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DECISION MAKING STYLES: CLASSIFICATION SYSTEM, CONTEXTUAL ANALYSIS AND VALIDATION OF CLASSIFICATION SYSTEM

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Abstract

The Joint Command Decision Support for the 21st Century Technology Demonstration (JCDS 21 TD) project investigates individual and organizational factors, as well as technology, with respect to decision making. As part of the JCDS 21 TD work plan, it is necessary to gain an understanding of current scientific research on human decision making, individual differences, and the potential to identify consistent individual preference for specific decision making styles.

Research has indicated that a variety of individual factors affect the way in which people make decisions. In addition, individual strategies can be more or less suited to different kinds of task domains. Thus, it is important to develop an understanding of the individual differences in decision making strategies or approaches. In particular, this work seeks to identify separate decision strategies within an organized categorization scheme which is based on empirical research. This framework will serve as the basis for then exploring the individual factors that predict the use of given strategies as well as the consistency with which individuals favour any given strategy. The ultimate aim of this work was the development of a survey tool that can be used to classify the kinds of decision strategies consistently adopted by an individual.

This work represents follow-on work from a literature survey in which a review was conducted of current scientific literature relevant to decision making styles and person-based, social/group and situation/context factors that may affect one's selection of or preference for specific decision making styles. In particular, this report describes a contextual analysis of tasks performed by the JSTAFF with respect to decision making styles, the development of a decision making styles classification system and an experimental validation methodology with which to evaluate the decision making styles classification system. In addition, recommendations are made for future iterations of a decision making styles classification tool and further validation of the classification tool.

Résumé

Le Projet de démonstration de technologies – Aide à la décision des commandements interarmées pour le XXI^{e} siècle (PDT ADCI 21) porte sur les facteurs individuels et organisationnels et sur la technologie qui interviennent dans la prise de décisions. Dans le cadre du plan de travail du PDT ADCI 21, il est nécessaire d'arriver à une meilleure compréhension de la recherche scientifique actuelle sur la prise de décisions des humains, les différences individuelles et la possibilité de reconnaître des préférences individuelles constantes pour certains styles de prise de décisions.

Les recherches ont montré que divers facteurs individuels ont une incidence sur la façon dont les gens prennent des décisions. De plus, des stratégies individuelles peuvent être plus ou moins bien adaptées à différents domaines de tâches. Il est donc important d'en arriver à comprendre les différences individuelles dans les stratégies ou les approches décisionnelles. Ce travail vise en particulier à distinguer des stratégies décisionnelles en fonction d'une catégorisation méthodique reposant sur des recherches empiriques. Ce cadre servira ensuite de base à l'étude des facteurs individuels qui invitent à l'utilisation de stratégies données et de la constance avec laquelle des individus favorisent telle ou telle stratégie. L'objectif ultime de ce travail est la définition d'un outil d'enquête qui puisse servir à classifier les types de stratégies décisionnelles auxquelles un individu a recours de façon constante.

Ce travail fait suite à une recherche bibliographique qui comportait un examen des ouvrages scientifiques récemment consacrés aux styles de prise de décisions et aux facteurs individuels, sociaux et contextuels qui peuvent avoir une incidence sur le style de prise de décisions qu'une personne applique ou préfère. Ce document présente en particulier une analyse contextuelle des tâches de l'État-major interarmées (EMI) du point de vue des styles de prise de décisions, de la définition d'un outil de classification des styles de prise de décisions et d'une méthodologie de validation expérimentale qui permettrait d'évaluer l'outil de classification des styles de prise de décisions. De plus, des recommandations sont faites au sujet des itérations futures d'un outil de classification des styles de prise de décisions et de la validation subséquente de l'outil de classification.

Executive Summary

The Joint Command Decision Support for the 21st Century Technology Demonstration (JCDS 21 TD) project investigates individual and organizational factors, as well as technology, with respect to decision making. As part of the JCDS 21 TD work plan, it is necessary to gain an understanding of current scientific research on human decision making, individual differences, and the potential to identify consistent individual preference for specific decision making styles. The work completed under this call-up contributes to a sub-project intends to develop strategies to achieve organizational agility and improve decision performance of the individual, team and organization, which is critical for achieving integrated planning and execution in a Joint Interagency Multinational Public (JIMP) environment.

Research has indicated that a variety of individual factors affect the way in which people make decisions. In addition, individual strategies can be more or less suited to different kinds of task domains. Thus, it is important to develop an understanding of the individual differences in decision making strategies or approaches. In particular, this work seeks to identify separate decision strategies within an organized categorization scheme which is based on empirical research. This framework will serve as the basis for then exploring the individual factors that predict the use of given strategies as well as the consistency with which individuals favour any given strategy. The ultimate aim of this work was the development of a survey tool that can be used to classify the kinds of decision strategies consistently adopted by an individual.

This work represents follow-on work from a literature survey in which a review was conducted of current scientific literature relevant to decision making styles and person-based, social/group and situation/context factors that may affect one's selection of or preference for specific decision making styles. In particular, this report describes a contextual analysis of tasks performed by the JSTAFF with respect to decision making styles, the development of a decision making styles classification system and an experimental validation methodology with which to evaluate the decision making styles classification system.

The contextual analysis attempts to characterize eight specific JSTAFF tasks (identified in the JCDS front-end analysis) and outlines relevant individual person-based, social/group and context/situation factors relating to decision making style. Unfortunately the JCDS front-end analysis did not provide sufficient detail about the specific operational or decision tasks to completely characterize the relevant factors (i.e. person-based, social/group or context/situation factors) related to decision making styles. Therefore, recommendations are made with respect to specific information that would be required about the general decision tasks in order to perform a comprehensive contextual analysis and subsequently create a validation methodology for the classification system.

The objective of the decision making styles classification tool is to attempt to predict the relative contribution of specific decision making styles (i.e. analytical, intuitive, etc.) given a specific decision task and individual characteristics of the decision maker(s). It considers factors relating to the task as well as the decision maker and calculates a score for each of six different decision making styles: analytical, naturalistic, avoidant, dependent, spontaneous and heuristics. The decision making style with the highest overall score can be considered the preferred style for the specific task in question.

An empirical methodology is then outlined that can be used to conduct a preliminary validation of the decision making styles classification tool. This methodology evaluates the ability of the classification

tool to predict the relative preferences of decision making styles for a given task and given specific characteristics of the decision maker(s). Relative preference refers to the fact that the classification tool outputs not only a single preferred decision making style, but a final score for each of the six decision making styles, with the highest score representing the preferred decision making style.

Finally, recommendations are made for future iterations of a decision making styles classification tool and further validation of the classification tool. Essentially, future iterations of a classification tool should be based on well-founded empirical research and account for different weighting of factors as well as interaction effects between factors when calculating final decision making style scores. Validation of the classification tool using a detailed analysis of a variety of JSTAFF tasks would be necessary to evaluate its power to predict a preferred decision making style.

Sommaire

Le Projet de démonstration de technologies – Aide à la décision des commandements interarmées pour le XXI[e] siècle (PDT ADCI 21) porte sur les facteurs individuels et organisationnels et sur la technologie qui interviennent dans la prise de décisions. Dans le cadre du plan de travail du PDT ADCI 21, il est nécessaire d'arriver à une meilleure compréhension de la recherche scientifique actuelle sur la prise de décisions des humains, les différences individuelles et la possibilité de reconnaître des préférences individuelles constantes pour certains styles de prise de décisions. Le travail fait dans le cadre de cette demande s'intègre à un sous-projet dont l'objectif est la définition de stratégies pour arriver à la souplesse organisationnelle et améliorer le rendement décisionnel de l'individu, de l'équipe et de l'organisation, ces facteurs jouant un rôle déterminant dans l'intégration de la planification et de l'exécution dans un cadre interarmées, interorganisationnel, multinational et public (IIMP).

