeditionary organizations in general.

Therefore, to be useful for the goal of this thesis, findings on the relationship between TFU's organizational design on safety from the perspective of 107 ASBt have to be firstly verified by studying other units within TFU in such a way that statements can be made on the relation between organizational design and safety at the level of TFU. After that, it has to be elaborated how these findings can be generalized to the level of expeditionary organizations in general, at Van Striens's level B.

In this chapter therefore, by conducting a second case study in which other units within TFU are studied, it is firstly attempted to generalize hypotheses on the relationship between organizational design on safety within TFU. After that analytical generalization (cf. Yin, 2003) is used to construct hypotheses on the influence of organizational design on safety for expeditionary organizations in general. These steps can be visualized by means of the figure depicted below.

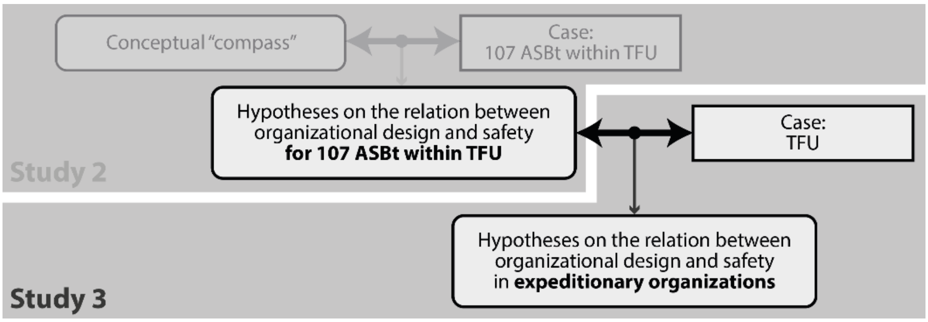

Figure 18: Research model Study 3

This chapter is subsequently divided into several sections. Firstly, the hypotheses on the relationship between TFU's design characteristics and safety developed in Chapter Three, that this chapter aims to verify, are presented. Secondly, more background information is given on Task Force Uruzgan. Secondly, the methodology that is used in this chapter is presented. Thirdly, the results and analysis are explicated. Finally, the chapter ends with a conclusion.

4.2 Hypotheses derived from the perspective of 107 ASBt

In this section only the hypotheses developed in Chapter Three on the relationship between TFU's organizational design and safety are presented. The reason for this is that in order to develop hypotheses on the relationship between organizational design and safety for expeditionary organizations in general, this chapter aims to generalize hypotheses on the relationship between organizational design characteristics and safety at the organizational level of TFU. So, only the hypotheses that were derived from the perspective of 107 ASBt on influences of design characteristics of TFU on their ability to develop safety are presented here.

Hypothesis 1: From the perspective of 107 ASBt, using a "mixing and matching" strategy to design TFU resulted in an expeditionary organization that was characterized by missing structural coupling between units.

Hypothesis 2: A combination of missing structural coupling within TFU and TFU's enactment threatened safety of both 107 ASBt and TFU.

Hypothesis 3: "Normal work" of 107 ASBt's operators was mainly aimed at self-designing 107 ASBt into TFU's production and control structure.

Hypothesis 4: Enactment of TFU in its environment and accompanying innovation of TFU's units with the Sperwer-UAV resulted in ongoing integration issues because of the changing configurations of units in which 107 ASBt operated.

Hypothesis 5: Self-designing efforts of 107 ASBt's operators were complicated by "rotation" of units within TFU, which resulted in safety threats.

Hypothesis 6: Due to incompatible rules and procedures, 107 ASBt and TFU were confronted with permanent safety threats during UAV operations.

4.3 Task Force Uruzgan[42]

Initially, in 2006, the Dutch government depicted the operation in Uruzgan as a reconstruction operation. However, over the four years of its deployment, TFU has engaged in numerous combat activities with opposing parties in the Uruzgan province. Along the way, within TFU an assembly process was developed to create operational units that could match these demands. These units were called Smallest Units of Action (SUAs) or Combined Arms Teams (CATs). Because assignments could practically vary per mission, the SUAs within TFU differed substantially from each other in composition (Kramer et al., 2012). The bottom-up design process of SUAs within TFU is schematically presented the Figure below. The blue dotted lines this Figure reflect that TFU staff had limited command and control over the Air Task Force, the military police and the Special Forces.

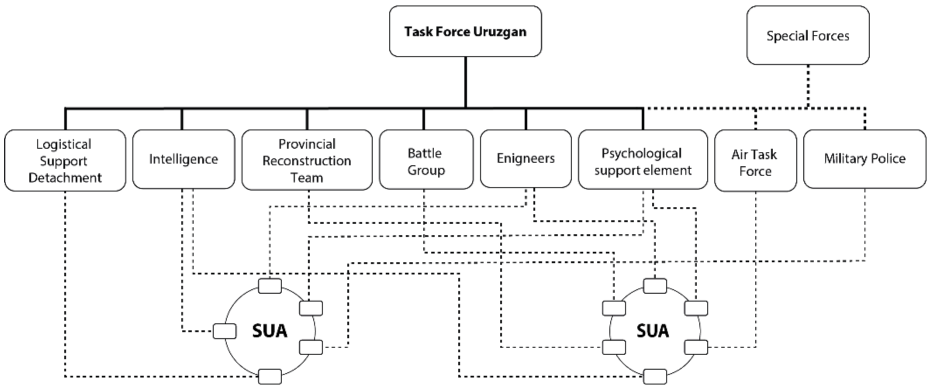

Figure 19: Task Force Uruzgan's Smallest Units of Action (SUA) assembly process

4.4 Methodology

To verify the hypotheses developed on the relation between organizational design and safety within TFU in Chapter Three and subsequently develop hypotheses on ways in which organizational design influences in expeditionary organizations, a normal work approach is taken that resembles the one outlined in Chapter Three. However, this chapter aims to generalize hypotheses on the relationship between organizational design and safety within

[42] This section serves as an extension to the background information on Task Force Uruzgan that was presented earlier in this thesis, in Chapter Three.

TFU. Therefore, instead of exploring the influence of TFU's interaction network on safety issues other units within TFU experienced and the ability of these other units to solve safety problems, this chapter aims to search for particular influences of the expeditionary interaction network on safety. This way of applying the "normal work" approach, is hence characterized by a more "deductive" approach than was followed in Chapter Three. That is to say, as an analytical strategy, deduction is aimed at "applying general rules to specific cases" (cf. Richardson & Kramer, 2006). Yet, the study presented in this chapter is not to be interpreted as "purely" deductive because during the analysis room is left for other experiences from respondents. Hence, the approach taken in this chapter can be interpreted as taking an approach that resembles analytical abduction, as the "rules" derived from Chapter Three are verified with the possibility for respondents to diverge from these "rules".

To carry out the study in this chapter, a second case study will be conducted. The main reason for using this methodological approach is that is applicable to study phenomena that are highly contextualized (Strauss & Corbin, 1990) which still is the case for operations of expeditionary organizations. Also, as was also highlighted in the previous chapter, a case study approach is able to map interactions and the way these interactions give meaning to experiences of individuals. However, based on the points stressed in this section, a qualitative case study approach has to be applied in a particular way to verify the hypotheses developed in Chapter Three. That is to say, based on the goal of this chapter and the potential problems of generalization highlighted in the introduction, three criteria for such a methodology can be emphasized.

Firstly, the relationship between organizational design and safety within TFU that was found from the perspective of 107 ASBt needs to be generalized to the level of TFU. To do so, it has to be verified whether the nature of the interaction network of TFU as experienced from the perspective of 107 ASBt, can be attributed to their uniqueness or that these influences are exemplary for the way other units within experienced operating within their interaction network. Determining whether the results from Chapter Three can be attributed to 107 ASBt's uniqueness or not, implies that it has to be investigated whether interaction of other units with 107 ASBt can be interpreted as being similar to the way these other units dealt with other interaction partners. Subsequently, when this is the case, it can be concluded that 107 ASBt's experiences were not that unique within TFU. This may subsequently imply that other units had experiences within TFU similar to 107 ASBt's experiences, which may suggest that a similar relationship between organizational design and safety can be analytically reconstructed. This subsequently may make attempting to verify the hypotheses developed in Chapter Three, to generalize these to the level of TFU, a road worthwhile to take. Only after these steps have been taken, it seems to be valid to investigate whether and how such findings from within TFU are relevant for expeditionary organizations in general.

To conduct a qualitative case study that enables taking the steps highlighted above, the next sections explicate research design, data collection and data analysis of the study presented in this chapter.

4.4.1 Research design

To verify whether 107 ASBt's experiences within TFU's interaction network can be attributed to the unique character of their operations or that they are exemplary for the way other units developed safety within TFU, 11 in- depth interviews were conducted with representatives of various units within TFU with which 107 ASBt needed to interact during their operations within TFU in the period between 2006 and 2010. By selecting respondents in this way, it can be studied how these units dealt with 107 ASBt, how they dealt with other interaction partners and whether they experienced influences from the TFU's interaction network in a way similar to 107 ASBt's experiences. According to Yin, this strategy can be called a single case study in which multiple sub units are embedded (2003, p. 40). A visual representation of the units studied within TFU is presented below.

4.4.2 Data collection

To gather data that is in line with the steps highlighted in the introduction of this section, a normal work strategy is used, similar to the approach outlined in Chapter Three. During the interviews respondents were firstly asked how they dealt with 107 ASBt during their operations and what strategies they employed to deal with other interaction partners in developing safety of their own operations within TFU. Subsequently, the interview was directed to investigating whether these strategies resembled the strategies of 107 ASBt. As such, the interviews were not "open" but guided by the results from Chapter Three. To refer to respondents in the results section of this chapter, respondents were given a "code" that represents to their function within TFU.

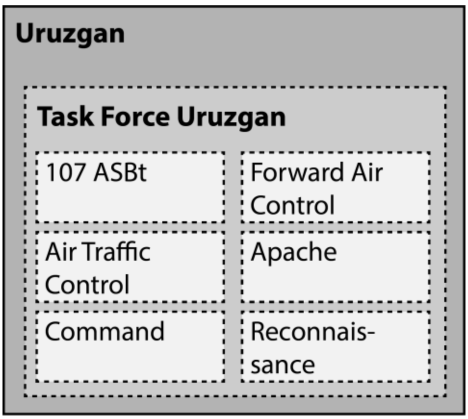

Figure 20: Research strategy of Study 3

These codes are shown in the table below. In this way anonymity is guaranteed because results are not traceable to individual respondents.

Table 3: Coding respondents of Study 3

Respondent	Code
Commanders	C
Air Traffic Controllers	ATC
Reconnaissance operators	REC
Forward Air Controllers	F
Air Liaison Officers	ALO
Apache pilots	AP

4.4.3 Data analysis

To verify the hypotheses that were developed for the level of TFU in Chapter Three and generalize these to the level of expeditionary organizations in general, this chapter employs the research steps Wester and Peters (2004) proposed for developing a grounded theory. This methodology is chosen because it gives the possibility to use the proposed research steps to systematically combine (cf. Dubois & Gadde, 2002) the experiences of units within TFU with the results from Chapter Three. Also, application of their research steps gives the opportunity to apply analytic generalization to generalize results from the level of TFU to the level of expeditionary organizations in general. To do so, the research steps proposed by Wester and Peters are not applied straightforward, but in the following way:

Firstly, the exploration phase is aimed at exploring ways in which the units studied in this chapter dealt with 107 ASBt and whether this had similar consequences for safety as compared to the results of Chapter Three. After that it is investigated how they dealt with other units within TFU and what influence this had on the type and amount of safety issues and their ability to solve safety issues. Subsequently, coding the interviews was done by "axial coding" (cf. Boeije, 2005) in which it was firstly investigated whether they dealt with 107 ASBt in a way similar to the way in which they dealt with other units. Secondly, in the specification phase, the experiences of other units were linked to those found from the perspective of 107 ASBt. After that, verifying the hypotheses that were derived from the perspective of 107 ASBt becomes possible. As such, thirdly, in the reduction phase, the findings of the specification phase are confronted with the hypotheses developed in Chapter Three. Fourthly, in the integration phase, it is established whether these findings can be analytically generalized beyond TFU, to expeditionary organizations in general. As a result of the integration phase, new hypotheses are developed on influences of organizational design on safety in expeditionary organization that are located at Van Strien's level B.

4.4.4 Reliability and validity

The methodological choices made in this chapter have consequences for reliability and validity of the results and analyses. The procedures employed in this chapter resemble those in Chapter Three. However, as the research goal of this chapter is substantially different than the goal of Chapter Three, the procedures followed in this chapter are different as well. Therefore, this section explicates the measures taken to attain reliability and validity of the results and analyses of this chapter in detail.

For attaining reliability, Yin (2003, p. 37) advises to document as many research steps as possible. Therefore, in addition to the procedure followed for documenting interviews conducted within 107 ASBt, interviews were also recorded digitally by means of a voice recorder and subsequently transcribed word-for-word. Internal validity refers to the ability of the study to detect possible intervening variables in making casual claims. The methodological steps proposed in the previous sections, which are an application of the grounded theory methodology developed by Wester and Peters, are aimed at detecting possible intervening variables. Especially in the exploration and specification phase are characterized by going back and forth between data, and the results from Chapter Three. With regard to attaining construct validity, it has to be shown in this chapter that changes in safety within TFU are due aspects of the expeditionary organization's structural design that influences the amount and type of safety issues and the way operators could solve safety issues. In order to do so, structural influences have to be reconstructed analytically. That is to say, these influences cannot be "seen" directly and therefore have to be "built" analytically from combining operators' experiences with theoretical constructs along the "normal work" approach outlined in Chapter Three.

External validity is particularly relevant for this chapter because the goal of this chapter was to develop insight into the relationship between organizational design and safety for expeditionary organizations in general, whereas data is gathered within a particular expeditionary organization, TFU, guided by hypotheses developed from the perspective of 107 ASBt. Several steps are taken in the analysis of this chapter to enable such generalizations. Firstly, it is verified how the units studied within TFU dealt with 107 ASBt and whether this resembled the way in which they dealt with units in their own interaction network. From this step, it becomes clear whether 107 ASBt is to be treated as a unique unit within TFU or that similarities can be detected between 107 ASBt and other units within TFU. When the latter is the case, results derived from the perspective of 107 ASBt may be relevant more broadly within TFU. Only after establishing this, it can be attempted to verify hypotheses derived from the perspective of 107 ASBt at the level of TFU. Thirdly, analytical generalization (cf. Yin, 2003) is used to elaborate on the relevance of these findings for expeditionary organizations in general.

An aspect that may hinder external validity in this chapter is that the results of Chapter Three steer the way other units are researched. Because of this strategy, the study in this chapter may not "see" that other units within TFU may have experienced other influences on safety from their interaction network, which may point to other influences of organizational design on safety. A counterargument to this is however, that analytical abduction, or systematic combining –in terms of Dubois and Gadde (2002)- is employed as an analytical strategy in studying these other units. By means of this analytical strategy, empirical data and the results from Chapter Three are constantly confronted with each other. This ensures that at the one hand, enough room was left in the interviews for the respondents to elaborate on potential other influences of the organizational network within TFU. On the other hand, it ensures that potential other influences of organizational design on safety are not missed. Lastly, in the step in which analytical generalization takes place, findings are generalized to expeditionary organizations in general with help from existing theory. This makes sure that hypotheses developed at the level of expeditionary organizations in general are connected to issues that can be interpreted as being relevant to the family of expeditionary organizations at which this thesis is aimed.

4.5 Results

The results are presented in the following way. Firstly, the results of the exploration phase are presented in which it is detailed how the units studied in this chapter interacted with 107 ASBt and whether this has similar consequences for the safety issues that they experienced and the way they could deal with safety issues. After that, it is detailed whether interaction with other partners within TFU influenced the amount of safety issues and the way they could deal with safety issues. Secondly, the results of the specification phase are presented in which it is explicated whether these influences of the interaction network on safety resembled influenced experienced by 107 ASBt. Secondly, in the reduction phase, it is attempted to verify hypotheses on the relationship between organizational design and safety developed in Chapter Three, which were presented above. After that, the integration phase applies analytical generalization to develop hypotheses on the relationship between organizational design and safety for expeditionary organizations in general.

4.5.1 Exploration phase: interaction with 107 ASBt and other units within TFU

This section first describes how the units studied in this chapter interacted with 107 ASBt and whether this, from their perspective, was associated with similar safety issues. After that, it is explicated whether this resembles the way they dealt with other interaction partners within TFU.

4.5.1.1 Interaction with 107 ASBt

From Chapter Three, it became clear that 107 ASBt's operators experienced limited integration between their units and other units within TFU. From the perspective of the units studied in this chapter, integration with 107 ASBt also seemed problematic and resulted in similar safety issues. A Royal Netherlands Air Force air traffic controller explains that it was unclear for air traffic control personnel what to do in the case of an incident or emergency with the Sperwer (ATC-2):

> *I witnessed that they said: "launch within ten minutes". And that we were waiting…and that the Sperwer crashed headfirst into the "dirt-strip[43]" immediately after launch… And then I had to coordinate with these guys because I didn't know what do. Is it dangerous? Are the guys from 107 going to retrieve it? What are we going to do? It was just lying there with its nose in the sand…*

Also, from Chapter Three it became clear that from the perspective of 107 ASBt, the unit was poorly integrated in the Uruzgan airspace as they could not participate in local deconfliction and see-and-avoid. In this way 107 ASBt relied on other units for safe operations[44]. An Apache pilot, however, explains that keeping clear of the Sperwer was an issue due to the Apache's limitations, which were discovered during operations in Uruzgan (AP-2):

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[43] The runway of Tarin Kowt airfield was referred to as the "dirt-strip" because it was unpaved.

[44] De Sitter would refer to this problem as a problem of external control capacity of 107 ASBt, which was transmitted to the interaction network of which 107 ASBt was part.

We did not have contact with the Sperwer operator. They were flying blind. So, we had to deconflict that before take-off. (…) Then we made agreements based on altitude. They were at altitude X, so then we had to stay away from that altitude… (…) That was arranged by mIRC. One of the problems with that was when we were in the air, we could not transmit that information to the aircraft. That was problematic because we only had [VHF] *line of sight connections.*

Along the way, Apache pilots found a way to get information on the whereabouts of other Sperwer UAVs, and other flying assets of TFU, by contacting Forward Air Controllers in the field with their onboard, line of sight, VHF radio. Forward Air Controllers (FAC-ers) were responsible for tasking and "deconflicting" fire support assets, for supporting SUA missions on the ground. Within TFU, Dutch Apaches, F16's and artillery mostly gave fire support. In addition, American F15 and F18 fighter jets were able to provide fire support in the Uruzgan province. During fire support, TFU staff in the OPS-room assigned a Restricted Operations Zone (ROZ) to FAC-ers. FAC-ers were consequently responsible for both tasking and deconflicting fire support assets. FAC-ers were one of the few operators on the field that had both a VHF radio and a tactical satellite radio (TACSAT). With TACSAT, FAC-ers were able to connect to many other units in the field, CAOC and the TFU operations room. On the question whether they were increasingly employed as a "radio relay station", a FAC-er answers (F-3):

That happened a lot. One of the channels was the TAC-P[45] *admin net. All TAC-P's in Afghanistan were on that channel. It happened that we were in an area that belonged to our Battle Group, but that we were working with units that were controlled by another Task Force. So, my situational awareness (SA) was much better than the SA of my commander.*

However, developing safety by means of this strategy did not always succeed. A consequence was that Apaches did not always know where Sperwers were flying. Keeping clear of Sperwers depended consequently on the visual ability of Apache pilots to spot and avoid a Sperwer in the air. Due to the size and color, however, Sperwers were hard to spot, as the same Apache pilot explains (AP-2):

[45] TAC-P stands for Tactical Air Control Party, which consists of a FAC-er, a laser operator and a driver.

Look, Sperwers were a pain in the ass … (…) *they were hard to spot…*

Also, a Forward Air Controller states that because of these problems to avoid the Sperwer, Apaches and Medevac (medical evacuation) helicopters, with which he had frequent contact, did not like the presence of the Sperwer in their airspace (F-3):

Apaches, the Sperwer and Medevacs were not each other's friends. (…) That went wrong (…) Sperwers were unable to keep the alititude to which they were assigned and they were unaware of each other's position in the air.

In Chapter Three, it was also highlighted that units within TFU started innovating with the UAV, that was found to increase the ability to operate in the dynamic Uruzgan operating environment. A TFU commander underscores this by stating that (C-3):

If you want to know what happens at the other side of a hill without a UAV, you have to walk. And when you arrive there and they [opposing forces such as Taliban] *start to shoot, you are in combat. When you have a UAV, you are able to scout whether opposing forces are present or not before you send your troops to that area. Also, when we conducted operations on roadside bombs, reconnaissance by foot is very time consuming. In addition, we were vulnerable when we stayed at the same place for some time…Then you have to keep an eye on the surrounding area to see whether they* [opposing forces] *were coming for us…That was all possible with a UAV.*

The Sperwer was increasingly tasked to various assignments with various units such as patrolling over ground forces who had to "rest overnight" in the field. A reconnaissance operator explains that in due time, they did not want to go on patrol without the presence of the Sperwer in the air above them to scout for possible dangers (REC-1):

When we didn't have a Sperwer during operations in Mirabad, I'm sure that we had overlooked important things… Opposing forces moving in the field… (…) And so, we were very happy to have a Sperwer above us because then we were able to see what was going on. (…) The element of surprise was removed by using a Sperwer. (…) *It* [the Sperwer-UAV] *was very important to us.*

Also for TFU's OPS-room the Sperwer became important for creating "situational awareness" (SA). As a result, the Sperwer was often tasked to improve SA of TFU's staff despite its negative effects on ground operations, as a FAC-er explains (F-3):

> *Then it happened that when I was in a TIC* [Troops in Contact] *situation a UAV was launched while I asked for fixed wing combat support. Then I said: that is no use to me out here…They answered: the UAV can help improving SA. Well, I didn't need that because I already knew where the enemy was…*

An Apache pilot explains that such innovation with the Sperwer, however, increased safety issues in the Uruzgan airspace because Apaches were sent to areas were a Sperwer was flying because they had to eliminate opposing forces discovered by a Sperwer (AP-2):

> *With regard to safety in the air… What happened a lot was that a Colonel or a General saw something on the Sperwer's live feed* [in TFU's OPS room] *and then decided to send Apache to that area. (…) In these cases we were sent to areas were a Sperwer was flying…*

These statements highlight that also from the perspective of other units, integration with 107 ASBt was problematic, that they too attempted to create and shape interaction with the UAV unit but that this was not always successful and led to safety issues that could hardly be solved. The next question addressed is: what strategies did the units studied in this chapter use to interact with other units? That for engaging in TFU's operations, interacting with other units may show similarities to the way they had to deal with 107 ASBt was already highlighted briefly by the quoted FAC-er who explains his role as a "radio relay station". This quote reveals that FAC-ers were not only used in this way to create integration with Sperwers, but that they seemed to be contacted many other units for similar issues. This may imply that for more units, integration into TFU was an issue and that they used ad-hoc solutions in attempt to solve these issues. Therefore, in the next section, it is detailed how the units studied in this chapter dealt with their interaction partners in order to develop meaningful and safe operations within TFU and whether this resembles the way they dealt with 107 ASBt.

4.5.1.2 interaction with other units within TFU

In this section, it is detailed 1) whether the way the units studied in this chapter interacted with 107 ASBt in a way that resembled the way in which they interacted with other units within TFU and 2) whether this had similar influenced on the type of safety issues and the way they could deal with safety issues. With regard to integration within the Task Force, an operator from TFU's reconnaissance unit explains that they also used "sales pitches" to familiarize themselves with other units within TFU (REC-1).

