A HYBRID PUSH/PULL SYSTEM IN AN SME BAKERY IN JOHANNESBURG

F.I. Masanabo[1*] & S. Chatur[1]

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Contact details
* Corresponding author
immaculatefezi97@gmail.com

Author affiliations
1 School of Mechanical, Industrial and Aeronautical Engineering, University of Witwaterstand, Johannesburg, South Africa

ORCID® identifiers
F. I. Masanabo
https://orcid.org/0009-0007-5708-9439

S. Chatur
https://orcid.org/0009-0007-2255-8135

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ABSTRACT

Bakery X is a small business in Johannesburg, South Africa that produces baked goods and sells these directly to the end customer. Bakery X has difficulties meeting customer demand for fat cakes during the peak hours of 06:00 to 10:00 and 12:00 to 14:00. Interviews were conducted with employees to identify the production and demand management practices at Bakery X in order to evaluate improvement opportunities. The two main bottlenecks that were identified were a policy bottleneck (dough rising process) and a communication bottleneck. In the current production system, work is released on the basis of perceived demand and not real demand, which has resulted in shortages and the formation of long queues. A hybrid push/pull production system is proposed for implementation to help to eliminate the bottlenecks in the production process, using a Kanban to smooth out the flow and so deliver value to the customer and to Bakery X.

OPSOMMING

Bakery X is 'n klein besigheid in Johannesburg, Suid-Afrika wat hulle gebak direk aan die eindkliënt verkoop. Bakkery X sukkel om in die spitstye van 06:00 tot 10:00 en 12:00 tot 14:00 in die vraag na vetkoeke te voorsien. Onderhoude is met werknemers gevoer om die produksie- en aanvraagbestuurspraktyke by Bakery X te identifiseer ten einde verbeteringsgeleenthede te evalueer. Die twee hoofknelpunte wat geïdentifiseer is, was 'n beleidsknelpunt (deeg-rysproses) en 'n kommunikasiebottelnek. In die huidige produksiestelsel word werk vrygestel op grond van waargenome vraag en nie werklike vraag nie, wat tot tekorte en die vorming van lang toue gelei het. ’n Hibriede druk/trek-produksiestelsel word voorgestel vir implementering om te help om die knelpunte in die produksieproses uit te skakel, deur ’n Kanban te gebruik om die vloei glad te maak en sodoende waarde aan die kliënt en aan Bakery X te lewer.

1. INTRODUCTION

There are three types of production system: push, pull, and hybrid push/pull [1]. A push production system is one that is based on a forecast. Future demand/sales are predicted using various methods of forecasting as part of demand management procedures; this forecast is used as a guide for production, and decisions are based on the forecast. The number of products to be produced is based on the prediction, and these are released into the next station of the system as quickly as possible to ensure that the predicted demand is met. This type of production system works in environments that have a large variation in demand. The pull-type production system is based on actual customer demand and not on a forecast. A customer order is used as a signal in the system to trigger production. When a customer order is placed into the system, the product is released from the finished products (or inventory) that are in the system, and this triggers the production of another product to replace the released product. Products kept as inventory can be in a finished or an unfinished form. This system works best in environments that have low variation. A hybrid push/pull production system consists of both push and pull systems to increase the performance of the

overall system. The activities upstream are controlled by a push-type system, and the activities downstream are controlled by a pull-type system.

The focus of the research study is on a small-scale bakery, referred to here as 'Bakery X', that is located in Braamfontein, Johannesburg. The bakery offers a variety of baked goods and sells them directly to its customers. The main product driving the sales of Bakery X is fat cakes[1]. Bakery X is currently unable to meet the demand for fat cakes, as this product has the highest demand. This good will be the primary focus of this study. The main customers of Bakery X are students from surrounding schools and adults working in businesses in the area. Bakery X currently has difficulty forecasting and efficiently meeting its demand during the peak hours (from 06:00 to 10:00, and between 12:00 and 14:00, during lunchtime). The bakery experiences long queues and an average waiting time of 30 minutes per customer. The long waiting time results in balking, reneging, and customer dissatisfaction. This harms the financial aspects of Bakery X, which can result in low revenue and less profit. The bakery currently operates on a pure pull production system, and does not use a reliable forecast method to predict demand. It relies significantly on the judgement of the bakers in deciding on the quantity to be produced in a day. Products sold at the bakery run out before closing time, which results in a loss of revenue from potential sales, and leads to customer dissatisfaction. The research study is organised in different sections. The literature review discusses the literature and previous work on push and pull systems, and how these production systems are integrated. The section on hybrid production systems presents an overview of the hybrid push/pull production system developed for Bakery X. The section on the tath to implementation details how the hybrid system has been fully implemented for operation. The last section of the paper concludes the research study.

