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A framework for the study of organizational agility

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Abstract

Increasingly, the Canadian Forces (CF) and public safety organizations face the challenge to develop organizational structures and technologies that promote the agility required to deal with the complex demands of crisis management situations. The present document describes a framework for the study of agility, either at the organization or team level, which can be used as a foundation to guide research efforts on that topic. This framework was developed as part of the Tracking Agility and Self-Synchronization in Crisis Management (TASSCM) project conducted under the Research Partnership program between the Department of National Defence and the Natural Sciences and Engineering Research Council of Canada. The framework includes a task environment that allows developing complex and dynamic team-based scenarios, and a series of metrics to measure agility and relevant teamwork variables. To observe transitions between command and control (C2) approaches requires a functional simulation in which we can vary contextual and organizational characteristics to create various conditions where a transition from one C2 approach to another can arise, and observe the emergent behaviours displayed by participants. The task environment that seemed best suited to fulfill this mandate is the C^3Fire microworld platform, a forest firefighting simulation. In order to understand the ways in which teams or organizations achieve optimum performance through agility, the framework includes a series of metrics assessing various dimensions of teamwork such as the processes and behaviours within teams, overall performance, and the kinds of team decisions that these processes and behaviours lead to. This framework should help in guiding and supporting research efforts undertaken to further our understanding of organizational agility, which will allow enhancing education, training, and support systems to increase agility of CF teams.

Résumé

Les Forces canadiennes (FC) et les organisations de sécurité publique sont de plus en plus confrontées à l'élaboration de technologies et de structures organisationnelles favorisant l'agilité nécessaire pour gérer les exigences complexes de situations de gestion de crises. Le présent document décrit un cadre pour l'étude de l'agilité, au niveau de l'équipe ou de l'organisation, pouvant servir d'élément de base pour orienter les efforts de recherche en la matière. Ce cadre a été conçu durant le projet d'investigation de l'agilité et de l'auto-synchronisation en gestion de crises (TASSCM), dans le cadre du programme de partenariat de recherche du ministère de la Défense nationale et du Conseil de recherches en sciences naturelles et en génie du Canada. Le cadre comprend un environnement de simulation permettant l'élaboration de scénarios d'équipe dynamiques et complexes, de même qu'une série de paramètres pour mesurer l'agilité et les variables pertinentes en matière de travail d'équipe. Un simulateur fonctionnel, dont les caractéristiques organisationnelles et contextuelles sont modifiables, est nécessaire afin d'observer les comportements émergents des participants et les transitions entre les approches de commandement et contrôle (C2). Les caractéristiques variables de cet environnement de simulation permettent de créer diverses conditions pouvant mener à la transition d'une approche C2 vers une autre. Le micromonde C^3Fire, une simulation de lutte contre un incendie de forêt, semblait convenir le mieux pour remplir ce mandat. Afin de comprendre comment les équipes ou les organisations obtiennent un rendement optimal avec l'agilité, le cadre comporte une série de paramètres évaluant diverses dimensions du travail d'équipe telles que les processus et les comportements au sein des équipes, le rendement global, ainsi que les types de décisions d'équipe auxquels mènent ces processus et comportements. Ce cadre devrait aider à orienter et appuyer les efforts de recherche entrepris afin de mieux comprendre l'agilité organisationnelle, permettant ainsi d'améliorer l'instruction et l'entraînement, en plus de soutenir les systèmes pour accroître l'agilité des équipes des FC.

Executive summary

A framework for the study of organizational agility

Marie-Eve Jobidon; DRDC Toronto TM 2012-109; Defence R&D Canada – Toronto; February 2013.

Introduction: Increasingly, the Canadian Forces (CF) and public safety organizations face the challenge to develop organizational structures and technologies that promote the agility required to deal with the complex demands brought on by asymmetric warfare, crisis management situations, as well as national and international joint operations. Organizational agility can be used to set the conditions for effective and efficient services by adopting situation-tailored command and control (C2) approaches (Farrell & Connell, 2010).

The present document describes a framework for the study of agility, which can be used as a foundation to guide research efforts on that topic either at the team or organization level. This framework was developed as part of the Tracking Agility and Self-Synchronization in Crisis Management (TASSCM) project conducted under the Research Partnership program between the Department of National Defence (DND) and the Natural Sciences and Engineering Research Council of Canada (NSERC).

Method: The framework includes a task environment that allows developing complex and dynamic team-based scenarios, and a series of metrics to measure agility and relevant teamwork variables. To observe transitions between C2 approaches requires a functional simulation in which we can vary contextual and organizational characteristics to create various conditions where a transition from one C2 approach to another can arise, and observe the emergent behaviours displayed by participants. The task environment that seemed best suited to fulfill this mandate is the C^3Fire microworld platform, a forest firefighting simulation.

