

SELECTION OF ENTERPRISE ARCHITECTURE BASED ON AGILE PARAMETERS FOR SCM-BASED CASE STUDY

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ABSTRACT

Aim/Purpose: This paper being a review paper shows mapping of enterprise architecture with respect to supply chain domain as per agile parameter so to find the best architecture for the development of the enterprise solution used in SCM company. **Background /Methodology:** Without EA, companies muddle through. In an agile environment selection of enterprise architecture is difficult even considering different parameters with SCM phases. This is a question and answer based research survey done for finding the mapping of SCM with different EAs were evaluated with 20yrs of experienced five experts. **Originality/Value:** This paper shows different EA mapped to SCM domain. Tabular format mapping of agile parameter with EA helps to find best EA for developing enterprise solutions even in agile environment. **Findings:** Comparison of 11 EA with a set of agile parameters shows that TOGAF is the most suitable EA for the development of the enterprise software solution. Systematic and structural working of TOGAF, handles the development in agile situation. **Practical implications:** Set of agile parameter from different phases of SCM may help practitioners to understand agile environment gives technical and logical gap which needs to consider in developing the software solution. **Social implications:** Mapping agile parameters at different strategies can help system to withstand in the changing environment with its impact on different operational levels of SCM. **Research limitations/implications:** Finding the type of agility and amount of agility in the SCM system can be an enhancement of this paper. Even more effective agile parameters affecting agility are the future of SCM.

Keywords: SCM phases, SCM strategies, agile supply chain, agile environment, agile parameters

Article Classification: General review with case study

1. INTRODUCTION

The Company considers Information Technology only for informational purpose. IT manager needs to fulfill all changes requested by client. IT manager needs to have standards which can handle business value in agile situation. (Ian 2006) Successful Enterprise architecture practice in an organization focuses on handling business process agility. Agile environment in SCM is used to handle situations like time-to-market response, partnering strategies, low development cost, and higher customer satisfaction. This paper focuses on the analysis of different enterprise framework with respect to SCM domain functionality. This paper is figured around 10 common agile parameters evaluated with different enterprise framework. Using lists of agile parameters, this paper compares different architectures for selection of best architecture for given case study.

Detail study of different architecture is done based on the list of research papers. This paper also specifies a case study of ABC Company is working on the kaizen process. Interview analysis with business analyst (expert) was more useful for comparing architectures based on agile parameter for SCM domain. Experts were the people who work for more than 20 yrs in the field of solution provider in SCM domain. As per their experience, they were interviewed with the framework's issues and their satisfactory answers were noted in this paper for finding the analysis.

II. Supply Chain Management

A. SCM Domain

The Supply Chain Management domain works in inventory based operations such as manufacturing, buying, transportation, and physical distribution of the product with a seamless business process execution. Order processing, customer service, re-planning, scheduling and forecasting are supplementary processes to SCM domain. Stakeholders may be vendors, transporter, third party suppliers, and information providers. The most important principle of SCM is to understand the customer's true needs with strategic coordination of traditional business functions. Supply chains can be complex chain with one or more business component, with one or more suppliers, and customers.

B. Agile Supply Chain

Supply chain works in two approaches Lean and Agile. Quality, service level, and lead-time are market qualifier for lean supply. (Stefan 2012) Cost, performance, and benchmark are an important qualifier for agile supply. (Martin 2000)

As shown in figure 1, Agile supply chain works on agile principles which are connected to lean strategy, agile supply, organizational agility, real-time demand and flexible quick response. (Eyong 2009) Manufacturing strategy, supplier relations, and product distribution can be challenged by supply chain in agile environment. As per the literature survey based on the SCM domain, table 1 shows the classification of parameters affecting SCM sub processes as per the agile classification. (Martin 2001) Agile environment parameters can be differentiated based on their working style and based on their importance in the agile environment. (N. Ashrafi 2006)

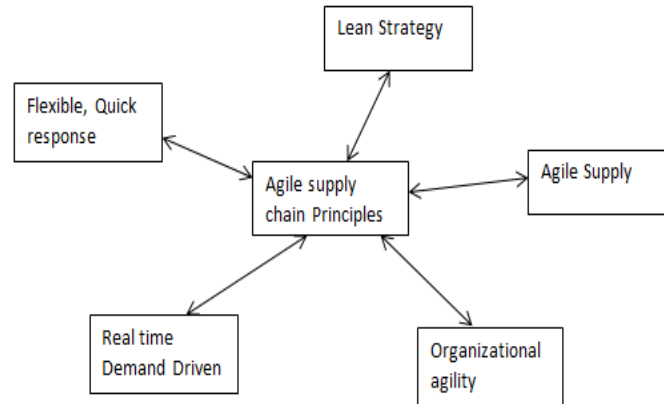


Figure 1: Agile Supply chain qualifier

1. Agile Driver: Agile drivers are the key factors for the change in the business environment that force a company to search for new ways of running its business. These imposed pressures of business environment act as a driving force, advancing the organization towards agility. (Zhang 2007) (Yi-Hong 2011)

2. Agile Cap Abler: Agile cap abler are the reason behind the existence or nonexistence of agility gaps. Principle elements for agile capabilities are the key factor affecting quality fact. (Behzad 2011)

3. Agile Enabler: Agile enablers are the technologies which are critical to successfully accomplish agile manufacturing. Agile enablers further can be classified as virtual enterprise formation factors, physical teams, partnership formation tools, parallel engineering, integrated product information system, prototyping tools, and e-commerce. (Eleonora 2009)

