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Decentralization and decomposability: determinants of responsive crisis deployment

Erik de Waard
Faculty of Military Sciences, Netherlands Defence Academy, Breda, The Netherlands
Henk W. Volberda
Rotterdam School of Management, Erasmus University Rotterdam, Rotterdam, The Netherlands, and
Joseph Soeters
Faculty of Military Sciences, Netherlands Defence Academy, Breda, The Netherlands

Abstract

Purpose – Crisis management entails among other things developing organizational systems that are capable of reacting to unpredictable and different types of crises. It also involves designing cohesive operational elements to deal with the local dynamics of an actual crisis situation. This challenge of responsiveness – where organizations simultaneously need to react to change demands of different task environments – has hardly been investigated in management theory. The purpose of this paper is to initiate to shed more light on this blind spot.

Design/methodology/approach – Modular organizing and organizational sensing are introduced as key drivers of organizational responsiveness. Based on a large-scale survey among 1,200 senior officers the study investigates how these two variables have influenced the responsiveness of the Netherlands armed forces for crisis response deployment.

Findings – The findings indicate that the level of modularization is an important facilitator of organizational responsiveness. Organizational systems that are made up of semi-autonomous work groups are in a better position to simultaneously live up to the change demands of different environmental levels than organizations that follow a fine-grained modularization approach.

Originality/value – It uses the military crisis response organization as an exemplary case for project-based organzations in general to take advantage of.

Keywords Crisis management, Responsiveness, Defence, Modular design, Organizational sensing

Paper type Research paper

1. Introduction

Since the 1990s the business landscape has changed considerably. Business scholars argue that a new era of deliberately and continuously creating competitive disequilibrium has come (D'Aveni, 1994; Izosimov, 2008; McNamara *et al.*, 2003; Selsky *et al.*, 2007). With this new reality of ongoing flux the call for organizational flexibility has rocketed (Evans and Bahrami, 2004; Hamel *et al.*, 1998; McKelvey and Holmen, 2006; Pasmore, 1994). At first, business scholars believed that the stretching and leveraging of internal organizational resources could help to flexibly tap new sources of profit (Barney, 1991; Hamel and Prahalad, 1994; Wernerfelt, 1984). However, the idea of creating new competitive advantages through the exploitation of a firm's unique resources has been debated soon after. Critics emphasized that in a turbulent business environment resources are too static to support the process of repetitively breaking the existing

International Journal of Managing Projects in Business
Vol. 7 No. 3, 2014
pp. 380-404

1753-8378
DOI 10.1108/IJMPB-10-2013-0052

competitive status quo. Instead, dynamic capabilities are needed that actively support the re-shaping of the competition process (Teece *et al.*, 1997).

After its introduction the dynamic capabilities view has developed into a research stream of its own (Helfat *et al.*, 2007; Helfat and Peteraf, 2009; Teece, 2007, 2009). Although the key argument that continuous strategic renewal is important to stay ahead of competition seems valid, it only partly explains what organizational flexibility entails. Arend and Bromiley (2009) stress that the dynamic capabilities view basically treats organizational flexibility as the ability to remain adaptable over time, which strongly ties the concept to issues of strategic change. It does not really take into account the organization's level of responsiveness, which is crucial to deal with changing operational, organizational, and strategic conditions simultaneously (Eppink, 1978; Evans, 1991; Krijnen, 1979).

The aspect of organizational responsiveness has to some extent been addressed in the academic debate on what dynamic capabilities actually are. Winter (2003) points out that within today's turbulent business environment organizations are confronted with a wide variety of competitive influences. He draws an imaginary picture of a spectrum that varies from zero-order, to first-order, and ad hoc change demands. To his opinion dynamic capabilities can typically be linked to first-order change demands, because they involve deliberately changing, for example, the product, production process, scale, or the customers served. Zero-order influences do not ask for these fundamental change capabilities, but are confined to the competitive dynamics of "how to earn a living now." Ad hoc change demands refer to organizations having to respond to novel and unpredictable stimuli. Because ad hoc organizational responses are improvisational, not routine, not highly patterned, and not repetitious they do not rest on dynamic capabilities according to Winter.

It is remarkable that in the positioning debate on dynamic capabilities the reality of organizations having to deal with both "the here and now" and the future has only been mildly touched. Moreover, the fact that organizations most of the time will act in a routine way, but at the same time have to be capable of improvising is also a fact of everyday business life that deserves further investigation. As yet, actual research on this challenge of responsiveness – where in Winter's terminology organizations have to be prepared to simultaneously respond to zero-order, as well as first-order, and ad-hoc change demands – has hardly been undertaken. The present study was initiated to shed more light on this blind spot in strategic management theory. The general aim is to start a discussion on the underlying forces of organizational responsiveness. More specifically, this study introduces "sensing" and "modular organizing" as determinants for the organizational balancing act of dealing with different sorts of environmental influences at the same time.

"Sensing" refers to an organization's ability to fathom its complex relationship with the outside world. It consists of three distinctive stages:

(1) noticing;

(2) interpreting; and

(3) action (Daft and Weick, 1984; Kiesler and Sproull, 1982; Thomas *et al.*, 1993; Weick, 1979).

In addition to these three stages, sensing is also a cognitive process of individual actors constructing meaning to their immediate working context (Jeong and Brower, 2008). This implies that sensing is not purely a strategic positioning task restricted to top

managers. Instead, sensing can be seen as a general activity of employees throughout the organization to respond to the dynamics of their own specific task environments. Machine operators, staff specialists, project leaders, frontline managers, and top executives are all confronted with their own typical change demands; these can be zero-order, first-order, as well as ad-hoc. It could be argued that organizational responsiveness strongly depends on the cumulative sensing effort of all these people acting at different organizational levels and within different functional areas.

"Modular organizing" – or modularity – is a typical organizational design strategy aiming to increase flexibility without jeopardizing operational performance. By using fixed, self-supporting, autonomous organizational modules and by controlling only the required output of these modules a loosely coupled system is created that can be reconfigured into different constellations (Sanchez, 2003; Schilling and Steensma, 2001; Worren *et al.*, 2002). Available insights make clear that firms that know how to use a modular organizational architecture are able to effectively absorb different types of competitive interactions. Sanchez and Collins (2001) explain that modularity's mixing and matching principle satisfies first-order change demands such as increasing product variety and technologically upgrading products. According to Sagan (1993) redundancy and decentralization – typical elements of modular system design – help to minimize "zero-order" operational problems such as dealing with time delays, changing production sequences, or incorporating new production devices. Pil and Cohen (2006) stress that autonomous and specialist modular component structures facilitate the acquisition and exploitation of dedicated knowledge, which enhances the speed and quality of ad-hoc problem solving.