In order to understand the ways in which teams or organizations achieve optimum performance through agility, the framework includes a series of metrics assessing various dimensions of teamwork such as the processes and behaviours within teams, overall performance, and the kinds of team decisions that these processes and behaviours lead to. It is important to note that the framework is flexible. For instance, some metrics could be removed while other relevant metrics could be added to ensure that meaningful data is collected and that participants remain engaged.

Significance: Team research is labour-intensive and time-consuming in preparation, running, and analyses. However, teamwork is one of the linchpins of CF operations and it is important to conduct studies in team settings on various topics or issues that can significantly impact mission effectiveness. One of the benefits of studies conducted

within this framework is that they will provide a very rich data set that can be mined beyond the original research questions.

Organizational agility is a complex phenomenon that is required especially in complex situations, with a number of influencing and interconnected actors and variables. This framework should help in guiding and supporting research efforts undertaken to further our understanding of organizational agility, which will allow enhancing education, training, and support systems to increase agility of CF teams.

Sommaire

A framework for the study of organizational agility

Marie-Eve Jobidon ; DRDC Toronto TM 2012-109 ; R & D pour la défense Canada – Toronto; février 2013.

Introduction : Les Forces canadiennes (FC) et les organisations de sécurité publique sont de plus en plus confrontées à l'élaboration de technologies et de structures organisationnelles favorisant l'agilité nécessaire pour gérer les exigences complexes générées par la guerre asymétrique, les situations de gestion de crises et les opérations interarmées nationales et internationales. L'agilité organisationnelle permet d'établir les conditions pour obtenir des services efficaces en adoptant des approches de commandement et de contrôle (C2) sur mesure (Farrell & Connell, 2010).

Le présent document décrit un cadre pour l'étude de l'agilité pouvant servir d'élément de base pour orienter les efforts de recherche en la matière au niveau de l'équipe ou de l'organisation. Ce cadre a été conçu durant le projet d'investigation de l'agilité et de l'auto-synchronisation en gestion de crises (TASSCM), dans le cadre du programme de partenariat de recherche entre le ministère de la Défense nationale et le Conseil de recherches en sciences naturelles et en génie du Canada.

Méthode : Le cadre comprend un environnement de simulation permettant l'élaboration de scénarios d'équipe dynamiques et complexes, de même qu'une série de paramètres pour mesurer l'agilité et les variables pertinentes en matière de travail d'équipe. Un simulateur fonctionnel, dont les caractéristiques organisationnelles et contextuelles sont modifiables, est nécessaire afin d'observer les comportements émergents des participants et les transitions entre les approches C2. Les caractéristiques variables de cet environnement de simulation permettent de créer diverses conditions pouvant mener à la transition d'une approche C2 vers une autre. Le micromonde C^3Fire, une simulation de lutte contre un incendie de forêt, semblait convenir le mieux pour remplir ce mandat.

Afin de comprendre comment les équipes ou les organisations obtiennent un rendement optimal avec l'agilité, le cadre comporte une série de paramètres évaluant diverses dimensions du travail d'équipe telles que les processus et les comportements au sein des équipes, le rendement global, ainsi que les types de décisions d'équipe auxquels mènent ces processus et comportements. Il importe de souligner que le cadre est flexible. Par exemple, certains paramètres pourraient être supprimés alors que d'autres, plus pertinents, pourraient être ajoutés afin d'assurer la collecte de données utiles et l'engagement continu des participants.

Importance : La recherche sur les équipes demande beaucoup de temps et d'efforts pour la préparation, l'exécution et l'analyse. Or, puisque le travail d'équipe est l'un des éléments essentiels des opérations des FC, il est important de mener des études sur les équipes sur divers sujets ou problèmes pouvant avoir des répercussions importantes sur l'efficacité d'une mission. Les études menées à l'intérieur de ce cadre ont l'avantage de fournir de riches ensembles de données permettant d'aller au-delà des questions de recherche initiales.

L’agilité organisationnelle représente un phénomène complexe nécessaire surtout dans les situations complexes. Elle comporte plusieurs acteurs et variables d’acteurs et de variables ayant une influence ou qui sont interreliés. Ce cadre devrait aider à orienter et appuyer les efforts de recherche entrepris afin de mieux comprendre l’agilité organisationnelle, permettant ainsi d’améliorer l’instruction et l’entraînement, en plus de soutenir les systèmes pour accroître l’agilité des équipes des FC.

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1 Introduction

Agility can be conceptualized at a number of different levels; for instance at the team, organizational, or enterprise (group of organizations) level. The Canadian Forces (CF) and public safety organizations face the challenge to develop organizational structures, processes, and technologies that promote the agility required to deal with the complex demands of crisis management situations. Organizational agility can be used to set the conditions for effective and efficient services by adopting situation-tailored command and control (C2) approaches (Farrell & Connell, 2010).

