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RESEARCH ARTICLE

SYSTEM ENGINEERING AS A DEPLOYABLE ENTERPRISE SYSTEM GENERATION TOOL

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ABSTRACT

This paper verifies the effectiveness of system engineering by its impacts towards enterprise system generation. An industrial case studies is presented about IBM adopted a model-driven engineering method to determine intentional services that meet business goals. It aims to extend the understanding of a specific method of system engineering- Service Oriented Architecture (SOA), with its flexible integration of business process and effective simplification of generation framework. Besides, system engineering tool is also proved to benefit asset collection for enterprises in fashion industry, with Service Oriented Computing (SOC) applied, along with integration of wireless sensor networks framework. In the last, several specific methodologies are also implemented to demonstrate the examinations and assessment ways of the proposed approach, supporting how system engineering provides a practical approach to balance all needs, satisfying enterprise operators, and benefit the system operation throughout the life cycle, not a single tool used for demand analysis.

INTRODUCTION

Once the business needs are met, developers must use specific engineering tools to ease service availability and improve business development. Specifying all business processes from the details is time consuming, especially for companies that focus on a range of similar businesses. With more regarding standards for fully developed business processes, Systems Engineering, a new approach that significantly simplifies low-level processes and frameworks, has become a key component of service-oriented business generation and upgrades. Systems engineering as a formal approach to managing uncertainty product development and deployment are facing the challenge of solving increasingly complex problems. With the rapid change of technology and economy, the product life circle is confronted with growing risks, such as higher cost and stricter quality The restrictions, which requires a new restructure of business conduction. pace of technical innovation, compressed product life cycles, cost, quality, and risk are fundamentally demanding a restructuring of the way business is conducted. Besides, significant enough by themselves, other challenginges disruptions are emerging as well as forming mutual benefits from other formalized process. Which must also benefit from the rigors afforded by this formalized process. Enterprise Management, is introduced in this paper to represent the concept of an approach introduced in this paper to meet satisfying the larger interest set of an organization corporations, also aims to improve - inclusive of the people, integration of processes, strategy, technology, and the external factors of customer and stakeholder satisfaction.

Background

What is System engineering: Systems engineering is an interdisciplinary approach to achieving a successful system for systematical success. With targeting it focuses on defining elevated allocation of customer needs user needs and required functions functional objectives early in the development cycle, it also enables documentation acceleration, integrating documenting requirements, and then continuing design prototypes synthesis and into system validation to facilitate testing, while considering complete issues. Systems Engineering integrates synthesizes cross disciplinary problem solving progress all those disciplines and specialty groups into a team effort forming aa more flexible extent structured development process that it enables conceptual proceed proceeds from concept to production to operation. Systems Engineering In this sense, it retains balance among considers both the business and the technical, with needs of all customers with the goal of providing a quality ensured product that meets the user needs (Jarke *et al.,* 2010).

System engineering tools for enterprise

Service Oriented Computing (SOC): According to system engineering principles, the ability of System Engineer mindset to identify actors, to analyze their relationships in the context, to represent them through abstract models, is applicable also to study market dynamics, value chains and sketch the outcomes of the analysis as business architectural models. Therefore, the applications of these principles are then relevant for Business Developers or Product Managers to perform market analysis in order to define business strategies and understand how to position their business in the market landscape. Service-Oriented Computing has been recognized as an important application activity, to adapt to enterprise system. It designs and generates a business process a service-oriented application that will potentially be used for subsequent development activities. With the new graph - Service-Oriented Computing (SOC), in the past few years, systems engineering has grown rapidly, breaking separating developers into three separate roles distinctive branches: application builders, service agents, and service developers. As result of this, it is obvious that tasks like translating objective specification for adaptation have been

