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Measuring Effectiveness of Teams and Multi-team Systems in Operation

Topic:

C2 Assessments Metrics and Tools

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Abstract

Military operations have evidently become more complex. The development toward multi-service, multi-national operations with teams often functioning in larger systems of teams is one of the complexities commanders have to deal with. Therefore commanders need not only to gain and maintain insight in the effectiveness of single teams but also in the performance of the multi-team system as a whole. The Command Team Effectiveness instrument is a diagnostic instrument for commanders to assess within team aspects, processes and effectiveness (Essens et al., 2005). We extended this instrument to include a module on multi-team system characteristics and cross team processes. Furthermore, we developed a simple support system for easy data collection, processing data, and reporting to improve the usability of the instrument in the operational context. The support system is currently being used in a Naval-Marines mission (Atalanta, 2009). We will discuss the strengths and limitations of using the support system for measurement of staff processes during operational missions.

Introduction

Business organizations and military organizations have made a transition from more individually-oriented structures towards more team-oriented structures. It is no longer the individual that is the most important for organizational performance but collectives of individuals are, i.e. the team. Research has focussed on the formation, development and effectiveness of teams (e.g. Salas, Sims, & Burke, 2005; Sundstrom, McIntyre, Halfhill, & Richards, 2000). Recently, new forms of collectives are being described: collectives of teams, so-called 'multi-team systems' (MTS) (DeChurch & Matthieu, 2008). MTS is defined as two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals. MTS boundaries are defined by virtue of the fact that all teams within the systems, while pursuing different proximal goals, share at least one common distal goal; and in so doing exhibit input, process, and outcome interdependence with at least one other team in the system (Mathieu, Marks, Zaccaro, 2001, p. 290). This tightly coupled collection of teams offers specialized skills and capabilities, and aims at achieving goals too large or complex

to be reached by a single team. MTS's are found in many settings where complex tasks require multiple teams and often diverse expertise (DeChurch & Marks, 2006).

Military staffs in their main role of supporting the commander's decision making processes are typically organized in a section structure with each section addressing a specific aspect of the operational mission. In the traditional structure, the staff is subdivided into separate sections for intelligence, current operations, future operations, personnel, logistics, and communications. The activities of the sections in the staff are tightly coupled in their common distal goal which is contributing to produce well-balanced options for actions within given time constraints. In this sense a staff operates as a multi-team system in a configuration of interdependent inter-team and intra team processes.

Measuring operational effectiveness[1] in military operational context (i.e. exercises, operations) has shown to be a difficult enterprise. Systematic assessment of the effectiveness of the operational processes is often felt by the participants to interfere with the operational focus, which is under time pressure to get the job done. Evaluations and after-action-reviews by commanders, responsible for their units effectiveness, often rely on general impressions and analysis of evident failures to address what should be improved. NATO HFM[2] Task Group-078 looked into a more systematic and well founded method that could support commanders to improve operational effectiveness. The Task Group developed a comprehensive model for Command Team Effectiveness (CTEF) and a corresponding instrument to measure team conditions, processes and outcomes (Essens et al., 2005). The CTEF model is based on an extensive literature review on team effectiveness and analysis of operational command teams. Examples of these teams are the Commander, Chief of Staff and Section heads in a staff, or the Commander and Sub-commanders. A subsequent NATO Task Group aimed to empirically verify the model and the instrument and reduce the items if possible. This was done with an international survey with military officers and with the application of

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[1] Operational effectiveness defined as the ability of an organization to align its resources and processes to achieve its strategies (cf. Porter, 1980).
[2] Task Group operating under the umbrella of the Human Factors and Medicine Panel of the NATO Research & Technology Organisation

CTEF in operational settings. The findings from the survey resulted in a condensed model and less sub-items in the questionnaire. To distinguish from the earlier model the new model is referred to as CTEF 2.0 if we specifically refer to the details of the model (Essens et al., in press).

In this paper, we will first briefly summarize the CTEF 2.0 model, and discuss some observations from the application of CTEF that led to the developments and data presented here. Next, we will present the additional module that includes the measurement of multi-team system characteristics and cross team processes. Furthermore, we will discuss the strengths and limitations of using the support system for measurement of staff processes during operational missions.

