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Improving Regional Food Hub Operational Efficiency with Lean Practices

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Keywords

Sustainability, inventory management, local food systems, standardized work methods, process improvement, quality control

Disciplines

Operations Research, Systems Engineering and Industrial Engineering

Comments

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Improving Regional Food Hub Operational Efficiency with Lean Practices

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Abstract

Food hubs aggregate and distribute regionally-produced food and help small and mid-sized farmers find markets for their products. They provide a valuable service as an intermediary between consumers and farmers who value sustainable food systems. However, their internal operations are often highly inefficient, and as a result they struggle to meet their customers' expectations. To maintain low operational costs, food hubs often depend upon volunteer labor. However, an inconsistent and improperly trained volunteer labor force can lead to inventory and order fulfillment errors. Additionally, because many food hubs are unable to afford sophisticated inventory management software, they employ ad-hoc methods to track inventory and sales. This results in inadequate data collection to support decision making. In this paper we identify the operational challenges that regional food hubs commonly face, and we evaluate methods based on lean principles for overcoming these challenges, including standardized work procedures, process improvement mechanisms, and efficient data capturing techniques.

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1. Introduction

A regional food hub acts as an aggregator and distributor to assist in moving food from small and mid-sized farms to consumers within the same region. The USDA defines a food hub as "a business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail, and institutional demand" [1]. Food hubs in the United States fall into three broad categories according to their targeted market channels: direct-to-consumer, wholesale, and a hybrid combination of direct-to-consumer and wholesale. They aim to provide high levels of food quality, variety, and traceability to their customers. A distinguishing characteristic of food hubs is their aim to promote social, environmental, and economic sustainability in their communities.

There are four key aspects in which food hub operations differ from conventional food distributors: pricing, market access, development service, and food traceability [2]. Compared with conventional food supply chains, participants in regional food supply chains experience more transparent pricing, and producers receive a larger percentage of profits. Regional food hubs provide increased market access to small and mid-sized producers and increased opportunities to sell to institutional customers like restaurants, schools, and wholesale markets. Food hubs also often offer their producers business development services, such as training and assistance with crop planning, business and farm management, quality control techniques, and insurance [2,3]. They maintain increased transparency in the supply chain by providing customers with detailed information about products, including farming practices and farm stories.

In some ways, however, food hub operations are similar to those in conventional food supply chains. A food hub is responsible for delivering the right product, to the right location, and in the right quantity and quality. As an aggregator and distributor, a food hub must be efficient at handling highly perishable goods. It must manage the procurement of products from multiple farmers and ensure on-time arrivals to their distribution facilities. Because of these similarities, many innovations in conventional food supply chains, especially those related to quality assurance, distribution efficiency, food traceability, market information management, and product development, have been recommended for

adoption by regional food supply chains to support their long-term growth and sustainability [4]. However, because of financial constraints and a social mission driving their business structure, they are often unable to employ conventional and efficient supply chain practices in their operations.

A study conducted in 2013 on the structure and operations of food hubs in the United States found that out of 106 food hubs, nearly one-third began their operations in the last two years, with an average age of around eleven years and a median business efficiency ratio (i.e., the ratio of revenues to expenditures) close to one [5]. This suggests that their operations are quite new, and there is a need for a better understanding of their practices to increase their overall operational efficiency. Improving the efficiency and effectiveness of a food hub's internal operations is a critical area of focus for the managers of these facilities. These types of improvements typically involve the physical layout and infrastructure of the facility, the information flow and tracking associated with material movement, and the scheduling and training of the people who perform operations within the facility. The design and management of these three interdependent systems determine both the effectiveness of a distribution center (i.e., how well it meets the requirements of its customers) as well as its efficiency (i.e., how cost-effectively it performs its tasks). Without operations management plans and best practices in place, food hubs are likely to suffer from excessive operational costs (particularly labor and inventory storage costs), as well as dissatisfied customers and employees. To address these concerns, job and workflow analysis should be performed to assess food hubs' operations and assess whether the redesign of existing facilities, systems, and processes would help to minimize slack time, improve efficiency, and make the food hubs more resilient to supply and financial pressures. In this paper, we describe the existing work processes and internal operations of a food hub in Iowa, identify the problems in its current operating structure, and suggest ways in which these problems can be addressed with the help of lean supply chain principles.

