E-Collaboration for Maritime Operations using Business Process Modeling

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Abstract

One of the highly globalized fields such as Marine Industry, shipping operations are hugely dependent on e-collaboration tools that holds potential to provide quick and readily accessible information across ports, organizations and people across nations concerned with industry. Improving operational efficiency is very much dependent on business process transformation by affording better communication and collaboration between the different parties and information technology. This paper focuses on proposing an architectural methodology to overcome the frequently occurring problems in maritime sector by establishing collaboration between the service providers and potential users of the collaboration tool by identifying key processes. The methodology is developed based on empirical studies of Norwegian SW national initiative, MIS project (http :/ / www .sintef.no/Projectweb/ MIS/)

Keywords: *Collaboration, Maritime Operations, Business Process Modeling, Process Optimization, Collaboration Oriented Architecture.*

1. Introduction

The maritime transport sector is one of the most environmentally friendly transport means, but will nevertheless have to face the common challenges of reducing green house gas emissions. One of the areas w here there are significant operational gains to be made is in conjunction with port operations. This can reduce loading, discharge and waiting times for ships and , thus, allow the ships to use lower speed during transit and correspondingly less fu el. Presently, there has been an increased interest in areas related to new work processes, communication and collaboration based on the acknowledgement that successful implementation of information technology is closely interweaved with human and organizational conditions (the Man, Technology and Organizational perspective – MTO).

The transformation of business and flexibility to manage changes are two important drivers of the increasing interest in business modeling in recent years, apart from these two factors another important driver is " The need to manage increasing complexity"(David M.et.al, 2008). The complexity owing to the fact that majority of the work in business world depends on human collaboration as contributions of various factors in MTO are *"It's 80 percent about people, 15 percent about processes and 5 percent about technology"* (David Latin, 2009). So, imp roving operational efficiency is very much dependent on business process transformation by affording better communication and collaboration between the different parties and information technology.

Recent developments in process modeling have opened many new dimensions for the maritime field , which ranges from effective utilization of the resources in various processes to using the processes as means to gather the information. Today's practice where all interaction links are one to one and reuse of data is limited , is leading to unnecessary time and resource-demanding working days for everybody involved. There is a need to improve the collaborative processes for making the operations efficient. Therefore it is necessary to design a system where different processes can facilitate collaboration between actors and provide a means to information and resources available in the Resource Hub, (i.e. database w here the list of the resources are available) developed by MIS.

2. Maritime Operations

These days, supply chain operations are vastly distributed inter-business activities frequently varying from countries and continents. Supply Chain Management (SCM) is a set of synchronized decisions and activities performed to integrate suppliers, manufacturers, warehouses, transporters, retailers, and customers such that right product is delivered at right time to right locations effectively and thus achieving customer's satisfaction [(H au Lee.et.al, 2004),(Ling Li , SCM)].

The involved business partners often aim for optimizing the complexity of supply chains and maximizing the efficiency between supply chain operations by facilitating proper collaboration and at the same time flexibility, agility between operations (Christopher. M, (2000)). For example, in the case of Oil industry basic transportation medium is through marine shipping, as illustrated in Fig. 1

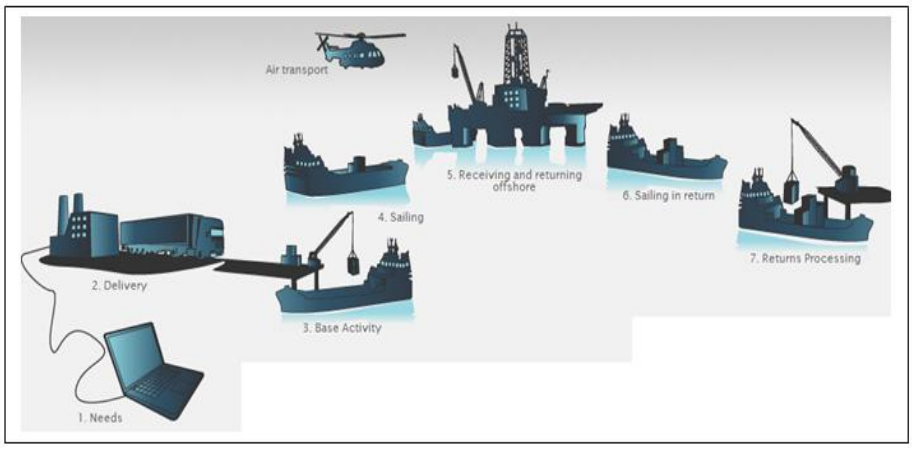

Fig.1 Maritime Operations in Oil Industry (Statoil Logistics Portal, 2011)

