International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Collaboration of Design and Manufacturing Using Web Service

Sanjeev Mishra[1], Rajat Upadhyay[2]

[1]Research Scholar, Mechanical Engineering Department, Maharishi University of Information Technology, Lucknow,(U.P), India

[2]Assistant Professor, Mechanical Engineering Department, Maharishi University of Information Technology, Lucknow,(U.P), India

Abstract: ***Efforts from diverse domains are made to use the Web as a platform of integration for all service components. Design and Manufacturing (D&M) process area being no exception. Leading manufacturing companies recently have announced plans for web-based systems to coordinate transactions with their suppliers. If the design, production and delivery of products have to be done in collaboration with corporate departments, suppliers, resellers and customers, potential manufacturing partners should be identified, and design activities and production plan should be carried out concurrently based on the design requirements and manufacturing constraints. Such process involves many complex tasks, and each task can be either performed in the same organization, of be outsourced. The recent developments in IT technology, specifically e-business are useful to coordinate these activities. However, current e-business tools tend to focus on transactions involving standard parts and products among network of suppliers. Therefore, e-business tools require research focusing on creating business processes from composite Web services, and executing processes that can interact with both internal and external Web services.This study looks into creation of a service from composite Web services using Orchestration and Choreography offered by Web services. Business Process Execution Language for Web Services (BPEL4WS) or BPEL (for short) was used to orchestrate and choreograph a Die Design and Manufacturing process, in which four Web Services were involved (viz. Die Casting Buyer, Die Manufacturer, Die Design Analyzer, and Casting Manufacturer). The combined process can also be used as a Web Service for further use. Collaboration was achieved in the above said Design and Manufacturing process using Java based, open domain software tools such as Apache Tomcat, Apache AXIS, and Parasoft BPEL Maestro.***

Keywords: Design and Manufacturing, Web service, World wide Web Consortium

1. Introduction

Efforts from diverse domains are made to use the Web as a platform of integration for all service components. Design and manufacturing (D&M) process area being no exception. Leading manufacturing companies recently have announced plans for web-based systems to coordinate transactions with their suppliers. Potential manufacturing partners should be identified, and design activities and production plan should be carried out concurrently based on the design requirements and manufacturing constraints. Such a process involves many complex tasks, and each task can be either performed in the same organization, or be outsourced. The recent developments in IT technology, specifically e- business are useful to coordinate these activities. However, current e-business tools tend to focus on transactions involving standard parts and products among network of suppliers. Therefore, e-business tools require research focusing on creating *business processes* from composite Web services, and executing processes that can interact with both internal and external Web services. *Web services* are generally accepted as applications that interact with each other using web standard interfaces, which include three major functionalities: description, discovery, and communication.

They offer high interoperability between cross-organizational components in a loosely-coupled way. The coordination of collaborating low level service is often mentioned as next step in the development of Web service. Web Service choreography working groups in World Wide Web Consortium (W3C) visualized that a framework for creating business process should be able to compose and describe the relationship between lower-level services. Several Web Service choreography languages inspired by industry have been proposed, such as BPEL4WS, BPML, BPSS, and WSFL and OWL-S. These efforts focus on defining the orchestration and choreography between Web Services to create business processes and organizing services into a workflow. This study looks into possible organization of Web Services into workflow using Orchestration and Choreography offered by Web Services. Business Process Execution Language for Web Services (BPEL4WS) or BPEL (for short) was used to orchestrate and choreograph a Die Design and Manufacturing process, in which four Web Services were involved (viz. Die Casting Buyer, Die Manufacturer, Die Design Analyzer, and Casting Manufacturer). The combined process can also be used as a Web Service for further use.

2. Literature Survey

Integrated enterprise of the future will tie together all existing applications, so that data from one application can be easily used in another. Business Processes, which may stretch across different applications, will be combinable, so the output from one will be input to another. The integration mechanisms will not create performance bottlenecks. And the integrated enterprise will be easy to change. Johannesson et al. [2] compared three architectures for enterprise application integration viz. point-to-point, message broker, and process broker. In point-to-point solution every application is directly connected to every other application, This solution could work for a small number of applications, but as the number of applications increases, the number of connections quickly becomes overwhelming. Chung et al. [3] proposed a system called MIDAS (Manufacturing Integration and Design Automation System) which can be viewed as an extension of agent-based approach. Each task