simplified, and facilitated towards easier access to approach the developer no longer needs to make the executable that meets the requirements translated from the task specification, and the application development is done via discovery and composition, without still applying rather than traditional design and coding techniques design and coding. In other words, the application entire development and application progress is completed through a collaborative environment based on the three independent roles: application builders, service developers, and service brokers (Mabert *et al.,* 2003). Currently, there comes a tendency for growing acceptation of Service-Oriented Computing has been applie, via numerous application insided to many areas, for example, electronic business, cloud computing, Internet of Things (loT), Mobile-Edge Computing. Service-oriented computing involves developing service-oriented architecture (SOA) and corresponding middleware that can virtualize any business process with a variety of interoperable services, regardless of psychological constraints or user context (Vasista *et al.,* 2013). As a result, with offering a contributive SOA can provide an environment that can be used to run running distributed applications, SOA enables a more smooth user experience ly and at a reasonable cost. In particular, the coarse-grained server approach allows SOA to provide flexibility and functionality for specific business needs. There are two commonly adopted approaches to implement SOC -- Grid services and Web services. As to the former one, are the most common service for implementing SOC, where it offers foundational distributions to systems as data set support. Compared to Grid services' large scale service focus, Web services engages Grid services provide the foundation of the distributed systems to support the processing of very large data sets. In contrast to Grid services, Web services provide relatively small improvements to facilitate service access over the network, becoming one of the most. Therefore, Web Services have become the preferred implementation technology for realizing SOA solutions with technology implemented insides.

Service Oriented Architecture (SOA): As we all know it is well known that in May 2018,, IBM has proposed a SOA application as its flagship lifecycle process model (Wada *et al.,* 2011), which includes four phases: modeling, assembly, deployment and management, in which the model developed during the modeling phase is used for all subsequent phases. In order to maximize the improvements of modeling r in previous life circle, it incorporates addition, the evaluation results and feedback will be used to improve the model obtained in the previous cycle, a, which in return encourages the running and testing ofnd another round of life cycle, will be performed again until reaching a satisfying outcome the application obtained is good enough. In fact, the key SOA principles are reusability. Initially, SOA focused on reusing Web services, those available on the Web, for example, on UDDI servers. However, this has proven to be impractical due to various safety and liability issues. Sprott suggests that SOA adoption usually follows an incremental approach (Beckman, 2007). Following the Sprott adoption model, organizations can launch SOA projects with few reusable services and gradually develop reusable services for internal use, and Create a large reusable service repository. In this way, service-oriented business process development follows a domain engineering approach in which reusable services are identified, collected, categorized, and reused to make it easier to build business processes. To every individual user, As one after certain amount of practices, they are able to identity reusability of software assets, which means this approach is not only intended for practiced this approach, one can recognize that not only services can be reused to building a SOA business process, but also many other software assets can be reused. Specifically, supposing that a business workflow can be reused in addition tout of the those services used by the ordinary work- flow, A an application process framework from collaboration template would also be reasonable enough to be transformed into reusable asset via that involving es multiple services is another reusable asset. Even an application process framework that consists of multiple collaboration templates and services can be reused.

CASE STUDY

To create new, faster, more profitable opportunities for businesses, and increase flexibility, companies see themselves as a set of interconnected features - discrete processes and services, such as sales assurance options, checking customer credits or verifying users - then Decide which features are core or differentiated. If a company can mix and match these functions at will, it will have a huge competitive advantage in the market. Therefore, utilization of reusability is being urgently adopted by numerous enterprises there is an urgent need to develop as an application framework development tool, as well as facilitating to reuse and combine discrete business processes and services. That make up a business. This is a blueprint or map of how the service works.

SOA and IBM's model-driven engineering method: To achieve this level of flexibility, IBM developed service-oriented modeling and architecture. It is a model-driven approach to business process, benefiting generation in a business process generation composition or orchestration layer composition of an SOA application architecture. As to the The modeling process, its includes identification, specification, and implementation. In addition, there is a well-developed platform it has been developed as a platform to supporting SOA solution design using the SOMA method (Panda *et al.,* 2008). In terms of its functionality, with open resource platforms for Web service, SOA intends to accelerate business service components connection, as well as generating innovation inside processes and application developments. When SOA is built on open standards such as Web services, you can connect business service components processes and applications faster and easier than ever, regardless Instead of plat forming or programming language, a whole. Web services are a set of industry-standard technologies has been implemented inside SOA, so that engineers can agilely modify that plug and play with your infrastructure to increase business agility in the face of changing market conditions for increased market shift.

