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Studying continuous improvement from a knowledge perspective

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Abstract

This paper describes a project undertaken at BAE SYSTEMS to study the process of Continuous Improvement (CI) from a knowledge perspective. We used the Knowledge Structure Mapping (KSM) technique to identify ways of managing the underlying knowledge resource in order to share and disseminate best practice and thereby increase the effectiveness of CI on site. A secondary goal was to investigate the potential for applying KSM to other areas of the business. We provide background to the project, a discussion of the approach taken along with initial results and conclusions.

Keywords: Knowledge structure mapping; Continuous improvement

1. Introduction

This paper concerns a project undertaken at BAE SYSTEMS to study the way that Continuous Improvement (CI) is actually implemented by staff in a particular work cell. CI is a strategic activity within a business that faces major competitive pressures to reduce manufacturing costs and timescales, whilst increasing quality and productivity. This study was intended to supplement its knowledge about how CI is currently working and how CI itself could be improved. Traditional process studies tend to focus on what happens and less so on how it happens, the latter being the focus of this novel study.

Knowledge Structure Mapping (KSM) is the main technique that we use within the framework of a Structural Knowledge Audit (SKA) [4,2]. SKA provides a complete methodology within which KSM can be applied with confidence and includes detailed definitions of each of the key stages of an audit, including the important preparatory work that must be undertaken to establish the context for the actual KSM.

1.1. Background for the study

The Samlesbury Factory in Lancashire is at the heart of Eurofighter Typhoon production. Manufacture in this and almost all other areas of aerospace demands constant innovation and improvement. Technological advances mean that advanced aircraft need to come into service much faster than they used to which means that manufacturing methods and assembly lines need to reach near optimum performance much sooner. Even at these levels, improvements must always be sought and general lessons learned must be studied to provide improved methods for future projects.

CI in aerospace manufacture needs to be more than a manufacturing approach, it needs to be a way of life.

BAE SYSTEMS staff at Samlesbury have, for many years, been closely involved in the work carried out by the Applied Knowledge Research Institute (AKRI), the research arm of Blackburn College. This has meant that the company is fully aware of developments made within AKRI and in many cases has contributed to those developments.

This combination of business need and knowledge research involvement meant that BAE SYSTEMS was

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able to consider novel approaches to existing problems that had not been tested before.

1.2. Why apply knowledge structure mapping to continuous improvement?

Making a link between KSM and CI may not appear obvious at first sight. However, BAE SYSTEMS were involved in some initial trials of the early work on KSM in 1998 and through its internal improvement processes it is constantly looking for ways to improve. The early trials of KSM in the factory were very successful, leading to significant cost savings in one manufacturing area. BAE SYSTEMS were aware of the developments to KSM that had been achieved since then and therefore, the company was in a good position to consider the application of KSM to CI from a well-informed perspective [5].

Part of Eurofighter Typhoon Manufacture is the Advanced Manufacturing Technology (AMT) cell. This cell carries out complex, high technology and high precision automated machining operations on aircraft frames. The cell has a well-motivated staff who are used to adapting to change, solving problems and improving performance to match more and more demanding schedules. The staff from this cell have worked with a CI mentality for some time and have developed their own techniques that are additional to those used within the rest of the factory.

The factory at Samlesbury had also recently appointed a new manager in charge of the development of CI across the site. This meant that CI would be studied with fresh eyes and improvements to CI would be sought. The four key areas that met to make this project both possible and desirable were in summary:

1. A serious demand for CI and a need to disseminate Best Practice.
2. A participatory knowledge of KSM.
3. An active and well motivated cell with CI experience.
4. A new site wide initiative in CI.

An additional factor was that the company could use the project also as an opportunity to evaluate the effectiveness of applying KSM to specific business issues. This was an important additional factor because although KSM had been used successfully several years earlier, this was intended to address a specific business need and no attempt was made at the time to evaluate the approach in a more general business context.

2. The knowledge structure mapping

A Knowledge Structure Map (KSM) is intended to provide several things that support the management and development of a knowledge resource. A KSM also represents an excellent way of studying a concept from a knowledge perspective. Detailed descriptions of KSM, its intended uses and how it supports management have been dealt with in more detail elsewhere [3]. The aim here is to show how a KSM is an appropriate way to study the area of CI.

2.1. Outputs from a KSM investigation

One of the main claims about a KSM is that it provides people with a way of visualising and taking informed decisions about an invisible asset, a knowledge resource. Within this context, a knowledge resource is considered to be only that knowledge that is contained in the heads of people and not information in books, documents or computer and network systems. A KSM project provides:

1. A map of boxes and connecting links. Each box represents a specific piece of knowledge and each link shows learning dependency.
2. Data about each knowledge node that represents the informed opinion of experts relating to several pre-defined parameters.
3. Analysis of data and map structure using a software tool that provides answers to questions that can be posed based using it range of analytical features.

Fig. 1 is a screen shot from the tool ‘SKAT’ that is used to build, analyse and view KSMs. SKAT is a software tool developed by the AKRI to meet the specific requirements of Knowledge Structure Mapping and analysis. It has a number of features in common with other knowledge acquisition tools, as well as several not available elsewhere. For example, it has a range of sophisticated map layout algorithms that produce a highly readable and logical layout with minimal manual intervention. Overall, it greatly facilitates the mapping and data collection process and saves considerable time in analysing the results. The main part of Fig. 1 shows the complete KSM for CI from the project. The map is scaled down to fit on the screen and therefore, shows no other data such as node names. Text boxes below the map show the name of the node selected on the map (shaded grey) and a brief description of the knowledge represented there. Four sliders provide values for each of four parameters for the selected node. These values were assigned at the interview stage and validated with an overall domain expert who is called a ‘knowledge leader’ during the project.

Analysis is available through the menu system and either provides data through map colour and shading or through separate graphs, tables and report windows. The map, both electronic version and large A0 plot, the raw data, the analytical outputs and more general observations and recommendations are combined in a final project report. Observations and recommendations concentrate on a knowledge perspective of the study and should not offer advice that is outside the scope of the study. People in