As can be seen from Fig.1, the various phases involved in maritime domain are Alignment & Marketing, Planning, Execution and Completion (Lone, B report).

2.1 Alignment & Marketing

The Alignment, Marketing and Sale processes are concerned with creating contact between the actors that have a need for transport or services and those who can offer transport and services that fulfill the demand; and the sale of the transport or service.

This phase consists of the publishing of needs or offered services, establishing contact between the parties, agreeing on the terms of the service and the sale of the service.

2.2 Planning

The provision of transport and services is planned and managed based on actual and foreseen demands, information about the Transportation Network infrastructure and traffic conditions. This is based on information provided by the transportation Network Management domain. The planning includes decisions about routes, schedules, service types and use of resources.

2.3 Execution

The Execution phase begins when work processes are initiated in accordance with the execution plans and ends when the execution is either completed or cancelled . The execution of the operations includes movement of goods, cargo hand ling, document hand ling, monitoring and control of operations and goods. The latter may involve interactions with the On-board Support and Control domain. The domain's exchange of information with the Transport Demand domain shall support effective coordination and accomplishment of the whole transport chain, which is managed in the Transport Demand domain. This may include transport and terminal operations managed by several Transport Service Providers (transport companies, terminals, etc.). This phase also deals with detection and management of deviations.

2.4 Completion

The completion phase includes the agreed completion of the services (e.g. Delivery of the transported goods at the destination), handling of payment and claims when the actual service has deviated from the agreed terms. Also, while the handling of payment for services may come at any time in the process (e.g. prepayment), it fits in the completion phase from a logical view point. As it is evident from above phases, the operations and processes involved in maritime domain are complex and hence the collaboration is needed to construct an aligned process flow and flexible transport plan.

3. Need for Collaboration

Collaboration is a process in which different entities share information, resources and responsibilities to jointly plan, implement, and evaluate a program of activities to achieve a common goal (Camarinha -Matos.et.al, 2006).

In general, Collaboration always takes place when any group / people from different fields are working together for their common goals. In business world , collaboration takes place via exchange of information from various sources of information such as databases, online chats etc. For instance, in our case of maritime operations; different operations and resources are required to perform the activities in ship , port and terminal level.

There are different concepts interlinked with collaboration, as illustrated in below Fig 2, the concepts such as network, coordination and cooperation constitute the building blocks for the collaboration (Camarinha -Matos.et.al, 2006).

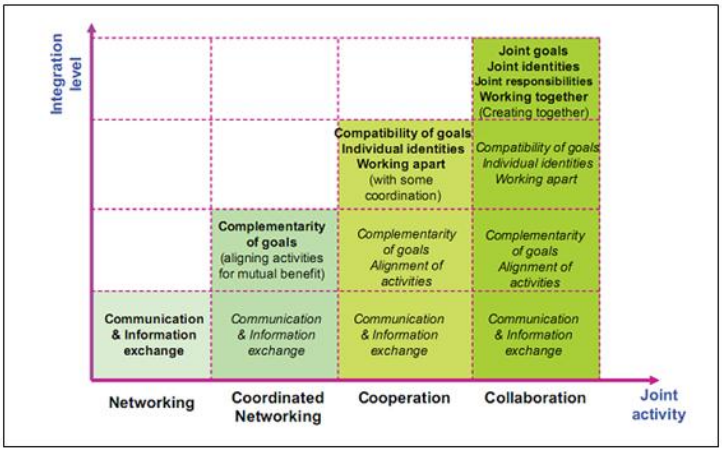

Fig.2 Levels of Joint Endeavour (Camarinha -Matos.et.al, 2006)