> *Look, I don't need to tell my commander here* [in the Netherlands] *how to work with reconnaissance units. Within TFU, however, commanders were often not used to work with us. So, then I need to tell them what the possibilities and limitations of our unit were.*

Forward Air Controllers, seemed to experience integration issues as a FAC-er explains that, in the beginning of TFU's operations, other units within TFU were not used to operate with fire support assets and that an understanding of the possibilities and limitations of fire support was developed along the way (F-2).

> *It was a challenge for FAC-ers to prove our added value, and that we were included in planning processes. In the beginning, that wasn't the case.* (…) *Within the Battle Group they gradually discovered that we were quite essential …* (…) *a lot of units were unknown and unpopular over there…*

Next to reconnaissance operators and FAC-ers, air traffic controllers also had to discover with whom to operate within TFU, as an air traffic controller explains (ATC-2):

> *We had to work with all kinds of Army people over there, like and S1, S2 and S3*[46]*… When we came there, I had no idea what that meant…At a certain point I made a list on which I noted with what and who we had to work…*

From these quotes, it becomes clear that reconnaissance units, FAC-ers and air traffic controllers also experienced limited integration within the Task Force. Also, it becomes clear that they used ad-hoc solutions in trying to overcome these issues. To highlight that these solutions were sometimes initiated after safety problems already had occurred, an Apache pilot stresses that he was constantly confronted with safety problems in interaction with Army units and that he had to subsequently, make agreements with these Army units (AP-2):

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[46] S1, S2 and S3 are NATO abbreviations used by the Dutch Army to refer to personnel, intelligence and operational functions, respectively.

We were constantly surprised over there by the Army… (…) Everything that is not allowed on an airfield here [in the Netherlands] *was happening over there…They suddenly decided to put up a large crane, or a balloon or a UAV…They were not thinking about the implications for us… (…) So we had to train these Army guys in with whom they had to coordinate…*

Related to limited integration and subsequent efforts to create integration, a Task Force commander points out that for TFU, 49 different units were operating in a configuration that substantially differed from the way these units were used to work and train within their parent organizations (C-3):

I don't know the exact number, but we had units from 49 different parts of the organization. (…) *So, we had to create one unit out of 49 different units* (…).

Of course, before these units were sent abroad, training exercises were organized to train these units in an expeditionary configuration. For TFU, a formation exercise and an integration exercise were organized. The formation exercise took about four weeks and the integration exercise was about two weeks. However, as the same Task Force commander points out, units were not always all present during these excercises (C-3).

About 25 of these units were present from the start of the training period. The remaining units were gradually merged into the expeditionary organization. The last units were added at the beginning of the integration exercise.

That this way of training did not fully prepare individual units for operating in an expeditionary configuration, as is highlighted by a Forward Air Controller, who states that he was not able to train in "real life" with units that he encountered within TFU (F-2):

I was added during the integration exercise. And then I discovered that they did not know what to do with fire support. Also, exercises were mostly "pro memorie": that we had to imagine training with units such as airplanes and helicopters but that they were physically absent. Radio communications were also absent so we had to improvise with cell phones. (…) Due to that, it was discovered in the mission area what it means to be part of the Task Force.

Due to these training issues, it seems that to a large degree, integration between the units of TFU had to be developed in the mission area. Forward Air Controllers subsequently experienced that in shaping interactions with other units within TFU, existing rules and procedures had shortcomings and that application of these rules during operations resulted in safety issues. During training in brigade formation, FAC-ers were used to deconflict fire support with 81-millimeter mortars only at the level of their company[47] and inform battalion-staff afterwards. During brigade operations, this is possible because companies are assigned to separate geographical areas that do not overlap. In Uruzgan, however, companies were not assigned to separate geographical areas, and mission areas overlapped. Deconflicting fire support by means of brigade "rules" consequently, resulted in safety problems, as a FAC-er explains (F-3):

> *My 81 millimeters were deconflicted within the company and the Sperwer was launched on TFU-staff orders. So, it was possible that I ordered 81-millimeter fire support and that nobody of TFU staff knew that. (…) So, when they launch that UAV, they do not know what my 81-millimeters are doing…*

Not only were TFU's units innovating with the Sperwer UAV and Apache helicopters, as was shown in the previous section. This was also the case for Forward Air Controllers. Along the way, TFU's units discovered that fire support was an asset that could not be missed during operations in Uruzgan, as a FAC-er explains (F-3):

> *They* [TFU's units] *wanted us to accompany them more and more. Because they discovered that when they were in a TIC* [Troops in Contact] *situation, we could solve that by means of fire support. They were quite happy with us along the way.*

The same FAC-er points out that during operations within TFU he experienced uncontrolled, unexpected and unsafe interactions between fire support assets on which he had no influence (F-3):

> *There were times that I was firing with artillery and that I suddenly heard the sound of a helicopter in the area. (…) Also, once I was training with two F18 fighter jets when I suddenly heard something…two German Tornado fighter jets soared through my*

[47] A brigade is built from several battalions of about 500 soldiers that are divided into several companies of about 150 soldiers. Companies are subsequently divided into several platoons.

"restricted operations zone" with a speed of 1000 kilometers per hour… (…) *I got used to it, in the beginning you are stupefied: did that really happen? After two months, you just start to accept that it happens…because I could not do anything about it.*

The exploration phase presented in this section has shown how units within TFU interacted with 107 ASBt and whether this resembled the way they interacted with other partners. This clearly seems to be the case, which leads to the conclusion that 107 ASBt was unique to some extent, but not in the way they experienced influences from the interaction network from within TFU on safety issues and their ability to solve safety problems. Therefore, in the next section, it will be investigated in more detail whether these influences can be interpreted as being similar to the influences experienced by 107 ASBt, which is a necessary step before it can be attempted to verify the hypotheses from Chapter Three.

4.5.2 Specification phase

In this section, it is investigated whether the units studied experienced influences of TFU's interaction network on safety similar to the influence experienced by 107 ASBt. These influences experienced by the units studied in this chapter are subsequently reflected by means of the experiences of 107 ASBt derived from Chapter Three.

Quite clearly, the degree in which limited integration within TFU that was experienced by 107 ASBt was also experienced by the majority of the units studied within this chapter. Also, it was witnessed that ad-hoc solutions were subsequently used to develop such integration. For example, reconnaissance units attempted to develop integration between themselves and other units by means of "sales pitches". On the other hand, they discovered that existing rules and procedures were not fitting the dynamic operations of TFU. As a result, reshaping such rules and procedures was attempted to fit operations, as was for example witnessed in the way FAC-ers were used as a radio relay station for deconfliction in the air. Subsequently, they experienced that integration issues and incompatibility of rules and procedures has safety consequences, as was witnessed in the problems FAC-ers experienced in their Restriced Operations Zone.

From the previous section, it may hence be inferred that the influences of TFU's interaction network on safety found while studying 107 ASBt were not unique for them. Other units within TFU too seemed to experience similar influences and consequences for safety. Moreover, they seemed to employ similar strategies in shaping the interaction network in order to operate safely, which did not always succeed. As such, it seems to be possible to attempt verifying the hypotheses on the relation between TFU's design and safety developed in Chapter Three.

4.5.3 The reduction phase

The **first hypothesis** emphasized the relationship between "mixing and matching" and limited structural coupling between units in the expeditionary organization. It was found in this chapter that units, such as reconnaissance units and FAC-ers, too had to familiarize themselves extensively within TFU. It seemed to be the case more units had poorly integrated input and output relationships with other units within TFU's primary process. Also, it was shown that units experienced missing agreements between, for example, Air Force and Army units. This hints at missing structural coupling between units in TFU's control structure. Moreover, a Task Force commander highlighted that "an organization" had to be created from scratch out of the 49 units of which TFU was assembled. This highlights that missing structural coupling between units may be a more widely spread issue within the Task Force. Quite clearly, the quote of the Task Force commander links this finding to the "mixing and matching" process by which the Task Force was assembled. As such, it can be stated the first hypothesis, developed from the perspective of 107 ASBt, can be verified for TFU.

The **second hypothesis** stated that: "A combination of missing structural coupling within TFU and TFU's enactment threatened safety of both 107 ASBt and TFU". In the results section, it is highlighted that the apparent absence of agreements between Army and Air Force units, resulted in "constant surprises". Also, a Forward Air Controller pointed to similar "surprises" within his restricted operations zone. This indicates that these units apparently too had to operate with underdeveloped integration for critical interactions and that this resulted in safety issues during operations. Combined with the statement from the Task Force commander highlighted above, this seems to give support at the level of TFU for the second hypothesis developed from the perspective of 107 ASBt. It seems to be the case that missing structural coupling was a more general problem within TFU, which combined with TFU's enactment in the Uruzgan operating environment, had safety consequences. In addition, this highlights the relevance of the arguments on IOR's "design parameters" put forward in the previous chapter. That is to say, at the level of TFU too, safety issues can be related to missing structural coupling, which is not accounted for by IOR's design parameters.

Concerning the **third hypothesis**, it was found that several units were attempting to develop input-output relationships between themselves and other units within TFU in order to contribute safely to TFU's operations. Forward Air Controllers, air traffic controllers and reconnaissance operators employed similar "sales pitch" strategies compared to the strategies 107 ASBt's used to contribute to TFU's operations. Also, it was shown that other units were engaging in efforts to develop and refine rules and procedures in order to operate safely. This was shown in the way Apaches and other units tried to use FAC-ers as a "radio relay station". As such, it can be argued that hypothesis three, which stated that: "Normal work" of 107 ASBt's operators was mainly aimed at self-designing 107 ASBt into TFU's production and control structure", can be verified at the level of TFU. As to the **fourth hypothesis**, it was discovered by TFU how the ability to operate in Uruzgan could be improved by means of innovating with assets such as the Forward Air Controllers, Apaches and fire support. In terms of De Sitter (1994) such innovation within TFU can be defined as product innovation because, while enacting the Uruzgan environment, TFU's units were constantly reinventing the way they could best tackle operational issues by changing configurations of units. At the same time, such innovation resulted in new configurations in which they had to operate with accompanying integration problems as was shown during operations of Apaches and Forward Air Controllers. Hence, it can be argued that hypothesis four, which stated that: "enactment of TFU in its environment and accompanying innovation of TFU's units with the Sperwer-UAV resulted in ongoing integration issues because of the changing configurations of units in which 107 ASBt operated", can be verified at the level of TFU.

Most units that were included in the study in this chapter somehow discovered along the way that procedures that they were using did not work for developing safety of their operations within TFU. As was shown by the difficulties Apaches had to receive and transmit information about deconfliction in the air, the problems FAC-ers had to deconflict 81-millimeter mortars and controlling their restricted piece of air space. As a result, operators of these units attempted to change these rules and procedures in order to develop safety of their operations. These attempts, however, did not always result in safe and controllable operations within TFU, as was highlighted by a FAC-er who simply decided to accept that he could not always deconflict aircraft in his restricted operations zone. In this way, it can be argued that incompatibility of rules and procedures resulted in permanent safety threats for TFU. As a result of these findings, it can be pointed out that **hypothesis six**, which stated that: "due to incompatible rules and procedures, 107 ASBt and TFU were confronted with permanent safety threats during UAV operations" can be verified at the level of TFU. With regard to **hypothesis five**, that stressed to hindering effect of "rotation" of units within the Task Force, no evidence was found to verify this finding with other units within TFU.

Despite the fact that this chapter has included a limited number of TFU's units, a Task Force commander explained that within TFU, about 49 different units within the Task

Force had to form "an organization" along the way. Therefore, it seems to be the case that more units within TFU have had experiences similar to the experiences reported by the units studied in this chapter. Hence, it is plausible to propose that more units had to develop safety of operations within TFU by developing structural coupling, creating and reshaping control loops, local product innovation and experienced issues with regard to incompatible rules[48] and procedures while attempting to operate safely within TFU. This may stress the relevance of the hypotheses 1, 2, 3, 4 and 6 presented for TFU as a whole.

Next, it is pointed out that while self-designing, TFU's operators seem form their interaction network in a particular way by developing particular kinds of input and output relations and control loops. More specifically, it may be interpreted that they seem to search for specific kinds of interdependence and forms of coordination between themselves and other units within TFU. To gain more detailed understanding of this, the next section aims to unravel this by using Thompson's (1967) widely used definitions of interdependence and coordination.

4.5.3.1 Complexity and searching for interdependence and coordination within TFU

Thompson (1967) distinguishes between three different forms of interdependence between organizational units: pooled, sequential and reciprocal interdependence. When two units have pooled interdependence, they are part of the primary process of an organization but perform separate functions and are not directly dependent on each other. Sequential interdependence refers to dependence in which the input of one unit depends on the output for another. The dependence between intelligence and operational activities within TFU has such a sequential character. For example, a reconnaissance operator quoted above did not want to start his operations without the input from the Sperwer. Reciprocal interdependence refers to units that rely on each other's input and output. This was the case between 107 ASBt, Apaches and Forward Air Controllers, for example. For carrying out work, in particular during ad-hoc operations, these units were reciprocally dependent on each other. According to Thompson, each of these types of interdependence requires a different form of coordination. Standardizing input and output of units best coordinates pooled interdependence. Coordination by means of a predetermined central plan is best suited for units that are sequentially interdependent. According to Thompson (1967, p. 56) coordination by means of a central plan involves creating schedules for the interdependent

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[48] Note that there is a difference between rules for interaction with other units and task based rules such as "skills and drills" that are essential for conducting a particular task. The arguments in this chapter with regard to rules and procedures of TFU's control structure refer to the first definition.

units, which is less rigid than standardization. With regard to reciprocal interdependence, Thompson (*ibid.*) stresses that this form of interdependence is best governed by means of mutual adjustment.

From the way TFU's operators tried to develop input-output relationships and change rules and procedures, it can be inferred that they gradually discovered and created reciprocal interdependence during operations, for which mutual adjustment was needed for developing safety instead of central coordination. The results in Chapter Three and this chapter showed, however, that there was a tendency within TFU to coordinate movements "in the field" and in the air centrally from TFU's OPS-room. As was described in chapter Three, all kinds of liaison officers from different units were involved in the process of deconflicting units in the field. For assets in the air such as Apaches and UAVs it was attempted to deconflict movements through the Combined Air Operations Centre in Bahrain. Such centralized coordination attempts did not seem to fit the dynamic character of TFU's operations in Uruzgan. That is to say, operations in the field seemed to change quickly in reaction to environmental dynamics for which coordination by means of a central plan was too slow and too complicated. This, in combination with an organizational network in which some units needed to discover existing rules and procedures, led to difficulties.

These arguments are highlighted by Apaches that reported to have problems with connecting with TFU's OPS-room to get updated information on "friendly" movements in the air. Also, Forward Air Controllers reported to be surprised from assets that were centrally tasked from TFU's staff. Moreover, although 107 ASBt's liaison officer attempted to deconflict the Sperwer's movements from inside TFU's OPS-room, the Sperwer had serious local deconfliction issues due to its inability to participate in "see-and-avoid" and local radio contact. A Forward Air controller even reported that TFU's staff once launched a Sperwer to improve "situational awareness" in TFU's OPS-room, which hindered him in engaging hostile opponents in the field. What seems to be the case is that units "in the field" and TFU-staff were trying to develop safety by means of different and sometimes conflicting coordination methods for forms of interdependence.

It can be argued that these, sometimes conflicting, attempts to develop safety were originating from an organizational network in which units were still discovering and continuously changing relations with each other while applying and refining existing rules. Searching for interdependence and suitable coordination mechanisms is inevitably present in organizations, especially while operating in a dynamically complex environment. Weick (1974, p. 360), for example, points out that "*in the everyday world there are probably connections that are both constant and variable, frameworks that are both rigid and variable* (…) *organizations have analogues of variable connection, flexible frameworks and sliding bonds*".

However, within TFU, conflicts between different coordination mechanisms, that surfaced in the quest for finding suitable coordination mechanisms for changing forms of interdependence, seemed to have created a "grey" uncontrolled area in which critical dependencies were not coordinated, or missed. This was shown by the dangerous interactions between 81-millimeter mortars and other flying assets, Dutch Apaches and the Sperwer, Artillery and fighter jets and the Sperwer and various helicopters. These interactions can be interpreted as *hidden interactions* (cf. Perrow, 1999, p. 79) because they were missed by coordinators and seemed to be appearing from out of nowhere from the perspective of operators such as FAC-ers[49].

Next to the attempts to coordinate particular forms of interdependence with sometimes incompatible mechanisms, hidden interactions seem to be associated with an organizational interaction network that is hard to grasp for individual units and operators. It seems to be the case that within TFU, the search for forms of interdependence and coordination was complicated by complexity of TFU's interaction network in which 49 different units tried to find out with whom to work and how to coordinate that work. A simple formula ((n(n-1))/2; cf. Kuipers et al., 2010) shows that with 49 different and poorly integrated units (*n*= 49), 1176 interactions are potentially possible. This, combined with inevitable searches for interdependence and coordination that are always be present in organizations makes it hard, or even impossible, for operators and TFU staff to develop insight into dependencies between units within TFU's production structure and develop suitable coordination mechanisms. Such complexity due to the sheer number of "building blocks" may also further explain the existence of "hidden interactions".

Furthermore, by means of the concept of *structural complexity* (e.g., De Sitter, 1994; Kuipers et al., 2010) it is argued that, next to the number, the nature of building blocks also contributes to the complexity found in the network between TFU's units. The concept of structural complexity, which was also briefly highlighted in Chapter Three, points to the notion that high degrees of functional concentration of workstations, per definition, leads to an interaction network that is complex and incomprehensible for operators and controllers. It can be argued that within TFU, functional concentration was present. That is to say, Figure 13 shows that specific specialist activities, such as intelligence, the Battle Group, Air support, Provincial Reconstruction Teams and Engineers were all located at specialist departments. Hence, it can be argued that next to the sheer number of building blocks and missing

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[49] This highlights the relevance of Taylor's (1981) definition of an accident as being a "black hole" in the perception of operators.

integration, functional concentration within TFU too contributed to organizational complexity within TFU.

With regard to TFU's design, it is argued that several aspects of TFU's organizational structure can be related to the way military parent organizations in the Netherlands are designed. Firstly, as was highlighted in the first chapter of this thesis, the layout military parent organizations in the Netherlands do not match expeditionary demands. Therefore, the need to "mix and match" all kinds of different units from parent organizations into expeditionary organizations, which was regarded as the origin of missing integration, can be related to the layout of Dutch military parent organizations. Secondly, most control loops seemed to be transplanted from parent organizations to the expeditionary context. For example, this was shown by the way FAC-ers, 107 ASBt and Apaches tried to develop safety of their operations by means of standard "brigade" and NATO deconfliction procedures.

Subsequently, the next section focuses in more detail on influences of the military parent organizations in the Netherlands.

4.5.3.2 The influence from the military parent organizations in The Netherlands

As was pointed out in Chapter Three and section three of this chapter, TFU was mainly built from units from the Royal Netherlands Army parent organization. Also, it was shown that the Dutch Army is structured by means of so-called brigades. A brigade is a unit of about 3000 soldiers and is mainly designed for classical large-scale armed conflicts between nation states. Within the Dutch Army, the Brigade is regarded as an entity in which all functions necessary for military operations are grouped. This is often referred to as the level of "combined arms". As can be seen in Appendix One, the Dutch Army and its brigades are built from many specialized units that all perform a separate function or activity such as maneuver (infantry), fire support (artillery), logistical, medical, engineering and intelligence units. Following IOR's "design parameters" and based on the figure presented in Appendix One, the organizational structure of the Dutch Army's parent organization can be interpreted as highly functionally concentrated because all kinds of performance, preparing, supporting and controlling activities are divided over many specialized units.

Yet, the Dutch defense doctrine states that the present Army organization with many specialized units has the ability to be flexible (ministry of Defense, 2013, p. 89). Indeed, an organization with many specialized units provides the opportunity to assemble many different expeditionary organizations. Kramer and De Waard (2007) define this type of apparent flexibility as "composition flexibility". However, Kramer and De Waard (2007)[50] also argue that assembling many different specialized units into an expeditionary organization decreases operational flexibility, the ability to function as a "well-oiled machine" and adapt to local circumstances. The case presented in this chapter highlights the latter. For TFU, "composition flexibility" of the Army parent organization by "mixing and matching" functionally concentrated units from the parent organization into an expeditionary organization resulted in missing integration, which was associated with direct safety consequences due to TFU's necessity to act in its environment.

As stated in Chapter Three, TFU was not only "mixed and matched" from units of the Royal Netherlands Army. The Air Force, Military Police and Navy too provided "building blocks" for TFU. These other parent organizations, and the Royal Netherlands Air Force in particular, are often regarded as being less functionally concentrated (see: De Waard & Kramer, 2008). However, it can be argued that grouping all air support and transport aircraft into one separate organization (i.e. the Air Force) shows traces of functional concentration at the level of the military parent organization as a whole[51]. Similar signs of functional concentration can be found in the Military Police (MP) and the Marines of the Royal Netherlands Navy. That is to say, for comprehensive military expeditionary missions such as TFU, specialized MP building blocks are often added to the expeditionary organization. Also during later missions, Marine units provided building blocks for TFU's Battle Group, Fire Support and Intelligence. As such, the Dutch military seems to be confronted with a *holographic composition problem* due to functional concentration. That is to say, due to functional concentration at various organizational levels a "mixing and matching" expeditionary organizing strategy has to be applied to come up with an expeditionary organization. This composition problem was present within units such as 107 ASBt, within TFU which was shown by the continuously changing layout of operational units such as SUAs (see section 4.3) and both within and across parent organizations.

Furthermore, the way of designing military organizations seems to be transplanted from parent organizations to expeditionary organizations. That is to say, although the configuration in which units had to work in TFU differed substantially from the configuration in which they were used to work in their parent organization, the way in which they were grouped together in that new configuration shows a traditional, functionally concentrated, military organizational design. This is highlighted by dividing infantry,

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[50] See also: De Waard & Kramer (2008) for an English article on this subject.

[51] As functional concentration of an organization's production structure is defined in relation to its stream of orders (cf. De Sitter, 1994), this can only be defined as functional concentration in relation the stream of expeditionary "orders" at the level of the military parent organizations.

artillery, intelligence, logistics and engineers in different departments. Therefore, functional concentration within TFU can be related to functional concentration within the Army parent organization. This finding does not seem to be unique for the Dutch military organization. From an US military perspective, Snook (2000) highlighted that: "*Task Forces are designed by taking basic unit building blocks and assembling them along hierarchical lines consistent with the mission and time-honored military traditions*". This means that it is likely that the US military too expeditionary Task Forces are designed along the way the military organization at home is designed.

Lastly, a high degree of functional concentration may explain the problems in applying rules and procedures that are developed for the traditional Army brigade. As was highlighted in Chapter Three, low levels of autonomy and process oversight at the operational level characterize highly functionally concentrated organizations. This results in the need for hierarchical and centralized control (e.g., Kuipers et al., 2010). Therefore, it comes as no surprise that many rules and procedures within TFU were characterized by a tendency to coordinate by means of standardization and centralized plans. This however, is proved to be quite incompatible with, often self-designed, reciprocal interdependence between units during operations in Uruzgan's dynamically complex environment for which mutual local coordination was needed.

As such, this section has highlighted that the rather problematic relationship between organizational design and safety within TFU is intertwined with design issues at the level of the military organization as a whole. In the next section, it will be attempted to generalize the findings in the preceding sections to the level of expeditionary organizations in general.

4.5.4 Integration phase

To generalize aspects of the findings presented in this chapter and formulate hypotheses on the relation between organizational design and safety for expeditionary organizations in general, this section will use analytical generalization (cf. Yin, 2003, p. 30-32). This means that this section attempts to build analytical arguments by combining results from within TFU with existing literature to demonstrate the applicability of these results to expeditionary organizations in general. This also implicates that the new hypotheses that are developed are located at Van Strien's level B of knowledge generalization because analytic generalization should result in hypotheses that apply to the broader family of expeditionary organizations.