Les recherches ont montré que divers facteurs individuels ont une incidence sur la façon dont les gens prennent des décisions. De plus, des stratégies individuelles peuvent être plus ou moins bien adaptées à différents domaines de tâches. Il est donc important d'en arriver à comprendre les différences individuelles dans les stratégies ou les approches décisionnelles. Ce travail vise en particulier à distinguer des stratégies décisionnelles en fonction d'une catégorisation méthodique reposant sur des recherches empiriques. Ce cadre servira ensuite de base à l'étude des facteurs individuels qui invitent à l'utilisation de stratégies données et de la constance avec laquelle des individus favorisent telle ou telle stratégie. L'objectif ultime de ce travail est la définition d'un outil d'enquête qui puisse servir à classifier les types de stratégies décisionnelles auxquelles un individu a recours de façon constante.

Ce travail fait suite à une recherche bibliographique qui comportait un examen des ouvrages scientifiques récemment consacrés aux styles de prise de décisions et aux facteurs individuels, sociaux et contextuels qui peuvent avoir une incidence sur le style de prise de décisions qu'une personne applique ou préfère. Ce document présente en particulier une analyse contextuelle des tâches de l'État-major interarmées (EMI) du point de vue des styles de prise de décisions, de la définition d'un outil de classification des styles de prise de décisions et d'une méthodologie de validation expérimentale qui permettrait d'évaluer l'outil de classification des styles de prise de décisions.

L'analyse contextuelle vise à caractériser huit tâches distinctes de l'EMI (qui ont été définies dans l'analyse préliminaire de l'ADCI) et à préciser les facteurs individuels, sociaux et contextuels qui se rapportent aux styles de prise de décisions. Malheureusement, l'analyse préliminaire de l'ADCI ne contenait pas assez de renseignements au sujet des tâches opérationnelles ou décisionnelles de l'EMI pour que les facteurs propres aux styles de prise de décisions (c'est-à-dire les facteurs individuels, sociaux ou contextuels) puissent être intégralement caractérisés. Des recommandations ont donc été faites au sujet des renseignements qu'il faudrait réunir sur les tâches décisionnelles de l'EMI pour être en mesure de faire une analyse contextuelle complète et d'énoncer ensuite une méthodologie de validation de l'outil de classification.

Un outil logiciel reposant sur la classification des styles de prise de décisions établie dans la recherche bibliographique antérieure (Bruyn, Bandali et Lamoureux, 2005) a été conçu pour servir à évaluer des styles de prise de décisions pour certaines configurations de facteurs. L'outil de classification des styles de prise de décisions devrait servir à faire des recommandations sur la contribution relative de certains styles de prise de décisions (le style analytique ou le style intuitif, par exemple) en fonction d'une tâche décisionnelle donnée et des caractéristiques du décideur. L'outil de classification tient compte des

facteurs relatifs à la tâche et au décideur et il établit une note pour six styles différents de prise de décisions : analytique, naturaliste, évitant, dépendant, spontané et heuristique (Bruyn et coll., 2005). Le style de prise de décisions qui obtient la note globale la plus élevée peut être considéré comme le style préféré pour la tâche en question.

Une méthodologie empirique de validation préliminaire de l'outil de classification des styles de prise de décisions est ensuite définie. Cette méthodologie montre comment pourrait être évaluée la capacité pour l'outil de classification de recommander des préférences relatives de styles de prise de décisions pour une tâche donnée et compte tenu des caractéristiques du décideur. La préférence relative désigne le fait que l'outil de classification n'aboutit pas seulement à un style de prise de décisions préféré, mais bien à une note finale pour chacun des six styles de prise de décisions, la note la plus élevée correspondant au style préféré.

Enfin, des recommandations sont faites au sujet des itérations futures d'un outil de classification des styles de prise de décisions et de la validation subséquente de l'outil de classification. Essentiellement, les itérations futures d'un outil de classification devraient s'appuyer sur des recherches empiriques fondées et faire intervenir différentes pondérations des facteurs ainsi que les effets des itérations sur les facteurs dans le calcul des notes finales attribuées aux styles de prise de décisions. Pour voir dans quelle mesure l'outil de classification peut servir à recommander un style préféré de prise de décisions, il faudrait en faire une validation en fonction d'une analyse détaillée de diverses tâches de l'EMI.

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1. Background

As described in the Statement of Work for call-up 7911-03, Contract Number W7711-4-7911/01 TOR, the Joint Command Decision Support for the 21st Century Technology Demonstration (JCDS 21 TD) project investigates individual and organizational factors, as well as technology, with respect to decision making. JCDS 21 TD has developed into a large, multidisciplinary team with scientific leadership provided by DRDC Valcartier, DRDC Toronto and Director General Operational Research (DGOR). The project sponsor is Director Joint Force Capabilities (DJFC). The Scientific Authority (SA) is Dr. David J. Bryant of the Command Effectiveness Behaviour (CEB) group at DRDC Toronto. As part of the JCDS 21 TD work plan, it is necessary to gain an understanding of current scientific research on human decision making, individual differences, and the potential to identify consistent individual preference for specific decision making styles. The work completed under this call-up contributes to Sub-Project 3: Organizational and Individual Factors. This sub-project intends to develop strategies to achieve organizational agility and improve decision performance of the individual, team and organization, which is critical for achieving integrated planning and execution in a Joint Interagency Multinational Public (JIMP) environment.

Research has indicated that a variety of individual factors affect the way in which people make decisions. In addition, individual strategies can be more or less suited to different kinds of task domains. Thus, it is important to develop an understanding of the individual differences in decision making strategies or approaches. In particular, this work will seek to identify separate decision strategies within an organized categorization scheme which is based on empirical research. This framework will serve as the basis for then exploring the individual factors that predict the use of given strategies as well as the consistency with which individuals favour any given strategy. The ultimate aim of this work is the development of a survey tool that can be used to classify the kinds of decision strategies consistently employed by an individual.

This report represents the second deliverable of this call-up and satisfies tasks 2, 3 and 4 of the Statement of Work (SOW) as follows:

- Task 2: Contextual Analyses for JCDS 21 TD
- Task 3: Design of a Classification System
- Task 4: Recommendation and Final Report

This work represents follow-on work from a literature survey in which a review was conducted of current scientific literature relevant to decision making styles and person-based, social/group and situation/context factors that may affect one's selection of or preference for specific decision making styles.

1.1 Results from literature survey

Based on the literature survey (Bruyn, Bandali & Lamoureux, 2006), three high-level classes of factors were identified that have demonstrated relationships to decision making strategy: person-based, social/group and situation/context factors. Within each of these three classes, specific characteristics were identified that are linked to decision making strategy. However, in general there is limited empirical support for all.

Tables 1, 2 and 3 below outline the various person-based, social/group and situation/context factors identified in the literature as well as their relationship to specific decision making styles. A parentheses around an 'X' indicates a secondary decision making style. An asterix indicates that the relationship is supported by empirical research.

Overall, the literature survey did not identify any pre-existing, well-defined and comprehensive framework for relating individual factors to specific decision making styles. Similarly, the literature survey also revealed that there is no potential assessment tool in existence that could be used to classify personal preferences for decision making.

However, the individual factors identified do provide a starting point for investigating the predictive power of individual factors in decision making style preference.

