Defence Research and Development Canada
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Enabling Collaborative Capability through Virtual Teamwork ...

The Way Ahead

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TECHNICAL MEMORANDUM
DRDC Ottawa TM 2003-217
December 2003

Canada

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Abstract

The concept of virtual teamwork is being applied throughout various organizations by bringing together key players into a collaborative environment to work on joint initiatives and solutions to common problems. In essence, enabling collaborative capability through virtual teamwork represents a fundamental transitioning to more effective organizational work practices. In this paper, a conceptual overview of the people, processes and technologies for supporting virtual teamwork is examined and applied to integrated collaborative environments. The focus is on providing a strategic roadmap , a way ahead, to enable work teams to collaborate more effectively across organizational boundaries. The innovative development and implementation of a collaborative capability engineering environment concept, entitled, *Facilities for Optimization, Conceptualization, Collaboration and Integration (FOCCI)*, is introduced in conjunction with the Advanced Collaborative Capability Engineering System (ACCES) lab environment. This environment is being supported by a knowledge portal that will enable enhanced team collaboration and communication for optimum decision-making capabilities. The primary focus is on creating an integrated environment that will facilitate virtual teaming skills, techniques and tools to foster greater synergy among teams. The paper concludes with the importance of establishing business processes for advancing collaborative environments, and puts forward the initial steps for establishing a strategy for virtual collaboration and teamwork. It underscores the importance of understanding teamwork processes and strategies, including: group and interpersonal processes/group dynamics, social networks, communication strategies and information technology availability for effective teamwork within virtual collaborative environments. Integrative theoretical frameworks and models in group dynamics (e.g., team cohesion, team building) and group processes (e.g., team recognition and rewards, team reporting, team performance) and the embedding context in which groups operate (e.g., virtual collaborative environments or face-to-face) will need to be researched further to better understand the impact of enabling collaborative capability through virtual teamwork.

Résumé

Le concept de travail d'équipe virtuel est appliqué dans diverses organisations; il consiste à rassembler des joueurs clés dans un environnement de collaboration afin qu'ils travaillent ensemble à des initiatives et à des solutions liées à des problèmes communs. La mise en œuvre d'une capacité de collaboration grâce au travail d'équipe virtuel constitue essentiellement une transition importante vers des pratiques de travail organisationnelles plus efficaces. Dans le présent document, un aperçu conceptuel des personnes, processus et technologies nécessaires à l'appui du travail d'équipe virtuel est examiné et appliqué à des environnements de collaboration intégrés. L'objectif est de fournir une feuille de route stratégique, une voie à suivre, pour permettre aux équipes de travail de collaborer plus efficacement en dépit des frontières organisationnelles. L'élaboration et la mise en œuvre innovatrices d'un concept d'environnement destiné à l'ingénierie de la capacité de

collaboration, intitulé *Installations d'optimisation, de conceptualisation, de collaboration et d'intégration (FOCCI)*, sont présentées parallèlement à l'environnement de laboratoire du *Système avancé d'ingénierie de la capacité de collaboration* (ACCES). Cet environnement est appuyé par un portail de connaissances qui améliorera la communication et la collaboration d'équipe pour optimiser les capacités décisionnelles. Le principal objectif est de créer un environnement intégré favorable aux aptitudes, aux techniques et aux outils de travail d'équipe virtuel pour accroître la synergie entre les équipes. La conclusion du document traite de l'importance d'établir des processus opérationnels pour favoriser les environnements de collaboration et présente les étapes initiales en vue d'élaborer une stratégie relative à la collaboration et au travail d'équipe virtuels. La conclusion insiste sur l'importance de comprendre les stratégies et les processus liés au travail d'équipe, y compris les processus de groupe et interpersonnels/la dynamique de groupe, les réseaux sociaux, les stratégies de communication et l'accessibilité à la technologie de l'information pour assurer un travail d'équipe efficace au sein d'environnements de collaboration virtuels. Des recherches additionnelles seront nécessaires en ce qui a trait aux cadres et modèles théoriques d'intégration dans les domaines de la dynamique de groupe (p. ex., cohésion de l'équipe, promotion du travail d'équipe) et des processus de groupe (p. ex., reconnaissance et prix d'équipe, rapports d'équipe, rendement de l'équipe) ainsi qu'au contexte intégré dans lequel les groupes travaillent (p. ex., environnements de collaboration virtuels ou face à face) afin de mieux comprendre l'incidence de la mise en œuvre d'une capacité de collaboration misant sur le travail d'équipe virtuel.

Executive summary

The concept of virtual teamwork is being recognized as an essential component for enabling collaborative capability within an integrated workspace environment. Technological feasibility, time efficiency, immediate access and cost effectiveness are significant business process improvements to effective virtual teamwork, and in turn, provide greater incentives for building collaborative environments. As organizations begin to work and collaborate virtually, the need for collaborative tools enables people to share data, information and knowledge in real-time. Collaborative environments encourage people to build trust, enhance communications skills, and facilitate interactive communication and social interaction.

The building blocks of virtual collaborative environments—people, process and technology—demonstrate the importance of sustaining successful teams across global networks. In enabling collaborative capability through virtual teamwork, the establishment of Integrated Project Teams (IPTs) represents a central and fundamental element of organizational design for enabling more effective work processes. Similarly, virtual communities (e.g., virtual IPTs and communities of practice or communities of interest) are regarded as communities engaged in collective learning within a collaborative environment and apply this learning into social practice. Working within a virtual community enables members to contribute to the successful integration and empowerment of teams.

With the advent of collaborative environments and the fundamental role of virtual teamwork, organizations are implementing global network infrastructures to foster and maintain stronger linkages for enhanced communication and productivity. There are several examples of collaborative tools and technologies that are being employed within virtual environments for enhanced communication and organizational knowledge. These tools enable meetings and information sharing (e.g., file, application and presentation sharing, joint authoring and white boarding, and use of public folders); messaging and discussion (e.g., chat, instant messaging and threaded discussions); and audio and video conferencing (e.g., teleconferencing and audio and video capabilities). Knowledge portals, business directories, WebCams, and virtual team collaborative software and GroupWare also contribute to the effectiveness of teamwork strategies.

The need to explore collaborative environments within the defence community has led to the conceptualization of an infrastructure that will support distributed collaborative workspaces. The exploration of an overarching concept, entitled, *Facilities for Optimization, Conceptualization, Collaboration and Integration (FOCCI)*, is introduced to facilitate a better understanding of working within a virtual team environment. Leading change for enhancing business processes, supporting virtual teams, sharing knowledge, communicating, building trust and empowering teams are the main tenets of FOCCI. One of the facilities under FOCCI is the introduction of the Advanced Collaborative Capability Engineering System (ACCES) lab environment that is currently being implemented within the Future Forces Synthetic Environments (FFSE) section in Defence Research and Development Canada (DRDC)—Ottawa. The primary focus is on creating an integrated environment that will enable virtual teaming skills, techniques and tools to foster greater synergy among teams. The intent of this facility is to enable teams to build greater alliances and to work more effectively cross-

functionally, globally and virtually between team members. This environment is being supported by a knowledge portal that will enable enhanced team collaboration and communication for optimum decision-making capabilities.