First of all, a main observation on the findings in this chapter is that the units studied attempted to develop safety by means of shaping the interaction network in a way that can be interpreted as self-design. They did so for two reasons, firstly to overcome missing structural coupling within the Task Force. Secondly, they tried to adapt to a dynamically complex operating environment by means of local product innovation that entailed configuring the network of partners with whom to interact while enacting the operating environment. As such, it can be argued that TFU's operators were constantly building and re-building their organization to operate both meaningfully and safely. In particular, and along Thompson's (1967) concepts of interdependence and coordination, it was argued that units created (and discovered) reciprocal interdependence for which local, mutual, coordination was needed.

Along recent developments in organization science, the organization resulting from these efforts shows characteristics of a "network organization" (e.g., Kuipers et al., 2010) in which relationships with partners, or other units, has to be constantly reshaped in order to the match variety of tasks, or "orders", in a dynamically complex operating environment. However, it seems to be the case that attempts to build such ad-hoc networks were hindered by characteristics of design of both the expeditionary organization itself and military parent organizations, which provided the building blocks and coordination mechanisms for the expeditionary organization.

To show how these findings and the findings in the preceding sections in this chapter can be generalized to hypotheses on the relation between organizational design and safety for expeditionary organizations in general, analytical arguments are constructed. In constructing these arguments, findings of this chapter are combined with theoretical insights that relate to these findings.

Firstly, it is argued that more expeditionary organizations may suffer from integration problems similar to those of TFU, due to a complex mixing and matching process. It was already highlighted in Chapter One that more organizations, especially those at the left-end of Modig's continuum seem to employ a "mixing and matching" design strategy similar to that of TFU and also operate under dynamic complex conditions. Due to a similar "mixing and matching" design strategy, it also is likely that such temporary organizations have limited structural coupling, or limited input and output relationships and accompanying agreements, between mixed and matched units because the configuration of units in the parent organization differs substantially from the configuration in the temporary organization. More in particular, and in line with the "holographic composition problem" of the Dutch military organization stressed in the preceding section, it can be argued that such limited structural coupling is particularly present when expeditionary organizations are mixed and matched from highly functionally concentrated parent organizations. That is to say, the more parent organizations are functionally concentrated, the more complex the "mixing and matching" process will become to make an organization that fits the demands of expeditionary tasks and the more configurations of units are assembled that do not resemble the way these units were used to work in the parent organization. Subsequently, it is argued that the findings of this chapter hold relevance to *those* expeditionary organizations that are assembled out of "stationary", or "parent" at the "left-end" strategy of Modig's continuum, are characterized by a high degree of functional concentration and operate in a dynamically complex environment.

This seems very specific, and may give the impression that the findings in this chapter have limited generalizability. However, high degrees of functional concentration are found in organizations with a standard bureaucratic design (De Sitter, 1994) and it is well known that bureaucratic organizational designs are still commonplace in the contemporary business environment (Kuipers, et al. 2010; Laloux, 2014). So, it may well be that more expeditionary organizations are assembled out of functionally concentrated, static, parent organizations and hence are faced with a complex "mixing and matching" process similar to that of TFU, which has similar effects on structural coupling between units within the expeditionary organization. Therefore, the first hypothesis is formulated as follows:

Hypothesis 1: Functional concentration in parent organizations, leads to a complex "mixing and matching" design process that limits structural coupling in expeditionary organizations.

It was also stressed in Chapter One that all expeditionary organization operate in a dynamically complex environment and that operating in a dynamic complex environment places emphasis on enactment and the necessity to act (cf. Weick, 1979). Hence, it can be hypothesized that operating in a complexly "mixed and matched" expeditionary organization with accompanying limited structural coupling, will result in safety issues similar to those found in the TFU case. That is to say, due to such limited structural coupling, units will have to operate with an underdeveloped interaction network within the expeditionary organization. Hence the second hypothesis can be developed:

Hypothesis 2: Limited structural coupling within the expeditionary organization, combined with enactment and the necessity to act, threatens safety in expeditionary organizations.

Subsequently, to overcome integration issues it is likely that self-design emerges to create structural coupling between units and develop an organization that can operate meaningfully and safely in its operating environment. Furthermore, as all expeditionary organizations operate in a dynamically complex environment, as was highlighted in Chapter One, enactment and the necessity to act will place emphasis on reciprocal interdependence between units and the need for mutual adjustment during operations. That is to say, the complex nature of tasks to be carried out combined with the need for constant adaptation makes activities and units more dependent on each other and emphasizes the need for constant local adjustment to adapt both meaningfully and safely.

Also, enacting a dynamically complex operating environment will likely result in a particular kind of product innovation at the operational level in expeditionary organizations. That is to say, it is likely that due to enactment and the necessity to act in a dynamic complex environment, organizational action results in bottom-up discovery of innovative new configurations of units that are able to deliver a "new product" in relation to their operating environment. It can therefore be argued that operators in expeditionary organizations in general have to develop safety by means of self-design that aims for building ad-hoc networks similar to those found within TFU. Hence the following hypothesis can be formulated.

Hypothesis 3: Because of limited structural coupling and product innovation at the operational level, safety in expeditionary organizations is developed by operators engaging in self-design of ad-hoc networks.

The ability to develop safety by self-design within TFU was hindered by organizational complexity within the expeditionary organization. It was found that organizational complexity was associated with hidden interactions, which threatened safety at the level of the expeditionary organization. For TFU these characteristics too were related to high degree of functional concentration within both the expeditionary and parent organizations in the Netherlands. With regard to generalization of this finding to expeditionary organizations in general, Modig (2007, p. 812) states that within temporary organizations work processes are often organized along "dominant traditions" within parent organizations. As such, it can be hypothesized that it is likely that "mixing and matching" expeditionary organizations out of functionally concentrated parent organizations, will result in expeditionary organizations that too are characterized by a high degree of functional concentration. Moreover, previous sections already highlighted, by means of the work of De Sitter (1994) that functional concentration in any organization results in structural complexity, a complex web of interactions that hinders controllability of the organizations operations.

It can hence be argued that it is likely that for those expeditionary organization that are assembled out of functionally concentrated parent organizations, organizational design is also characterized by a high degree of functional concentration and that these expeditionary organizations suffer from organizational complexity that threatens safety. That is to say, it is likely that in these expeditionary organizations, structural complexity arises that may hinder the ability of operators to develop safety by means of self-design and threatens safety at the level of the expeditionary organization. Hence the fourth hypothesis can be formulated.

Hypothesis 4: Mixing and matching expeditionary organizations out of functionally concentrated parent organizations leads to functional concentration in expeditionary organizations, which results in organizational complexity that complicates the process described in hypothesis three and threatens safety at the level of the expeditionary organization.

The last hypothesis developed in this section relates to incompatible coordination mechanisms that hindered developing safety by means of self-design within TFU. It was pointed out that coordination by means of central plan, did not fit the network-character of the organization that was self-designed within TFU. This was associated with critical interactions that were "missed" by controllers such as the TFU operations room and operators in the field. For two reasons, it is likely that expeditionary organizations that are built from functionally concentrated building blocks and originate from functionally concentrated parent organizations, suffer from similar coordination and safety issues.

Firstly, coordination by means of a central plan is a frequently used and maybe inevitable way of coordination within highly functionally concentrated organizations. Perrow (1999) highlighted that in case of tight coupling, centralization of control is the only way to ensure safe organizational output. Functional concentration within any organization's primary process results in tight coupling between workstations. The only way to coordinate such tightly coupled work stations, therefore, seems to provide a centralized plan for the operations of these workstations. Therefore, it comes as no surprise that centralizing tendencies were found in the TFU case. Also, this argument points to the presence of such coordination mechanisms within both functionally concentrated parent and expeditionary organizations. Secondly, by using the argument based on the work by Modig (2007), in which she stated that it is likely that "ways of organizing" are transplanted from stationary parent organizations to temporary organizations, it seems feasible to hypothesize that coordination instruments, with tendencies to coordinate by means of a central plan, are brought along from parent organizations to expeditionary organizations. Quite understandably, these coordination mechanisms are incompatible with the self-designed network character of expeditionary organizations, which places emphasis in reciprocal interdependence. Hence, the following hypothesis can be formulated.

Hypothesis 5: Coordination by means of a central plan, which can be related to a high degree of functional concentration in parent and expeditionary organizations, hinders the process described in hypothesis three and leads to safety issues at the organizational level.

4.6 Conclusion

This chapter has developed hypotheses on ways in which safety within expeditionary organizations is influenced by structural organizational design. To do so, first, influences of TFU's interaction network on safety experienced by 107 ASBt were verified at the level of TFU. This subsequently resulted in the verification of five out of the six hypotheses on the relation between organizational design and safety within TFU. Subsequently, analytical generalization was used to translate these findings to the level of expeditionary organizations in general. Hence, by studying 107 ASBt and other units within TFU and applying analytical generalization, the relationship between organizational design and safety in expeditionary organizations is specified at Van Strien's level B. These hypotheses therefore form the basis of the "map" on the relationship between organizational design and safety in expeditionary organizations. The next chapter aims to verify these hypotheses in order to provide a validated conceptual map for the development of a theory on organizational design and safety in expeditionary organizations, which is presented in Chapter Six.

Chapter Five: Verification of hypotheses on the relation between organizational design and safety in expeditionary organizations

5.1 Introduction

In the previous chapter, hypotheses were developed that specified the relation between organizational design and safety for expeditionary organizations in general. By means of analytical generalization (cf. Yin, 2003) it was attempted to generalize findings within TFU to other expeditionary contexts. It was stated in Chapter One however, that the conceptual map developed in this thesis has to meet specific requirements regarding generalizability in order to be useful for the development of a theory on the relation between organizational design and safety in expeditionary organizations at Van Strien's level B. According to Yin, analytic generalization is only one of two steps that have to be taken in order to ensure external validity of a substantive theory that is developed by means of a qualitative methodology (2003, p. 37). The second step Yin proposes to ensure external validity of such a theory is *replication*. This means that the hypotheses, that form the backbone of the grounded theory developed in the previous chapter, must be "tested" by means of a second or third case study to see whether the mechanisms that are expected to occur in comparable contexts, do occur. Thus, to establish whether the hypotheses developed in the previous chapter of this thesis are also relevant for other expeditionary organizations, it has to be established whether the hypotheses based on the case studies within Task Force Uruzgan, can be replicated in other expeditionary contexts. As such, this chapter will focus on answering the fourth research question of this thesis:

> **Can hypotheses on the relation between organizational design and safety in expeditionary organizations be verified by studying other expeditionary organizations?**

To formulate an answer to this research question two additional, existing, expeditionary cases are studied: a Dutch military expeditionary organization in Iraq and the crisis response organization that was established after the crash of flight MH17. These cases are selected by using a *replication logic* (cf. Yin, 2003, p. 47-56). This means that these cases are selected by using specific criteria on the basis of which it can be expected that results similar to the results of the TFU case are found. Subsequently, a more deductive approach to qualitative research is taken to replicate the hypotheses developed in the previous chapter. The research steps of this chapter are visualized by means of the research model depicted in the figure below. `

Figure 21: Research model of Study 4
SFIR=International Stabilization Force in Iraq; and MH17=Malaysia Airlines Flight MH17

This chapter proceeds as follows: firstly, the methodology that is used in this chapter to conduct the replication is explicated. Because existing case studies are used in this chapter, the methodology section will –amongst other things- explicate how it will employ a "secondary analysis" on existing case study material. Also, the aforementioned "replication logic" is detailed. Secondly, the cases are introduced in separate sections. Thirdly, the analysis will be conducted. Lastly, a conclusion is presented.

5.2 Methodology

In this section, the methodology that is employed in this chapter to carry out the verification of the hypotheses formulated in the previous chapter is presented.

5.2.1 Replication logic

According to Yin (2003, p. 47), selection of cases for replication in qualitative research should to be done by means of replication logic. Such a replication logic is the underlying rationale by means of which suitable cases can be selected. Following Yin, such a rationale firstly has to explicate whether the cases are selected to find *similar* or *contrasting* results. Secondly, a conceptual framework has to be constructed that states the conditions under which the particular phenomena of interest are likely to be found (Yin, 2003)[52].

For replication in this chapter, cases are selected for finding *similar* results. That is to say, cases are selected in order to confirm the hypotheses developed in the previous chapter. However, as Yin (*ibid.*) also stresses, it may turn out that hypotheses cannot, or can only be partly, confirmed. In that case, hypotheses may have to be revised or nuanced. The theoretical frame that guides the selection of cases is based on the general premises on organizational design and safety in expeditionary organizations, which were described in Chapter One.

5.2.1.1 Analytical frame for replication

Firstly, the concept "expeditionary organizations" can be used to select cases. This concept was highlighted in the first chapter of this thesis. Also, the previous chapter provided some more detail, by means of the work of Modig (2007) and De Waard and Kramer (2008). It was highlighted that expeditionary organizations are large collections of units or "building blocks" and operate in a configuration that differs significantly from the configuration of units in which they are located in their parent organization(s). Also, it was pointed out that parent organizations of the expeditionary cases that are selected have to be located in the "stationary" left end of Modig's continuum. More in particular, these parent organizations have to be characterized by a high degree of functional concentration. Secondly, the concept "dynamic complexity", which is intertwined with the concept of expeditionary organizations, can be used for selecting cases. This concept was introduced in the first chapter by means of the work of Kramer (2004; 2007) and emphasizes that the temporary organizations that are selected have to operate under uncertain, ambiguous and reactive circumstances. By using these concepts two cases are selected: the Dutch military expeditionary organization that carried out operations in Iraq under the flag of SFIR and the crisis response organization that was established after the crash of flight MH17 in the eastern part of Ukraine.

The Dutch contribution to SFIR was a temporary organization assembled from different building block from the Dutch Army, Military Police and Air Force (see: Delahay et al., 2009). In the case study report by Delahay et al. it is pointed out that the Dutch SFIR contribution did not resemble a "normal" military battalion, but that all kinds of "extra" units were added in order to assemble a Task Force. As such the configuration in which units were operating within the Task Force differed significantly when compared to the

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[52] Note here that the framework for detailing a replication logic is different from the analytical framework with which the cases in this chapter are analyzed. As stated in section 5.2.1, the latter is based on the results from Chapter Four.

configuration in which they were located in their parent organizations. Furthermore, in the previous chapter, it was argued extensively that the parent organizations of the Dutch military are located at the left end of Modig's continuum and are characterized by a high degree of functional concentration, at different levels of the parent organizations.

The MH17 crisis response organization was temporarily assembled from different stationary government organizations such as the Dutch ministries of Security and Justice, Foreign Affairs, Defense and the Dutch Police. Also, several private parties can be interpreted as being part of the crisis response organization such as parts of Schiphol Airport, Malaysia Airlines and the Dutch Victim Support organization[53] (Torenvlied, Wessel, Giebels, Gutteling, Moorkamp & Broekema, 2015). This means that the configuration in which all these, both private and government, units had to work was significantly different when compared to their situation within the different parent organizations. Also, these parent organizations can be located in the left part of Modig's (2007) continuum because all these parent organizations have their own "primary process" during everyday operations to which units are returning after the crisis. With regard to the degree of functional concentration within these parent organizations, it cannot be stated that all these parent organizations have a high degree of functional concentration. However, it is well known that government organizations and ministries in particular are often characterized by bureaucratic organizational designs (see for example: Boin, 2009) and should therefore are likely to possess such a high degree of functional concentration.

Concerning the concept "dynamic complexity" both temporary organizations operated in an area that can be interpreted as uncertain, ambiguous and reactive. In Iraq, opposing parties were actively trying to undermine the operations of the Dutch SFIR mission. In the eastern part of Ukraine, pro-Russian separatists and the Ukrainian government army were, at the time of the MH17 crash, engaging in several battles, which resulted in an operating environment that was uncertain, ambiguous and reactive. However, a large part of the crisis response organization did not operate in Ukraine, but was operating in the Netherlands. In the Netherlands, no opposing parties were active. This means that this part of the crisis response organization was confronted with another kind of operating environment when compared to the part that was operating in East-Ukraine. Although the crisis environment in the Netherlands could be described as uncertain and unpredictable, the characteristic reactiveness can be interpreted as being different. That is to say, although parties in the crisis environment did respond on the actions of the crisis organization, they did not try to actively undermine the operations of the crisis response organization. This

[53] In Dutch: Slachofferhulp Nederland.

made the crisis environment in the Netherlands, during the MH17 crisis, differently dynamically complex than the crisis environment in Ukraine. Still, the crisis environment in the Netherlands complies with the characteristics of dynamic complexity, as it can be argued that any crisis environment can be defined as uncertain, ambiguous and reactive (cf. Moynihan, 2008).

After the selection of the cases and detailing a replication logic, it has to be explicated how existing data is analyzed to enable the analysis in this chapter to verify the hypotheses that were developed in the previous chapter. To do so, the next section elaborates on so-called secondary analysis of case study data.

5.2.2 Secondary analysis of case study data

Using existing case study material for analysis is referred to as secondary analysis (e.g, Heaton, 2008). Heaton (2008, p. 35) highlights that secondary analysis of existing qualitative data can be used to verify findings of previous research. However, to be able to replicate the hypotheses developed in Chapter Four, data used in this chapter has to possess certain characteristics. It was argued in Chapter Three, that a particular way of studying "normal work" enabled unraveling influences of organizational design on safety within expeditionary organizations. For replication of the hypotheses developed in the previous chapter such a normal work approach can be applied by using specific case study data. That is to say, to be able to replicate the hypotheses, the data has to be able create insight into whether the interaction network was also characterized by limited integration between operational units. Also, the data has to be able to create insight into whether operators attempted to create, shape and reshape interactions within the expeditionary organization. After that, this information can be interpreted using the "compass directions" presented in Chapter Three to establish whether self-designing of ad-hoc networks, as defined in the previous section, took place. Secondly, it needs to provide information on the expeditionary organization and parent organizations in order to reconstruct whether similar effects of design of both the expeditionary organization and parent organization(s) on the expeditionary interaction network were present. In this section, it will be elaborated how data was collected in the cases selected for replication and why it is suitable for secondary analysis in this chapter.

With regard to the SFIR case, the case study report (see: Delahay et al., 2009) argues that interview data was gathered by means of document analysis and interviews. A total of nine interviews were conducted with military personnel from different hierarchical layers of SFIR-4. The interviews were transcribed literally and content analysis was conducted from different theoretical perspectives. The interviews were conducted by means of the following topic list[54]:

- How was SFIR-4 structured and organized?
- What did normal operations within the Task Force look like?
- How is safety of patrols organized during normal operations?
- How does the unit deal with problems during patrols?
- What procedures exist for emergency situations?
- To what degree were these procedures trained, prior to the ambush?
- What happened during the ambush?
- What can be learned from the ambush?

As can be seen in the topic list, questions were directed towards "normal operations", problem solving strategies, safety of patrols, organizational structure and the influence of procedures. From information on "normal operations" and problem solving strategies it may be possible to infer how units interacted and whether they attempted to develop safety by attempting to shape the nature of these interactions in such way that safety of operations was improved. Also, information on the way SFIR-4 was structured and what procedures were used may enable linking characteristics of design of both the expeditionary organization and military parent organization to possible effects on interactions within the expeditionary organization. This seems to make the data gathered in the SFIR-4 study suitable for a secondary analysis that is in line with the goal of this chapter.

For an analysis of the MH17 crisis response organization, this chapter uses the data presented in an evaluation report that is publicly available (see: Torenvlied et al., 2015)[55]. The aim of the evaluation report was to get insight in the way the national crisis response organization functioned after the crash of flight MH17. This was done in three separate studies. Firstly, insight was created in the way the crisis response organization itself operated. Secondly, the perspective of the victims' families on the operations of the crisis response organization was taken. Thirdly, it was investigated how the crisis response organization communicated with media, society and Dutch parliament. This chapter will focus on the results of the first study because this study was aimed at reconstructing the way the crisis

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[54] The topic list is a literally translated version of the original topic list reported by Delahay et al (2009). For the original Dutch version of the topic list, see their report.

[55] Due to confidentiality of the original interview transcripts, this chapter uses the publicly available report for the analysis instead of the original interview transcripts.

response organization dealt with the crisis in detail by means of 46 in-depth interviews[56] across hierarchical levels[57]. To reconstruct the activities of the crisis response organization, the MH17 evaluation report employs a distinction between five parallel[58] core activities: crisis response in The Hague, international diplomacy, crisis response at the crash site, crisis response to the victims' families, information provision to the House of Representatives, information provision to the media and society. The core activities were subsequently studied within three timeframes: the immediate crisis response on the 17th of July, the period from the 18th until the 24th of July and the period from the 25th of July until the 8th of September 2014.

A general premise of the first study was that, due to the dynamic crisis context, control of a crisis is developed gradually by means of activities at the operational level of the organization and that a main task of actors in the control structure of the crisis organization is to facilitate these operational activities (Torenvlied et al., 2015, p. 26-31). Hence, the interviews aimed to map problem-solving activities of employees across different hierarchical layers of the crisis response organization and reconstruct whether and in which ways controlling actors and fora within the crisis response organization operated facilitated operational activities. Also, substantial attention was directed to mapping the layout of the crisis response organization (see: Torenvlied et al., 2015, p. 44 and p. 184). This means that data collected within the first study of the MH17 study, may provide information on the way operators within different units in the crisis response organization interacted and whether operators attempted to develop safety means of shaping and reshaping the interaction network within the expeditionary organization. Also, due to the information that is present within the evaluation report on design of the crisis response organization, it may be possible to relate effects on interactions to characteristics of the expeditionary organization. Furthermore, within the evaluation report, it is pointed out from what parent organizations different units and operators were originating. This may enable linking aspects of expeditionary organization to characteristics of parent organizations. Hence, the data from the evaluation report can be interpreted as suitable for attaining the goal of this chapter.

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[56] The author of this thesis was part of the research team that evaluated the crisis response organization after the crash with flight MH17 and co-conducted 37 of the 46 interviews.
[57] For the interview list, see: Torenvlied et al. (2015, p. 339-342)
[58] The choice for parallel activities was made because crisis control activities at different locations and different hierarchical levels were initiated at the same time (Torenvlied et al., 2015).

5.2.3 Replication and the role of deduction

As becomes clear from the previous section, particular pieces of data are needed to verify, or replicate, the hypotheses developed in Chapter Four. This implies that this chapter employs a different analytical strategy as compared to Chapter Three and Four. In the previous chapters, development of the hypotheses on the influence of organizational design on safety for expeditionary organizations was done by means of using an abductive analytical approach. Abduction, as stated by Richardson and Kramer (2006) is a suitable approach to connect, or in terms of Dubois and Gadde (2002) systematically combine, theoretical constructs with empirical data to understand *new* situations. In this chapter, however, it is not attempted to understand new situations by means of theoretical constructs, this was done in Chapter Three and partly done in Chapter Four of this thesis. Instead, this chapter aims to determine whether the hypotheses that were developed in the previous chapters apply to other expeditionary cases. As such, it attempts to investigate whether "general rules" apply to other specific cases, which can be interpreted as a deductive analytical strategy (cf. Richardson & Kramer, *ibid.*). Applying such a deductive analytical strategy means that the hypotheses developed in the previous chapter, are employed as an analytical framework with which the cases are analyzed. However, because these hypotheses are about organizational design and safety, parts of the conceptual compass described in Chapter Three are still needed to relate case study data to concepts on organizational design in order to verify these hypotheses because, as was highlighted at several places before in this thesis, characteristics of organizational design cannot be observed directly but have to be reconstructed analytically.