With the characteristics of close relationship between software engineering, enterprise IT architecture, service-oriented architecture is able to optimize infrastructure framework and in term facilitate business needs. In this sense, on the basis of open platform, SOA aims to leverage technology to facilitate agility of business, with elevated services constructing blocks inside enterprise info structure. With the Service-oriented architecture has the characteristics of close relationship between software engineering, enterprise IT architecture and business architecture. Our idea is to optimize your IT infrastructure to meet your business needs. SOA is ideally built on open standards and has nothing to do with technology. Services, not

applications and platforms, become IT building blocks that enable business agility. Service-oriented modeling and architecture, SOA separates the business logic of a process from its technology platform. Besides, input can be taken via the integration of, taking input from IBM Component Business Model TM methods or other business analysis and modeling methods. Mapping the business goal essentially, these SOA models offers an understanding to component business activities, triggering better performance from events and roles, as well as inputs, control points, and outputs. These models map a business's goals to its essential processes, providing an understanding of componentized business activities, the events that trigger them and the roles that perform them, as well as inputs, control points and outputs. While as to Business process modeling, same critical as it is for IT business, it still is not universal for while as critical for IT as for business, does not typically reach into the IT architecture and implementation domains. Thus, it is reasonable to create Service Oriented Modeling and Architecture as solution of was created to help bridging e this gap.

SOC and enterprise asset collection with wireless sensor: In product lines or fashion lines, Organizations typically develop business in product lines or fashion lines into i.e., multiple versions of business processes, thus leading to the evolvement of in a given domain will be developed. Therefore in this sense, the collective adoption of service-oriented computing to simplify the complexity of asset collection has significant advantages. Relying on a wireless sensor frame, this service oriented computing system functions collectively to simplify complexity inside asset collection. To elaborate, it is realized with the integration of A service-oriented computing system based on a wireless sensor network framework is used to work in a collective manner to achieve complex asset collection. Functional integration of adjacent sensor nodes, as facilitation of is achieved in terms of cooperation between sensor nodes, in which the sensor nodes manifests the energy using of WSN service. Where the sensor nodes are encapsulated and represented as energy aware WSN services. In terms of usability, WSN service has various classifications regarding service categories, enabling WSN services are classified into multiple service classes based on their functionality. As a result, the service class chain generation based on is generated according to the requirements of the domain application requirements. Beside, another advantage of WSN serviceis its automatic matching and selection service, which incorporates all kinds of service classes The combination of WSN services is constructed by discovering and selecting the appropriate WSN service as an instantiation of the service classes contained in the chain into a composition. This composition simplifies. The WSN service composition is simplified to multi-objective and multi-constrained optimization problems, with the application of where Particle Swarm Optimization (PSO) algorithm and Genetic Algorithm (GA). Besides) are applied to solve this problem. Experimental results show turn out that in fact PSO performs is better than GA in areas of locating finding approximate optimal WSN services ingredient [76].

DISCUSSION

In the previous paragraphs, two system engineering tools were proposed, which are exemplary areas of excellence in industrial cases. In the following paragraphs, we use four specific methods as test methods to propose the suitability and effectiveness of the tool. The analysis begins starts with with the input of the demand introducing demand input and then provides offers the structure of the different analytical gradients.

Framework analysis: Framework analysis includes analysis of many aspects, including requirements and functionality. It primarily identifies process framework in the requirements, and it will be reused if a reusable process is available.

Demand Analysis: Define and improve the quantifiable characteristics features of the final end product or system. The loop develops technical requirements based on all the functions and sub-secondary functions of the system life cycle to gradually provide offer more detailed definition and description of performance requirements. Identifications and correlations are made for raising requirements and standards, offering an clarified relationship map for manifestation of All requirements are identified and correlated to each other to provide a relationship map, overall rank priority and absoluteness. Thus, is comes to be easier for the generation of product impact and task requirements,. Impact of user requirements/objectives and derived requirements by task, operational environment, constraints and effectiveness metrics, eliminating difficulties for user need are analyzed to provide the basis for both derive derivation and defined needs definition. Whereas these user needs actually consist the continual evaluation, especially focusing on phases of validation the impact of these needs forms the basis for continual examination of validity, consistency, desirability. attainability. Physical resources, human resources and performance capabilities. Besides, factors such as, life cycle costs, schedule and other required constraints also play vital role. And the output from these is phases of the process offers identification offices technical performance and its unknown needs to be verified, thus avoiding the isolation of - which either verify known or stated requirements or isolate new needs (Wu *et al.,* 2013).

Functional Analysis/Allocation: The intention of Functional analysis is used to for elevated definitione, iteratione or integration of product functione, which mainly concentrates on the functionality of an item. Primary functions and sub-functions are progressively improve customer review and stakeholder satisfaction iterated to achieve satisfactory customer performance. These approaches are developed collaterally and iteratively cohesively to provide stimulate facilitations of definitions for dependencies - both internally and externally - and facilitate alternatives at both sub and super function levels. To better improve performance outcome, Traceableility through the analysis phase has become ais crucial tool to ensure meet that performance requirements are met.