In establishing business processes and strategies for advancing collaborative environments, such as ACCES, several initial steps have been proposed, namely: defining virtual collaboration and what it means for an organization; assessing the activities, tasks and initiatives that would benefit from virtual collaboration or virtual team work; examining work practices and the cultural implications of working within collaborative environments; understanding the role of trust among virtual team members for better awareness of group dynamics and social interactions; exploring with senior management the benefits of collaborative environments and teamwork, and their impacts on business models; developing a set of guidelines and a framework for a clearer definition of the changing nature of current work practices; and incorporating the performance metrics and the success of virtual collaborative environments. These initial steps will enable people to assess the importance of adapting workspaces to meet the demands of future business practices.

Various collaborative technology platforms can enable teams to work within a virtual environment; however, it is essential to ascertain if particular teamwork processes and strategies contribute to effective global teamwork practices. Building social networks of team members can be difficult, especially when trying to bridge project teams within a global context. The impacts and limitations of geographical separation, organizational cultural norms and practices, physical environment, information technology support, communication policies and strategies, and leadership are key elements to understanding the implications of virtual teamwork. Integrative theoretical frameworks and models in group dynamics (e.g., team cohesion, team building) and group processes (e.g., team recognition and rewards, team reporting, team performance) and the embedding context in which groups operate (e.g., virtual collaborative environments or face-to-face) will need to be researched further to better understand the impact of enabling collaborative capability through virtual teamwork.

Waruszynski, B.T. 2003. Enabling Collaborative Capability through Virtual Teamwork … *The Way Ahead*. DRDC Ottawa TM 2003-217. Defence R&D Canada - Ottawa.

Sommaire

On reconnaît maintenant le concept de travail d'équipe virtuel comme un élément essentiel pour mettre en œuvre une capacité de collaboration au sein d'un environnement de travail intégré. La faisabilité technologique, l'économie de temps, l'accès immédiat et la rentabilité sont des améliorations importantes apportées par les processus opérationnels du travail d'équipe virtuel, et partant, favorisent davantage la mise en place d'environnements de collaboration. À mesure que les organisations commencent à travailler et à collaborer de façon virtuelle, des outils de collaboration sont nécessaires pour permettre aux personnes d'échanger des données, de l'information et des connaissances en temps réel. Les environnements de collaboration encouragent les gens à créer un climat de confiance, améliorent la capacité de communiquer et facilitent la communication interactive et les interactions sociales.

Les composantes de base des environnements de collaboration virtuels—les personnes, les processus et la technologie—mettent en évidence l'importance de soutenir des équipes efficaces dans des réseaux mondiaux. Dans le cadre d'une capacité de collaboration recourant au travail d'équipe virtuel, la mise sur pied d'équipes de projet intégrés (EPI) est un élément central et fondamental de conception organisationnelle afin de parfaire l'efficacité des processus de travail. Dans le même ordre d'idées, les communautés virtuelles (p. ex., les EPI, les communautés de pratique ou les communautés d'intérêts) sont considérées comme des groupes se vouant à l'apprentissage collectif au sein d'un environnement de collaboration et appliquent cet apprentissage dans le cadre de pratiques sociales. Le travail au sein d'une communauté virtuelle permet aux membres de contribuer au succès de l'intégration et de la responsabilisation des équipes.

Avec l'arrivée d'environnements de collaboration et compte tenu du rôle fondamental du travail d'équipe virtuel, les organisations implantent des infrastructures réseau mondiales pour établir et maintenir des liens forts dans le but de favoriser la communication et d'accroître la productivité. Il existe plusieurs exemples d'outils et de technologies de collaboration utilisés dans les environnements virtuels pour améliorer les communications et le savoir organisationnel. Ces outils permettent aux personnes de tenir des réunions et d'échanger de l'information (p. ex., échange de dossiers, d'applications et d'exposés, création conjointe, utilisation du tableau blanc et partage de répertoires publics); d'échanger des messages et de discuter (p. ex., clavardage, messagerie instantanée et fils de discussion); de participer à des conférences audio et vidéo (p. ex., téléconférence et capacités audio et vidéo). Les portails de connaissances, les répertoires d'entreprises, les caméras Web, les logiciels de collaboration d'équipe virtuelle et les collecticiels sont également des éléments qui contribuent à l'efficacité des stratégies de travail d'équipe.

Le besoin d'explorer des environnements de collaboration au sein de la collectivité militaire a mené à la conceptualisation d'une infrastructure qui soutiendra les espaces de travail de collaboration répartis. L'exploration d'un concept d'ensemble appelé *Installations d'optimisation, de conceptualisation, de collaboration et d'intégration (FOCCI)* est présentée pour accroître la compréhension du travail au sein d'un environnement de travail virtuel. Être à l'avant-garde des changements pour l'amélioration des processus opérationnels, soutenir les équipes virtuelles, échanger des connaissances, communiquer, créer un climat de confiance et

responsabiliser les équipes sont les principes de base des FOCCI. Un des éléments des FOCCI, l'environnement de laboratoire du Système avancé d'ingénierie de la capacité de collaboration (ACCES), est en cours d'implantation au sein de la section des environnements synthétiques pour les futures forces (ESFF) à Recherche et développement pour la défense Canada (RDDC) – Ottawa. Le principal objectif est de créer un environnement intégré favorable aux aptitudes, aux techniques et aux outils de travail d'équipe virtuel pour accroître la synergie entre les équipes. Le but de cette installation est de permettre aux équipes de bâtir des alliances solides et de travailler plus efficacement, interfonctionnellement, globalement et virtuellement. L'environnement est soutenu par un portail de connaissances qui accroîtra la collaboration d'équipe et la communication afin d'optimiser les capacités décisionnelles.

En établissant des processus opérationnels et des stratégies pour l'avancement d'environnements de collaboration, tels qu'ACCES, plusieurs étapes initiales ont été proposées, notamment : définir la collaboration virtuelle et ce qu'elle signifie pour une organisation; évaluer les activités, tâches et initiatives qui bénéficieraient de la collaboration virtuelle ou du travail d'équipe virtuel; examiner les pratiques de travail et les incidences culturelles liées au fait de travailler au sein d'environnements de collaboration; comprendre le rôle de la confiance entre les membres d'une équipe virtuelle pour mieux comprendre les dynamiques de groupe et les interactions sociales; explorer avec la haute direction les avantages des environnements de collaboration et du travail d'équipe ainsi que leurs incidences sur les modèles opérationnels; élaborer un ensemble de lignes directrices et un cadre pour définir plus clairement la nature changeante des pratiques de travail actuelles et inclure des mesures de rendement et le succès des environnements de collaboration virtuels. Ces étapes initiales permettront aux personnes d'évaluer l'importance d'adapter les espaces de travail afin de satisfaire aux demandes des pratiques opérationnelles futures.

Diverses plates-formes technologiques de collaboration peuvent permettre aux équipes de travailler dans un environnement virtuel. Toutefois, il est essentiel de déterminer si des processus et stratégies particulières contribuent à l'efficacité globale des pratiques de travail d'équipe. Constituer des réseaux sociaux formés de membres d'équipe peut être difficile, surtout lorsqu'on tente d'établir des ponts entre les équipes de projet dans un contexte mondial. Les incidences et les limites liées à la distance géographique, les normes et pratiques culturelles organisationnelles, l'environnement physique, le soutien en matière de technologie de l'information, les politiques et stratégies de communication ainsi que le leadership sont des éléments clés qui permettent de saisir les répercussions du travail d'équipe virtuel. Des recherches additionnelles seront nécessaires en ce qui a trait aux cadres et modèles théoriques d'intégration dans les domaines de la dynamique de groupe (p. ex., cohésion de l'équipe, promotion du travail d'équipe) et des processus de groupe (p. ex., reconnaissance et prix d'équipe, rapports d'équipe, rendement de l'équipe) ainsi qu'au contexte intégré dans lequel les groupes travaillent (p. ex., environnements de collaboration virtuels ou face à face) afin de mieux comprendre l'incidence de la mise en œuvre d'une capacité de collaboration misant sur le travail d'équipe virtuel.