behaves as an agent that carries out a specified task by selecting an appropriate tool based on constraints, input data and assigned resources. If the result of the task does not meet the requirements, the agent must select other alternative or input data. Modules of MIDAS, written in Java, communicate with each other using RMI. Process databases, servers, and external applications that are distributed over various companies can be integrated into the system transparently to users. XML is utilized to represent task knowledge and execution status. The core of MIDAS is the process grammar, which provides the theoretical foundation to represent, manipulate and execute D&M processes., upfront suggestions for a designer, to modify his design if required, to fit the capabilities of specified facilities. DFF system is implemented using the Java programming language and the main GUI (graphical interface) is eventually converted into Java servlet, for actual application Presence of process grammar supports the iterative nature of engineering process and provides a layered approach to information modeling. into the design process. The DFF system analyzes the parametric design with respect to the fixturing (machine datums) capabilities and generates Qureshi et al. [4] introduced a methodology called 'Design for Facility over Internet (DFF)'. This methodology provides an Internet-based environment for designers to perform manufacturability analysis of product designs with respect to the capabilities of existing manufacturing facilities over the internet. Leitão et al. [5] proposed architecture for the development of distributed manufacturing applications based in the Holonic Manufacturing Systems (HMS) and Bionic Manufacturing Systems (BMS) concepts and which uses an agent based approach to implement those concepts. The proposed agent-based architecture has modules viz. Decision making module, Co-operation module, Communication module, Local control and Monitoring module, Physical communication and operational control modules, and Operational control module. Sequin et al. [6] proposed a Java based, Internet-based paradigm for design and fabrication in a global, networked CAD/CAM environment. They established an "Internet based Mechanical MOSIS service". Some specific results and achievements Muammer et al. [7] introduced an e-Manufacturing architecture, and outlined its fundamental requirements and elements as well as expected impact to achieve high- velocity and high-impact manufacturing performance. Web- enabled and infotronics technologies play indispensable roles in supporting and enabling the complex practices of design and manufacturing by providing the mechanisms to facilitate and manage the integrated system discipline with the higher system levels such as SCM and ERP. For future work they pointed out research needs in the fields as: data mining, reduction and data-to-information-to-knowledge conversion tools, distributed and web-based computing and optimization and synchronization systems for dynamic decision making. For the future work they indicated web services fulfill their needs. Wright et al. [8] proposed a networked manufacturing service named CyberCut. They said CyberCut will be "an experimental fabrication test bed" for an Internet-accessible, computerized machining service. Client-designers will be able to create mechanical components, beginning with a CAD system of their choice, and submit appropriate files to the server at Berkeley for process planning. CyberCut will utilize an existing open-architecture, computerized machine tool for fabrication. To facilitate this step, we will develop a bureaux called a "Manufacturing Analysis Service" that will evaluate the design for fabrication by Stereolithography or Selective Laser Sintering, and pass it on to our industrial collaborators for fabrication. Shyamsundar et al. [9] developed a collaborative Product Assembly Design (cPAD) tool that utilizes a compact and comprehensive representation of product assembly, and serves as an integrated interface through which product assembly modeling can be performed. Jørstad et al. [10] proposed and investigated the use of SOA in the construction of collaborative services. Introducing SOA they defined it as A Service Oriented Architecture (SOA) is a form of distributed systems architecture that is typically characterized by the properties. Peltz Chris [11] investigated the present scenario of Orchestration and Choreography in Web Services. Collaboration in Web services is achieved through *Orchestration* and *Choreograph.*

