

Foundation for a consistent benchmark on workflow technologies for the aerospace manufacturing engineering industry

Jaime ROJO ABOLLADO¹ Essam SHEHAB²

^{1,2}*Cranfield University, School of Aerospace, Transport and Manufacturing*

Abstract. Workflow management Systems (WfMSs) support the automation of all or parts of a company business processes. This technology is considered key by many businesses from a strategic point of view, and its market growth does not show any sign of receding. Business process digitisation is a crucial component of the digital transformation and the aerospace manufacturing engineering industry is lacking research efforts on the performance of different workflow management systems. In order to compare different workflow solutions, they need to be categorised based on some criteria. This research provides a classification of the different workflow technologies that exist in the market, with the respective advantages and disadvantages, together with a high level approach for a consistent digitisation of different workflows.

Keywords. Workflow management systems, benchmarking, workflow technologies, digitisation.

1. Introduction

Organisations operating in considerably regulated sectors, such as aerospace or defence, have additional challenges aside the constant competition which requires innovation and continuous cost reduction. This is in addition to fulfilling all the regulatory requirements which adds complexity to the way they have to do business [1]. In order to thrive in this context, companies improve their information systems and applications, and optimise their various business processes.

Traditionally, companies sought process optimisation by improving the way each activity was carried out. However, workflow technology takes a different approach, focusing on the optimisation of the flow of activities. How they are handed from one employee to the next, improving integration of different tools, optimising resource allocation and reducing waiting times. Workflow technology facilitates the realisation of these requirements by providing software, IT tools and techniques to support business process mapping, optimisation and workflow digitisation.

Companies generally make use of a great number of IT tools to support their necessities in terms of information processing. There are numerous personal information tools that are successful such as spreadsheets, word processors, etc., but fewer tools have been designed for the optimisation of collaboration of teams and different organisation sectors [2]. A prominent organisational group tool is the so called

¹ Rojo Abollado, J. [j.rojo-abollado@cranfield.ac.uk]

Workflow Management System (WfMS). These systems are designed to help employees in the performance of a task flow, containing organisational knowledge of how the work is supposed to flow, and the different resources that need to be allocated to each of the tasks.

2. Challenges and motivation

Recently, key players in the aerospace manufacturing industry have identified digital workflows as a great opportunity to manage complexity, and are attempting to follow the lead of different sectors that had previously implemented workflow technology in their businesses, such as banking, finance, healthcare, etc., and have already realised huge benefits out of this implementation [3]. But this sector is finding it difficult to start the implementation because of the lack of a consistent benchmarking that helps them comparing performance of different workflow technology tools and applications.

This industry has products that are complex from a technological point of view and an environment which is greatly regulated, driving complexity to their business processes [4]. In addition, organisations in the aerospace manufacturing sector typically have an intricate organisational structure and external supply chain as well as a wide set of systems and IT tools. These facts influence these companies management systems, which are usually comprehensive to be capable of managing all the requirements [5]. Being able to effectively manage this complexity is a major concern for aerospace companies, and that is the main reason why they are demanding solutions enabling the simplification of their processes, such as WfMSs.

Workflow management systems (WfMSs) are a vital element of cross organisational, business critical processes. For global manufacturing applications, both the availability and performance of WfMSs are key factors and they have to be flexible and configurable in order to meet these companies demands. There has been many research efforts regarding the scalability of these systems architectures, but what literature has neglected so far is the important topic of how to determine the best configuration without having to adopt a trial-error approach or guesswork [6].

There are many opportunities to benefit from the implementation of this technology in aerospace manufacturing applications, but this technology brings several implementation challenges which need to be carefully managed.

For the last decade there has been a prevalent use of workflow technology in labour intensive operations, within an office environment, like general administration, banking and legal. But lately, as demand increases, various workflow software vendors have been trying to expand their capabilities to the manufacturing sector, and intended to build applications that fit aerospace manufacturing industry as well. The availability of large number of workflow products in the market is allowing particular workflow vendors to focus on specific functionalities and customers are buying particular products that meet very specific needs. However, the issue derived from this behaviour is that some companies are creating islands of business process automation that are difficult to integrate. In order to help aerospace manufacturers, section 2 establishes a consistent categorisation of the different workflow systems that these companies could implement, together with a description of their main advantages and drawbacks.

3. Categorisation of workflow systems

It is clear that workflow systems bring several benefits to the aerospace manufacturing industry [7], as they consume large amounts of data and require high levels of collaboration. However, it is important to understand the advantages and limitations of the different workflow solutions. As the demand of workflow systems keeps rising, there is an increasing number of workflow softwares in the market, some of them specializing in a function, but others offer overarching solutions, aiming to cover the whole product lifecycle. As aerospace manufacturers focus on cost reduction, they cannot afford implementing a solution that does not meet their needs. In addition, running demonstrations with workflow vendors adds the risk of having biased information regarding the benefits that each of the workflow systems could bring.