4. Enterprise Integration

Enterprise Integration is associated with providing information, effective control and communication across various organizations within enterprise (Vernadat, 1996). The Maritime Enterprise embraces large number of people with different roles working seamlessly in order to perform the various functions in the enterprise. Essentially, the main objectives for these functions can be any of these factors Product, Place, Price, Time, Quantity (P^3TQ) as illustrated in figure below (Dorian, 2003). The enterprise integration can be made possible by understanding and managing the intricacies and vagaries of P^3TQ and thus using the business processes to lay the foundation for smooth functioning of the enterprise.

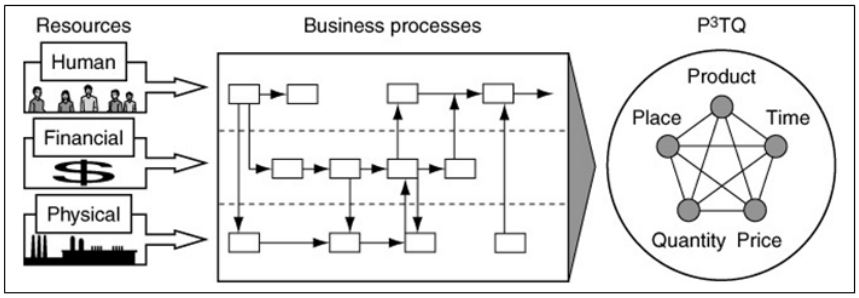

Fig.3 Mapping Business Processes and P3TQ (Dorian, 2003)

5. Process Centric Approach

The advantage of any organization lies in business processes and technology together to execute business decisions taken by organization involving actors with strategic dependencies among each other; however the approach of organizations is more **"Process Centric"** than **"Technology Centric"**. The Technology existing today allows organizations to build up rules, roles, and workflows depending upon requirements and need of flexibility, rather than previous notion of having focus on concrete programming logic alone (Modus21, PCA). This approach of being more concerned with process instead of technology alone will provide

great advantages to organizations such as better control on execution of business processes, better capture of knowledge needed by organization and efficient usage of existing resources within organization, In addition to gain corporate value, aligning business and IT strategy (Modus21, PCA).

A Process Centric approach can be mainly divided into three phases, namely Discovery, Implementation, and Maintenance. These phases are vital for successful execution of overall business directives set by any organization and in case of not meeting these requirements may lead to failure of organization's success.

5.1 Discovery

According to Gartner Research Inc., *"more than 40% of the entire project effort takes place in the discovery phase."* (Modus21, PCA). This phase is essential for identifying business requirements and setting up goals and successful completion criteria by organizations. Majority of organizations fail in this phase as they are unable to identify goals either due to lack of technological development at that time or lack of foreseen future prospects, developments. The discovery phase will depend upon the nature of the organizations and its goals. It can occur mainly either at domain level of organization i.e. Macro Process Analysis or at larger scale at Enterprise level i.e. Enterprise Architecture Analysis.

Macro Process Analysis (MPA)

Macro Process Analysis mainly is to identify processes within domain of an organization rather than processes covering entire organization. Generally, it comprises details of each process, relationships between those processes, and aids in optimizing and automation of processes (Modus21, PCA).

Enterprise Architecture Analysis

Enterprise Architecture (EA) is a model representation of various components of enterprise with focus on mainly four viewpoints: strategy, business, systems, and technology into an organized EA plan that become accustomed to needs of enterprise over time (Modus21, PCA). The Enterprise Architecture analysis provides models representing the goals, business processes, rules and relationships among them and also useful for analyzing *how changes would affect the enterprise? What are changes required for improving operations and process flow across enterprise?*

5.2 Implementation

Consistency is critical for implementation of business processes in Business Process Management (BPM), consistency can be achieved by using Process Centric approach by process analysis, usage of right technology / tools, implementing the required tools, and thereby establishing appropriate solution for needs of business. However, these steps are independent and needs to be addressed individually (Modus21, PCA).

