Demand Activated Manufacturing Architecture (DAMA) Supply Chain Collaboration Development Methodology

Marge Petersen & Dr. Leon Chapman
Sandia National Laboratories
PO Box 5800, MS 1137
Albuquerque, NM 87185 USA
email: ldchapm@sandia.gov & mbpeter@sandia.gov

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ABSTRACT
The Demand Activated Manufacturing Architecture (DAMA) project during the last five years of work with the U.S. Integrated Textile Complex (retail, apparel, textile, and fiber sectors) has developed an inter-enterprise supply chain collaboration development methodology.

The goal of this methodology is to enable a supply chain to work more efficiently and competitively. The outcomes of this methodology include:

- A definitive description and evaluation of the role of business cultures and supporting business organizational structures in either inhibiting or fostering change to a more competitive supply chain.
- "As-Is" and proposed "To-Be" supply chain business process models focusing on information flows and decision-making.
- Software tools that enable and support a transition to a more competitive supply chain, which result from a business driven rather than technologically driven approach to software design.

This methodology development will continue in FY00 as DAMA engages companies in the softgoods industry in supply chain research and implementation of supply chain collaboration.

INTRODUCTION
A collaborative environment is one in which people can work together, sharing information, and knowledge. Other terms used for some types of collaborative environments where technology is employed include "GroupWare" and "Computer Supported Cooperative Work" (CSCW) systems [2]. Our interest has been in developing technologies that support collaboration and the efforts of teams across companies. Inter-enterprise collaboration and streamlined manufacturing supply chains require the implementation of a collaborative software environment. Delivery of the best software in the world will not ensure a successful collaborative environment. Through our research on the DAMA project, we have realized time and again that successful collaborative environments are achieved only when they are business driven, not technology driven.

METHODOLOGY TEAM
Developing a business driven solution requires the application of many disciplines, not just business systems analysis or computer science. Leveraging our experience from work on collaborative supply chains and environments, we have instituted a multidisciplinary approach for developing collaborative environments. Those disciplines include cultural anthropology, business systems analysis, industrial psychology, industrial engineering, systems engineering, data base analysis and computer science.

The viewpoints applied to our methodology have been summarized as culture, modeling, users, use cases, human computer interaction (HCI) and computer science. The application of these viewpoints to the architecture is shown below in Figure 1. Culture analyzes activities, Modeling analyzes information and data, Use Cases and HCI viewpoints are concerned with defining the application, and computer science is responsible for the infrastructure.

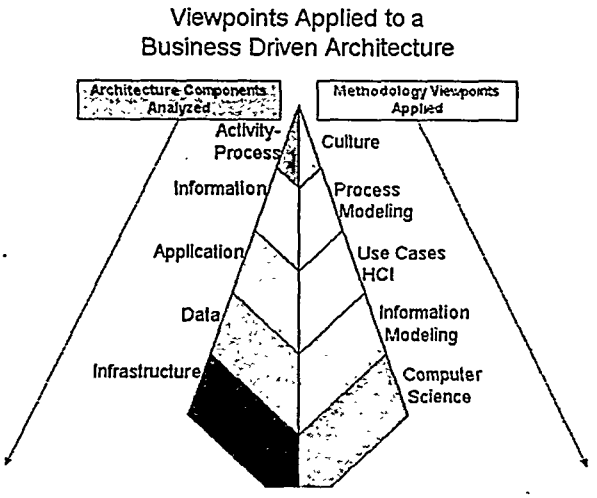

Figure 1 Business Driven Architecture

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Culture Viewpoint

Everyone who lives within an organizational structure learns how to live within that structure. The rules are not always written and, in fact, the written rules are not always in synchronization with the "real" culture. For example, teamwork is often cited as a corporate value when individual "thinking out of the box" and innovation are what is truly valued and rewarded. The culture viewpoint has to uncover these unstated contextual issues so that any proposed improvements to the supply chain or work environment are not in conflict with the corporate culture.

The cultural viewpoint is one not frequently included in software development. However, if one takes time up front to understand the business culture and business practices, the likelihood of succeeding in a collaborative relationship improves significantly. As one takes time to understand the business culture, the subsequent pilots and/or software implementation are more prone to be business driven, instead of technology driven.

Modeling Viewpoint

The modeling viewpoint is central to understanding the "As-Is" process, "To-Be" processes, and the information required supporting those processes. Modeling presents a "systems" view of the problem: understanding of people, processes, information, applications, and technology.