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1. Introduction

The concept of virtual teamwork is being applied throughout various organizations by bringing together key players who need to work on joint initiatives and solutions to common problems. In essence, working within an integrated collaborative environment enables people to capture, share and leverage organizational knowledge to advance organizational business objectives. Collaborative environments encourage people to build trust, enhance communications skills, and facilitate interactive communication and social interaction. Enabling collaborative capability through virtual teamwork is carried out through the creation of a synergistic integrated work space environment. Creating a collaborative lab environment, for example, provides a specific venue for workers and geographically dispersed workers to participate in discussions, share information and engage in more creative and innovative thinking for enhanced decision-making capabilities. As organizations begin to work and collaborate virtually, the need for collaborative tools enables people to share data, information and knowledge in real-time. Technological feasibility, time efficiency, immediate access and cost effectiveness are significant business process improvements to effective virtual teamwork, and in turn, provide greater incentives for building virtual collaborative environments.

This paper provides a conceptual overview of the people, processes and technologies for supporting virtual teamwork through an integrated collaborative environment. It introduces the innovative development and implementation of a collaborative capability engineering environment concept, entitled, *Facilities for Optimization, Conceptualization, Collaboration and Integration (FOCCI)*. Leading change for enhancing business processes, supporting virtual teams, sharing knowledge, communicating, building trust and empowering teams are the main tenets of FOCCI. One of the facilities under FOCCI is the introduction of the Advanced Collaborative Capability Engineering System (ACCES) lab environment that is currently being implemented within the Future Forces Synthetic Environments (FFSE) section in Defence Research and Development Canada (DRDC) Ottawa. The primary focus is on virtual teaming skills, techniques and tools to help foster collaborative capability. Finally, this paper builds on the importance of establishing business processes for advancing collaborative environments, and puts forward the initial steps for establishing a strategy for virtual collaboration and teamwork.

2. The Building Blocks of Virtual Collaborative Environments: People, Process and Technology

Collaboration is defined as: "a relationship that involves active participation of partners in joint projects in order to develop new or significantly improved products (goods or services) and/or production processes" (Statistics Canada, 1999). Collaboration can also be regarded as a "complex problem-solving process in which people strive toward one or more common goals, seek to understand each others' perspectives, and share ideas that stimulate the thinking of others" (Gumpert, 2003). These definitions can be extended even further when a catalyst, for example, a collaborative environment, is initiated to build stronger linkages for enhanced decision-making capabilities. Collaborative environments are primarily regarded as social network environments of subject matter experts supported by interoperable tools, information resources, and product/process models that are structured around a common initiative or set of problems. Collaborative environments enable organizations to accomplish important strategic changes and improvement processes successfully by: collaborating across organizational boundaries; empowering work teams with information and knowledge; teaming skills and techniques to foster collaborative capability; building trust and enhancing communication skills for effective delivery; and reducing stovepipes. Virtual collaborative environments unite the workforce into a central virtual workspace (mainly Web-based) to enable team members to work on a specific set of goals for enhanced problem-solving and decision-making capabilities.

Drawing from the concept of virtual collaborative environments is the introduction of the Collaborative Capability Engineering Environment. The Collaborative Capability Engineering Environment stems primarily from the virtual teamwork concept, stressing the importance of linking people with a common purpose to cross-disciplinary information by using a shared toolset in real time. The collaborative capability engineering environment has its origin rooted in the virtual laboratory or virtual lab concept. A virtual lab can be defined as "a heterogeneous, distributed problem-solving environment that enables a group of researchers located around the world to work together on a common set of projects (*Internet 2*, 2001).[1] Virtual labs and collaborative engineering environments are becoming more pronounced within the scientific community, integrating shared information and resources toward achieving common business goals and objectives. As a result, key contributors are able to work collaboratively using resources for completing joint work objectives.

The issue of managing collaborative engineering labs provides some insights into how these labs are being transformed through the implementation of advanced technologies. At an

[1] See *Internet 2* for a more comprehensive understanding of virtual labs. http://internet2.edu/html/virtual_laboratory.html. *Internet2* is a group of more than 180 universities that are collaborating with industry and government for advancing network applications and technologies.

International Quality and Productivity Center (IQPC) event in London (England),[2] emerging trends in innovation management indicate a move away from centralized to decentralized labs. Linking people and work teams across geographically dispersed locations represents the importance of unity and robustness in more collaborative functions between organizations and their satellite communities.

2.1. People: Integrating Virtual Teams

The concept of virtual teams has sparked great enthusiasm among organizational communities. According to Jude-York et al (2000, 5), the move towards virtual teams has resulted from global competition, fast-paced work, strategic alliances/partnerships, cross-organizational teamwork, decentralized decision-making, traffic and commute challenges, work/home balance, cost savings to organizations, accelerated learning and knowledge sharing, cultural diversity, customer focus, flatter organizational structures, the "team" as the unit of performance, and mergers/acquisitions. British Petroleum Amoco (BPA) was one of the earliest corporations to fully embrace virtual teamwork on a company-wide basis by employing satellite videoconferencing technology to manage dozens of remote sites around the world. As a result, BPA was able to share critical data and accident prevention strategies among platform workers, construction contractors, structural engineers, and geologists.[3] In a Norwegian engineering company, virtual teams represent a viable way of organizing knowledge work (Line, 1997). The researchers who examined virtual engineering teams within this medium-sized Norwegian company with 16 regional offices concluded that "virtual teams will be a common and natural organizational form for companies who want to be part of the open information society." Royal Dutch/Shell also employ virtual team environments by implementing a full spectrum of collaborative tools, including e-mail, video and teleconferencing with its core team application (i.e., Livelink software by OpenText).[4] Canadian Tire has also employed the concept of virtual teaming within its Human Resources division. Human Resources practitioners are located in different regions of the country and use video conferencing (with telephone and email for side channels) as their principle means for gathering and for exchange ideas (VirtualTeamworks.com). These examples demonstrate the significance of developing and implementing virtual teams for enhanced collaborative capability.

Interdependence within a team environment is key to being able to work toward shared common goals. There are four key ingredients that enable teams to be successful: the urgent need to work together, shared accountability, commitment to teamwork and active communication (Jude-York et al, 2000, 22). On-line communities are most successful when the virtual team members work together in a virtual space, and are able to recognize each

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[2] David Skyrme Associates (1999) provides an overview of the IQPC findings on virtual laboratories within the R&D environment. See his web site: http://www.skyrme.com/updates/u17.htm as well as links to IQPC Web site.

[3] In VirtualTEAMWORKS.com, there are several case studies that specifically examine virtual collaboration and teamwork.