Table1: SCM sub-process working with agile parameter

SCM SUB-PROCESS	AGILE ENABLERS	AGILE DRIVERS	AGILE CAPABLERS
Manufacturing flow Management Policy (Z. Ayağ 2009)	Manufacturing Flow, Order Fulfillment	Demand Management	
Buyer selection, ontology for buyers (Mark Ko 2010)(C. Chang 2008)	Joint Optimization for The Multi-Buyer And Single-Supplier Problem		
SC planning (Felix 2005)			Collaboration
Production management (Behzad 2011)	Production Planning		Trends Analysis
Supplier management (Vipul 2008)	Finance Modeling	Price, Cost, On-Time Delivery, Supplier Selection, Criteria, Service	Consistency, Reliability, Uncertainty, Time, Lead Relationship, Flexibility, Adaptability, Technological Capability, Availability, Performance, Attributes Of Quality

		Performance	
Performance management (Dharmendra 2013)		Outlier Cluster	
Business intelligence management (S.L. Yang 2002)	Ability of Change		Speed, Leanness, Proactivity, Quality, Unpredictability, Adaptability, Speed Of Response, Flexibility, Innovation, Quickness, Robustness, Innovation Uncertainty, Competency, Proactivity, Unpredictability, Responsiveness,
Agile supply chain		Statistical Analysis	
Forecasting (Kaastra 1996) (Su-Li Yan 2011)	Simulation Planning	Prediction, Decision Support	Strategy, Optimization, Prediction, Modeling, Generalization
Optimization (Nazri 2013)		Cost	Reliability, Flexibility, Responsiveness
Quality management (Bojana 2014)		Asset Prioritizing, Stakeholders	Customization, Generalization Cost, Evaluating Criteria
Risk management (Felix 2005) (Tseng 2005)	Need, Customer's Expectations	Cost, Supplier's Profile	Service Performance

C. Agile supply chain based agile parameter

As per the Table 1, number of parameters is available, but out of it, following listed parameter can be more suitable for SCM-based agility evaluation. This parameter helps to find a more agile system in the expected or unexpected environment.

A-1 Strategy: It is the strategy within the suppliers to exchange the information and ensure the safety of the supply based on the flexible contracts

A-2 Customization: It is the change in the value-adding content of products as per the change in the requirement or in the service.

A-3 Capacity: It is a change in the requirement of the information to upgrade or downgrade storage affecting the productivity of the system

A-4 Speed: It is the shortest possible time in carrying out activities for product or service.

A-5 Responsiveness: It is the sensitiveness exhibiting output response time for input scenario

A-6 Productivity: It is the output of the activities supporting environment and mapping the same activity in un-supporting environment

A-7 Flexibility: It is the accommodation of changes by activities in the different environment.

A-8 Interoperability: It is the impact of dependencies among different modules from the system.

A-9 Integration: It is the combination of material communication & information affecting interaction between processes, products, and suppliers.

A-10 Visibility: It is the accessibility of the information in the execution of the module of the system

D. Kaizen Process with SCM

Stakeholders need to understand the different processes designed for improving organization's profits in terms of cost and time in agile environment. (Mayank 2015) (Vladimira 2012) Kaizen process basically works for improving the business area, analysis of the key problem, identifying the cause of the improvement, planning the remedial measures, implementation of the improving project, and standardization of the process. The Kaizen process normally used to increase productivity, competitive advantage and business performance in a tough competitive market. (Gratiela 2011) (T. Karkoszka 2009) Kaizen is required for making changes or improvements in the system modules like people's efforts, improved process execution styles, technology and etc. (Li S. 2005)

II. Different Enterprise Architecture

Enterprise Architecture (EA) defines the principle of organization, modular relationships, and organizational environment. (Lise 2006) EA provides a platform for identifying, understanding and communicating business processes, matching with its strategic objectives. EA allows stakeholders to document their plans and align them as per business needs. (Nasdaq 2011)

A. Agile Enterprise Architecture (AEA)

The business driver depends on technologies. (Mentzer 2001) EA's are mostly technology focused on its utility space. As per Agile environment, EA needs to connect with changing processes. (Robert 2007) (Web Ref 1) (Web ref 2) The key areas of changes in agile environment are business analysis, stakeholders, skill development, frameworks, methods, and tools. For a successful EA practice in an agile environment, it is required to give more preference on the process design, implementation and measuring enterprise-wide changes using feedback. (Ruth 2006) (N. Ashrafi 2006) AEA works in continuous, collaborative and evolutionary manner. AEA qualifies better quality solutions, understanding more reliable environment for change. (Anirban 2009)

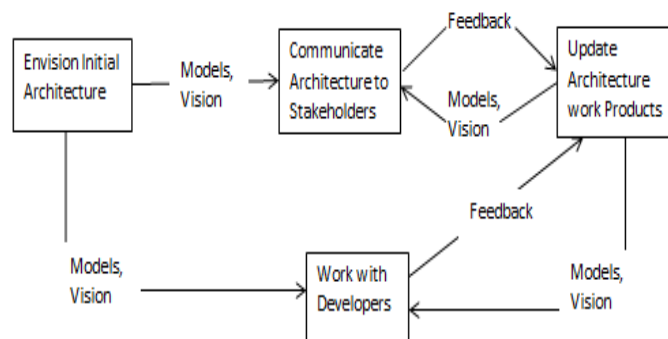


Figure 2. Agile Model driven development

Figure 2, shows a stepwise explanation of the Agile Model Driven Development approach used in the enterprise architecture. (Web Ref 1) (Web ref 2) Values, principles, and practice of agile solution should help to guide EA Modeling and documentation. Agile software methods deliver business values to the requester immediately. (Jaya 2009) (G.A. Cox 2001) To develop a framework in an agile environment,

there may be possibility that all requirements are not fully understood at the beginning of the process. (Subba 2005) Hence handling EA, with specified criteria helps to identify the technology gap.