2. LITERATURE REVIEW

Manufacturing systems use a push system, a pull system, or a hybrid push/pull system. In a pull system, the production of goods is triggered by customer orders; a good or service is not produced upstream until it is asked for by the customer downstream. The company keeps as many goods as needed to respond to existing customer orders. Once a customer order is placed, the required goods are pulled from the inventory of goods or semi-finished products, or work-in-progress (WIP), which triggers the production of the goods upstream. This is done to ensure that goods sold from the inventory or semi-finished products are replenished. A pull system reduces the WIP; however, it often results in a higher delivery lead time than the push system. A pull system is efficient in a system when the variation in demand is low, while a push system is used in systems that experience a high variation [2]. The pull system aims to produce the right products at the right time in order to increase customer satisfaction [3] [4], while the pull system is used to replace resources only when they are needed or requested. The Toyota-style Kanban system uses a Kanban, or signal, to trigger the movement of material and information [6]. The Kanban is attached to items, and when it reaches the end of the supply chain, it is sent back to the beginning of the supply chain to trigger another production cycle of the item that has exited the system. The next activity in the process is not initiated until it receives a signal from the preceding activity to initiate. However, using a Kanban is not efficient in a system with a large variety of items; therefore, the pull system can be implemented differently without the use of a Kanban [6]. This system can be implemented by using a 'make-to-order' system in which customer orders are used to pull a product from the system. The pull system is used when the aim is to reduce waste (as identified in lean manufacturing) in the production process, to optimise the use of resources, and to increase efficiency. It limits the amount of WIP present in the system or reduces the time that a product will spend in the system to avoid overstocking. Production is based on the actual demand instead of on a forecast. One of the advantages of the pull system is that it allows workers to work on a single task at a time instead of multiple tasks. It allows the company to increase its flexibility and quickly adapt to changes in the production process [7].

A push system is a production system in which the quantity of the produced goods is based on a forecast of the expected demand. Production is triggered by a demand forecast that is based on the historical data of the demand. This type of production system is also called 'make-to-stock manufacturing'. The produced goods are sent downstream to avoid them being depleted downstream. The finished product is stored or distributed, and waits for customers to purchase or place an order [1]. The push-type system is used in production where there is a low fluctuation in demand, and helps to reduce the delivery lead time of goods. However, it results in high inventory costs and a high level of WIP of finished or semi-finished goods. This

[1] Fat cakes are traditional South African fried dough bread. They are made with yeast dough, and they have a shape similar to a doughnut but without a hole.