2. Case Study

The food hub considered in this study is located in an urban area of central Iowa and sells regionally-produced food directly to consumers via an online grocery store. The food hub typically has two order fulfillment cycles per month. The cycle begins with food producers listing the products that they have available to sell on the food hub website. This is followed by a six-day shopping period for the customers, during which they may add products to their online shopping carts. After the shopping carts close, producers prepare and deliver the customers' orders to the food hub's distribution facility, where they are stored. After all products are received at the distribution facility, food hub personnel sort and pack customer orders and distribute them to seven different customer pickup locations throughout central Iowa. The timeline for these activities is shown in Figure 1.

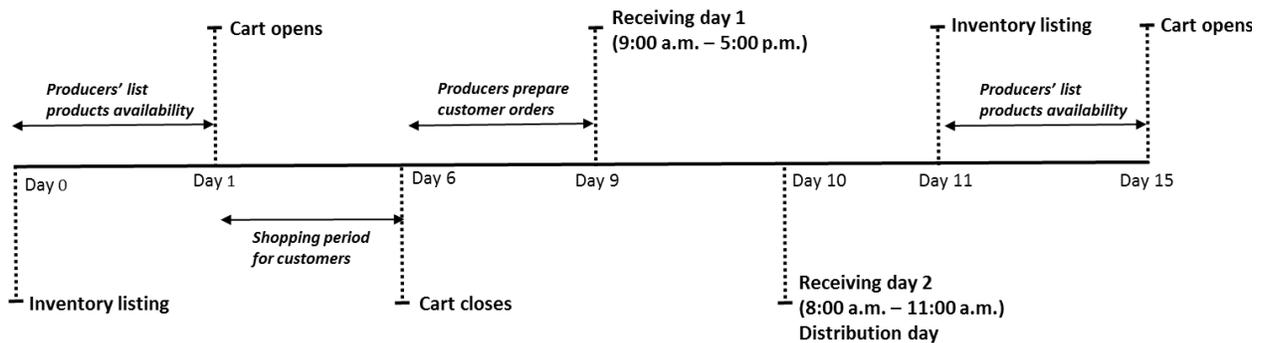


Figure 1: Timeline of the four stages in an order cycle at the food hub

One of the biggest problems that the food hub currently faces is customer retention. Figure 2 shows an increasing gap between the number of customers who are members of the food hub and those who actually make purchases. On average, only 22% make purchases in each order cycle. Although new members continue to join the food hub, many older members appear to have stopped buying. One of the major reasons for this increasing gap is the prevalence of quality and order issues that customers experience. The food hub's database shows that on average, 6% of all customer orders were affected by poor product quality or errors in their orders. The error percentage in some order cycles was as high as 13%. This leads to a decrease in customer satisfaction and willingness to participate in the system. A lack of standardization in the food hub's work processes is a major contributing factor to these problems, particularly with respect to producer delivery scheduling, inventory management, employee training, and performance assessment.

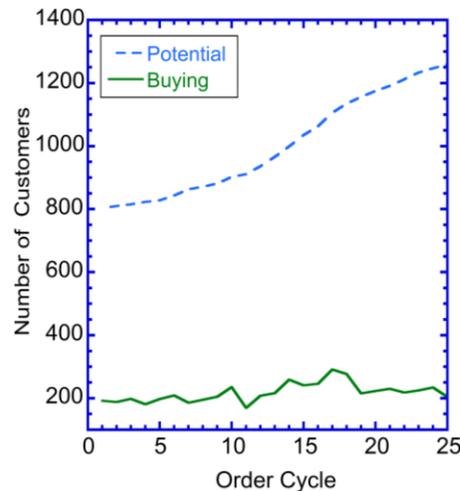


Figure 2: Comparison of number of potential customers and actual buyers in 26 order cycles