Within team aspects, processes and effectiveness

Increasingly, mission success will rely on how well commanders understand the strengths and weaknesses of their teams, and how well they can improve conditions and processes within the teams. Knowledge of the factors that affect the success of the teams will help to build effective command teams. For a team to be effective, commanders must have a clear understanding of: (a) the conditions they are working in, comprising the operational conditions and quality of available resources; (b) the task and team processes that are needed to perform the tasks, given those conditions; and (c) the intended (intermediate and end) outcomes, and (d) the criteria for evaluating the progress toward these outcomes. Effective commanders regularly review the task and team processes against intermediate outcomes, and adjust these processes, or even seek to adjust conditions, if possible. The CTEF model helps the commander to address the relevant factors in managing and improving effectiveness. The model will stimulate awareness of critical variables that may affect the team's effectiveness. CTEF 2.0 with its components and the top level aspects is shown in Figure 1. The model describes the critical factors for effective teamwork, and is subdivided in four mayor components: conditions, processes, outcomes and feedback (see Table 1). Now, we will give some examples of items within these four components. An item within the component condition, for example, is goal ambiguity. Unambiguous mission goals are assumed to have a positive influence on team performance because they give direction to prioritizing and fulfilment of tasks (Locke &

Latham, 2002). When the mission goals are not clear to the team members, in particular when goals are not stable, the commander has to pay extra attention to making the objectives clear to ensure that team members know what is expected from them. Another condition that is important for team effectiveness is, for example, the composition of the team. Diversity within the team can be beneficial for team performance as different expertises and point of view can be put forward. But when the difficulties of interacting effectively with dissimilar others are not managed well, no performance benefits can be expected (Tsui & O'Reily, 1989). An example of an item within the component processes is managing information. The degree to which the team effectively manages information flow within the team affects the team's ability to perform well (Cummings & Cross, 2003). So, when team members point out that managing information does not run well, the commander has to discover ways, together with the team, to improve this. An alternative process that has to be paid attention to is, for example, back-up behaviour. Team members have to support each other when necessary. Shifting tasks to team members who are less busy will improve the performance of the team. The CTEF-instrument also measures outcomes: task outcomes assess for example team members' perception whether the goals of the commander and of higher echelons are met. Team outcomes, on the other hand, are used to assess team members' perceptions whether for example trust between team members has been built up. The feedback items assess whether measures were taken to improve task and team processes.
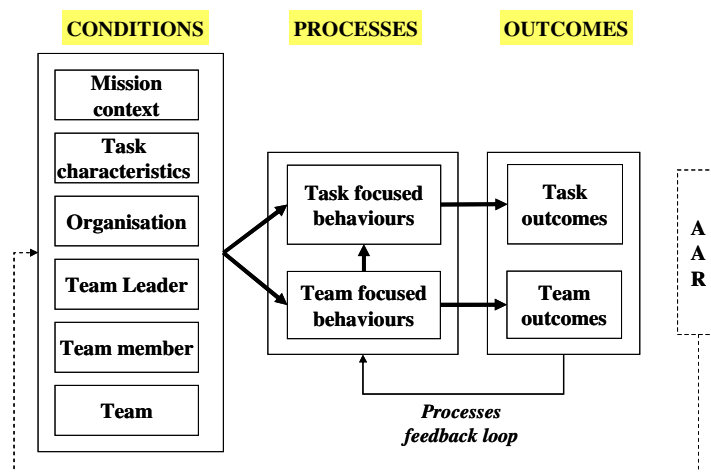

Figure 1. CTEF 2.0 model of team effectiveness components and aspect. (Essens, et al, in press)

Table 1. The set of items of the CTEF 2.0 model and instrument

CONDITIONS	
Mission Context	**Task Characteristics**
Situational uncertainty	Task complexity
Lack of goal stability	Workload
Organisation	**Team Leader**
Clarity of command structure	Team Leader competencies
Organisational support	Match of personal goals and organisational goals
Match of team's mission and organisational goal	
Team member	**Team**
Team member competencies	Mix of people
Match of personal goals and organisational goals	Team structure
	Team maturity
	Match of team goals and organisational goals