is because there is no limit on the WIP inventory in the system, as no signals are used in production [8]. Hybrid manufacturing is a system that uses the combination of the pull and push systems in the manufacturing environment. An example of a case for a hybrid system would be if products were manufactured from raw materials into semi-finished products at one point in the system (push system) and the next processes were triggered by orders to make the finished product (pull system). The push/pull interface is the point where the push activities end (the last activity in the push-type system) and the pull activities begin (the first activity in the pull-type system). This is the point where the push-type system combines with the pull-type system. In the push-type system, goods are produced on the basis of a forecast, which could be done daily. Semi-finished products are stored in the system at the push/pull interface and the semi-finished products at a safety stock level. Production of the goods in the push system is stopped once the safety stock level is reached [9]. The hybrid system is designed to absorb the positive characteristics of both systems: it allows inventory to be kept low while providing the production system with the flexibility to respond quickly to changes in demand. Demand forecasting is used in the push system to set out a base for inventory; and once the base is set, customer orders are used as a signal or trigger for further production as part of the pull-type system [5]. Safety stock is kept at the end of the pull-type system, and the safety stock is replenished when products are below the safety stock level. Two types of hybrid system can be implemented: vertically integrated and horizontally integrated [1]. The vertically integrated system only has two levels: the upper level is a push system, and the lower level is a pull system. In a vertically integrated hybrid system, the just-in-time (JIT) principle is used for the production procedure. It is important to consider the processing time variations, load levels, and machine breakdowns when implementing the JIT principle in a pull system. A horizontally integrated system has multiple stages that combine the push-type and pull-type systems. The push systems are mostly placed in the early stages, and the pull systems are placed in the later stages. Having a hybrid production system allows it to have the benefits of both push-type and pull-type systems. This allows for an efficient lead time and a throughput of a high percentage, both of which are obtained from the combination of the pull-type and push-type systems [10]. A pull-type system is integrated to control the WIP experienced in bottlenecks in the system; the push-type stages help to decrease the lead time; while the pull-type system controls the amount of inventory and WIP in the system.

3. METHOD

The research design of the study was an interview that was used to evaluate the demand management practices at Bakery X, in order to develop a hybrid push/pull production system for it. The significance of a hybrid production system is that it absorbs the positive characteristics of both push and pull systems to increase the flexibility and agility of the production system relative to the changes in demand. The bakery business has high variations and fluctuations in demand. Therefore, it is important to have a flexible system to support those variations and fluctuations. Qualitative data was collected to gain insight into the operations and production systems at Bakery X. A qualitative research method was used, selected on the basis of its relevance in understanding processes and human experiences that cannot be measured using quantitative studies [11]. The method used to assess the human factors was data collection using calibrated instruments (interviews), developing open-ended interview questions, using probes to follow up on answers, and actively listening to the participants. Thematic analysis was used to analyse the collected data. Latent codes derived from the theoretical literature were used in the thematic analysis to identify patterns in the collected data. The data collected in the study was used to evaluate how demand management processes at Bakery X could be improved to meet customer demand by implementing an effective production system to complement the variation in demand. A purposive sampling technique was used in the study to understand the processes at Bakery X, and five of its employees were interviewed.

A calibrated instrument was constructed, and interview questions were developed based on the reviewed literature. The interview questions are attached (Appendix A). The interview that was developed focused on three themes: demand management practices (theme 1), factors that affect the demand management process of the business and its ability to respond to demand (theme 2), and stock management (theme 3). The same interview questions were asked of all five participants to ensure the consistency and reliability of the findings. Ethical clearance was sought from the School of Mechanical, Industrial and Aeronautical Engineering Ethics Committee (Ethics clearance number MIAEC 050/22), since the research study involved human participants. The interviews were recorded and transcribed to corroborate the accuracy of the data. The collected data was compared with the reviewed literature to test for external validityThe implementation of demand management practices in small businesses is often related to the level of support a company has and the industry the company is in. . This study aimed to analyse the demand management practices in small businesses. Therefore, the findings of this study might not be relevant to

all small-scale bakeries/businesses; but they should be relevant to bakeries/businesses that are similar to Bakery X.

4. HYBRID PRODUCTION SYSTEM

The current production system at Bakery X is a pure pull system. The production of goods is based on employees' judgement, which is influenced by various factors such as customer consumption and changes in the weather. The bakers monitor the queue that forms outside the shop and the changes in the weather, and decide how many items to prepare, based on their observations. The production system is shown in Figure 1 below.