2.1 Producer Delivery Scheduling

A major issue that the food hub faces is insufficient producer delivery scheduling. The food hub has an online system that allows its producers to schedule the date and time of their deliveries in advance; however, only 25% of the producers participate, and only a few of those producers actually show up in their chosen time slot. The food hub manager is unwilling to enforce a delivery schedule, because he wants to allow the producers flexibility [6]. However, these unscheduled deliveries often result in a bottleneck in the warehouse receiving process, which in turn causes the food hub employees to rush through the process in an effort to reduce producer queue time. This leaves insufficient time for adequate quality checks and correct inventory storage. Many producers arrive at the very end of the receiving process, which causes receiving activities to overlap with the picking and packing process. This also causes employees to rush through the process to meet the delivery deadline, which increases the likelihood of poor-quality products or wrong orders reaching the customer. Unscheduled producer deliveries also make it difficult for the food hub manager to appropriately schedule workers for the receiving process. Workers remain idle for long stretches of time when no product is being delivered to the hub, but during busy times there are not enough workers. This can lead to a variety of negative outcomes, including ineffective man-hour utilization, worker frustration, and frequent turnover [7].

2.2 Inventory Management

The food hub currently uses an ad-hoc and complicated system to manage its inventory, which can consist of as many as 3000 different products. These products are categorized according to how and where they are stored, which varies considerably (see Table 1). For example, shelf-stable goods (e.g., salsa, flour, potatoes) are stored according to customer pickup location and are further sorted by each customer's identification number. Similarly, frozen goods are stored in designated freezers as per the customer pickup location; the items are then sorted by producer name and customer identification number. In contrast, the process of storing refrigerated products is extremely ad hoc and varies from one order cycle to the next. These products are not stored according to customer identification number; instead, they are stored either by customer pickup location or by producer name, depending on the product type. For example, eggs are always stored together in the same refrigerated location but are sorted by producer. In contrast, other items (e.g., carrots, berries) are stored in refrigerators that are designated for specific pickup locations. To further complicate things, these procedures may change from one order cycle to the next. While this gives the food hub the flexibility to efficiently use the space, the lack of consistency often leads to errors in the picking and packing process. To comply with the various storage policies, the food hub has adopted different labeling formats for different product categories, creating another potential source of error, particularly for producers who are selling products in multiple categories. The operation of this inventory management system relies entirely on a system of complex paperwork and worker memory.

Table 1: Four different types of product categories at the food hub

#	Product Type	Description	Variables Used for Storage		
			Customer Identification #	Customer Pickup Location	Producer Name
1	NON	Shelf-stable goods	X	X	
2	FROZ	Frozen goods	X	X	X
3	REF	Refrigerated goods		X	X
4	Plants	Plants	X		X
5	Inventory goods	Shelf-stable, refrigerated or frozen goods kept as an inventory			X

The food hub's storage equipment is also not standardized. Most of the equipment has either been donated to the food hub or purchased on an ad-hoc basis. Because of financial constraints, the food hub cannot afford standard industrial refrigerators or freezers. Instead, they rely heavily on traditional domestic or household refrigerators, which are set up poorly in terms of ergonomics, causing workers to have to repeatedly bend and stoop to add and remove items. In addition, the shelves do not allow much flexibility in terms of configuration for storing products of multiple dimensions. According to the current facility layout, the food hub is using only about 75% of their overall available space.

2.3 Employee Training and Scheduling

Reliance on volunteer labor and finding seasonal or part-time staff are major operational challenges for food hubs [5]. While volunteer labor helps save on operational costs, there are drawbacks related to efficiency and consistency [3]. The Iowa food hub is entirely dependent on volunteer workers, whose availability may be inconsistent. This results in a lack of formal scheduling and labor efficiencies, especially during peak hours. Unless they have previously volunteered many times, these volunteer workers have little to no experience in correctly identifying quality issues, nor do they know how to go about efficient product placement and packing. These challenges are compounded by a lack of formal training and limited availability of experienced volunteers.

2.4 Performance Assessment and Quality Assurance

Because the food hub has no formal inventory management system in place, it is unable to capture sufficient information to track and evaluate its own performance and the performance of its suppliers. For example, if there are quality problems or items missing from a producer delivery, the issue is marked on the producer's invoice, but typically this information is lost after the order cycle is completed. There is also no systematic method for capturing customer complaints, and as a result, the food hub is often unable to identify where in their processes a mistake occurred. Thus the food hub is unable to provide accurate feedback to its stakeholders, which would be very valuable in motivating producers and volunteers to improve their performance for future orders.

