13th ICCRTS: C2 for Complex Endeavors

"Situational Common Operating Picture for Collaborative Sensemaking"

Collaborative Technologies for Network-Centric Operations

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Situational Common Operating Picture for Collaborative Sensemaking

Abstract

Timely, accurate and relevant information is a key contributor to making good decisions in complex endeavors. Thereby, it is often necessary to put structured and unstructured information originating from multiple entities and sources into a certain context – often the whole is more than the sum of its parts. Combining information from different sources can help answer different questions such as what? (for instance road "diamond" unavailable) why? (contextualization with news that roads are clogged due to an evacuation), to whom (contextualization with re-assignment of sustainment responsibilities), etc. In certain situations decision makers are only able to detect certain patterns if they are exposed to different information. Pre-defining such patterns or scenarios generically proves difficult. Often they have to react to unexpected, critical circumstances that cannot be pre-modeled. Hence, a system to support agile collaborative sensemaking in such situations by fulfilling ad-hoc information demands must provide means to identify relevant information blocks and contextualize information on the fly. We propose that decision makers need to be able to interact with the system in a non-technical way, with an intuitive user interface and an easy to use situational Common Operating Picture composite application.

Keywords: Situational Applications, Mashups, Web 2.0, Enterprise 2.0, Common Operating Pictures, Composite Application

Introduction

Collaborative Sensemaking

The defense ecosystem in play in today's operational environment reaches far and wide. Many governmental and non-governmental organizations are involved (e.g. Red Cross / Crescent, World Food Program, Médecins Sans Frontières, etc). On the industry side – "suppliers on the battlefield" is a very common occurrence. From providing weapon system support, infrastructure management, security services, or even comforts from home. National Defense organization mostly deploy as joint task forces in this coalition environment.

Decision makers at all levels, we call them as a metaphor "Strategic Corporals", from this highly diverse ecosystem work together in teams to achieve the mission objectives. Like Darwin stated "In the long history of human kind (and animal kind too), those who learn to collaborate and improvise most have prevailed." (Kelly & Littman, 2005 p114). Alberts and Hayes (Alberts & Hayes, 2006, p138) proposed that the team characteristics as well as its individual members characteristics will shape its behaviors and capabilities. Further the diversity (or lack thereof) plays an important role in how collective sensemaking is achieved.

Sensemaking, at its most fundamental purpose, is to aid in decision making. Collective Sensemaking extends this notion by bringing the collective know-how and constitutes a paradigm for mapping the expertise of an organization from its many stakeholders (Celestine A. Ntuen et al., 2005). Collaborative sensemaking enables members of the defense ecosystem to leverage the network of brains. By bringing together the right people, with the right information, at the right time - in the context of the mission - execution is taken to a new level through the harnessing of social power and knowledge. Collaborative sensemaking supports the process of the team, freeing the energy of Strategic Corporals to transform their results through innovative execution.

The Internet Generation

The IT experience of the current generation, the Net Generation (Tapscott, 1998, p1), is much different than the IT experience of current generation of decision makers. The Next Generation users do not know what life is without the Internet. They are also very comfortable with online immersive gaming environments and social networking sites. Sharing has also become second nature to this generation. On the other hand, the decision makers were part of the emergence of IT and the Personal Computer and view this technology as productivity tools. Their software consumption habits are still so ingrained from the last 20 years of the desktop tools that their sense of urgency to migrate to better solutions has been slow. Most of them do not play these immersive games nor take part in social networking sites. They have also lived through the chaos of the frontier times and now feel they are cleaning up the mess that ensued. As such, they view their role as developing requirements to be provided to IT for delivery under a very tightly rigorous process. In contrast, the current generation of users believes in a much more collaborative approach through community self-sufficiency and progressive improvement iterations.

The Long Tail of Enterprise Software

Many have observed that history is repeating itself. A return of sort to the frontier times of the Personal Computing of the late 1980's and early 1990's where the users rebelled against IT. Users started creating their own applications using what ever they could get their hands on to address their information needs. Today's conditions are similar. Organizations responsible for Command, Control, Communications, and Computer Systems (i.e. J6) and their leadership have locked down their systems in order to get control of TCO, security, compliance, etc.

Many users again feel underserved and this means that smaller, niche, and situational requirements most often do not get addressed by corporate programs. The sum of all of these seemingly small requirement add up to more than what the enterprise is currently delivering creating a Long Tail (Anderson, 2004) of unfulfilled requirements. The current generation of users, culturally pre-disposed to do so, have begun to tackle the Long Tail using croudsourcing (Howe, 2006) and available tools and resources common on the Internet to compose situational applications like they do in their private lives. And as such, we believe that the IT systems used by these "Strategic Corporals" within Defense organizations also need to reflect these realities.