Therefore this research provides a categorisation of those vendor's types, together with the main advantages and disadvantages, in order to help narrowing down the selection of the convenient workflow technology.

In order to understand the difference among workflow technologies, meetings with workflow vendors, live demonstrations of workflow apps and interviews with aerospace manufacturers using workflow technologies were conducted. In order to complete the study, some manufacturing companies operating in different sectors such as automotive and marine have been interviewed.

As a result of this study, a taxonomy of the workflow solutions has been illustrated in Figure 1. There are five main workflow systems classes:

1. Overarching corporate workflow systems,
2. Off the shelf all encompassing workflow system,
3. Modular IT system,
4. Subsystem workflow and
5. Flexible workflow application.

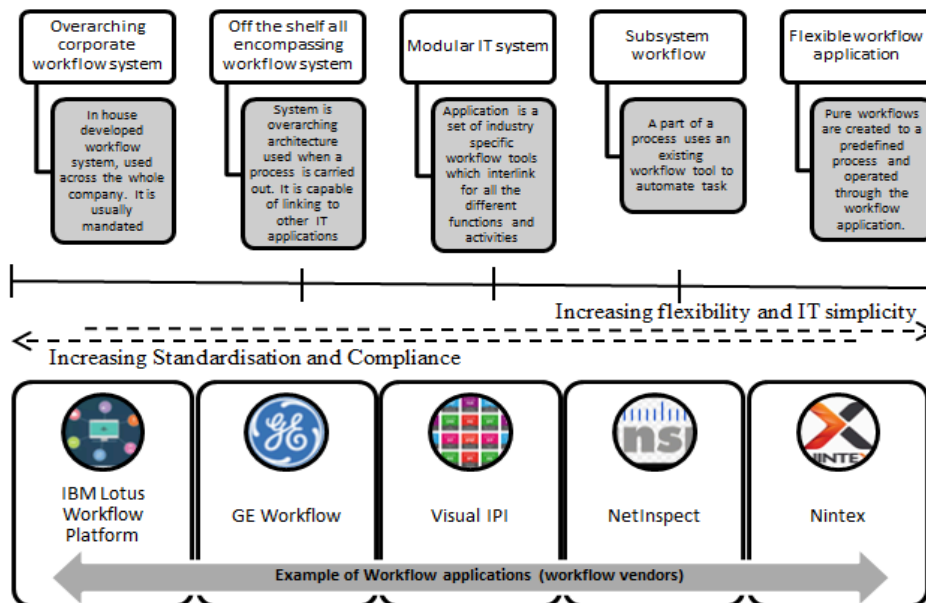


Figure 1: Taxonomy of the available workflow technologies

The criteria for this taxonomy is ease of implementation, configurability and user-friendliness, against in house developed standard workflows that are typically complex but fully compliant to the business. Each workflow technology type has various benefits and disadvantages. The following section highlights the most significant ones.

4. Advantages and disadvantages of each workflow technology type

1. Overarching Corporate Workflow System: The main advantage of an overarching corporate workflow system is that developing it in house ensures that all the automated workflows are compliant to the mandatory rules and follow the organisation's processes. Also, it helps in the standardisation of the business processes, as the system can easily become mandated within the business.

On the other hand, this alternative requires large efforts in terms of mapping all the business processes, identifying all the workflows involved in each process, and developing software for their digitisation. Another concern is the integration of all IT tools, systems and databases used. Not having an appropriate integration would make difficult the realisation of most benefits. Manufacturing organisations have to exhaustively contemplate change control within each workflow. Typical concerns are how to define concurrent parts, come back to past points in the workflow, etc.

2. Off the shelf all encompassing workflow system: These systems offer overarching solutions, trying to cover the whole product lifecycle. They are quicker to implement than the corporate systems, and do not require software development, as the vendor usually tailors it for the company. Additionally, these off the shelf software systems are typically integrated with other organisation systems and tools, such as databases, e-mail, communication apps, etc. giving structure to the business processes [8]. The main concern when choosing an off the shelf technology is the risk of 'not invented here' feeling. Implementing this kind of system requires a lot of change management effort. Moreover, there is a risk of implementing digital workflows that do not fully follow the company processes. IBS QMS and GE Workflow are examples of workflow vendors selling this type of solution.

3. Modular IT System: The workflow system is a suite of workflow applications. The system links smoothly all the modules of the workflow solution, and typically has powerful automation tools, tailored to the specific requirements that the industry demands. But most of these softwares follow their own processes, so there is a risk that those could not be compliant to the company processes or regulatory requirements, and the interfaces with existing company tools are not well defined. Nonetheless these systems are usually compliant to industry standards, so they can be really powerful. An example of a software operating in this space is Visual IPI.