Decomposing

Complex functions or performance requirements are decomposed has been incorporated into sub-functions, facilitating definition of until requirements for a discrete task, action, or activity are defined in sufficient detail to enable synthesis. As these are derived derivation being made, the allocation of performance requirements continually identity is continued to identify all further other functional interrelationships in a further degree. While the. Trade-off

studies are performed to determine determines intra and inter-functional requirements needs, supporting ensuring identified interface identifications, resolving cause and effect conflicts between cause and effect relationships, and determininge lower level functional impact when especially when higher level levels are not tasks are indivisible (Nik Bessis, 2018).

Modelling and automation

Collaboration modeling: Collaborative modeling means that for each activity of the process framework, and bridging links between a cross-reference link between the application ontology and the collaboration ontology, which are is used to retrieve matching collaboration templates in the collaboration library. Take the delivery tracking system of the enterprise as an example. The SOA tools in the enterprise's freight tracking system can accelerate fast business processes generation. In collaborative modeling, for each activity, if it is a new activity without a link. Analysis through navigating the corresponding part of the CO is able to be accomplished with the collaboration template in the repository. Meanwhile, Through the collaboration template in the repository, the analyst navigates through the corresponding part of the CO is able to function similarly, which is in the same domain as the selected process. Supposing that, and looks for a collaboration template group that can implement the activity. If the activity is not a new activity, an automatic recommendation based on asset link intending to satisfying the collaboration template that satisfies the matching activity matching function is automatically recommended will be generated, which in term serves as based on the asset link in the repository RDF description. With the recommended collaboration template. In this sense, analysts can examine the graphical workflow, BPEL code. Besides, and asset links for manifesting template capability can be configured to facilitate implementation and collaboration of service for each template that this template has,. The asset link which clarifies the implementing capability of this shows the activities that this template can implement and the potential collaborative services incorporated inside in the template. Supposing that if there is an analyst cannot find a matching template, he will modify the existing template or in term create a new one and add the new template to the collaborative repository. Thus, the Asset links in the collaborative repository RDF file will be updated (Oliveira *et al.,* 2014).

Service modeling: While service modeling means that for each collaboration template, a matching service is found in the service repository using a cross-reference link between the collaboration ontology and the service ontology. In the case of delivery of the enterprise's freight tracking system, for service modeling, discoveries have been made on the basis of asset links regarding details about each collaboration template. The repository service is discovered based on the asset link for each collaboration template exported during the previous modeling phase. As to for the collaboration template "Track Update shipping", the repository service "Track by tracking No" matches. Discover the expected service "Check Shipment" and drag the service to Collaboration "Track Update shipping" to implement it. All discoveries display service, ellipse indicates the service found, the character is Brackets indicate the behavior of the service.

Synthesis and integration: It has been well known that Synthesisze, an universal tool to define systematical elements, also favors elevating physical configurations into a more satisfying level utilized as tools to d of systematical elements is used to define system elements and refine them into physical configurations that meet the requirements. Synthesis elements allows providing alternatives for Define and refine system element alternatives for each logical functional requirement set. Perform trade-off studies to determine contemplating through preferred system component solutions based on the basis of functional requirements, derived design requirements, and functional and physical interface requirements. System elements are gradually integrated into projects that provide integrating end-use functionality. In every single aspect, interfaces At each level, the physical and physical interfaces required by the final design are verified to ensure that functional for satisfying functional requirements are met. Establish and control the correlation of interacting ion-related elements. With intended to properly identify, document, and implement technical and programmatic data for development, production, testing/validation, deployment/installation, operations, support, training, and disposal, engineers tried to ensure each configuration item is evaluated and verified, which means that it meets performance, functionality, design requirements, and objective user requirements. The integrated products resulting from these design requirements. The end products out of these process offers reference for further configurations around updating functional distribution and product baselines. In this sense, programs can be figured out regarding to constitute the basic reference source for developing, building and updating functional, distribution and product baselines. It also includes system segments, configuration items, process and material specifications, interface control documentation, and facility requirements. Besides, both manual material and digital files can be loaded similarly.. Program manuals and teaching materials, as well as files loaded by personnel tasks.