PROCESSES	
Task focused behaviours	**Team focused behaviours**
Managing information	Providing vision and intent
Decision Making	Collaborating between team members
Planning	Motivating
Executing plans	Monitoring team member's behaviours
Interacting with other command teams	Providing back-up
	Maintaining team cohesion

OUTCOMES	
Task Outcomes	**Team Outcomes**
Meeting the goals of the commander and higher echelons	Trust between team members
	Collective confidence in achieving goals
Staying within the limits and intentions of the mission	

FEEDBACK
Taking measures to improve task processes when needed
Taking measures to improve team processes when needed

Conclusions from CTEF applications

CTEF covers critical team characteristics and was intended to be used to address command teams, namely a commander plus his sub-commanders or section heads. However, when CTEF was applied for military (naval) staff assessment, the commander wanted to include all staff members who fulfil an operational role in the assessment as there are many ad hoc work teams in a staff that exist very short to address a particular issue, and some people belong to several teams. Therefore we gave feedback on the assessment to the staff as a whole. This may, however, have led to undervaluation of the contribution of the between-section interactions. One of the recommendations for the further development of CTEF was to include features of more complex organizations, where multiple interdependent component teams, sections, staffs, sometimes from different organizations work together to achieve common overarching goals. We

developed, based on multi-team and industrial/organizational literature, an additional module to include MTS characteristics and processes important for MTS effectiveness.

Multi-team system characteristics, cross team processes and effectiveness

MTS is a relatively new and emerging organizational form that poses new challenges for commanders. MTS is formally defined as "two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals" (Mathieu, Marks, & Zaccaro, 2001, p. 290). MTSs are found in many settings where complex tasks require multiple teams and often diverse expertise (DeChurch & Marks, 2006). The Netherlands Maritime Force (NLMARFOR), for example, can be seen as MTS. NLMARFOR is an operational staff (150 people) that leads operations of naval units and the Marine Corps. Depending on the mission, frigates, submarines, and helicopters can be added to the operation. The staff exists of experts from diverse backgrounds. Besides, military personnel from other branches of military services are placed in the staff, as are military personnel from other NATO-countries. NLMARFOR is in command of maritime operations all over the world. NLMARFOR can independently carry out operations, but can also be fitted in existing or to be formed ad hoc collaborations. So, NLMARFOR is a quick and all round 'instrument' to manage crises all over the world. The complexities of this MTS present challenges for the commander of NLMARFOR as he attempts to coordinate the efforts of multiple sections. We therefore developed a module (a questionnaire) that measures MTS characteristics and cross team processes. The items in the questionnaire measure staff members' *perceptions* of the status of these characteristics and processes. In this way the commander can use this instrument to assess the strengths and weaknesses in the MTS. These findings can than serve as a basis for discussions and improvements within the MTS. In the multi-team and industrial/organizational literature we found several factors that can be expected to influence the effectiveness of a multi team system. We will describe a number of these multi team system characteristic and cross team processes below. Although most of these characteristics and processes are also applicable to teams, these are far more complex in MTSs.

Leadership within MTS

Leadership in MTS contains the added complexity of requiring a dual focus on within-team and cross-team functions of leadership (Mathieu et al., 2001). Leaders within MTS have to direct the efforts of multiple teams simultaneously, working toward both proximal team goals and MTS goals. The leaders of the teams within the MTS have to exhibit the right expertise to match the work of team members within the team towards proximal team goals and at the same time monitor and maintain alignment of various teams to attain collective outcomes. In our questionnaire we have entered one item about leadership in MTS. For the complete set of items see Table 2.