In this paper, SCM domain is mapped for Modeling with different architecture. SCM domain is the most agile environment due to niche market condition, change in the stakeholder's requirement, working style and business policies of the organization. Agility creates a relationship like enterprise strategy, development, costs, and customer satisfaction among the SCM modules. To select the best architecture which will withstand in agile environment for SCM functionalities, different SCM modules are analyzed for listed agile parameters.

B. Different Framework with agile parameters in SCM domain

B.1 Zachman-framework (ZF)

ZF is a de-facto for classifying developed artifacts as per logical structure. (S. Shervin 2010) As per stakeholder perspectives, it gives a classification of solution in an organized way. For designing and building complex systems, it is mandatory to understand detailed information and its relationships among different business component of the system. (L. Ertaul 1999) This framework works as generic framework. It majorly focuses on functional requirements than that of nonfunctional requirements. EA does not add value to the current business objectives in agile environment. Hence ZF is not suitable for agility. (S. Shervin 2010)

Table 2: Zachman for SCM

	DATA	FUNCTION	NETWORK	PEOPLE	TIME	MOTIVATION
Scope	Product, Services	manufacturing, ordering, distribution of product, transportation	Location of SCM Company as per operation	Suppliers, Customers	Seek time, slack time	Customer satisfaction
Business model	Data semantic model	Inventory model integrating all above operation	Networking as per value chain	Connection of Department wise stakeholders , suppliers, distributor	Order access	SCM business plan to deliver order to customer
System Model	Data element for inventory analysis of product	Model for order fulfillment, Customer model Supplier model	Complex supply chain models	m : n relations of supplier to customer and distributors	Model to fulfil request of product or process	Rule for handling inventories
Technology model	Physical structure of data	Flow chart for model connection	Connection of hardware and software	Reports are presented as information	Validation and verification	Rule for verification and validation
Detailed representation	Meta model	Programs for models	Hardware and software	Access to module connection	timing to handle functionality	Rules for module as per role
Functioni	SCM	Function for	Network	Organizatio	Schedule	AS – IS or

ng system	data	development		n for supplier customer	for processing	TO-BE strategy
Descriptive model	E- R diagram	i/p – o/p processing	Node analysis	Reporting format	Event cycle	Objective

Zachman with SCM: ZF for SCM system represents a Modeling tool with great utility, integrating value and alignment within the IT infrastructure. As shown in the table 2, SCM domain information was structured as per the standards of ZF. This table is built based on the interview taken from experts. Question for the interview was made as per ‘wh’ question of ZF. This framework helps to find the technical gap related to different views for scope, business, system, and technology used for different system modules. (L. Ertaul 2005) SCM system is built on the integration of modules in the structural way, considering interoperability within the modules. Different views give information visibility as per the value chain. It is possible to put the sub-domain of SCM in the different blocks of the ZF framework mapping with answers. This framework shows the dependencies among the functional parameters. But addition of new information due to changes will not be supported by ZF. Table 2 helps the organization, to find the logical and technical gap present in each layer of the modules. But this framework structure is fixed with type of ‘wh’ question. Hence, it is observed that this framework will not support runtime changes not only for SCM but for any domain.

B.2 Kruchten’s 4+1 View Model of Architecture

This model is used for team building, training, and coordination with other view levels. (Kruchten 1995) Logical view describes end user services as per functionality specification and association between objects. Process view describes non-functional fundamentals along with concurrency and synchronization aspects. Development view describes software’s view with its development environment. Physical view describes the mapping between software and hardware.

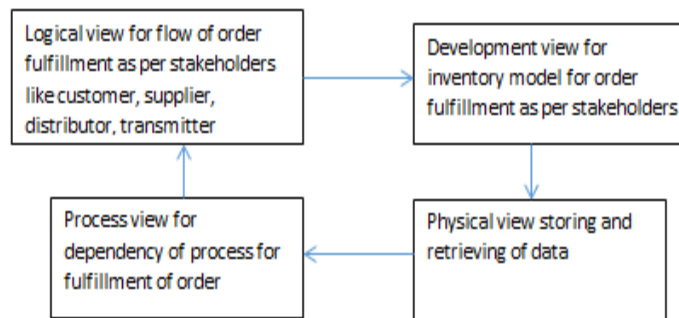


Figure 3. Kruchten’s 4+1 View Model for SCM

Kruchten’s Model for SCM: This model is useful only in Scenario-driven approach. Different view of this framework helps to understand its related risks also. There may be chances that all views will not be possible in single software architectures. Different stakeholders may have different analysis for different module. These frameworks make SCM processes to be refined, matured, and better understand the changing environment. Hence this model may help to modify the identified risks associated with the SCM modules. Framework with SCM handles data agility, application agility depending on the product handled by the system. Agility in the business view needs to be handled by the logical view. This framework understands dependencies among the modules. A change in one view will affect in the continuous and sequential way on the rest of the views.

B.3 Tapscott and Caston (TC)

This model follows a transparent working style of the organization. It works independent of agile parameters like time, space, and IT resources. (Tapscott 1993) This model is limited to only 5 views. The business view gives information flow between business functions, business activities and their interactions. Information view shows the way information resources are modeled. (Eyong 2009) Application view connects work view, information view and the technology view with required technology platforms.