To learn more about how "sensing" and "modular organizing" affect organizational responsiveness, the study draws upon crisis response experiences of the Netherlands armed forces. In a broader sense, it uses the expeditionary crisis response task setting of many of today's western armed forces as a metaphor for organizations confronted with environmental turbulence. Although the ultimate consequences of suffering casualties during military operations are quite different from the socio-economic losses of competitive battles, a comparison can be made on a more abstract organizational level (Soeters *et al.*, 2010). After all, crisis response management entails among other things developing organizational systems that are capable of reacting to unpredictable and different types of crises. It also involves designing cohesive and effective operational elements to deal with the local dynamics of an actual crisis situation. As such, a strong resemblance exists with the general organizational dynamics of dealing with environmental turbulence, where organizations typically have to react to urgent ad hoc problems as well as to rather predictable change demands, and everything in between. Consequently, a systematic way of engaging environmental change has to be combined with an improvised learning-by-doing approach.

For dealing with this challenge, knowledge from the military domain could well be beneficial. First, almost all expeditionary crisis response operations are unique endeavors but are conducted by similar modularly built tasks forces (De Waard and Kramer, 2008). This shows that the armed forces have found the modular design strategy a useful approach to react systematically to very distinctive crisis situations. Second, a deployed military task force finds itself in a permanent state of flux: it needs to constantly react to changing local circumstances in order to keep or regain the initiative, it has to cope on an ongoing basis with intelligent actors actively trying to undermine its operations, and it needs to react at high speed all the time in order to stay ahead of the game. Under these constantly changing operational circumstances

sensing – or, in military terms, achieving continuous situational awareness (Alberts *et al.*, 2000) – has become a critical success factor for repeatedly outsmarting the opponent and staying on top of the situation.

The reasoning above has led to the following research question: to what extent do organizational sensing and modular organizing support the Netherlands armed forces in achieving organizational responsiveness? To answer this question the paper is divided in five main parts. The first part explains the relationship between the theoretical constructs organizational sensing, modular organizing, and organizational responsiveness. The second part discusses the study's research methodology. It explicates that it is based on a large-scale survey, in which 1,208 senior officers of the Netherlands armed forces have participated. The research findings are presented in the third part. In general, the results make clear that an organization's level of modularization – or system-decomposition – is an important factor to take into account when it comes to organizational responsiveness. A high degree of system granularity most certainly leads to structural complexity. As a result centralized control, in combination with all kinds of coordination mechanisms, becomes necessary to facilitate smooth intra- and inter-organizational collaboration. However, when organizations consist of semi-autonomous organizational structures, it becomes easier for operational units to deal with the local circumstances they encounter and for the strategic apex to concentrate on higher order change demands. The fourth part discusses how other organizations can take advantage of these domain-specific research findings and also identifies avenues for future research. The fifth part ends the paper with an overall conclusion.

2. Theoretical overview and hypotheses

2.1 Organizational responsiveness

Kohli and Jaworski (1990, p. 6) give the following definition of responsiveness: "the action taken in response to intelligence that is generated and disseminated." This general definition, however, does not take into account that the environment of an organization has different levels of aggregation, varying from, for example the macro-economical level to the resource pool level (Castrogiovanni, 1991). Since different organizational responses are needed to cope with the specific forces of these different environmental levels Ansoff and Brandenburg (1971) make a distinction between operating, structural, and strategic responsiveness. Operating responsiveness refers to the organization's short-term reaction ability to make quick and efficient changes in its levels of throughput. Structural responsiveness refers to the ability to make medium-term adjustments to the organization's structure and supporting (technological) systems and processes. Strategic responsiveness refers to an organization's long-term maneuvering capacity to keep up with changes in its indirect environment.

More recently scholars have added to this categorization that the organization's overall level of responsiveness depends on the contribution of every organizational member (Grant, 1996; Huber, 2004; Volberda, 1998). After all, strategic renewal is less and less dominated by a strategic apex that directs a central demand to a dedicated R&D department, but is becoming far more an emerging, joint, learning-by doing process of different teams and functional specialists working together and sharing knowledge in temporary, inter-organizational project structures (Gann and Salter, 2000; Kogut and Zander, 1992). Moreover, an organization's everyday functioning depends more and more on the ability to smartly develop and successfully manage consecutive

value networks. As a result, the streamlining of the horizontal coordination that takes place between different network partners has become at least as important as managing the efficiencies of the organization's own internal business processes. From the strategic down to the operational level softer relational aspects, such as negotiating with others, enhancing social bonds, and building up trust, seem to play to upper hand in this new setting (Ancona and Caldwell, 1992; Hoegl *et al.*, 2004; Mohrman *et al.*, 1995).

According to Volberda (1996, 1998) dealing with variety and speed are the two main variables for every organizational member – regardless of organizational position or functional expertise – when performing his job. Although these dimensions work out differently per organizational level, in combination they should lead to a mixture of flexibility types. His main assumption is that strategic renewal and organizational adaptation can only prosper if, above all, the controllability of the organization at the operational level is safeguarded. As a result, a sort of causal hierarchy is expected, starting with operational flexibility that lays the foundation for the organization's structural flexibility; and subsequently the organization's structural flexibility creates a solid base for its strategic flexibility. The following hypothesis has been derived from this theoretical reasoning:

H1. Responsive organizations display a mixture of operational, structural, and strategic flexibility.

2.2 Organizational sensing

Oxford Advanced Learner's Dictionary defines "to sense" as "to become aware." Yet, according to organizational theory sensing implies more than merely intelligence gathering. Organizational sensing depends not just on the activation of an information system that serves as a kind of antenna to pick up signals from the environment, but is perhaps even more about giving meaning to the often equivocal environmental signals that are being picked up. In this process of giving meaning, organizations have to be aware of the fact that they are constantly interacting with their environment and thus play an active role in how it is shaped (Hedberg, 1981; Weick, 1979). This situation makes it impossible for organizations to observe and judge their environment truly objectively. Being biased does not, however, have to be problematic as long as organizations are capable of establishing a workable level of certainty and do not fall into the cognitive trap of "believing is seeing" (Weick, 1979, p. 3).

With these complicated issues, the existing literature treats organizational sensing as a multi-dimensional construct. Kiesler and Sproull (1982) argue that organizational sensing is made up of three distinctive cognitive processes:

(1) noticing;

(2) interpreting; and

(3) incorporating stimuli.