Part of the Tracking Agility and Self-Synchronization in Crisis Management (TASSCM) project focuses on the study of agility, and will contribute to the validation of the assumptions and concepts hypothesized in the C2 Agility model (Farrell, 2011; Farrell & Connell, 2010; Farrell, Jobidon, & Banbury, 2012), which models agility at the enterprise level (although the concepts could be applicable not only between organisations but also within a single organization or single team). TASSCM has been developed under the Research Partnership program between the Department of National Defence (DND) and the Natural Sciences and Engineering Research Council of Canada (NSERC).

NATO Research Task Group (RTG) SAS-065 (2010) has conceptualized and identified five distinct C2 approaches, namely: conflicted, de-conflicted, coordinated, collaborative, and edge. In complex operations, a C2 approach is adopted by a group of organizations or entities, which together form a collective, in order to achieve the operational goals. Transitioning from one of these approaches to another – as required by situation complexity – has been defined as C2 agility (Farrell & Connell, 2010; SAS-085, 2011). The C2 approach space has three primary dimensions (SAS-065, 2010): allocation of decision rights (ADR), distribution of information (DI), and patterns of interaction (PI). ADR is the formal and informal distribution of authorizations to undertake decisions to the entities part of the collective, DI refers to information sharing amongst the entities, and PI refers to the possible interaction configurations between members of the collective. These three dimensions define the C2 approach space.

Transitioning between C2 approaches (see Farrell, 2011; Farrell et al., 2012) takes time. There can be enablers and inhibitors to this change, which will speed up or slow down the "organizational momentum" as the collective moves within the C2 approach space. Transitioning from de-conflicted C2 to coordinated C2 should theoretically be shorter than going from de-conflicted C2 to edge C2 for a given set of enablers and inhibitors. Borrowing an analogy from mechanical engineering of a mass-damper-spring system, the following parameters of the collective govern the transition dynamics; that is, the time it takes to transition and the distance between different C2 approaches (Farrell, 2011; Farrell & Connell, 2010):

1) Collective *size* (e.g., people, budget, infrastructure, equipment, resources);
2) Collective *resistance* (e.g., system attributes that restrain the collective from changing C2 approaches such as lack of trust, malfunctioning technology, or antagonistic entity);
3) Collective *stiffness* (i.e., a characteristic related to the increase in discomfort as the collective moves further away from its most comfortable C2 approach).

The C2 Agility model includes certain assumptions relating to the parameters described above. For instance, according to the model (Farrell et al., 2012), as the collective's size gets smaller, it would respond faster with a smaller overshoot and it would be able to keep up with quick changes. Conversely, as the collective's size gets larger, it would be slower to respond.

With regards to resistance, the C2 Agility model predicts that an enabling entity within the collective might facilitate moving from one C2 approach to another by promoting the appropriate levels of ADR, PI, and DI, while an antagonistic entity may inhibit movement towards another C2 approach.

Stiffness refers to the extent to which the collective is comfortable with a certain C2 approach. If the collective finds itself in the region of the C2 approach space that they are comfortable with, there is no inclination to move from this position. If the collective adopts an approach with which they are unfamiliar, there will be a tendency (i.e., a pull) to move back towards the comfortable approach. This causes tension within the collective and may affect the responsiveness of the transition.

Another assumption of the model is that the collective will be most efficient and effective when the C2 approach matches the level of complexity. That is, the model posits that while there is a cost for moving to one approach to another, a cost also comes with the collective operating at a different level than required. Therefore, the C2 approach adopted should match the required approach for optimal effectiveness and efficiency.

The purpose of this document is to present a framework for the study of agility, either at the organization or team level. We describe a methodology and metrics that can be used as a foundation to guide research efforts on that topic, whether these efforts aim to validate models of agility or investigate solutions to problems related to agility in organizations or teams.

2 Method

2.1 Participants

Conducting studies on organizational agility – i.e., agility within an organization or a collective – can be cost prohibitive and logistically very challenging. Given that models such as the C2 Agility model (Farrell, 2011) are scalable, it is possible to use small teams (four to eight people). For instance, if access to a university lab is possible, small teams of students could be recruited. As team tasks lead to more variability in the data than individual tasks, it is important to have an adequate number of teams per condition for sufficient statistical power (e.g., 15 to 20 teams per condition). Participants can have the possibility to enrol in the experiment alone or to enrol as a team. However, the experimenters should keep track of the extent to which team members know one another for analyses purposes, and control for it if possible. Previous personal knowledge of team members can affect team-related metrics such as trust. Unaccompanied participants can be matched with other participants by the experimenter.

2.2 Task environment

In order to test the transitioning from one approach to another, as required by the situation's complexity, a microworld (also referred to as a functional simulation or a synthetic environment) with the capability to develop team-based scenarios and support teamwork is required. Also, process and performance measures should be captured in a real-time experimental situation involving different types of intra-organizational interactions. The 'Cognitive Network Tracing' (Banbury & Howes, 2001) approach allows researchers to assess the teamwork processes employed by teams as they are trying to achieve goals within the simulation[1]. Unlike 'output' and 'subjective quality' based measures, Cognitive Network Tracing can be used to provide a fine-grained indication of the processes and communications between team members. The recent work of Cooke and Gorman (2009) proposed an interactionist approach to the assessment of team performance that capitalizes on variability in cognition and behaviour distributed across time, people and the environment. This approach involves the deliberate propagation of scenario events, or 'seeds', in the collaborative simulation environment and the subsequent observation of their trajectory throughout the team (Banbury & Howes, 2001). Clearly, the information seeds must be both critical enough to demand action by team members, and salient enough for the experimenter to observe their subsequent effect on team members' behaviour.

