SERVICE-ORIENTED ARCHITECTURE IN AUTOMATION INDUSTRIES

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Abstract

This paper addresses issues and difficulties in the advancement of cutting edge installed gadgets, applications and its administration that Service-Oriented Architecture (SOA) handles in Automation Industries (AI).Because of SOAs expanding knowledge and traces of the methodology received, just as the business points of interest advancement, the assembling business with SOA expresses deep complexity and yet simple usage in process of automation. The future assembling undertakings will be portrayed by as often as possible changing business sector requests, time-to-showcase weight, constantly developing new advances and, most importantly, worldwide challenge.

SOA and web innovation have evolved its route to support an unavoidably arranged world in which billions of individuals and trillions of devices and gadgets will be interconnected in different ways. As a component of this development, Internet innovation is rising as the essential bearer for interconnecting – utilized in mechanical mechanization, car hardware, building controls, home robotization, service automation, and so on.
SOA situated advancements and the management has picked up consideration in the recent years, raising an approach to make the reason for deftness so industries can convey new, progressively adaptable business forms that saddle the estimation come closer from a client's point of view. Management are to arrange methodologies that will be utilized for creating programming applications and programming as-a-benefit that can be sourced as virtual equipment assets, including on-request and utility registering.

Key Words: Service-Oriented Architectures, Industrial Automation, Programming,

1   INTRODUCTION

The progressing of information and correspondence development structure, execution, transmission and reusable data is creating new possibilities. They consolidate redeploying people, re-structuring affiliations, sharing information, and placing assets into developments.

The endeavors are proposed to yield specific game plans that fit in with a changing business condition, and effectively utilize the estimation of learning in organization associations that make high business regard. (Arsanjani, 2004).

The rendering of business forms and their change into executable work processes are issues that are being tended to by new best in class approaches, including the Unified Modeling Language (UML) and Business Process Modeling Notation (BPMN). Now, the questions are: how to implement these changes by industries providing services and emerge them with SOA?and, by what means should changes in the business side impact the arrangement of data frameworks, and the other way around? (John Nicholas, 2006)

The presence of web services advancements has activated the talks on and for SOA, which has been upheld for decades now, as far back as CORBA (Barry D. K., 2013) broadened the guarantee of coordinating applications on divergent heterogeneous stages.

Today, production lines are created and organized by a few frameworks saw and connecting in a various leveled mold following basically the particulars of standard undertaking structures. Anyway, with the strengthening offered by present day benefit arranged models, the functionalities of every framework or even gadget can be offered as at least one directions of shifting intricacy, which might be facilitated in the cloud and created by others.
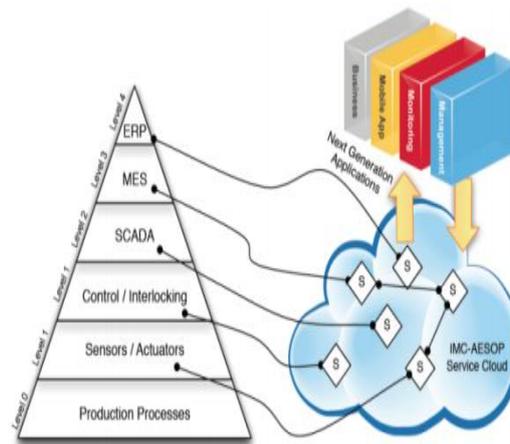

Figure 1Future automated context perception of cloud-based organization of cyber-physical direction(Matthias Foehr, 2017).

Several efforts so far were coordinated towards characterizing structural and architectural aspects of services management systems. The most applied procedures are the classifications set up within the ISA 95 / IEC 62264 standard (www.isa-95.com).

Topological and structural qualities are driven by client or application needs as for most recent, sealed or satisfactory innovative capacities. The real thought is to building up acloud satisfying service that present prerequisites for creation the executives' frameworks. The piece of the cloud is focused towards the appropriateness of supporting tasks and exercises (Stamatis Karnouskos, 2019). Accordingly, keeping the authoritative perspectives built up in the present generation frameworks, the relocation to future SOA based basic engineering abusing the abilities innate to SOA is drawn closer.

2   DEFINITION

A group of many operations that provide one singular yielded result can be defined as a definition of a service. A more complex transaction or a collection of services on gathering and/or providing information together by triggering one-another is the way SOA does improve any industry.