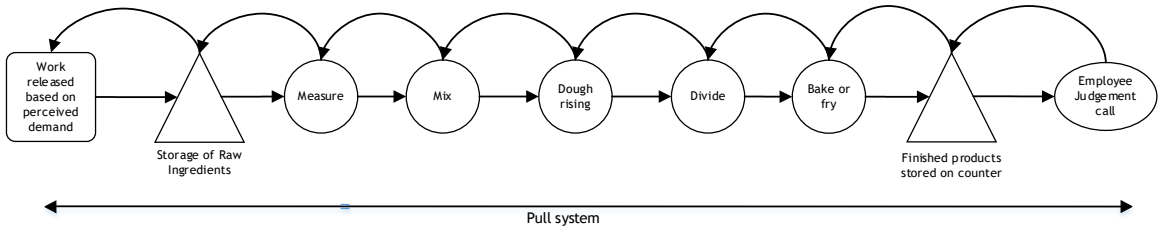

Figure 1: Current production system for Bakery X

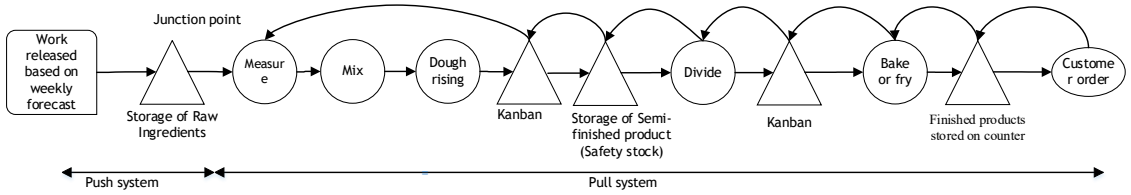

Figure 2: Proposed hybrid push/pull type production system for Bakery X

Figure 2 shows the hybrid push/pull production system to be implemented at Bakery X. In the push system, work is released on the basis of a weekly forecast to track changes in demand more accurately. The weekly forecast is also used to replenish the ingredients to ensure that there are enough to meet the weekly demand. The activities involved in the push system are the storage of ingredients, measuring, mixing, dough rising, and the storage of semi-finished products. The activities involved in the pull system are dividing the mixture, frying, and ensuring that the items on the front counter are kept at a safety stock level. The push/pull junction is located before the activity of frying/baking in the process. The goods are stored in a cooling system as semi-finished products. For the process of fat cakes, a Kanban signal is used as a visual management indicator to trigger the step involving the dividing and rolling of fat cakes to be stored in a cooling system. The Kanban is incorporated into the hybrid push/pull system to eliminate the policy bottleneck. Having this Kanban enables the bakers to prepare the fat cake dough ahead of time, thus not delaying the process and ensuring that finished goods are always available. Therefore, a batch of finished products is always kept at a safety stock level on the store counter. Once the finished products are below the safety stock level, production in the pull-type system is triggered, and it pulls from the semi-finished products stored during the push-type process. The dough would already have been prepared in advance, according to the forecast, reducing the total production time while a customer is waiting. The finished products in the pull-type system are replenished accordingly.Therefore, the hybrid production system significantly reduces the lead time in the production process. The objective of the proposed hybrid production system is to have a production system that can respond quickly to changes in customer demand by introducing buffer points (safety stock). Having a safety stock of semi-finished products ensures that products can be produced in a short time, reducing the waiting time of customers during peak hours and increasing the flexibility of the production system.

The proposed hybrid production system eliminates the identified policy bottleneck and the time that the bakers spend waiting for the fat cake dough to rise. In addition to the policy bottleneck, a communication bottleneck was identified in the process. The data analysis revealed that the bakery constantly experiences shortages in raw materials (baking ingredients), which causes production delays. When this occurs, the

employees need to find alternative ways to acquire the ingredients, which delays initiating the fat cake process, adding to the existing policy bottleneck in the system and increasing the lead time. The bakery manager is the person responsible for replenishing the baking ingredients. However, the manager is not always available at the bakery, because they have another day job to which they need to attend. The flow of communication about shortages in the raw materials is broken if the manager is unavailable and unable to attend to the needs of the bakery when this occurs.