Table 1: Person-Based Factors and Dominant Decision Making Style(s) (Bruyn et al., 2006)

Factor	Analytical	Naturalistic	Avoidant	Dependent	Spontaneous	Heuristics
Age						
**Young*	x					x
**Old*		x				x
Personality						
Locus of Control						
**Internal*	x	(x)				
**External*			x	x	x	
Innovativeness						
**Less*	x		x	x	x	
**More*		x				
Social Desirability						
**High*	x					
**Low*		x	x		x	
Self Esteem						
**High*	x	x				
**Low*			x	x		
Myers-Briggs Type Indicator						
**Intuiting/Thinking*		x				
**Sensing/Feeling*	x					
Risk Seeking						
**Less*	x					
**More*		x				
Agreeableness and Conscientiousness						
**High*	x	x				
Goal Orientation						
**Learning Goal Orientation*	x		x			
** Performance Goal Orientation*	x		x			

Factor	Analytical	Naturalistic	Avoidant	Dependent	Spontaneous	Heuristics
Cognitive Style						
Need for Cognition						
**High*	x					
Personal Fear of Invalidity						
High			x			
Personal Need for Structure						
High		x				x

Parentheses indicate secondary style
* indicates empirical support

Table 2: Social/Group Factors and Dominant Decision Making Style(s) (Bruyn et al., 2006)

Factor	Analytical	Naturalistic	Avoidant	Dependent	Spontaneous	Heuristics
Culture						
Individualistic vs. Collective						
**Individualistic*	x					
**Collective*		x	x			
Other Specific Cultures						
**French*	x					
**Danish*		x				
Groupthink						
High	x	x				x
Social Loafing						
High		x				

Parentheses indicate secondary style
* indicates empirical support

Table 3: Context/Situation Factors and Dominant Decision Making Style(s) (Bruyn et al., 2006)

Factor	Analytical	Naturalistic	Avoidant	Dependent	Spontaneous	Heuristics
Type of Behaviour						
Simple Rule-Based	x					
Complex Rule Based	x	x				
Knowledge Based	x	x				
Skill Based		x				
Time Pressure						
**High*						x
Ambiguity						
**High*						x

Parentheses indicate secondary style
* indicates empirical support

1.2 Approach for this report

This report includes the following:

1. Description of a contextual analysis of JCDS 21 TD with respect to decision making styles;
2. Description of the design of a decision making styles classification system;
3. Recommendation of an experimental validation methodology to evaluate the decision making styles classification system, and,
4. Specific recommendations on how to use these results in developing a decision style classification tool predictive of a preferred decision style for a given task type and decision maker(s).

2. Contextual Analysis for JCDS 21 TD

2.1 Objective

The contextual analysis, as described in the SOW consists of:

- An analysis of the literature collected in Task 1 with respect to JCDS decision tasks/contexts as described in the "front-end analysis" deliverables.
- The identification of specific kinds of decision making tasks (individual and team) relevant to JCDS, as well as individual, organizational, and environmental factors in JCDS that are relevant to decision making.

In terms of deliverables, it was originally intended that a separate contextual analysis report be produced that summarized individual, organizational, and environmental factors relevant to decision making in the JCDS environment. However, in collaboration with the SA, it was agreed that the method used and results of the contextual analysis would be integrated into this final report.

2.2 Method

2.2.1 Identification of Operational Tasks and Extraction of Relevant Data

The Joint Staff (JSTAFF) Front End Analysis Data Analysis Report (Greenley, Baker & Cochran, 2005) was used to identify a subset of JCDS decision tasks/contexts that involve both individual and group decision making. It was anticipated that the front end analysis would provide an understanding of decision making, Information and Intelligence (I2) analysis and collaborative activities performed by the JSTAFF.

In order to identify a subset of operational tasks of the JSTAFF, the results of the Operational View #3 (OV-3) Information Exchange Matrix presented in Annex E of the Front End Analysis report were examined (Greenley, et al., 2005). The following information was extracted from the OV-3:

- Operational task
- JCDS reference #
- Purpose
- Operational node/responsibility (person or persons responsible for task)
- Decision requirements
- Timeliness
- Criticality

2.2.2 Linking JSTAFF Tasks and Decision Making Style

The following eight JSTAFF tasks were selected primarily based on the anticipated amount of decision making involved in these tasks:

1. Initiate operations planning
2. Acquire situation awareness
3. Liaison with external agencies
4. Request J2 intelligence information
5. J2 conduct situation brief
6. Assess situation
7. Define intent, assumptions, constraints and forces
8. Prepare CDS initiating directive

For each of these tasks, factors relating to decision making style were deduced based on knowledge of the purpose, operational responsibility, decision requirements, timeliness and criticality. Table 4 shows the links made between selected JSTAFF operational tasks (as outlined in Annex E of Greenley et al., 2005), task characteristics and factors relating to decision making styles. The "factors most relevant to decision making style" is an attempt to provide a link between characteristics of the task and/or the decision maker(s) and the classification system to predict decision making styles. The factors listed in this column are factors that will be used by the classification tool to predict the preferred specific decision making style for a given task. The tasks highlighted in blue are those that will be selected as the focus for validation of the decision making styles classification tool (described in Section 3.5.1 of report).

2.2.2.1 Assumptions

For the purposes of this analysis only, the following assumptions were made in linking JSTAFF tasks to decision making style.

1. Although it could be argued that all person-based, social/group and context/situation factors may apply to any of the tasks listed, assumptions were made in terms of the most relevant factors. For example, if the task clearly involves group decision making, then social/group factors affecting decision making styles was included, and person-based factors were not. This is not to say that person-based factors may not be relevant to a task; it was simply assumed that social/group factors are prevalent.
2. Specific person-based factors and social/group factors relevant to a specific task cannot be known until the exact person(s) performing the task are known. Therefore, all person-based and social/group factors that may be relevant depending on the person(s) performing the task were included as factors relevant to decision making style.
3. The type of behaviour involved in specific tasks (i.e. simple rule-based, knowledge-based, etc.) was assumed based on knowledge of the planning process and the limited amount of information provided in OV-3 of the JCDS front-end analysis.

4. Time pressure was included as a relevant factor when the timeliness of the task was "hours", not "days" or "weeks". Of course, time pressure relates not only to the amount of time allowed to complete a task but the amount of work required to complete the task. Given that limited information was provided on the overall amount of work to complete each task, timeliness was the only factor taken into account that suggests the amount of time pressure.
5. The relevance of contextual factors such as ambiguity was evaluated based on knowledge of the Canadian Forces Operations Planning Process (CF OPP) rather than any explicit descriptions of the task (Bruyn, Lamoureux & Vokac, 2004; Department of National Defence, 2002). The task descriptions were quite limited and did not provide enough information to make a straightforward judgement about the level of ambiguity associated with each task.
6. Based on the person or persons responsible for each task, an assumption was made about the social context of the task in terms of whether it involves individual or group decision making. That is, if the responsibility for the task was assigned to the COS J3, it was assumed that the task primarily involves individual decision making and therefore factors relating to individual decision making (i.e. person-based factors) were considered most relevant. Conversely, if the responsibility of the task was assigned to the JSTAFF as a collective, it was assumed that the task primarily involves group decision making and therefore factors relating to group decision making (i.e. social/group factors) were considered most relevant. This assumption was necessary because this level of detail (i.e. social context of decision making) was not provided in the JCDS Front End Analysis Data Analysis Report.

Table 4: JSTAFF Tasks and Decision Making Styles

Operational Task	JCDS reference #	Task Characteristics Relevant to Decision Making						Most Relevant Factor(s) Relating to Decision Making Style
		Purpose	*Responsibility (operational node)*	*Decision requirements*	*Timeliness*	*Criticality*	*Group or individual DM*	
Initiate operations planning	JC203.2	To define DCDS mission objectives and scope	DG International Security Policy	DCDS intent, assumptions, constraints and possible forces	Weeks	High	Group	*Social/group factors:* Culture (Individualistic vs. Collective, other specific cultures – French, Danish), Groupthink, Social Loafing *Context/situation factors:* Type of Behaviour (*Simple Rule-Based or Complex Rule Based)*
Acquire situation awareness	JC203.2.1	To identify impending crisis, domestic or internal and developing situations relevant to Canadian interests	JSAT	Persistent global situation elements that are accessible, shared and trusted	Hours	High	Group	*Social/group factors:* Culture (Individualistic vs. Collective, other specific cultures – French, Danish), Groupthink, Social Loafing *Context/situation factors:* Type of Behaviour (*Knowledge Based)*, Time Pressure, Ambiguity
Liaison with external agencies	JC203.2.2	Identify options for providing CF aid to a situation in response to MND request for options	COS J3 Staff	List of options for aid that might be rendered and the impact on existing operations	Days	High	Individual	*Person-based factors*: age, personality, locus of control, innovativeness, social desirability, self esteem, Myers-Briggs Type Indicator, Risk Seeking, Agreeableness and Conscientiousness, Goal Orientation (Learning or Performance Goal), Cognitive Style (Need for Cognition, Personal Fear of Invalidity, Personal Need for Structure) *Context/situation factors:* Type of Behaviour (*Complex Rule Based, Knowledge Based)*, Ambiguity