Noticing refers to the process by which managers distinguish potentially threatening or valuable stimuli from the variety of stimuli that surround them. Environmental scanning systems and procedures are important facilitators of this process. They define interpreting as managers constructing meaning for, or assigning meaning to, the stimuli they pay particular attention to. Explicit organizational reference points, such as formulated goals, policies, and strategies, can help managers in making this

kind of interpretation. Incorporating stimuli has to do with the organization's ability to tap into relevant information sources and into its own memory base in order to associate the interpreted stimuli with other existing, or previously obtained cognitions. The size, age, form, and business group affiliation of an organization may be important factors influencing this process (e.g. Vissa *et al.*, 2010).

Daft and Weick (1984) identify largely the same three cognitive processes but offer two additional insights. First, they introduce action as a crucial underlying factor. By taking concrete measures, organizations can actually learn from the things that are happening and changing around them as a result of these actions. Second, drawing on Weick's (1979) earlier work, they emphasize that sense-discrediting plays a crucial part in all this. To be more specific, to prevent walking into the trap of "believing is seeing," organizations should try to bring doubt into the equation by deliberately criticizing existing strategic paths, norms, and paradigms.

Because of the growing trend toward the intertwining of operational performance and strategic maneuvering sensing has become a key capability of organizational responsiveness (Doz and Kosonen, 2008, 2010). A theoretical assumption growing stronger and stronger is that organizations should try to create a culture in which all employees are challenged to proactively scan and interpret their immediate environment (Cohen and Levinthal, 1990; Lane *et al.*, 2006; Todorova and Durisin, 2007). More specifically Huber (2004, p. 57) states the following. "In tomorrow's business environment, where sources of change will be less anticipatable than in the past, eclectic responsibility will be needed to complement the practice of assigning specialized personnel to monitor and report on particular environmental components. Without eclectic responsibility, many unanticipated threats, and opportunities would go unnoticed because no specialized sensor had been assigned to the source." Based on these insights the following hypothesis has been formulated:

H2. Organizational sensing is positively related to an organization's responsiveness.

2.3 Modular organizing

Business scholars also explicate a relationship between modular design and the responsiveness needed to deal with the increasingly turbulent business environment (Fang *et al.*, 2010; Schilling, 2000; Schilling and Steensma, 2001). Modularity theorists base their thinking primarily on Simon's (1962) work on the architecture of complexity. Simon sees all complex systems – biological, technical, or social – as hierarchically nested entities. He explains that each system is composed of interrelated finer subsystems, which in turn consist of finer subsystems, and so on, until ultimately the level of elementary particles is reached. The challenge in modular design is to find a structure that leads to the best system decomposition. In other words, the aim should be to set the boundaries in such a way that interdependencies between subsystems are minimized and the system can be almost cleanly decomposed (Langlois, 2002). This principle, known as near-decomposability, lays the foundation for modularity's potential to simultaneously support strategic, structural, and operational responsiveness.

In general, a module can be seen as an independent sub system, except for the restriction that its output has to comply with the general rules or specifications of the overall system it is entirely free in its own design. In this respect, Brusoni (2005, p. 1886) states that: "each module, at the extreme, could become the sole business of a

specialist firm, which would have complete design authority over the specific module on which it focusses." Standardized interfaces allow the mixing and matching of these independent modules into different constellations. This ease of recombining modules has stimulated strategic responsiveness. For example, it has stimulated the invention and application of new technologies, the development of new products, and the upgrading of existing products (e.g. Brusoni, 2005; Langlois and Robertson, 1992; Loch *et al.*, 2001; Sanchez, 1995, 1996; Sanchez and Mahoney, 1996; Ulrich, 1995; Worren *et al.*, 2002).

Furthermore, Sanchez and Mahoney (1996, p. 65) explain that modularity "is a special form of design which intentionally creates a high degree of independence or 'loose coupling' between component designs by standardizing component interface specifications." Basically, by controlling only the required output of components effective coordination can be achieved without the continual exercise of managerial authority. This principle of loose coupling has positively influenced structural responsiveness. For example, it has offered organizations the possibility to reorganize their internal production processes in such a way that economies of scope and scale could simultaneously be obtained (Brusoni and Prencipe, 2006; Langlois, 2000). Moreover, the widely embraced standardization approach has also stimulated the development of modular value networks between organizations (Anand and Daft, 2007; Krikke *et al.*, 2004; Majumdar, 1997; Mikkola, 2003).

When the level of environmental uncertainty grows too high, organizations should, according to Galbraith (1973), try to reduce the need to process information by creating self-contained tasks. The modular design approach strongly complies with this idea. Generally speaking, the reliance on self-supporting, autonomous organizational modules creates an overall system that can benefit from specific advantages, such as the localization of adaptation and trouble, and the reduction of costs for coordination (Orton and Weick, 1990; Weick, 1976). These advantages effectively seem to contribute to the generation of operational responsiveness. In this respect, one could think of having the ability to deal with time delays, change production sequences, adjust the overall production process by using other materiel or production devices, and to react to short-term fluctuations in a firm's level of activity by building in different sorts of slack (Perrow, 1984; Sagan, 1993). All this leads to the following hypothesis:

H3. Modular organizing is positively related to an organization's responsiveness.

Existing theory also makes clear that organizational sensing seems to benefit from modular design principles. Hansen (1999) explains that loosely coupled systems that exchange codified and independent knowledge have major search benefits and few transfer problems. With this assertion he implicitly suggests that modularity's key principle of using intentionally created standardized interfaces to link independent organizational modules helps an organization to flexibly tap new sources of knowledge. His statistical findings indeed show that weak inter-unit ties support the process of extracting useful knowledge from other organizational units. To this can be added that the autonomous and specialist character of modular components enhances the speed of problem solving. In this regard, Pil and Cohen (2006, p. 1001) state that "since each component or subsystem maintains a consistent functional focus, developers may acquire cumulative experience with certain kinds of problems faster. This enables them to search for and evaluate alternative solutions more quickly." From this following can be hypothesized:

H4. Modular organizing is positively related to organizational sensing.

2.4 Research model

The literature review has resulted in the research model presented below. The model presents modular organizing (MO) and organizational sensing (OS) as two important drivers of an organization's responsiveness (R). The model also sets out the dual role of modular organizing. Not only does it directly influence responsiveness, but it also has an indirect effect, as a facilitator of organizational sensing. Because of this connection modular organizing can be labeled as independent variable, organizational sensing as mediator variable, and responsiveness as dependent variable (Figure 1).