The design must be done from the perspective of the integrated system elements. Design must be simple: easy to maintain, including common access and common non-complex ordinary tools; support includes supply; manufacturing and production, including tools, layout, process and assembly; training; testing; and mission/requirement completion. Wherever practicable, the design should use standard components, technologies, services and facilities. Other standardization considerations include mandatory or user structure and infrastructure, supportability, training, and interoperability. The inter-system and out-of-system design compatibility of the engineering interface is described in the form of interface requirements in the appropriate specification. Coordinate, establish and maintain sustain interface control requirements and drawings. These interfaces are: primary contractors or prime contractors, participating contractors for contractors, team members, subcontractors; and other equipment, computer programs, facilities and information provided by the customer. While dissemination has been made by changing specifications and Clarifyingear communication channels. Changes to specifications and documents must be disseminated in a timely manner. These interfaces are: primary contractors or prime contractors, participating contractors for contractors, team members, subcontractors; and other equipment, computer programs, facilities and information provided by the customer.

Assessment analysis and evaluation: System analysis and control provides the assessments, progress measurement and decision-making mechanisms needed to assess design capabilities, determine progress to meet technical program

objectives, develop and evaluate alternative action plans, and develop the entire system to meet customer needs. As being integrated into system engineering process, Comprehensive system analysis is an integral part of the system engineering process. Systematic analysis contains comprehensive analysis on project effects, with measurements such as includes the effectiveness of the project and its alternatives, design assessments, performance capabilities, and physical attributes. While the way to identity and control this analysis highly depends on the metrics inside, which relates traceability modification technology, ensuring the resolution capability. Identify and control the relationship between assessments by using metrics of effectiveness levels. This technology is used to provide top-down traceability. The hierarchy also provides a bottom-up assessment to gradually validate the capabilities of the design solution. Users tend to prefer a highly traceable standard as to the Traceability of performance, functionality and design requirements embedded inside the enterprise systemis required and required for user needs. Apart from providing a pivotal balance with formalized techniques, system analysis targets System analysis and control also provides a critical balance through the use of formalized techniques. These are trade-off studies, further functions such as risk evaluation, technique and assessment, technical performance measurement, configuration management and technical data management data analysis. In the case of a delivery tracking system for an enterprise, a particular generation assessment includes mapping each activity to a set of services through a collaboration template. Assign the input and output of the service. Generate the final shipment tracking business process and encode it in BPEL. With the rapid derivation of business deployment, evaluation of service lifecycle comes to be easier, which in term similarly facilitates data When deployable business process derivation, the service-oriented development lifecycle goes into the evaluation, code generation, and execution of execution, and data analysis phases. If the application does not meet the expect expectation of ed require dements or the initial requirements change, the application needs to be rebuilt. Therefore, the modeling process is iterative. The reusability of service and process framework can lead to the repetition of four modeling phases in multiple times, and in term accelerating business development. By reusing assets such as services, process frameworks, and collaboration templates, you can repeat any of the four modeling phases multiple times to improve the resulting business process.

Conclusion

As most engineering systems have proven today, the complexity of products and processes is blurring the distinction exaggerating the vague distinctions between design and tasks and engineering. For example, individual differences in the performance of mechanical, electronic or software components of products are becoming smaller and smaller, and interconnectivity and compatibility are increasing. Similarly, customers are increasingly demanding products as a technical design and an economical cost-effective, timely and high quality elevated delivery system throughout their lifecycle. Therefore, the required engineering, business infrastructure and information system complexity thresholds require innovation and new enterprise functions across the entire performance and operating range of the system. There's also growing need for elevated corporate service, Corporate performance must also be excellent. Since factors such as competitors as a market, geopolitics. Competitors, labor, environmental and business performance expectations change all the time, requiring and companies must quickly adapt to or face extinction. Besides, customer review and stakeholder satisfaction are in growing need as necessary definition of successIn the innovation and financial competitive market, two interrelated and related factors - customer and stakeholder satisfaction - now define success. As a formal tool of systematical product and service supply, Systems Engineering aims to become preferred method provides a formal way for suppliers and customers to of complex products and systems to effectively manage complexity inside product concepts. The requirements determination process is optimized through its disposal requirements for maximum benefit, schedule, cost and quality. It is more than just not only a demand analysis tool, but it provides delivering a practical way to balance all the requirements that a product or system will have with its satisfactory operation and beneficial use over its useful life. This approach provides defines a framework for performing and balancing an iterative process purposing of balanced iteration process, for implementing step-by-step refinement definitions of systems, subsystems, configuration items, and their performance verification and validation.

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