5.3 Description of the cases

In this section, first the SFIR-4 case is described. After that, the MH17 case is detailed. Before reading this section, it should be noted that for both the SFIR and the MH17 case, using the results of the previous chapter as an analytical framework for secondary analysis enables this chapter to be selective in describing the cases. As both cases are studied extensively, this chapter cannot describe both in detail. This is not regarded as problematic because the goal of this chapter is not to give an exhaustive overview of both cases but to verify the hypotheses of the previous chapter. This section and the next section will present the cases in such a way that enables this chapter to do so.

5.3.1 Iraq, Dutch troops ambushed[59]

From December of 2003 until March of 2005 the Dutch military organization contributed substantially to the international Stabilization Force in Iraq (SFIR). The Dutch contribution to SFIR consisted of expeditionary organizations that were built around an infantry battalion[60] from the Dutch Army's Air Assault brigade (see: Appendix 1 for a schematic layout of the Army) that was complemented by a helicopter detachment, logistical units, engineers and units from the Military Police (MP; Delahay et al, 2009, p. 17-19). An officer of the Dutch SFIR-mission explains this "mixing and matching" within the Dutch SFIR detachment[61]:

> *We were not sent as a battalion but as a Battle Group. This means that all kinds of assets are added that are normally not part of the battalion: logistics, transport, Military Police, intelligence… all kinds of things.*

An Army officer explains what it meant to cooperate with these "newly added" units:

> *That is what I would like to address as a problem. Units from outside our club were added at the last moment. They were motivated, but came from an entirely different world.*

In the night between August 14 and 15 2004, around 23:45 hours, opposing forces in the town of Ar Rumaythah ambushed Dutch military units of SFIR-4[62]. Delahay et al. (2009, p. 14) describe that:

> "*During an investigation on an earlier shooting incident, a small unit from the Military Police was attacked by hostile opponents, which resulted in one fatality and one wounded military policeman.*"

Kramer (in: Delahay et al, 2009, p. 61) shows that two "misunderstandings" complicated the military response to the ambush. Firstly, procedures within the Army prescribed that units

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[59] The text in this section is based on the report by Delahay et al. (2009).
[60] The battalion consisted of three infantry companies, a staff company and an anti-tank company.
[61] The interview quotes in this section are adapted from Kramer (in: Delahay et al, 2009) and literally translated from Dutch to English.
[62] SFIR-4 refers to the fourth "rotation" of the Dutch contribution to SFIR.

who leave the compound, should use a particular radio frequency to report to the Operations Room (OPS-room) of the Company responsible for that particular area, in this case "Bravo-Company". This procedure is aimed at ensuring that it is known which units are outside the compound. The MPs, however, did not report to the OPS room because they did not seem to be aware of this particular procedure and hence, did not have the right radio frequency. A non-commissioned Army officer explains:

> "*They* [MPs] *did not load the right radio frequencies for Ar Rumaythah. That is why they could not contact OPS. They were just driving around, while we did not know where they were. We cannot help them when they load their radio in the wrong way.*"

As a result, the MPs could not contact the OPS-room of Bravo-Company after the attack. They tried to communicate their position to the battalion OPS-room by means of a satellite telephone. Although battalion OPS did not receive their location, it was realized that the situation was serious. As a result, a Quick Reaction Force (QRF), Medical evacuation (medevac) and Apache helicopters were put on stand-by. Meanwhile, a unit on patrol nearby overheard the attempts of the MPs to communicate their distress via radio and decided to assist, as a commander explains:

> *They* [the patrol] *were going north, to the border of their section and listened to radio traffic. At a certain moment, they reported themselves at the company communication network and said: Listen… I can be there in five minutes, what do you want? Ok, I am aborting the patrol and we are going there now!*

On arrival at the scene, the patrol assisted in securing the area and reported the details of the location of the ambush to the OPS-room of Bravo company. Ten minutes later, the first QRF from Bravo-Company with two ambulances and a recovery vehicle arrive at the scene. At about the same time, two Dutch Apache helicopters and an American Black-Hawk medevac helicopter were given the assignment by battalion OPS to go to the location of the ambush.

At the moment the first QRF leaves the compound of Bravo-Company a second QRF is formed. This second QRF is bigger than the first and consisted of armed vehicles, an ambulance, a salvage vehicle and a crane-vehicle. Also, a Forward Air Controller (FAC-er) is added to the QRF to help directing and landing of helicopters. The second QRF leaves the compound at about 00:30 hours. The moment the second QRF enters the city of Ar Rumaythah, it is attacked with heavy weapons. Standard procedure in such a situation is to go forward in high speed in an attempt to escape from the attack. After a while, the second QRF arrives at the scene where the MPs were ambushed. At this moment, it is discovered that one vehicle is missed in action. After this is reported to the OPS-room of Bravo-company, a third armored QRF is formed to search for the missing vehicle. At roughly the same time, the battalion OPS-room, which is informed about the escalating incident, decides to send their QRF to the city of Ar Rumaythah. A commander of Bravo-Company explains his vision about this decision:

> *At that moment, I could not use a unit from outside* [from outside Bravo-Company]. *As long as I can do it myself* (…) *I don't want them here. One: before they are up to date with what is going on… I don't have that time. Two: before I have them guided to the good location, because they do not know the terrain, I don't have that time… I recall that I shouted: Stop this show! If I need anything I can ask for it. Then they* [the battalion QRF] *decided to stop moving…*

The commander subsequently decides to put the battalion QRF into waiting position outside the city and receive the arriving helicopters. The same commander states:

> *The commander of the battalion QRF came to me… Then he received the assignment to assume a "blocking position" and receive the helicopters. That is what they did.*

Upon arrival at the location of the ambush, the FAC-er consults with the two Apaches to discuss tasks of the helicopters. They decide to task one Apache to flying above the city to secure the third QRF from Bravo-Company, the other Apache is tasked to secure the Black-Hawk medevac helicopter. The FAC-er explains:

> *What I thought was important that we lost a vehicle, and that helicopters are perfect or assisting to find them. They not only have weapons but also have a mega-view. I was thinking about using one helicopter for guiding us through the city and look for the missing vehicle… And then I had to arrange it because they were originally tasked to protect the medevac.*

Tasking the Apache to securing the third QRF decreased the amount of gunfire from opposing forces that the QRF and other units was encountering. As a result, they, and the other vehicles could enter and exit the city without much trouble. Eventually, all personnel, including deceased and wounded soldiers, returned to the base of Bravo-Company around 03:30 hours.

The fact that the MPs did not report themselves to the OPS-room of Bravo-Company seems to have complicated the response in the first minutes after the ambush. A non-commissioned officer however, explains that these problems between Army units and the MP were not an incident but a more general problem between Army and MP units within the Dutch contribution to SFIR:

> *The MP's didn't know how to operate with radios and stuff like that. They were just driving around over there…*

A non-commissioned officer explains that this happened more than once with all kind of units that were "added" to the Battle Group.

> *Those people are going on a mission and sometimes have an office job at home, and then they think after one month: "I am going to look around here". And we received people at the compound that were not registered in the area. Often, they responded: "but we didn't load the radio for your area". When something would have happened in the city of Ar Rumaythah, they wouldn't be able to contact us. Sometimes they don't even know how radios work (…) Especially the MPs and some higher non-commissioned officers and officers didn't know that.*

5.3.2 Crisis response after the crash with flight MH17

Malaysia Airlines Flight MH17 was shot down above eastern Ukraine on the 17th of July in 2014. All 298 persons on board died in the crash of the airplane. The Dutch national crisis response organization was initiated to deal with the events following the crash. In the winter of 2014, Dutch parliament initiated an evaluation of the national crisis response organization. The evaluation was commissioned to the Scientific Research and Documentation Centre[63] of the Dutch ministry of Security and Justice and carried out by a multidisciplinary research team of the University of Twente. This section is based on their publicly accessible report[64] and provides a description of the actors, organizations and fora

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[63] In Dutch: Wetenschappelijk Onderzoek en Documentatie Centrum.
[64] For the report see: Torenvlied et al. (2015).

involved. After that, a description of relevant findings is presented. In the descriptions below, claims are supported by references to the report. These references are numbered and placed between brackets [x]. In Appendix 2, the references to the report are listed.

5.3.2.1 The Dutch national crisis response organization

For describing the Dutch national crisis response organization, a distinction can be made between actors, fora/committees in The Hague that are described in the national handbook for crisis management[65] (see: Ministry of Security and Justice, 2013) and so-called "crisis partners". These crisis partners are mostly operational parties that often differ per crisis. Regarding the actors and fora in The Hague that were activated, the national handbook states that, because every crisis is different, activation can be done flexibly [1]. As such, not all fora described in the handbook were activated. Also in the course of the crisis, new (controlling) fora were assembled to match the specific demands of the MH17 crisis [2].

After receiving news of the crash at the 17th of July 2014 at about 17:00 hours, in The Hague two interdepartmental fora were gradually activated [3]. These fora can be interpreted as the core of the controlling part of the national crisis response organization: the interdepartmental crisis control team (in Dutch: ICCb[66]) and the ministerial crisis control team (in Dutch: MCCb[67]). In the ICCb, high ranked civil servants of the ministry of Security and Justice, the ministry of Foreign Affairs, the ministry of Defense and the ministry of General Affairs took seat. In the MCCb the ministers of these ministries took seat and were accompanied by advisors on communication, Police and Defense. The ICCb and MCCb were coordinated by the Dutch National Coordinator on Counterterrorism and Security (in Dutch: NCTV[68]) gathered in the ministry of Security and Justice that facilitates the national crisis response organization by means of a National Crisis response Centre (NCC) [4]. Also, within the ministry of security and Justice, the National Crisis Communication Team (in Dutch: NKC[69]) supports external communication activities and is assembled from communications advisors from the different ministries involved [5]. With regard to "flexible" crisis fora, after some time a "steering group MH17" was formed, in which operational activities of the repatriation mission in Ukraine were coordinated [6]. Also, due to the amount of questions from Dutch parliament an ad-hoc parliamentary accountability team was formed [7].

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[65] In Dutch: Nationaal Handboek Crisisbesluitvorming.
[66] ICCb: Interdepartementale Commissie Crisisbeheersing.
[67] MCCb: Ministriële Commissie Crisisbeheersing.
[68] NCTV: Nationaal Coordinator Terrorismebestrijding en Veiligheid.
[69] NKC: Nationaal Kernteam Crisiscommunicatie.

As for "crisis partners" multiple parties started their activities immediately after they heard from the crash of flight MH17. These were parties in the vicinity of Schiphol Airport such as the Airport's crisis management team, Malaysia Airlines' Europe/ UK headquarters and the operational team of the safety region of Kennemerland[70] [8]. Also, several parties that are related to care of victims' families started activities such as the National Team of Forensic Investigations (in Dutch: LTFO[71]), family liaison officers[72] of the Dutch Police and the Dutch Victim Support organization [9]. Furthermore, several municipalities started activities that related to caring for victims' families [10]. Besides these parties, the ministry of Defense and the ministry of Foreign Affairs started employing operational activities to send employees to Ukraine.

5.3.2.2 Description of relevant findings

Most activities in the first crisis response on the 17th of July 2014 were aimed at reconstructing a passenger list and list of next-of-kin[73], taking care of the victims' families at Schiphol Airport, starting a national telephone number and initiating a party to travel to Ukraine and visit the crash site [11]. The evaluation report highlights that in the first crisis response a number of actors and organizations in the vicinity of Schiphol Airport attempted to assemble and validate a passenger list and start immediate help to family members of passengers [12]. To do so, Malaysia Airlines communicated a passenger list to the Military Police at Schiphol Airport [13] and initiated shelter for family members at the Steigenberger Hotel [14]. Because the passenger list missed some crucial information on the nationalities of the victims, employees worked through the night in order to verify that information [15]. At the same time, the Operational Team of the safety region of Kennemerland, in which the airport of Schiphol is located, was activated and started investigating options to start a national emergency number [16]. They, however, pointed to the national impact of the MH17 crash and had the position that the national government should take care of such an emergency number [17]. The different actors and organizations in the vicinity of Schiphol Airport were organized in the Council of Consultation[74] (CoC), which was initiated an hour after the news of the crash of flight MH17 was known [18].

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[70] For crisis response, the Netherlands is divided into 25 administrative safety regions, Kennemerland is one of these regions and responsible for crisis response activities in the vicinity of Schiphol Airport.
[71] LTFO: Landelijk Team Forensische Opsporing (in Dutch).
[72] In Dutch: Familierechercheurs.
[73] In Dutch: Verwantenlijst.
[74] In Dutch: Commissie van Overleg

A main finding of the evaluation report on the first crisis response was problematic communication and coordination between the actors in The Hague and the actors and organizations in the vicinity of Schiphol Airport [19]. For example, it was unknown in The Hague that a passenger list was given to the Military Police two hours after the crash of flight MH17 [20]. Also, the report highlights that several attempts to reach the National Crisis Centre, both with regard to the passenger list and the initiation of a national emergency telephone number, failed [21]. Besides that, the following morning, the NCTV visited Schiphol Airport to inform the actors and organizations there that "they were taking over" [22]. This "control strategy" did not facilitate the work that was still carried out by the various actors and organizations in the vicinity of Schiphol, that were still working on validating the passengers list [23].

Activities in the second period, between the 18th and the 24th of July 2014, centered on reaching the crash site, repatriating victims' remains, organizing the national day of mourning and assisting the families of victims [24]. The evaluation report highlights that a small party of LTFO and Military Police personnel arrives in Ukraine and attempts to reach the crash site of flight MH17 [25]. It is pointed out in the report that the trip leads the team via Charkiv and Donetsk to the crash site, which is controlled by rebel forces in the eastern part of Ukraine [26]. The report describes that this trip is undertaken through an area that resembles a war zone, and that personnel of the team is not equipped with protective material such as helmets and bulletproof vests [27]. Upon their arrival at the crash site, the team discovered that Ukrainian State Emergency Service personnel were underway in recovering the remains of victims [28]. These remains are then transported to a train in Torez. The team subsequently boards the train, which after some time and discussion with rebel forces goes "en-route" to Charkiv via Donetsk where it arrives the 22nd of July [29].

Assistance to the victims' families in the first week started in an ad-hoc manner, as the report highlights, due to problems with validation of the passenger list and the creation of a list of next-of-kin [30]. Next to these issues, the evaluation report highlights that family liaison officers, who were praised by families on their work, were doing numerous tasks, which were outside the traditional scope of their role [31]. This was mainly due to the central role they had from the beginning of crisis, which was also emphasized by members of the MCCb [32]. As such their tasks expanded from gathering material to facilitate identification of victims' remains to taking care of victims' families at various levels, including social assistance. Core activities in the third period, from the 25th of July until the 8th of September 2014 were focused on a repatriation mission at, and around, the crash site and assistance to victims' families [33].

The evaluation report describes that during the first week of the crisis response, several actors in The Hague were concerned about the progress of the repatriation of victims' remains to The Netherlands. To accelerate repatriation, several scenarios are developed to deploy a large repatriation mission to the crash site. After some time and discussion, this mission is defined as an unarmed policing mission, headed by a police officer [34]. Personnel of the mission consisted of both military and police personnel [35]. After arrival of a large part of its personnel in the area, several attempts are undertaken to reach the crash site. In the first days of the mission these attempts are aborted due to military activity in the area that resulted in safety concerns for mission personnel [36]. The mission reached the area at the first of August and continues repatriation efforts until the 6th of August [37]. During the period of their deployment, both the Staff of Large and Special Missions (SGBO)[75] of the National Police and the Directorate of Operations (DOPS) of the ministry of Defense controlled the mission. According to the evaluation report, this resulted in coordination problems because the Police was much more hesitant to operate in a hostile area then the ministry of Defense [38]. After some time, as is highlighted in the report, mission commanders stop feeding the police with information on mission activities [39].

Regarding the assistance of victims' families, the Dutch Victim Support organization and municipalities also aimed at providing assistance and care. In the first weeks however, the evaluation report highlights that the three organizations seemed to be working "uncoordinated" [40], which resulted in a lack of information sharing and families getting agitated because they were being visited by all kinds of parties asking the same questions [41]. After some time, and due to improvisation [42], coordination between parties that assisted victims' families improved. Also, it is highlighted in the report that contact of family liaison officers with actors in The Hague was hindered by complicated coordination through several controlling parties both within the Police and the national crisis organization [43].

5.4 Analysis

In this section, the analysis of the cases introduced above is presented. To do so, the hypotheses developed in the previous chapter, and accompanying arguments, are used as an analytical framework. These hypotheses are:

[75] In Dutch: Staf Grootschalig en Bijzonder Optreden.

Hypothesis 1: Functional concentration in parent organizations, leads to a complex "mixing and matching" design process that limits structural coupling in expeditionary organizations.

Hypothesis 2: Limited structural coupling within the expeditionary organization, combined with enactment and the necessity to act, threatens safety in expeditionary organizations.

Hypothesis 3: Because of limited structural coupling and product innovation at the operational level, safety in expeditionary organizations is developed by operators engaging in self-design of ad-hoc networks.

Hypothesis 4: Mixing and matching expeditionary organizations out of functionally concentrated parent organizations leads to functional concentration in expeditionary organizations, which results in organizational complexity that complicates the process described in hypothesis three and threatens safety at the level of the expeditionary organization.

Hypothesis 5: Coordination by means of a central plan, which can be related to a high degree of functional concentration in parent and expeditionary organizations, hinders the process described in hypothesis three and leads to safety issues at the organizational level.

Firstly, the SFIR case is analyzed. Secondly, the analysis on the MH17 case is explicated.

5.4.1 Analyzing the SFIR case

The description of the SFIR case described above starts off with an ambush of Military Police personnel who aimed to investigate an earlier shooting incident. It becomes clear that, what was also witnessed within the TFU case, procedures between units of the SFIR Task Force were underdeveloped and organizational integration between the units within the Task Force that were studied seemed to be problematic. The MPs didn't know the specific Army procedures for leaving the compound. This hindered the response of the SFIR Task Force, and of Bravo-Company in particular. The company did not have information on the location of the MPs. As was also witnessed within the TFU case, subsequent actions that are aimed at controlling the event, and establish safety of the MP units that were under fire, were oriented toward creating ad-hoc relationships between units. In the case, it was described that another patrol overheard radio transmissions of the MPs, decided to take action and signaled the location of the ambush to the company OPS-room.

With regard to the **first hypothesis**, it can be argued that support can be found. The case description starts by highlighting that the Dutch SFIR organization consisted of a battalion to which all kinds of other units with specific functionalities were added. According to respondents, this complicated integration within the task force. They stated that units that were added "came from an entirely different world" and didn't know how to operate within a Task Force such as SFIR-4, which was highlighted by the unawareness of radio procedures. Hence, it seems to be the case that –at least to some extent- structural coupling was missing between the "core" of SFIR-4 and "added units". That is to say, at least between these two groups of units, input-output relations and accompanying coordination mechanisms did not seem to be entirely present. From the case description, it can also be inferred that these issues of coupling between units can be tied to the way the units were "mixed and matched" within the Task Force.

Like TFU, SFIR-4 too was assembled out of many different, specialized units into a configuration that did not resemble the way the military parent organization is designed. Furthermore, the Dutch SFIR organization was largely assembled out of the Army parent organization in the Netherlands, which' design was already defined as highly functionally concentrated. This implies that SFIR-4 too was assembled by means of a complex mixing and matching process that may explain the issues of structural coupling between Army units and MP.

Some might argue, however, that the Military Police has such a special position within the military organization, as the organization's police force, that this may also account for their limited coupling within the Task Force. At the end of the case description, however, more general integration problems between the units of the Dutch SFIR organization are highlighted, which may lead one to conclude that limited structural coupling between MPs and Army units within the Dutch SFIR organization can be interpreted as being symptomatic for of a broader problem within the organization. As such, it is argued that the SFIR case provides support for the first hypothesis.

As to the **second hypothesis**, the integration problems between Army units and the MPs clearly manifested in safety issues during operations as it delayed the response after the ambush had taken place. This highlights that the units described in the SFIR case, apparently, had to act with underdeveloped coupling, which had consequences for safety during operations. The second hypothesis therefore seems to be able to explain the relation between some aspects of SFIR-4's design and safety outcomes.

The **third hypothesis** stressed that due to missing structural coupling and local product innovation, self-design emerges that is aimed at forming ad-hoc networks to improve safety of operations. It can be read in the case results that indeed ad-hoc reciprocal relationships were created to overcome issues of integration, as was witnessed between the patrol that overheard radio traffic and the MPs, which hints at the presence local self-design of a network that aimed to improve safety of the ambushed units. Also, it was shown that a FAC-er tasked an Apache helicopter to guiding them through the city instead of protecting the medevac helicopter. The resulting new, and self-designed, network seems to have improved safety of personnel on the ground and accelerated the response and recovery of personnel and material from the ambush site.

Hypothesis four pointed to the relationship between design of parent and expeditionary organizations, organizational complexity within the expeditionary organization and safety outcomes. It is argued that only some minor traces can be found in the case that support parts of the hypothesis. That is to say, clear traces were already found that the Dutch SFIR organization and its parent organizations were/ are characterized by high degrees of functional concentration of their production structure. Therefore, along the arguments on structural complexity by De Sitter, it seems logical to state that within the Dutch SFIR organization too organizational complexity was present. However, the information in the case provides very little information on organizational complexity to confirm that part of the fourth hypothesis. The only event that in some way may be interpreted as a symptom of organizational complexity is that after the ambush the battalion OPS-room decides to task the battalion QRF to the city, which seems to come out of thin air for the local commander on the ground. Although this did not help him in providing a solution for the incidents, no evidence is found that this hindered self-design or resulted in safety issues at the level of the expeditionary organization.

The **fifth hypothesis** was about the negative influence of "coordination by means of a central plan" on self-design of ad-hoc networks. It is argued that some traces can be found in the SFIR case that support the hypothesis. After the battalion OPS-room had decided to task the battalion QRF to the city, the on-scene commander explains that this decision is not helpful because the battalion QRF is not acquainted with the area. The decision by the Battalion OPS-room shows similarities to the top-down way the TFU-OPS aimed to coordinate its actions in the Uruzgan province. In the SFIR case, the local commander finds an ad-hoc solution to this problem and tasks the battalion QRF to a "waiting position". Nevertheless, the top-down way in which Battalion-OPS sends their QRF to the location of the ambush shows traces of coordination by means of a central plan, which did not seem to help the local efforts of the on-scene commander. However, no clear evidence is found that relates this issue to a hindering effect on self-design of ad-hoc networks or safety outcomes.

Summing up, the SFIR-4 case provided confirming evidence for hypotheses 1, 2 and 3. Some evidence for parts of hypotheses 4 and 5 were found, but the case did not provide evidence that the particular design aspects addressed in these hypotheses influenced self-design of ad-hoc networks in such a way that it had negative consequences for safety outcomes at the level of the Task Force.

5.4.2 Analyzing the MH17 case

At first glance, it seems questionable whether the MH17 case provides confirming evidence for the hypotheses. In the MH17 case, safety seems to be important but safety issues do not seem to relate to aspects of design of the crisis organization. However, it is pointed out that aspects of design seem to relate to other issues within the crisis organization. For example, it was highlighted in the results section that actors in the vicinity of Schiphol and family liaison officers experienced missing integration between themselves and other actors and between themselves and actors in The Hague and that this had some influence in delay of passenger list validation, initiating a national emergency number and miscommunication in the assistance to victims' families.

Therefore, it can be argued that disturbances that seem to be associated with design of the crisis organization relate to other aspects of *controllability* (cf. De Sitter, 1994, p. 207) than safety. In the Third Chapter of this thesis, it was already highlighted that, from an IOR perspective, it can be stated that safety and controllability are related concepts. As such, it may well be the case that when particular design characteristics explain safety issues within expeditionary organizations, these design characteristics can also be related to more general controllability outcomes. Therefore, based on the first indications on the relationship between design of the crisis organization and controllability outcomes presented in this section, it seems worthwhile to investigate whether the hypotheses developed in the previous chapter also hold relevance for the relationship between organizational design and controllability in expeditionary organizations.

