PRACTICAL BUFFER SIZING TECHNIQUES UNDER DRUM-BUFFER-ROPE:
DEVELOPMENT OF A MODEL AND FUZZY LOGIC IMPLEMENTATION

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In Memory of Louis Borman

(1913 - 1994)

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Abstract

A production buffer is a queue of work waiting in front of a manufacturing work-station for processing. The buffer protects the work-station utilisation from variability in the flow of work from feeding work-stations. Effective buffer management is critical to the smooth flow of work and the maintenance of a predictable output rate.

An effective buffer management policy must address three questions that characterise the buffer management problem (BMP):

1. What objective function to use?
2. Where to locate buffers?
3. What is the appropriate buffer sizes?

Despite being simple to describe, to date few practical heuristics for buffer management have been developed by researchers. The approach of researchers is to place a buffer of work in front of every work-station, whatever the objective function is being used. The answer to the third issue is then typically found by applying a combinational optimisation technique. The practical benefits of locating buffers throughout a manufacturing facility and the use of complex combinatorial optimisation methods to solve over-stylised problems are questionable. As a consequence of this "academic" approach, research results are rarely used by practitioners who still rely on intuition to solve the BMP.

The production application of the Theory of Constraints, Drum-Buffer-Rope (DBR), provides exact answers to the first and second questions. Throughput (or output rate) is adopted as the objective function. Buffers locations are limited in front of the constraint work-station, in assembly areas using constraint processed parts and in the shipping area.

Buffer size is a open issue in a DBR implementation and directly influences the time-based competitiveness of a manufacturing facility. Too small a buffer can result in the constraint

work-station being starved and due date promises missed; too large a buffer can result in a longer than necessary lead times.

Buffer sizing advice is vague and non-specific and relies heavily on managerial understanding and experience. This can reduce the effectiveness of DBR implementations and greatly increases the implementation lead time as intuition rarely guarantees the best possible outcome for a given set of circumstances.

In today's competitive and increasing globalised economy, a structured approach that sizes buffers in an effective and implementable manner is likely to yield significant benefits over a traditional DBR implementation. This thesis explores the subject of practical buffer sizing in a DBR environment.

A fuzzy logic approach is proposed and used to size buffers in a simulated DBR environment. The effectiveness of the technique is assessed and contrasted with a simple and commonly used buffer sizing heuristic.

Simulation results demonstrate that fuzzy logic effectively sizes buffers and is likely to provide a satisfactory answer to the third question of the BMP: what is the appropriate buffer size.

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