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Convergence Perspective of TOGAF-ADM and Lean Six Sigma in Supply Chain Operations

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Abstract: Organizations use several standards and frameworks to sustain their supply chain performance improvement to be able to compete and cope with the fast changing market, where data-science and information became decisive to success, and continuity is crucial. Based on Business-IT alignment and Service Oriented Architecture "SOA". The research suggests a model that converges The Open Group Architecture Forum TOGAF framework with Lean Six Sigma "LSS" for performance and tasks improvement in industries and services Extended Supply Chain Operations. A TOGAF's Architecture Development Method "ADM" phases, iterations, features and information architecture mapped to LSS's DMAIC stages for a systematic processes wastes removal, knowledge creation and data-mining to develop a unified model that sustains supply chain efficiency and performance, pushes them to a new level of edge technology infrastructure, of service-bus, Data-Centers and Data-Hubs advantages of resiliency, business continuity and savings. Supply Chain measures identified as possible activities, based on knowledge accumulated and active ADM-phases. A literature review was followed to collect the common features, characteristics, principles and tools listings in the new model to achieve a full converged model of a continuous optimization nature.

Keywords: Supply Chain, Convergence, Lean Six Sigma, TOGAF ADM.

1. INTRODUCTION

In organizations, whatever their activities, it is applicable to get ready to deal with imperfection. Therefore, continuous monitoring of wastes, errors and variations should be considered. As the change is an existing standard, supply chain "SC" should optimize its operations, monitor performance, and manipulate change consequences in a timely revision function. "DMAIC" of, Define, Measure, Analyze, Improve and Control is a non-specific industry Lean Six Sigma "LSS" approach, brings efficiency, satisfaction, profitability benefits by being structured, if wisely deployed, vary in quality and implementation from one firm to another and recognized as combines the best of Lean and Six Sigma [1].

This work suggests to enable TOGAF-ADM, as an Enterprise Architecture "EA" environment framework, to continuously synchronize DMAICs' cyclic tools of stages and intersect them with ADM principles, iterative structured features and mechanisms in time-functions independently share data and Information Technology "IT" resources. "Architecture" and how the supply chain is represented in "EA" framework says that it is any organization or parts of it that share common objectives in a

"viewpoint" and work together to achieve common goals and "EA", is a holistic and dedicated environment to optimize performance.

Architecture Development Methodology "ADM", the core of The Open Group Forum "TOGAF" is suggested to be the actor and interface [2]. To achieve the objective of a timely continuous "SC" optimization, a high level "EA" and "LSS" mapped to a "SC" viewpoint in "TOGAF". As organization strategy has several dimensions, the technology dimension is set to organize enterprise development tracks, affect "SC" operations, organize methodologies, and connect interrelated parts. Software and hardware components comply with technology dimension goals, principles and infrastructure objectives to help "SC" Target architectures, objectives realization in an Architecture that defines relations and communications, composed of shared applications (portal, Mobile Apps, Contact Center, IVR/SMS/USSD), Service Bus, shared, common and support applications, Data-Hubs and Applications Data. Other Infrastructure components and

Services used to guide SC services and offer "SC" as a service, "SCaaS" [3].

The research methodology aims to align strategy, "SC" operations [4] and information technology "IT" and converge them in a modern "SC" that uses edge technology defined in architecture layers and SCOR levels, developing a consistent model as a crucial part of operations success. The current state assessment reports and benchmarks are used as inputs and guidelines of model development [5]. "TOGAF" treats enterprise elements as a top-down. So, it is necessary to make sure bottom-up developments are part of an overall consistent model and well-reflected on all SCOR levels. All architecture elements are related to strategy dimensions. "LSS" tools are used as non-structured bottom-up to enhance operations, selectively implement a reactive problem solving and speeding up tools independent of the enterprise industry, size and headcount.