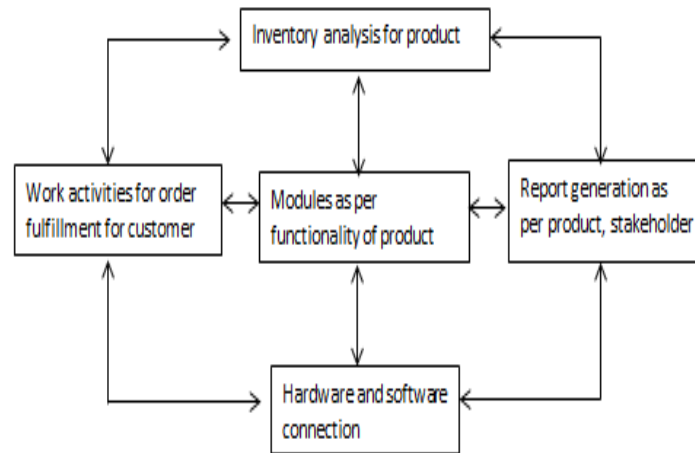


Figure4. Tapscott and Caston for SCM

T & C with SCM: Business views in the SCM system may have modules like manufacturing, purchasing, and physical distribution of the product. Information views may have modules like report generation, pattern generation and etc. (Frank 2006) In the same pattern, all views will have different functionalities associated with it. This framework, with SCM helps to update views in the agile environment. But the connection between all the views may or may not be possible. Depending on the business policy for using product, different types of modules of SCM are designed. Work view gives more agile nature, but restricted to the activities of modules. Inventory analysis of the products is handled with the help of its infrastructure and with expected output. Dependency among the view gives interoperability among the modules giving the quick response to the output in agile environment. It is required to understand the functionality of the product for agility. This architecture fails to understand detail issues of data view, but concern only about information view.

B.4 Federated enterprise architecture frameworks (FEAF)

FEAF framework specifies vertical and horizontal perspective of the software solution as shown in the table 3. (Jeffrey 2008) Vertical perspective defined as per Data architecture (data attribute and storage), Application architecture (activities designed and executed), and Technology architecture (software and hardware). Horizontal perspectives defined as per Planner view (objective or scope of the enterprise architecture), Owner's view (organizational policy about owning), Designer's view (perspective of displaying information), Builder's view (perspective about application module), and Subcontractor's view (sub model developed in the application). (FEAF 1999) (USA 1999) In this framework, changes in the higher rows effect the changes in the lower rows. A disadvantage of this framework is of making invalid assumptions resulting in increased costs or rescheduling of the application.

Table 3: FEAF with SCM

	DATA ARCHITECTURE (WHAT)	APPLICATION ARCHITECTURE (HOW)	TECHNOLOGY ARCHITECTURE (WHERE)
Planner's View	List of business objects	manufacturing, ordering, transportation, distribution of product	business locations as per stakeholder
Owner's view	Flow of data as per stakeholders	Inventory Business process Model	Product Logistics system
Designer's view	Logical data model for product and stakeholders	System Design as per process	System Geographic Deployment
Builder's View	Physical Data Model for application	System Design	Hardware software for application
Subcontractor's View	Meta model for physical data model	Non-functional requirement for product services	Network for connection of application

FEAF with SCM: Different views in horizontal perspective like the planner, owner, designer, builder, and subcontractor handles SCM inventory modules from stakeholder viewpoint. This framework's vertical perspective handles SCM modules based on the data, application and technology. This framework develops SCM applications in the more structural way; hence it can handle operational agility of the application. SCM modules like manufacturing, transportation allows changing the system design as per designer and builder view. These views consider the performance of the functional and non-functional parameter. This view allows for the integration of the modules. The advantage of this framework is that it handles all changes as per the technology architecture, even though it depends on the data or application architecture. This framework has separate views for the planner, owner, and designer. These separate views are advantages to have a detail study as per the data and application of the system. But it needs to consider the risk of overlapping of the view in the agile environment. Business view is differentiated into different views hence all the views are responsible to handle data, application and technology architecture of the software.

B.5 C4ISR Architecture Framework (Command, Control, Computers, Communications, Intelligence, Surveillance, and Reconnaissance)

Across organizational boundaries, C4ISR framework has views like operational, business, and technical views. This architecture's operational view describes activities, operational elements, and its generated information flow. System and technology view is derives from the operational view. The systems view describes graphics and interconnections for supporting functions. The technical view defines governing rules for arrangement, interaction, and interdependence between system modules.

Table 4: C4ISR with SCM

CONCEPTUAL DESCRIPTION	LOGICAL DESCRIPTION	PHYSICAL DESCRIPTION
Operational View		
Planning of value chain analysis as per stakeholder, product and product services	Connection of application modules to each other	Supporting operation for representation of information
System view		
Flow chart, DFD, E_R representing data and module connection and relationship	Logical connection of modules to each other with their interoperability	Hardware and software requirement analysis for modules and data
Technical view		
Rules for connection of modules to each other	Integration of different modules	Implementation shows dependency among the module.

C4ISR with SCM: With SCM domain, C4ISR handles all the views of the application considering its conceptual, logical and physical description. This architecture includes an integration model of operational view. This architecture shows planning, relation, and analysis of the system modules. Technical rules are defined for an application dependency but not for the agile condition. SCM modules logical dependencies can be clearly understood for the rest of the modules. Agile environment maps integration of modules along with their logical dependencies. Agility in product or service needs to refer to the operational view of the system. This architecture works for flexibility, interoperability and gives efficiency among the modules. SCM logistics and marketing modules may face the risk of handling agility using this framework. This framework focuses on the core processing hence processes requires handling runtime risk need to analyze before taking the action against it.