3. Method

3.1 Sampling and data collection

To test the research model a large-scale survey was conducted. More specifically, a questionnaire was distributed to a large sample population from the Netherlands armed forces. This group consisted of Majors, Lieutenant-Colonels, and Colonels from the three main services: army, navy, and air force. The sampling deliberately concentrated on the middle and higher officer echelons as the comprehensive research required respondents who had experience and knowledge of, missions abroad, but, quite emphatically, also had an insight into all kinds of strategic and organizational aspects of the Netherlands armed forces. The study's main concern was to gain an overall understanding of the way in which the variables modular organizing and organizational sensing supported the responsiveness of the Netherlands armed forces as a whole. Therefore, within the questionnaire the individual officers were explicitly asked to describe the armed forces collectively, despite their different service backgrounds.

The initial mailing consisted of 3,706 paper questionnaires sent to the officers' home addresses. Within five weeks a total of 1,533 persons filled out and returned the questionnaire by mail directly to the lead author of this paper. Because of this high volume of returns no reminders were sent to increase the response rate. The data set was cleaned up by leaving out any questionnaires with missing values on the model and control variables. Questionnaires from respondents without actual mission experience were also disregarded. Altogether, 1,208 usable questionnaires remained, leading to a response rate of 33 percent. An overall profile of the respondents is presented in Table I.

Possible differences between early and late respondents were examined. For this purpose, each questionnaire was coded with the number of the week in which the questionnaire had been returned. An independent sample t-test showed no significant differences between the groups 1 and 5 (for LC $t(435) = 0.944$, $p > 0.05$; for MO $t(435) = 0.843$, $p < 0.05$; for SF $t(435) = 0.673$, $p > 0.05$).

The sample was also tested for representativeness by examining the distribution of the respondents over service and rank. There was a slight over-representation of army respondents; therefore, an ANOVA-analysis was conducted to find out if significant

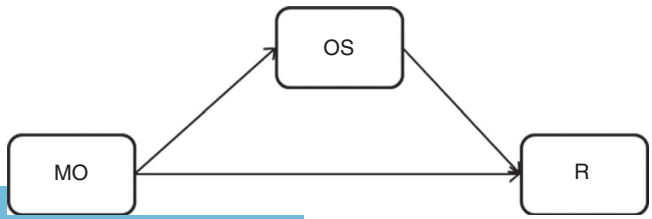


Figure 1.
Research model

Respondents	Number of operational deployments 1	2	3	4	5	(sub)total	
Army							
MAJOR	138	132	59	25	16	370	676
LTCOL	118	78	40	14	8	258	
COL	26	16	4	2	0	48	
Air force							
MAJOR	76	49	20	12	12	169	296
LTCOL	43	31	20	3	4	101	
COL	14	8	2	1	1	26	
Navy							
MAJOR	43	29	31	11	8	122	236
LTCOL	31	32	14	5	3	85	
COL	13	8	3	4	1	29	
Total	502	383	193	77	53	1,208	

Table I.
Research sample

differences occurred between these two categories on the model variables. This indeed proved to be the case. A *post hoc* analysis (Hochberg) made clear that the Navy respondents scored significantly lower on MO than the air force respondents. A second Hochberg analysis showed that Colonels scored significantly higher on all model variables then the Majors and Lieutenant-Colonels. Based on these results rank level and service background were included in the research as control variables.

3.2 Instrument and construct validation

Existing Likert-type scales were used to measure the variables organizational sensing and responsiveness. A new scale had to be developed to measure the variable modular organizing because no usable alternative was available (see Appendix for the measurement scales). Regarding the use of existing scales, a general point of concern was in how best to translate the individual scale items from a commercial business context into a military crisis response context. Some of these changes were relatively straightforward, such as substituting "team" for "unit." Others turned out to be more fundamental, however. To give an example, competitors, suppliers, and customers are unequivocal entities within the commercial business jargon. However, applying these terms in an international crisis response setting that is politically driven would undoubtedly lead to ambiguities of interpretation. To overcome this problem, experts with knowledge of both the business and military domains were consulted to help with the translation process. The resulting draft questionnaire was then discussed with a methodologist to get feedback on the nature of the questions and on wording issues. After amendments had been made the draft questionnaire was pre-tested within a small group of ten military experts, from different services and officer ranks. Based on their comments on wording, layout, and length, the questionnaire was adjusted to its final form.

To measure organizational sensing, Volberda's (1996) sensing scale was used. An exploratory factor analysis was conducted to validate Volberda's construct within a military crisis response setting. Because the sample size exceeds 250, a combination of the Kaiser criterion and the scree plot was used to determine how many factors to extract from the factor analysis (Field, 2005). The analysis resulted in the extraction of a single factor for measuring organizational sensing. The variable received a satisfactory Cronbach's α score of 0.74.

The variable responsiveness was measured by merging Volberda's (1996, 1998) scales of operational, structural, and strategic flexibility into one scale. After running a factor analysis, again using the Kaiser criterion in combination with the scree plot, a single factor was extracted. This scale received a Cronbach's α score of 0.70. Despite the fact that this result is sufficient from a statistical point of view, it is considerably lower than the alpha of Volberda's original scale. Translating the original scale items into a military crisis response setting has probably caused this deviation.

For measuring modular organizing a new scale was developed, building on earlier work of Sanchez and Mahoney (1996) and Worren *et al.* (2002). In short, their main assumption was that a modular organization is built upon an architectural system capable of recombining organizational elements into tailor-made configurations. In order to make this architectural system work, organizations need organizational and technological interoperability. Organizational interoperability means that by using standardized interfaces such as standardized rules, procedures, and programs a plug-and-play situation is created, in which organizational modules can be slotted together, removed, replaced, and reconnected fairly easily. This same principle applies to the organization's technological resource base. To reach the desired plug-and-play end state, it is equally important for an organization to have compatible technological means. Moreover, looking at the human aspects, a modular organization needs people with a broad operational knowledge base and a cooperative mindset to enable it to function properly within different operational contexts and in varying organizational constellations.

A scale of 14 items, covering these various areas, was developed to measure modular organizing. Analyzing the scree plot resulted in the extraction of a single factor. Four items had factor loadings below 0.40. For theoretical reasons, however, they were retained. To be precise, items 8 and 9 (see Appendix) had factor loadings of 0.31 and 0.35, respectively, but because they address the important aspect of organizational connectivity they had to remain part of the scale. Furthermore, items 1 (loading 0.36) and 3 (loading 0.37) were not dropped as they focus on the key issue of mixing and matching units into tailor-made organizational formations. Altogether the modular organizing scale received a Cronbach's α score of 0.70.