IT Power to the Edge

Historically, the current crop of large enterprise IT system in defense organizations serves single purposes and internal communities of users. Flexible collaboration is not normally built-in but rather fixed, and single purposed interfaces to other large enterprise IT systems exist. The defense ecosystem, in contrast, is highly dynamic with joint and coalition partners, NGOs and industry. This is the case with wartime operations (e.g. Iraq) or in humanitarian operations (e.g. Hurricane Katrina). In order to properly serve the IT needs of "Strategic Corporal" within Defense Organization; we propose a different approach that leverages the efforts seen on the Internet while applying the rigors required by an Enterprise.

User Centric View of the Enterprise

For agile organizations and individuals, routine is never assumed. Strategic Corporals are constantly solving (new) problems. IT systems need to reflect the same agility attributes. Enterprise systems are necessary and provide the platform to empower users to find and/or compose what is required to solve the problem at hand at the speed of change. The IT platform provides the J6 with the necessary governance framework and mechanism to ensure that TCO, security, compliance, etc. are kept in check.

Even though a Service Oriented Architecture (SOA) enables applications within and outside the Enterprise to interoperate with each other, the consumption of those combined applications is still not high by Strategic Corporals for their decision-making and workflow automation (Saha, 2008). Supported by a strong IT platform, the organization can turn loose its users to address the Long Tail while it focuses on the Head.

They Build - You Compose

Current generation is used to creating their own presence on social networking sites using what others have built. They also contribute content to wikis, blogs and photo/video sharing communities. They can easily self-organize in the absence of formal organizations (Shirky, 2008).

Similar to what was done for Linux as a collaborative coding effort, now it's about composition using modeling tools and techniques. It allows for the recombination of existing services based on models and therefore no manual coding is required. These

tools allow creating pattern-based as well as free-style user interfaces by simply dragging and dropping services and defining the data flow between them. Models are stored in meta-data that are machine-accessible. At the surface, the modeling tools have to be simple enough to allow users to compose their solution in a natural and intuitive way while hiding the complexity associated with code generation that is platform or language specific. These code generators are highly sophisticated and specialized and provide mechanisms to synchronize the model with the code.

Enterprise Situational Composite Applications

Enterprise Service Oriented Architecture (Enterprise SOA) is a blueprint for an adaptable, flexible, and open IT architecture for providing services-based, enterprise-scale business solutions to end-users. An enterprise service is typically a series of Web services combined with business logic that can be accessed and used repeatedly to support a particular business process. Aggregating Web services into business-level enterprise services provides a more meaningful foundation for the task of automating enterprise-scale business scenarios. Enterprise SOA enables defense organizations to link stand-alone processes and to compose new business processes to meet their needs.

Composite applications are defined as applications that sit on top of other applications and reuse their functionality by service calls. They empower defense organizations to drive innovative business processes and leverage existing IT-investments. This class of application is also known as “Mashups” (Paul Rademacher's HousingMaps.com powered by craigslist and Google Maps being the original Internet example (Hinchcliffe, 2007)). Gartner has recently stated that this is one of the top 10 disruptive technologies (Pritchard, 2007).

Classical defense applications are based mainly on the concept of manually entering data and reporting on that data. The high market motivation for this model was to enable process reengineering and to empower end-users. The focus was on data collection, control, reporting, and business process optimization based on analysis of the data reporting.

These kinds of defense applications could provide only limited help to the relatively unskilled user and knowledge workers both in and outside the organization. Their needs could only be met by tailored, hand-coded applications or, to a certain extent, by workflows based on a sequential programming model. Such workflow integration, however, did not give users an overview of the process but only showed them the individual steps to be executed and did not help process owners to take responsibility or handle exceptions effectively.

To summarize: classical defense applications collect and analyze process data effectively and can also run fully automated processes, but they tend to fall short of fully involving the user in user-centric collaborative and iterative processes. Even today, many processes are recorded in defense systems but are actually executed using traditional paper-based or office productivity tools (e.g. Microsoft Office, Open Office, etc) in a fairly unstructured and uncoordinated way, more sophisticated have adopted Messenger / Video but this only

added new channels to the unstructured mess. Classical defense systems do not encourage the establishment of novel or agile business processes which defense organizations need to meet their operational needs. Last but not least, classical applications are self-contained and assume that all data and all business logic are owned by the application.

From a defense organization and end user's perspective there are requirements for applications which the classical defense application cannot meet. Such requirements include:

- providing a single, intelligent user experience across IT system and within the defense ecosystem
- crossing functional, system and even boundaries within an organization
- viewing the enterprise or supply chain as a whole rather than in its separate parts
- forcing enterprise-wide and process-wide system and human collaboration
- assembling a solution primarily from existing multi-source content
- being able to be adapted by business analysts

These requirements can be divided into two parts. Firstly, the user experience; the application has to operate in such a way as to reflect the user's work context. This is not a new requirement and has already been addressed in different projects and by different technologies the role-based User Interface approach and portals, for example. But this is not sufficient. There is an additional requirement to provide applications that are fed by different systems and to unify them in such a way that the end user detects no boundaries or discrepancies between them. Combining end user experience and cross-system application integration needs leads compellingly to the topic of composite applications.