B.6 OMG's Model Driven Architecture (MDA)

MDA provides architecture in a layered structure for the development of the system. (Anneke 2003) MDA checks for the cross-platform interoperability hence it reduces time, cost and complexity associated with the applications. (Igor 2007) It is made up of different levels. Computation Independent Model gives the computational operating system for the development of the system. Platform Independent Model contains detail about business functionality not the information about the technical details. Platform Specific Model contains specifications about the working of the concrete technical platform. Change in the lower model may affect change in other upper levels (Steven Witkop)

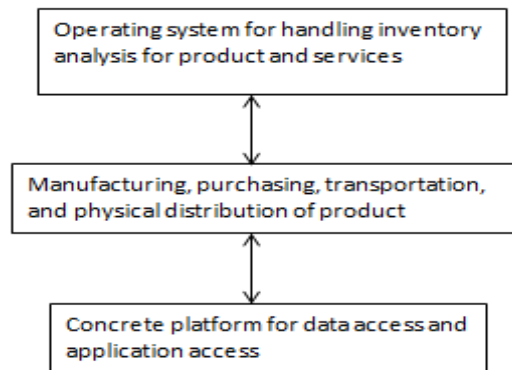


Figure 5. MDA for SCM

MDA with SCM: MDA with SCM defines the working system for product and services among different stakeholders. It lists business activities of the different platform for the purpose of storage and retrieval of data. SCM with MDA make system logically portable, Interoperable, Platform Independent, and Productive. Infrastructure dependencies among modules of SCM may affect the changes affecting artifacts and relationships from the above levels. Agility may affect the efficiency and speed of other modules. A different view of abstraction gives multiple representations of the artifacts. These representations are manually created for sub processes of SCM; hence this may face the problem of duplicate work and inconsistency. Management process may affect strategies in sequence with other processes. Agility needs to be handled with consideration of the lower module to higher module working.

B.7 The Open Group Architecture Framework (TOGAF)

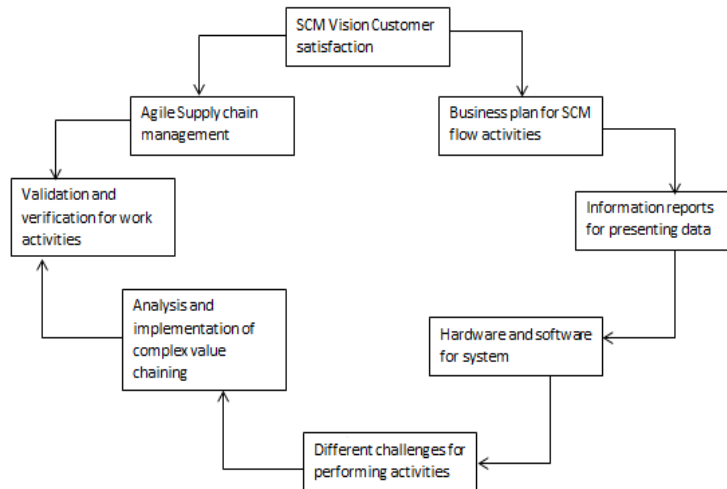


Figure 6. TOGAF for SCM

TOGAF works in iterative and continuous manner for the implementation of a system. This process consists of multiple, consecutive phases enclosed in a closed loop. It increases transparency of accountability and control risk. (TOGAF 2002) It provides proactive control, value creation through monitoring, and management mechanisms like evaluation, and feedback. TOGAF follows agile thinking for each phase having its own processing changes.

TOGAF with SCM: Analysis of each phase with respect to SCM, gives structured plan for different modules of SCM like manufacturing, purchasing, transportation, and physical distribution of product modules. TOGAF allows complex value chain in distributed nature for product distribution. TOGAF makes SCM work in a more detailed to handle different opportunities and risks. (Frank 2006). Understanding detail relationship of all the modules in SCM helps to find the technical and operational gap present in the modules. Considering the business goal of the system, business plan is prepared. This plan may get affected with the agile business plan. This architecture is suitable with all agile parameters based on the business modules. TOGAF understands risk related to each phases, increasing speed of the execution. Procurement management, logistics, supper management process of SCM need to analyze input properly, this may help for listing more agile parameters. Security of the information is handled in TOGAF w.r.t. each phase.

B.8 Enterprise Architecture Planning (EAP)

EAP gives procedure for planning, information development, applications, and technology architectures. EAP process exposes all business connections so that all stakeholders will be able to see the flows of data, work, and outcomes. (G.A. Cox 2001) It also gives notification for trend analysis. It detects consistencies and inconsistencies in the business process as data model is tracked with business activities. The disadvantage of EAP is that there is no information ownership regarding governance or accountability of the key information assets.

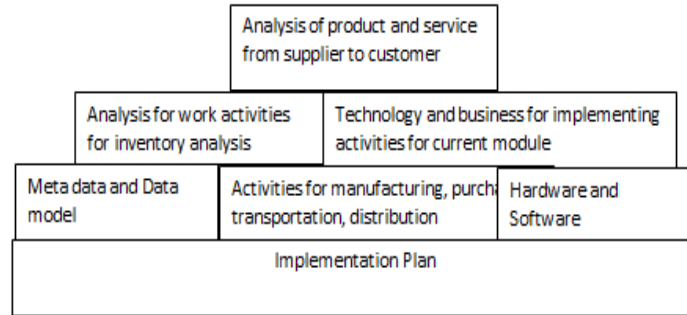


Figure 7. EAP with SCM

EAP for SCM: This defines data, application and technology modules separately based on the analysis of product or services. EAP framework based on SCM finds all possibilities of solution required as output for the product life time management along with all its sub modules. But this framework does not handle security of data or application flow of system in agile environment. It addresses business pain points of information evaluated within the functional units. Agility in EAP distinguishes answer from how, who, when, where, and why questions to simpler analysis of the modules. Implementation plan of EAP for SCM modules works well with inventory management. It helps for understanding applicability of data, activities and technology. Governance of each phase may not be linked with each other.