The food hub's problems related to lack of standard work procedures, dependency on volunteer labor, and poor inventory tracking and data management systems are interdependent, as shown in Figure 3. The primary reason for the lack of standardization in the food hub's operations is the fact that they were designed and developed by individuals with limited or no background in lean methods. They lacked the resources and knowledge to implement best practices. Hence there is an opportunity for the food hub to strategically address these issues to serve its customers more effectively and efficiently.

3. Recommended Approach

Based on the current operating structure of the food hub, we have identified four lean initiatives that the management can adopt to make the internal operations at their distribution facility more effective and efficient: standardization and documentation, people management, material flow, and quality control. These lean principles were identified by the authors after observing the work processes at the food hub warehouse over multiple order cycles, gathering data from their operations, and analyzing the technical, economic, and operational feasibility of implementation.

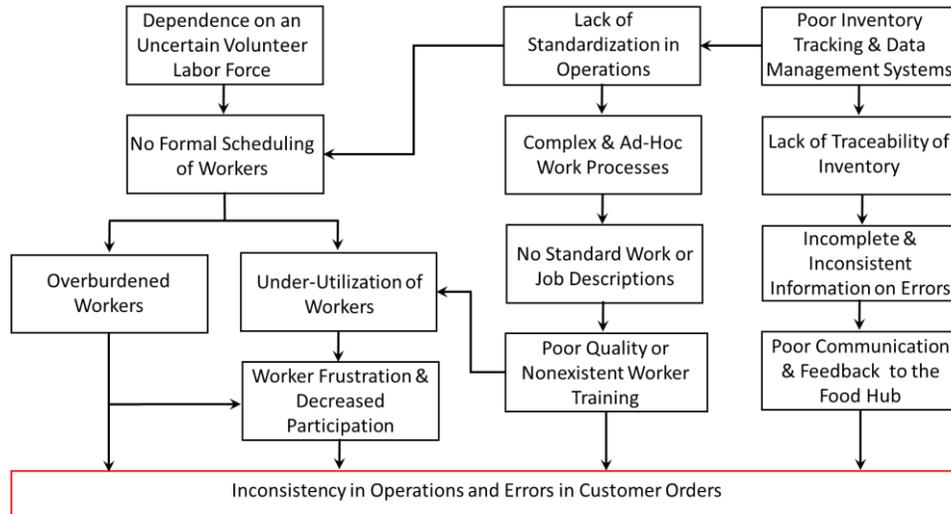


Figure 3: Interdependency of problems in the internal operations at the food hub

3.1 Standardization and Documentation

By adopting standardized work processes, the food hub can avoid confusion among workers regarding the exact tasks required and the optimum completion time for each job. It will also help them identify and eliminate non-value-added activities, which will allow worker time and effort to be spent on more important tasks (e.g., quality inspections). In addition, standard work procedures are the backbone for new worker training. It will help the food hub manager in developing training material, standard operational procedures, and standard job descriptions to provide clear, effective, and standardized training. The food hub should also eliminate its complex labeling and storage policy. Instead, a common storage and picking policy across all product types should be adopted, which will help to prevent errors in customer orders. Standardized work procedures will reduce the number of steps and time taken to complete various tasks through elimination of non-value added activities.

3.2 People Management

The food hub would greatly benefit from conducting time studies to estimate the hours required to complete different tasks and start tracking the volunteer hours for each of the assigned tasks. This will help the food hub to assign tasks to the volunteers more efficiently based on the volunteers' strengths, availability, and experience. It will also help to optimally allocate volunteer hours based on expected work volumes. Other than contact information, the food hub currently does not keep any records of their volunteer workforce. Tracking volunteer hours will help the food hub manager plan for future labor requirements. The effectiveness this lean practice would be measured by comparing the overall volunteer retention and man-hour utilization rate before and after its implementation.