Process Analysis (PA)

Process Analysis is a short phase of any project where process discovery and analysis are performed for a particular process within the organization. The analyses are usually conducted by numerous interviews, process model reviews and requirements from the clients to thoroughly identify the scope of the existing processes (Modus21, PCA).

Implementation

Implementation of BPM, SOA and Enterprise architecture requires proper tools deployment. Apart from providing BPMS (Business Process Management System), tools are vital for implementing business architecture in order to get maximum utilization of resources. This is mainly done by means of identifying and making use of needed or accessible web services, as well as potentially deploying an Enterprise Service Bus to serve the needs of enterprise.

Solution Implementation

An efficient tactic to implement BPMS should include mainly five stages namely, planning, analysis, prototyping, quality assurance, deployment. Along with these stages MPA and PA are also carried out (Modus21, PCA).

5.3 Maintenance

The last phase of the process centric approach is maintenance of the desired results of organization. This is mainly achieved by aligning IT and business operations, applying optimization techniques and monitoring processes continuously to be in agreement with the desired results. A successful business often demands change, which forces organizations to concentrate on integrating their processes management within their infrastructure and thereby making process owners to be able to support collaborative effort between executive level, business owners, and IT (Modus21, PCA).

Presently, most of BPMS provides ability to cope with rapid changes in requirements by changing business process, However Process centric approach gives addition advantage by making process owners to be aware of changes made with processes will effect whole business management and at same time it would improve in planning of changes to suit to business needs.

6. BPM- A Solution to Process Centric Approach

Gartner Research Inc. states that, *"Organizations that had the most-successful BPM initiatives spent more than 40 percent of the initial project time on process discovery. Establish core team responsibilities, select the right tools and use an iterative method to create a process model that supports ever-changing business conditions."* (Michael James, 2005)

These views are in agreement with "Process Centric approach". It is very likely that organizations seek for advantage by following certain process plan or by adopting some particular tools to achieve what they think right for them at that moment rather than achieving long term business goals. This methodology is sure to letdown and will result in process failure. However, implementation of Process Centric strategy will allow an organization to have an edge over tackling problems within processes steadily. This approach ensures that all problems are tackled before implementation or while monitoring processes continuously over time.

As an organizational viewpoint, the primary task is to identify process and thereby apply Process Centric approach, scrutinize the results and finally establish appropriateness of process. In case of in existent process, then best way is to initiate with known business problem and extending it further. It's always preferable to illustrate proof of concepts via pilot project to the decision-making management and hence applying it to whole organization upon successful results.

For any organization, it is essential to implement good process flow for gaining competitive edge and most importantly it all starts by Process Centric approach.

7. Intersection of Processes, Tools and Users

In the maritime transportation sector, collaboration is very much evident as intersection takes place between various elements such as business processes (or service management), software tools (or technologies) and users for common goal as illustrated in following figure. As a result, collaboration is crucial to either to make good plans that are aligned with the different stakeholders or can be used as a tool for deviation management if such a think occurs

Presently, "Integrated practice" has been increasing largely in maritime sector which means that different roles/ organizations and their operations are more integrated and coordinated through improved interaction and information exchange facilitated by MIS. In Oil and Gas industry, they developed an integrated approach known as "MTO (Man, Technology, Organisation)" where Human factors, supporting Technology and organizations have to work closely to achieve their goals and maritime activities are central for their goals acheivement (Lone , B report). In the same way, In Maritime sector, we identified three coinciding factors namely "UTP (Users, Technology, Business Processes)" to improve operations and processes due to increased opportunities for collaborating, sharing and integrating information across professional, organizational and geographical boundaries.