This hypothesis looks forward to succeed in answering the research question of; how the iterative TOGAF-ADM iterations may contribute to continuously improve the supply chain in all SCOR levels. A book research is carried out for research objective [6] and a literature review performed by Alduraibi [7], shows the proposed model originality. A few studies used the integration concept, e.g. the work of Mathew et al. [8], Liao and Wang [9]. As a result, the contribution added is a convergence model that continuously optimizes supply chain operations, frequently revises and updates performance with a set of tools.

2. METHODOLOGY

The critics of using each methodology alone give a rationale for the blend of the trio to obtain system requirements that increase service effectiveness. In order to take into account all aspects of objectives, TOGAF describes the functional environment and industry standards in which the firm survives as inputs of entities, objectives, industry standards and resources to align Business-IT in a business case and cover the service catalog as well as business evolution. DMAIC technique has proven discrete in supply chain improvement, but TOGAF-ADM, LSS convergence concept in supply chain adds the required continuity, reliability and sustainability. Figure 1. Indicates the cyclic stepping behavior of the perceptive optimization continuity. ADM iterations timely deliver supply chain needs, capture problems, wastes, and variations as well as opportunities, share outcomes with cycling LSS stages of tools, provide the enterprise (no more called an organization) with the capability to ensure alignment and orchestration of all architectural components to business-IT strategic direction.

Fig1. Iterative nature as the basis of continual optimization

A manual mapping of "TOGAF ADM" and "LSS" components is carried out for this task, as no justified method identified for a specific "LSS" components mapping to "ADM" in literature so that "LSS" DMAIC stages principles, attributes and features aligned to similar "ADM" phases' principles and roles.

3. MODEL ANALYSIS

The mapping process flow is depicted in Fig. 2, as "ADM" components mapped to that of a kind in "LSS", two relations; 1:1 and 1: Many occur, finding full match between components from each process. Mappings may be non-specific, as any "LSS" tool may intervene in any iteration. The approaches are practically independent, data-related and goal-focused [8]. For the converged model, "LSS" tools are treated as an architecture blocks use a real-time "ADM" features mapped to "DMAIC" stages as in Fig. 2. "ADM" "Architecture Context" iteration is mapped to "DMAIC" Define stage. "SC" inputs like stakeholders, scope, objectives, structure, teams, resources, gaps, risks, and approvals were identified. Proper tools, data types, and applications identified to be hosted in servers, data centers, shared or collocated, definitions and status stored in the separate database as "for-demand" information. "Architecture Delivery" and "Requirement" iterations are bidirectional and of multi-relations as double head-arrows in Fig.2.

"SC" operations share their scope and strategic objectives, continuous measures, and updates KPIs with "ADM". Data collected in the "Architecture delivery" iteration, is used in LSS "DMAIC" Define-stage, iteratively updated, giving a new gap data stored in a configuration database for authorized update order. Collected data offered to "DMAIC" Analysis-stage, compared with phase "R" data and former performance data stored. This becomes the basis for the next phases Opportunities-and-solutions "E", Migration "F", Governance "G" and "R" in order to fulfill "DMAIC" Improve-stage requirements. Fine-tuned with new settings suggested by Analysis-stage, to make a new optimum status that either alter or replace the previous one with a backup always available for redundancy and safety reasons. "Transition planning" iteration supports the analysis and improvement activities [10]. "Governance"

iteration and "DMAIC" Control-stage sustain the overall SC performance, use LSS tools to sustain the improvements.

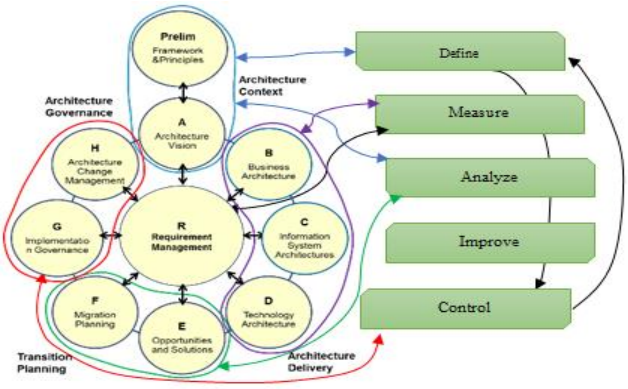

Fig 2. Visual mapping of ADM with LSS overview [11]