SOA is not something new, that came up just now. It has been for some time among us. Initially was known as Distributed Component Object Model (DCOM) that was introduces in 1996 (Barry D. K., 2019) based on the COBRA specification.

The 'Service' needed to be clearly understood to be realistically implemented. The 'Operation' had to be the function that on a singularity will be executed (reused as need be), while the Architecture would be the foundation. The SOA is based on two pillars: the "service request & the service provider". The best solutions at this time are based on cloud computing. The cloud can be either Private, Public or Hybrid.
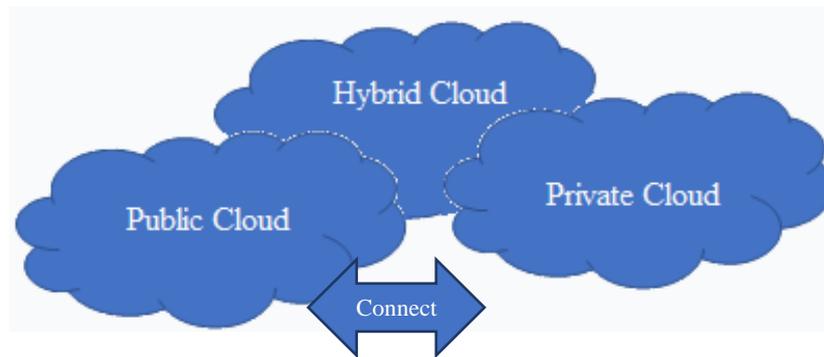
Figure 2 Illustration of interconnection and data sharing on different could types (Hawlett Packard Enterprise, 2018)

The Service-Oriented Architecture(SOA) is best understood if it is defined separately. There are many authors that have placed definition for SOA expressing its role and function in various ways, yet delivering the same needed information.

3   THE DESIGN

The architectures design is the crucial part for making SOA acceptable, admirable and well used. Here, the focus on designing the conceptual perspective in respect to the evolvement of technology that are potentially the keys for its success in automation industries are:[i] *Monitoring, [ii] Compatibility, [iii] Combinable, [iv] Network dynamics, [v] Integration, [vi] Evolution of infrastructure, [vii] Management, [viii] Mobility Support, [ix] Real-time Information and [x] Feedback.* As pointed the main activities to be part of SOA for the industry automation, the explanation of each part shall be elaborated, briefly:

Monitoring, refers to asset and process monitoring: The checking of advantages is of key significance particularly in an exceptionally intricate foundation. It will be for all intents and purposes difficult to do compelling data procurement with the customary strategies for example regularly pull the gadgets for their status. Additionally, encouraging methodology is to have an occasion driven foundation combined with arranges service models. In that capacity any framework will have the capacity to give the data it produced as an occasion to the intrigued substances. Due the cozy connection between resource observing, control and process checking the segments required to make an expansive scale framework event driven services for the most part; the principle contrast lives in that benefit reach to whatever it makes for the industry, and keeping in mind that this incorporates machines that are observed and controlled.

Compatibility: The future industries will continuously evolve and develop new faster and more efficient ways to perform. In this respect, the compatibility must continuously support existing machinery and/or services in order to keep going smoothly and have as little as possible hassle with interferences and increase of maintenance costs, and in the other hand to go forward and keep track of new evolvement in Technology, Machinery and Services too.

Combinable services: The pattern in programming applications is fast and consolidating existing usefulness is a must. It is normal that this pattern will likewise engage cutting-edge mechanical applications. Since frequently the advancement of such usefulness is especially undertaking focused, new apparatuses are to be produced too, in a perfect world they should effectively join the existing frameworks.

Cross network dynamic discovery: Zero-setup system can provide the fastest and yet the best futuristic scenario buildup. The industries invest in order to convey, and the investment normally are made in new machinery that are more sophisticated and have the cutting-edge technology, that would most probably be supporting its operational generation. The objective is to be addressed towards ongoing consciousness of all digital and physical parts and having SOA considering their capacities.

Integration: The optimization of the existing with new architectural levels is the greatest challenge, hence, to make this less painful and effective certain steps are to be taken prior:

- must document how the information flows and what activities are taking place,
- where improvement is required and how to implement it,
- identify functioning and study technologies that can be operated to meet the requirements,
- standardize functionalities (if they are not)and provide explanation for any function that may remain out of standards, and
- administer greatest infrastructure.