Diversity within MTS

Diversity can be seen as 'every aspect in which people can differ'. One of the typologies of diversity makes a distinction between readily observable demographic attributes (ethnicity, age and gender) and non-observable, more job-related attributes such as education, technical skills, functional background, experience within the organization and personality (Jehn, Northcraft, & Neale, 1999; Milliken & Martins, 1996). Teams within an MTS will incorporate such differences in functional, educational, organizational and/or national backgrounds, which will have a effect on effectiveness. When examining the effects of diversity, it is important to make a distinction between objective (dis)similarities and perceived (dis)similarities. Research within the similarity/attraction perspective (Byrne, 1979) has shown that perceived (dis)similarities influence to a large degree the way people think about each other and the way they deal with each other. When people think they resemble one another, they feel more committed, they communicate more often, and like each other better then when they perceive large differences. In our questionnaire we have entered three items about perceived diversity in cultural background, organizational background, and areas of expertise.

Interdependency within MTS

Between teams that comprise an MTS several types of interdependency exist. DeChurch and Mathieu (2009) distinguish three forms of functional interdependence in an MTS: input, process and outcome interdependencies. Input interdependence in a staff refers to sharing of resources such as equipment, information, expertise. Process interdependency

is characteristic of a staff where parts of the plans are being developed by the different teams, but have to remain coordinated and aligned as much as possible. Boundary spanning activities have an important role to maintain the processes integrated. Outcomes refer to the objectives and values of the component teams and outcome interdependence reflects how the achievement of these outcomes are dependent on the goal accomplishments of other teams in the MTS. The degree and form of interdependency can be different for teams within the MTS. The more intensive the interdependency, the more important the inter-team coordination processes (i.e. alignment the sequencing and timing of interdependent actions among teams) will be (DeChurch & Marks, 2006). Every team within the MTS has its own team goals (proximal goals), but on a higher level these team goals come together to collective, distal, MTS goals (Bateman, O'Neill, & Kenworthy-U'ren, 2002). Conflicting goals and interests hinder effective decision making within MTS (Schaafstal, Johnston, & Oser, 2001). Besides, it is expected that when teams within a MTS focus on achieving the more global MTS goal, their own team processes and accomplishment of team goals have to be accommodated which may result in extra effort while their proximal goals are less well realized. In the same way when teams in the MTS keep focusing on team goals, MTS processes and distal goal achievement will decrease (Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005). In our questionnaire we have entered two items about mutual interdependency.

MTS structure

The structure of the MTS, defined as how tasks are assigned and how decision-making power is specified, can affect MTS effectiveness in the same manner as organizational structure impacts organizational effectiveness. Organizational structure is the formal system of tasks and authority relations regulating how organization members coordinate their actions and how resources are used to reach the organizational goals (Jones, 2004). Organizational structure can thus be seen as a set of decisions that are made regarding a range of organizational topics such as the amount of specialization in tasks, the amount of autonomy, the type of interdependencies, and mechanisms for coordination and integration. An appropriate MTS structure will support the coordination between the teams within the MTS. Therefore the tasks and responsibilities have to be assigned to the teams with the right expertise and team members have to be aware of the division of tasks

between teams. In addition, it must be clear for members of MTS who has the power to decide. In our questionnaire we have entered three items about MTS structure.

Table 2. The set of items of the MTS module

MTS CONDITIONS
It is clear which teams have to carry out which tasks
The tasks are assigned to the teams with the appropriate expertise
The chiefs of other teams have the right expertise to carry out their tasks
The members of other teams have the right expertise to carry out their tasks
Members of my team differ from other teams concerning organizational background
Members of my team differ from other teams concerning area of expertise
Members of my team differ from other teams concerning their cultural background
When working with other teams it is clear who has the power to decide
Between my team and other teams conflicting interests occur
My team is dependent on other teams when carrying out the tasks
MTS PROCESSES
Exchanging information between my team and other teams goes well
Within the staff decision making goes well
Within the staff planning processes goes well
Cooperation between my team and other teams goes well
OUTCOMES
Within the staff we have a collective confidence in achieving the goals
Members of different teams depend on each other

Note. All questions are rated on a five-point scale ranging from 'strongly disagree' to 'strongly agree'.