This data becomes massive so, data-hubs and technologies like Internet of Things IoT and a hosting server farm are required [12]. In this model, data smoothly collected from as-is process, analyzed by detailed process improvement tools. ADM's four iterations - shown in loops in Fig. 2, are frequently visited to capture data changes compared to that primarily stored in the repository as "SC" data to feed ADM's Requirements "R" phase. "ADM" uses refreshed data as a baseline for the next iteration, inputs change, and enters a new iteration to call an Architecture Building Block "ABB" as a prioritized components' set of activities and tools, become part of the operation and updated "ABB"s or Solution Building Blocks "SBB"s, developed and called as needed. If data gathered is not enough for the "Analyze" stage to isolate the problem's root cause, back iteration is required to enter a "Measure" stage. ADM receives the demand as a "requirement"; and retrieves a knowledge case block, stored data, and a preselected relevant Measure tool. DMAIC's power as a methodology lies in structure and consistency of hundreds of Total Quality Management "TQM" tools developed in years and detailed belts of "TQM" includes quality design, control, improvement and assurance, integrating all quality functions and operations, supports all knowledge modes and thought of as a problem solving roadmap and operation improvement method of LSS's 7 Belts of tens of tools used.

The tools and techniques matrix determines which are useful in each case and phase. "DMAIC" stages take part inside "ADM" performance, as data measured, stored, retrieved and compared each time, depending on "Requirements" phase "R" and communicated to "Change management" phase "H". This track ends up shaping a well-defined and customized "ABB"s and "SBB"s to settle in a unique enterprise repository as an accumulated knowledge. The resultant LSS measures in Architecture partially briefed in Table 1.

TABLE 1: Lean and Knowledge measurement models in ADM [13]

ADM Phase call	**Knowledge** Access	**Supply Chain Measures**	
A,B,C,D,E,G,H,R		Lean production system	
A,B,C,E,G,H,R		Concurrent Engineering	
A,B,E,H,R		Daily huddle meeting	
A,B,C,E,G,H,R		The Kanban System	
A,B,C,E,G,H,R		Value Stream Mapping	
A,B,C,D,E,F,G,R		PDCA and TQM	
A,B,C,D,E,F,G,R		Building Information Modelling	
P.A,B,C,D,E,F,G,H		HR Management, Team work,	
A,B,D,E,G,H,R		Socialization	
B,C,D,E,H,R	Knowledge Creation	Externalization	
B,C,D,E,H,R		Combination	
B,C,D,E,H,R		Internalization	
B,C,D,E,G,H,R			Rework
A,B,C,E,G,H,R			Customer satisfaction
A,B,E,F,G,R		Waste Elimination	Transportation cost
P,A,B,C,E,G,R			Material waste
C,D,E,F,G,H,R	Lean Performance		Waste disposal
A,C,D,E,F,G,R			Set-up time reduction
A,B,C,D,E,G,R		Just-In-Time	On-time delivery
P,A,B,C,E,G,H		Employee	Employee Engagement
P,A,B,C,E,G,H			Employee Training

SC's performance is optimized each time the enterprise uses this updateable accumulated data, information and knowledge, performing a proactive integrity, as firms integrate networks, infrastructures and systems. Figure 3 illustrates the resultant model, showing different model parts, mechanisms and deliverables.