Infrastructure evolution management: The effect of industry structure, strategy, and financial matters joined with scattered basic leadership and horde partners require a frameworks approach with profound specialized and sociology points of view, this was recently treated as setting is presently part of the planed procedure. Such connections ought to permit learning to stream among the scholarly world and the actual practice. The goal that examination would be educated by pragmatic substances, while hypothesis underpin the successful change.

Usually on industrial infrastructure the investment approach span of a generation, say 20 years. Being technology agnostic of the future advancements, the challenge is to be bright enough on designing today's infrastructure that will sustain the investment timeframe, be sophisticate and in harmony with evolving technologies on future, at least for its projection life span. We can probably rely on the today's' software updates, they will continuously support and make better solution to the existing hardware. This can be taken as an illustration on how to design and futuristic sustainable and manageable industry investments, that in course of time can be upgraded with easy and low costs. Standardized format for information sharing, evolution and migration is a must today and the same will be tomorrow. SOA is here and will assist industries of all kind to evolve with time and will provide the support integration of sharing information, migration of functions and exchange.

Management:The future of industrial facilities will have the cutting-edge frameworks and will use thousands of devices that will be programable. The Industries use today automated serviced based on SOA, and will expand the use of automatization as much as possible, while SOA expansion will make the processes easier. The challenge that remains today and would probably stay with us for some time, is in identifying machinery and provide functional operation tasks, where no proper documentations are in place. The management of the network and SOA will at some point merge (in some industries today, this is a reality) to become conceivable to do programming updates and mass reconstructing or reconfiguration of entire frameworks. Furthermore, research should look at the dynamic conduct of foundation, both at the operational and transformative time scales. Most frameworks are intricate versatile frameworks that have developed after some time from endless and every now and again autonomous choices about explicit advancements, subsystems, and despite consistent vulnerabilities about future burdens and execution. In such manner, the development of the essential gauges and their interrelationships in every foundation must be contemplated intently. Representation of the genuine framework is an absolute necessity, as it will give the chance of better understanding and maintain. The utilization of industry machineries and frameworks from various makers includes necessities, for example, adaptability and extensible to an administration framework. Utilizing a typical correspondence engineering will relieve a portion of these requirements. Adaptability and vigor are additionally vital components when the quantity of oversaw (SOA-empowered) upgrades.

Mobility support:The term 'mobile industry' covers a great scope of industries that are being managed from any location. These incorporate movement of the self-driven machines, the staff using smart tools providing various operation functions as well as monitoring and control. Undoubtedly, going mobile is the way of the future. The industries have already implemented a success stories with mobility support. Take a peak at Zebra solutions (zebra.com).

Mobility allows access to real time measurements at any time. The industries will have to reflect on mobility in many ways, especially on:

- Choice of devices that can be intergraded and upgraded software and hardware wise,
- Futuristic support on infrastructure and implementation SOA,
- Staff support and training, interaction with industry infrastructure
- Mobility enable SOA, upgrade to real-time data flow.

Feedback:It is essential for any industry to have crucial information at any given time, thus, feedback is the most crucial part of the SOA for the industry automation. The resources and service quality are not to be compromised by any design. The redundancy of the information must flow smoothly and uninterruptedly. The SOA is to provide vide solution services to the architecture and at the same time sustain information for the ongoing operation, the status of the overall hardware and software, and a clear picture for the potential pre-fail information for the management decisions. The lifecycle of each part of the puzzle must be included on the design and calculated continuously.

As stated above, benefit introduction strengthens programming and engineering standards, notwithstanding presenting ideas. To fabricate a framework that complies (Srinivasan & Treadwell, 2005) with SOA standards, industries should embrace new logics by separating different parts of operations and manufacture services per items and/or lines.

4   SERVICES ECONOMY AND SERVICES RESEARCH

The world economy is currently transitioning from a goods-based economy to an economy in which value creation, employment, and economic wealth depend on the service sector(Spohrer & Maglio, The Emergence of Service Science: Toward Systematic Service Innovations to Accelerate Co-Creation of Value, 2009).

Service-oriented thinking is one of the fastest growing paradigms that has integrated Information Technology(IT), with relevance to accounting, finance, supply chain management and operations, strategy and marketing and more. According to *Forrester Research*, companies that implement SOA are able to reduce costs for the integration of projects and maintenance by at least 30% (Wall, 2007).