Every process step has inputs, outputs, enablers and constraints. The level of detail in the model depends on the level of detail in the potential solution space. The model should not be anymore detailed than the most detailed description of the proposed approach to improving the effectiveness of the supply chain or work environment.

User Viewpoint

Users are a catchall that references all of the participants from the "content" community as opposed to the "design, analyze, and implement" software community. The user community includes corporate champions, managers whose organizations will be affected by modifications of the collaborative environment, and real users who would have to use the new processes or software to make the project successful.

Use Case Viewpoint

The Use Case viewpoint integrates culture and modeling viewpoint results with an understanding of the customers, software capability and development difficulty into a functional description of the software product. The use case describes how each of the target users would use the system to do their jobs and how each user interacts with other users.

Human Computer Interface (HCI) Viewpoint

The human computer interface viewpoint is concerned with user interaction design. It includes conducting a series of targeted interviews with users, understanding the users' tasks in the context of their work, identifying existing interface capabilities and constraints, assessing usability, and designing a functional user interface. A contextual task analysis should also be incorporated and usability goals should also be established. Usability goals are determined by business goals, user profiles, and user contextual task analyses.

The main point is that the software has to be designed to fit the users needs, thought-patterns, and goals or software will not be used effectively.

Computer Science (CS) Viewpoint

The computer scientists make the use-case and the HCI design a reality. They design and build the software. This is extremely important and probably requires more effort than any of the other steps, but without careful consideration of the other viewpoints, what the CS viewpoint builds is almost guaranteed not to make a difference. It may be architecturally well designed, fast, pretty, and use the latest whiz-bang technology, but it will end up as shelf-ware without all of the other steps. Too often in our design of new systems we only build software, and are technology driven, not business driven.

Methodology Team Composition

The methodology team may consist of six individuals, each filling a specific role on the team, or the team may only consist of two individuals, but each individual considers all of the viewpoints while proceeding through each step of the methodology. Throughout the development cycle, the team members (viewpoints) interact. The deliverables of each viewpoint are generally required by the other viewpoints to continue development.

PROCESS FOR DEVELOPING A COLLABORATIVE ENVIRONMENT

The Webster dictionary defines collaboration as the act of working together, esp. in a joint intellectual effort. The concept of working together implies a certain level of trust between the parties collaborating.

The culture of the environment must support the premise that it is in everyone's best interest to collaborate if the collaborative environment is going to be successful [1].

Through our work in designing collaborative software environments and forming collaborative supply chains, we have learned that collaboration is not something that is simply put into practice. Generally collaboration is instituted gradually, and there are three distinct phases required to fully realize a collaborative environment. They are the preparation phase, piloting phase, and scaling phase. All of these phases must occur if collaboration is to succeed. The phases of collaboration are iterative in nature. Figure 2 illustrates the iterative phases.