The functional simulation that seems best suited to fulfill this mandate is the C^3Fire microworld platform (Granlund, 1998, 2003; Granlund & Granlund, 2011). C^3Fire is a command, control and communications (C3) simulation environment for teamwork using forest firefighting mission scenarios. The goal is to extinguish as much of the fire as possible while saving houses and inhabitants of neighbourhoods spread on the map (see Figure 1). The fire model in the simulation

[1] A distinction can be made between teamwork and taskwork. Taskwork refers to team behaviours that are related to the specific tasks that a team needs to accomplish, while teamwork refers to behaviours that team members adopt in order to coordinate and support each other in their tasks, such as coordination and information sharing (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995).

is based upon research on actual forest fires and the C3 context is based on case studies of emergency coordination centres (Brehmer, 2004). For these reasons, the ecological validity of the simulation is very high. C^3Fire has been widely used for research and training purposes in a range of work domains such as emergency response, Air Force, homeland security, and healthcare. The scenario building capability of C^3Fire makes it possible for researchers to simulate characteristics of real world crisis management environments (complex, dynamic, and opaque) and is well-established for being very engaging for participants and highly tractable from the experimenter's perspective (see Gray, 2002). C^3Fire involves time pressure, uncertainty, and teamwork – three key considerations for crisis management teams and the study of agility. Like real-life crisis management situations, the simulated task requires dynamic team decision making and involves regulating a dynamic system in which: (i) a series of activities are required to reach and maintain the overall goal, (ii) activities depend on the outcome of previous activities, (iii) task parameters are continuously varying in response to changes, and (iv) tasks are accomplished in real time. Various team sizes and team structures can be designed in C^3Fire by assigning the control of various unit types to different participants and by providing different information sources to participants, thus giving them one or many roles to accomplish. Depending on the role/unit allocation, team members may be relatively independent or may need to exchange information or resources with others (Lafond, Tremblay, Dubé, Rousseau, & Breton, 2010).

The C^3Fire interface (see Figure 1) consists of a geospatial map, displayed on a cell grid built up by a set of four interacting simulation layers. The *fire layer* defines four different states for each cell of the map, represented by a colour code: on fire (red), extinguished (brown), burned-out (brown), or clear (no colour). The *geographical objects layer* corresponds to the different types of physical entities displayed on the map (plain, pine, birch, or house). The content of a cell directly influences its ignition time. The *weather layer* determines the strength and direction of the wind. The stronger the wind, the faster the fire spreads to neighbouring cells. Finally, the *unit layer* refers to the intervention units (i.e., the resources) that the participants control. There are six types of units in C^3Fire: firefighters (FF), fire breakers (FB), water tankers (WT), fuel tankers (FT), search units (S), and rescue units (R), each represented by a numbered icon colour-coded by type of unit. Each type of unit has a specific role: FF extinguish fires by moving to a burning cell; FB create firebreaks to control the spread of fire; FT and WT supply water and fuel, respectively, to the other units; S explore the map in order to find new fires and survivors; and R collect the survivors and bring them to a safe transit point.