The industries need to adapt existing as well as to develop new policies to support SOA, the funding and documentation to this regard is a crucial part for its success. A complex, yet simple illustration shown below explains how the process involves all parties. By following this simple illustration, you have learned much for SOA. SOA can be used to specific projects and/or tasks by providing smooth service-oriented capabilities with low cost and high precision.

According to Oracle there are six steps that ensure success for SOA Governance, and these steps are: [1] to defining goals, [2] defining standards, policies and to have a portfolio, [3] define metrics, [4] place governance [5] continuously improve existing processes and [6] to improve and top-up SOA (Oracle, 2018).
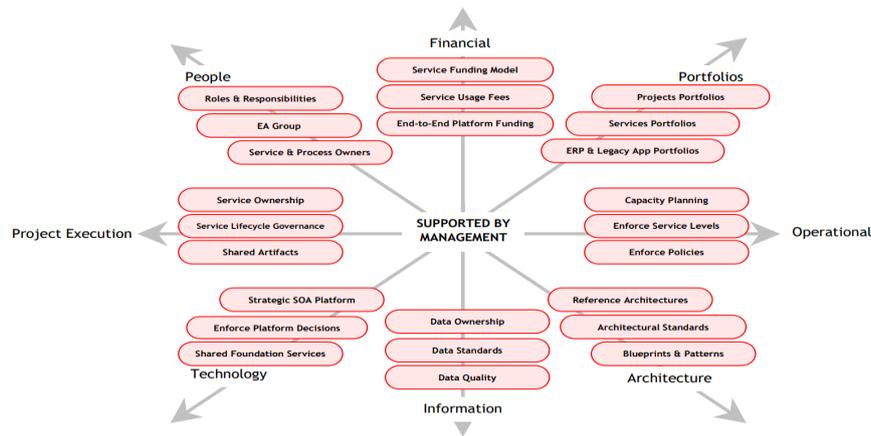
Figure 3 Key Leverage points for SOA Governance (Oracle, 2018)

There is a long history of academia and industrial interest in the service sector,the history continues to be written even today. Yet most of the interest in services has focused narrowly on marketing or management as well as in service sector economics. With the rise of technology-enabled services, many traditional companies have begun to see more and more revenue generated by their service operations. So, in industries, there has been a growing recognition in the past decades that service innovations now are as important as technological innovations.

(Spohrer, Maglio, Bailey, &Gruhl, 2007)characterizes the services as the utilization of ability and information to make an incentive among suppliers and recipients. These esteemed collections of bits of information are derived from the connections of elements that are known as SOA.

They are associated in and out by incentives with service components that support and mediate the determination. The objective of this science is to record and comprehend SOA and to apply that understanding wisely on the raising the industries capacity.

4.1   Industries should reorganize SOA to get its real value - service profundity

It is clear, the economies worldwide are shifting towards services and the workforce is changing its function in each division. The labor on the field and in front of the production line machinery is evolving. The services are being articulated to replace labor force. If we look 30 years back the percentage on transformation has been tremendous, in some industries the change has been over 90%. Basically, administration is taking the main role. In United States only, today, less than 3% of the population works on farms. This 3% provides more goods that 90% in 1800. This decline in labor represents increase in productivity(Spohrer & Maglio, 2008). According to International Labor Organization (ILO), since 2006, *"more people worked in the service sector worldwide than in either the manufacturing or agricultural sectors"*(ILO, 2007).

The main struggle of the industries into regards for implementation and/or expansion of SOA are the missing important bits and part of documentation, standards and procedures that follow up. The decision makers are to set time, means and tools to make change possible, this is a no easy task.

The data already piled up needs to be examined and sorted in order to start building a documentation and to standardize procedures – this is where SOA fits in.

Industries of all kinds, including government and government agencies, and other privately-owned corporation struggle on process improvement in strategical perspectives. This reflection is based on reduction of time and cost for their day-to-day operation (Desouza, Awazu, & Wan, 2005).

The organization culture needs to be addressed towards customization flows and service-orientation, they need also to assemble the intercommunication for the *service-request* and *service-providers* (meaning the clientele) in order to maximize automation on inputs/outputs or to better sum-up the service deliverance.

In response to these challenges, it is also needed to make adjustments on the traditional business processes and integrate SOA with more advances and usage of Information Technologies (IT)(Luftman & Ben-Zvi, 2010).Considering the circumstance, industry decision makers must progress with expected alteration and

respond accordingly. This is a step towards SOA, they also need to adjust their assets too, as needs arise. At the point when the business partners sense the change, they have to meet the needs, and so far for most, at the given time were not able respond dynamically with the infrastructure at hand. Moreover, the industries need to make culture changes and adapt to the progress, and highlight the necessity of SOA(Stabell & Fjeldstad, 1998).