It is argued that the case description provides information that, at least partly, stresses the relevance of the **first hypothesis** for the relation between organizational design and controllability in expeditionary organizations. The first hypothesis stated that functional concentration in parent organizations results in a complex "mixing and matching" process that limited structural coupling within the expeditionary organization. In the MH17 case it can be found that indeed the crisis response organization seems to have suffered from missing structural coupling between units. This can be interpreted from the problematic interaction and communication between several actors in the vicinity of Schiphol, actors in The Hague and the police in relation to validation of passenger lists, the national emergency number and the assistance to victims' families. The case description highlighted that between these actors "communication and coordination" were problematic at the beginning of the crisis. It seems to be the case that no developed linkages between these actors were present and that developed coordination mechanisms for these linkages were absent as well. Therefore, from an IOR perspective, it may be argued that for these actors, developed input-output relationships and accompanying rules or agreements were not entirely present at the beginning of the crisis response.

However, it can be questioned whether this can be attributed to a complex mixing and matching process and functional concentration in parent organizations. Although the evaluation report explicated from what parent organizations the different units and operators were originating, the report does not provide information on design of parent organizations. Hence, it may be hard to confirm parts of the first hypothesis. However, it is argued that these aspects of the first hypothesis can be verified by means of using existing literature on crisis response operations. Boin (2009), for example, stresses the bureaucratic nature of government organizations taking part in crisis response efforts by referring to this issue as the "impossible job of crisis management". Within the MH17 crisis response organization, many government units from both local, regional and national levels took part. As such, it may well be that many parent organizations, and especially those related to government, are characterized by high degrees of functional concentration. Due to this, and the large size of the MH17 crisis response organization, it can be argued that a complex, and gradual, "mixing and matching" process took place in which many different units from varying, and often functionally concentrated, parent organizations were merged into the crisis response organization. This may, on its turn, have affected the degree of structural coupling present within the expeditionary crisis response organization.

With regard to the **second hypothesis**, it can be interpreted from the case description that limited structural coupling between units/ actors had consequences. Similarly to the necessity to act that was witnessed in the TFU and SFIR cases, units within the MH17 crisis response organization had to act, for example, to validate a passengers list, initiate a national crisis telephone number and care for victims' families. Also, they had to do this with underdeveloped structural coupling between actors, units and organizations. This can, for example, be found in the observations that units worked "uncoordinated", which resulted in problems such as delay and miscommunication. From an IOR perspective, and related to the arguments highlighted for confirming the first hypothesis, it seems to be the case that, uncoupled units/ actors in, for example, the field of assistance to victims' families had to act, with the consequence that victims' families were visited by several parties, asking the same questions. Thus, it seems to be reasonable to propose that the second hypothesis developed in relation to safety outcomes also has relevance for explaining other controllability outcomes.

Similar relevance of the relationship between design of expeditionary organizations and controllability can be found in the way operators tried to self-design a controllable crisis organization, which was emphasized in **hypothesis three**. For example, it was highlighted in the case description that family liaison officers and actors in the vicinity of Schiphol airport tried to create ad-hoc relationships and agreements with other actors to improve the operations of the crisis organization. Some actors went in lengths to (try to) establish linkages between themselves and other actors to improve the way victims' families were assisted. With regard to self-design, the results section highlighted that, along the way, family liaison officers and the other actors in this field, "improved their coordination". This seems to hint at a process in which the actors themselves engaged in actions to improve their local coordination, which implies the successful creation of an ad-hoc network. At the one hand, this form of self-design seems to be oriented towards overcoming the drawbacks of missing coupling. On the other hand, in the case of care for victims' families, the new network that seemed to be established, in which a new task for family liaison officers had a central place, improved the ability of the crisis organization to assist these families. Therefore, these results seem to highlight the relevance of the third hypothesis for organizational outcomes from the broader category of controllability.

The **fourth hypothesis** stressed the relation between of characteristics of parent organizations, design of the expeditionary organization, organizational complexity and the process of self-design. It was already highlighted above that the MH17 case provided ample information on design of parent organizations. Some observations can, however, be made about design of the crisis response organization. It indeed seems that the MH17 crisis response organization was characterized by some degree of functional concentration. This can be inferred from the way in which different operational units, such as family liaison officers, the ministry of defense, municipalities, Malaysia Airlines and the Dutch foundation for victim support were operating. They all seem to have performed particular and sometimes overlapping activities within the national crisis organization. What can be seen in the first period of the crisis response, is that apart from missing structural coupling, overview that different units and actors had in this period, for example in relation to validation of passenger lists, was problematic. Such a lack of "process overview" may have hindered the way in which actors could "find" each other and establish local coordination for activities that seemed to be reciprocally dependent.

A lack of overview may be interpreted as a symptom of organizational complexity. Along IOR's concept of structural complexity it can be argued that in an organization with many, often functionally concentrated, building blocks, between which coupling is not entirely present, oversight that individual units have over an entire process is challenged. Some might argue that this complexity is inherently related to a first period of crisis response. However, due to functional concentration, and along the premises of the concept of structural complexity, it can be argued that this apparent design characteristic of the MH17 crisis response organization may have impeded the ability of actors to develop ad-hoc networks and hence contributed to delay in, for example, validation of passenger lists. Hence, it can be argued that within the MH17 case traces of evidence can be found hat stress the relevance of the fourth hypothesis for controllability of expeditionary organizations.

Also, some traces can be found in the MH17 case that seems to stress the relevance of the **fifth hypothesis** for the relation between organizational design and controllability in expeditionary organizations. It can be argued that some coordination mechanisms used by controlling actors within the national crisis organization can be interpreted as an attempt to coordinate by means of a central plan, which seemed to have hindered the ability of operational actors to develop ad-hoc networks for improving controllability. This was, for example, witnessed in the difficulties family liaison officers had in getting information from different actors in The Hague, because they had to adhere to several hierarchical layers both within the police organization and the national crisis organization. This lack of information due to "long hierarchical lines" may have hindered family liaison officers in finding the right local actors in establishing an ad-hoc network with other actors for assisting victims' families. As such, these design aspects may explain some of the problems reported in the controllability of care for victims' families.

Another example can be found in the way the NCTV tried to coordinate activities of actors in the vicinity of Schiphol. The centralizing tendency of the NCTV can be interpreted along the definition of coordination by means of a central plan, because the NCTV tried to coordinate work on, for example, validation of passenger lists centrally. The case description highlights that this strategy "did not facilitate" work of several actors that was still ongoing on the verification of passenger lists. It hence, seems to be the case that in this way coordination by means of a central plan influenced controllability of the crisis organization because it may have contributed to delay. However, the case description does not provide traces of evidence on the effects of this coordination method on the ability of operational actors to establish ad-hoc networks.

With regard to the relation of these coordination mechanisms and design of parent organizations it, again, seems to be hard to trace this way of coordinating back to design of parent organizations, based on data present in the case description. Yet, based on the argument made by Boin (2009) on the influence of bureaucracy during crisis response, and because of the large amount of government actors taking part in the crisis response, it seems likely that coordination by means of a central plan found in the MH17 case can be traced back to the way government parent organizations are designed. That is to say, it is not surprising that mechanisms that try to coordinate by means of a central plan were present in the crisis organization as many actors were originating from large, and probably bureaucratic, government organizations.

Summing up, secondary analysis of the MH17 case provided some traces of confirming evidence for all the hypotheses developed in the previous chapter of this thesis. More in particular, the hypotheses seemed to be able to explain the relationship between aspects of organizational design and controllability within the crisis response organization.

5.5 Discussion

Quite clearly, the goals and methodologies employed in the two case studies presented in this chapter were different than the goal and methodology of the other empirical studies in this thesis. These case studies were not specifically focused on studying the relationship between organizational design and safety. As such, only some *traces* of support for the hypotheses could be found by deductively analyzing the cases with the hypotheses developed in Chapter Four. However, despite this inevitable shortcoming of a secondary analysis of existing case study data, this chapter has provided some support for the hypotheses developed in the previous chapter. Next to support, the verification in this chapter has also provided some *contrasting* elements, on the basis of which, as Yin (2003) also stresses, hypotheses need to be refined. As such this section will provide a discussion on the basis of which the hypotheses are be rewritten in order to still be applicable to expeditionary organizations in general.

The first hypothesis developed in Chapter Four stressed the relation between functional concentration in parent organizations, complexity of the mixing and matching process, and consequences for structural coupling in the expeditionary organization. As argued in the section above, it can be stated that both the MH17 and the SFIR case provided support. Hence, the first hypothesis remains unchanged and can be formulated as follows:

Hypothesis 1: Functional concentration in parent organizations, leads to a complex "mixing and matching" design process that limits structural coupling in expeditionary organizations.

As to the second hypothesis, that stressed the relationship between limited structural coupling and safety issues, it can be argued that both cases highlighted integration issues that in in combination with the necessity to act of the expeditionary organization in its environment, manifested in problems. For the Dutch SFIR mission in Iraq, these problems were related to safety, as Army units did not know the location of the ambushed MPs, which led to delay in rescue efforts. For the MH17 case however, these problems were not related to safety outcomes. Instead the issues within the MH17 crisis response organization could be defined as other controllability problems, such as delays in validating passenger lists, delays in starting an emergency number and miscommunication in the care for victims' families. It was subsequently argued that the hypotheses on the relationship between organizational design and safety are also relevant for controllability issues in general. Hence, the second hypothesis can be reformulated as follows:

Hypothesis 2: Limited structural coupling within the expeditionary organization, combined with enactment and the necessity to act, threatens safety and controllability in expeditionary organizations

Subsequently, the third hypothesis highlighted that due to limited structural coupling and the inevitable dynamics of operating in a dynamic complex environment, self-design emerges that is aimed at creating ad-hoc network structures. In both cases presented in this chapter traces were found of such self-design because operators in both the SFIR and MH17 case attempted to build ad-hoc networks, as result from lacking coupling within the organization and as a result of a response to environmental dynamics. In the SFIR case, it was shown that operators seemed to do so to improve the ability of their organization to operate meaningfully and safely. In the MH17 case operators seemed to develop ad-hoc networks to improve aspects of controllability of crisis operations. Hence it was argued that the third hypothesis developed in the previous chapter holds relevance not only with regard to safety but to controllability outcomes in a more general sense. Therefore, the third hypothesis is reformulated as follows:

Hypothesis 3: Because of limited structural coupling and product innovation at the operational level, operators attempt to develop safety and controllability in expeditionary organizations by means of self-designing ad-hoc networks.

The fourth hypothesis stressed the relationship between design of parent organizations, design of expeditionary organizations, organizational complexity and consequences for safety in expeditionary organizations. For this hypothesis, analysis of the SFIR case provided only some traces of evidence and failed to provide evidence for safety consequences. The analysis of the MH17 case, however, traces of evidence seemed to support the hypothesis for the relationship between these aspects of design and controllability outcomes. As such, the fourth hypothesis can be reformulated as follows:

Hypothesis 4: Mixing and matching expeditionary organizations out of functionally concentrated parent organizations leads to functional concentration in expeditionary organizations, which on its turn, results in organizational complexity that hinders the process described in hypothesis three and threatens controllability at the level of the expeditionary organization.

With regard to the fifth hypothesis, it can be argued that both the SFIR and the MH17 case provided some traces of evidence for the statements that coordination by means of a central plan hindered self-design and had safety consequences at the level of the expeditionary organization. Within the SFIR case however, it could not be verified that these design aspects resulted in safety issues at the level of the expeditionary organization. In the MH17 case, however, it was argued that coordination by means of a central plan may have hindered the formation of ad-hoc networks in such a way that it resulted in controllability issues at the level of the crisis organization. This was highlighted by consequences for delay and miscommunication in the field of assistance to victims' families. In both cases, it seemed possible to trace such control mechanisms back to design characteristics of parent organizations. That is to say, it was argued that parent organizations seemed to possess some degrees of functional concentration. This, combined with the arguments of Modig (2007), who stressed that "ways of organizing" are often brought along from parent to temporary organization, made it reasonable to propose that coordination mechanisms were brought along from parent to the expeditionary organization. Based on this and the results of the MH17 case, there seems to be enough solid ground to propose that hypothesis four can be redeveloped as follows:

Hypothesis 5: Coordination by means of a central plan, which can be related to a high degree of functional concentration in parent and expeditionary organizations, hinders the process described in hypothesis three and leads to controllability issues at the organizational level.

In relation to the concepts of controllability and safety, it can be argued that –based on the results of this chapter- some environmental characteristics seem to have influenced whether design characteristics of expeditionary organizations can be associated with safety issues or with more general controllability problems. It was pointed out in section 6.2.2 that a difference between a military crisis context and the crisis context of the crisis response organization in the Netherlands was that the latter was characterized by a different kind of reactiveness. That is to say, in a military crisis context, reactiveness is characterized by opposing parties that deliberately try to undermine the expeditionary organizations, for example by means of the use of weapons. This was not the case in the crisis context in the Netherlands. Interestingly, organizational design characteristics could be associated with safety issues in a military expeditionary context, did not result in safety problems within the crisis organization, but were associated with other controllability problems.

Therefore, may be proposed that "extreme" reactiveness, as witnessed in the military cases, poses more stress on the expeditionary organization itself and makes organizational design more safety critical. As such, it can be argued that the relationship between organizational design characteristics of expeditionary organizations, such as limited structural coupling and incompatible coordination mechanisms, and safety depends on the degree of reactiveness present in the operating environment. That is to say, the more reactive a particular dynamically complex operating environment, the more the organizational design characteristics will have controllability consequences that manifest themselves as safety issues within expeditionary organizations. Hence, the following hypothesis is proposed:

Hypothesis 6: The more reactive a dynamically complex environment, the more the design characteristics of expeditionary organizations can be associated with controllability consequences that manifest as safety issues.

The next chapter will address the findings of this chapter to develop a theory on the relationship between organizational design and safety for expeditionary organizations, which is located at Van Strien's level B of knowledge generalization.

Chapter Six: Constructing a theory on organizational design and safety in expeditionary organizations

6.1 Introduction

This chapter presents the last study of this thesis that addresses the fifth research question, which is:

> **What theory on the relation between organizational design and safety in expeditionary organizations can be constructed?**

The results of the previous chapter resulted in refining the hypotheses that were formulated in Chapter Four. In this chapter, these refined hypotheses will be employed as the basis for constructing a theory on the relation between organizational design and safety in expeditionary organizations. In doing so, the theory developed in this chapter needs to possess certain characteristics, as was detailed in Chapter One. Firstly, the theory needs to be located at Van Strien's level B of knowledge generalization, which is the level of problem-oriented theory. Secondly, the theory has to possess a particular degree of explanatory power. Thirdly, the theory has to be of predictive value.

Therefore, in this chapter firstly, based on the hypotheses developed in the previous chapter, an elaboration of the contents of the theory will be given at Van Strien's level B. Also, a conceptual model is presented that visualizes the mechanisms of the theory. Furthermore, a section is devoted to explicating the "scope of explanatory and predictive claims" that are made by the theory. Secondly, although the theory developed in this thesis did not aim at developing a (normative) design theory, the third section in this chapter *explores* potential ways for finding solutions for the issues addressed in the theory on organizational design and safety in expeditionary organizations. Thirdly, this chapter ends with a conclusion. Related to the research model presented in Chapter One, this chapter aims to take the last research step of this thesis, as is visualized in Figure 22.

Figure 22: Research model Study 5

6.2 A theory on organizational design and safety in expeditionary organizations

In this section first, the main results of this thesis are presented. These results form the main content of the theory on the relation between organizational design and safety in expeditionary organizations. As the hypotheses developed in the previous chapter are used as the fundament for the theory, it is argued that the statements presented in the section below are located at Van Strien's level B of knowledge generalization. That is to say, the previous chapter was specifically aimed at verifying hypotheses that were developed in Chapter Four, which were also located at Van Strien's level B because in Chapter Four, analytic generalization was used to "elevate" findings from within TFU to expeditionary organizations in general.

After that, it is argued that a theory on organizational design and safety in expeditionary organizations needs to be linked explicitly to assumptions from systems theory, at Van Strien's level A. Because, as was highlighted in Chapter Two, implicit and inconsistent use of such assumptions may result in limited applicability of safety theory. Lastly, the scope of the theory is detailed, which elaborates on the scope of explanatory and predictive claims made in this chapter.

6.2.1 The relationship between organizational design and safety in expeditionary organizations

In this section mechanisms, or relationships, between concepts are explicated by using the hypotheses developed in the previous chapter. These mechanisms are visualized in a conceptual model, which is presented later on in this section. In this model, each proposed mechanism is given an alphabetical letter that refers to the letter between brackets in the statements presented below.

A main finding of this thesis is that controllability and safety in expeditionary organizations is directly and negatively influenced by (*a*) limited structural coupling between units within the expeditionary production and control structure, that can be attributed to a complex "mixing and matching" process in which building blocks from functionally concentrated parent organizations are assembled into an expeditionary organization (*b*). Due to this design strategy, expeditionary organizations will enact a dynamically complex environment with an underdeveloped interaction network, which directly results in controllability and safety issues. To develop structural coupling (*c*) and deal with the inevitable characteristics of a dynamic operating environment (*d*), controllability and safety are consequently developed by means of operators self-designing ad-hoc network structures, which improves controllability and safety (*e*).

Referring to the mechanisms between the concepts that are presented above, it can be argued that shaping the organizational interaction network by means of self-designing ad-hoc networks is an inevitable strategy of developing controllability in a dynamically complex environment. That is to say, in such an environment organizations need to discover what needs to be done by acting. As the environment is characterized by variation and uncertainty, this means that organizational configurations that can deal with such an environment need to vary as well. Not surprisingly, therefore, in the cases presented in this thesis a particular kind of product innovation at the operational level was found, which meant that operators developed new networks of units that were able to deliver an innovative "product" in relation to the operating environment. As such, self-designing ad-hoc networks is inevitably present during operations in a dynamically complex environment. Therefore, parts of the third hypothesis, that emphasize product innovation and self-design, developed in the previous chapter seem quite straightforward.

However, the first hypothesis of Chapter Five also stressed that self-design was initiated due to limited structural coupling within the expeditionary organization that could be associated with an organizational design strategy that mixes and matches functionally concentrated building blocks into an expeditionary organization. This points to the notion that self-design within expeditionary organizations is apparently aimed at dealing with two different sources of uncertainty. At the one hand, it is aimed at dealing with the inevitable characteristics of a dynamically complex environment. On the other hand, it is directed towards overcoming the drawbacks of creating expeditionary organizations out of functionally concentrated building blocks. This implies that, although work in expeditionary organizations will always to some degree be characterized by self-design of ad-hoc networks, there may be better and worse "sets of building blocks" to assemble an expeditionary organization out of. This issue is dealt with in the second section of this chapter because it hints to formulating an organizational design solution, which was not part of the characteristics defined for the theory outlined in this section.

Furthermore, it was found that organizational complexity and particular coordination mechanisms, hindered the development of networks in such a way that controllability within the expeditionary organization was compromised. Organizational complexity, that could be associated with functional concentration within both the expeditionary and parent organization, resulted in an incomprehensible organizational interaction network, which threatened controllability (*f*). Also, it was found that in expeditionary organizations coordination mechanisms that were used, were characterized by bureaucratic influences that could be related to a high degree of functional concentration in parent organizations, and hindered self-design of ad-hoc networks. That is to say, it was found that within expeditionary organizations coordination by means of a central plan was used to coordinate operational units while interdependence between these units was often reciprocal. It was pointed out that such incompatibility hindered self-design in such a way that it contributed to controllability issues at the organizational level (*g*). Lastly, with regard to the concepts of controllability and safety and their relation with expeditionary organizational design, it was argued that the more reactive a particular environment is, the more the aforementioned design characteristics of expeditionary organizations will result in controllability problems that manifest themselves as safety problems (*h*).

As such, the main mechanisms that characterize the relationship between organizational design, controllability and safety in expeditionary organizations are explicated. These mechanisms are schematically visualized in the conceptual model presented below. In the next section, a systems theory based foundation will be given at Van Strien's level A, that relates to the level B statements presented above.

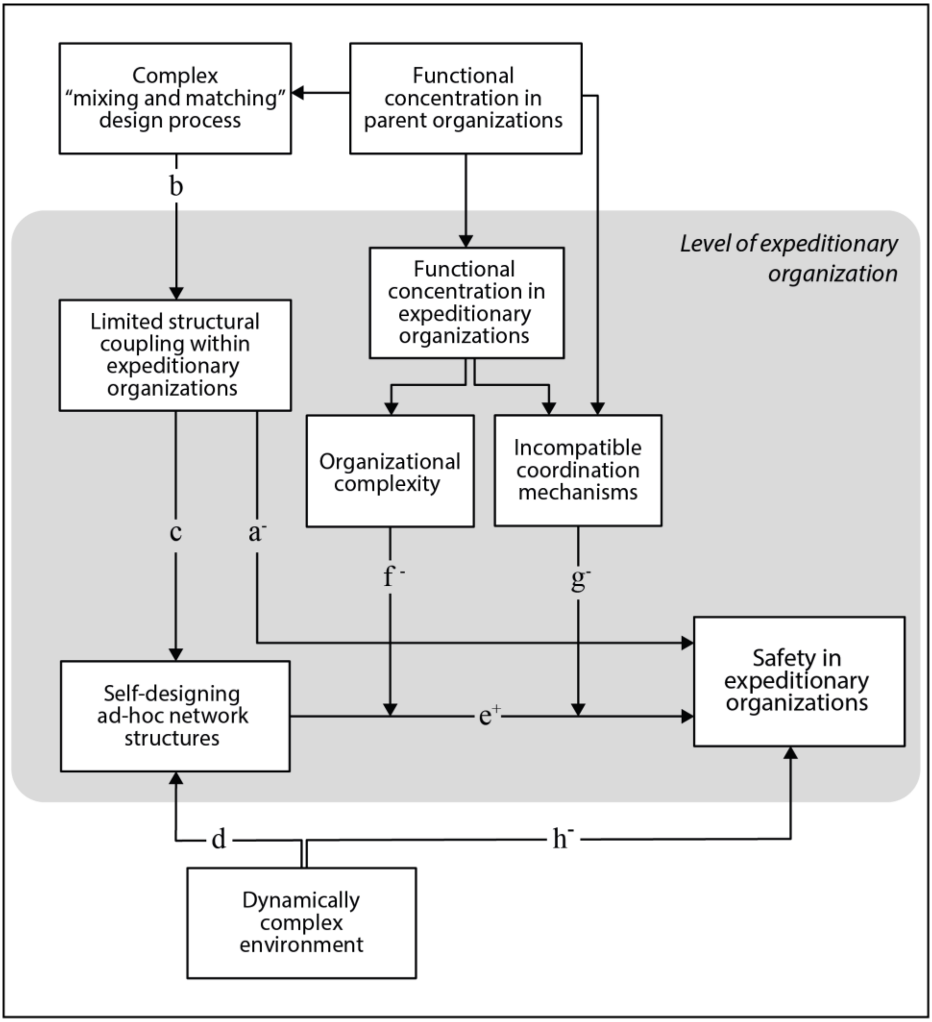

Figure 23: Proposed conceptual model

6.2.2 A foundation based on systems theory

A critique in Chapter Two on the four organizational safety theories reviewed was that some theories used all kinds of implicit and inconsistent assumptions and concepts from systems theory, which had a negative effect on their applicability in this thesis. It was also argued in Chapter Two that a self-referential systems perspective suits the premises on organizational design and safety in expeditionary organizations, that were presented in Chapter One, best. Therefore, in this section, a consistent and explicit foundation for the theory developed in this thesis will be constructed based on self-referential systems theory.