Operational Task	JCDS reference #	Task Characteristics Relevant to Decision Making						Most Relevant Factor(s) Relating to Decision Making Style
		Purpose	*Responsibility (operational node)*	*Decision requirements*	*Timeliness*	*Criticality*	*Group or individual DM*	
Request J2 intelligance information	JC203.2.3	To define information and intelligence information collection and analysis	DCDS	Specific requirements for data collection and analysis with respect to an impending or existing operation	Weeks	High	Group	*Social/group factors:* Culture (Individualistic vs. Collective, other specific cultures – French, Danish), Groupthink, Social Loafing *Context/situation factors:* Type of Behaviour (*Complex Rule Based, Knowledge Based)*, Ambiguity
J2 conduct situation brief	JC203.2.4	To provide relevant trusted and persistent information in support of CF operations	DCDS	Processed and fused multi-source intelligence information	Days	High	Group	*Social/group factors:* Culture (Individualistic vs. Collective, other specific cultures – French, Danish), Groupthink, Social Loafing *Context/situation factors:* Type of Behaviour (*Complex Rule Based, Knowledge Based)*, Ambiguity
Assess situation	JC203.2.5	To provide an analysis of situational information that can be used to develop COAs	DCDS	Analysed situational information	Days	High	Group	*Social/group factors:* Culture (Individualistic vs. Collective, other specific cultures – French, Danish), Groupthink, Social Loafing *Context/situation factors:* Type of Behaviour (*Complex Rule Based, Knowledge Based)*, Ambiguity
Define intent, assumptions, constraints and forces	JC203.2.6	To define mission objectives, resource and scope, duration, assumptions and constraints	CDS	CDS intent, assumptions, constraints, mission activities and forces required	Weeks	High	individual	*Person-based factors*: age, personality, locus of control, innovativeness, social desirability, self esteem, Myers-Briggs Type Indicator, Risk Seeking, Agreeableness and Conscientiousness, Goal Orientation (Learning or Performance Goal), Cognitive Style (Need for Cognition, Personal Fear of Invalidity, Personal Need for Structure) *Context/situation factors:* Type of Behaviour (*Complex Rule Based, Knowledge Based)*, Ambiguity

Operational Task	JCDS reference #	Task Characteristics Relevant to Decision Making						Most Relevant Factor(s) Relating to Decision Making Style
		Purpose	*Responsibility (operational node)*	*Decision requirements*	*Timeliness*	*Criticality*	*Group or individual DM*	
Prepare CDS initiating directive	JC203.2.7	To provide direction for operations planning by the JSAT	CDS	Mission objectives, role, duration, end states, forces, assumptions and constraints	Weeks	High	Individual	*Person-based factors*: age, personality, locus of control, innovativeness, social desirability, self esteem, Myers-Briggs Type Indicator, Risk Seeking, Agreeableness and Conscientiousness, Goal Orientation (Learning or Performance Goal), Cognitive Style (Need for Cognition, Personal Fear of Invalidity, Personal Need for Structure) *Context/situation factors:* Type of Behaviour (*Complex Rule Based, Knowledge Based)*, Ambiguity

2.3 Future work and recommendations

Unfortunately the JCDS front-end analysis did not provide sufficient detail about the specific operational or decision tasks to characterize the relevant factors (i.e. person-based, social/group or context/situation factors) related to decision making styles. Therefore, recommendations are made with respect to specific information that would be required about the general decision tasks in order to perform a comprehensive contextual analysis and subsequently create a validation methodology for the classification system (described in next section of report).

In order to characterize the relevant factors related to decision making styles, the following specific information would be needed about the specific JCDS decision tasks identified in Table 4 above:

- Situation/contextual factors – including time pressure, level of ambiguity and type of behaviour involved in the task (i.e. rule-based, skill-based or knowledge-based).
- Social/group factors – does the decision task involve individual or group decision making (or both)? If the decision task involves group decision making, it is possible that social factors such as groupthink and social loafing may play a role and thereby affect the decision making style of the decision maker(s). Additionally, does the decision task entail the interaction of individuals with various cultural backgrounds? A decision making task involving a diversity of cultures (e.g. individualistic vs. collectivist) may affect the decision making style adopted by the decision maker(s).
- Person-based factors - If the decision making task involves individual decision making, characteristics of the specific decision maker can affect the decision making style adopted. Person-based factors such as personality (i.e intuiting/thinking, sensing/feeling, agreeableness, etc.), innovativeness, social desirability, self esteem, goal orientation, need for cognition, fear of invalidity and need for structure may all influence the particular decision making style adopted for the decision making task. It is recognized that person-based factors will vary between individuals and therefore, characterizing these factors for each JCDS decision making task is unlikely to be practical or feasible, given that these factors depend on the individual and not on the specific task. However, knowledge of these person-based factors of the individual decision maker could certainly be taken into account when applying the decision making styles classification tool in an attempt to predict a dominant decision making style.

Once JSTAFF decision making tasks have been characterized in more detail, these specific tasks can be used to validate a decision making styles classification system that can predict preferred decision making style(s) based on characteristics of the task and decision maker(s). Such a classification system, along with a validation methodology with which it can be evaluated, is described in following section of the report.

3. Design of a Classification System

3.1 Objective

The literature survey conducted in the first phase of this project identified that there is no existing, well-defined and comprehensive framework for identifying individual factors and specific decision making strategies and therefore no existing assessment tool that could be used to classify personal preferences for decision making (Bruyn et al., 2006). The objective of this task was therefore to develop a classification system to index decision making styles by decision task type and individual factors. The individual factors identified by the literature survey provide a good starting point for investigating the predictive power of individual factors for decision making style preference.

The contractor, in collaboration with the scientific authority, was to propose a classification system or a framework to index decision making styles by decision task type and individual factors. The proposed system or framework would need to be assessed and validated prior to any system design. Thus, the contractor, in collaboration with the scientific authority, was directed to propose an empirical study to validate the proposed system or framework.

In terms of deliverables, it was originally intended that a separate report outlining the decision making styles classification system or framework as well as a validation methodology be produced. However, in collaboration with the SA, it was agreed that a description of the classification system and recommended validation methodology be integrated into this final report.

3.2 Method

A survey of literature on decision making styles identified six types of decision making styles: analytical, naturalistic, avoidant, dependent, spontaneous and heuristic (Bruyn et al., 2006). It also identified three high level classes of factors that appear to influence one's decision making style: person-based, social/group and situation/context factors. The objective of the decision making styles classification tool is to attempt to predict the relative contribution of specific decision making styles (i.e. analytical, intuitive, etc.) given a specific decision task and individual characteristics of the decision maker(s). It considers factors relating to the task (e.g. time pressure) as well as the decision maker (e.g. age) and calculates a score for each of six different decision making styles: analytical, naturalistic, avoidant, dependent, spontaneous and heuristics. The decision making style with the highest overall score can be considered the preferred style for the specific task in question.

3.2.1 Identification of levels of each factor

A total of 20 main factors were identified in the literature review, which were categorized as person-based, social/group or context/situation. Each of the 20 factors were further characterized and assigned certain values or levels (e.g. high/low, less/more) according to the specific investigations reviewed for the literature survey. For example, age was assigned two levels; young or old, and time pressure was assigned two levels; high or low. Table 5 shows the levels assigned for all 20 factors as well as their relationship to specific decision making styles. That is, the decision making style associated with each level of each factor is shown in brackets. "N/A" indicates that the relationship between that particular

level of factor (e.g. low agreeableness and conscientiousness) and preferred decision making style was not documented in the literature.