4. Analysis and results

A first concern was the occurrence of common method bias. Harman's one-factor test was conducted to investigate whether or not this phenomenon was present. The unrotated principal component factor analysis, principal component analysis with varimax rotation, and principal axis analysis with varimax rotation all revealed the presence of multiple factors. The first of these factors accounted for only 18 percent of the total variance. Thus no general factor became apparent, which seems to indicate that potential problems associated with common method bias have not negatively influenced the reliability of the research findings (Podsakoff *et al.*, 2003; Podsakoff and Organ, 1986).

Table II provides summary statistics and correlations for the model variables. The correlation values suggest that the model variables have a medium to large effect on one another. Table III presents the results of the hierarchical regression analysis, in which modular organizing and organizational sensing are entered in Model 2 as predictor variables of the organization's responsiveness. The results make clear that MO ($\beta = 0.32$) and OS ($\beta = 0.31$) significantly and equally contribute to R. Moreover, the adjusted R^2 of 0.29 indicates that the proportion of variance explained by just these two variables is quite considerable.

In general, the statistical outcomes corroborate earlier research findings on the crisis response performance of the Netherlands armed forces, indicating that intra- and inter-organizational task force structures have become a necessity for effectively dealing with the complexity of international crisis-response situations (De Waard *et al.*, 2012). Most missions seek resolution of a complex mix of military, diplomatic, economic, and humanitarian problems. Under such circumstances of causal ambiguity, no single actor can provide a complete solution. Progress can only be made by military and non-military partners working together, sharing their knowledge and generating new ideas. Working in different multinational, multi-service, multi-actor task forces has increased the armed forces organization's learning ability. Moreover, the cooperation that takes place among different individuals and organizational groups, over a long period of time and under extreme circumstances, deepens understanding of each other's ways of doing things. Not only is new knowledge acquired, but insights may be obtained that allow new knowledge to be translated into concrete, usable routines, and processes. New knowledge and insights can then be used to improve the tactics and techniques of a running mission as well as missions to come. On the whole, the strong influence of modular organizing and organizational sensing is based on the fact that they appear to reinforce each other. Essentially, a positive feedback loop develops where learning outcomes can be applied in new settings and constellations, leading to new insights that can be applied, and so on.

Although the reasoning above seems to confirm the proposed mediation effect of OS, it still needs to be statistically verified. There was a significant relationship between the independent variable MO and dependent variable R ($\beta = 0.46$, $p = 0.000$) that declined after controlling for the mediator OS ($\beta = 0.32$, $p = 0.000$). However, to

Table II.
Summary statistics and correlations

		N	Mean	SD	Min	Max	(1)	(2)	(3)
(1)	Modular organizing	1,208	3.51	0.36	1.86	4.64	–		
(2)	Organizational sensing	1,208	3.08	0.59	1.00	5.00	0.47**	–	
(3)	Responsiveness	1,208	3.43	0.38	1.62	4.54	0.46**	0.46**	–

Note: **Correlation significant at 0.01 level (two-tailed)

Table III.
Hierarchical regression of variables predicting organizational responsiveness (R)

	Model 1				Model 2			
	B	*SE B*	*β*	ΔR^2	*B*	*SE B*	*β*	ΔR^2
Constant	3.56	0.04			1.76	0.10		
Control variables								
Dummy Service 1	0.02	0.03	0.02		0.00	0.02	−0.00	
Dummy Service 2	−0.03	0.03	−0.03		−0.05	0.03	−0.06	
Dummy Rank 1	−0.16	0.04	−0.22***		−0.09	0.03	−0.12*	
Dummy Rank 2	−0.12	0.04	−0.15	0.02	−0.06	0.04	−0.08	
Predictor variables								
MO					0.33	0.03	0.32***	
OS					0.20	0.02	0.31***	0.28
df				1,203				1,201
Adjusted R^2				0.01				0.29

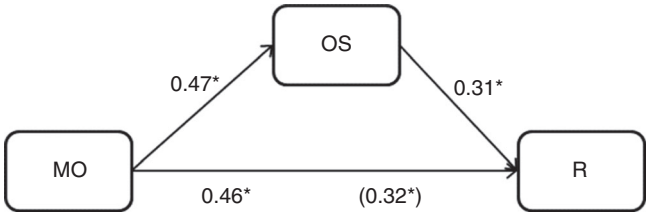
Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

confirm a significant decline of MO, a separate Sobel mediation test was done (Baron and Kenny, 1985). This indeed proved to be the case. Figure 2 schematically presents the outcome of these analyses.

The regression analysis also revealed a significant effect of dummy variable Rank 1. This specific control variable measures the difference in scores between the Colonels and the Majors. The negative result in model 2 of −0.12 means that the Majors assessed the Netherlands armed forces' responsiveness significantly less positive than the Colonels. The other control variable (service background) did not show any statistically significant differences between the three services, despite the earlier ANOVA-analysis indicating otherwise.

When concentrating on the divergent opinions of the Majors and Colonels a possible answer could be found in the level of operational experience that is presented in Table I. In this table can be seen that the Majors form a highly experienced group in comparison to the Colonels. What makes it even more interesting is that many of the critical notes, made in the open question at the end of the survey, mainly come from these highly experienced officers. The remarks made point in three directions.

A first group of 19 respondents argues that the Netherlands armed forces are too much swayed by the issues of the day that they do not really learn from past experiences. Several respondents have stated that the organization "keeps reinventing the wheel." A second group of 16 respondents addresses the issue of imperfect modularization. The open remarks refer to the organization's permanent structure not being attuned to its crisis response role. As mentioned previously, a tailor-made configuration is required for each mission. The process of mixing and matching that follows cuts through all kinds of existing hierarchical and functional boundaries. As a result, the tailor-made military formations that are deployed have to deal with the problem of organizational unfamiliarity. The fact that they are formed on an ad hoc project basis, for very specific operational assignments, leads to situations in which units and individuals have to work closely together, without actually knowing each other very well. Despite extra training programs these ad hoc units never reach the level of operational flexibility of regular units. A third, smaller, group of four respondents complains about the fact that in order to increase its responsiveness the



Notes: Standardized regression coefficients for the relationship between modular organizing and the Netherlands armed forces' responsiveness as mediated by organizational sensing.
The standardized regression coefficient between modular organizing and the Netherlands armed forces' responsiveness controlling for organizational sensing is in parentheses. *$p < 0.05$

Figure 2.
Research model outcome

Netherlands armed forces' strategic apex focusses too much on task generalization. Concrete examples that are mentioned vary from navy and air force personnel having to conduct infantry-like tasks to soldiers in general being deployed as surrogate aid workers or policemen.