In Chapter Two, the concept of "circularity" was interpreted as a main cornerstone of self-referential systems thinking (cf. Heylighen & Joslyn, 2001). This concept emphasized the circular relationship between the system's characteristics and its adaptive capacities in relation to the environment in which the system operates. In this sense, systems adapt to environmental circumstances "in reference" to themselves. Related to the principle of circularity, it is argued that the relationship between "agency" and "structure" put forward by Giddens (1984) is of particular relevance for the theory developed in this thesis. Giddens (1984) points to the "duality of structure", which means that: "the structural properties of social systems are both a medium and outcome of the practices they recursively organize" (in: Kramer, 2007, p. 61). Such a duality emphasizes that structures in social systems at the one hand provide the repertoires that are used in social action while it is also the outcome of such action. The concepts of duality and circularity hence enable understanding the relationship between social action and structures, which can be interpreted as relevant as a foundation for understanding the relationship between structural aspects of both the parent and expeditionary organization, self-design, controllability and safety. That is to say, a large part of preceding section emphasized that social action within an expeditionary organization consisted of self-design in an attempt to develop controllability and safety. Self-designed network structures hence can be interpreted as the outcome of social action. However self-design was influenced by design characteristics both at the level of the expeditionary organization and the level of parent organizations. Hence it can be interpreted that circularity and the duality of structure is witnessed in the interplay between self-design and the influence of design characteristics of the expeditionary and parent organization(s).

In the interplay between agency and structure, the hypotheses developed in the previous chapter point to the notion that structural design properties at several organizational levels influence social action in such a way that adaptation, in the form self-designing ad-hoc networks, is hindered. Within self-referential systems thinking, influences of the inside of the system on adaptation are theorized frequently. Examples of such theorizing can be found in the works of Beer (1984) and Luhmann (1990). In his Viable Systems Model, Beer (*ibid.*), for example, theorizes about the specific functions a particular system should possess in order to attain viability in its environment. Luhmann, in short, theorizes on the constraining influences of a system's structure in its self-producing (or autopoetic) abilities. In this sense, it can be argued that the theory developed in this thesis shows what issues of poor viability, due to characteristics of the "inside" of a system, might look like for a particular organizational form at Van Strien's level B. Hence, self-referential theories at Van Strien's level A may be employed to improve viability of expeditionary organizations by suggesting alternatives for the "inside" of a system. However, this section deliberately omits the specific combinations of functions or structures at level B, which could be translated from the works of Luhmann or Beer that could facilitate viability or survivability against the background of a dynamic environment. Coming up with a perspective for formulating a design solution, is not part of the theory developed in this thesis. Instead the theory developed in this thesis aims to possess explanatory and predictive characteristics, on which the next section deliberates.

Summing up, in this section, some cornerstones of a self-referential systems perspective at Van Strien's level A were connected to the mechanisms of the theory developed in this thesis. This is done to provide a background for understanding the relationship between organizational design and safety, at Van Strien's level B.

6.2.3 The scope of explanatory and predictive claims

The mechanisms presented in the first section of this paragraph explained the relationship between organizational design characteristics, safety and controllability in expeditionary organizations. That is to say, it unraveled mechanisms by which design characteristics at different organizational levels influenced safety and controllability in expeditionary organizations, both directly and indirectly. Also, it can be pointed out that these mechanisms seemed to be present within Task Force Uruzgan, the Dutch contribution to SFIR in Iraq and the MH17 crisis response organization. This emphasizes predictive aspects of the mechanisms present within the proposed theory. However, the limits of explanatory and predictive characteristics of the theory proposed have to be highlighted in order to stress that the model and accompanying mechanisms are applicable to only a family of particular organizations operating under particular environmental circumstances. This is done by emphasizing the concepts of expeditionary organizations and dynamic complexity once more.

By means of the work of Modig (2007), De Waard and Kramer (2008) and the cases studied, it was highlighted throughout this thesis that expeditionary organizations are temporary organizations that consist of large collections of units or "building blocks" of functionally concentrated parent organizations that are located in the "stationary" left end of Modig's continuum. It was also pointed out in the course of this thesis that the concept of dynamic complexity is intertwined with the concept of expeditionary organizations. This concept was introduced in the first chapter by means of the work of Kramer (2004; 2007) and emphasizes that expeditionary organizations operate under uncertain, ambiguous and reactive circumstances. These two concepts place specific boundaries on the mechanisms proposed in this chapter. That is to say, the mechanisms are only expected to explain and predict safety and controllability outcomes in expeditionary organizations that can be located within these boundaries.

Lastly, by using the work of Weick (1979, p. 35) who employs Thorngate's (1976) principle of commensurate complexity, issues of generalizability, accuracy and simplicity can be addressed. Thorngate's principle boils down to the idea that no research attempt can attain all three characteristics at the same time. Trying to attain two of the three characteristics results in sacrificing the third. This also seems to be the case with a theory on the influence of organizational design on safety in expeditionary organizations. It can be argued that the theory proposed is characterized by simplicity because it is constructed of six hypotheses and its mechanisms can be schematically presented in a figure that is comprehensible. However, with regard to the aspects of generalizability and accuracy some concessions are made in the course of this thesis. With regard to generalizability, it can be pointed out that due to the aim of this thesis, the theory constructed had to be applicable to a wider range of expeditionary organizations. The theory presented above was able to do so. However, in relation to this aim, the theory sacrifices some detail, or accuracy, of the proposed mechanisms. For example, the grounded theory and accompanying hypotheses developed in Chapter Three, possessed more detail compared to the hypotheses developed in the previous chapter.

As was pointed out before in this thesis, the theory developed does not aim to possess prescriptive characteristics regarding a solution for organizational redesign or safety management. However, based on the preceding sections in this chapter, a possible way for finding solutions and improve safety in expeditionary organizations can be *explored*. This will be done in the next section.

6.3 A possible way for finding solutions

Based on the previous sections of this chapter it can be argued that improving safety and controllability in expeditionary organizations points to facilitating self-design of ad-hoc networks by tackling high degrees of functional concentration within both the expeditionary organization and parent organizations. A possible way for finding solutions may therefore be found in literature that elaborates on design of so-called "network organizations".

Literature on different forms of network organizations is abundant and growing (e.g., Alberts, Gartska & Stein, 2000; Chisholm, 1998; Fjellstad, Snow, Miles & Lettl, 2012; Miles & Snow, 1992; Volberda, 1996). However, Kuipers et al. (2010, p. 433) argue that such literature and theories quite often propose design strategies that do not address or attempt to change underlying organizational designs. Trying to "design" network organizations while leaving underlying, often bureaucratic, organizational structures intact, therefore, may result in what Kuipers et al (2010) refer to as a "pseudo network organization". Hence according to Kuipers et al., redesign of such underlying structures is eminent for creating a "true" network organization. Accordingly, they developed a step-by-step redesign approach[76], which consists of five steps that, according to Kuipers et al., explicitly aim to change the underlying structural framework, in order to facilitate self-organization aimed at dealing with environmental dynamics.

The next section will therefore explicate the step-by-step approach developed by Kuipers et al. (2010). In this section, it will also be pointed out whether and how their approach can be used to formulate first and explorative steps to redesign both parent and expeditionary organizations to improve safety in expeditionary organizations.

This attempt in integrating aspects of the theory on organizational design and safety in expeditionary organization and the step-by-step approach of Kuipers et al., however, is not to be understood as a redesign or safety management theory for expeditionary organizations. Relating aspects of the step-by-step approach to the theory developed in this chapter is to be interpreted as an explorative first step in this direction. In doing so, it has to be noted that the text in the following sub-sections is largely based on, and adapted from, Kuipers et al (2010, p. 428-460).

[76] In Dutch: herontwerpketen

6.3.1 A step-by-step approach for designing network organizations

For designing network organizations, Kuipers et al (2010) propose an approach that enables designing network organization by means of five steps (2010, p. 435). These steps are:

1. Determining the object of redesign.
2. Determining the mission and the accompanying goals and strategy of the organization.
3. Determining design specifications. These are specifications that have to be kept in mind wile redesigning and are derived from three characteristics of the organization's primary process: characteristics of the "flow of orders", the pattern of activities that is needed to perform these orders and the functional demands that have to be met while performing these activities.
4. Designing the new structural layout of the organization in which firstly the production structure is designed and secondly a matching control structure has to be developed.
5. Designing technical systems, starting with technical systems for the organization's primary process, after that technical systems for the supporting the control structure and lastly, technical organizational information systems.

In the next sections, the relevance of the steps is explicated for finding solutions for the hindering influences of functional concentration within both parent and expeditionary organizations on safety and controllability within expeditionary organizations.

6.3.1.1 Step 1: the object of redesign

Kuipers et al. (2010, p. 436) state that, for network organizations, the object of redesign is less clear compared with traditional organizations. Borders between network organizations and between network organizations and its environment may be less obvious than is the case in, for example, bureaucratic organizations. In relation to improving safety and controllability in expeditionary organizations, determining the object of redesign can, at first sight, be seen as unproblematic. That is to say, aspects of organizational design that hindered developing safety and controllability within the expeditionary organization were to a large extent related to parent organizations with a high degree of functional concentration. For improving safety and controllability in expeditionary organizations, the object of redesign therefore shifts, for a large part, from the expeditionary organization to parent organizations. This implies that for applying organizational redesign to improve safety in expeditionary organizations redesign of parent organizations is eminent for providing suitable building blocks to assemble expeditionary organizations. However, the nature of some parent organizations complicates the application of some steps, and step three and four in particular, of the step-by-step approach developed by Kuipers et al. These complications are explicated below.

6.3.1.2 Step 2: Strategy

With regard to strategy, mission and goals, Kuipers et al (2010, p. 437) point out that creating a fine grained and detailed strategy is hard, if not impossible, for network organizations. This is due to a dynamically complex operating environment in which network organizations operate in which tasks and goals vary quickly and are never the same. Processes of network organizations are therefore not known beforehand. The chapters of thesis have shown the tasks and goals of expeditionary organization are mostly developed along the way by means of enactment (cf. Weick, 1979) of the expeditionary organization in its environment.

These notions for formulating a strategy are, however, in conflict with the way strategy is often formulated within bureaucratic organizations. That is to say, bureaucratic organizations are mostly characterized by a predetermined strategy that is implemented in a top-down way (Mintzberg, 2000). Hence, a first step in limiting the hindering influence of parent organizations in expeditionary organizations may start with implementing a more bottom-up approach to strategy.

6.3.1.3 Step 3: Design specifications

Design specifications, as defined by Kuipers et al. (2010, p. 435) are characteristics of the network organization that have to be taken into account when (re) designing network organizations. These specifications are derived from characteristics of the primary process of network organizations (Kuipers et al. 2010, p. 440). According to Kuipers et al. so-called “nonlinear processes” characterize primary processes in network organizations. This means that, in contrast to stable processes that are characterized by repetitiveness, the processes of network organizations change continuously. The non-linear nature of tasks also means that processes in network organizations are characterized by a, never-ending, sequence of problem solving cycles that guide enactment of the network organization in its environment.

With regard to redesign of parent organizations, it can be argued that the character of processes in network organization seems to be in contrast with the nature of processes in parent organizations. Being located at the left-end of Modig’s continuum, static parent organizations with high degrees of functional concentration may well be characterized by stable processes that cannot be changed easily. Also, it is questioned whether these static processes can always be changed to fit expeditionary demands. That is to say, for some parent organizations such as, for example, the police in the case of the MH17 crisis response organization, contribution to the expeditionary organization is not part of the "regular" flow of orders. This is different compared to, for example, the Dutch military organization for which expeditionary "orders" form a major part of their flow of orders. Hence, some parent organizations may have their own order flow and accompanying processes and hence cannot simply change the nature of its processes to fit expeditionary demands. This implies that operators who originate from these stable parent organizations and are transplanted to an expeditionary organization will always be confronted with the difference between linear and non-linear processes.

6.3.1.4 Step 4: Criteria for redesigning the structural layout of organizations

For designing organizational structures, balancing between what to make "fixed" and what to keep "loose" within the network organization is the central problem in defining criteria for the structural layout of network organizations. This challenge centers on the question: "which structural conditions facilitate useful emergence?" (Kuipers et al., 2010, p. 445). That is to say, which structural conditions facilitate emergence that improves the ability to deal controllably with a dynamic complex expeditionary environment? Finding structural conditions that enable such forms of self-organization and emergence also implies that network organizations without any structure do not exist and that some form of structure and hierarchy is still needed. In developing structural criteria, the so-called P-C-I sequence (P-B-I in Dutch, cf. De Sitter, 1994) is followed. This sequence means that firstly, criteria for the production structure are developed, starting with the macro level and working the way down to meso- and micro levels of the organization. An important aspect of network organizations is that they are structured along flows of orders at the macro level. This means that activities are divided along a commonality in the orders an organization has to conduct. Kuipers et al. stress however, that borders between these macro level units have to be permeable because orders will always cross borders at the macro level due to the dynamic nature of order flows. With regard to the meso (department) and micro (team/job) level, network organizations depend largely on self-design, which is facilitated by some form of control that keeps track of partnerships within the network.

With regard to the applicability of these design premises to improve safety and controllability in expeditionary organizations, and in line with the sections above, application of this step applies to a large extent to parent organizations. Tackling bureaucratic production structures in parent organizations and applying the macro, meso and micro level design "rules" for network organizations as stated above results in less functional concentration and therefore decrease its hindering effects on the operations of expeditionary organizations. However, it was already stated that some parent organizations have their "own" order flow.

Applying the network design premises to these parent organizations may result into too much "looseness" that can lead to internal turmoil within parent organizations. Kuipers et al (2010) stress a similar point by stating that network designs are only suited for organizations with a dynamic flow of orders. It can however be argued that when redesign of some parent organizations is impossible, applying network design concepts to the level of the expeditionary organizations may provide some grip in overcoming integration issues and decrease functional concentration within the expeditionary organization itself.

For design of the control structure, Kuipers et al (2010) do not mention any detailed criteria. A reason for this may be that control structures and the premises of network organizations seem a to be contradictory. That is to say, rules and procedures may be interpreted as hindering any form of self-organization. In relation to the results presented in this thesis, however, it can be argued that control structures within parent organizations should at least be able coordinate critical interactions between units that have to work together in an expeditionary configuration. Also, based on the result of this thesis, it may be argued that control should be focused on local coordination to facilitate mutual adjustment and reciprocal interdependence. This implies that coordination mechanisms based coordination by means of a central plan should be abandoned. However, as Thompson (1967) highlights in "complex organizations" different forms of interdependence exist alongside each other and that hierarchy, in some way, is needed to reduce complexity of the organizational network. With regard to design of control structures, it should be emphasized here that applying these proposed principles of designing a control structure cannot be done without firstly addressing production structure design. When, for example, high degrees of functional concentration are not addressed and remain to exist, it is questionable whether these premises of designing a control structure can be implemented. However, for some parent organizations redesign of parent organizations along the premises of network organizations seems to be problematic. For these parent organizations, that were also addressed above, the aspects of control structure design may be applied in redesign of expeditionary organizations in order to facilitate development of safety and controllability during expeditionary operations. Yet, also in such cases, substantial attention first has to be directed to redesign of the expeditionary production structure for which the premises of network design can be used.

Next, criteria are developed for the information structure, such as the need for supportive technical information systems. This third criterion will also be addressed in the next sub-section on design-step 5.

6.3.1.5 Step 5: Designing technical (information) systems

Kuipers et al. (2010) argue that technical (information) systems have to facilitate the self-organizing nature of network organizations. They point out that it is eminent that such systems should facilitate searching and discovering contact with other members of the network organization in order to find suitable partners for carrying out dynamic operations. However, De Sitter (1994, p. 101) points out that in organizational practice, technical information systems are often implemented in ways in which the design of the organization's production structure is treated as a given. In relation to this, Van Bezooijen and Kramer (2014) point to limitations of the concept of "network centric operations" (NCO; see also: Alberts et al., 2000), which is used frequently in Western armed forces. In short, the concept of network centric operations aims to share information between all units of an organization by connecting all units by means of Information Technology. Such increased information sharing is thought to result in increased situational awareness and an improved ability to operate under dynamic circumstances. Van Bezooijen and Kramer (2014) stress that connecting all kinds of units with each other without addressing the underlying structural organizational framework may result in "tight coupling" (cf. Perrow, 1999) between units which, on its turn, may influence controllability negatively. Examples of this phenomenon might be found in Chapter Three and Four, in which it was highlighted that Sperwer-UAV images were shared with all kinds of units within the TFU operations room. On the one hand, sharing these images resulted in innovative Sperwer assignments. At the other hand, sharing these images led to assignments with increased, and sometimes hidden, dependencies at the level of TFU between the Sperwer-UAV and other flying units that compromised safety within TFU. Therefore, it can be regarded as eminent that production structure and control structure design of parent organizations are addressed before technical information systems are implemented in expeditionary organizations. When this is not possible, due to the nature of particular parent organizations as was outlined above, applying the principles of designing network organizations to expeditionary organizations may provide solutions.

6.4 Conclusion

This chapter aimed to construct a theory on organizational design and safety in expeditionary organizations. To do so, the hypotheses of the previous chapter were used to explicate mechanisms between concepts. It was argued that these mechanisms complied with the criteria presented in Chapter One, which meant that the mechanisms had to explicate relationships between characteristics of organizational design and safety in expeditionary organizations at Van Strien's level B of knowledge generalization. Also, it was argued that the mechanisms presented in this chapter had explanatory and predictive characteristics with regard to a specific scope. With this, the last research question is addressed and the aim of this thesis is reached.

In addition to that, it was explored how the theory developed relates to prescriptive theory on organizational redesign, which was argued to have relevance for managing (i.e improving) safety and controllability in expeditionary organizations. However, during this exploration, it became clear that applying a step-by-step approach to design network organizations to the design problem of expeditionary organizations has both possibilities and limitations. Developing re-design theory for parent organizations assembling expeditionary organizations based on the network design theory of Kuipers et al. may hence be a potential fruitful avenue for further research. The next chapter will reflect on the research presented and the theory developed in this thesis and it will also address potential avenues for further research in more detail.

Chapter Seven: Discussion and reflection

7.1 Introduction

This final chapter will present five sections that reflect on the theory that was developed in this thesis. In reflecting, the theory developed is placed in wider scientific and methodological contexts, which enables this chapter to address both pros and cons of the theory developed. Firstly, a reflection will be detailed at Van Strien's level C. This means that the results of this thesis are placed in the wider context of studies on expeditionary organizations. Secondly, a reflection is provided at Van Strien's level B that aims to place the results of this thesis in the context of safety theory and organizational theory. Thirdly, a methodological reflection is presented that aims to discuss the methods that were employed in this thesis. Finally, the last section addresses suggestions for future research.

7.2 A reflection at Van Strien's level C

It was highlighted throughout this thesis that the theory developed is located at Van Strien's level B of knowledge generalization. This meant that the mechanisms presented in the previous chapter are thought to have explanatory and predictive power in a broader category of level C expeditionary contexts. As such, the theory developed can be used to reflect on existing research in such expeditionary contexts. This section will therefore place the theory in the context of recent studies on military expeditionary organizations, crisis response organizations and other forms of expeditionary organizations such as temporary construction organizations. The section concludes with some limitations regarding applicability of the theory developed to Van Strien's level C.

7.2.1 Relevance for studying military expeditionary operations

In this section, the theory developed in this thesis is placed in the context of recent studies on military expeditionary operations.

This thesis is not the only study into problems of organizational design within military task forces. Kramer (2004; 2007) conducted much research on the influence of organizational design on flexibility and adaptability of military task forces. Also, Snook

(2000) already addressed lack of integration and the role of military parent organizations' design in explaining a friendly fire incident in 1994. However, it can be argued that a study on the relation between organizational design and safety in expeditionary organizations is of added value to this existing work. Firstly, although Kramer highlighted the relevance of organizational design for adaptability and flexibility, he did not explicitly address the relation between organizational design and safety in military task forces, which has shown to be a rather relevant subject for military expeditionary organizations in the course of this thesis. Secondly, in relation to the work of Snook, it can be pointed out that this thesis did not only attempt to explain problems in one particular case, but attempted to unravel mechanisms present in expeditionary organizations in general. In this sense, aspects of Snook's analysis may be interpreted as supporting at least parts of the theory developed in this thesis.

Also from more organization-psychological perspectives researchers addressed the role of leadership (e.g., Vogelaar & Dalenberg, 2012) trust (e.g., Van der Kloet, 2005; Soeters, Bijlsma & Van den Heuvel, 2012) and (organizational) culture (e.g., Soeters, Winslow & Weibul, 2006) in relation to expeditionary military operations. It can be argued that this thesis provides a theory that can be of added value to this line existing research because it employs a perspective that is used rarely within more organization-psychological research perspectives. That is to say, this thesis has developed a perspective that is able to relate organizational design to safety and controllability issues present in expeditionary organizations, whereas more psychologically oriented perspectives seem to be mostly insensitive to influences of organizational design on organizational outcomes[77].

Lastly, the theory developed may hold relevance for literature on civil-military cooperation in military expeditionary contexts. Rietjens and Bollen (2008, p. 2), for example, highlight the temporary ad-hoc nature of civil-military cooperation in expeditionary contexts and highlight that absence of coordination mechanisms hinders viable cooperation in such configurations. By means of the theory developed in this thesis, an explanation can be sought that furthers understanding of civil-military interaction. That is to say, by means of the theory developed in this thesis such problems can be related to the way both the expeditionary configuration and parent organizations are designed.

[77] For a similar argument, related to psychological stress within organizations, see: Christis (1998).

7.2.2 Relevance for studying crisis response organizations

In this section, the theory developed in this thesis is placed in the context of recent studies on crisis response organizations. Literature on crisis response organizations seems to acknowledge issues of integration and coordination during multidisciplinary operations frequently (e.g., Steigenberger, 2016). For example, Smith and Dowell (2000) address point out that crisis response organizations suffer from a "lack of coordination between various agencies". Also, Ansell, Boin and Keller (2010) address problems of integration during "transboundary" crises, which are crises that span over multiple government agencies and/ or national borders. Explanations of the origins of these issues however, seem to disregard the influence of organizational design on controllability of crisis response operations. Often, explanations and solutions are sought in management and decision-making (e.g., Drabek, 1985), information sharing (e.g., Bharosa, Lee & Jansen, 2010), communication (e.g., Kapucu, 2006), and aspects of (organizational) culture (e.g., Hart, 1993). Van Duin and Wijkhuijs (2015, p. 202) even argue that a crisis is inevitably associated with chaos and that researchers therefore should temper their criticism in evaluating government authorities, which seems to advise moving science away from critically studying crisis response actions. By taking an organizational design perspective, the results of this thesis may hence contribute to this line of research in providing alternative explanations for issues of integration and coordination in crisis response organizations.

In relation to the relevance of "network organizations" for crisis response, some crisis management studies acknowledge the importance of seeing crisis organizations as network organizations. For example, Boin (2009) points out that managing large networks is inevitably related to managing crisis response organizations. Related to this, Moynihan (2008; 2009), stresses the learning aspect of crisis networks. With regard to the results of this thesis it can indeed be stressed that learning and designing network organizations is inevitably related to operating in crisis organization. However, aspects of organizational design, at both the level of parent organizations and crisis response organizations, that hinder the learning efforts of operators and the emergence of networks in crisis organizations seem to be overlooked by Moynihan. For example, in a study on Incident Command Systems, Moynihan (2009) recognizes all kinds of effects, such as cognitive and political effects that may hinder learning during crises. However, Moynihan's study seems to be insensitive to organization design influences. Following this line of reasoning it may even be argued that Moynihan's findings on learning in crisis networks may be in danger of referring to learning in, what Kuipers et al. (2010) define as a "pseudo network organization", because influences of underlying structures on the operations of organizational networks during crisis operations are not addressed. Boin (2009), however, stresses the influence of bureaucratic government organizations on crisis management operations. Yet, it was already pointed out in the previous chapter that he refers to dealing with such influences as the “impossible job” of crisis management. Based on the theory developed and the potential way for a solution that was put forward in the previous chapter, the results of this thesis may provide some ways out. Hence, it can be argued that the explanations put forward in this thesis are contributing to crisis response literature in such a way that it is able to link issues of coordination and integration to structural design of both crisis response organizations and parent organizations.