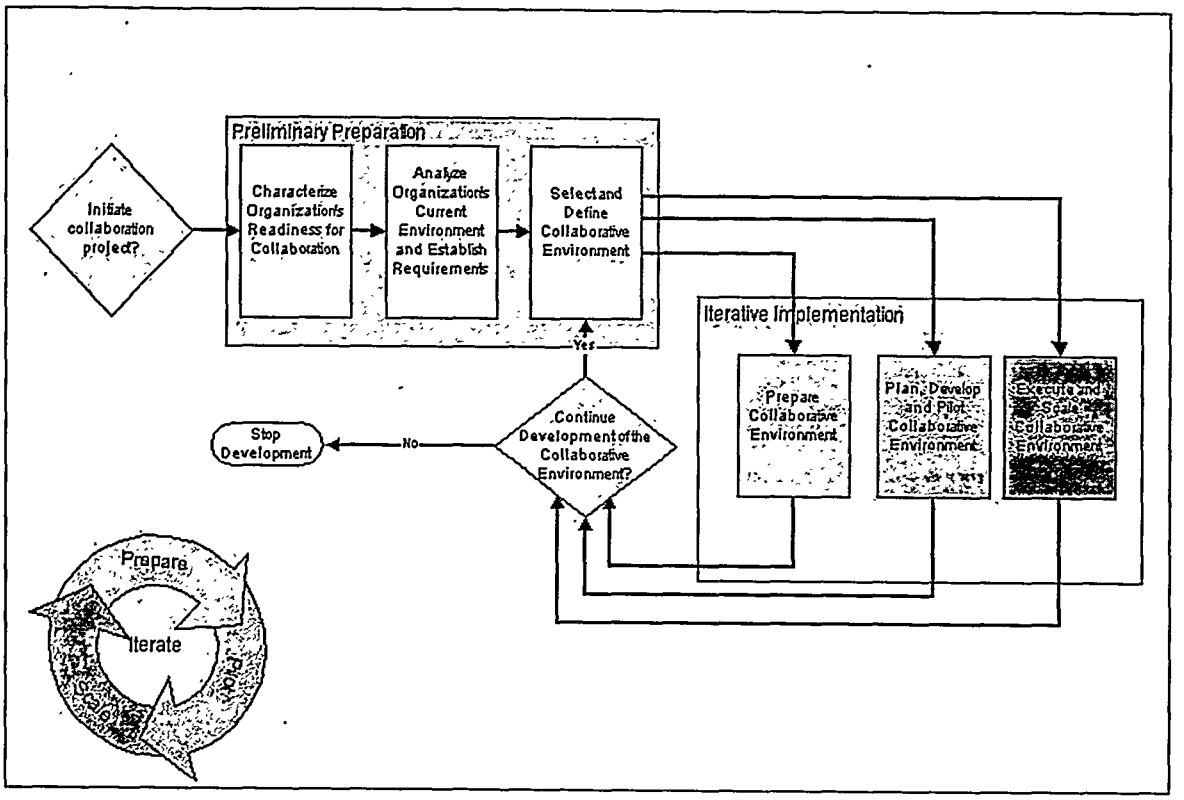

Figure 2. Methodology for Developing a Collaborative Environment

There is a comprehensive preparation phase that is done at the onset of the effort. When the preliminary preparation phase is completed, the first pilot in the piloting phase is ready to begin. When pilots subsequent to the first one are scheduled with the same participants, planning and preparation are required before the initiation of each pilot. Planning and preparation are also required before implementing the scaling phase (where prototypes are extended to support full-scale collaboration, generally with information technology applications.).

A collaborative environment can be piloted without software. But as the pilot grows, the development of technology will support the scaling of the environment. Figure 2 illustrates the iterative nature of the process to realize a fully scaled collaborative environment. The preliminary preparation phase must be completed before any other steps are taken. After that time, the phases for collaboration are iterative in nature, and require ongoing evaluation by the partnership to determine whether or not continued development is required.

Preliminary Preparation Phase

The preliminary preparation phase of developing a collaborative is where the organization takes time to asses its readiness to begin this new way of business. It is a time to characterize the organizations' readiness for supply chain collaboration, analyze the organization's current environment and establish requirements for collaboration, and finally select and define the collaborative environment to be implemented.

Characterize Corporate Readiness for Supply Chain Collaboration

An assessment of corporate readiness for collaboration is required for the initial preparation of each company to participate in a collaborative supply chain. Making this assessment involves the company members (users) and requires that during the process, the team engage the Cultural and Modeling point of view. Questions that might be asked during this initial preparation phase of Assessing Corporate Readiness are as follows:

- Is supply chain collaboration a potentially significant area of improvement?
- Does the company/supply chain have experience with collaborative relationships?

Each company entering this supply chain collaboration should assess their own corporate readiness to collaborate by considering some of these questions:

- Do cross-functional teams exist within your company?
- How do the teams share information?

- Is the coupling between teams sparse and intermittent or deep and constant?
- Is internal information shared freely?

The results of the corporate readiness assessment are used to determine if the organization is ready to begin collaborating with another organization.

Analyze Organizations Current Environment and Establish Requirements

In order to establish the requirements of the technology to support a collaborative environment it is essential for the development team to have a full understanding of the current business practices and culture. Establishing the requirements involves the Culture, Modeling, User and Human Computer Interaction (HCI) viewpoints.

Business practices and individual behavior take place within a given business environment or corporate culture, and are conditioned by it. Behaviors and texts provide clues to corporate culture and relevant aspects of individual behavior. The culture viewpoint should pay particular attention to the *business environment, business practices and individual behavior.*

The *business environment* (corporate culture) defines the overall context for business practices and individual behavior. Some portions are explicitly constructed (e.g. mission statement, corporate goals), others emerge over time (e.g. corporate values). The characterization of the business environment is often found in oral and written texts and in symbols.