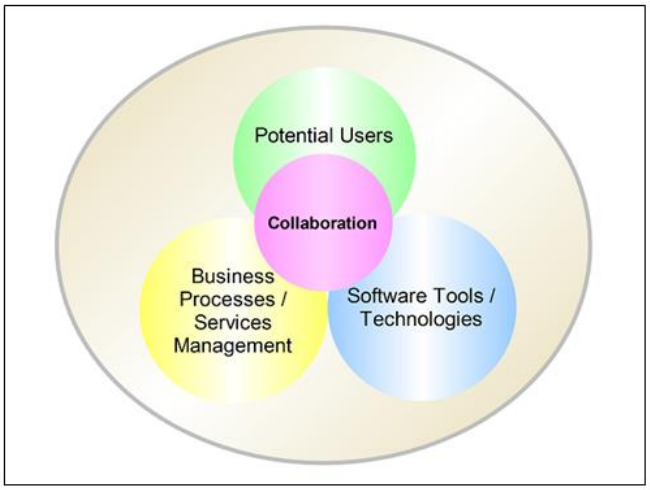

Fig.4 Intersection of Processes, Tools and Users

7.1 Process

In business world, a process is primarily composed of one-to-many activities where either humans or information systems are involved. These set of activities combine together to achieve their business/ organizational goals. In general, these activities can be captured as sequence of business activities supporting information and can be represented using BPMN (Stephen, BPMN).

7.2 Software Tools / Technologies

The Software Tools and Technologies are referred in general to the various forms of tools which aid in the process of collaborations. The most general form of tools which aid in collaboration are online video chat, shared documents / spreadsheets, portals where tracking and monitoring of work is possible. The usage of tools may vary from person to person or within organizations but still they serve their purpose of providing collaboration and aligning the business processes.

7.3 Users

The users can be any stakeholder such as business analyst or customer, who are using various tools and technologies to either monitor flow of processes or aligning the processes to work in systematic way to achieve the business goals.

8. Collaboration Platform

This section mainly deals with ***how can collaboration be established between various elements associated with maritime operations?*** The importance of collaboration in integrated approach are already discussed in section 3 and also we identified phenomenon of intersection between various elements Users, Technology, Business Processes (UTP) to improve operations and processes due to increased opportunities for collaborating, sharing and integrating information across professional, organizational and geographical boundaries. In order to realize this integrated approach one should identify means to integrate inter-organizational systems and collaboration among them (Franklin, 2010). The figure below, illustrates the collaboration and Integration platform for facilitating management of various activities governing maritime enterprise

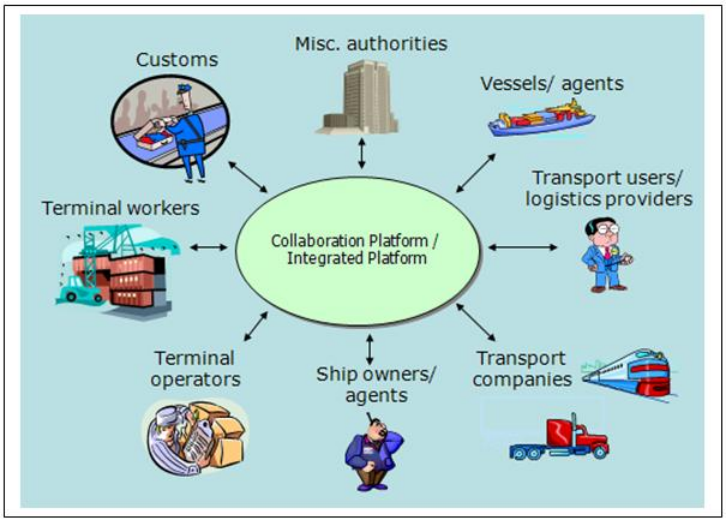

Fig.5 Collaboration/ Integration Platform (VITSAR, D1.1).

As can be seen in Fig 5, the collaboration platform will provide facility to integrate all related services either used or provided by participants in maritime enterprise such as ship owners, agents, terminal workers, transport companies, vessel agents, terminal operators, logistic providers, customs and so on. The seamless of all these services will add additional

advantages such as interoperability, scalability, adaptability, availability, predictability within enterprise operations and thereby substantially increase process optimization and business efficiency [(VITSAR, D1.1), (Franklin, 2010)].