A recent study into crisis response operations that explicitly addresses aspects of organizational design influencing operations is conducted by Wolbers (2016). Wolbers studied aspects of coordination and integration of recent crisis response cases such as the response during the Turkish Airlines crash at Schiphol in 2009. Quite interestingly, Wolbers points to the positive role “fragmentation”, or missing integration, within the crisis response organization may play in continuously shaping and reshaping crisis response networks. He stresses that instead of seeing fragmentation as something “negative”, lacking integration between crisis response units spawns innovative ways of working. These results of Wolbers' study may be interpreted as being partly in line with the results of this thesis. That is to say, it was pointed out throughout this thesis that limited integration, interpreted as the absence of structural coupling between units, indeed leads to emerging self-design that shapes new networks of units during expeditionary operations. However, this thesis explicitly addresses aspects of organizational design at both the level of the expeditionary organization and the parent organization that hinder such self-designing efforts. Furthermore, these hindering aspects of organizational design had direct and indirect effects on controllability of the crisis response organization. Such effects of aspects of organizational design on controllability issues such as miscommunication and delay seem to be neglected by Wolbers. Hence, the results of this thesis may shed some new light on Wolbers' concept of fragmentation.

7.2.3 Relevance for other expeditionary organizations

In line with military expeditionary organizations and crisis response organizations, research on project organizations in construction frequently elaborates on problems of coordination, integration and performance. For example, Flyvbjerg et al. (2003) refer to the “megaproject paradox”, by which they mean that more and more temporary project organizations are assembled that perform poorly with regard to outcomes such as costs and time delay. Explanations for these, what De Sitter (1994) would refer to as controllability issues, are sought by Flyvbjerg et al. in a lack of accountability and risk sharing between partners in such a temporary project organization. The results of this thesis may provide alternative explanation for temporary building projects' poor performance. These organizations can be defined as expeditionary organizations because they are quite often "mixed and matched" from large, probably static, building corporations. Also, temporary building projects are confronted with an environment that can be called dynamically complex, due to competition forces, financial pressure and public and political forces. As such, the aspects of organizational design put forward in this thesis, may influence controllability in these temporary building projects. Hence, the possible road to solutions put forward in the previous chapter may provide a first step in finding a way out of the paradox described by Flyvbjerg et al.

Next to the more financial controllability issues addressed by Flyvbjerg et al. safety literature frequently elaborates on safety issues in construction projects. For example, Swuste, Frijters and Guldenmund (2012) provide a review on safety issues and possibilities for improvement in construction organizations. Swuste et al. point out that organizational aspects for improving safety in organizations are underdeveloped and that a much-heard reason for this is that "construction is different" (*ibid*, p. 1341). This "difference" relates, according to Swuste et al., to the nature of the construction process and the dynamic and fluid character of many construction organizations. Related to the work of Flyvbjerg et al., and along the arguments provided above, it can be argued that many temporary construction organizations may be characterized as expeditionary organizations and that the temporary nature and dynamics of the construction environment indeed makes these organizations "different". Hence, the results of this thesis may provide some alternative explanations for the difficulties in implementing organizational safety measures and may also provide an alternative perspective on safety issues in temporary construction organizations. That is to say, the "mixed and matched" character of organizational designs in expeditionary organizations may make it hard to integrate safety procedures of the different organizational units and actors taking part in the construction project. Lastly, an explanation for safety incidents from the perspective of organizational design may contribute to literature on safety issues in construction projects.

7.2.4 Limitations at level C

In this section, some limitations are put forward with regard to the relevance of the theory developed in this thesis for research at Van Strien's level C of knowledge generalization. A first limitation is that, although the theory developed in this thesis possesses explanatory and predictive characteristics, it does not have a prescriptive character. This can be interpreted as a limitation because in safety literature much effort is directed to providing prescriptive safety-improving solutions. A counterargument to this limitation may however be that a first step in developing safety measures is a well-developed risk identification and analysis processes. The theory developed in this thesis may provide a foundation for such processes.

A second limitation of the theory developed in this thesis at Van Strien's level C, may be nature of explanatory statements proposed in the theory. That is to say, this thesis has provided insight into the relation between organizational design, safety and controllability in expeditionary organizations. Although this influence was found to be profound and relevant for operations of expeditionary organizations, safety and controllability effects may also come into existence due to other influences. Hence, the results of this thesis are not to be interpreted as an all-explaining theory of *all* safety and controllability effects in expeditionary organizations. In the next section, the theory developed will be placed into the context of research at Van Strien's level B of knowledge generalization. In this section, the theory developed in this thesis will also be placed in the context of safety theory that offers explanations from perspectives other than an organizational design perspective.

7.3 A reflection at Van Strien's level B

A review of organizational safety theory was already conducted in Chapter Four. This review concluded that the four theories reviewed were not suitable for getting an understanding of the relation between organizational design and safety in expeditionary organizations. This emphasizes the relevance of the results of this thesis in relation to the four theories reviewed. In this section, however, the results of this thesis are placed in the broader context of safety theory. Secondly, organizational theory is used to reflect on the results of this thesis.

7.3.1 Relevance for safety theory

This thesis can be interpreted as having added value to the movement within safety science that tries to escape the "human-error" perspective, as it attributed safety outcomes to the way a particular form of organizations is designed. However, this thesis is not the only work on the relation between aspects of organizational design and safety, this was also shown in Chapter Two. In addition to the theories outlined there, Grote (2009) stresses a "sociotechnical systems design approach" in studying safety in organizations. Also, Guldenmund (2007) addresses aspects of an organization's structure in studying safety in organizations. In relation to these works, this thesis has used a particular definition of organizational design, based on the Sociotechnical Systems Design tradition and Integral Organizational Renewal in particular. This interpretation of organizational design, which can neither be found in the work of Grote nor Guldenmund, has shown to be of explanatory value with regard to safety and controllability issues in expeditionary organizations. Hence, the particular interpretation this thesis has given to the concept of organizational design can be regarded as being of added value to safety theory and the aforementioned contributions to safety literature.

In relation to the nature of claims stressed in the preceding section, it has to be underscored that the results of this thesis do not imply that more psychological or technical approaches to safety are irrelevant. Instead, the results of this thesis are to be interpreted as complementary to such existing approaches to safety. Such complementarity is also argued in relation to the "normal work" approach taken in this thesis. It was pointed out, for example in Chapter Three and Four, that studying normal work of operators gives insight into the dynamics of working on the crossroads between environmental challenges and organizational context influences. This approach was adapted from Dekker (2005) who stresses a similar point in relation to normal work of operators. However, although Dekker recognizes the crossroads at which operators find themselves, he does not give a "design" interpretation to the organizational influences that operators experience. Instead, Dekker points to the influence of procedures and regulations. Based on Integral Organizational Renewal premises and the theory developed in this thesis, it can however be stated that procedures and regulations are part of an organization's control structure and that these can never be addressed without going into the details of an organization's production structure. As such, the interpretation this thesis has given to the normal work can be regarded to have added value to the approach put forward by Dekker.

7.3.2 Relevance for organizational theory

From an organization science perspective, the result of this thesis can be placed in the wider context of theory on temporary organizations. Chapter One already highlighted the work of De Waard and Kramer (2008) and Modig (2007). De Waard and Kramer (2008) highlight, theory on temporary organizations seems to disregard the relationship between temporary and parent organizations. Modig (*ibid.*), however, explicitly highlighted this relationship and pointed out that static parent organizations may hinder work in temporary organizations due to the stable nature of routines and vertical coordination mechanisms. A significant result of this thesis is that indeed aspects of parent organizations hinder work in temporary organizations in such a way that outcomes at the level of the temporary organization are compromised. In particular, the theory developed in this thesis has shown that an organizational design perspective provides explanations for such hindering influences that go beyond the mere observation of conflicting routines and coordination mechanisms. A such, the studies presented in this thesis can be interpreted as building on the work in this particular avenue of research on temporary organizations by theorizing on the relationship between temporary and parent organization in a more detailed manner.

A second organizational science tradition in which the results of this thesis can be located is, quite obviously, that of the Sociotechnical Systems Design and the Integral Organizational Renewal approach in particular. As pointed out in Chapter One, IOR, and especially the works of De Sitter (1994) are developed for a particular kind of organizations, standard bureaucratic organizations that were called "Mainstream Holland Inc." As such, the object of study of this thesis was different than the object of study within "classic" IOR. Nevertheless, it was argued that IOR concepts could be employed as a heuristic analytical compass in guiding the studies in this thesis. This approach proved useful and enabled unraveling relationship between organizational design, safety and controllability in expeditionary organizations. In this sense, this thesis contributes to IOR by applying it as an analytical perspective. Moreover, it was found in the course of this thesis that safety and controllability problems that related to organizational design within expeditionary organizations could not solely be explained by using IOR's "design parameters", of which functional concentration is the first and foremost. Apparently, these design parameters are developed based on organization with existing and already developed structural coupling between workstations. In this thesis, it was found that many safety and controllability problems could be associated with the absence of structural coupling between units. This was at the one hand certainly related to functional concentration within parent organizations, and therefore relates to the first design parameter of De Sitter (1994). However, De Sitter's parameters could not account for the relationship between missing structural coupling and safety within the expeditionary organization itself. An explanation for this finding may be that De Sitter (1994) already pointed out that his works are aimed at, and probably limited to, "Mainstream Holland Inc.", which he uses as a metaphor for large bureaucratic organizations. Although expeditionary organizations are built from bureaucratic parent organizations, they themselves are not comparable to "Mainstream Holland Inc.", due to the underdeveloped nature of its organizational design. As such, the findings in this thesis draws some lines for application of some concepts developed in classic IOR and hence may provide an opportunity to develop IOR into a theory that can also be applied to organizations with more contemporary structural shapes.

As an advance on such future contributions, the previous chapter explored the applicability of "hyper flexible network design" from Kuipers et al. (2010) to the design problem of expeditionary organizations. This application gave some starting points to improve safety and controllability in expeditionary organizations but also ran into some profound difficulties that centered on the nature of some parent organizations. Hence, the results of this thesis can, at the one hand, be interpreted as building on the still young "network" tradition within IOR. On the other hand, substantial work remains to be done in order to come up with a suitable redesign solution for expeditionary organizations.

7.3.3 Limitations at level B

As discussed before in this thesis, the theory developed was not built for having prescriptive properties. This provides a limitation at the problem-oriented level of knowledge generalization that van Strien referred to as level B. That is to say, the theory developed in this thesis lacks prescriptive aspects for both safety theory and organizational theory, as it did not aim at being a safety management theory or an organizational redesign theory.

A second limitation at Van Strien's level B may be found in the use of IOR concepts throughout this thesis. That is to say, by choosing this perspective from the start, this thesis may have become insensitive to other organizational design influences that affect safety. Although this may pose some limitations to the results presented, the choice for IOR concepts was motivated and resulted in relevant findings. Also, the use of IOR concepts as a conceptual compass led to the inclusion of other relevant theoretical concepts, such as Thompson's concepts of interdependence and coordination, in the construction of the theory. Nevertheless, and this was also pointed out above, alternative explanations for safety and controllability outcomes in expeditionary organizations should not be regarded as irrelevant. Instead, applying different level B perspectives on explaining safety and controllability effects in expeditionary organizations, and organizations in general, can be regarded as the best foundation for results.

7.4 A methodological reflection

In this section, the methods used in this thesis will be reflected upon. This seems necessary as this thesis did not have one particular methodological perspective but combined different methodologies in order to answer the different research questions. In Chapter Three and Four of this thesis, a grounded theory was employed in a slightly different way than was proposed by Wester and Peters (2004) as such, the next section will reflect on the use of grounded theory methods in this thesis. After that, the different analytical strategies that were followed throughout this thesis are subject of reflection.

7.4.1 A reflection on grounded theory methodology

In Chapter Three and Four the different phases described by Wester and Peters (2004) were used to construct a grounded theory both within 107 Aerial Systems battery and Task Force Uruzgan by using a particular “normal work” approach in order to detect influences of organizational design on safety. These phases were respectively: the exploration, specification, reduction and integration phase. In Chapter Three these analytical phases were used to explore the relationship between organizational design and safety within an expeditionary organization. In Chapter Four, the phases were used to verify the hypotheses derived within 107 ASBt by studying other units within Task Force Uruzgan and to come up with hypotheses at van Strien’s Level B. In both cases, the methodology proposed by Wester and Peters was used to combine case study data with theoretical premises in a systematic and step-by-step manner. It was stated that this was done heuristically, which is a common method in qualitative analysis. Wester and Peters however, do not explicitly elaborate on such use of theoretical insights. This means that a contribution of this thesis may be that their phases can be employed to develop grounded theory by means of heuristic use of theory throughout the research process of constructing a grounded theory. Similar developments of Wester and Peters’ phases have been suggested by Richardson and Kramer (2006). However, they proposed heuristic use of theory as being part of the reduction and integration phase, whereas in this study theoretical concepts, mainly originating from IOR, were used in all phases. This was done deliberately because the main interest of this thesis did not lie in all aspects of the experiences of operators but at a particular aspect of their experiences, those aimed at dealing with a dynamic environment while being located within a particular organizational context.

A main issue in reconstructing organizational design influences was that these could not be witnessed as such and had to be constructed analytically during the four analytical phases. As such, the way this thesis used theoretical insights in Wester and Peters' analytical phase may be suitable for qualitative research aimed a similar subject. That is to say, it may be suitable for qualitative research aimed at a particular part of operators' experiences while being confronted with (latent) constructs of interest that can only be "seen" by analytically combining experiences of operators with existing theoretical insights.

7.4.2. A reflection on systematic combining

To develop a theory on organizational design and safety in expeditionary organizations, different analytical techniques were used in this thesis. In Chapter Three and Four, analytical abduction was used to study case study data by means of a theoretical compass. In Chapter Five deduction was used to verify hypotheses in two other expeditionary cases. As such the method of "systematic combining", as developed by Dubois and Gadde (2002; 2014) was used in a specific way. Although Dubois and Gadde elaborate on the use of existing theory in developing theory from qualitative analyses, they do not refer to different levels of knowledge generalization. This thesis has used the categorization developed by Van Strien deliberately to keep claims and theories at different levels apart. For example, abductive analytical strategies in Chapter Four resulted in hypotheses at Van Strien's level B, whereas deduction was used to verify level B claims at level C in Chapter Five in order to strengthen these claims. As such, this thesis is characterized by alternating analytical strategies at different levels of knowledge generalization. It can therefore be argued that explicating the different analytical strategies and different levels of knowledge generalization is of added value to the method of systematic combining as developed by Dubois and Gadde. In the figure below, the different analytical strategies and different levels of knowledge generalization used in the different research stages in this thesis are presented.

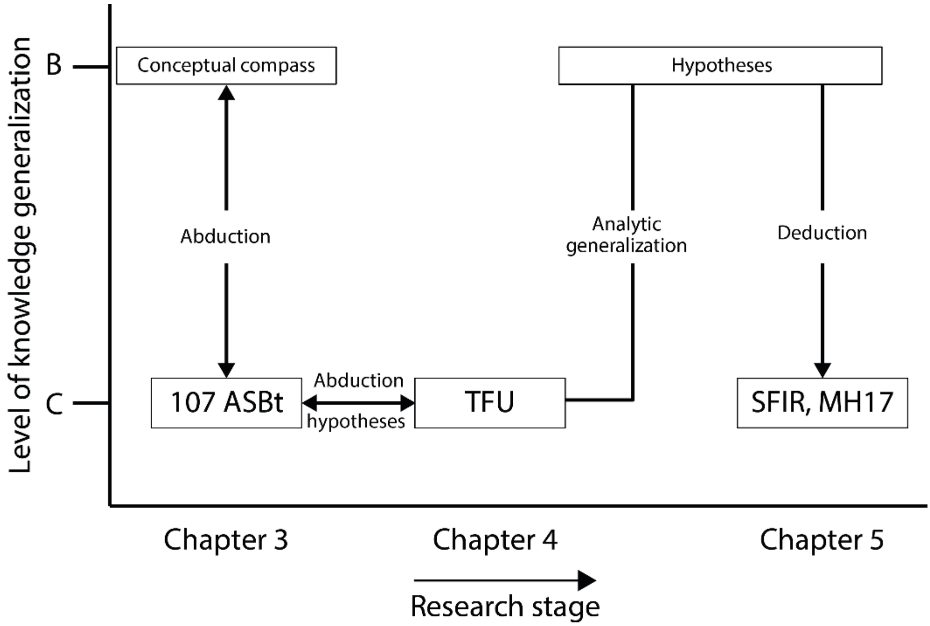

Figure 24: Analytical strategies, levels of knowledge generalization and research stage

7.4.3 Some methodological limitations

Starting this study at 107 Aerial Systems battery has been useful in developing a theory on organizational design and safety for expeditionary organizations. However, attempting to generalize results from this unit to other units and organizations may at the same time provide a limitation. That is to say, although hypotheses developed by studying 107 ASBt were generalized to TFU, it may well be that other units experienced all kinds of design influences on safety that were not included in this thesis. This was also highlighted in Chapter Four by stating that 107 ASBt had some specific characteristics that were unique to them. Also, 107 ASBt was part of the intelligence unit within TFU, which made them part of a particular section of TFU's primary process. Counterarguments to this limitation can be found in the notion that the problems of other units resembled those of 107 ASBt and were hence regarded as key design influences on safety. Also, analytic generalization was employed to generalize hypotheses from TFU to other expeditionary organizations. This made sure that, by combining the findings within TFU with existing organizational theory, relevant hypotheses for all expeditionary organizations are formulated. Furthermore, this strategy has resulted in findings that could at least partly be verified in the Iraq and MH17 cases.

Nevertheless, in replicating the theory, researchers should remain sensitive to other influences of organizational design on safety and/ or controllability in other expeditionary organizations.

A second limitation of the research presented in this thesis may be that hypotheses were verified, in Chapter Five, by means of secondary analysis of existing case study data. In this way only traces of evidence for the hypotheses were found. Also, parts of the hypotheses developed in Chapter Four, could not be verified in Chapter Five. A reason for this may be that the case studies used for secondary analysis had a research goal and used methods that yielded data that could only be partly used. As such, and this will also be addressed below, future research may use to the hypotheses developed in Chapter Four and attempt to verify these in other expeditionary contexts by using methods similar to those employed in this thesis.

7.5 Suggestions for further research

The last section of this thesis will elaborate on some directions for further research. Firstly, some suggestions will be given for research at Van Strien's level C. Secondly, directions for further research at level B will be presented.

7.5.1 Suggestions for further research at level C

As highlighted in the previous section, replication of the theory developed in this thesis in other expeditionary contexts is recommended. This might include studying other military missions and crisis response organizations. For example, the present military mission of the Dutch Armed Forces in Mali consists of a task force that is assembled out of different building blocks from the Army and Air Force and hence may provide an interesting case for replication. With regard to crisis response organizations, replication might also be possible employing secondary analysis of existing evaluations. For example, the evaluation report on the crash of the Turkish Airlines airplane at Schiphol in 2009 points out that, over and over again, similar problems of integration and coordination are found by the Dutch Safety Board (2010). Juffermans and Bierens (2010) who conducted a review on operations of medical services found similar issues after recent crises in the Netherlands. Attempting to replicate the theory developed in this thesis therefore in such crisis response cases may provide alternative explanations for these issues during crisis response. As such, employing the theory developed in this thesis may provide an alternative, organizational design, perspective to "learning after crises" which may have added value compared to the more traditional political, communication, information sharing and psychological explanations sought in crisis literature.

With regard to replication in other expeditionary contexts, literature on temporary organizations is abundant and growing (e.g., Bakker, 2010). Some examples of temporary organizations that may fall under the category of expeditionary organizations are construction projects (e.g., Bryman, Brensen, Beardsworth, Ford & Keil, 1987), shipbuilding project organizations (e.g., Levering, Ligthart, Oerlemans & Noorderhaven, 2013), offshore organizations (e.g., Gaisford, 1986) and architecture projects (e.g., Lieftink, Bos-de Vos, Lauche & Smits, 2014). Hence, future research may attempt to replicate the theory developed in this thesis within these temporary organizations.

7.5.2 Suggestions for further research at level B

The section on the relevance of the theory developed in this thesis for safety highlighted that the theory could be integrated in to safety management. However, this means translating the theory to fit in an organizational control model, as a safety management instrument is often defined as such (see: Hale et al., 1997). Quite notably, and in line with the approach taken in this thesis, this does not mean that control should be interpreted in the classic "top-down" bureaucratic way that results in translating the theory into rules and procedures. Instead, the study presented in this thesis emphasized sensitivity to aspects of organizational design on safety and stressed facilitating self-design and "normal work" of operators. This means, amongst other things, that organizational control should be understood in such a way that it facilitates the efforts of operators in developing safety in a dynamic environment.

With regard to organizational theory at level B, it was highlighted above that developing a redesign theory that fits expeditionary organizations and their "parents", seems necessary. It was shown in the previous chapter that the kind of organization Kuipers et al. (2010) defined as a network organization differs from the expeditionary organization, as defined in this thesis. This difference was particularly salient in relation to the role that parent organizations play in problems within expeditionary organizations. It was emphasized that "the object of redesign" referred to both the expeditionary organization and parent organizations, which complicated the applicability of the step-by-step approach developed by Kuipers et al. This implies that their step-by-step approach should be redeveloped in order to fit the design problem of expeditionary organizations. Also, using the results to reflect on IOR's "design parameters" could further develop IOR and Sociotechnical Systems Design into an organizational design perspective that is applicable to more contemporary organizational forms.

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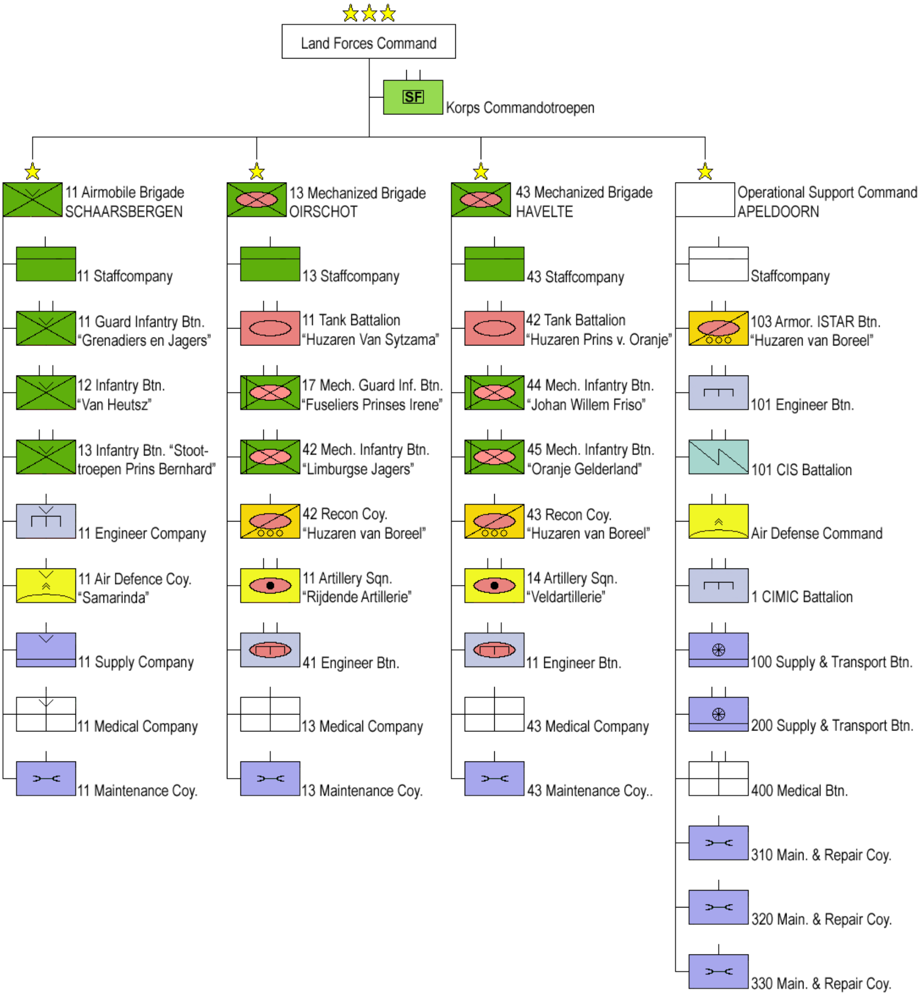
Appendix One

Organizational layout of the Royal Netherlands Army[78]



78 Based on: https://www.defensie.nl/organisatie/landmacht/inhoud/organisatiestructuur and https://www.defensie.nl/english/organisation/army/contents/units.