Looking at end users', enterprises' and software vendors' requirements from a more technical perspective, it becomes clear that composite applications must have the following characteristics:

- Composite applications are based on services already provided by other applications or components. They combine available service operations with new application logic, user interfaces, and business process orchestration.
- Composite applications are user-oriented applications that support cross-system collaboration. They have a user interface, although they might contain automated process steps requiring no user interaction.
- Composite applications are process-centric and manage business processes which span one or more underlying applications and/or components that are often data-

centric. The process may include process steps from third-party or customer-proprietary software components.

- Composite applications have their own lifecycle. They can be built, packaged, deployed, and upgraded independently of the underlying applications or business process platform. Consequently, composite applications establish a new logical application tier. This type of loose coupling also requires that there be no shared volatile states and no transactional locks between the composite application and its underlying components, thus imposing the requirement of a stateless service-oriented communication protocol.

- Composite applications often need to abstract from the components they are based on in order to be able to run in heterogeneous landscapes as well as various releases of the same backend system at customer sites without having to upgrade the main application systems. A particular requirement is that composite applications be able to cope with the existing configurations of the underlying components.

Composite applications require the service-enablement of the underlying applications or components. However, the applications on top of which organizations want to build composite applications often do not have interfaces a composite application can plug into, so that further development as well as further shipment and delivery processes is required to add those interfaces to the underlying components or applications.

While the gap between business and IT does not pose a problem for highly structured business problems and processes that are stable in time, it is a major obstacle for all other problems and processes. In certain cases decision makers are only able to detect certain patterns if they are exposed to different information. Pre-defining such patterns or scenarios generically proves difficult. Often they have to react to unexpected, critical circumstances that cannot be pre-modeled. Hence, a system to support agile collaborative sensemaking in such situations by fulfilling ad-hoc information demands must provide means to identify relevant information blocks and contextualize information on the fly. These processes emerge situationally, they are altered while running, and stop when they are finished or become unnecessary. Information requirements within such processes only arise after a certain task has been started, and structurally equivalent tasks in different contexts may require different information.Users need to be able to interact with the system in a non-technical way, with an intuitive user interface and an easy to use situational Common Operating Picture composite application.

The question arises if such processes and problems can be meaningfully supported, given the gap between business and IT, and the answer must be ‘no’, because:

- For every such problem, the solution can be individual. It is impossible to let IT create an individual solution first.

- Requirements are changing for each new process instance. Even if support for an infrequent process was established, the next process instance can look significantly different.

- Requirements can be bound to an individual or a small team. A group of users sharing the same set of goals may have very different approaches on solving them and may be unwilling to change them if they are successful with them.

- Enterprise IT Systems are not built for changing requirements on instance levels. It is rather challenging to adapt established Enterprise IT Systems to requirements on process instance level.

Situational Composite Applications provide an effective means to bring important information directly to decision makers without complicated navigation to reports available somewhere in the system. They furthermore enable client-side mashups and hence an integration of enterprise-related information without complicated backend integration for many scenarios where this is possible. In addition, they provide a new user-experience and increased useability. They extend the characteristics of Composite Applications:

- Have a much shorter lifespan and address specific needs of a relatively small user community and provide value in terms of days or weeks rather than months and years.

- Composed largely by the end-users themselves with significant involvement of communities of interest to share models and best practices

- It does not need to be personalized, it personal by its inception (Clay Shirky, 2004).

- The compositions are often created ad-hoc, and as such, they are more directed at data flow (extracting, transforming, combining content) than control flow (passing control from one service to another, using complex workflows).

- As they are used by non-technical users, the composition interfaces have to be very robust. To allow experimenting, and easily switch from design-time to run-time modes, the borderlines between static and dynamic perspectives have to be blurred.

- Leverages the Semantic Web for an ontology assisted Web services discovery. This provides users context aware recommended information sources to further explore.

Power to the edge is not only a paradigm valid for the warfighter, but literally also valid for the military decision makers who need to solve adhoc problems. We believe, that in order to have end-users benefit from SOA and directly be able to use the flexibility it offers, we need to provide them with an easy to use service composition platforms that let

them deploy these situational applications in extremely short time, as compared with typical development cycles. In other words, given architectures and technologies such as SOA, enterprise application integration, data warehouses, and mash-ups, how can IT provide end-users with ability to compose simple applications that follow their requirements, and not require programming skills, or even understanding of the concept of SOA?