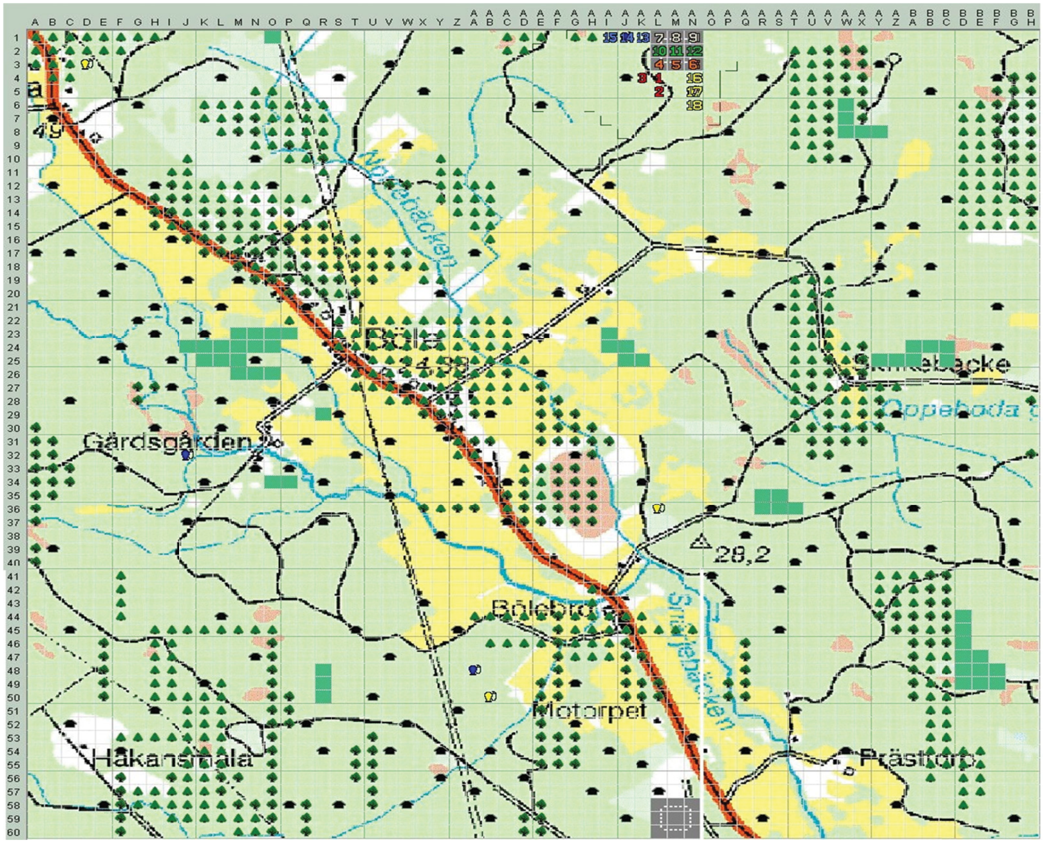

Figure 1. An image of the C³Fire.

C³Fire allows the replaying of completed scenarios to enable the observation of the participants' actions in the context that they occurred. The participants can be filmed while the simulation runs, making it possible to analyze coordination and communication between team members. The C³Fire program also creates a detailed log of the events that occur over the course of the scenario (state of units and cells over time).

2.3 Metrics

In the ever increasingly dynamic, complex and information rich environment of joint operations, crisis management and integrated C2, the need to augment human performance at the individual and team levels is growing ever more important. One key challenge is to develop the capability to assess the effectiveness of education, training, and support systems in improving teamwork and operational performance. Such a capability would require measurement methodologies that capitalize on variability in cognition and behaviour distributed across people and the environment. It is essential that metrics be not only reliable and conceptually valid but also unobtrusive and capable of providing objective, predictive, and diagnostic information.

Several metrics can be used to assess how teams respond to changes in resistance and situation complexity and how they adjust their C2 approach, as well as the impact on team performance and teamwork (see Figure 2). This section describes some of these metrics but does not constitute an exhaustive list of all the metrics that can be analyzed.

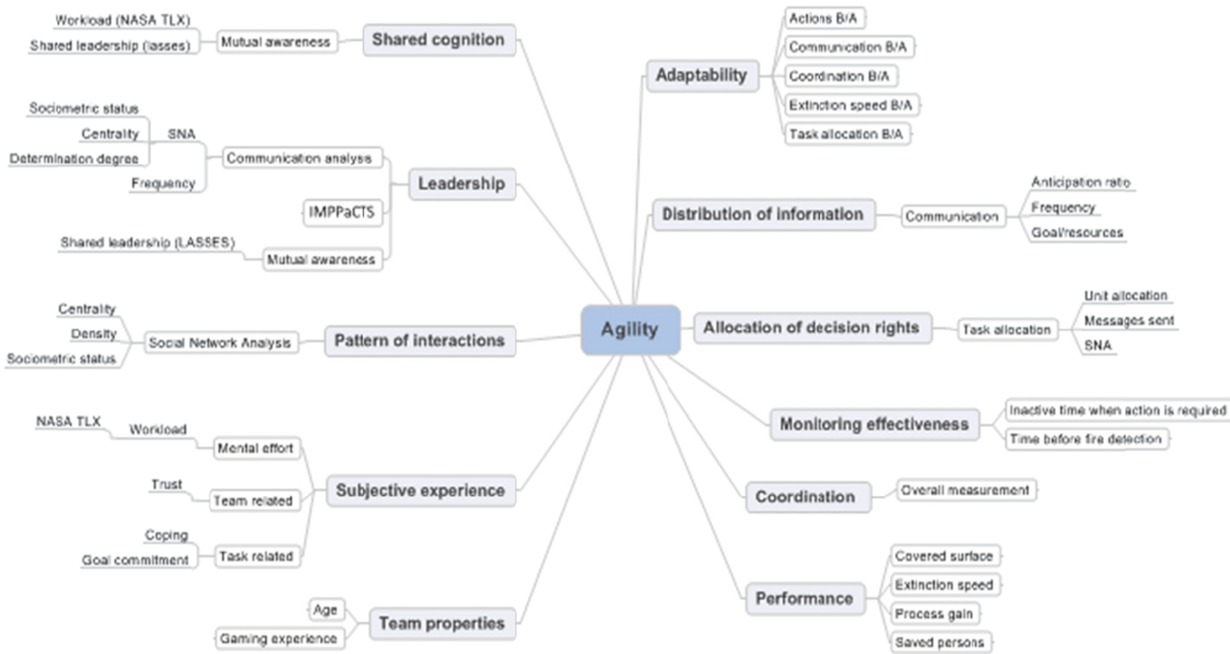

Figure 2. Mind map of the various concepts related to agility and metrics associated with each concept.