This collaboration platform can be realized on the same lines as mentioned in FI PPP (Franklin , 2010), where building blocks can be aligned with most desirable domain-specific capabilities and inter-organizational process coordination, transport monitoring and tracking, event-driven re-planning, and security and privacy management. The following are four major activities needed in order to implement collaboration platform and attain collaboration among various services (Franklin, 2010).

(1) Domain Analysis: This phase is to understand the know-how about the processes taking place in the domain and identify key processes, requirements of stakeholders and investigating new business prospects.

(2) Design and Implementation: This phase deals with integration of collaboration platform with core design platform and critical business components.

(3) Monitoring: The monitoring is one of the important phases wherein the status of process is identified. This gives great advantage as in case of any deviation or errors within processes can be easily solved by collaboration between parties associated with those effected processes and thereby maintain proper functioning of processes.

(4) Enhancements: This phase is to improve the capabilities of existing collaboration platform by providing addition facilities or adding additional users.

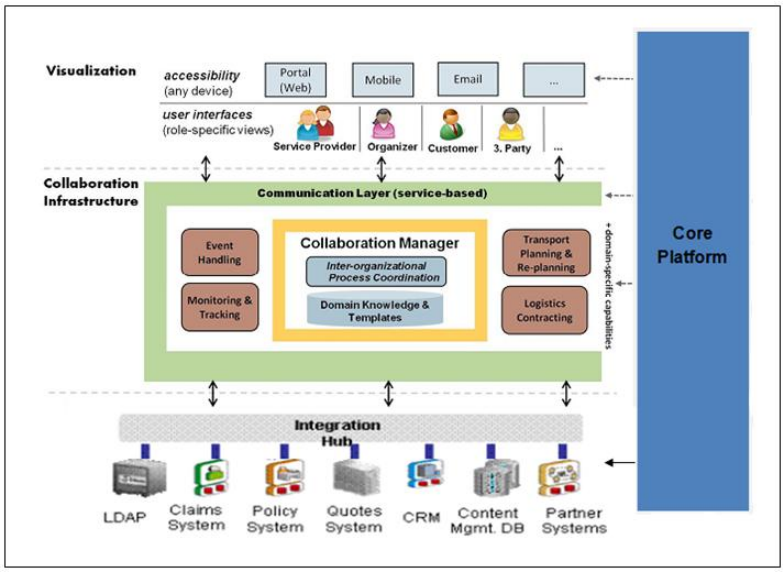

Fig.6 Collaboration Oriented Architecture [(Kapil Pant, 2008), (Franklin, 2010)]

9. Collaboration Oriented Architecture

As seen in previous section, collaboration platform is most crucial part of enterprise architecture for facilitating collaboration among various services encompassing enterprise especially transport and logistics services. Fig. 6 illustrates collaboration oriented architecture, which is based on approaches as described in (Kapil Pant, 2008) and (Franklin,

2010). In our preliminary studies, we have identified that in process centric approach; business processes play an important role in defining enterprise and its operational goals, wherein processes can be modeled using BPMN graphical notation. So, the working principle of collaboration oriented architecture is based on process centric approach and collaboration platform.

The collaboration oriented architecture is developed by building collaboration platform on top of the core functionalities, which facilitates business oriented features such as ubiquitous access and availability, service-based information and system integration, and transport monitoring and tracking on the basis of sensor networks (Franklin, 2010).

The architecture demonstrates possible architectural solution for achieving collaboration between various services governing maritime enterprise. In bottom, we can see integration hub providing access to various systems such as some lightweight access protocols, activities claiming system, regulatory and rules governing system (i.e. policy system), related databases and third party systems providing data pertaining to weather, AIS (i.e. sensor information for finding location of ship vessel) etc. The middle layer encompasses the domain-specific capabilities that provide business-relevant functionalities and will be developed on top of distinct facilities provided by the Core Platform (Franklin, 2010). The main envisioned platform services are the collaboration manager that is concerned with coordinating the planning and execution of international goods transportation processes among the involved business entities, transport monitoring and tracking and end-to-end visibility for customers enabled by real-world integration techniques along with pro-active event handling for allowing efficient treatment of delays and other unforeseen events, the integration of IT systems for enabling efficient transport planning and re-planning, and (semi-) automated support for contracting within logistics business networks (Franklin , 2010).