In a more general sense these remarks show that affinity with either the operational or the organizational/strategic level determines the assessment of the organization's responsiveness. Majors, who have a strong connection with the organization's operational-level task execution, refer more strongly to the negative, practical consequences of certain strategic-level decisions. Colonels, on the contrary, act on a higher organizational level and thus have a better understanding of the complex mixture of factors influencing a strategic decision. They, probably, take for granted that perfect decisions do not exist and that tricky operational consequences are just part of the game. Their overall judgment primarily concentrates on a mission's overarching goal-setting, paying less attention to inherent practical drawbacks.

5. Discussion

Recapitulating, the study has uncovered that modular organizing and organizational sensing are reinforcing drivers of responsiveness. Yet, the study has also made clear that the question whether or not the interaction between these two drivers develops into a positive feedback loop depends greatly on the level modularization. On the one hand, the formation of consecutive multi-national, multi-service, multi-actor task forces is the key to continually renewing tactics and processes, as needed to deal with the complexity of today's military interventions. On the other hand, an imbalance between the parent structure and the modular component structures leads to a disproportionate internal orientation, because there has to be dealt with all sorts of unfamiliar task interdependencies between the participating organizational elements within such a customized task force.

The unpredictability of the current security environment makes it very difficult for the Netherlands armed forces to create fixed operational units within the parent organization that are by nature capable of covering the vast array of crisis response operations they might encounter. With their mixing and matching strategy of delivering customized solutions, the Netherlands armed forces seem to focus on achieving strategic and structural responsiveness. The resulting loss of operational responsiveness – due to the reconfiguration process that has to take place – is dealt with by spending extra time and energy on joint exercises and training programs. It is, however, questionable if this strategy is wise, because it, at least partly, conflicts with the alignment of operational, structural, and strategic responsiveness Volberda (1998) deems necessary. It is even more problematic, knowing that within the current complex security environment, which is dominated by non-traditional conflicts such as Guerrilla wars and insurgencies, organizational structure could be a significant contributor to the success of a military force deployed (Sinno, 2008). The crucial point here is that an organizational structure with inherent deficiencies, due to the process of mixing and matching unfamiliar units into tailor made organizational systems, will have a hard time coping with the resilient, fragmentized, and atomized structures of most of today's opponents.

5.1 Scholarly and managerial contributions

On a more abstract level, what is happening in a military crisis response setting strongly relates to the problem of ambidexterity discussed in recent strategic management literature (O'Reilly and Tushman, 2008). In short, ambidexterity means

two-headedness in the sense that organizations should combine their striving for search and exploration with safeguarding organizational stability and exploitation (Benner and Tushman, 2003; He and Wong, 2004; Holmqvist, 2004; Rivkin and Siggelkow, 2003; Tushman and O'Reilly, 1996). This paper makes clear that finding an appropriate balance between search and stability is a difficult struggle for the Netherlands armed forces. The struggle itself depends to a large extent on the underlying design choices of the organization's modular deployment philosophy. Deliberating on these choices and the consequences may be of value for other organizations as well.

In line with Volberda's flexibility framework, organization structure is seen as a sort of linking-pin between the two demands of organizational ambidexterity (Raisch and Birkinshaw, 2008; Chang and Hughes, 2012). Modularity has emerged as a contemporary design approach able to fulfill this role (Sanchez and Mahoney, 1996). Yet, available insights make clear that successful modular organizational systems largely thrive on the principles near-decomposability and loose-coupling (Schilling and Steensma, 2001). This is where the Netherlands armed forces encounter most problems because of the size of the organization. Important to know is that all western land forces are hierarchically divided into standard sub-units. In terms of Mintzberg (1983) the grouping of these organizations is divisional, which means that they are built up of a number of "smaller armies." These "smaller armies" come in different sizes. To be more precise, a military division consists of several brigades. Subsequently, a brigade can be sub-divided into battalions, and a battalion can be split up into companies. Yet, the smaller the unit becomes the smaller its maneuver, fire support, logistical support, and command elements will be. A brigade is perceived to be the smallest organizational building block that possesses a sufficient combination of functional elements to conduct military operations autonomously for a longer period of time. With this characteristic the army brigade complies with modularity theory's rule of near-decomposability, and is, therefore, pre-eminently fit for force tailoring (Bonin and Telford, 2004).

Yet, for smaller countries, such as the Netherlands, a brigade is a rather large organizational structure. To give an idea, the entire Netherlands Army consists of only three maneuver brigades. Deploying a single brigade for each crisis response operation would be an operational burden too heavy to carry for the organization. Therefore, the Netherlands Army has abandoned the brigade as its main deployment structure. When a crisis situation occurs, the different functional elements needed are picked from anywhere in the parent organization and merged into a temporary battalion-size task force. For performing their operational task these functional units (e.g. infantry, artillery, close air support, engineers) structurally dependent on one another, asking for tight instead of loose-coupling.

Because of this dilemma, a number of smaller countries have begun to deliberate on changing the structure of their permanent organizations. What many of these plans have in common is that they try to restore the structural balance between the parent organization and the building blocks that are to be deployed (Hutcheson, 2003; Ryan, 2003). Moreover, a precondition taken into account is that a certain level of mixing and matching will always be necessary to remain responsive to the unpredictable task environment. Opposed to the approach of the Netherlands armed forces, aimed at the maximization of strategic responsiveness by using the entire organization as a sort of giant toolbox, from which basically every unit can be used for the mixing and matching process; the new design solutions try to minimize the mixing and matching effort by creating basic structures within the permanent organization, based on past

experiences, that possess the most likely combination of functional elements needed. These basic structures can always be further customized with additional functionalities. In this case the primary focus seems to be the safeguarding of the organization's operational responsiveness, while keeping the loss of structural and strategic responsiveness within certain limits.

Other organizations that regularly participate in temporary inter-team project structures could probably learn from these insights. Some work already exists on modularity and the dynamics of recombining organizational units (Helfat and Eisenhardt, 2004; Karim, 2006). Yet, these contributions focus on the aggregation level of the business unit. Generally speaking, business units carry the overall responsibility over a single product-market combination. Because of this autonomous position, they are spared from all kinds of task related external interdependencies and, therefore, seem to comply with modularity's basic rules of near-decomposability and loose-coupling.