3.3 Material Flow

As the food hub's business grows and it handles more material, it will be unable to sustain its operations with the current paper-based receiving and picking process. Implementing barcode or RFID scanning will make these processes faster and more efficient by reducing non-value-added time. Also, scanning will simplify the training process for new volunteers, as the task complexity will be reduced. Material flow analysis should be performed to assess the current flow of materials and then reconfigure receiving stations and storage locations so as to reduce the total number of steps taken by the workers to complete the tasks. The food hub can also improve its space utilization by working with producers to reduce the amount of packing material that they use. This will increase the food hub's ability to store more products as their customer base increases, without requiring additional equipment and storage space.

3.4 Quality Control

The food hub currently relies on subjective evaluations of product quality. To simplify and standardize the quality inspection process, a quality control guide should be developed that establishes clear quality standards, which should be communicated to workers during training. The food hub should adopt an efficient inventory tracking and data management system that will enable the capture of data on errors that are caught and corrected at the warehouse, as well as errors that reach the end customers. This data can be summarized in the form of a balanced scorecard, which

can be used to provide producers feedback on their performance and to help the food hub manager manage his supply base. Implementing quality control procedures will help food hub to reduce the number of quality issues that customers experience, thereby increasing customer retention.

4. Challenges

The proposed solutions have the potential to greatly improve the food hub's operational efficiency and effectiveness, thereby increasing customer retention. However, there are many challenges associated with implementation. In particular, the cost associated with adopting an inventory tracking and data management system can be prohibitive. Installation of these systems will not only be expensive initially, but will also require continuous maintenance, which can be an extra financial burden on the food hubs. However, multiple food hubs in the region may be able to work together to overcome this financial problem by procuring the required inventory management system collectively. Another potential challenge in the actual implementation of the lean practices is the cultural change required to encourage the current food hub employees to adopt new work procedures.

Apart from financial and cultural challenges, a major challenge that food hubs face in meeting their customers' expectations is their unique relationship with the producers. An important objective for food hubs is to provide economic support for small and mid-sized food producers. Many consumers are motivated to purchase food from the food hub because they want to support this social mission. Therefore, they tend to be more accepting of delivery errors or stock-outs, and even if they are unhappy, they are unlikely to complain because of their personal relationships with the producers and the food hub employees. As a result, the food hub manager does not receive useful customer feedback, and he mistakenly believes that customers are unaffected by quality and delivery issues. This disconnect is likely a major contributor to the food hub's low customer retention rate. Reduced customer participation leads to poor sales, as well as reduced volunteer availability – when customers stop purchasing, they also tend to drop out of the volunteer pool.

5. Conclusion

In this paper we have identified various lean practices that can help to increase the operational efficiency and effectiveness of regional food hubs. Implementation of these lean practices will not only improve customer retention, but it will also improve the level of service that workers provide, since they will not be as pressed for time as they complete their tasks. Furthermore, it is likely that the employees' experience will become more satisfying, as the work becomes less overwhelming, frustrating, and confusing (especially for new and inexperienced workers). However, there are various barriers associated with an actual implementation of the suggested lean practices. Future work includes developing effective management strategies to address these financial, cultural, and structural barriers to enable the food hub to overcome its current operational challenges.

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References

1. Barham, J., Tropp, D., Enterline, K., Farbman, J., Fisk, J., & Kiraly, S. (2012). *Regional food hub resource guide*. USDA.
2. Moraghan, M. R., & Vanderburgh-Wertz, D. (2014). *Food Hub Business Assessment Toolkit*. Wholesome Wave.
3. Matson, J., Thayer, J., & Shaw, J. (2015). *Running a Food Hub - A business operations guide*. USDA.
4. Rogoff, J. (2014). *Improving Systems of Distribution and Logistics for Regional Food Hubs*. Retrieved from http://www.cannetwork.org/documents/MIT_CAN_Food_Hub_ReportNovember2014_000.pdf
5. Fischer, M., Hamm, M., Pirog, R., Fisk, J., Farbman, J., & Kiraly, S. (2013). *Findings of the 2013 National Food Hub Survey*. CRFS - Michigan State University & The Wallace Center at Winrock International.
6. Mittal, A., & Krejci, C. C. (2015). A hybrid simulation model of inbound logistics operations in regional food supply systems. *Proceedings of the 2015 Winter Simulation Conference* (pp. 1549-1560). IEEE Press.
7. Sampson, S. E. (2006). Optimization of volunteer labor assignments. *Journal of Operations Management*, 24(4), 363-377.