Forecasting is important in the operations management of a business, as it helps with the planning process for the different activities that are involved to ensure that demand is met efficiently. Poor forecasting can result in excess inventory, stockouts, or the inefficient use of resources [12]. Using a reliable forecast reduces the variation and risks such as staffing inefficiencies, machine breakdowns, and environmental factors that can have an impact on the profit margins of a company. In this research study, forecasting was introduced at Bakery X to understand the variations in demand at the bakery and to improve the planning procedures for the anticipated demand. It was important to understand the variation in demand during the day. A weekly forecast was chosen because the short-term factors that influence demand are more predictable, and this forecast could be used in the replenishment process. Owing to limitations in the storage space, Bakery X needs constantly to replenish the ingredients used in the baking process within a short period; so using a weekly forecast would help the replenishment process by estimating the amounts of the ingredients that would be required ahead of time.

5. CASE STUDY

5.1. System description (process flow for the hybrid push/pull system)

Bakery X sells baked goods such as brownies, muffins, scones, fat cakes, and ravana cake, with polony, chips, and pickles as sides. The major process of the bakery is that of making fat cakes – the product making up most of its sales. Other goods at Bakery X are produced in smaller quantities than the fat cakes because of the lower customer demand for them. The main focus is on the process of making fat cakes, which was where problems had been identified.

The current production system for fat cakes is based on a pure pull production system and on the number of customers coming into the shop (or those waiting in the queue outside the shop). The bakers assess the number of customers entering the shop, and decide whether to produce more fat cakes. The process of fat cakes production starts with the preparation of the ingredients: boiling the water, and mixing the yeast with the water to get a solution that will be used when mixing the fat cake dough. Boiled water is required, and this is mixed with a pre-prepared yeast solution and the rest of the ingredients to produce the dough. The ingredients are mixed in a large bowl to yield eight to 10 trays of fat cakes, depending on how much the dough has risen. Each tray consists of 50 fat cakes. After the dough is fully mixed, it is covered with plastic to enclose the contents, and this is placed to one side while it rises; the wait for the dough to rise takes 30 minutes. The dough's rising time was identified as a bottleneck in the process of making fat cakes. When the dough has risen, the bakers divide it into right-sized portions and roll them to give the fat cakes their round shape. The rolled fat cakes move to frying, which produces the finished product. The frying station can fry 100 fat cakes at a time. Once the fat cakes are fried, they are transferred into a bowl that is used to drain excess oil, after which they are moved to a separate bowl on the front counter. The process map for the production of fat cakes is shown in Figure 4 below. The processing times for the different activities are shown below their respective activities.