However, organizations increasingly rely on project-like temporary organizations to react quickly to changes in the environment (Kenis *et al.*, 2009). These intra- and inter-organizational cooperation structures are most of the times formed within the business unit level, directly addressing the competitive frontline. Van Heck and Vervest (2007) explain that a key characteristic of contemporary "smart business networks" is the ability to rapidly connect and disconnect members. They present modular design as the structural backbone of such networks. Regarding the relationship between network smartness and modularity they state: "A crucial decision is the degree of modularity or granularity of a system, or business network, and that is determined by the balance between coordination costs and the complexity of the network" (Van Heck and Vervest, 2007, p. 34).

The findings of this study strongly relate to this statement. They make clear that the Netherlands armed forces follow a strategy of fine-grained modularization, which makes it possible to form a wide range of different organizational constellations, maximizing strategic responsiveness. The flipside of this coin is that the level of operational responsiveness is compromised, because all kinds of extra coordination mechanisms are needed to transform the collection of functional elements into a well-working machine. One could say, in this specific case, that the smartness of the network is primarily directed inwards to deal with the complexity of the network itself, while this smartness should actually be mobilized to cope with the external environmental volatility. This is exactly why Sir General Rupert Smith has criticized western expectations of the new network-based military crisis response approach. Smith (2007, p. 411) warns of the potential risk "of knowing more and more about oneself and proportionally less and less about the enemy."

Having said this, what other organizations can learn from this military case is that the trade-off between strategic and operational responsiveness can be settled by developing a modular component structure that better complies with the principles near-decomposability and loose-coupling. This makes it easier to extract organizational elements from the parent organization and connect them to other network partners. As a result, organizations will become more responsive to network participation, because their average "plug-and-play" speed will increase. At the same time, network coordination requirements will decrease, which makes it easier to focus managerial attention on strategic responsiveness, rather than being busy with all kinds of internal adjustment problems.

The research findings can also be relevant for the public domain. For example, the increased focus of many western governments on homeland security and disaster relief

capabilities has stimulated tighter project-like cooperation between public services at the operational level (Denning, 2006). In case of a crisis situation most countries follow a standardized incident management approach, in which military, security, and emergency services all take part. The deployment of these organizations is strongly based on their hierarchical nested character. The fact that they are built upon standardized organizational elements, that use a common operating language and follow a similar command and control process, offers the potential to mix and match these operational structures into various constellation without jeopardizing operational effectiveness. Yet, this study shows that unit size is an important variable to take into account. The smaller a unit becomes the more it will depend on other organizational elements to fulfill its task. For a collaborative crisis response effort a combination of too many functionally dependent organizational elements can become problematic. In this respect the emergency response to the hurricane Katrina offers some useful insights. Majchrzak *et al.* (2007) explain that in the immediate aftermath of this disaster the formal response system failed, which had dramatic consequences. Referring to a government report they state: "Despite the existence of these formal plans, extensive training, and bureaucratic structures, when the authority structure breaks down, as occurred during Katrina, so do the formal plans." At the same time, they hail the US Coast Guard, as one of the few government agencies, for its responsiveness. The ability of the Coast Guard operational commanders to act relatively autonomously in the field is seen as the main reason.

Implicitly the Katrina study also addresses the advantages of near-decomposability and loose-coupling. It makes clear that a centralized complex network of interdependent organizations and organizational parts is vulnerable, since coordinating the activities of the different network members depends on a formalized command and control hierarchy. If somewhere in this hierarchical line nodes are missing, unavailable, unanticipated, or in conflict – typical conditions for an unpredictable crisis situation – the decision-making process can become seriously jeopardized. If, on the contrary, a network consists of largely independent organizational building blocks, decision making can be decentralized, which makes the network as a whole more resilient. It leads to a situation in which central command and its different network partners only discuss and decide on issues that concern the network as a whole. The vast majority of lower level decisions and coordination activities can be kept in the hands of the decentralized organizational parts, closest to where it all happens.

This is, basically, how the Coast Guard operated in the emergency network after Katrina had struck. Its relative independence offered the Coast Guard commanders the possibility to make their own decisions and to improvise. They, for example, accepted help from civilian boat operators to rescue people from the waterways. This had never been standard protocol in any emergency exercise, but turned out to be a very effective and efficient way of covering the vast crisis area.

The organizing dynamics discussed above have a strong relationship with earlier work of Siggelkow and Levinthal (2003). They argue that organizations capable of switching between a centralized and a decentralized structure are in a good position to deal with the ambidexterity dilemma. Interesting is their explanation that organizations should temporarily decentralize to react more decisively to fundamental environmental changes. However, after a phase of decentralization, the knowledge obtained should be reintegrated within the overarching organizational system. This requires a centralized structure, in which the parent organization takes up the role of central coordinator. Although these findings are based on computer simulations, they seem very appropriate

for emergency response organizations that, under normal conditions, are part of large formalized organizational systems (e.g. the police force, fire department, public health service). Only when a crisis occurs, members and units from these organizations are merged into temporary combined structures to deal with the situation. After the crisis the people return to their parent organizations and take up their normal jobs. Thus, alternate phases of centralization and decentralization are a fundamental routine for these sorts of organizations.

This study has taught that the level of modularization acts as a facilitator for the sequential phases of centralization and decentralization. If a parent organization consists of largely independent organizational structures, it becomes easier to integrally deploy these units without the continual exercise of central managerial authority. Moreover, after a deployment has taken place these units can easily be reconnected with the centralized parent organization, which will probably make it easier to systematically share useful operational experiences with partnering units as well. The Katrina study tells the same story, but from an opposite direction. The fine-grained modular organizational system of emergency response units was so complicated that a centralized command authority was needed to coordinate the crisis response effort to a very small detail. When this central hierarchy broke down, the overall system became disconnected and failed. Due to its relative independent position within the emergency network, the Coast Guard can be seen as a positive exception.

5.2 Future research

In general, this study points out that the level of modularization is strongly related to the level of organizational responsiveness. The findings indicate that fine-grained modularization leads to all kinds of task interdependencies. As a result, extra coordination is needed to integrate the different parts into one organizational system. This could ultimately lead to a predominantly internal focus. At the same time a wide range of studies point out that organizations cannot do without task interdependencies, because they are important for letting knowledge flow across organizational boundaries (Tsai, 2002; Cummings, 2004; Jansen *et al.*, 2005; Todorova and Durisin, 2007). That is why this study speaks of relatively autonomous organizational structures. The word "relative" points to the fact that a certain number of task-related interdependencies are necessary and will always exist.