[4] For a comprehensive look on team collaboration in the workplace, please refer to Lowell Rapaport's article on *Team Collaboration Unites the Workforce*, Transform Magazine, February 2003, URL: http://www.transformmag.com/db_area/archs/2003/02/tfm0302f2_1.shtml.

other's identities and personalities (Carpenter, 1998). The social development of teams is pivotal to fostering interpersonal relationships. Researchers at Harvard Business School conducted a study on virtual teams using the American Management Systems international consulting firm to understand employees' interpersonal relationships within virtual teams. The researchers discovered that although communication technologies play a vital role in maintaining interoperable teamwork, on-line managers focused heavily on the social development of their project teams and ensured that the technologies were linked to the needs of the team members (Leonard et al, 1998, 293).

People represent the fundamental core of an organization; and as a result, developing team work strategies will enable individuals and groups to communicate and establish better skills for enhanced decision-making capabilities. Significant benefits of work teams continue to be evidenced across organizations, focusing on the importance of individual contributions to effective teamwork. Table 1 outlines the importance of individual benefits arising from successful work teams. Fostering high impact teams is integral to augmenting organizational capacity. Maintaining a common vision (and goals), valuing and harnessing diversity, and fostering effective communication are key enablers to successful team implementation.[5] By working within virtual environments, work teams are able to improve organizational capabilities by providing better, faster and more rigorous products and services. For example, investing in (virtual) Integrated Project Teams (IPTs) is becoming more desirable across organizations to ensure that customer needs and requirements are being fulfilled. Integrated Project Teams are spearheading the advancement of organizational work practices. Implementing IPTs within collaborative environments elevates this advancement to a new level.

[5] See Ron Jungalwalla for a comprehensive overview on *Transforming Groups into Teams*, Team Management Systems Online, URL: http://www.tms.com.au. This article was originally published in the *Executive Excellence*, Vol. 17, No. 2, February 2000.

Table 1 Teams and their Benefits

Individual Benefits

"Teams can satisfy some of the strongest needs suggested by Maslow (1954)'s hierarchy: *the need to belong and the need for self-fulfillment.* Belonging to a team provides a sense of security and individual worth, and the opportunity for contribution at a higher level than we may be able to achieve as individuals. IPTs[6] also offer the opportunity for individuals to satisfy the inherent social needs of communication, sharing, and helping others. It may seem that self-actualization could only be reached by an individual alone. However, individuals working in teams can help each other reach high levels of performance and by doing so bring about self-actualization.

Teams can also provide emotional support through rough times. Katzenbach and Smith (1993) consider a high performing team as one whose team members feel a close responsibility for the individual welfare of other team members. High team spirit is an expression of an emotional relationship among team members.

Empowered teams may satisfy Maslow's highest needs for creativity and self-fulfillment and can capture the hearts and minds of their team members. When this occurs, team members have tremendous job satisfaction, high morale and a strong sense of contribution to team goals.

The way you come to know yourself as an individual is through your relations with others. Being a team member offers significant opportunities to learn from the interpersonal relationships built up through team collaboration. The inherent feedback among team participants helps individual members know themselves better. Through an understanding of their own contributions to the team and the results of the full power of team accomplishment, they each gain a sense of purpose and commitment. These are significant factors in creating empowerment leading to a further increase in team and individual performance.

Teams can greatly facilitate individual learning through team discussions, problem solving and decision making. Senge (1990) has noted that adults learn by interaction and by trial and error, both of which are natural to teams. How work gets done in organizations and how teams interact can influence both individual and organizational learning."

Source: Office of the Assistant Secretary of the Navy (Research, Development and Acquisition), DON Acquisition One Source, Department of Defense(US). (2003). Reprinted with permission.

[6] The Office of the Assistant Secretary of the Navy for Research, Development and Acquisition focuses on Integrated Product Teams. The individual benefits outlined within the Integrated Product Teams are congruent to the benefits that can be derived within Integrated Project Teams.

2.1.1 Integrated Project Teams

In enabling collaborative capability through virtual teamwork, the establishment of Integrated Project Teams (IPTs) represents a central and fundamental element of organizational design for enabling more effective work processes. Integrated Project Teams help to incorporate and augment cross-functional knowledge and cross-organizational perspectives to provide more effective concept development, decision making, problem solving and project implementation. Integrated Project Teams can be regarded as *information and knowledge teams* that bring their expertise, skills and knowledge for faster and better decision-making capabilities within individual groups and contribute to other IPTs for meeting specific objectives and targets. Team knowledge and knowledge transfer are fundamental to the success of attaining group objectives and targets. Streamlining coordination and communication within IPTs and between multiple IPTs help to promote a better understanding of the objectives, issues and milestones. Enhanced coordination and communication also create a stronger sense of empowerment, ownership, responsibility and accountability to ensure that the project will run successfully and synergistically within and across all work streams.

From a virtual perspective, IPTs are being recognized as an essential component of organizational business strategies. Not all virtual work teams run successfully; however, it is important to realize the benefits are predominantly in line with enhanced team dynamics, collaboration and communication. Continuous team development, whether face-to-face or virtually, will be critical to sustaining successful IPTs.

2.1.2 Virtual Communities of Practice

Communities of practice (CoP), whether virtual or face-to-face, involve groups that share certain types of knowledge, information, interests or expertise—forming communities that engage in collective learning through social practices. Wenger (1999, 1) defines these communities as "communities that accumulate collective learning into social practices." Amidon (1997, 49) defines the mission of *communities of knowledge practice* as: "Harnessing complementary competencies with a shared purpose toward a common strategic vision." In general, communities of practice lay the foundation for leveraging tacit knowledge. Some groups meet virtually, and others physically converge at group meetings. These thematic groups help organizations cultivate new and innovative ideas in situations where process improvement or new product development is necessary to remain competitive in the marketplace (APQC, 2000). Communities of practice engage in free-flowing discussions, and focus on creative ways that may encourage new approaches to problems. Communities of practice can promote and drive strategy, foster new business lines, focus on problem-solving techniques, and help to disseminate best practices (Wenger and Snyder, 1999).

According to the American Productivity and Quality Center (2000), communities of practice are becoming more integral to implement within organizations. The Center states:

> *This new organizational form is becoming a key success factor for impacting time to market, reuse of knowledge, response time, employee development, creation of knowledge–sharing relationships, organizational learning, and change implementation. Organizations that want to embed knowledge management are viewing Communities of Practice as an essential business practice for the 21st century.*

Similarly, virtual communities of practice can be regarded as communities who engage in collective learning within a collaborative environment and apply this learning into social practice. Working within a virtual community enables members to contribute to the successful integration and empowerment of teams. By creating a shared workspace environment for these communities, practitioners are able to communicate using effective tools and technologies for advancing their business objectives.

2.2. Advancing Teamwork through Synergistic Processes

Fusion work strategies for implementing virtual collaborative processes are receiving greater recognition across organizations. The discipline of virtual teams (Katzenbach and Smith, 2001) denotes the importance of understanding the concept of team…*what does "team" really mean*? In one particular study, people from diverse cultures, countries and languages, different companies, work sites, and skill-sets, with varied processes and hierarchical levels all collaborated within the integrative construct of a commonly shared goal (Katzenbach and Smith, 2001). The team discipline is based on a "compelling and commonly held performance challenge", a shared goal or objective that will entail a number of people with the appropriate skills and knowledge. According to virtual team experts, "teaming depends on collaboration, because collaboration entails sharing information, knowledge and views of other people (Katzenbach and Smith, 2001). However, virtual teams will not be successful at collaborating with another unless they learn to trust each other and start to develop positive relationships. Clear communication between people is also key to building and sustaining positive working relationships.