Table 5: Levels of individual factors and associated decision making styles

Category	Factor	Level
Person-based factors	Age	• Young (Analytical, Heuristics) • Old (Naturalistic, Heuristics)
	Locus of control	• Internal (Analytical) • External (Avoidant, Dependent, Spontaneous)
	Innovativeness	• Less (Analytical, Avoidant, Dependent, Spontaneous) • More (Naturalistic)
	Social Desirability	• High (Analytical) • Low (Naturalistic, Avoidant, Spontaneous)
	Self Esteem	• High (Analytical, Naturalistic) • Low (Avoidant, Dependent)
	Myers-Briggs Type Indicator	• Intuiting/Thinking (Naturalistic) • Sensing/Feeling (Analytical)
	Risk Seeking	• Less (Analytical) • More (Naturalistic)
	Agreeableness and Conscientiousness	• High (Analytical, Naturalistic) • Low (N/A)
	Goal Orientation	• Learning goal orientation (Analytical, Avoidant) • Performance goal orientation (Analytical, Avoidant)
	Need for Cognition	• High (Analytical) • Low (N/A)
	Personal Fear of Invalidity	• High (Avoidant) • Low (N/A)
	Personal Need for Structure	• High (Naturalistic, Heuristics) • Low (N/A)
Social or group factors	Culture	• Individualistic (Analytical) • Collective (Naturalistic, Avoidant)
	Specific Individualistic Culture	• Inductive (Analytical) • Deductive (Naturalistic)
	Groupthink	• High (Analytical, Naturalistic, Heuristics) • Low (N/A)
	Social Loafing	• High (Naturalistic) • Low (N/A)
Situation or context factors	Type of Behaviour	• Simple rule-based (Analytical) • Complex rule-based (Analytical, Naturalistic) • Knowledge-based (Analytical, Naturalistic) • Skill-based (Naturalistic)
	Time Pressure	• High (Heuristics) • Low (N/A)
	Ambiguity	• High (Heuristics) • Low (N/A)

As outlined in Table 5, there was no link found in the literature between decision making styles and the following levels of individual factors:

- Low time pressure
- Low ambiguity
- Low groupthink
- Low social loafing
- Low agreeableness and conscientiousness
- Low learning goal oriented
- Low performance goal oriented
- Low need for cognition
- Low personal fear of invalidity
- Low personal need for structure

As previously noted, the overall objective of a classification system to index decision making styles by decision task type and individual factors was the ability to predict a preferred decision making style given certain characteristics of the decision task and the decision maker(s). Therefore the classification system had to take into account all applicable factors that may affect a decision task, relate those factors to specific decision making styles and then calculate which decision making style would most likely be preferred for the given task. For each decision making style (e.g. analytical), the classification system assigns a score of 1 for each factor that has, either empirically or theoretically, been shown to relate to that style, and a score of 0 for factors that have not been shown to relate to that style. All factors related to a specific decision making style were assigned an equal weighting of 1, regardless of the actual strength of the relationship between the factor and the specific decision making style. Table 6 shows the way in which the scores were allocated for each factor and decision making style.

Table 6: Scores allocated for each factor and decision making style

Factor	Analytical	Naturalistic	Avoidant	Dependent	Spontaneous	Heuristics
Age						
**Young*	1	0	0	0	0	1
**Old*	0	1	0	0	0	1
Personality						
Locus of Control						
**Internal*	1	1	0	0	0	0
**External*	0	0	1	1	1	0
Innovativeness						
**Less*	1	0	1	1	1	0
**More*	0	1	0	0	0	0
Social Desirability						
**High*	1	0	0	0	0	0
**Low*	0	1	1	0	1	0

Factor	Analytical	Naturalistic	Avoidant	Dependent	Spontaneous	Heuristics
Self Esteem						
**High*	1	1	0	0	0	0
**Low*	0	0	1	1	0	0
Myers-Briggs Type Indicator						
**Intuiting/Thinking*	0	1	0	0	0	0
**Sensing/Feeling*	1	0	0	0	0	0
Risk Seeking						
**Less*	1	0	0	0	0	0
**More*	0	1	0	0	0	0
Agreeableness and Conscientiousness						
**High*	1	1	0	0	0	0
Low	0	0	0	0	0	0
Goal Orientation						
**Learning Goal Orientation*	1	0	1	0	0	0
** Performance Goal Orientation*	1	0	1	0	0	0
Cognitive Style						
Need for Cognition						
**High*	1	0	0	0	0	0
Low	0	0	0	0	0	0
Personal Fear of Invalidity						
High	0	0	1	0	0	0
Low	0	0	0	0	0	0
Personal Need for Structure						
High	0	1	0	0	0	1
Low	0	0	0	0	0	0
Culture						
Individualistic vs. Collective						
**Individualistic*	1	0	0	0	0	0
**Collective*	0	1	1	0	0	0
Individualistic						
Deductive	1	0	0	0	0	0
Inductive	0	1	0	0	0	0
Groupthink						
High	1	1	0	0	0	1
Low	0	0	0	0	0	0
Social Loafing						
High	0	1	0	0	0	0

Factor	Analytical	Naturalistic	Avoidant	Dependent	Spontaneous	Heuristics
Low	0	0	0	0	0	0
Type of Behaviour						
Simple Rule-Based	1	0	0	0	0	0
Complex Rule Based	1	1	0	0	0	0
Knowledge Based	1	1	0	0	0	0
Skill Based	0	1	0	0	0	0
Time Pressure						
**High*	0	0	0	0	0	1
Low	0	0	0	0	0	0
Ambiguity						
**High*	0	0	0	0	0	1
Low	0	0	0	0	0	0

In the above table, shaded rows highlight the factors that have not been investigated with respect to decision making style. That is, it illustrates gaps that currently exist in the decision making styles literature.

3.3 Results

The decision making styles classification system was developed in Visual Basic. It is interactive such that a user is asked to select the factor(s) relevant for a specific decision making task. The factors are divided into person-based, social/group and situation/context factors. An input is not required for every factor identified; only the factors relevant to the task in question. For example, the user may select only one relevant person-based factor, two social/group factors and no context/situation factors. The classification system then considers the factors that are inputted, assigns scores for each factor (as outlined in Table 6), and calculates a score for each decision making style. For example, if the user selects "young" age, the output would be a score of 1 for Analytical Decision Making and 1 for Heuristics. If the user selects "young" age and "high" time pressure, the output would be 1 for Analytical Decision Making and 2 for Heuristics. The classification system considers each score as independent and therefore does not take into account possible interaction effects between factors.

The total possible score for each decision making style can be calculated by summing each column of Table 6. For example, the highest possible score for analytic decision making style is 17; for naturalistic decision making style it is 16; for avoidant decision making style it is 8; for dependent decision making style it is 3; for spontaneous decision making style it is 3; and for heuristic decision making style it is 6. In other words, these numbers reflect the total number of factors that were found to be related to each particular decision making style.

The final output of the classification tool is a total score for analytical, naturalistic, avoidant, dependent, spontaneous and heuristic decision making style. The decision making style with the highest score is considered to be the preferred decision making style for the specific decision task in question. For example, given the following scores for a particular decision task, it is predicted that a naturalistic decision making style would be chosen over other styles.

- Analytical = 1

- Naturalistic = 5
- Avoidant = 1
- Dependent = 1
- Spontaneous = 0
- Heuristic = 0

If two decision making styles have the same score, it is considered that they are of equal preference and there is an equal likelihood that either decision making style will be adopted for the decision task or the two decision making styles could be applied in combination.

In the classification system interface, users select relevant factors from several drop-down menus (see Figure 1 below) and then an output window displays the total scores for each decision making style (see Figure 2 below). As seen in Figure 1, person-based factors are referred to as individual characteristics, group/social factors are referred to as group characteristics and situation/context factors are referred to as context characteristics. For enhanced usability, definitions for each factor are available by clicking on the factor title. For example, Figure 3 shows the definition window for what appears when the user clicks on 'type of behaviour'.