Appendix Two

List of references to the MH17 evaluation report by Torenvlied, Wessel, Giebels, Gutteling, Moorkamp & Broekema (2015).

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Summary

Many temporary organizations are assembled out of static, bureaucratic, parent organizations. Some of them operate (far) away from home in a difficult and sometimes dangerous environment. In this thesis, these temporary organizations are defined as "expeditionary organizations". Examples of these "expeditionary organizations" can be found in military missions, large construction projects, offshore operations and in crisis response organizations.

Previously published research within military expeditionary organizations has found that in these organizations units had to work in a configuration that did not resemble the configuration in which they were used to work or train within their parent organizations. They had to cooperate with all kinds of units in a configuration in which they didn't operate before. This poses the question whether design of expeditionary organizations makes operating in an already difficult and sometimes dangerous environment even harder and less safe. The influence of organizational design on safety in expeditionary organization could be studied by means of safety theory that is able to explicitly relate expeditionary organization design to safety outcomes. It is questioned, however, whether present safety theories that pay attention to the relation between organizational influences and safety outcomes, are able to do so. This dissertation is therefore aimed at developing organizational safety theory that is able to understand and explain the relationship between organizational design and safety outcomes in expeditionary organizations. To do so, the following five systematically designed research steps are followed.

The **first** step aims to investigate in detail whether existing and frequently used organizational safety theories are able to get an understanding of the relation between organizational design and safety in expeditionary organizations. By applying a systems-theoretical framework, a theoretical review is performed to analyze Safety Management Systems theory, Resilience engineering theory, Normal Accidents Theory and High Reliability Theory. The results show that these four theories have a limited ability to relate aspects of organizational design to safety outcomes. Moreover, inconsistent and implicit use of systems theory based concepts in some safety theories, hinders the applicability of these theories to the apparent design problem of expeditionary organizations. As such, the analysis results in the identification of a theoretical "gap". To build a theory that is able to "fill" this gap, four subsequent research steps are followed.

The **second** research step explores the relationship between organizational design and safety in expeditionary organizations by means of an exploratory case study within Task Force Uruzgan (TFU). TFU was a Dutch military expeditionary organization and part of

NATO's mission in Afghanistan from 2006 until 2010. In particular, the case study was aimed at the operations of the Dutch Army's 107 Aerial Systems Battery (107 ASBt), who operated with Unmanned Aerial Vehicles within TFU. Because both 107 ASBt and TFU were assembled out of different building blocks from military parent organizations, their operations were regarded as a good starting point for getting insight into the relation between organizational design and safety in expeditionary organizations. The exploration is carried out by using several theoretical premises on organizational design from the sociotechnical design tradition in organization science, and the Integral Organizational Renewal-approach (IOR) in particular. The results show that design of TFU and design of the unit itself impacted safety substantially. It became clear that integration of 107 ASBt into the Task Force was poor, which resulted in several safety issues at the level of the Task Force. From an IOR perspective, it could be stated that structural coupling between 107 ASBt and other units within the Task Force was largely missing from the start of the mission. This means, in short, that it was unclear for 107 ASBt with whom to cooperate and what agreements or rules could be used for cooperation. From the perspective of 107 ASBt, it was found that missing structural coupling between 107 ASBt and other units within TFU could be related to the "mixing and matching" design strategy that was used to build TFU. To overcome the issue of missing structural coupling and develop safe operations within the Task Force, a process of *self-design* emerged right from the start of operations within TFU. This process entailed searching for units to conduct missions with, and the (re-) development of agreements and rules to carry out these missions. An interesting finding was that the process of self-design was hindered by several design characteristics of the Task Force. Organizational complexity within the Task Force and incompatible rules and procedures made some problems unsolvable. This resulted in permanent safety threats during operations of the Task Force. The nature of the first case study was, however, exploratory and therefore generalizability of these findings to the level of Task Force Uruzgan was limited. Therefore, in the following research step, a second case study within TFU was conducted.

The **third** research step in this dissertation was subsequently aimed at attempting to generalize the findings from the first case study to the level of TFU. This was done by conducting a second case study within the Task Force in which multiple units were included. The results showed that the majority of the results on the relationship between design of the Task Force and safety could be generalized. Indicating that the absence of structural coupling could be associated with safety consequences within TFU. Also, to develop safe operations, other units engaged in the process of self-design as well. In particular, from a reflection on this self-designing process, it became clear that operators attempted to form a particular organizational form to operate both safely and meaningfully within the Task Force. It was argued that they engaged in the development of a *network organization*, which emphasizes the bottom-up creation of continuously changing reciprocally interdependent configurations. It was found that during this particular process of self-design, several design characteristics of the Task Force hindered the self-design process. Both organizational complexity and incompatible rules hindered the self-design process in such a way that safety of the Task Force was compromised. In this research step, it was subsequently argued that these design characteristics of the Task Force could be related to design of military parent organizations from which the expeditionary organization was assembled. These parent organizations are characterized by a high degree of "functional concentration", which means – in a general sense- that to a large extent specialist activities are located at specialist departments. Such a high degree of functional concentration resulted in a complex design process to assemble expeditionary organizations. Also, it became clear that design principles and coordination mechanisms are brought along from the parent organization to the expeditionary context. As a result, expeditionary organizations are also characterized by a high degree of functional concentration, which increases complexity within the expeditionary organization. Also, this may account for the incompatibility of coordination mechanisms because highly functionally concentrated organizations demand for different coordination mechanisms compared to (self-designed) network organizations. At the end of the third research step, it is attempted to combine the results of the second case study with existing theory in organization science. This is done to develop hypotheses on the relation between organizational design and safety in expeditionary organizations in general. However, for developing a theory on organizational design and safety in expeditionary organizations, analytically developed hypotheses are not sufficient. These hypotheses have to be replicated, or "tested" in other expeditionary organizations to prove their external validity. This is done in the next research step.

In the **fourth** research step, it is therefore attempted to verify the hypotheses in to two previously published expeditionary cases: one additional military case on the Dutch contribution to military operations in Iraq, and a case on the crisis response organization that was initiated after the crash with flight MH17. Results of the replication show that traces of evidence were found that supported the hypotheses developed in the previous step. Only traces of support could be found because this research step used so-called secondary case study data, which has its limitations. Nevertheless, the analysis of the Iraq case showed that for the majority of the hypotheses support could be found. In the MH17 case, however, it was found that although the hypotheses were able to explain the relationship between design of the crisis organization and disturbances, these disturbances were not related to safety. Instead, the hypotheses seemed to be able to explain the relationship between characteristics of organizational design and more general controllability issues, such as delay and miscommunication in the crisis organization. As such, it was proposed that the hypotheses that were developed to explain the relationship between organizational design and safety in expeditionary organizations, also hold relevance for explaining more general controllability issues in expeditionary organizations.

Lastly, in the **fifth** research step, the verified hypotheses are presented by means of a conceptual model, which gives a visual representation of the theory that this dissertation aimed to develop. Also, the fifth research step provides an explicit and consistent systems-theoretical foundation, because implicit and inconsistent use of such concepts jeopardized applicability of organizational safety theories to the expeditionary context. Furthermore, it is explored how organizational redesign theory may be used to come up with a solution for the design issues found in this dissertation. This exploration attempted to apply recent organizational redesign theory on "hyper flexible network designs" to the design problem of expeditionary organizations. The application however, was problematic because of a misfit between this network design theory and the nature of design of some parent organizations. These limitations, aspects of scientific relevance and limitations of the studies carried out in the research steps are discussed in the last part of this dissertation that directs attention to reflection and discussion.

Nederlandse samenvatting

Veel organisaties maken gebruik van een bepaald type tijdelijke organisatievorm, die in dit proefschrift "expeditionaire organisatie" genoemd wordt. Expeditionaire organisaties worden ontworpen door uit verschillende statische, en veelal bureaucratische, "moederorganisaties" onderdelen te selecteren en deze in een tijdelijke organisatie samen te voegen. Daarbij voeren expeditionaire organisaties (ver) van huis taken uit in een moeilijke en soms gevaarlijke omgeving. Voorbeelden hiervan kunnen gevonden worden bij het uitvoeren van militaire missies, grote bouwprojecten, offshore operaties en crisisbeheersingstaken.

Eerder gepubliceerd onderzoek binnen militaire expeditionaire organisaties toont aan dat eenheden in een configuratie moesten werken die sterk verschilde van de configuratie waarin zij binnen de moederorganisaties gewend waren te werken en te trainen. Zij moesten hierdoor samenwerken met andere eenheden waarmee zij geen of weinig ervaring hadden. Daardoor rijst de vraag of het ontwerp van expeditionaire organisaties het opereren in een gevaarlijke omgeving niet nog lastiger en wellicht gevaarlijker maakt. Deze mogelijke invloed van organisatieontwerp op veiligheid zou in kaart gebracht kunnen worden door middel van veiligheidskundige theorie waarin organisatieontwerp expliciet verbonden wordt aan veiligheidsuitkomsten. Het is echter de vraag of bestaande veiligheidskundige theorieën, die zich richten op organisatie-invloeden en veiligheid, hiertoe in staat zijn. Dit onderzoek richt zich daarom specifiek op het ontwikkelen van een veiligheidskundige theorie voor expeditionaire organisaties waarbij organisatieontwerp expliciet aan uitkomsten op het gebied van veiligheid wordt verbonden.

Hiervoor zijn een aantal stappen doorlopen die alle in aparte studies zijn uitgevoerd. In de **eerste stap** is in detail bekeken of, en hoe, bestaande veiligheidskundige theorieën, die organisatie invloeden op veiligheid meenemen, in staat zijn de ontwerpproblemen van expeditionaire organisaties te herkennen en te verbinden aan veiligheidsuitkomsten. Hiervoor is een literatuurstudie uitgevoerd om te bepalen of vier veel gebruikte veiligheidskundige theorieën, Safety Management Systems Theory, Normal Accidents Theory, Resilience Engineering theorie en High Reliability Theory, gevoelig zijn voor dergelijke problematiek. Het resultaat van de literatuurstudie laat zien dat deze vier theorieën in beperkte mate de relatie tussen ontwerpinvloeden en veiligheidsuitkomsten kunnen leggen. Daarbij is naar voren gekomen dat sommige theorieën inconsistent en impliciet gebruik maken van verschillende systeemtheoretische concepten. Dit maakt het onmogelijk de vier onderzochte theorieën te gebruiken voor het verkrijgen van inzicht in de relatie tussen organisatie ontwerp en veiligheid binnen expeditionaire organisaties. De literatuurstudie mondt daarom uit in het identificeren van een "gap" in bestaande veiligheidskundige literatuur. Om deze "gap" te dichten is in de volgende onderzoekstappen systematisch empirisch onderzoek gedaan binnen expeditionaire organisaties om zo uiteindelijk gedetailleerd inzicht te verkrijgen in de relatie tussen organisatieontwerp en veiligheid binnen expeditionaire organisaties. Dit, om uiteindelijk zelf met verklarende mechanismen te komen die de relatie tussen organisatieontwerp en veiligheid binnen expeditionaire organisaties verduidelijken.

Om een eerste beeld te vormen van de relatie tussen organisatieontwerp en veiligheid binnen expeditionaire organisaties, is in de **tweede** onderzoeks-stap van dit proefschrift een verkennende casestudie uitgevoerd naar het opereren van een specifieke eenheid binnen Task Force Uruzgan (TFU). TFU was onderdeel van de NAVO-missie in Afghanistan van 2006 tot en met 2010. De eenheid waar deze casestudie zich op richtte was 107 Aerial Systems Batterij (ASBt), die binnen de Koninklijke Landmacht met zogenoemde Unmanned Aerial Vehicles vliegt. Zowel het detachement van 107 ASBt in Uruzgan als Task Force Uruzgan zelf waren ontworpen door het samenvoegen van (gedeelten van) eenheden uit moederorganisaties van de Nederlandse Krijgsmacht. Hierdoor zijn de operaties van 107 ASBt binnen Task Force Uruzgan een goed startpunt voor een verkenning van de relatie tussen organisatieontwerp en veiligheid binnen expeditionaire organisaties. Om deze verkenning uit te voeren is gebruik gemaakt van een aantal uitgangspunten op het gebied van organisatieontwerp, die ontleend zijn aan de socio-technische organisatiekundige traditie en de Integral Organizational Renewal-benadering (IOR) in het bijzonder.

De resultaten laten zien dat voor de operaties van 107 ASBt binnen Task Force Uruzgan, het ontwerp van de Task Force en het ontwerp van de eigen eenheid een aanzienlijke relatie had met veiligheidsuitkomsten. Het werd duidelijk dat 107 ASBt vanaf het begin van de missies in Uruzgan, slecht geïntegreerd was in de Task Force en dat dit verschillende consequenties voor veiligheid had. Vanuit het perspectief van IOR kan gesteld worden dat er tussen 107 ASBt en de andere eenheden van de Task Force weinig tot geen structurele koppeling aanwezig was. Dit betekent, in het kort, dat het niet direct duidelijk was met wie samengewerkt moest worden en met welke regels dat te doen. Vanuit het perspectief van 107 ASBt kan dit gebrek aan structurele koppeling verbonden worden aan de wijze waarop zij, samen met de andere eenheden van de Task Force, vanuit de moederorganisaties, als losse bouwstenen in een tijdelijke expeditionaire organisatie waren samengevoegd. Om veiligheid te ontwikkelen ontstond direct na de start van de missie een proces van *zelf-ontwerp.* Dat wil, in beknopte zin, zeggen dat medewerkers van 107 ASBt allerlei acties ontplooiden om uit te zoeken met wie zij missies moesten of konden uitvoeren en met welke regels dat gedaan zou moeten worden. Dit proces van zelf-ontwerp leidde gaandeweg tot een verbetering van het vermogen van de eenheid om veilig te opereren binnen de Task Force. Wat opvallend was, was dat tijdens het proces van zelf-ontwerp, verschillende organisatieontwerp karakteristieken een hinderende rol hadden. Zo zorgden niet-passende regels en procedures, zoals bijvoorbeeld regels voor interactie met andere vliegende actoren, voor onoplosbare problemen die permanente veiligheidsbedreigingen met zich meebrachten. Het was bij de resultaten van deze verkennende casestudie echter wel de vraag in welke mate de resultaten golden voor de hele Task Force of dat deze bepaald werden door uniekheden van 107 ASBt. Omdat het doel van dit proefschrift is een theorie te ontwikkelen over organisatieontwerp en veiligheid van expeditionaire organisaties in het algemeen, was het nodig deze resultaten te proberen te generaliseren naar het niveau van Task Force Uruzgan. Dit, alvorens ook maar gedacht kon worden aan generalisatie naar expeditionaire organisaties in het algemeen.

In de **derde stap** van dit onderzoek is daarom een tweede casestudie binnen Task Force Uruzgan uitgevoerd om de resultaten van de eerste casestudie te kunnen verifiëren. In deze casestudie zijn meerdere eenheden binnen Task Force Uruzgan meegenomen. De resultaten van deze tweede casestudie lieten zien dat de resultaten over de relatie tussen het ontwerp van Task Force Uruzgan en veiligheidsuitkomsten voor het grootste gedeelte geverifieerd konden worden. Dat betekent dat het ontbreken van structurele koppeling binnen de Task Force voor veiligheidsproblemen zorgde. Ook andere eenheden binnen de Task Force gingen vervolgens al zelf-ontwerpend proberen veiligheid te ontwikkelen. Uit een reflectie op dit zelf-ontwerpende proces werd duidelijk dat het medewerkers binnen de Task Force niet zomaar een organisatiestructuur ontwikkelden, maar dat zij gaandeweg werkten aan het vormen van een *netwerkorganisatie*. Hierbij ligt de nadruk op de noodzaak van onderaf (bottom-up), steeds wisselende configuraties van eenheden samen te stellen waarbij deze eenheden een wederzijdse afhankelijkheid van elkaar hebben. Ook bij dit proces van zelf-ontwerp kwam naar voren dat ontwerp karakteristieken van de Task Force het proces tegenwerkten. Zowel de complexiteit binnen de Task Force en niet-passende regels en procedures zorgde ervoor dat zelf-ontwerp niet altijd tot een veiligere organisatie leidde, hetgeen het veilig opereren van Task Force Uruzgan problematisch maakte. De ontwerp karakteristieken van de Task Force die het lastiger maakten van onderaf netwerken vorm te geven konden vervolgens worden gerelateerd aan ontwerp eigenschappen van de verschillende moederorganisaties van de Nederlandse Krijgsmacht. Deze kennen namelijk een ontwerp dat in hoge mate wordt gekenmerkt door "functionele concentratie", wat wil zeggen dat in hoge mate allerlei specialistische activiteiten op specialistische afdelingen zijn geplaatst. Dit functioneel geconcentreerd ontwerpen zorgt niet alleen voor een ingewikkeld ontwerpproces voor het samenstellen van expeditionaire organisaties.

Ook blijkt dat ontwerpprincipes en afstemmingsmechanismen worden meegenomen vanuit de moederorganisatie naar de expeditionaire organisatie. Hierdoor kent ook de expeditionaire organisatie een hoge mate van functionele concentratie, wat complexiteit in de hand werkt. Dit geeft ook een verklaring voor de passingsproblemen van afstemmingsmechanismen. Namelijk afstemmingsmechanismen in een functioneel geconcentreerde organisatie hebben heel andere eigenschappen dan de afstemmingsvorm die nodig is in een (zelfontworpen) netwerkorganisatie. In een organisatie die in hoge mate gekenmerkt wordt door functionele concentratie zal de nadruk liggen op centraliserende afstemmingsmechanismen terwijl in een netwerkorganisatie wederzijdse afstemming belangrijk is.

Aan het eind van de derde onderzoeks-stap wordt getracht, door middel van het combineren van de casestudie resultaten en bestaande theorievorming in de organisatiekunde, te komen tot hypothesen over organisatieontwerp en veiligheid voor expeditionaire organisaties in het algemeen. Echter, voor het ontwikkelen van een theorie over organisatieontwerp en veiligheid in expeditionaire organisaties zijn analytisch opgestelde hypothesen alleen niet voldoende. Deze dienen ook gerepliceerd te worden in andere casestudies. Dit is gedaan in de vierde onderzoeks-stap.

In de **vierde stap** van dit onderzoek wordt getracht de ontwikkelde hypothesen te repliceren door het bestuderen van twee andere, reeds gepubliceerde, expeditionaire cases: een militaire case over de Nederlandse expeditionaire bijdrage aan SFIR-4 in Irak en een case over de crisisbeheersingsorganisatie die werd opgetuigd na het neerstorten van vlucht MH17. De resultaten van deze replicatie laten zien dat, in beperkte mate, bewijs gevonden kon worden die de hypothesen ondersteunen. De beperkingen van deze stap in het onderzoek hebben te maken met het gebruik van zogenoemde secundaire casestudie gegevens. Het gebruik van gegevens die, in vergelijking met de andere empirische studies in dit proefschrift, met een ander doel en andere methode zijn verzameld, maakt het mogelijk alleen te zoeken naar sporen van ondersteuning voor de hypothesen. Desalniettemin werden in de analyse van de SFIR-case duidelijke aanwijzingen voor ondersteuning gevonden voor het grootste gedeelten van de hypothesen. In de MH17 case daarentegen, werd in de analyse geconstateerd dat, hoewel de hypothesen in staat bleken een relatie te leggen tussen ontwerp karakteristieken van de crisisorganisatie en verschillende verstoringen, deze verstoringen niets te maken hadden met veiligheid binnen de crisisorganisatie. In plaats daarvan leken de hypothesen een relatie te leggen tussen ontwerpkarakteristieken en andere beheersbaarheidsproblemen zoals vertraging en miscommunicatie. Dit leidde ertoe te onderzoeken of de hypothesen relevantie hadden voor het verklaren van de relatie tussen ontwerpkarakteristieken van de crisisorganisatie en een bredere categorie van beheersbaarheidsproblemen, waarvan veiligheid een onderdeel is. Dit bleek, voor het grootste gedeelte van de hypothesen het geval te zijn, hetgeen ertoe leidt te betogen dat de hypothesen ook verklaringskracht hebben voor de relatie tussen organisatieontwerp en beheersbaarheid binnen expeditionaire organisaties.

In de **vijfde stap** zijn de geverifieerde hypothesen voor de relatie tussen organisatieontwerp, veiligheid en beheersbaarheid binnen expeditionaire organisaties uitgewerkt in een conceptueel model. Dit model geeft een visuele weergave van de theorie, die dit proefschrift tot doel had te ontwikkelen. Daarbij is aandacht besteed aan het formuleren van een consistent en expliciet systeemtheoretisch fundament. Dit, omdat in de eerste onderzoeks-stap van dit proefschrift andere veiligheidskundige theorieën door inconsistent gebruik van systeemtheoretische concepten onbruikbaar werden geacht. In de vijfde onderzoeks-stap wordt vervolgens aandacht besteed aan het verkennen van een ontwerpgerichte oplossing voor de veiligheids- en beheerbaarheidsproblemen die in dit proefschrift werden gevonden. De verkenning probeert recente socio-technische herontwerptheorie op het gebied van “hyperflexibele netwerkorganisaties” te gebruiken om oplossingen te vinden voor het ontwerpprobleem van expeditionaire organisaties. Dit stuit op een aantal problemen, waarvan de belangrijkste is dat de herontwerptheorie onvoldoende aandacht heeft voor de onderliggende organisatievormen van de moederorganisaties waaruit expeditionaire organisaties samengesteld worden. De tekortkomingen van deze nieuwe en nog jonge tak van de socio-technische organisatiekunde worden meegenomen in het laatste gedeelte van het proefschrift wanneer tot discussie, reflectie en het vormgeven van adviezen voor toekomstig onderzoek wordt overgegaan.

Curriculum Vitae

Matthijs Moorkamp was born on September 6th, 1982 in the city of Enschede in the Netherlands. He graduated from high school in Overveen in 2001. In August 2001, he joined the Royal Netherlands Naval Academy. In 2005, he left the Navy as a second lieutenant to pursue his studies at the University of Twente, where he obtained a Master of Science in organizational psychology in 2007. In December 2010, he started this PhD research at both the Netherlands Defense Academy and the Safety Science department at Delft University of Technology. From 2015 until 2016 he was a lecturer in security management at Saxion University of Applied Sciences. In this period, in 2016, he was also a member of the multi-disciplinary research team of the University of Twente that conducted the evaluation on the Dutch national crisis organization that was initiated after the crash of Malaysia Airlines flight MH17. From November 2016 until now, he works as an Assistant Professor in Organizational Design and Development at Radboud University in Nijmegen.