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Service Oriented Architecture (SOA) Integration with Industrial Machinery

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Abstract. *This article describes the usage of Service-Oriented Architecture in the industrial segment, showing the motivations and advantages of the approach, but also the challenges and implementation issues for this architecture model.*

Resumo. *Esse artigo mostra a utilização da Arquitetura Orientada a Serviços no segmento industrial, mostrando suas motivações e vantagens, além dos desafios e dos problemas que podem ser encontrados ao implantar esse modelo de arquitetura.*

1. Introduction

Corporate systems are evolving fast, thanks to increased processing power and to the need of overcome competitors, demanding big investments but making systems more mature and efficient for the execution of business processes.

The usage of Service-Oriented Architecture (SOA) has allowed enterprise IT to grow in an ordered fashion, reusing business components already developed and, mainly, easing the integrations of different systems in the corporate context.

As a result, business processes can now be soft-integrated with machinery, either manufacturing or for industrial automation, with great abstraction from programming and from complex interactions among the target systems.

In this article, we will discuss some motivations, advantages and challenges of such integration, presenting a case study based on a prototype work where implementation issues are also shown. Section I is this Introduction. In Section II we review some concepts of SOA and of Complex Event Processing (CEP), while Section III presents the means of integrating industrial machinery with higher levels of software architecture. Finally, in Section IV we draw some conclusions and suggestions for future work.

2. SOA and CEP

Whenever integrations involve physical devices, namely in the case of industrial automation, systems exposing the machines' functionalities are in need of a manual

initial programming – the code to be executed by the devices needs to be developed and implemented by a human programmer. Additionally, adapters need to be developed in order to allow talking to the low level languages of the machinery controllers. A possible consequence is the lack of professionals with adequate knowledge of such languages.

It is noticed that there is a significant initiative for industrial equipment when it comes to adoption of standardized technologies in enterprise systems architecture. The fierce competition that companies are facing in the current market has resulted in increased investment in research and development, and improvements such as in the purchase of modern equipment.

The integration of these devices also require significant costs for companies, making them lose time-to-market deployment of their software or industrial automation tools, and that "currently, one third of the costs in a manufacturing business is spent on installation and configuration of equipment " (JAMMES and SMIT, 2006).

With the increased processing power of controlling this machinery, programming these devices is becoming easier using languages of higher levels. Nowadays, there already exist devices that operate through network protocols such as SNMP, exposing certain features, which can be invoked over the network by customers using this protocol.

However, no big processing and memory requirements are in need when managing the industrial machinery. Also well-known is the fact that the development of Web Services, although not inherently complex, requires high processing capabilities of servers, primarily driven by converting and transforming XML content into data that is ready to be processed.

In matters of software and systems architecture, one of the next steps in a service-oriented architecture is the adoption and management of Complex Event Processing (CEP), which is a basic component of analysis of real-time business intelligence (LUCKHAM and SCHULTE, 2012). With the adoption of CEP, it is possible to add intelligence to information that travels on the service bus, in an organized, quick and easy to understand way. For example, consider a Telecom business environment where there is a drop in requests for new services. One can set an event such that, when a critical level is reached, a notification is automatically sent to those responsible for products or corporate strategy so an action plan can be developed, such as promotions and so forth. Exposing these services may imply creating a governance of the features available within the corporation, reusing rules and automating calls even when complex business rules are involved.

As SOA adoption in business is increasing, there is a need to bring large IT processes closer to the business area, making the whole IT aligned with these high-level business processes and with systems outside from the user's view, such as mainframe systems and Big Data. CEP allows abstracting from the layers where there is a great demand for low-level technical services, at the same time managing to add the SOA value to the IT assets, listening to the data on the service bus and invoking processes according to defined rules.

Currently, there are tools that implement the concepts of CEP usually deployed in the Enterprise Service Bus (ESB), such as EPO (Oracle Event Processing), which belongs to the Oracle SOA Suite.