4. Subsystem workflow: The boundaries are well defined. This off the shelf workflow tool optimises one workflow and benefits can be quickly realised. They can be useful when a bottleneck has been identified, requiring a quick solution to deal with it. On the other hand, their configurability is sometimes limited, as for instance some of them does not allow patterns that are required in this industry, like creating conditional

passes or making trade-off decisions. And also, there is a risk of creating islands of automation that are then difficult to integrate.

5.Flexible workflow application: This is usually the quickest solution in terms of implementation, and if applied to the right workflows, has a quick return on investment. It is very user friendly and does not need any software developer. It is undoubtedly useful for simple processes like approvals or documents filling. The major disadvantage is the need of having a well defined process in place, which has been already leaned out. There are a lot of vendors operating in this space, as it is not specific to the manufacturing industry. Some examples are Nintex Workflow, ETQ, Decisions 4.0., ProcessMaker, etc.

The selection of one type of technology or the other will depend on the needs of the organisation and the available budget. But the investment in workflow management tools cannot solve issues related to the underlying process. The automation of a business process just digitises existing practices, so organisations need to be aware that they need to follow an approach that ensures a proper preparation before digitising workflows. The following section describes an implementation approach, which tries to avoid embedding waste into the workflow system.

5. High level approach for a consistent implementation

The aim of this section is to provide a high level approach of how to consistently implement digitised workflows, together with the success factors. It is crucial to be aware of the fact that most workflow vendors, regardless the category, take a business process and digitise it, so having the process map right at the first place is key.

Figure 2 illustrates the approach to ensure effective workflow digitisation process.

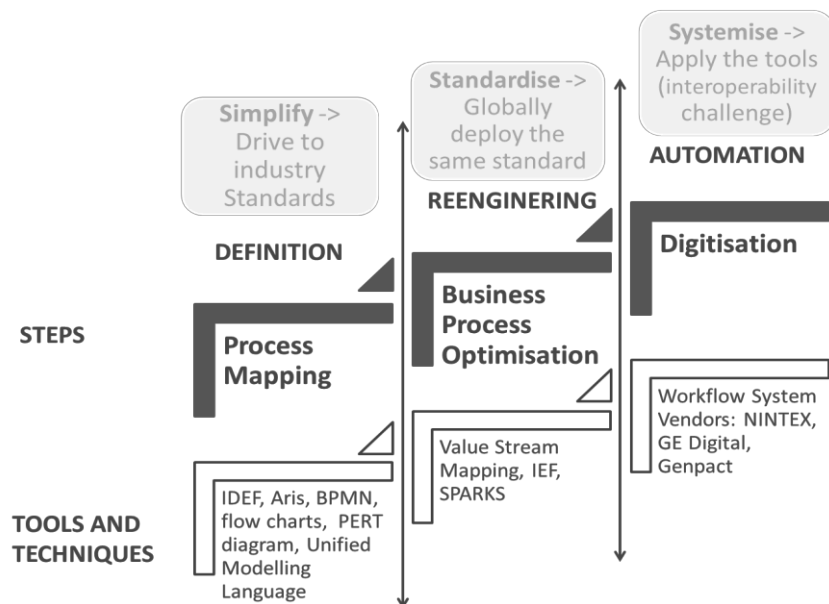


Figure 2: An effective workflow digitisation process

The first step in this approach is the definition of the process. This can be achieved by traditional process mapping techniques such as flow charts. Typically processes in the aerospace manufacturing industry are intricate, due to the complexity of the manufactured product, industry requirements and business scale, making the mapping out of the business process a difficult task.

In this phase, capturing all requirements and having a detailed understanding of the underlying process is crucial. First, organisations have to map all business processes, but this is not necessarily how the work flows, it can go from function to function. Once the business process has been mapped, all the workflows operating in this process needs to be identified. Each business process may involve more than one workflow.

Next step, prior to the automation of the workflow, is the optimisation of it. Removing redundancies or waste at this point becomes an essential step, in order to avoid embedding waste into the system. The outcome of this step is a well defined and streamlined workflow, ready to be automated using a workflow software.

6. Conclusion

Most aerospace manufacturing companies have identified digital workflows as an opportunity for enhancing their competitiveness, and are looking at implementing a workflow solution in their businesses. The number of workflow management systems focused on manufacturing has increased in the last years, and their functionality is very diverse. Therefore, selecting the most suitable workflow system has become a challenge for these organisations.

This research provides a taxonomy of different workflow technologies available for aerospace manufacturing organisations, identifying five main different solutions. An overview of key advantages and disadvantages of each type of solution will help industry in selecting the right workflow system.

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Rojo Abollado, Jaime

2017-09-11

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Rojo Abollado J, Shehab E. (2017) Foundation for a consistent benchmark on workflow technologies for the aerospace manufacturing engineering industry. In: 15th International Conference on Manufacturing Research (ICMR 2017), 5-7 September 2017, Greenwich, London, UK

<https://doi.org/10.3233/978-1-61499-792-4-441>

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