Business practices are generally observed through behavior. The behavior must be congruent with corporate culture. Business practices are usually explicit and constructed. Information about these practices can be gleaned from the organizational structure, programmatic definitions, and budget allocations. It is also important to determine if there are any collaborative practices already in place.

Individual behavior generally conforms to corporate values, and follows established business practices. Individuals tend to select organizations with whose culture and business practices they feel comfortable. It is important to try to understand the personal history of the individuals in the organization, their personal motivators and their personal values that support collaborative work.

Understanding The Role Of Business Cultures And Supporting Business Organizational Structures

Characterizing the organizations and how individuals operate within an organizational structure has proven to be a critical component to successful implementation of a collaborative supply chain. Questions that might be asked during this initial preparation phase of characterizing the organization to assess the readiness of the organization for collaboration are as follows:

- Is collaboration a potentially significant area of improvement?
- Does the organization/supply chain have experience with collaborative relationships?
- Do current work practices support collaboration?
- What technology is in place, and will it support a collaborative environment (network, intranets, internet, desktops for all users)?

Organizations entering this supply chain or collaborative environment should assess their own corporate readiness to collaborate. The modeling viewpoint should determine if cross-functional teams exist within the organization, and determine how they share information.

One enabling tool for this readiness assessment is a strengths, weaknesses, opportunities and threats (SWOT) analysis conducted jointly by the culture viewpoint, modeling viewpoint and users. Characterizing the organization through a SWOT analysis enables each organization and the supply chain as a whole to carefully determine their readiness to participate in a collaborative environment. The result of this SWOT analysis should provide a corporate decision that directs the project.

The initial assessment conducted by the HCI viewpoint is to develop the User Profiles. User profiles are another tool that can assist the team in assessing the readiness for an organization to enter collaboration.

The objective for characterizing the computing environment at this stage of the process is to provide information for the HCI from which they can more completely develop the User Profiles. This characterization is done at a relatively high level, and should primarily focus on the main capabilities and constraints of the environment

Understanding "As-Is" And Proposed "To-Be" Supply Chain Business Process Models

The modeling viewpoint should look to understand the sources of information, and how it is used. This step will result in an information model that describes the organization. There are a number of methodologies and tools that can be used to support the gathering of the information model. As the information model is developed, the team should look for information that is missing, as well as for information that is being passed but is not used.

Select and Define Collaborative Environment

The third important activity in the initial preparation phase is the actual formation of the supply chain partnership. The steps in this preparation phase lay the

groundwork for the development of the collaborative business agreements that must be developed between the partners.

The following questions should be considered:

1. What supply chains are potentially available for improvement?
2. What are the problems with the current approach to the supply chain management?
   - time to realize product
   - product quality
   - management of changing requirements
   - synchronization or
   - execution monitoring
3. What are the potential benefits of improving the supply chain?
4. How important is the supply chain to core business?
5. How well is the current supply chain understood? Are there baseline metrics?
6. Is there a high level of management support for collaboration?

Identifying the supply chain partners is critical to the success of any collaboration effort. This is because TRUST must be established between the partners. This step, again incorporates the viewpoints of the company (users), culture, and modeling teams.

Iterative Implementation

The iterative implementation for developing a collaborative environment includes three steps:

1. Prepare the collaborative environment
2. Plan, develop and pilot the collaborative environment, and
3. Execute and scale the collaborative environment.

The activities to consider in within each of these three steps are delineated in Figure 3. Simply stated, these can be summarized as prepare, pilot, and scale.

Prepare Collaborative Environment

This methodology is iterative in nature. Once the initial preparation phase has completed and a firm decision to continue has been made, the methodology maps to the phases of collaboration: prepare, pilot and scale. Each of these phases is followed by an evaluation to determine if the work should continue.