3. Integration with Industrial Machinery

With the various architectural models available, it is possible to enable communication between industrial machinery and corporate systems that operate in any segment of business, at the same time receiving the benefits that SOA brings.

One way of enabling this communication between the services available in a service-oriented architecture and the controllers of the machines is "using a *Cell Controller* that performs command and control functions usually installed on a PC" (KOMODA, 2006). With it, it is possible to receive data from machines on the PC and send it to the service bus, as shown in Figure 1.

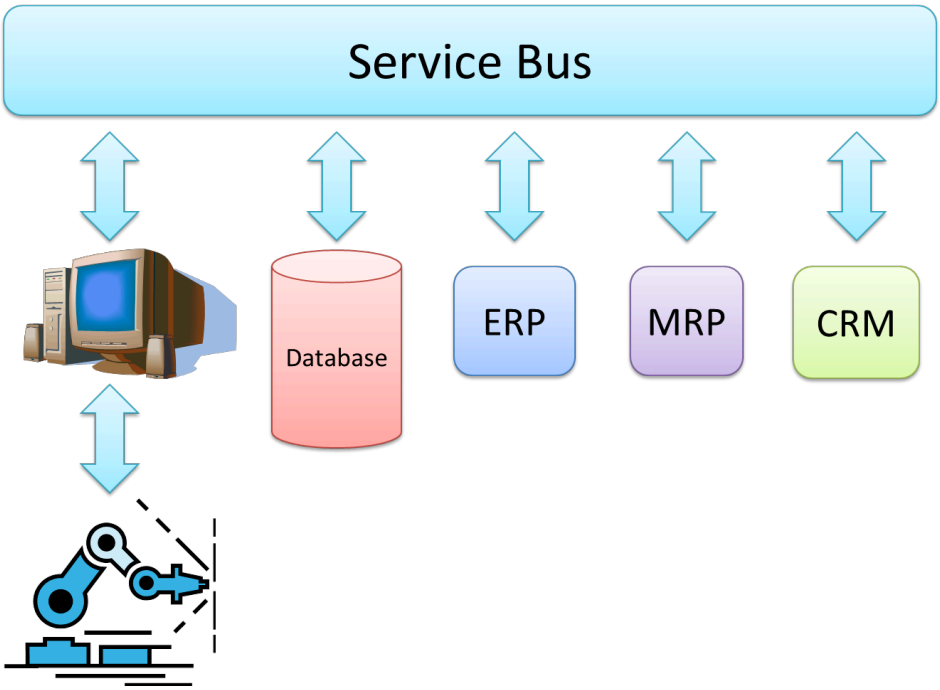

Figure 1: Integration among machines and enterprise systems.

One of the biggest challenges to promote real-time communication of enterprise systems with industrial machinery is the latency. Due to this, Internet communications are not advisable, and local network connections should be used to ensure the on-time delivery of data sent by the machines, such as sensors, motors, or even sending tasks through other systems, like a MRP, CRM or a Web application.

4. Conclusion

The ability to abstract behaviors and details of communication between industrial systems and enterprise systems helps the understanding of developed services and the applied business rules, resulting in greater productivity and reduced costs for companies which need to evolve the business.

This evolution involves technical issues about the processes themselves, such as adding new modules to interpret the communication of the machines with the services, implementing fault tolerance both in industrial machinery and in the service bus, and increasing control over IT assets that were developed, creating new business functions and applying governance processes.

The visibility of business rules facilitates the understanding of the processes and also allows the creation of scenarios in order to simulate problems, enabling industries to test their mechanisms of risk management where extreme situations can impact the production or service delivery.

Finally, it is clear that there is great advantage in the adoption of service-oriented architecture by companies as the benefits make them more prepared for an upcoming scenario where changes are becoming more frequent and competition is becoming fiercer. With an adequate architecture defined and implemented, forecasts are more precise when changes are made, and so are simulations of operating and evolving costs. The same is true for the analysis of alternative scenarios, ensuring the best decisions are taken in the process of improvement.

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