B.9 Generalized Enterprise Reference Architecture and Methodology (GERAM)

GERAM provides a generalized architecture for all types of enterprise engineering. It separates the methodologies for enterprise engineering (EEMs) and its Modeling languages (EMLs). (Ovidiu 2003) EEMs are used to describe and to model structure, content and behavior of the enterprise objects. It allows a number of elementary differentiations that can combine more powerful concepts. It helps for integration of heterogeneous environments of an enterprise solution. GERAM is based on requirements of IT and rather than of its business. (PallabSaha) It gives insufficient guidance on how to align stakeholders with the information system, human capabilities, mental models, and information capabilities.

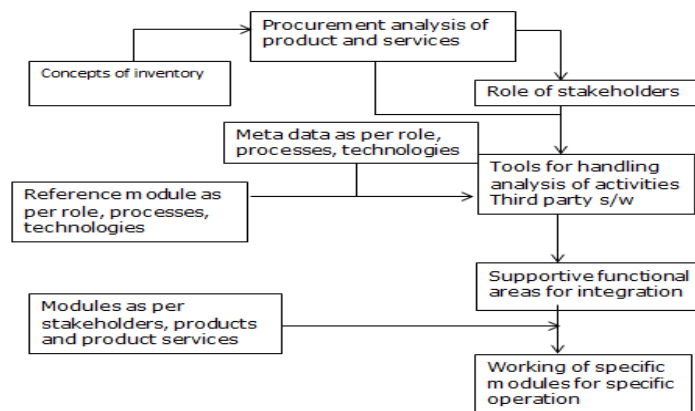


Figure 8. GERAM for SCM

GERAM for SCM: It describes the business object's structure and behavior with procurement analysis of the product. It understands the stakeholder's role in detail. GERAM for SCM handles integration and interoperability in a heterogeneous environment of the enterprise solution. Agility for specific modules needs to be checked with its dependency. Agility can handle data, technology or third party analysis. This architecture allows customization of the modules increasing speed and efficiency of the system. It increases the information visibility of the supply chain. As numbers of modules are tightly coupled with each other,

this system doesn't allow up-gradation of the new module. Generation of metadata allows storage of data models at one place which can update with changes.

B.10 IEEE framework

IEEE 1471 is IEEE's Recommended Practice for Architectural Description of Software-Intensive Systems. (Rich 2000) IEEE 1471 provides definitions and a Meta model for description of the architecture. This asserts multi view for stakeholder view point. (IEEE 2000) IEEE makes 1-to-1 correspondence between its developed viewpoints. It provides guidance for architecture's validation and identifying inconsistency issues among its views. (Jignesh 2014) IEEE is not structured for agile parameters such as reliability, maintainability, flexibility, security. IEEE gives more focus on the documentation.

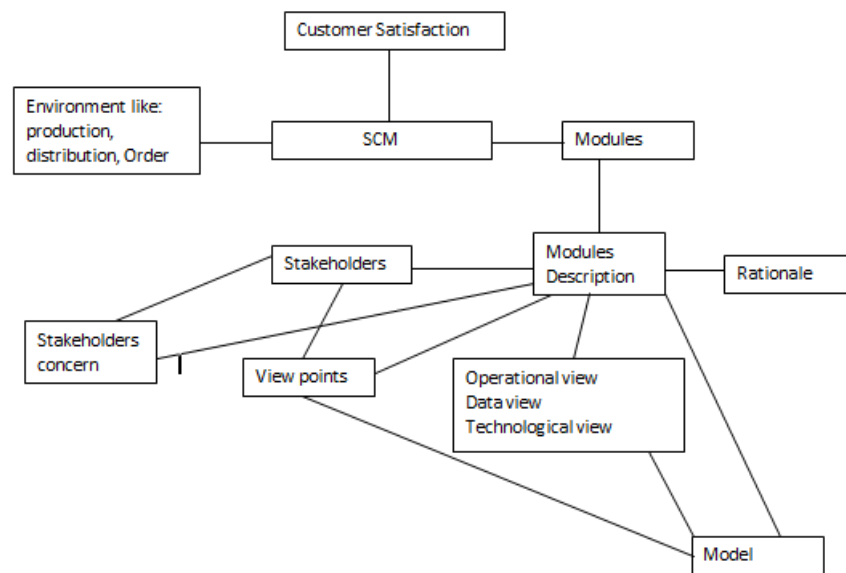


Figure 9. IEEE std 1471 for SCM

IEEE with SCM: For SCM, IEEE creates Meta model for data architecture based on the inventory analysis of the system. This framework for SCM gives perspective for stakeholders in the sense with different viewpoints. Changes with the stakeholder's requirement are handled with the highest priority in the all set of modules. IEEE handles different types of agility like data, application etc. This architecture allows customization as per the requirement, resulting in the increased flexibility of the system. As per the different modules in the system, it gives visibility of the information within the system. Different environment helps in the integration of modules. This architecture gives more preference to the stakeholders. This framework is more focus on the business viewpoints rather than infrastructure. Hence the change in the platform may not be properly handled by this framework.

B.11 Gartner Enterprise Architecture

Gartner Process Model provides a continuous improvement approach for developing an Enterprise Architecture. This architecture focuses on development, evolution, migration, governance of business processes based on organization's business principle. (R. Scott 2005). It predicts the future state, which illustrate all EA viewpoints in support of the business strategy. It translates business strategy into effective enterprise change. This architecture is used to manage long-lived business processes that affect people, systems, functional boundaries with external and internal driven changes, and driving improvements in efficiency. (Lisa 2015) This architecture handles the process in continuous and increment manner to handle changes properly. It senses, evaluate, decide, response, and control the requirement changes.