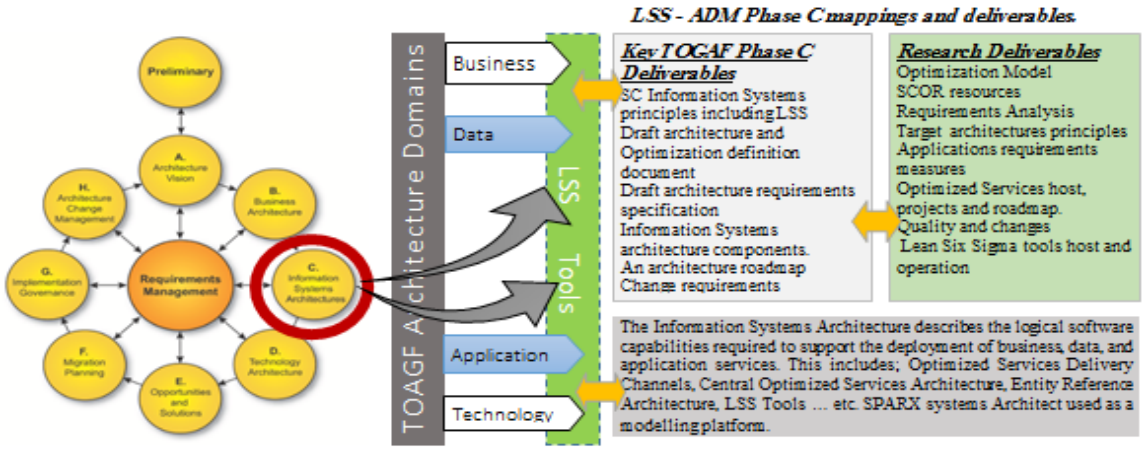

Fig 3: Data and Applications at ADM phase-C LSS deliverables.

4. Discussions and implications

For convergence reasons both Supply Chain Operations Reference "SCOR" and "ADM" are compared and found multi-level, industry-neutral, designed to support analysis and focused on top of three-operation levels. "SCOR" model is short to explain topics like demand generation, product development, Research & Development, or post-delivery support activities, with an opportunity for "ADM" to cover such issues. In addition, "SCOR" does not suggest how organizations may conduct operations or customize systems' information flow. "ADM" may interface with any other data dependent best practice [14]. However, "ADM" handles Supply Chain operations in each up-iteration, links such flow in a meaningful artifact that is guided by industry, organization, operations' location and standards. "SCOR" describes operations, not functions, focuses on effective activity, not the responsible entity element. From a structure viewpoint, both "ADM" and "SCOR" frameworks describe operation architecture to make sense to key partners. From the Lean part of "LSS" methodology, "ADM" provides a higher-level knowledge to start-up improvements, supports quick decision-making. It shares Lean context in that both foster team learning and efficient knowledge creation, increases innovation for effective settle of matters, eliminating waste and keeping competitive. Converged Lean tools and "ADM" facilitate knowledge creation, make individuals promote their knowledge assets, create new knowledge shared, measures and build a holistic and efficient knowledge system, makes big data mining, flow and storage of high requirement for innovative infrastructure of Service-Bus "SB", data-center "DC", data-hubs and initiate knowledge spiral. Table 2, shows primary comparison outcomes and joint areas of SCOR and TOGAF-ADM from SC's information viewpoint.

TABLE 2: Primary comparison outcomes of SCOR and TOGAF-ADM

Feature	SCOR	ADM
Levels	Multi-Level	Multi-Level
Industry	Neutral	Neutral
Analysis	Supports analysis	Covered
Demand	Short in generation	Fully Covered
Product	Short in development	Fully Covered
R&D	Short in R&D	Fully Covered
Post-delivery	Short in support	Fully Covered
Information flow	Describes process not functions	Supported by industry
System	Not supported	Customizable
Interface	Not clarified	Cooperate
Description	Processes not functions nor	Processes, functions,
Process	Process not functions Described	Both Described detailed
HR	Not detailed	Covered in detail

During and after conducting "ADM"s performance development cycle, whole supply chain components and stakeholders are informed by an authorized access. The implementation phase adapts "EA" on ontology of

"what to be built" not "how to do it". On such ontology broader issues, such as how to communicate with "SC" stakeholders, may be addressed as a model success, depends on dominant culture, people attitudes; skills, mindset and stakeholders implementer's endorsement [15]. "ADM" assigns a track to change management in phase "H" to carefully inject accurate and periodic information, designed to the predefined roles and status, by a communication plan with a defined channels, iteratively visited to cover human issues such as training and development and offer customized information to decision makers. Culture complemented by Kaizen involvement, understands work problems and philosophy [16]. The "EA" principle of bringing together technical resources with "SC" requirements always keep in focus operations and customer needs and how optimized system adds value by meeting these needs. "EA" measurements allow "SC" architecture evaluation in terms of cost, benefit and risk as subjects of LSS tools. Many tools gained in each intersection between "TOGAF-ADM", "SCOR" and "LSS" represented in resultant cross-features (Circles overlap) in Fig. 4.