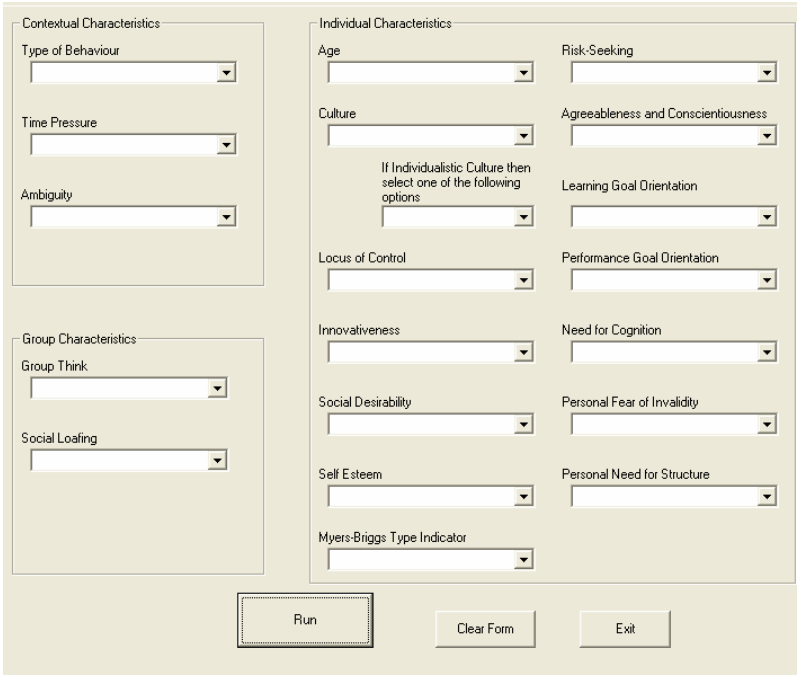

Figure 1: Classification tool interface showing contextual, group and individual factors

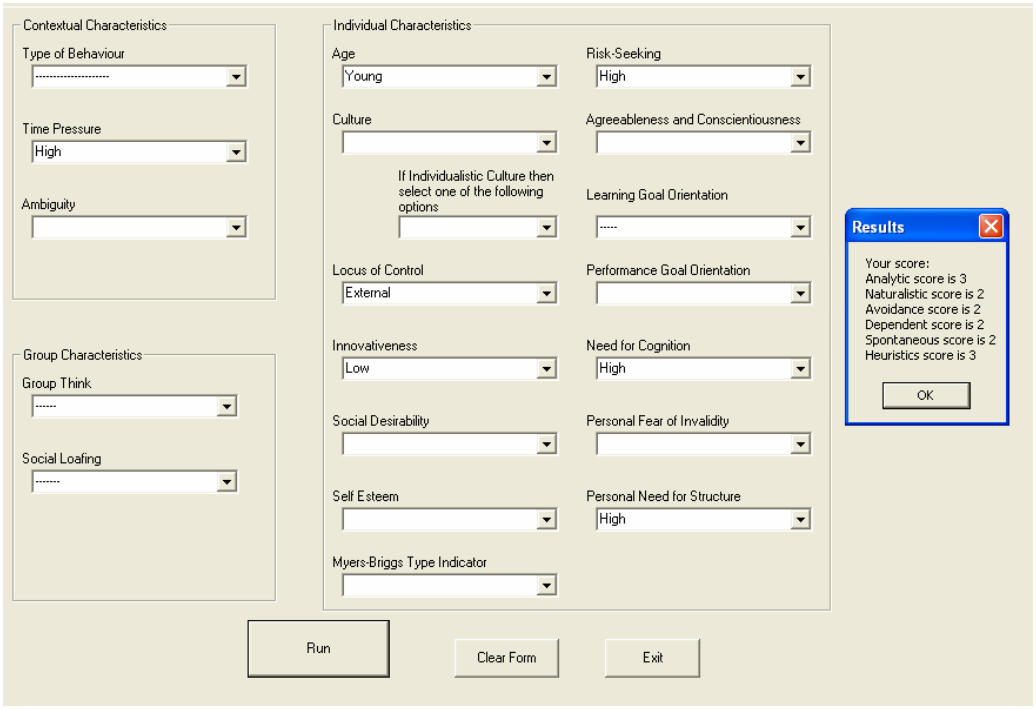

Figure 2: Classification tool interface showing selected factors and output window

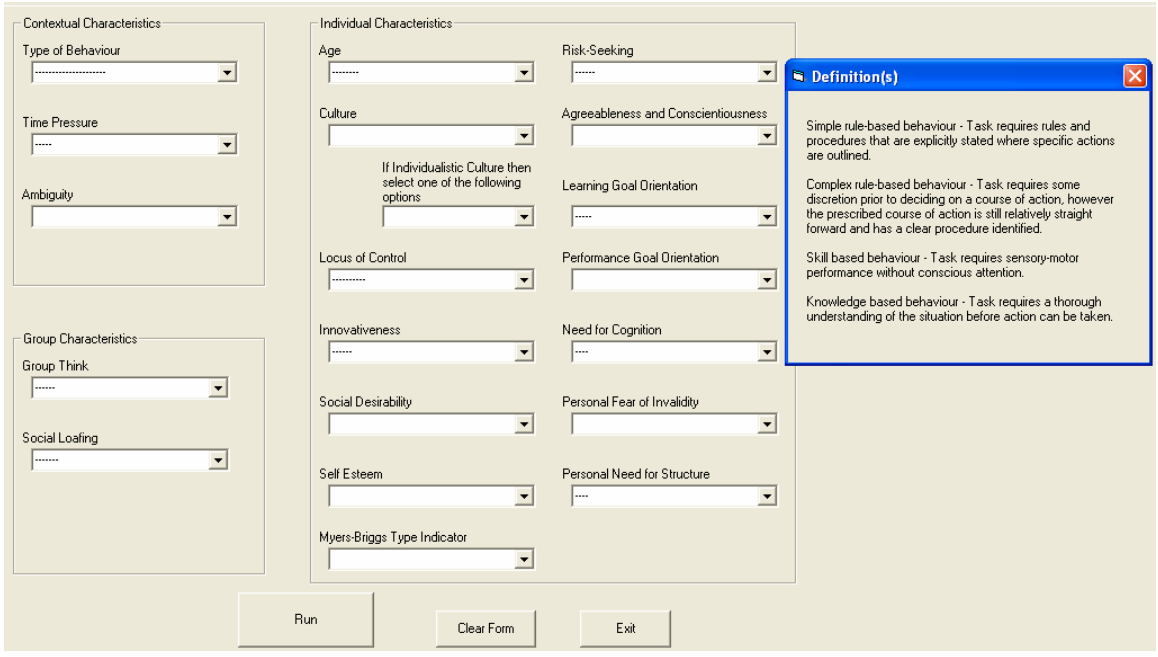

Figure 3: Classification tool interface showing definition for 'type of behaviour'

As an illustration, the classification tool was used to calculate preferred decision making styles for three JSTAFF decision tasks (show in Table 4): acquire situation awareness, assess situation and define intent, assumptions, constraints and forces. For each of the three tasks, the relevant person-based, group/social and situation/context factors were inputted into the classification system. The outcome decision making style scores are shown in Table 7 below.

Table 7: Decision making style scores for 3 JCDS tasks

Operational Task	JCDS reference #	Most Relevant Factor(s) Relating to Decision Making Style	Decision making style scores
Acquire situation awareness	JC203.2.1	*Social/group factors:* Culture (assume collectivist), Groupthink (assume high), Social Loafing (assume high) *Context/situation factors:* Type of Behaviour (assume *Knowledge Based)*, Time Pressure (assume high), Ambiguity (assume high)	Analytic score = 2 Naturalistic score = 4 Avoidance score = 1 Dependent score = 0 Spontaneous score = 0 Heuristic score = 3 Dominant decision making style = naturalistic
Assess situation	JC203.2.5	*Social/group factors:* Culture (assume collectivist), Groupthink (assume high), Social Loafing (assume high) *Context/situation factors:* Type of Behaviour (assume *Complex Rule Based)*, Ambiguity (assume high)	Analytic score = 2 Naturalistic score = 4 Avoidance score = 1 Dependent score = 0 Spontaneous score = 0 Heuristic score = 2 Dominant decision making style = naturalistic
Define intent, assumptions, constraints and forces	JC203.2.6	*Person-based factors*: age (assume old), locus of control (assume internal), innovativeness (assume high), social desirability (assume high), self esteem (assume high), Myers-Briggs Type Indicator (assume intuiting/thinking), Risk Seeking (assume low), Agreeableness and Conscientiousness (assume high), Goal Orientation (assume low learning and high for performance), Cognitive Style (assume high need	Analytic score = 8 Naturalistic score = 8.5 Avoidance score = 3 Dependent score = 0 Spontaneous score = 0 Heuristic score = 3 Dominant decision making style = naturalistic

Operational Task	JCDS reference #	Most Relevant Factor(s) Relating to Decision Making Style	Decision making style scores
		for cognition, high personal fear of invalidity, and high personal need for structure) *Context/situation factors:* Type of Behaviour (assume *Complex Rule Based)*, Ambiguity (assume high)	

3.4 Conclusions

The decision making styles classification tool allows a user to select various person-based, social/group and situation/context factors that are relevant to a specific decision task and then predicts a preferred decision making style. Such a predictive tool does not exist according to the literature and has the potential to be very valuable in the creation of decision support tools for commanders and staff involving high risk decision making. It could also be useful in determining appropriate or preferred procedures for specific decision making tasks or for specific individual characteristics of a decision maker (e.g. commander).