2.3.1 C2 approach transitions

To assess transitions from one C2 approach to another, it is possible to analyse measures such as the time teams take to adapt their C2 structure to changes in situation complexity, particularly the rise time and settling time. The rise time (t_r) refers to the time elapsed between the moment complexity changes (e.g., the occurrence of a second fire) and the moment a team reaches the C2 approach required to deal with that level of complexity. The clock begins when situation complexity changes. Post-hoc analyses can assess when the team has reached the appropriate C2 approach based on how they were trained. Settling time (t_s) refers to the point when a team or organization “settles” in their C2 approach; that is, when the indicators related to the C2 approach adopted stabilize. It should be noted that this metric can be more difficult to observe, especially if the scenarios do not provide enough time to teams to settle in a C2 approach before the next cycle of complexity starts.

2.3.2 Performance

In C^3Fire, team performance can be defined by the team’s success in managing both the defensive and the offensive aspects of the task, namely protecting the houses from the fire and putting out as many fire cells as possible. Therefore, this measure takes into account all the objectives pursued by the participants and reflects team responsiveness.

In order to get an accurate portrait of team performance, the results observed on each sub-objective of the mission in C^3Fire can be compared to the “worst case” scenario; that is, the state of the situation (e.g., number of burnt-out cells and houses, number of victims) at the end of the scenario if no actions were taken. This requires running the simulation without any intervention in order to quantify what would be the extent of the loss after the scenario has run its course. This “worst-case scenario” is used as a baseline against which team processes and performance variables are measured (see Lafond, Jobidon, Aubé, & Tremblay, 2011) and provides contextualized measures that allow normalizing comparisons between conditions.

For each team, a ratio of the worst-case scenario and the actual team performance is calculated and serves as a quantitative measure of crisis management efficiency. This measure includes the number of extinguished cells as well as the proportion of saved houses. The formula used to calculate global performance is:

$$\text{Performance} = \left(\frac{\text{Number of houses saved}}{\text{Number of houses left*}} \right) \times \text{Number of cells extinguished}$$

* When a scenario is run without human intervention.

2.3.3 Communication

An analysis of team communication provides a window through which to view team cognition (see, e.g., Bowers, Jentsch, Salas, & Braun, 1998; Cooke & Gorman, 2009; Paley, Linegang, & Morley, 2002). One measure derived from communications that can be associated with team processes is frequency. Communication frequency refers to the total number of messages sent by each team member to his/her teammates. Analyses based on the frequency of communications can be used to infer role-specific workload related to information sharing (e.g., Lafond et al., 2010). However, analysing communication frequency yields limited information as it has been shown to be both positively (e.g., Brannick, Roach, & Salas, 1993; Sexton & Helmreich, 1999) and negatively (e.g., Cannon-Bowers, Salas, Blickensderfer, & Bowers, 1998; Svensson, 2002) correlated with team performance. Beyond frequency, communications can be categorized into different communication topics in order to evaluate whether they are related to goal-oriented coordination or to resource-oriented coordination.

The anticipation ratio is a measure of communication efficiency that is associated with effective team performance for a variety of different types of teams (Entin & Entin, 2000; Entin, Entin, & Serfaty, 2000). This measure corresponds to the ratio of the number of communications transferring information to the number of communications requesting information.

By analysing the communication logs, information flow within the team environment can also be evaluated objectively. Aspects of the information flow that can be assessed include: to which team members and in what order; how long it takes for the communication to get to other team members; and whether the information content is maintained correctly. These data can then be subjected to Social Network Analysis.

Social Network Analysis (SNA) provides both visual and mathematical representations of the relationships between team members, and tracks the evolution of the team's structure over the course of a scenario. SNA can be used as an indicator of the level of ADR, PI, and DI, and help in determining the C2 approach used at a given time. Decision rights can be mapped to the social network metric called 'sociometric status' that measures of 'how busy' a node (i.e., a team member) is relative to the overall number of nodes in the network. Patterns of interaction can be mapped to the social network metric 'centrality' that measures the distribution of information (or power) within the team. Finally, distribution of information can be mapped to the social network metric 'density' that refers to the degree of connectedness of a network; that is, it shows if a network is dense in connections or scarce (Benta, 2005).