Various collaborative technology platforms can enable teams to work within a virtual environment; however, it is essential to ascertain if particular teamwork processes and strategies contribute to effective global teamwork practices. Building social networks of team members can be difficult, especially when trying to bridge project teams within a global context. The impacts and limitations of geographical separation, organizational cultural norms and practices, physical environment, IT support, communication policies and strategies, and leadership are key elements to understanding the implications of virtual teamwork. Employing theoretical models to further understand group/interpersonal processes, group dynamics, social networks, communication strategies and IT availability may provide a comprehensive understanding of effective teamwork within virtual collaborative environments.

2.3. Technologies for Supporting Virtual Collaborative Environments

In today's rapid pace of technological change, communication, coordination and collaboration are becoming increasingly important for linking virtual team members across global networks. Personal computers, local and wide area network technology are considered to be more than adequate in supporting virtual teamwork (Line, 1997); however, reliable electronic communication plays a pivotal role in virtual teamwork. There are many benefits to using effective technology to support teamwork. Table 2 provides a brief overview of some of the benefits of enabling technologies for enhanced communication between team members.

Table 2 Technology as an Enabler to Virtual Collaborative Environments

Time Efficiency: Routine processes otherwise done manually can now be automated.
Immediacy: Quick access to the latest and greatest global knowledge and information.
Mobility and Flexibility: Work can be done from multiple locations at various times.
Shared Documentation: Online record of work that has been done and why it was done; a team's history is organized for easy retrieval.
Career Opportunity: Members can work with the best minds, no matter where they reside.
Cheaper: The company can save costs on reduced travel time and required work space.
Emotional Distance: Members do not have to react immediately, they have time to reflect if voicemail or email is upsetting. Sometimes, difficult topics can be easier to address online than face-to-face.
Distribution of Information: Faster and easier to do.
Knowledge Transfer: Many people can participate in a discussion, increasing the opportunity for information sharing, creativity, innovation and better decision-making.
Source: Virtual Teaming: Breaking the Boundaries of Time and Space, Deborah Jude-York, Lauren Davis and Susan Wise, 2000, p. 76.

Technology is depicted as an enabler, allowing individuals to capture, share, transfer and leverage their knowledge within and across organizations.[7] With the advent of advanced computer technology (e.g., intranet, extranet and Internet), organizations are able to work within collaborative spaces for communication, discussion groups, decision-making capabilities, and knowledge leveraging. Collaborative tools and technologies that focus around collaborative capability are enabling people to advance their strategic initiatives by creating synergistic environments that permit group cohesion and dependable social dynamics. According to The State of the Knowledge Industry Progress Report / Government 2000 (SKIPR-Gov 2000), technologies at the centre of knowledge leveraging initiatives focus on: data warehousing; decision support; data mining; search engine retrieval; workflow analysis; document/content management; e-mail/messaging; collaborative computing video-conferencing and teleconferencing; and Web based technologies.

There are several examples of collaborative tools and technologies that are being employed within virtual environments for enhancing communication and organizational knowledge. These tools enable meeting and information sharing (e.g., file, application and presentation sharing, joint authoring and white boarding, and use of public folders); messaging and discussion (e.g., chat, instant messaging and threaded discussions); and audio and video conferencing (e.g., teleconferencing and audio and video capabilities).[8] Some of these collaborative tools include: knowledge portals, business directories, video-teleconferencing, WebCams, electronic whiteboards, electronic messaging/emails and virtual team collaborative software and GroupWare.

Knowledge Portals: The use of portal technology is helping work teams and organizations to leverage their decision-making capabilities to a higher level. Knowledge portals or collaborative environments (e.g., Livelink by OpenText, Autonomy, Hummingbird) may include the following functionalities: scheduling, calendaring, file sharing, e-mailing, chat groups/discussion fora, bulletin boards, expertise locator, latest news, team co-location, task management, workflow management, brainstorming, online meetings, and other collaborative software. Knowledge portal technology links virtual teams and communities into a shared workspace, one that enables collaboration and communication between integrated teams (e.g., chat rooms, brainstorming capabilities).

Business Directories: There are several business directories that assist organizations in identifying expertise, information and knowledge, including: Yellow Pages (expertise indexing), White Pages (employees), knowledge workflow and mapping, and other related repositories. These business directories enable workers to leverage their knowledge by locating experts and colleagues, and by communicating with them to further advance their organizational initiatives.

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[7] For a comprehensive overview on the role of information management and collaborative technologies for leveraging knowledge, please see: Waruszynski, Barbara. *Working Towards a Knowledge Investment Strategy: An Analytical Overview of the Science and Technology Community*. Defence R&D Canada, Technical Memorandum, DRDC HQ TM 2000-003, 2001.

[8] For more information on specific collaborative tools and name brands, please revert to: Collaborative Tools Resource, Network World Fusion, URL: http://www.nwfusion.com/careers/2001/0924manside.html.

Video-Teleconferencing: The introduction of video-teleconferencing technology has enabled virtual teams to work more effectively in real time. Video-teleconferencing, along with Web based meeting software (e.g., Livelink), is becoming a preferred way of working within the business environment.

WebCams: WebCam technology is receiving considerable attention for enabling more real-time project collaboration. WebCams enable people to send and receive video images via the Internet. This technology is being depicted as an effective way to creating stronger relationships between geographically dispersed team members.

Electronic Whiteboards: Electronic whiteboards allow team members to capture and distribute group ideas electronically. The implementation of Smart or Plasma screens are being implemented for enhanced collaborative capability.

e-mails or electronic mail: E-mail is used across most organizations for effective day-to-day communications.

Virtual Team Collaboration Software: There are many companies marketing their virtual collaborative tools or GroupWare for teamwork, including: Livelink®, Lotus Notes, Groove Networks, Hummingbird, Autonomy and Microsoft Office tools (e.g., Microsoft Office Project 2003, Netmeeting). For instance, Livelink®, the leading collaboration and knowledge management software, enables virtual teams to plug into a portal and get connected to virtual co-workers. Livelink's Team Collaboration Suite (e.g., Meeting Zone) provides capabilities that support virtual teamwork. *TeamRooms* (e.g., Lotus Notes) allow geographically dispersed team members to work on common documents and advanced e-mail systems that categorize stored information.

GroupWare: Organizations are also employing Group Decision Support System (GDSS) tools to provide computer-supported group decision-making (e.g., generating ideas, organizing ideas, consensus building, conducting evaluations, voting, and analysis planning). GDSS is mainly oriented around quantitative units of ideas, providing support for decision-making by helping groups to generate, organize or brainstorm ideas, select or evaluate criteria, and plan the analysis.

The *building blocks of virtual collaborative environments*-- people, process and technology-- have demonstrated the importance of sustaining successful virtual teams across global networks. With the advent of collaborative environments and the fundamental role of virtual teamwork, organizations are implementing global network infrastructures to foster and maintain stronger linkages for enhanced communication and productivity. As a direct result, the need to explore collaborative environments within the defence community has prompted the need for conceptualizing an infrastructure that will support distributed collaborative workspaces. This need has led to the exploration of an overarching concept, entitled, *Facilities for Optimization, Conceptualization, Collaboration and Integration (FOCCI)*.