This assumption relates to recent findings of Fang *et al.* (2010). They have found that a semi-isolated group structure with a moderate level of task interdependency performs better than nearly decomposed or fine-grained modular organizational structures that have either hardly any cross-group linkages or a large number of such linkages. An intriguing question that, however, remains is what does "semi" actually mean; or in other words, how many task interdependencies to actually allow? When posing these central questions more concrete, follow-up questions pop up immediately. To mention a few: can this number to some extent be quantified, or not at all? If so, should this number then be focussed on the network as a whole, or just on the individual organizations within the network?

Up till now studies, including this one, have remained vague about this important issue. Available insights paint a rough picture of an inverted u-shape, where too few as well as too many task interdependencies will have a negative impact on organizational responsiveness. Finding the bandwidth of task interdependencies that are beneficial to organizational performance may be a challenging future research project. Such practical information could really help managers to improve their organizations and

their network capabilities. Perhaps, linking modularity theory with actor-network theory could help to deliver more concrete answers on this complex matter.

Moreover, many of the studies available base their conclusions entirely on computer simulation models. Although their conclusions sound plausible, it would now be a useful exercise to verify the assumptions made in a variety of real-world empirical settings. Since this study focusses on a very specific organizational setting, it can only be seen as starting-point. It could well be the case that the questions posed above vary between, for example, different industries, sectors, regional areas, or even countries. Unraveling such differences could also be of real value for practitioners.

6. Conclusion

This paper has investigated to what extent modular organizing and organizational sensing stimulate the responsiveness of the Netherlands armed forces. Overall it could be stated that both predictors indeed play a supporting role. In combination they even seem to reinforce each other. To put it more clearly, working in different organizational constellations stimulates the development of a broad knowledge base from which the organization can draw useful insights. These insights can then be applied in new settings and organizational configuration, which again creates new knowledge that can be exploited; etc. The study has also revealed that the level of system decomposition is an important facilitator for this process. It has made clear that organizational systems made up of largely independent modules are more responsive than fine-grained organizational systems. The first reason for this is that autonomous organizational structures can be slotted together, removed, replaced, and reconnected fairly easily, which will increase an organization's "plug-and-play" speed. Second, responsiveness also increases because managerial attention does not leak away in dealing with all sorts of collaboration problems. Third, autonomous units are internally better attuned to deal with the dynamics of their immediate task environment.

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Appendix

Table AI.
Measurement scales

Modular organizing (MO)		
1	To execute crisis response operations the Netherlands armed forces merge units, parts of units, and individuals into tailor-made formations	$\alpha = 0.70$
2	The composition of Dutch crisis response formations depends primarily upon the task that has to be executed	
3	Dutch crisis response formations mostly participate in larger multinational task forces	
4	During crisis response operations the composition of a Dutch formation can be altered if the operational circumstances require this	
5	During crisis response operations standardized work processes, such as doctrines, SOP's, and drills make it possible to co-operate with units from other services and countries	
6	During crisis response operations our Dutch tailor-made formations rely on structured systems for planning and command and control	
7	During crisis response operations the division of work within our Dutch tailor-made formations is defined in detailed descriptions of jobs and tasks	
8	During crisis response operations everything in our Dutch tailor-made formations has been laid down in rules	
9	During crisis response operations consulting takes place between different organizational levels within the Netherlands armed forces	
10	Dutch servicemen and women master multiple tasks, SOP's, drills, skills, and techniques	
11	Dutch servicemen and women are up to date regarding technology and necessary know-how	
12	Dutch technological assets can be used for different types of missions and tasks	
13	The technological assets of the Netherlands armed forces are to a large extent compatible	
14	Dutch technological assets are to a large extent compatible with the equipment of partnering countries	

(*continued*)

Organizational sensing (OS)		
1	The Netherlands armed forces regularly analyze how partnering countries conduct crisis response operations	$\alpha = 0.74$
2	Armed forces from partnering countries have no major secrets for the Netherlands armed forces regarding their organizational strengths and weaknesses	
3	The Netherlands armed forces systematically keep track of technological developments that could influence operational tasks and performance	
4	The lessons learned during actual deployment are systematically being registered within the Netherlands armed forces	
5	The lessons learned during actual deployed are systematically being internalized by the Netherlands armed forces	
6	The Netherlands armed forces belong to the trendsetters in the international military sector	
Responsiveness (R)		
1	During crisis response operations our units can easily divide essential operational activities amongst each other	$\alpha = 0.70$
2	During crisis response operations our units can easily leave certain essential operational activities to units from other countries	
3	During crisis response operations our units can easily adjust to changing operational circumstances	
4	During crisis response operations our tailor-made formations possess a certain amount of slack that can be used to handle fluctuating operational demands	
5	Whatever service our units belong to, they co-operate easily with one another during crisis response operations	
6	During crisis response operations our units co-operate easily with units from other countries	
7	Our organization has the capacity to easily shift functions and tasks in case a crisis response operation requires this	
8	Our servicemen and women can easily take on alternative roles and tasks in case a crisis response operation requires this	
9	From its permanent structure our organization is capable of repetitively adjusting to changing mission contexts	
10	If needed our organization can add new types of missions to its existing operational product portfolio	
11	Our organization regularly implements new technologies	
12	Our organization is pro-active in seeking a fit between what it can offer and what our politicians are expecting	
13	Our organization tries to secure its added value by being capable of dealing with all kinds of crisis situations	

Table AI.

About the authors

Dr Erik de Waard is an Assistant Professor of Management and Organization Studies at the Netherlands Defence Academy. Strategic management, organization design, and project management are his key areas of interest. He has published on these topics in *Financial Accountability and Management*, *International Journal of Project Management*, *European Security*, *Journal of Management and Organization*, *Journal of Organization Design*, and in several books with publishers such as Routledge and Edward Elgar. Dr Erik de Waard is the corresponding author and can be contacted at: ej.d.waard.01@nlda.nl

Henk W. Volberda is a Professor of Strategic Management and Business Policy and Director Knowledge Transfer at the Rotterdam School of Management. His work on strategic renewal, coevolution of firms and industries, knowledge flows, new organizational forms, and innovation

has been published in various journals, such as *Academy of Management Journal*, *Business Strategy Review*, *Decision Support Systems*, *European Management Journal*, *European Management Review*, *Global Strategy Journal*, *Group & Organization Management*, *International Studies of Management & Organization*, *Journal of Management Studies*, *Long Range Planning, and Management Science*.

Joseph Soeters is a Professor of Management and Organization Studies at the Netherlands Defence Academy and the Tilburg University. He has published widely on issues of military management and multinational cooperation in both military-related and management journals, including more than ten books with publishers such as Routledge.