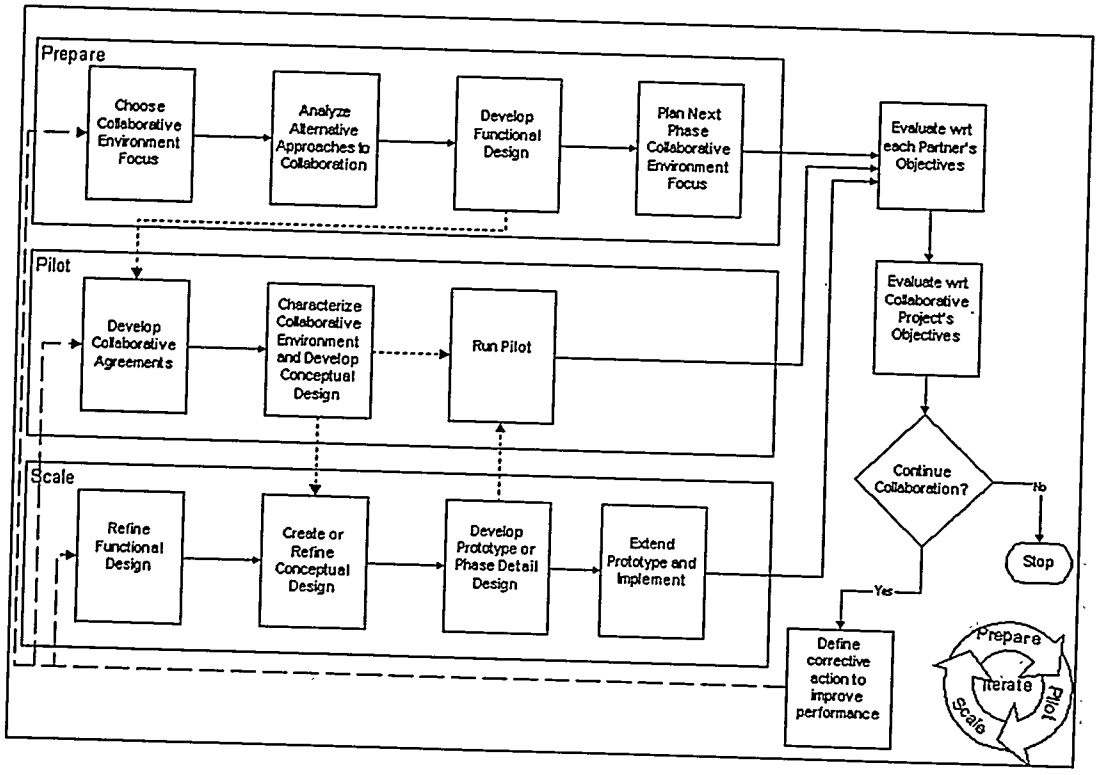

Figure 3 Iterative Process for Developing a Collaborative Environment

The key activities in the prepare phase for collaboration in this methodology are:

1. Choose supply chain product focus.
2. Analyze alternative approaches to supply chain management.
3. Write use cases (functional requirements).
4. Plan the next supply chain project.

During this preparation phase, the additional viewpoints of use-cases, human computer interface, and computer science are introduced. When the writing of the use-cases is completed, the team might choose to move directly into the pilot phase. They begin developing the business planning agreements. An evaluation phase may take place where the team determines if they will continue with the collaboration before moving on into the pilot phase.

Pilot Collaborative Environment

Once the supply chain has been selected and the preparation phase is completed, piloting can begin. In order for a pilot to be successful, business agreements must be established between the partners. Then the team can characterize and scope the supply chain pilot. This process activity includes the development of As-Is and To-Be models, user profiles, and characterization of the corporate computing environments. The level of detail encompassed in each activity will be dependent on the breadth and depth of the pilot.

Scale Collaborative Environment

When a pilot has been completed successfully and the supply chain determines that it will continue with the collaboration effort, the Collaboration Phase to scale the implementation begins. The scaling phase is where the scope of the pilot is increased to include more products, more collaboration functions and/or more participants. It is during this phase that the Computer Science team becomes a significant contributor to the methodology. Functional designs are developed, conceptual designs are created, and the iterative cycle of prototyping and development of software begins.

A "thin-line" prototype is a working system that is designed to handle a subset of problem instances. It will implement all aspects of system architecture (e.g. user interface, network communication, data storage, major algorithms), although some may be done in a partial manner. Its purpose is to provide a working test of all major areas of system functionality, which can incrementally be extended into a full working system. An example of a thin-line prototype for a collaborative supply chain system is one that is complete enough to handle all orders for denim, but has not been extended to handle all orders for all products for the full supply chain.

SUMMARY

The two main processes of the Collaboration Development Methodology are the preliminary preparation phase, and the iterative implementation phase. The key elements of the preliminary preparation phase are to characterize the organization's readiness, analyze the organization's current environment to establish requirements, and select and define the collaborative environment. For each collaborative environment that is selected, the organization will need to prepare, pilot and scale according to the organization's readiness. The process is iterative in nature, and it is important to get experience-based feedback from the participants early and continuously throughout the development cycle. We have found 2-6 months can provide time for an entire iteration.

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