3. Facilities for Optimization, Conceptualization, Collaboration and Integration

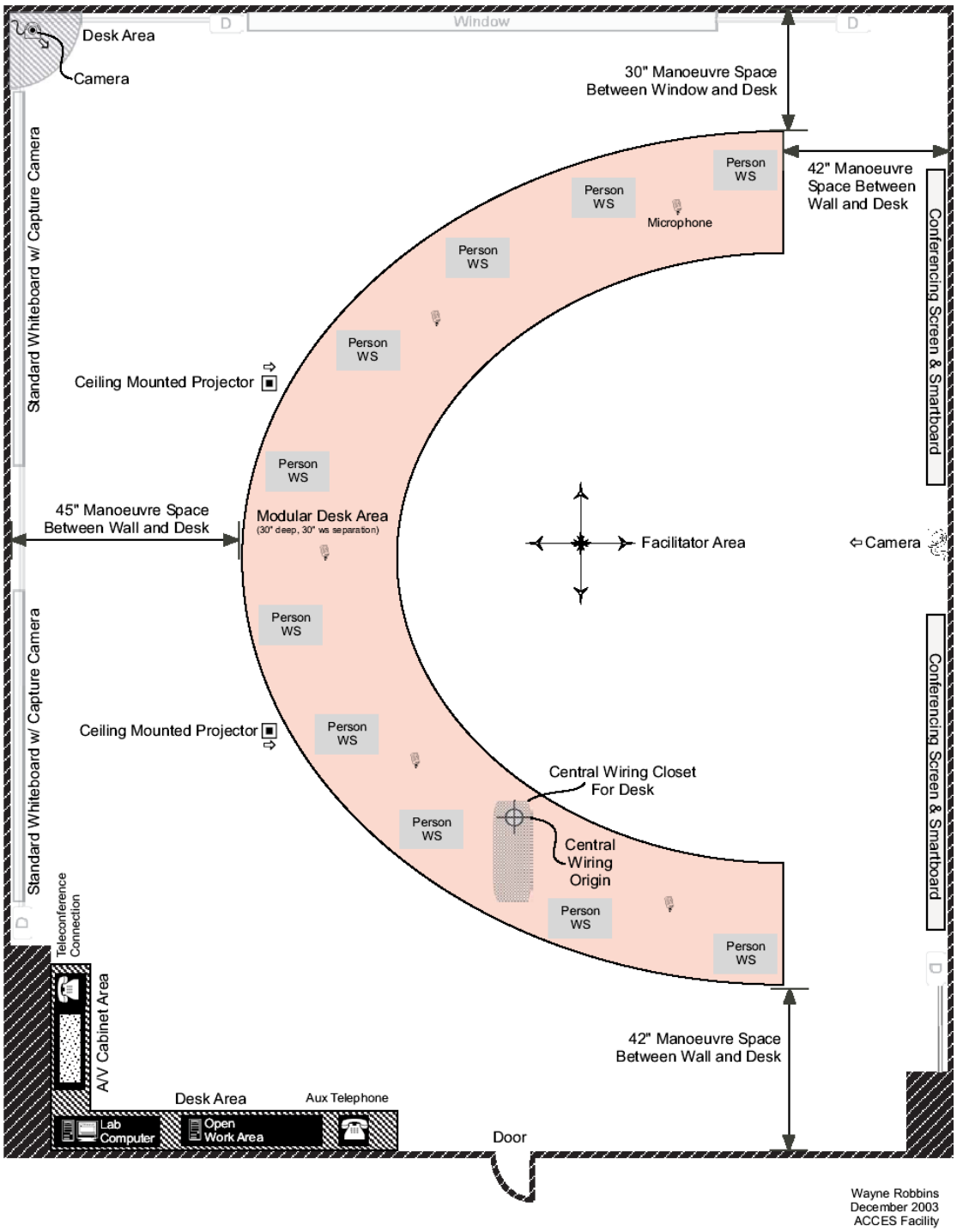
The concept of Facilities for Optimization, Conceptualization, Collaboration and Integration (FOCCI) epitomizes a collaborative environment that enables people to capture, share and leverage organizational knowledge to advance business objectives. FOCCI espouses the following principles, namely: interactive communication (including, among geographically dispersed workers) integrated work space environments; shared data, information and knowledge; collaborative tools; multi-disciplinary use (e.g., training, distance learning, Decision Support System); work practices (e.g., communities of practice); and supportive cultural and business processes. FOCCI promotes the use of collaborative facilities to enable people to be co-located for enhanced communication and more effective decision-making capabilities. The first of these facilities, the Advanced Collaborative Capability Engineering System (ACCES) lab, is being developed, implemented, piloted and tested within DRDC Ottawa.

3.1. Advanced Collaborative Capability Engineering System

The Advanced Collaborative Capability Engineering System (ACCES) represents the first virtual collaborative environment lab under the FOCCI initiative. As illustrated in Figure 1, ACCES is currently being built within DRDC Ottawa for enabling integrated project teams (IPTs) to work within a reliable, friendly and constructive virtual environment. As the primary driver for the Collaborative Capability Definition, Engineering and Management (CapDEM) Technology Demonstration Project (TDP), the intent of this lab is to create a facility for collaborative capability, where IPTs and individuals can engage in discussions and in decision-making across remote locations, using advanced tools, technologies and techniques. This lab environment will help to facilitate distributed collaborative processes and will enable real-time distributed workspaces using shared applications, tools and information. The basic infrastructure will include: a configurable switcher and display/projection options; an audio conferencing suite; a video conferencing suite; a conference table; and a whiteboard. ACCES lab participants will be able to plug-and-play and have access to the FFSE and CapDEM knowledge portals that are currently being implemented for enhanced collaboration among IPT members.

As part of the CapDEM project, DRDC Valcartier will be developing and implementing a similar lab to help facilitate IPT discussions and decision-making capabilities. A pilot study is being considered for assessing the feasibility between the two labs, DRDC Ottawa and DRDC Valcartier, to determine if it would be viable to work within virtual collaborative environments across DRDC and the Department of National Defence (DND). The performance metrics of this pilot study will address the user requirements for virtual teamwork, business processes and cultural impacts of FOCCI. It will focus on group dynamics, tools and network requirements, and the overall enablers and barriers to working within virtual collaborative environments.

Figure 1 ACCES



4. Business and Knowledge Processes for Advancing Collaborative Environments

The business and knowledge processes of any organization focus on the importance of aligning people, process and technology to meet the demands of new business conditions. With the evolving nature of workplace environments (i.e., virtual collaborative environments), organizations are recognizing the need to support collaborative work processes for advancing business outcomes. The role of adaptive workspaces recognizes that "change is ceaseless, that geographically dispersed and culturally diverse organizations face difficulties in leveraging human capital across the enterprise, and that collaboration is the core of work when transactional systems reach their boundaries of hard-coded process definition" (Giga Information Group , 2002).