Limitations associated with the tool include the assignment of an equal weighting to each factor regardless of the strength of the relationship between the factor and the decision making style. Likewise, the tool does not consider interaction effects between factors. Finally, the classification tool is based on literature that has limited empirical support as well as several gaps in knowledge. Therefore, the predictive power of the classification tool could be strengthened by further empirical research on person-based, group/social and situation/context factors pertaining to decision making style.

3.5 Experimental Validation of the Decision Making Styles Classification Tool

There are several potential methods by which to validate the decision making styles classification tool. The validation methodology outlined below is just one method and represents a preliminary validation method.

3.5.1 Validation Methodology

This section proposes an empirical methodology that can be used to conduct a preliminary validation of the decision making styles classification tool. This methodology evaluates the ability of the classification tool to predict the relative preferences of decision making styles for a given task and given specific characteristics of the decision maker(s). Relative preference refers to the fact that the classification tool outputs not only a single preferred decision making style, but a final score for each of the six decision making styles, with the highest score representing the preferred decision making style.

Validation of the decision making styles classification tool will involve the following steps, each of which are defined further below:

1. Identify six decision tasks (one that will provoke each of the 6 decision making styles);

2. Identify relevant person-based, social/group and situation/context factors of the task;
3. Quantify these factors to the extent possible;
4. Have participants perform the decision task (actual or simulated), and,
5. Quantify or identify the dominant decision making style used to make the decision.

3.5.1.1 Identify six decision tasks

In order to conduct a validation of the classification tool in terms of its ability to predict all six decision making styles, six decision tasks must be identified; one that provokes each decision making style. From the JCDS front-end analysis, it was not possible to identify enough JCDS tasks such that each decision making style would be provoked by the decision making styles classification tool. Therefore, for the purpose of this example, one JCDS task; 'acquire situation awareness' is used. A description of this task including the purpose, responsibility, decision requirements, timeliness, criticality and social context (group vs. individual decision making) are identified in Table 4.

3.5.1.2 Identify relevant person-based, social/group and situation/context factors (i.e. independent variables)

The person-based, social and contextual factors relevant to the task of acquiring situation awareness can be considered independent variables as they represent inputs into the classification tool and thereby directly affect the preferred decision making style. According to the JCDS front-end analysis the task of acquiring situation awareness may include the following factors that are relevant to decision making styles:

- Social/group factors: Culture (individualistic vs. collective, specific individualistic culture – inductive vs. deductive), Groupthink, Social Loafing

The task of acquiring situation awareness is mainly the responsibility of the Joint Staff Action Team (JSAT) and therefore it is assumed that this task primarily involves group decision making as opposed to decision making at the individual level. It is therefore assumed that any of the social/group factors relating to decision making styles, such as culture, groupthink and social loafing, could be relevant to the task of acquiring situation awareness.

- Context/situation factors: Type of Behaviour (e.g. rule-based, knowledge-based, skill-based), Time Pressure, Ambiguity

Based on the limited amount of detail provided in the JCDS front-end analysis with respect to decision tasks, it is assumed that the task of acquiring situation awareness is associated with significant time pressure given that timeliness is listed in "hours" as opposed to "days" or "weeks" (see Table 4). It is also assumed that there is a certain level of ambiguity associated with this task given that the acquisition of situation awareness typically involves aggregating and interpreting a great deal of information and can be thought of as going from a state of unknown to known. Hence, at the beginning of the task of situation awareness acquisition, there would undoubtedly be a significant amount of ambiguity. Finally, it is assumed that acquiring situation awareness would involve mostly knowledge-based behaviour, as opposed to rule-based or skill-based, given that acquiring situation awareness typically involves situations that are novel and unexpected and therefore requires a more advanced level of reasoning, compared to following step-by-step instructions.

3.5.1.3 Quantify relevant person-based, social/group and situation/context factors to the extent possible

As mentioned above, the relevant social and contextual factors identified above represent the independent variables that would be inputted into the classification tool. In order to assess the validity of the classification tool to predict a particular decision making style that would be associated with the JCDS task of acquiring situation awareness, it is necessary to quantify these factors in some manner. The culture (i.e. individualist vs. collective) of the group involved in the decision making task can be assessed by means of a questionnaire. However, the existence of social loafing or groupthink would require either self-report or observational assessment of representative participants performing the situation awareness acquisition task.

3.5.1.4 Participants perform the decision task (actual or simulated)

Representative participants from the JSTAFF would be required to perform the task of acquiring situation awareness, either in an actual or simulated environment. Observation of the task by may be valuable in determining the decision making style(s) used by the decision maker(s). This is discussed further in the following section.

3.5.1.5 Quantify or identify relative contribution of decision making styles

The decision making styles classification tool provides a score for each of the six types of decision making style, of which the highest score represents the preferred decision making style. Therefore, the outcome of the validation methodology should also reflect a relative scoring of each decision making style. The notion of relative scoring of analytical, naturalistic, avoidant, dependent, spontaneous and heuristic decision making styles also has merit in that it is conceivable that a combination of decision making styles, rather than one single style could be used in any given task. However it is likely that, even when a combination of styles is used, one decision making style will dominate or be the preferred style. The validation tool was developed on this premise.

The relative scores for each decision making style used by the JSTAFF in acquiring situation awareness represent the dependent variables in this validation methodology. Hence, the relative preference for analytical, naturalistic, avoidant, dependent, spontaneous or heuristic decision making styles used by the JSTAFF in acquiring situation awareness (in an actual or simulated task) would need to be quantified. This can be done through self-report measures using a decision making styles scale designed to quantify the relative contribution or preference for each of the six decision making styles. Ideally such a measure would be administered at several points throughout the task to determine if the preferred decision making style changes throughout the duration of the task. The outcome of this measure, for each participant, would be a score for each of the six decision making styles which represents the preference for each of these styles. A measure of decision making styles could be modelled after the Decision Making Styles Inventory (DMI) developed by Nygren (2002) or the General Decision-Making Style Measure (GDMS) developed by Scott and Bruce (1995). The DMI was designed to identify and differentiate between analytical, intuitive, avoidance and regret-based emotional decision making styles, whereas the GDMS was designed to identify and differentiate between rational, avoidant, intuitive, dependent and spontaneous decision making styles.

Alternatively, decision making performance and the relative contribution of decision making styles could be rated by Subject Matter Expert (SME) observers. The SMEs would need to recognize specific behaviours that have been matched to the specific decision making styles. The matching of specific

behaviours to the six decision making styles would need to be completed prior to the validation process by individuals who are well acquainted with research in the area of decision making styles. The use of Behaviourally-Anchored Rating Scales (BARS) can facilitate the matching of behaviours with a rating scale. While there are a number of approaches to the construction of ratings scales, BARS have emerged as a preferred technique because the behavioural descriptors are thought to provide the necessary anchors to enhance the precision of the rating, to standardise across observers and to screen out idiosyncrasies.

Finally, preferred decision making styles could be identified by the participants themselves. The participants could be asked to verbalize their thought process (i.e. think aloud) while performing a simulated or actual decision task. An analyst could then associate participant thoughts or behaviours with corresponding decision making styles.

3.5.1.6 Data Analysis

To complete the validation process, the outcome of this step (i.e. the quantification of the relative contribution of decision making styles) must be compared to the output of the classification tool. The quantification of the relative preference for decision making style should be in a format that is comparable to the output of the decision making styles classification tool. That is, the outcome should be an individual score for each of the six decision making styles, with the highest score representing the preferred style. Alternatively, it could be assumed that an individual will adopt one specific decision making style and then have a number of participants perform the task and see if the numbers match those from the classification tool.