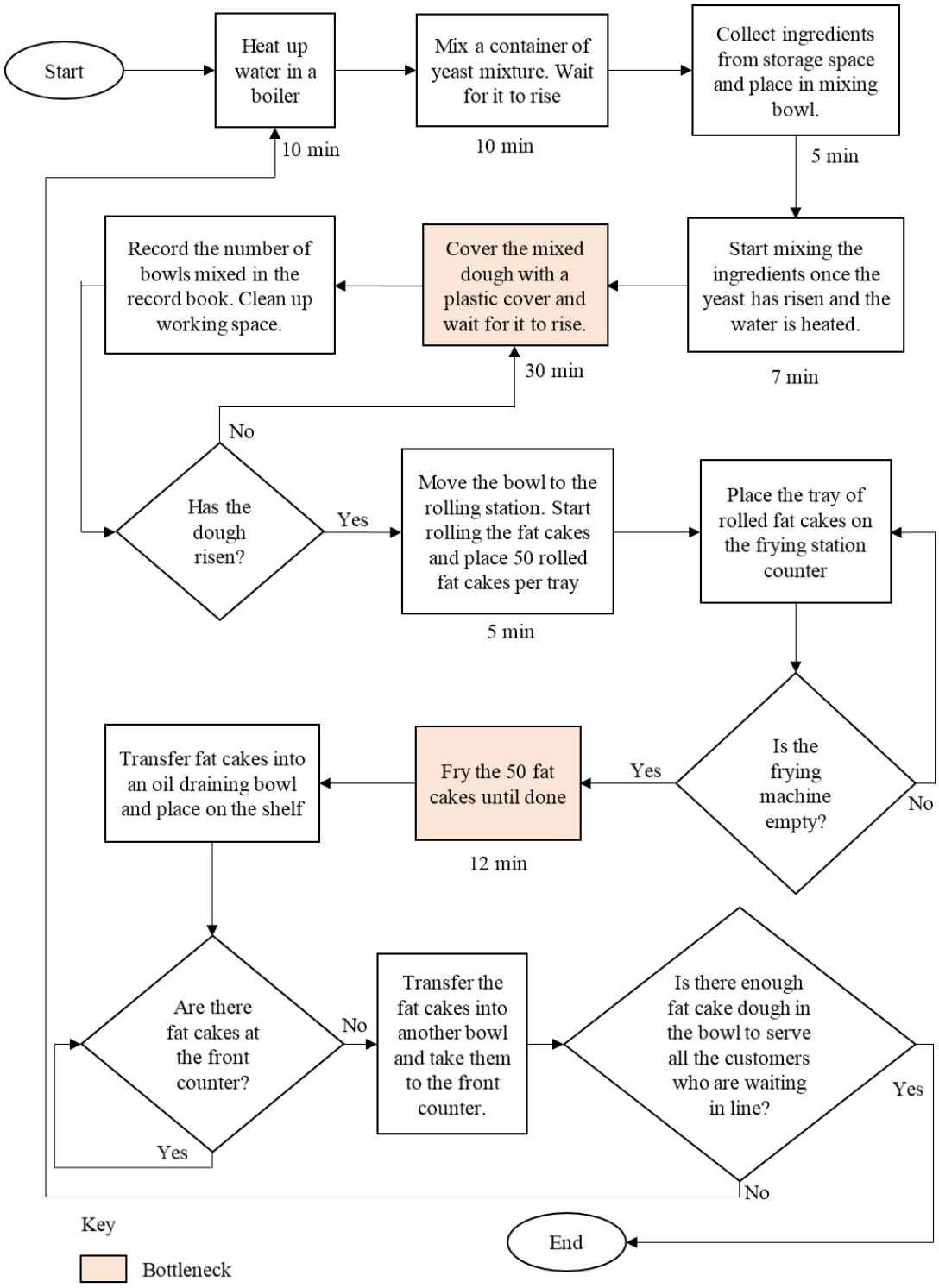

Figure 3: The production process of fat cakes at Bakery X

The process map for the proposed hybrid push/pull production system is shown in Figure 5 below.