The drivers for advancing collaborative environments through virtual team work revolve around establishing a capability to work more effectively and efficiently for advancing business outcomes. NASA's team collaboration pilot[9], for example, is examining the preliminary steps for establishing a corporate capability through the successful deployment of team collaboration. The pilot business drivers focus on employing a collaborative tool that will enable teams to hold virtual meetings and share information over the Web. Some of the driving benefits include: reducing reliance on travel; enabling collaboration among individuals and teams (including, government, industry and academia); creating and advancing synergy across organizational centres; and deploying tools that are easy to learn and use. The vision or the outcomes of the NASA pilot outline the following expectations:

- *Pilot teams' expectations are exceeded—their ability to collaborate without travel improves dramatically;*
- *Pilot teams rave about their positive experience with peers in the Agency;*
- *As an Agency, we have a better shared understanding of our requirements and the potential value of a corporate capability for basic team collaboration; and,*
- *We have a better understanding of team collaboration tool deployment issues in the NASA IT infrastructure (network support, desktop support, etc.).*

Team building and managing virtual teams are being embedded within business processes, and, as a result, will entail strong support and effective leadership for establishing and implementing collaborative environments. Managers or leaders of virtual teams will need training in virtual management skills and the ability to work in a highly interactive environment. Virtual team builder workshops are specifically designed to train virtual team managers and members how to work effectively within a collaborative environment through the process of team building exercises. These team building exercises help to foster the values of trust and commitment in virtual teams.

[9] NASA 2002. Team Collaboration Pilot, Call for Participation, Spring 2002, Steve Prahst, GRC and Manjula Ambur, LaRC.

Performance metrics will also play a critical role in ascertaining the value of virtual team work. Employing the right metrics for assessing a virtual team's collaborative performance will be key to understanding the benefits and lessons learned. These performance metrics will need to focus on distributed e-work platforms and how these platforms will help to support teamwork.

Identifying the business processes for virtual collaboration will be key to assessing a working architecture that will enable people to leverage their knowledge through advanced methods, tools and techniques. These business processes will shape the business model for virtual collaborative environments and will lay the foundation for the development of a virtual collaborative environment strategy.

4.1. Initial Steps Toward a Virtual Collaboration Strategy

Virtual collaboration for enabling project teams and communities to work more synergistically has been examined by the American Productivity and Quality Center (APQC). A Consortium Benchmarking Study (2003) currently being conducted by APQC is focusing on: strategies for virtual collaboration; the design and deployment of effective virtual collaboration; the support of virtual collaboration; and the effectiveness of virtual collaboration. Strategies for virtual collaboration centre primarily around: defining the types of tasks or activities that are best suited for virtual collaboration; assessing the readiness and appropriateness of virtual collaboration for a group or a task; understanding the leadership role in supporting the adoption of virtual collaboration; identifying the common barriers to virtual collaboration and how best practice organizations address them; and developing the guidelines for global collaboration.[10] Overall, the consortium benchmarking study will "enable participants to develop a collaboration strategy for virtual teams and communities, understand the required roles and responsibilities for virtual collaboration, and learn approaches and tools that are being used to make a virtual team or community successful" (APQC 2003, 3).

Organizations are aligning the benefits of virtual collaborative environments with their business strategies. Businesses are learning through recognized benchmarking authorities, however, that there are pertinent issues that need to be addressed before delineating a coherent virtual collaboration business strategy. For example, in their study on *Virtual Collaboration: Enabling Project Teams and Communities,* APQC (2003) recognizes the following areas that need to be addressed when considering strategies for virtual collaboration. Defining virtual collaboration and what it means for an organization is the first step to developing a strategy. Outlining the activities, tasks and initiatives that would benefit from virtual collaboration or virtual team work would be important to assess. Examining work practices and the cultural implications of working within collaborative environments will need to be evaluated to ensure a successful transitioning to these environments. Understanding the role of trust among virtual team members will help to create and maintain a better awareness of group dynamics

[10] For a comprehensive overview of the approach and methodology for conducting the APQC study, please refer to APQC. *Virtual Collaboration: Enabling Project Teams and Communities: A Consortium Benchmarking Study Conducted by APQC.* 2003.

and social interactions as they happen within a natural working environment. Empowering teams to work within collaborative environments will be essential to explore with senior management, including the benefits and their impacts on organizational business models. Developing a set of guidelines and a framework will also provide a clearer definition of the changing nature of current work practices. Finally, incorporating the performance metrics and the success of virtual collaborative environments will enable people to assess the importance of adapting workspaces to meet the demands of today's business practices.

Promoting and fostering virtual collaboration strategies will only be effective once there is a better understanding of group/interpersonal processes/group dynamics, social networks, communication strategies and effective IT for enabling global teamwork practices. The impacts and limitations of geographical separation, organizational cultural norms and practices, physical environment, IT support, communication policies and strategies, and leadership all play a pivotal role in determining the implications of virtual teamwork. Integrative theoretical frameworks and models in group dynamics (e.g., team cohesion, team building) and group processes (e.g., team recognition and rewards, team reporting, team performance) and the embedding context in which groups operate (e.g., virtual collaborative environments or face-to-face) will need to be researched further to better understand the impact of enabling collaborative capability through virtual teamwork.

5. Conclusion

With the advent of collaborative environments and the fundamental role of virtual teamwork, organizations are implementing global network infrastructures to generate more effective linkages for improved communication and productivity. In this paper, enabling collaborative capability through virtual teamwork has been examined from a strategic and conceptual overview of integrated collaborative environments. The building blocks of virtual collaborative environments—people, process and technology—represent the main components for sustaining successful virtual teams across global networks. Successful deployment of virtual teamwork through collaborative environments, therefore, is being recognized as a major step toward attaining a real-time corporate collaborative capability.

The need for conceptualizing an infrastructure that will support distributed collaborative workspaces has led to the exploration of an overarching concept, entitled, *Facilities for Optimization, Conceptualization, Collaboration and Integration (FOCCI)*. The main tenets of FOCCI revolve around leading change for enhanced business processes, supporting virtual teams, sharing knowledge, communicating, building trust and empowering teams. The proposed Advanced Collaborative Capability Engineering System (ACCES) collaborative lab environment under FOCCI will be implemented, piloted and assessed to determine the efficacy of virtual teaming skills, techniques and tools to enable and foster collaborative capability. This environment is being supported by a knowledge portal that will enable enhanced team collaboration and communication for optimum decision-making capabilities.

The importance of establishing business processes for advancing collaborative environments represents an initial step toward establishing a strategy for virtual collaboration and teamwork. The synergies behind building work teams or on-line communities in the virtual workspace will need to be examined in relation to organizational business processes. For example, the element of trust will play a key role in the social development of successful teams. Bringing people face-to-face to solve problems or make decisions is key to building trusting relationships and enhancing team productivity; however, understanding the dynamics behind "cohesion" and "norms of behaviour" will be critical for advancing team communication, coordination and collaboration. As a direct result, employing integrative theoretical frameworks and models to further understand group dynamics (e.g., team cohesion) and group processes (e.g., team recognition and rewards, team reporting, team performance) and the embedding context in which groups operate (e.g., virtual collaborative environments or face-to-face) will need to be examined further to better understand the impact of enabling collaborative capability through virtual teamwork.

References

American Productivity and Quality Center. (2000). *Building and sustaining communities of practice: continuing success in knowledge management*. American Productivity and Quality Center. URL: http://www.apqc.org/proposal/6576km6/ .

American Productivity and Quality Center. (2003). *Virtual Collaboration: Enabling Project Teams and Communities: A Consortium Benchmarking Study Conducted by APQC*. Houston, Texas: APQC.

Amidon, D. M. (1997). *Innovation Strategy for the Knowledge Economy: The KEN Awakening*, Newton, MA: Butterworth-Heinemann.

Carpenter, Jennifer L. (1998). *Building Community in the Virtual Workplace*, URL: http://cyber.law.harvrd.edu/fallsem98/final_papers/Carpenter.html, p. 4.

David Skyrme Associates. (1999). http://www.skyrme.com/updates/u17.htm .

