



## Assessing the impact of alternative manufacturing layouts in a service setting

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Available online 15 June 2004

### Abstract

This paper summarizes the results of a project designed to study and ultimately improve the overall operation of a service process, as found in one regional blood center. Driving this project was recognition that the current process, initially designed to accommodate a single customer group, was ill equipped to handle a changing customer mix now consisting of three disparate groups. The resulting mismatch between the process and users created long delays and an increase in the overall level of dissatisfaction with the existing process. To improve overall performance, this study turned to process analysis and computer simulation to stimulate a critical analysis of the process. As part of this approach, the study investigated three layouts: the existing worker paced assembly line, a modified assembly line, and service cells. The study examined the relationship between layout, customer mix and system performance. Key among the results was that a service cell approach led to higher performance and better customer satisfaction.

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*Keywords:* Service operations; Production/operations management; Public/nonprofit management; Simulation and statistics

### 1. Introduction

For most people, The American Red Cross (ARC) is best known for blood collection. The ARC, through its various chapters located in the United States, acts as an intermediary between the suppliers of blood (donors) and the users of the blood and its related products (e.g. plasma, packed blood cells, serum, factor 8 (for hemophiliacs), and platelets). The ARC is responsi-

ble for collecting, storing, processing and distributing blood and its related products.

The blood donation process is coming under pressure. One source of this pressure involves the multitude of customers served by this process. These customers include the donors, hospitals, doctors, ARC administrators and the nurses and their support staff. Customers bring their own specific set of requirements that at times come into conflict. A second source of pressure is the critical need to maintain a safe and assured source of blood products in an age of concern about such blood-borne illnesses as HIV/AIDS and hepatitis. In response, the ARC must do increased testing and paperwork that in turn increases the time needed to collect blood. Third, the nature of the donor/customer

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base is changing. In the past, the ARC collected blood from one type of donor, the regular donor who gives to the general pool. Now this same blood donation process must deal with two new categories of donors: (1) autologous, who give blood for their own use; and (2) directed, who give blood for a specific person. Each category must be handled differently in terms of paperwork and processing requirements.

Finally, the ARC must deal with the challenge of keeping the regular donor, who is the primary base of support and blood supply, satisfied while simultaneously meeting the demands placed on the blood donation process by the preceding factors. The blood donation process is dependent on volunteers. Since it does not pay for its blood, the ARC can only assure the future availability of its blood supplies by keeping these volunteer donors content. Central to this task is the need to ensure the amount of time spent giving blood is kept both short and predictable.

The ARC now faces an environment familiar to most managers. Processes initially designed to efficiently meet the needs of one specific type of customer/user are now stressed by the need to provide service to many different customers/users. Additionally, the ARC faces increased competition. Therefore, the ARC must restructure their service processes so that they can serve the varying needs of the different customer groups without raising the system's costs.

As a result, administrators at both the regional and national levels of the ARC are reexamining the blood donation process with the goal of improving its overall effectiveness and efficiency. This paper describes and summarizes the results of a project carried out to help the administrators of the Great Lakes Region of the ARC in this task. This project focused its attention on the relationship between the layout of the process, customer mix, and overall performance.

In selecting layout as a critical dimension of analysis, the researchers were drawing on the insights and results gained from studies carried out in the manufacturing arena that have concentrated on plant layout. As has been shown in numerous studies (e.g. Flynn and Jacobs, 1987; Kinney and McGinnis, 1987; Shafer and Charnes, 1993; Shafer and Meredith, 1993), the change in plant layout and workflows can have a significant impact on system performance. This aware-

ness of the importance of layout has also been recognized within many areas of the service sector (e.g. Usher et al., 1990).

The project evaluated three different layouts for the blood donation process: (1) the current worker-paced assembly line system in place; (2) a modified assembly system; and (3) a service cell approach. These three layouts were assessed using computer simulation. The data for this series of simulations was collected from the Lansing Blood Center in Lansing, Michigan.

## 2. The current blood donation process and the changing environment

The current process was designed to serve regular donors, who give blood to the general pool. Regular donors are the backbone of the ARC's blood bank system. As customers of the system, the regular donors give both their blood and time. Their return rate is affected by their perceived treatment during the donation process. That is, they return as long as they are happy with how they are treated and as long as the processing time is predictable and not thought to be "excessively" long.

When serving primarily regular donors, the current process was fast, dependable and generally balanced. However, this balance and predictability has been affected by the emergence of two new types of system users: the directed donor and the autologous donor.

### 2.1. The directed donor

The directed donor gives blood for a specific person or group of people (usually a family member). These donors are generally healthy and do not need help getting around the center. Additionally their blood does not have to be destroyed if it is not used for the intended person. But directed donors do add time to the system. First, they have special paperwork. Second, while they are requested to arrange appointments in advance, directed donors often arrive (1) without an appointment, and (2) in large groups for moral support that often request to be processed together, thus creating a large, noisy slow moving contingent in the midst of the process.

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