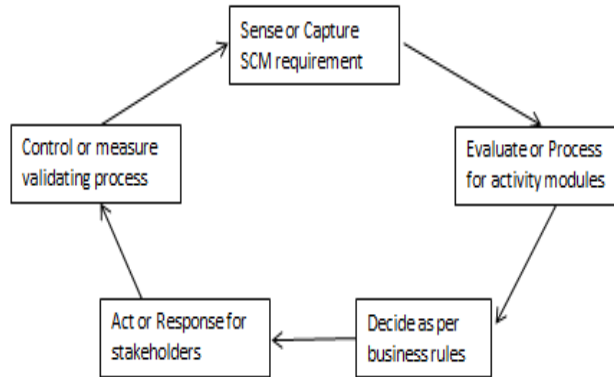


Figure 10. Gartner for SCM

Gartner for SCM: SCM modules are interdependent modules. Hence this framework works for sense, evaluate, decide, act and measure for its developed product and its dependent services. This framework builds business strategy as per the change in the requirement for application, data or for infrastructure. Gartner works in the continuous improvement manner which helps to work in an agile environment. It considers working with current state to predict the future state as per the data requirement and application analysis. Gartner focuses more on the documentation for each phase of applications. This architecture has provision for integrating new modules considering their interoperability with security. As all information is stored properly, speed of the output is more accurate in agile situation. Changes in the requirement may affect productivity of the system. Gartner helps to measure changes in incrementing nature.

IV. Case study for measuring effectiveness of framework

A. About ABC Company

ABC is an ISO 9001: 2008 Certified Company, engaged for Surface coatings and Cubic printing services for different motor company since 2002. The company's Mission is to be the global in their product by strengthening industrial base through the effective utilization of the service they offer. The company's vision is to offer value to the customers through technology solutions, services, and modern management practices. Based on the quality assurance of a company, authorities performed tasks as per the needs of customers in an ongoing and consistent manner. This company is handling tally as third party software for their accounts. The company is not having any primitive software for handling the overall operation of the company. Hence, to build ERP software as per the working of the company, a proper architecture need to be selected so that software can match with the company's style.

ABC Company's experts are the ISO 9001 certified who can handle security and quality of the process. These experts are having more than 20yrs of experience in their respective field. They were questioned with different agile scenario based on different architectural structure. Experts will not understand the architecture, but mapping the same architecture with SCM domain questions; help them for selection of framework. These questions were built based on the different architecture working scenario. Agile Enterprise Domain is best suited for agile supply chain modules. Out of the number of agile parameters, selected important parameters for the Supply chain domain are evaluated with a given architecture. Answers based on agile parameter's analysis with respect to different architectures in agile environment are written as shown in the Table 5. Architectures are measured with different technical, functional or manufacturing area, designing products, sales and so on. The same case study evaluated with different scenario gives different solution. This evaluation considers the current changing market condition.

Table 5: Agile parameter with enterprise architecture

A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10
Strategy	Customization	Capacity	Speed	Responsiveness	Productivity	Flexibility	Interoperability	Integration	Visibility
Zachman Architecture									
AS_IS fixed strategy as views are predefined	Works on current system hence no changes are possible		Time to output depends on system module dependencies	Sensitivity of giving output is dependent on structure of view of the system	Works on current system hence no changes are possible		Structural modules defines dependency among modules	Modules can be integrated for new module	Gives value chain visibility w.r.t stakeholders
Kruchten's 4+1 View Model									
Scenario based fixed strategy	Restricted 5 views, no changes possible avoiding increasing capacity and customization in agile environment		average speed for o/p, as per dependencies among modules	Associated risk increases responsiveness of the modules as per view	Efficiency of productivity is based on dependency of the view	Allows to adapt changes in the modules based on different scenario	5 views are sufficient to find operability of the module	Physical and logical views helps to integrate restricted modules	Gives value chain and visibility information as per logic
Tapscott and Caston									
expert's knowledge, business view defines strategy	Spiral model increases capacity for new model	Technology and application view allows for customization of new modules	Response time is very short for output as it works in spiral model	Sensitive to correct output based on expertise	efficient Output as per the customization	Information and work view allows for flexibility	Module are dependent on each other as specified in logical view	Integration of modules depends on application and work view	Information visibility is possible
Federated enterprise architecture frameworks									
Planner, designer, owner views gives strategy	Semantic model defines capacity	System designing or change in view allows kaizen based customization in product or services	Builder view works as per kaizen gives speed for output	Time require to generate output is based on the structure of module	Expert's knowledge gives dependent output	Restricted 5 views allows to add new process	Module defines output interoperability as per requirement	views allows for integration of changed modules	Gives supply chain visibility
C4ISR Architecture									
Strategy is based on	Logical description as	Kaizen allows customization	Operational view	Structure of module	kaizen affecting operation	Operational view as per	Different view are dependent	System views as per	Information visibility

