# Chapter 38
# Comparison of Connected vs. Disconnected Cellular Systems:
## A Case Study

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## ABSTRACT

*In this chapter, two cellular manufacturing systems, namely connected cells and disconnected cells, have been studied, and their performance was compared with respect to average flowtime and work-in-process inventory under make-to-order demand strategy. The study was performed in a medical device manufacturing company considering their a) existing system b) variations from the existing system by considering different process routings. Simulation models for each of the systems and each of the options were developed in ARENA 7.0 simulation software. The data used to model each of these systems were obtained from the company based on a period of nineteen months. Considering the existing system, no dominance was established between connected cells vs. disconnected cells as mixed results were obtained for different families. On the other hand, when different process routings were used, connected system outperformed the disconnected system. It is suspected that one additional operation required in the disconnected system as well batching requirement at the end of packaging led to poor performance for the disconnected cells. Finally, increased routing flexibility improved the performance of the connected cells, whereas it had adverse effects in the disconnected cells configuration.*

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## INTRODUCTION

Cellular Manufacturing is a well known application of Group Technology (GT). Cellular Design typically involves determining appropriate part families and corresponding manufacturing cells. This can be done either by grouping parts into families and then forming machine cells based on the part families or machine cells are determined first and based on these machine cells the part families may be formed or lastly both these formations can take place simultaneously. In a cellular manufacturing system, there may be a manufacturing cell for each part family or some of the manufacturing cells can process more than one part family based on the flexibility of the cells. The factors affecting the formation of cells can differ under various circumstances, some of them are volume of work to be performed by the machine cell, variations in routing sequences of the part families, processing times, etc.

A manufacturing system in which the goods or products are manufactured only after customer orders are received is called a make-to-order system. This type of system helps reduce inventory levels since no finished goods inventory is kept on hand.

In this chapter, two types of cellular layouts are analyzed, namely connected cells (single-stage cellular system) and disconnected cells (multi-stage cellular system) and their performance is compared under various circumstances for a make-to-order company. This problem has been observed in a medical device manufacturing company. The management was interested in such a comparison to finalize the cellular design. It was also important to research the impact of flexibility within each system for different combinations of family routings. A similar situation of connected vs. disconnected cellular design was also observed in a shoe manufacturing company, and in a jewelry manufacturing company. Authors believe that this problem has not been addressed in the literature before even though it has been observed in more than one company and therefore worthy to study.

## BACKGROUND

The connected cells represent a continuous flow where the products enter the cells in the manufacturing area, complete the machining operations and exit through the corresponding assembly and packaging area after completion of the assembly and packaging operations. In other words, the output of a cell in the manufacturing area becomes the input to the corresponding cell in the assembly and packaging area. The biggest advantage of connected cells is that material flow is smoother and hence flowtime is expected to be shorter. This is also expected to result in lower WIP inventory. This paper focuses on a cellular manufacturing system similar to the system shown in Figure 1. There are three cells in the manufacturing area and three cells in the assembly and packaging area. In these cells, M1 through M3 represent the machines in the manufacturing area, A1, A2 and P1 through P3 represent the machines in the assembly and packaging area. The products essentially follow a unidirectional flow. The three cells in manufacturing area are similar since they have similar machines and all the products can be manufactured in any of the cells. However, the situation gets complicated in the assembly and packaging area. The three cells have restrictions in terms of the products that they can process. Therefore, deciding which manufacturing cell a product should be assigned is dictated by the packaging cell(s) it can be processed later on. This constraint makes the manufacturing system less flexible.

In the disconnected cell layout, the products enter the manufacturing area, complete the machining operations and exit this area. On exiting the manufacturing area, the products can go to more than one of the assembly and packaging cells. In other words, the output from the cells in

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