2.3.4 Questionnaires

2.3.4.1 Goal commitment

This questionnaire measures the degree of team investment in achieving their goals (Aubé & Rousseau, 2005; Klein, Wesson, Hollenbeck, Wright, & DeShon, 2001). Participants have to rate seven items linked to a five-point scale ranging from *totally false* (1) to *absolutely true* (5). In team settings, team goal commitment means that team members feel an attachment to the team goals and that they are determined to reach these goals (Weldon & Weingart, 1993). Studies show that team goals are directly related to team performance (for a review see Rousseau, Aubé, & Savoie, 2006).

2.3.4.2 Trust

Trust has long been argued to be of critical importance within teams. Trust becomes especially critical in situations requiring interdependence with others, as well as those involving perceived risk, vulnerability, and uncertainty (Costa, Roe, & Tailleau, 2001; Rousseau, Sitkin, Burt, & Camerer, 1998). A questionnaire has been developed based on existing trust scales (e.g., Blais & Thompson, 2009) and adapted for the C^3Fire environment.

2.3.4.3 NASA-Task Load Index (NASA-TLX)

Workload is a critical element affecting human performance and is variable over the course of a situation or mission. The NASA-TLX is a subjective measure of the participants' level of mental workload during a task performance (Hart & Staveland, 1988). It comprises the following subscales: 1) mental demand, 2) physical demand, 3) temporal demand, 4) effort, 5) performance, and 6) frustration. Participants are asked to rate the level of workload on each subscale using a scale ranging from 1 (low) to 10 (high). Two particularly relevant subscales for this framework are the mental demand and temporal demand subscales. It can be very informative to ask participants to rate their own level of workload on each subscale, as well as for each of their teammates. This will provide a measure of a participant's own workload as well as their perception of their teammates' workload.

2.3.4.4 Coping style

Stress can have harmful effects on team processes and performance. Individuals usually respond to challenges with problem-solving coping strategies and to hindrances with avoidant coping strategies (LePine, Podsakoff, & LePine, 2005). While coping originates in individual team member behaviour, the construct follows a composition model of emergence (see Kozlowski & Klein, 2000). By interacting with teammates and monitoring their activities, team members' behaviours converge and a collective coping strategy emerges.

2.3.4.5 Shared leadership

Shared leadership represents a condition of mutual influence embedded in the interactions among team members that can significantly improve team and organizational performance (Day, Gronn, & Salas, 2004). Shared leadership creates patterns of reciprocal influence that further develop and reinforce existing relationships among team members. Every team member are asked to rate each of his/her peers on the question "To what degree does your team rely on this individual for leadership?", using a scale that ranges from "not at all" (1) to "to a very great extent" (5).

2.3.4.6 IMPPaCTS

The IMPPaCTS questionnaire assesses skills related to cross-cultural competence, which can have an impact on the ability of teams to perform effectively, particularly in contexts involving people from different organizations and backgrounds (see Brown & Adams, 2011 for a review). The questionnaire evaluates the following dimensions: Individual differences, Motivation, Professionalism, Problem solving, Cultural knowledge, Thinking skills, and Social skills (IMPPaCTS).

3 Conclusion

The CF and Canadian public safety organizations are increasingly required to be agile in the face of complex demands brought on by asymmetric warfare, crisis management situations (e.g., Op HESTIA in Haiti), as well as national and international joint operations. Organizational agility can be used to set the conditions for effective and efficient services by adopting situation-tailored C2 approaches (Farrell & Connell, 2010).

The present document describes the details of a framework for the study of organizational agility, which can be applied to research questions at the team or organization level. The framework includes a task environment that allows developing complex and dynamic team-based scenarios, and a series of metrics to measure agility and relevant teamwork variables. It allows investigating issues such as teams' response to changes in resistance and situation complexity; that is, how they adjust their C2 approach and how the situational changes and C2 approach transition impact team performance and teamwork. The framework was developed as part of the DND-NSERC project TASSCM, which investigates team agility and self-synchronization in crisis management.

A key prerequisite to observe transitions between C2 approaches is to develop a functional simulation in which we can vary contextual and organizational characteristics to create various conditions where a transition from one C2 approach to another can arise, and observe the emergent behaviours displayed by participants. The framework presented here proposes an approach that offers the best compromise between ecological and internal validity by creating controlled experiments in realistic simulations. Applying this approach requires a microworld within which a scenario representing a typical task is implemented, namely C^3Fire, a forest firefighting simulation.

If we are to understand the ways in which teams or organizations achieve optimum performance through agility, it is essential that researchers be able to measure the processes and behaviours within teams, overall performance, and the kinds of team decisions that these processes and behaviours lead to. For that purpose, the framework includes a number of metrics that assess dimensions such as performance, coordination, time to transition from one C2 approach to another, trust, leadership, and cross-cultural competence.

It is important to note that the framework is flexible. For instance, some metrics could be removed while other relevant metrics could be added. In determining what metrics to use, it is important to take into account that measures that need to be completed by participants' (e.g., questionnaires) add to the burden of the task. Too many metrics may lead participants to disengage and to provide responses or data that are not meaningful.