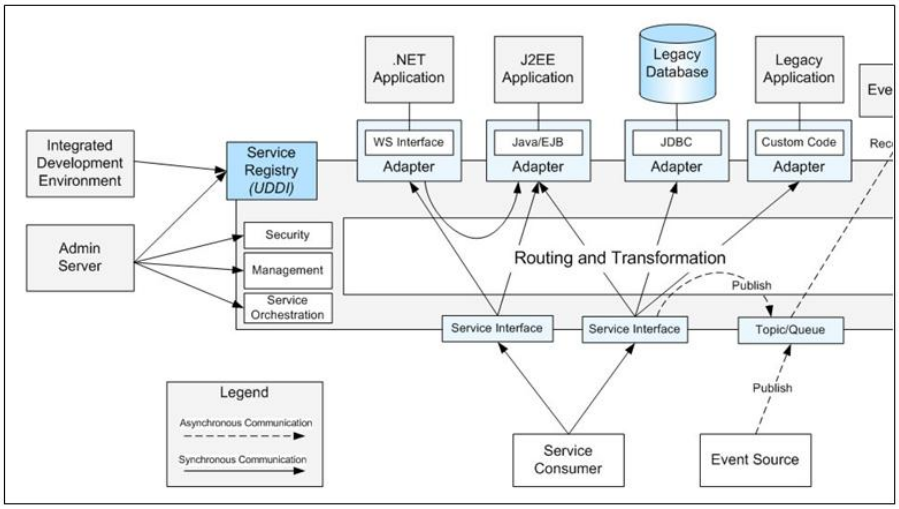

Fig.7 Generic Implementation of ESB (Enterprise Service Bus) [ESB pattern, NIH]

On the top layer, end-user interfaces with sophisticated visualization concepts for role-specific views in order to ensure information privacy as well as ubiquitous accessibility via various end-user devices are provided. The communication among all components thoroughly shall apply the service-based concept, thereby facilitating interoperability via standardized interfaces, along with integrated security and privacy management techniques for ensuring

exchange of confidential and business-critical information in a secure and reliable manner, which are mainly provided by core Platform (Franklin, 2010).

The collaboration oriented architecture is similar to industry standards of providing functionalities of ESB (Enterprise Service Bus) as illustrated in Fig. 7. The ESB facilitates key services for successfully implementing Service-Oriented Architecture (SOA) which includes management and monitoring, security, service orchestration, support for both asynchronous messaging and request-reply, and adapters for a variety of packaged applications and technology platforms [ESB pattern, NIH]. Therefore, the architecture proposed to facilitate collaboration using "Collaboration Oriented Architecture" is likely to handle all issues concerned with SOA such as monitoring, service orchestrations, messaging and enables to apply core functionalities, which facilitates business oriented features such as ubiquitous access and availability, service-based information and system integration, and transport monitoring and tracking on the basis of sensor networks.

10. Conclusion

The process-centric approach for constructing and integrating activities in enterprise is mainly dealt in this paper. The central notion behind this approach has been to identify activities and roles played by various parties involved in maritime enterprise. The information exchange between these parties influences formation of maritime enterprise. The efficient business processes enveloping these information exchanges with various parties can provide quick and easy access to information, thus it saves most of operating costs and assists in handling deviations as w ell. The building blocks for process centric approach as discussed in section 4 are Discovery, Implementation and Maintenance. Based on background provided in this paper, the best possible solution for providing collaboration in maritime enterprise is as follow s:

1. Identifying goals of enterprise and thereafter mapping goals with business processes.
2. Identify the collaboration needed to fulfill business processes.
3. Integrating business processes with collaboration platform , core platform , visualization and integration hub to comply with "Collaboration Oriented Architecture" as discussed in section 9.

This architecture resolves most of collaboration needs of enterprise and provides ability to handle deviations as well.

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