SOA design offers a useful and feasible way for exploration of options connection to business needs (P, K, H, H, & L, 2007). In the IT setting, it gives a system to the commoditization of equipment and programming, just as in business forms.

Administration its self is turning into a part where it is essential for the IT design to display that numerous associations and integrate the current storehouse model change.

Service-oriented architecture offers a practical and viable approachto explore services in relation to business needs (Zhaoet al., 2007), this does not exclude any of the industries department. As of the Information technology needs, in regards to hardware and software it outlines the crucial development that should take place for the industry to meet the needed process that supports service-oriented architectural. The table below explains how-to transit from current to where the industries are and where there should be.

Table 1 Transition from past to present with the SOA

From	To
Focus on goods	Focus on services
Cost reduction through manufacturing efficiency	Revenue expansion through services
Standardization	Customization
Mass marketing	One-on-one marketing
Transactions	Relationships
Function oriented	Coordination oriented
Limited ability to store and process data	Improved ability to store and process data
Limited information sharing capabilities	Improved information sharing capabilities
Application silos	Integrated solutions
Tightly coupled applications	Loosely coupled solutions
Contracts	Service-level agreements

Source (Demirkan, et al., 2008)

The illustration bellow using the IBM model is adapted from a business providing Security Services in Kosovo. SOA as a tool covers majority of the services flow by smoothly and automatically transferring data and information to the respective sources. The workflows are triggered autonomically and depending on service-request the service-deliver provide changes as programmed.

Table 2 IBM Model - organization activities by accountability level and competency

	Business Admnistration	New Business development	Relationship Management	Sales	Fullfilment	Financial Management
Direct	Business planing	Strategy follow-up	Engagement planing	Planing	Planing	Portfolio
Control	Unit Tracking	Department Management	Engagement Management	Management	Management	Compliance

Execute	Staff Appraisal	Service Management	Engagement Administration	Sales Customer Dialogue Routine contact		Reconciliation
	Unit Tracking	Service Delivery			Services	Costumer Accounts
	Staff Appraisal	Marketing Campain			Documents	GDPR

(By: Authors)

5   CONCLUSION AND FUTURE WORK

The Service Oriented Architectures (SOA) today is providing the cutting-edge automation platforms. The SOA and Web Services combined create the most added value to any industry to-day. The paper at hand provides key points for the need of measurements pre-SOA. As elaborated in chapter 3THE DESIGN, the main focus is to get prepared, plan all steps and create a passage as shown in *Table 1 Transition from past to present with the SOA*.

The adoption to the new era with involvement of Information Technologies, proper education, business culture and change management, any industry will prosper with much ease and much faster than any would in traditional business ways.

If we look deeper on the matrix shown at Figure 4 Key Leverage points for SOA Governance (Oracle, 2018)a clear pattern is provided for any type of industries that needs to adapt. Of course, not all have the ability, will or the resources to make it perfect and have no hassle. The industries of all types have to try and give the needed efforts and investment to be part of the tomorrows market. Most of the industries, including governments have to take their own time to implement changes. Moreover, the funds are subject of success.

However, any industry operating today within SOA (even partly), partly in traditional way, they have to recognize that that have something. They do have the people, they doo have the data and many of them have also the resources. Those that they don't will have to change.

It is a must that people get involved (regardless the role or the position they hold), they all must be noted with the change and possibly the timeframe of this change. The data they have need to be consolidated, they have to be organized and build a proper documentation following certain procedures are to be followed. The technology may not be complete, not all segments will be in place on the beginning to have the set of SOA and automation in place. This should no stop anyone to change, that change is coming and the industries slow or fats will be part of it.

Following studies should consider the management change and its role in the sense of time vs funds. The SOA in industry automation for those they haven't implemented yet, is a loss of time and money. However, the initial investment is no small thing and probably if not plannedwisely by the decision makers, it will become more expensive.

SOA automation, undoubtably is a step to the future. It involves direct investments in Information Technology hardware and software, these investment in long term are by all definitions a success story. Thus, any Industry, the Government, any Government Agency and/or private Business/Corporation regardless the field of the operation should consider taking its views and measure with what SOA would bring. Everything with SOA in long term is faster, better and cheaper.

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