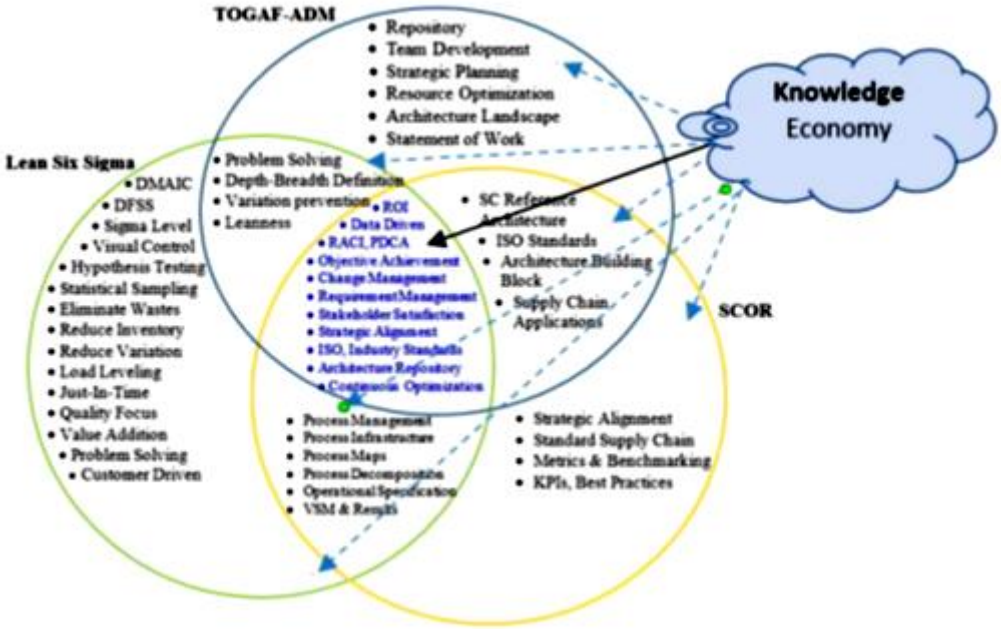

Fig 4. LSS, SC and TOGAF-ADM convergence [11].

5. CONCLUSION

The paper presents a conceptual model that converges the lean six sigma "LSS" approach and "TOGAF-ADM" framework in a supply chain "SC" reference architecture, collects the common features, requirements and components translated into Architectural and Solution Building Blocks, calls "LSS" tools to continuously provide optimized reference architecture, improves "SC" Services specifications, Shares delivery Channels, Applications and Data Hubs to continuously enhance supply chain, information access and delivery to involved parties, wherever they exist, in an efficient, safe and secure information exchange. This significantly cuts costs and time span, captures "SC" processes incidents and needs, recommends the support to a preset strategy and achieves the defined objectives. This significant convergence number of tools and attributes gained means that the combined model is effective to a substitute "SCOR". "LSS" and "ADM" coexistence complications, adding new features, getting specific under-call blocks and utilizes every single "SC" data piece acquired, enforces agility, responsiveness and intelligence, ensures a common enterprise language and standardizes methods, so that resources are utilized effectively and good return on investment (ROI) achieved in a knowledge economy, all this is combined to form the research's proposed model effectiveness and capability.

The resultant Enterprise Architecture Model opens a research track for almost any supply chain to develop, carry out further work, and contributes to set foundations for digital future where technology and knowledge are principals.

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