3. Orchestration and Choreography of web Services employed in Collaboration of Design and Manufacturing

3.1Objective of the present work

After going through an extensive literature survey it is evident that the propositions made by various researchers lack in one or other way. Chung et al.[3] proposed a system called MIDAS (Manufacturing Integration and Design Automation System) which had different modules written in Java and which communicated with each other using RMI (Remote Method Invocation), so it was very close to Web Services as Web Services also use RMI to communicate sometimes. They used a process grammar which supported the iterative nature of engineering processes and layered approach to information modeling. However, they had to use many servers viz. communication server, Objective of the present work is to look into possible use of Orchestration and Choreography offered by Web Services into design and manufacturing process. Web Services are platform independent, loosely coupled, and truly peer-to-peer architecture which needs no website. The service is described in machine interpretable WSDL language, which renders it to be discovered automatically. This is the main advantage of Web Services as a machine can discover and invoke a service automatically. WSDL can also be understood by humans who can control the process, if it is going in undesired fashion. As machine can not understand the meanings of words, lots of work are going on to introduce ontology which can provide semantic markup of Web Services. One such effort is Semantic Web Ontology Language (OWL-S). For global, use Web Services are registered on publicly available registries known as Universal Description Discovery and Integration (UDDI). UDDI also describes the binding templates and interfaces to the services. Site proxy server, and user info server which added to the complexity of the proposed system. The system was an extension of agent based client-server architecture but Web Services are purely peer-to-peer. Similarly, Qureshi et al. [4] proposed Design for Facility over Internet (DFF) methodology to provide an

environment for designers to perform manufacturability analysis of product designs. This system was distributed through the Java servlets. The process can not be automated as it uses only Java classes and not XML. Machine can understand data transferred through XML. Leitão et al. [5] proposed architecture for distributed manufacturing which was a very complex system based in the Holonic Manufacturing Systems and Bionic Manufacturing Systems concepts. This agent based architecture had various modules and a Knowledge Base module at the centre. This was again client-server architecture and was tightly coupled as different modules were dependent on one another. Then Sequin et al. [6] proposed a Java based networked CAD/CAM environment. This system requires CAD software to be installed at all the participating machines. Wright et al. [8] proposed a networked manufacturing service named CyberCut where a client-designer submits its design to a particular server for process planning. Server then utilizes open-architecture, computerized machine tool for fabrication. However, this is a one way flow where only server does the manufacturing work. Shyamsundar et al. [9] developed a collaborative Product Assembly Design (cPAD) tool. A Java based client interface was used. In the system, instead of installing the CAD software on every machine, the designer uses the CAD software which is packaged into a CAD server. However, this system uses too much servers i.e. an Intelligent Server as broker and five application servers viz. Web server, Solid Modeling server, Database server, Visualization server, and Catalog Database server. Objective of the present work is to look into possible use of Orchestration and Choreography offered by Web Services into design and manufacturing process. Web Services are platform independent, loosely coupled, and truly peer-to-peer architecture which needs no website. The service is described in machine interpretable WSDL language, which renders it to be discovered automatically. This is the main advantage of Web Services as a machine can discover and invoke a service automatically. WSDL can also be understood by humans who can control the process, if it is going in undesired fashion. As machine can not understand the meanings of words, lots of work are going on to introduce ontology which can provide semantic markup of Web Services. One such effort is Semantic Web Ontology Language (OWL-S). For global, use Web Services are registered on publicly available registries known as Universal Description Discovery and Integration (UDDI). UDDI also describes the binding templates and interfaces to the services.

3.2 Statement of the problem

A Die Casting Design and Manufacturing process involving four partners viz. Casting Buyer, Die Design Analyzer, Die Manufacturer, and Casting Manufacturer is taken into consideration, as this process consists of both design and manufacturing closely associated with each other. If the number of castings to be cast, changes at any moment then the die is designed afresh. And as the dies are made up of hard and thermal resistant materials which require special machine tools, the dies are made by companies which specialize in it. So, many companies are involved in this process. A company which needs a casting may not be willing to bother about the die design and manufacturing process, so the whole process should be seen as one service which can be done better through Web Services. After building the die casting design and manufacturing process which eventually contain four Web Services, the whole process can be presented as one Web Service. Therefore, this process is taken into consideration in this study. In the process Casting Buyer orders a casting by giving design requirements to Die Design Analyzer and Die Manufacturer both. After analysis, Analyzer forwards information about selected material for die to the Die Manufacturer, which prepares dies for both casting and trimming. On getting dies and trim dies from Die Manufacturer, Casting Manufacturer prepares casting and then trims it to give finished product. The process is shown below in the figure:

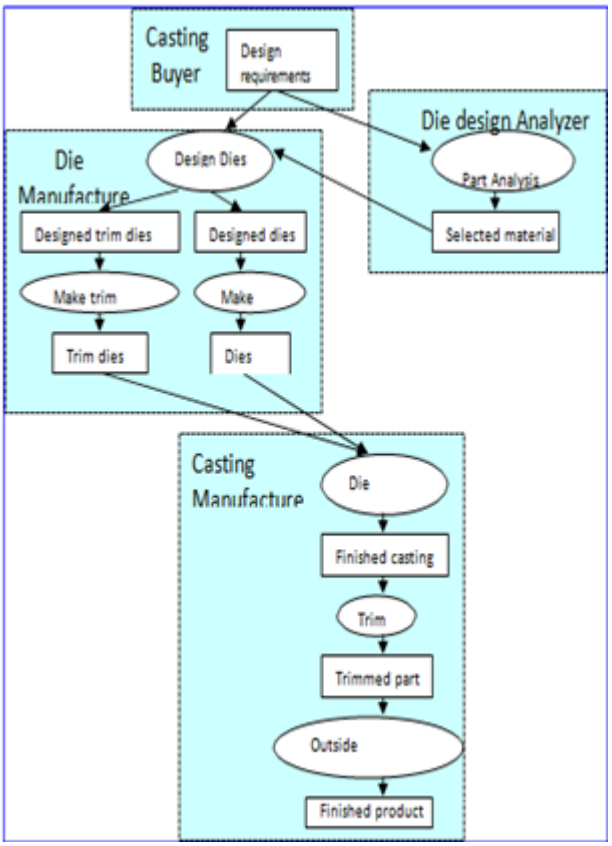

Figure 3.1: Overview of Die Casting Design and Manufacturing process

3.3 Software tools used in the study

In this study Java programming language as it is publicly available and platform independent and it is widely used in the networking domain due to availability of rich libraries which supports networking, though the Web Services can be written in other languages as it also platform and language independent.For deploying Web Services a SOAP (Simple Object Access Protocol) server is needed for which Apache-AXIS is used here as it is publicly available and widely used. Other technologies such as .NET from Microsoft® are proprietary and they use C++ programming language which is not platform independent. Apache-AXIS requires an application server which can support web application, for which Apache Tomcat/4.1.12-LE-jdk14 is used here since it is publicly available and AXIS works best with it and is widely used. Then for the orchestration of Web Services PARASOFT® BPEL Maestro for Web Service Orchestration, Version 1.6.0 is used which is a freely available Web

Services orchestration engine. Fig 3.2 shows how these softwares work in tandem to collaborate Web Services. It can be seen from the figure that all the web services are described in WSDL and can be located on disparate systems. They can use any technology to write web services. All the web services can be accessed irrespective of the software used and hardware on which it is employed. The messages which are being exchanged are in SOAP format. The ovals used in the figure show the particular setup of software used in this study. It is clear that Java is the core of the system, and that there is a layer of softwares viz. Tomcat, AXIS, and BPEL maestro, which are described above.