Team research is labour-intensive and time-consuming in preparation, running, and analyses. However, teamwork is one of the linchpins of CF operations and it is important to conduct studies in team settings on various topics or issues that can significantly impact mission effectiveness. One of the benefits of studies conducted within this framework is that they will provide a very rich data set that can be mined beyond the original research questions.

As part of the TASSCM project, the framework will be used for a study that will aim to validate a subset of the concepts hypothesized in the C2 Agility model (Farrell, 2011; Farrell & Connell, 2010; Farrell et al., 2012). The C2 Agility model postulates that during an operation, the C2 approach required to optimally deal with a given situation varies as a function of the complexity of the situation. The study will be run in the fall of 2012 and winter of 2013, and findings will be used to refine the framework.

Organizational agility is a complex phenomenon that is required especially in complex situations, with a number of influencing and interconnected actors and variables. The framework described here should help in guiding and supporting research efforts undertaken to further our understanding of organizational agility, which will provide knowledge to enhance education, training, and support systems with the aim to increase agility of CF teams.

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List of symbols/abbreviations/acronyms/initialisms

CF	Canadian Forces
C2	Command and Control
DND	Department of National Defence
DRDC	Defence Research & Development Canada
DRDKIM	Director Research and Development Knowledge and Information Management
NSERC	Natural Sciences and Engineering Research Council of Canada
R&D	Research & Development
TASSCM	Tracking Agility and Self-Synchronization in Crisis Management

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Increasingly, the Canadian Forces (CF) and public safety organizations face the challenge to develop organizational structures and technologies that promote the agility required to deal with the complex demands of crisis management situations. The present document describes a framework for the study of agility, either at the organization or team level, which can be used as a foundation to guide research efforts on that topic. This framework was developed as part of the Tracking Agility and Self-Synchronization in Crisis Management (TASSCM) project conducted under the Research Partnership program between the Department of National Defence and the Natural Sciences and Engineering Research Council of Canada. The framework includes a task environment that allows developing complex and dynamic team-based scenarios, and a series of metrics to measure agility and relevant teamwork variables. To observe transitions between command and control (C2) approaches requires a functional simulation in which we can vary contextual and organizational characteristics to create various conditions where a transition from one C2 approach to another can arise, and observe the emergent behaviours displayed by participants. The task environment that seemed best suited to fulfill this mandate is the C3Fire microworld platform, a forest firefighting simulation. In order to understand the ways in which teams or organizations achieve optimum performance through agility, the framework includes a series of metrics assessing various dimensions of teamwork such as the processes and behaviours within teams, overall performance, and the kinds of team decisions that these processes and behaviours lead to. This framework should help in guiding and supporting research efforts undertaken to further our understanding of organizational agility, which will allow enhancing education, training, and support systems to increase agility of CF teams.

Les Forces canadiennes (FC) et les organisations de sécurité publique sont de plus en plus confrontées à l'élaboration de technologies et de structures organisationnelles favorisant l'agilité nécessaire pour gérer les exigences complexes de situations de gestion de crises. Le présent document décrit un cadre pour l'étude de l'agilité, au niveau de l'équipe ou de l'organisation, pouvant servir d'élément de base pour orienter les efforts de recherche en la matière. Ce cadre a été conçu durant le projet d'investigation de l'agilité et de l'auto-synchronisation en gestion de crises (TASSCM), dans le cadre du programme de partenariat de recherche du ministère de la Défense nationale et du Conseil de recherches en sciences naturelles et en génie du Canada. Le cadre comprend un environnement de simulation permettant l'élaboration de scénarios d'équipe dynamiques et complexes, de même qu'une série de paramètres pour mesurer l'agilité et les variables pertinentes en matière de travail d'équipe. Un simulateur fonctionnel, dont les caractéristiques organisationnelles et contextuelles sont modifiables, est nécessaire afin d'observer les comportements émergents des participants et les transitions entre les approches de commandement et contrôle (C2). Les caractéristiques variables de cet environnement de simulation permettent de créer diverses conditions pouvant mener à la transition d'une approche C2 vers une autre. Le micromonde C3Fire, une simulation de lutte contre un incendie de forêt, semblait convenir le mieux pour remplir ce mandat. Afin de comprendre comment les équipes ou les organisations obtiennent un rendement optimal avec l'agilité, le cadre comporte une série de paramètres évaluant diverses dimensions du travail d'équipe telles que les processus et les comportements au sein des équipes, le rendement global, ainsi que les types de décisions d'équipe auxquels mènent ces processus et comportements. Ce cadre devrait aider à orienter et appuyer les efforts de recherche entrepris afin de mieux comprendre l'agilité organisationnelle, permettant ainsi d'améliorer l'instruction et l'entraînement, en plus de soutenir les systèmes pour accroître l'agilité des équipes des FC.

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agility, framework, crisis management, command and control, edge, NSERC, team performance, teamwork