The scores for each decision making style would then be correlated with the outcome of the classification tool. A strong positive correlation between the scores produced by the classification tool and those resulting from the empirical validation experiment would suggest that the classification tool is effective in predicting a preferred decision making style for a given task and decision maker(s).

As noted earlier in this report, the validation process should be repeated for a number of decision tasks such that each decision making style is provoked. As well, the validation methodology should be repeated with a number of participants in order to achieve a sample size that can be used to statistically validate the classification tool.

4. Final Conclusions and Recommendations

The ultimate aim of this work was to develop of a survey tool that can be used to classify preferred decision making styles adopted by an individual or group of individuals for a given decision task. This report describes a contextual analysis of tasks performed by the JSTAFF with respect to decision making styles, the development of a decision making styles classification system and an experimental validation methodology with which to evaluate the decision making styles classification system.

The objective of the contextual analysis was to identify and summarize individual, organizational, and environmental factors relevant to decision making in the JCDS environment. Unfortunately the JCDS front-end analysis (Greenley et al., 2005) was not as detailed as anticipated and therefore the contextual analysis could not be as comprehensive as desired. A more comprehensive contextual analysis would be possible given a more detailed characterization of JCDS decision making tasks.

Specific information that would be required with respect to decision making tasks in the JCDS environment that would facilitate a more comprehensive contextual analysis would include specific contextual factors such as time pressure, level of ambiguity and type of behaviour involved in the task (i.e. rule-based, skill-based or knowledge-based). If practical, knowledge of relevant social/group factors such as the cultural diversity or the existence of social biases such as groupthink and social loafing would be desirable for tasks involving group decision making. For tasks involving individual decision making, knowledge of characteristics of the decision maker(s) such as age, personality and cognitive style would be valuable in order to better predict preferred decision making style using the classification tool.

The goal of the decision making styles classification tool is to attempt to predict the relative contribution of specific decision making styles (i.e. analytical, intuitive, etc.) given a specific task and decision maker(s). It considers factors relevant to the task as well as the decision maker and calculates a score for six different decision making styles: analytical, naturalistic, avoidant, dependent, spontaneous and heuristic. The decision making style with the highest overall score can be considered the preferred style for the specific task in question. A literature review was conducted to identify several person-based, social/group and context/task factors that influence one's decision making style, as well as the six different decision making styles mentioned above.

As noted previously in the report, the decision making styles classification tool is based on literature with limited empirical support. Specifically, main effects of most person-based (e.g. personality), social (e.g. culture) and contextual factors (e.g. time pressure) on decision making style are tenuous at best. Not surprisingly then, interaction effects between different factors are also not well supported by the decision making styles literature. However, the person-based, social and contextual factors identified by the literature survey do provide a starting point for investigating the predictive power of individual factors in decision making style preference. Ideally future iterations of a decision making styles classification tool should be based on well-founded empirical research. It should also account for different weighting of factors as well as interaction effects between factors when calculating final decision making style scores. Validation of the classification tool using several tasks performed by the JSTAFF would be necessary to evaluate its power to predict a preferred decision making style. Ultimately, an assessment tool, based on solid empirical research, that can be used to classify the kinds of decision making styles consistently employed by an individual or group of individuals for a given decision task could be extremely valuable in high risk decision making tasks such as those encountered

by the JSTAFF. The creation of decision support tools for a commander and/or his staff could be a logical outcome of such a classification tool. As well, a decision making styles classification tool could lend itself well to the development of recommended procedures for specific decision making tasks and/or preferred individual characteristics of decision makers for specific tasks.

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List of Acronyms

The following acronyms and abbreviations have been used in this paper.

BARS	Behaviourally-Anchored Rating Scales
CDS	Chief of Defense Staff
CEB	Command Effectiveness Behaviour
CF	Canadian Forces
CF OPP	Canadian Forces Operations Planning Process
COS J3	Chief of Staff J3
DCDS	Deputy Chief of the Defence Staff
DG	Director General
DGOR	Director General Operational Research
DJFC	Director Joint Force Capabilities
DMI	Decision Making Styles Inventory
GDMS	General Decision-Making Style Measure
I2	Information and Intelligence
JCDS 21 TD	Joint Command Decision Support for the 21st Century Technology Demonstration
JIMP	Joint Interagency Multinational Public
JSAT	Joint Staff Action Team
JSTAFF	Joint Staff
MND	Minister of National Defence
OV-3	Operational View #3
SA	Scientific Authority
SME	Subject Matter Expert
SOW	Statement of Work

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(U) The Joint Command Decision Support for the 21st Century Technology Demonstration (JCDS 21 TD) project investigates individual and organizational factors, as well as technology, with respect to decision making. As part of the JCDS 21 TD work plan, it is necessary to gain an understanding of current scientific research on human decision making, individual differences, and the potential to identify consistent individual preference for specific decision making styles.

Research has indicated that a variety of individual factors affect the way in which people make decisions. In addition, individual strategies can be more or less suited to different kinds of task domains. Thus, it is important to develop an understanding of the individual differences in decision making strategies or approaches. In particular, this work seeks to identify separate decision strategies within an organized categorization scheme which is based on empirical research. This framework will serve as the basis for then exploring the individual factors that predict the use of given strategies as well as the consistency with which individuals favour any given strategy. The ultimate aim of this work was the development of a survey tool that can be used to classify the kinds of decision strategies consistently adopted by an individual.

This work represents follow−on work from a literature survey in which a review was conducted of current scientific literature relevant to decision making styles and person−based, social/group and situation/context factors that may affect one's selection of or preference for specific decision making styles. In particular, this report describes a contextual analysis of tasks performed by the JSTAFF with respect to decision making styles, the development of a decision making styles classification system and an experimental validation methodology with which to evaluate the decision making styles classification system. In addition, recommendations are made for future iterations of a decision making styles classification tool and further validation of the classification tool.

(U) Le Projet de démonstration de technologies – Aide à la décision des commandements interarmées pour le XXIe siècle (PDT ADCI 21) porte sur les facteurs individuels et organisationnels et sur la technologie qui interviennent dans la prise de décisions. Dans le cadre du plan de travail du PDT ADCI 21, il est nécessaire d'arriver à une meilleure compréhension de la recherche scientifique actuelle sur la prise de décisions des humains, les différences individuelles et la possibilité de reconnaître des préférences individuelles constantes pour certains styles de prise de décisions.

Les recherches ont montré que divers facteurs individuels ont une incidence sur la façon dont les gens prennent des décisions. De plus, des stratégies individuelles peuvent être plus ou moins bien adaptées à différents domaines de tâches. Il est donc important d'en arriver à comprendre les différences individuelles dans les stratégies ou les approches décisionnelles. Ce travail vise en particulier à distinguer des stratégies décisionnelles en fonction d'une catégorisation méthodique reposant sur des recherches empiriques. Ce cadre servira ensuite de base à l'étude des facteurs individuels qui invitent à l'utilisation de stratégies données et de la constance avec laquelle des individus favorisent telle ou telle stratégie. L'objectif ultime de ce travail est la définition d'un outil d'enquête qui puisse servir à classifier les types de stratégies décisionnelles auxquelles un individu a recours de façon constante.

Ce travail fait suite à une recherche bibliographique qui comportait un examen des ouvrages scientifiques récemment consacrés aux styles de prise de décisions et aux facteurs individuels, sociaux et contextuels qui peuvent avoir une incidence sur le style de prise de décisions qu'une personne applique ou préfère. Ce document présente en particulier une analyse contextuelle des tâches de l'État−major interarmées (EMI) du point de vue des styles de prise de décisions, de la définition d'un outil de classification des styles de prise de décisions et d'une méthodologie de validation expérimentale qui permettrait d'évaluer l'outil de classification des styles de prise de décisions. De plus, des recommandations sont faites au sujet des itérations futures d'un outil de classification des styles de prise de décisions et de la validation subséquente de l'outil de classification.

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(U) decision−making styles; individual differences