A simple support system

We developed a simple support system to increase the ease of administration and speed the reporting of results. The tool provides the commander pressure points and leads for improvement. The simple support system consists of a software tool that enables the commander to compose a questionnaire. The questionnaire comprises three options from which the commander can make a selection:

- Within team conditions and processes
- MTS conditions and processes
- Shared situational awareness (within team)

These components can be administered separately or combined. The commander then uses the tool to create digital questionnaires and sends them by e-mail to the teams' members. Then, the team members fill out the questionnaire and send it back to the commander. After that, the tool presents the results automatically in conveniently arranged tables (see Figure 2). The scores on the items are grouped to make visible positive and problematic topics. In this way, the commander gets a quick overview of (MTS) conditions and processes that require (more) attention.
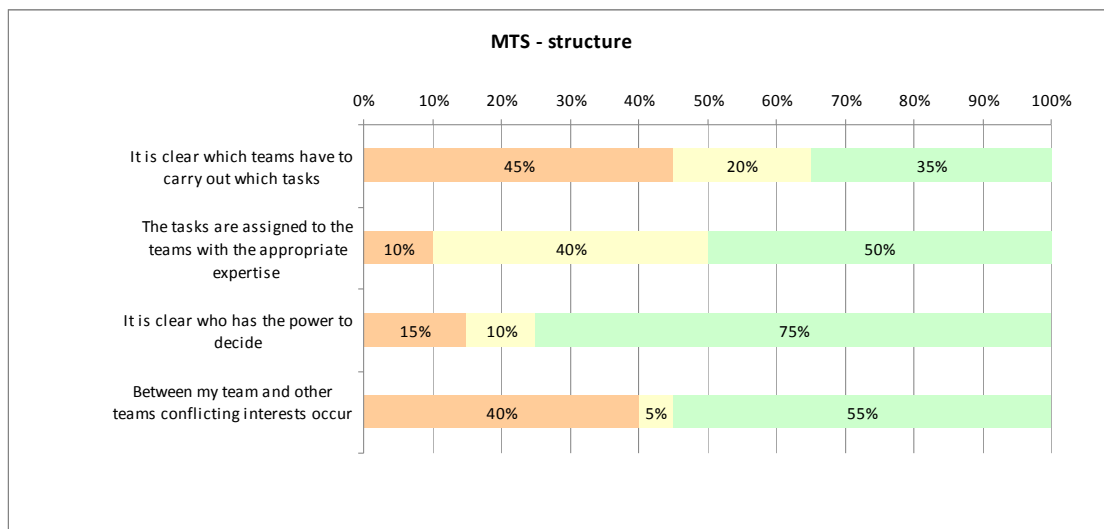

Figure 2. Illustration of feedback on the items

Application of CTEF 2.0 and MTS-module

The development of CTEF model and instrument and the MTS module is intended to bring a well-founded and systematic approach to assessment of operational teams. The primary purpose is to support commanders in their formal responsibility to create the conditions to realise effective operations. The instruments can be used by observers and evaluators to assess the command teams and staffs' effectiveness. This might be the best and most objective way to gather data, draw conclusions and give advice to the commander. For a whole staff this arrangement requires however a highly extensive effort. For more regular use of the assessment we assumed that the instruments should be self-supporting to have staffs assess themselves in a controlled way in order to identify and discuss the elements in their performance that could be improved. A problem may be that at the moment there are no objective norm-data against which to position your

performance. Currently, the emphasis is not to provide a definitive or final judgment on the team or staff, rather to sensitise the team to important issues and provide ways to improve the team. The approach is one of judgement of statements on a scale of 'strongly disagree'(1) to 'strongly agree' (5). One drawback of using a 5-point scale is that some respondents select the 'neither disagree/ neither agree' option routinely; they do not want to commit themselves to an answer. Not including a middle alternative forces respondents to give a clear answer, however, pushing people to express their opinion when they do not have one is to create false and unreliable answers (see Converse and Presser, 1986). Instead of a single commander making a judgement, the staff as a whole will provide their judgements. Problematic items are those in which a substantial number of staff indicates that a specific condition or process is negative. Opposite of this are the positive items which also should be identified, to motivate each other. What is a substantial number of staff? A simple criterion could be: if more than 30% of the staff members agree that a condition is poor or that a process is not working well, that item is flagged for discussion. However, the criterion is something the commander should think about and set his or her ambitions. For an item the negative answers may be few, but there may be too few positive answers with a lot of 'neutral' responses. For instance, the item asking whether the tasks are assigned to the teams with the appropriate expertise (see Figure 2) shows that only 50% of the respondents think that that statement is right. This should make alarm bells tinkle in the staff and discussion is required to understand what the problem is in order to improve that.