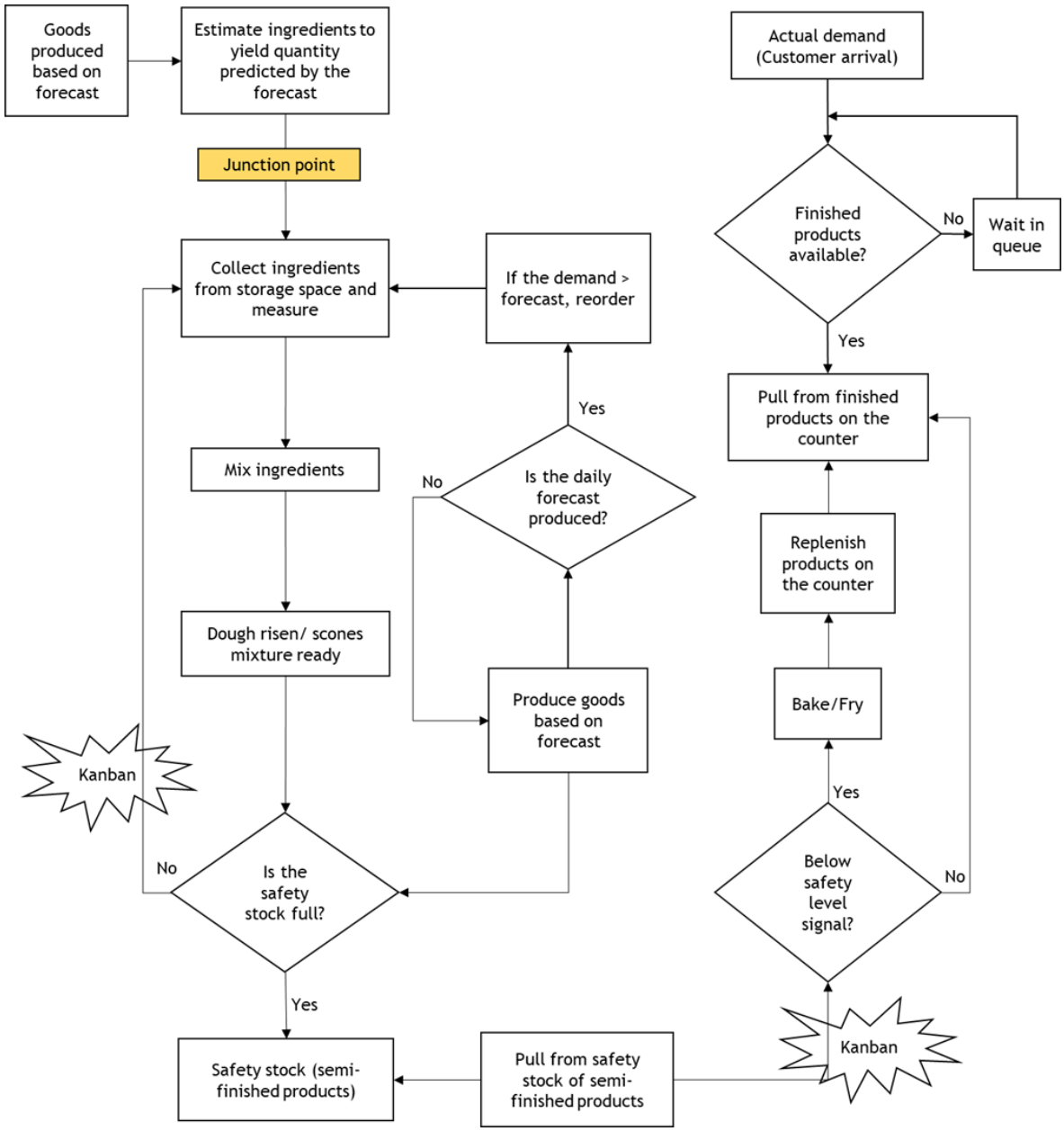

Figure 4: The proposed hybrid push/pull production system for Bakery X

5.2. Planning for demand

It was crucial to gain an understanding of the demand patterns throughout the day to plan and control the production and so to ensure that enough fat cakes were available to meet demand during peak hours. The production of fat cakes continues throughout the day. If there is a shortage, customers have to wait in line while the bakers prepare another batch. Kanban is introduced into the proposed hybrid push/pull production, and visual signals are used as a Kanban to trigger the production in the pull-type system. The bakery keeps the finished products in a large bowl on the store's counter. The bowl is marked, using two lines at different positions, to signal the level at which the production of fat cakes needs to be triggered. A yellow line is drawn one-third from the top of the bowl to warn the bakers, and a red line is drawn one-thirdfrom the bottom to signal the bakers to begin the frying/baking process in order to replenish the finished products on the counter. If the baked products fall below the red line, the bakers need to pull semi-finished products that have been produced in the push-type system, divide them as required, and

fry/bake them into finished products. Another Kanban is introduced to trigger the mixing process of the dough once the semi-finished products are below stock level. The bakers use two bowls to mix the dough; a line is drawn around the middle of each bowl. When the dough in the second bowl is below the marked line, this triggers the mixing of dough for the next batch of fat cakes. The production of the goods in the proposed hybrid push/pull production system is based on a weekly forecast. However, if the actual demand is higher than the forecast demand, the bakers need to continue with production.

From the process map presented in Figure 4, the bottleneck identified in the fat cake process was the time that the dough requires to rise. When the bakery experiences a shortage of fat cakes, customers have to wait in line for the goods to be produced. The minimum time the dough takes to rise is 30 minutes, creating a delay in the process. A Kanban is incorporated into the hybrid push/pull system to eliminate that bottleneck. The bakers have to mix the dough, based on the forecast, and wait for it to rise before the bakery experiences stockouts caused by the variation in demand.

