Digital Lean Manufacture (DLM): A New Management Methodology for Production Operations Integration

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Abstract. A methodology for the systematic integration of digital manufacturing is presented through Digital Lean Manufacturing (DLM). DLM offers a new management methodology for production operations integration that achieves vertical and horizontal integration of process, tools and systemic manufacturing effort. Vertical integration was achieved through the hierarchical structuring of effort according to business process, integrated cross-functional manufacturing processes, specific manufacturing activity and knowledge capture. Horizontal integration was achieved through the mapping of processes within functional swimlanes and through the specific activity mapping of the Digital, Lean and Manufacturing functions in particular. Validation elements have also been presented in this initial positioning of DLM as new and novel management methodology for production operations integration.

Keywords. Manufacturing system, digital manufacture, Lean, process modelling, manufacturing integration

1 Introduction

The main aim of the paper is to present a new management methodology for Digital Lean Manufacturing (DLM). The general concept of DLM was first presented by Curran et al. (2007) and the work herein now presents the specific methodology for DLM developed at Queens University Belfast (QUB). QUB are now working primarily with Bombardier Aerospace Belfast (BAB) to validate the methodology as part of the £2.5M DTI-funded PreMade research project, which involves a consortium of 12 partners also including DELMIA, Galorath, Bombardier Transport, Thales, Cardiff University (Lean Engineering Research Centre) and the Welsh Aerospace Forum. However, the paper already includes evidence of early validation particularly for the lower-level elements of DLM,
while also referring to the higher-level validation garnered from expert industry (BAB) opinion on the methodological approach. Consequently, although the DLM methodology is herein presented in a more generic format, the authors are currently working within the PreMade consortium to develop a specific implementation solution that is termed DLM-MAP; which is currently assessed to be at a Technology Readiness Level (TRL) of 6, i.e. moving out of the adaptation phase into the validation phase.

There are many research groups that are currently looking at an integrated approach to design and digital manufacturing technologies [1-3] and in a wider context, Product Life Management (PLM) modeling. It is not surprising that manufacture is now being elevated into the digital and virtual worlds and major aerospace players are now courting such Digital Manufacturing tools. Digital Manufacturing is an emerging software technology that will become a very fundamental and liberating component of Product Lifecycle Management (PLM).

Bob Klem, GM’s Global Director – Information Systems Services has been recently quoted [4] as saying “From an IT perspective, the main components are pretty much in place. Our role is in developing an IT toolkit and PLM Management process. The emphasis, or competitive advantage, is in the process and how we use it.” This quote encapsulates the rationale underwriting this paper: to present Digital Lean Manufacture (DLM) as a validated methodology for the manufacturing element within PLM management, essentially enforcing an integrated process that effectively utilizes an IT toolkit to facilitate competitive advantage. Consequently, the paper will begin with a brief overview of the state-of-the-art in Digital Manufacture and Lean as the context for the presentation of the DLM methodology. Subsequently, the paper will present an exemplar case study of the type of DLM activity associated with Tier 3 of the methodology before addressing the more general validation associated with the integrated approach that is presented in Tier 2.

2 State of the Art

There are many research groups who are currently looking at developing a more integrated approach to digital manufacturing [1-3]. This is also being driven by the fact that all major aerospace producers are now using digital manufacturing tools. According to a Dassault Systèmes press conference [5] “DELMIA – the leading digital manufacturing tool form Dassault System - was selected to join the team developing the new A380, Airbus' 21st century super jumbo aircraft, for the final assembly processes in Airbus' new manufacturing facility in Hamburg, Germany”. As well as Boeing [6], Bombardier and Lockheed Martin, etc other industries are also taking a lead, such as MicroTurbo, Hitachi Zosen and Volkswagen who are using the Dassault Platform as a PLM Solution.