

# Efficient real-time remote data propagation mechanism for a Component-Based approach to distributed manufacturing

V. Barot\*, S. McLeod, R. Harrison, and A. A. West

**Abstract**— Manufacturing Industries face a crucial change as products and processes are required to, easily and efficiently, be reconfigurable and reusable. In order to stay competitive and flexible, situations also demand distribution of enterprises globally, which requires implementation of efficient communication strategies. A prototype system called the "Broadcaster" has been developed with an assumption that the control environment description has been engineered using the Component-based system paradigm. This prototype distributes information to a number of globally distributed partners via an adoption of the circular-based data processing mechanism. The work highlighted in this paper includes the implementation of this mechanism in the domain of the manufacturing industry.

The proposed solution enables real-time remote propagation of machine information to a number of distributed supply chain client resources such as a HMI, VRML-based 3D views and remote client instances regardless of their distribution nature and/or their mechanisms. This approach is presented together with a set of evaluation results. Authors' main concentration surrounds the reliability and the performance metric of the adopted approach. Performance evaluation is carried out in terms of the response times taken to process the data in this domain and compared with an alternative data processing implementation such as the linear queue mechanism. Based on the evaluation results obtained, authors justify the benefits achieved from this proposed implementation and highlight any further research work that is to be carried out.

**Keywords**— Broadcaster, circular buffer, Component-based, distributed manufacturing, remote data propagation.

## I. INTRODUCTION

GLOBALISATION has led the manufacturing industries to face a crucial change from a vendor's to a customer market. Since it is a customer who controls the global market, change in their demands and expectations results into a dramatic fluctuation to the entire production process. In order to stay competitive by satisfying customer demands and expectations, industries must shorten their product life cycles, reduce the time to market their products, add variations to their products, satisfy customer demands quickly and reduce their investment costs. Furthermore, these consequences imply more

complex products, faster changing products and faster introduction of products [1].

Modern manufacturing production systems have to respond quickly to these continuous changes to meet the demands faced in this emerging agile manufacturing environment [2]. This requires systems to easily be reconfigurable to accommodate changes in the production process [3], [4], and geographically distribute manufacturing activities in order to stay competitive and flexible [5]. A good communication strategy has to be adopted to satisfy the requirements identified by this distribution of manufacturing activities. Manufacturing information must be delivered efficiently in soft real-time basis to a number of global supply chain engineering partners regardless of their distribution nature and / or their mechanisms. In order to achieve this, a prototype system has been developed at Loughborough University. This prototype is called "Broadcaster", which has been designed as a data propagation tool. Its aim is to efficiently deliver real-time manufacturing information to a number of remote distributed partners regardless of their geographic locations or implementation mechanisms.

The main aim of this paper is to highlight the implementation of an efficient data propagation mechanism presented for the "Broadcaster" prototype. This is to distribute information from the manufacturing sources to the remote manufacturing destinations, reliably without compromising the performance metric. The description of this approach is presented together with some evaluation results which are obtained from this implementation. The work concentrates particularly on the reliability and performance of this adopted mechanism. This paper is organised as follows. The next section describes the Component-Based automation approach followed by the section three which details the data propagation mechanism together with the algorithm which has been implemented. Section four shows the overall test bed set up used to obtain the evaluation results. Conclusions are drawn in the section five of this paper, and based on the results obtained, benefits and further work is justified.

## II. COMPONENT-BASED FOUNDATION

Component-Based (CB) approach not only meets the manufacturing requirements identified in the section one of this paper, but it also addresses the reconfiguration and reuse problems faced by the manufacturing industry [4]. CB paradigm aims to replace the existing widely used PLC based

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