The Importance of Communities of Interest

While the typical set of requirements for a Situational Composite Application can be bound to an individual or a small team, there are elements or patterns that span the organization. Communities of Interest will play a greater role for these users as they can learn more, identify trends, provide feedback, ask questions, network with colleagues, collaborate, and innovate. Specifically, the Communities of Interest support its members by facilitating:

- Ask a question or find an answer
- Share knowledge and expertise
- Collaborate with community members to get feedback and input for an idea
- Learn from others and then get inspired to add own experience. Showcase how members are using business process expertise to solve a problem or address an issue.
- Read articles, white papers, and case studies on best practices, methodologies, enterprise SOA, and ROI calculations written by community experts
- Find out about education and training opportunities
- Learn more about new tools available
- Get access to community-only content and events
- Exchange models

These Communities of Interest provide a unique opportunity to create a synergistic effect of peer-produced Situational Composite Applications.

Enterprise SOA Governance

The term “enterprise SOA governance” refers to the processes, policies and associated control mechanism a defense organization establishes in order to steer the adoption, implementation and evolution of SOA in line with business needs. These governance principles provide SOA initiatives, such as the realization of Enterprise Situational Composite Applications, with structure and control, resulting in the reusability of enterprise services. This marks the most compelling difference between so called plain

("vanilla") SOA – without SOA Governance - and enterprise SOA, supported by enterprise SOA Governance. Consistently successful enterprise SOA calls for a holistic and evolutionary governance approach that encompasses people, processes and technologies. Fragmented organizations with decentralized governance processes are not good candidates for service oriented computing (Gulledge, 2007). Enterprise SOA initiatives that rely on a tool-based governance approach alone will inevitably be limited in scope. To assure that the benefits of enterprise SOA are achieved, governance must expand beyond the core strategic alignment between business and IT. It has to encompass the full breadth and depth of ongoing transformation and growth of the company. Enterprise SOA governance embraces well throughout processes, guidelines and procedures that need to be systematically developed and matured.

Illustrative Example of a Situational Composite Application for Collaborative Sensemaking

We have developed a prototype that clearly illustrates that end users are in fact able to compose Situational Composite Applications themselves with a one-click operation. In contrast to the current crop of available tools that require extensive knowledge of the underlying technology to "wire" composite applications together from building blocks, this approach does not. Each Situational Composite Application component features a list of available follow-up services that comprise internal and external Web Services. A user can browse through and contextualize the rich repository of information internal sources and mashup this information with that of external sources to progressively build the Common Operating Picture. This approach allows users to take the "So what?" litmus test in rapid iterative loops as sensemaking occurs. With every contextual information added to the Situational Composite Application a more precise Common Operating Picture emerges and the "So what?" continues until a recommendation or decision can be made.

Prototype

The prototype build uses an impending natural disaster for its backdrop. A multinational coalition has been deployed to provide humanitarian assistance to the local population. Internally Displaced People and refugees have fled to camps. There is a critical shortage of supplies at one camp and the coalition has been asked to help.

As a first step, the Strategic Corporal pulls up a report that shows a list of material with critical shortages.

From there, the user is offered to contextually view additional master data on the missing material or view a list of coalition partners that normally stock that particular material. This could be different for each material.

From the list of potential suppliers, the user then wants to see where all these suppliers are located on the map. The user is provided with contextually relevant information to pull into the emergent Common Operating Picture.

From there, additional contextual information is added to the map. In this case, the user adds life traffic feed and reported events reported by civilian emergency services (e.g. fire, police, ambulance, etc) and coalition partners along with the location of the camps.

The Strategic Corporal can now see a clearer picture of the situation. They can see where the best source of supply would be. Next, from the list of potential suppliers, the user selects the best potential one and from the contextual menu, they can call a web service that interrogates the potential supplier to see if they indeed can meet the demand.

Now that a supplier that has stock that can deliver the critical supplies in a timely fashion has been found, the replenishment order is then invoked from the materiel availability view.

Prototype Results

In this prototype, the Strategic Corporal was faced with a critical shortage of material. They quickly and easily composed a Situational Composite Application by assembling a Common Operating Picture from contextually relevant information shared amongst the coalition partners leading to Collaborative Sensemaking. The result, access to understandable, contextually relevant, and actionable knowledge for the Strategic Corporal.

Conclusion

This paper showed how Situational Composite Applications can address the informational needs of decision makers providing them with understandable, contextually relevant, and actionable knowledge. The current generation of decision makers is very comfortable with the concept of composing and sharing through Communities of Interest. We demonstrated that decision makers can indeed interact with the system in a non-technical way, with an intuitive user interface and an easy to use situational Common Operating Picture composite application. Furthermore, we also demonstrated that composing, versus custom development, fits within a well managed SOA Governance framework while addressing the long tail of requirements that are not well addressed by traditional corporate IT Systems.

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