Davidson, Elizabeth and Albert Tay. (2003). *Studying Teamwork in Global IT Support.* Proceedings of the 36th Hawaii International Conference on System Sciences – 2003. No., 0-7695-1874-5/03 © 2003 IEEE.

Giga Information Group. (2002). *Adaptive Workplaces: Preparing for the Future of Work*, RPA-122002-00021, December 17, 2002.

Gumpert, Peter. (2003). *Collaboration: The Secret Ingredient?* MITRE Corporation. URL: http://www.mitre.org/news/the_edge/fall_03/gumpert.html .

Gundry, John. (2000). *Trust in Virtual Teams: A Knowledge Ability White Paper*, August 2000, Knowledge Ability Ltd., UK, URL: http://www.knowab.co.uk/wbwtrust.html.

Internet 2. (2002). URL: http://internet2.edu/html/virtual_laboratory.html.

Jude-York, Deborah, Davis, Lauren and Susan Wise. (2000). *Virtual Teaming: Breaking the Boundaries of Time and Space*, Crisp Publications, Inc.: Menlo Park, California.

Jungalwalla, Ron. (2000). *Transforming Groups into Teams*, Team Management Systems Online, URL: http://www.tms.com.au. (Note: This article was originally published in the *Executive Excellence*, Vol. 17, No. 2, February 2000).

Katzenbach, Jon. R. and Douglas K. Smith. (1993). *The Discipline of Virtual Teams*, Leader to Leader Institute (formerly the Drucker Foundation), No. 22 Fall 2001, URL: http://www.pfdf.org/leaderbooks/121/fall2001/katzenbach.html.

Leonard, Dorothy et al. (1998). "Virtual Teams: Using Communications Technology to Manage Geographically Dispersed Development Groups", in *Sense & Respond: Capturing Value in the Network Era*, Stephen P. Bradley and Richard L. Nolan, eds., Boston: Harvard Business School Press, 1998, p. 293.

Line, Lars. (1997). *Virtual Engineering Teams: Strategy and Implementation*, October 1997, Adger College, Affiliated to Program on Applied Coordination Technology at the Norwegian University of Science and Technology in Trondheim, URL: http://www.itcon.org/1997/3/paper.htm.

Maslow, Abraham. (1954). *Motivation and Personality*. New York: Harper Row.

Network World Fusion. (2001). *Collaborative Tools Resource*, URL: http://www.nwfusion.com/careers/2001/0924manside.html.

Office of the Assistant Secretary of the Navy (Research, Development and Acquisition), DON Acquisition One Source, Department of Defense(US). (2003). *Virtual IPT Learning Campus*. URL: http://www.acquisition.navy.mil/navyaos/content/view/full/218/ .

Prahst, Steve, and Manjula Ambur. (2002). *Team Collaboration Pilot. Call for Participation*, NASA, Spring 2002.

Rapaport, Lowell. (2003). *Team Collaboration Unites the Workforce*, Transform Magazine, February 2003, URL: http://www.transformmag.com/db_area/archs/2003/02/tfm0302f2_1.shtml.

Senge, Peter M. (1990). *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday Currency.

SKIPR-Gov 2000. (2000). *The State of the Knowledge Industry Progress Report / Government 2000* , "The Definitive Report on Knowledge Management in Government. Knowledge Management: An e-gov Conference", The Foundation for Electronic Government. Alexandria, Virginia.

Statistics Canada. (1999). *Innovation in Canadian Manufacturing: National Estimates.* Statistics Canada. Cat. No. 88F0006XIE01010.

VirtualTEAMWORKS.com. (2003). *Case Studies*. VirtualTEAMWORKS.com.

Waruszynski, Barbara. (2001). *Working Towards a Knowledge Investment Strategy: An Analytical Overview of the Science and Technology Community.* Defence R&D Canada, Technical Memorandum TM 2000-003, DRDC, Ottawa.

Wenger, Etienne. (1999). *Communities of Practice: The Key to Knowledge Strategy*. North San Juan, CA, pp. 1-16.

Wenger, Etienne and William Snyder. (1999). *Communities of Practice: The Organizational Frontier*. North San Juan, CA.

List of symbols/abbreviations/acronyms/initialisms

ACCES	Advanced Collaborative Capability Engineering System
APQC	American Productivity and Quality Center
BPA	British Petroleum Amoco
CapDEM	Collaborative Capability Definition, Engineering and Management
CoP	Communities of Practice
DND	Department of National Defence
DRDC	Defence Research and Development Canada
FOCCI	Facilities for Optimization, Conceptualization, Collaboration and Integration
FFSE	Future Forces Synthetic Environments
GDSS	Group Decision Support System
IPTs	Integrated Project Teams
IQPC	International Quality and Productivity Center
TDP	Technology Demonstration Project

DOCUMENT CONTROL DATA

(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1. ORIGINATOR (the name and address of the organization preparing the document. Organizations for whom the document was prepared, e.g. Establishment sponsoring a contractor's report, or tasking agency, are entered in section 8.)

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2. SECURITY CLASSIFICATION (overall security classification of the document, including special warning terms if applicable)

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3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S,C or U) in parentheses after the title.)

Enabling Collaborative Capability through Virtual Teamwork: The Way Ahead (U)

4. AUTHORS (Last name, first name, middle initial)

Waruszynski, Barbara T.

5. DATE OF PUBLICATION (month and year of publication of document)

December, 2003

6a. NO. OF PAGES (total containing information. Include Annexes, Appendices, etc.)

31

6b. NO. OF REFS (total cited in document)

27

7. DESCRIPTIVE NOTES (the category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

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8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include the address.)

9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant)

15as

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10a. ORIGINATOR'S DOCUMENT NUMBER (the official document number by which the document is identified by the originating activity. This number must be unique to this document.)

DRDC Ottawa, TM 2003-217

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The concept of virtual teamwork is being applied throughout various organizations by bringing together key players into a collaborative environment to work on joint initiatives and solutions to common problems. In essence, enabling collaborative capability through virtual teamwork represents a fundamental transitioning to more effective organizational work practices. In this paper, a conceptual overview of the people, processes and technologies for supporting virtual teamwork is examined and applied to integrated collaborative environments. The focus is on providing a strategic roadmap , a way ahead, to enable work teams to collaborate more effectively across organizational boundaries. The innovative development and implementation of a collaborative capability engineering environment concept, entitled, Facilities for Optimization, Conceptualization, Collaboration and Integration (FOCCI), is introduced in conjunction with the Advanced Collaborative Capability Engineering System (ACCES) lab environment. This environment is being supported by a knowledge portal that will enable enhanced team collaboration and communication for optimum decision-making capabilities. The primary focus is on creating an integrated environment that will facilitate virtual teaming skills, techniques and tools to foster greater synergy among teams. The paper concludes with the importance of establishing business processes for advancing collaborative environments, and puts forward the initial steps for establishing a strategy for virtual collaboration and teamwork. It underscores the importance of understanding teamwork processes and strategies, including: group and interpersonal processes/group dynamics, social networks, communication strategies and information technology availability for effective teamwork within virtual collaborative environments. Integrative theoretical frameworks and models in group dynamics (e.g., team cohesion, team building) and group processes (e.g., team recognition and rewards, team reporting, team performance) and the embedding context in which groups operate (e.g., virtual collaborative environments or face-to-face) will need to be researched further to better understand the impact of enabling collaborative capability through virtual

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