Chapter 15

Achieving Best Practice Manufacturing Involving Tacit Knowledge through the Cautious Use of Mixed-Mode Modelling

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ABSTRACT

In the real world, 'optimal' solutions for many production process problems do not exist. In such circumstances, 'best practice' is the realistic outcome for which practitioners aim. The reasons for this stem from many causes, including that data associated with production processes are often corrupted and/ or missing. These types of processes usually rely heavily on the subjective input of the process workers on the shop floor (tacit knowledge). This paper outlines how the use of mixed-mode modelling has been utilised to help solve these types of problems. The industry examples used in the paper incorporate the concept of Communities of Practice (CoPs) in the mixed-mode models that are developed as a means of capturing tacit knowledge and incorporating it into the solution process. Additionally, CoPs need to sit comfortably within the culture and values of the organisation and employee groups, and must be clearly owned and facilitated by the community of workers whose knowledge is to be shared. Finally, CoPs should be presented as opportunities to share, compare, and learn so that a 'craft' is not lost or diminished.

1. INTRODUCTION TO THE TACIT KNOWLEDGE PROBLEM

In some industries, the manufacturing process itself is not able to be fully represented using a 'hard' model which contains known parameters together with a definitive mathematical model representing its operation. Some production processes that *appear* well defined and quantifiable are in *reality* at best 'guestimates', subject to complex sub-processes that determine their values. Often, these sub-processes are not fully understood despite the fact that they form a part of the 'known' production process. Under these circumstances, only models that approximate the process can be developed with the factory floor workers or production operators holding in a tacit form, a further understanding of the process that has not be made explicit. Often this is experience or simply intuition. Examples of production involving tacit knowledge (hereinafter referred to as '*the tacit knowledge problem*') are found in the aluminium smelting industry (see Nicholls & Cargill, 2008), float glass production and the refrigeration industry. The consequences of this tacit knowledge problem include greater product development costs and often considerable increases in product manufacture time for a job (make-span). This is particularly true in the refrigeration industry where product development (and in the case of the most extreme version of a customised product - the 'one-off') make-span times can be up to a year in some extreme cases.

Polyani (1966) is considered the authoritative source on tacit knowledge. Tacit knowledge is considered very important since it is regarded by many (Nonaka & Takeuchi, 1995; Collins, 2001) as "fundamental to all human knowing and knowledge (Gourlay, 2006, p. 60). Tacit knowledge is popularly treated as personal or private knowledge and acquired through an individual's experience. There is also considerable discussion surrounding whether tacit knowledge can be actually converted into explicit knowledge. Some have suggested

that this is difficult to achieve (see Patel et al., 1999; Collins, 2001) while others, (Boiral, 2002; Gourlay, 2006) have adequately demonstrated that indeed tacit knowledge can be made explicit. However, the inability to articulate tacit knowledge in some situations is a real one and must be borne in mind (see Marchant & Robinson, 1999; Wagner et al., 1999; Zappavigna, 2006). An additional category of tacit knowledge exists, that of 'intrinsic knowledge'.

The capture, storage and interrogation of the tacit knowledge is the key to arriving at best practice under these circumstances (normally an iterative process) and this paper suggests how "Communities of Practice" (a people based 'soft' model) may be used to achieve the capture. The known aspects of the production processes can be represented by the usual 'hard' models (such as linear programming etc) which will depend on the soft models (say the Communities of Practice) to supply needed information. With this arrangement of hard and soft models, a soft heuristic solution algorithm (which integrates these) is required to arrive at a solution i.e., 'best practice'. This is the role of mixed-mode modelling, both as an approach to actually modelling the problem and also affecting its solution.

Section 2 explains the concept of mixed-mode modelling (essentially through a simple example) while Section 3 outlines its application to two industrial examples while also raising some of the difficulties associated with its use coupled with Communities of Practice. Section 4 discusses the difficulties in detail and suggests some ways of overcoming them.

2. MIXED-MODE MODELLING AND ITS USE

The term mixed-mode modelling covers a broad number of approaches encompassing "soft OR" and in this paper is used to describe the process of the bringing together of 'soft' and 'hard' sub-

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