Using the assessment tool, the commander can systematically address the items and subsequently use these insights in the briefing (i.e. feedback session), together with the teams, to uncover and understand why these conditions and processes have these scores. In addition, they should decide what specific actions should be undertaken to improve the negatively scored condition or process to mitigate its negative effects on team effectiveness. For example, when leadership of the teams within the MTS is scored negatively, it can be decided during the briefing that hereafter the commander and his team leaders monitor and communicate needs of each team related to required interaction with other teams.

The instrument can be used at several stages in the team or staff development. Shortly after a staff is operational, application could be beneficial in alerting and informing the leaders about aspects of staff performance which might support (or be detrimental to) the staff's task. This would allow 'self regulation' of context, people and process aspects, at least to the extent that these are under the control of the staff. As the staff matures, it might be useful to do a status check to support internal or external adjustment for the sake of improved effectiveness. A readiness check on a 'mature' staff may provide a senior commander with understanding of likely team effectiveness when faced with an upcoming challenge. For example, if a provisional task force headquarters has been formed for particular contingencies, it might be appropriate to assess the staff readiness in parallel with assessments of subordinate units' readiness for deployment. A status check for an active staff in the midst of an ongoing task might provide useful feedback on ways to improve staff effectiveness. Utilisation of the instrument following completion of a mission could identify lessons helpful in the formation of a similar staff in the future. In general, the instrument may be used either to assess current status or readiness at virtually any stage in the life cycle of a team.

Application in operations

The CTEF 2.0 and MTS-module (the instruments) were applied during an International Operational Headquarters (IOH) exercise and during a recent anti-piracy international naval mission (Operation Atalanta). In the IOH exercise four staffs from different organisations were participating dispersed over different geographical locations. The questionnaires from the instruments were distributed by the Chief of Staff electronically to the staff with the request to participate in the assessment. These electronic copies would be send back by email and the results were analyzed in an excel file automatically, providing daily previews of the results. As a back up option we also used hard copy questionnaires to hand out. These results had to be entered into MS Excel manually. In the IOH exercise the commanders were only indirectly engaged in the assessment. Only via our interviews we could reflect on the results, and via reports that were send to the commanders after the exercise. The complexity of the staff arrangements and the limited involvement of the commanders (who focussed on achieving their task goals) did not

prove to be a good environment to make optimal use of the instruments. It is essential to have commanders in the loop to field these instruments.

Commander involvement was optimal in the Operation Atalanta, despite that is was a real operation. The commander was familiar with CTEF and planned to use the instruments to support to his goals of leading an effective staff. Here, also the questionnaires were distributed electronically. The staff was at that moment about three months in operation. It was an international staff from nine countries; size was about 25 specialists organised in specialist sections. The automatic tool generated the graphs as shown in Figure 2. The commander analysed the results in and discussed with us the conclusions he drew from the data. These were then discussed with the staff to identify opportunities to improve. From the data the commander concluded that: substantial effort should be spend on better exchanging of information and checking that information was understood; better balancing of involvement of the diverse expertise from the experts in the sections; better take differences in experiences and knowledge into account. An interesting observation is that the discussion of these staff and team items is not usual in international staffs, with nations having different staff cultures. The instruments started awareness in an objective way, in the sense that all staff members were able to speak out in anonymity. Comments on the instruments were also given. The instruments are effective in creating sensitivity to issues that mostly are not addressed in staffs. The staff and the commanders claimed that discussion about the functioning of the staff, not only on the task oriented issues but also on the team aspects, this is the collaboration between the sections i.c. specialists, provides a valuable instrument to see and improve their performance.

Further work

We consider this MTS module offering a promise in providing a diagnostic tool for improving the ability of military organizations to assess and improve the conditions and processes considered important for effective functioning of MTS. Further work, however, needs to be done to validate the instrument with a large representative sample.

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