AS_IS	per kaizen specifics capacity	tion of new modules	defines speed of output	connection defines response time	al view gives efficient output	technical view allows unexpected changes	on each other	kaizen allows integration of different modules	y is possible
OMG's MDA - Model Driven Architecture									
Strategy depends on CIM with kaizen	PIM increases capacity	Experience allows customization based on PIM and PSM	average timespan for generating output	process dependent output is sensitive to input	Changes in PIM or PSM will not affect the output	Data and process are flexible based on changes	multiple artifacts of process allows interoperability based on structure	Multiple artifacts based on Kaizen effect for integration	Gives information visibility
The Open Group Architecture Framework									
Systematic phases of TOGAF gives improving strategy	analysis of product helps to add new product	Continuous improvement approach helps for customization	Migrating plans defines responsive output	Phases defines changes and accepts changes	Changes as per process effect working style of the process	changes handles opportunities and its solution	Based on 8 phases, it allows for interoperability among modules	allows for integration based on mitigation plan	Allows for value chain and information visibility within modules
Enterprise Architecture Planning									
Analysis of requirement gives Strategy	Analysis of modules by planning increases capacity to add module	changes as per Technology & business allows customization of current modules	Execution time of the process is high	process generate accurate answer without affecting changes	Activities defined based on the analysis of works which will be efficient under agile condition	allows to add expected changes to the work activities	Differed analysis interoperable on other module analysis	allows for integration on different plan based on Kaizen process	allows information report along with supply chain analysis
Generalized Enterprise Reference Architecture and Methodology									
Strategy based on the Procurement analysis as per inventory analysis	Allows to add reference handling the changes	Metadata and Kaizen gives customization to new modules	Reference model and metadata increases the response time	Kaizen process based changes exhibits response to request	Different analysis phases gives efficient output	Data, technology or third party analysis gives flexibility of modules	Specific module with supporting functionality works for interoperability	Integration allows between heterogeneous environments	gives insufficient guidance on the information visibility
IEEE framework									
Views are as per the concern with stakeholder which defines strategy	Changes with stakeholder's requirement are handled with highest priority	Identifies inconsistencies among the views may affect customization	data agility specifics response time for the output	Module description defines differed viewpoint which helps for responsive output	Communication among module helps for efficiency of the product	customization along with efficiency increases flexibility of the system	Number of views along with viewpoints allows interoperability along with description	Viewpoints helps integration of different modules	It gives visibility of information for SCM

GARTNER									
Continuous improvement approach multiphase, iterative model gives changing strategy	EA viewpoint support of the business strategy helps to increase capacity of the system	Different viewpoint helps for customization of the process	Output generated are based on the structure of their dependency	Manages long-lived business processes it works after change with Kaizen process	internally driven changes and driving improvements in improving efficiency	continuous improvement with Kaizen process helps for flexibility of the system	sense, evaluate, decide, act and measure for product and services makes interoperability of the system	integrating new modules considering their interoperability in agile environment	Information and product visibility is possible

B. Comparative Study of Framework for Case Study

Above comparison is formulated as shown in the Table 5. Agile parameters considered for supply chain management, are measured with enterprise architecture as per the selected Case study. (Roger 2007) (Thanos 2012) This case study is a supply chain management work based on kaizen process. Each agile parameter is evaluated with enterprise architecture, considering constraints of ABC Company. Due to change in the niche market, a planned enterprise solution may need to face agility in the future. Hence architecture is selected based on the compatibility for the changes. After understanding the current requirement of ABC case study, each architecture was evaluated with a current requirement with an expected future requirement. This evaluation is done with experts who can predict the changes as per the product or as per the customer.

C. Outcome of the Analysis

This comparative study helps in selection of enterprise architecture. This architecture based enterprise solution will be used in the company as an ERP solution. Agile parameter selected here are most common parameter, for a supply chain domain. These parameters are selected after studying different sub-processes of SCM. ABC Company works in kaizen process. It is similar to work on the basis of experience update the changes. Analysis is done based on the expert's interview who is working for designing strategy or solution of different modules. Table number 5 shows TOGAF as the most promising enterprise architecture for supply chain management case studies. TOGAF allows updating the model as per changes. It is more flexible, efficient and responsive to changes compared to other enterprise architecture. This paper helps ABC Company to select the best architecture as per the Kaizen process. This architecture is best suited for developing their enterprise solution which can withstand in the agile environment.

D. Future Work

This paper revolves around the SCM domain only. These frameworks can also be analyzed with ERP or CRM domain. This paper compares only 10 parameters most suited for SCM domain. This list further can be improved for getting more detail analysis of the modules present in the enterprise solution.

V. Conclusion

After doing research, it is observed that most of the architectures are quite similar to each other in case of logical, conceptual and physical representation. Enterprise architecture practice is important for any organization, as it delivers real business value to the organization. EA enhances partnership between business and IT groups. This paper helps to list and compare number of enterprise architecture on the basis of the selected agile parameter. This comparison is limited to SCM domain understanding working of the architecture with respect to different modules of it. Detail study of different modules gives a list of agile

parameters which are further analyzed with different enterprise architecture. As per the expert view, TOGAF is the most structured EA for analyzing and handling agile environment. As TOGAF is modularized into a number of phases, it handles problem in all directions. Analyzing each phase helps to think about the possibility of changes that can be handled properly. To check best suitable architecture, a case study was selected for comparing with list of agile parameters. Out of list of ISO parameters, selected parameter helps to strive in agile environment for supply chain domain. This list parameter helps to find and build technical and business gap for building different modules.

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Appendix

Questionnaires:

- What is the Kaizen Process?
- What are the different types of strategy by default used in SCM or using Kaizen process?
- How customization can be handled as per resources, products or as per the services?
- Capacity impact based on the different views of the architecture.
- Change in the working or processing in the product / service configuration can affect as per architecture framework.
- How immediate or sensitive for the output generated in case input is changed?
- Check the impact of Kaizen process for flexibility if it is mapped with selected framework.
- May changes can bring dependencies among modules as per different architecture level from the different enterprise architecture.
- Due to dependencies does any architecture structure will impact the integration of the different modules of SCM.
- Check how the information scope may vary from one module to another within the SCM for a particular architecture.