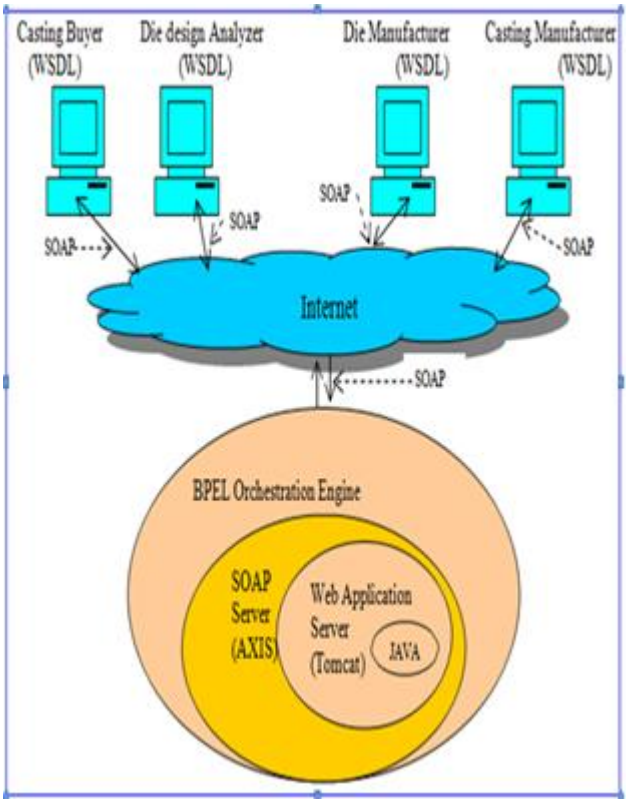

Figure 3.2: Conceptual model of the Orchestration Process

4. Results and Conclusions

4.1Results and Discussion

As presented in this study web services were written using Java programming language and then deployed to a SOAP server using Tomcat and AXIS to get *wsdl* files i.e. description file of the web services. Then the collaboration was done using orchestration engine BPEL Maestro and the *wsdl* files obtained through AXIS. The results obtained are encouraging. Orchestration and Choreography offered by Web Services can be used in collaboration in Design and Manufacturing. For global use, the most important part is the standardization of interfaces provided by the service. The name of the service and that of interfaces should be self-explanatory and some standard practice should be followed in order to render easy and accurate search of Web services. Ontology powered semantic search could be used to improve the performance of Web services. Then comes the security part, which is ubiquitous in every process which is implemented via. Internet. So, it is not a big problem as security aspects are always looked on in a big way by software developers.

4.2 Conclusions

In this paper, the *Collaboration in Design and Manufacturing using Web Services*, collaboration was achieved in a Design and Manufacturing process through orchestration and choreography offered by Web Services. First a Design and Manufacturing process was chosen in which collaboration is highly required. In this case it was a die casting design and manufacturing process in which four companies were involved.As reported in literature survey the architectures which are present currently are not enough for real time, automatic collaboration because they use tightly coupled CAD/CAM applications or client-server architecture with too many servers (one server each for a specific application).Then the Web Services were written and deployed using widely used public domain software and then they were orchestrated using orchestration engine. The results obtained were encouraging. Finally, the design and manufacturing process was presented as a Web Services for further use.

4.3 Scope for future work

In the study, public UDDI registry was not used since all the Web Services were written and deployed locally. Some publicly available services can be used in any process and moreover it should be searched automatically by the machine. For the automatic search semantic language should be used, e.g. Semantic Web Ontology Language (OWL-S) . The SOAP messages exchanged among the Web Services in this process were of simple types (e.g. string, int, float etc.). Study can be carried out using wSOAP i.e. SOAP with attachments. More technical details can be transferred using wSOAP.

References

[1] Nickerson V. Jeffrey, and Stohr A. Edward, “Intra Enterprise Integration: Methods and Direction”, Competing in the Information Age, Oct 2003.
[2] Johannesson Paul, and Perjons Erik, “Design principles for process modeling in enterprise application integration”, Information Systems, 2001(26) pp.165-184.
[3] Chung Moon Jung, Kim Sangchul, Kim Hyun, and Ham Ho Sang, “A Java-Based, Distributed Process Management System for Collaborative Design and Manufacturing”, FIDJI 2002, LNCS 2604, 2003, pp. 61-72.
[4] Qureshi A. Khurshid and Saitou Kazuhiro, “Design for Facility over the Internet: a case study with automotive connecting rod designs”, Proceedings of DETC’01 ASME 2001 Design Engineering Technical Conference and Computers and Information in Engineering Conference Pittsburgh, PA, September 9-12, 2001.
[5] Leitão Paulo and Restivo Francisco, “A Framework for Distributed Manufacturing Applications”, ICIMS-NoE 2000 Advanced Study Institute, Bordéus, September 2000.
[6] Sequin Carlo, Ahn Sung, and Wright Paul, “Internet-based Design and Manufacturing”, Proceedings of the

1998 Japan-USA Symposium on Flexible Automation, Ohtsu, Japan, July 13-15 1998, (1998).
[7] Muammer Koc and Jun Ni, "Introduction of e-Manufacturing", NAMRC 2003 E- Manufacturing Panel, McMaster University, May 2003.
[8] Wright Paul and Sequin Carlo, "CyberCut: A Networked Manufacturing Service", Transactions of NAMRC/SME, Vol. XXVI, 1998.
[9] Shyamsundar N. and Gadh R., "Collaborative virtual prototyping of product assemblies over the Internet", Computer-Aided Design 34 (2002), pp 755-768.
[10] Jørstad Ivar, Dustdar Schahram, and Thanh Do Van, "A Service Oriented Architecture for collaborative services", 3rd International Workshop on Distributed and Mobile collaboration (DMC), IEEE WETICE, Linköping, Sweden, IEEE Computer Society Press, 2005.
[11] Peltz, C. "Web Services Orchestration and Choreography," IEEE Computer (October), pp 46-52, October 2003.