Some employees work during the night shift and some during the day shift. The employees who work during the night shift mix a batch of dough for fat cakes to ensure that production runs smoothly in the first few hours of operation. This is done to eliminate the waiting delay that the day shift employees would otherwise experience when they arrived to open the bakery. The day shift employees can then start frying the fat cakes immediately upon their arrival. Production is stopped an hour before the operating hours of the bakery to prevent the overproduction of goods and food waste, as the goods have a short shelf life and freshness.

5.3. Capacity

The fat cake dough is prepared in large bowls; each bowl can yield 8-10 trays of fat cakes, each with 50 rolled fat cakes. The frying station can take up to 100 fat cakes at a time. The machine used to fry the fat cakes has two chambers, each of which fries 50 fat cakes at a time. Bakery X currently uses one frying machine for fat cakes. However, the bakery owns four machines that could be used. The second machine is used for frying potatoes, and the other two are not used, because the manager decided that the bakery must use only two machines. Therefore, the current use of the equipment is at 50%. The lead time for the first tray of fat cakes is one hour and 20 minutes. Since a single bowl yields more than one tray, the yield time for the other trays is shortened. Once the dough has been mixed and has risen, the lead time for each tray is 20 minutes. The total time it takes to mix two bowls simultaneously is 52 minutes. Four bakers are responsible for the process of making fat cakes: two are located at the station used for rolling fat cakes, one is located at the mixing station and simultaneously works at the frying station, and the fourth baker works at the frying station.

The low-level throughput map is shown in Figure 6 below. Productivity could be increased by increasing the use of the machinery at the bakery and removing bottlenecks in the system. The bakery has enough capacity to increase its productivity.

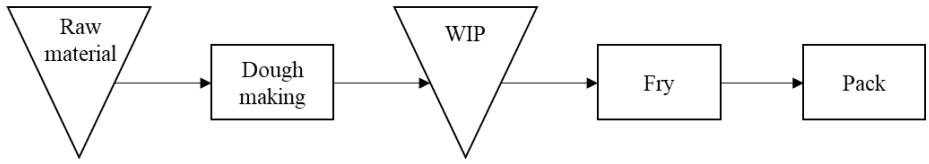

Figure 5: The fat cakes production process

5.4. Seasonal factors

Businesses in the food industry are subject to high variation in demand. At Bakery X, the variation in demand is caused by environmental factors (demand varies according to the seasons) and the operating periods of schools in the neighbourhood. The product that is in high demand at the bakery is fat cakes. A seasonal factor has been identified in the level of demand: the selling of fat cakes is highly sensitive to changes in the weather and seasonal changes. During winter the demand is high, and during summer the demand is low. On cold days the demand is high, and it is low on hot days. Bakery X's largest market is students who attend schools in the area. Braamfontein has multiple schools and tertiary institutions that are in close

range. The demand thus varies according to school terms. When schools are closed, fewer students come to the area; thus there is less demand for baked goods. This variation is taken into account in the planning process at Bakery X. The seasonality factor should help the bakery to choose the appropriate forecasting method. Bakery X needs to consider this variation in demand in their planning process and forecasting procedures.

5.5. Loadshedding

There are constant interruptions in the power supply, referred to as 'load shedding' in South Africa. Bakery X does not have a backup power system; therefore, production is halted during load-shedding periods. This means that the bakery's main product, fat cakes, cannot be produced during this time, as these are produced continuously during the day. Power cuts also result in waste in the form of incomplete products. The bakery employees cannot plan around the load-shedding schedule, as it changes daily. The inability to meet customer demand results in a loss in sales revenue, which is tough on small businesses.

5.6. Forecasting

Bakery X captures and records data on sales and the number of goods that are produced in a day. However, this data is not captured in a format that can be used in forecasting; nor is it kept for long periods because it is not used in any process afterwards. So the data is discarded shortly after it has been recorded. Data capturing is an important part of forecasting, as this is used in the selection procedure for an appropriate forecasting method. It is important that the bakery understand the variation in demand and capture the data in a way that reflects this variation. This would aid the forecasting process. Bakery X staff use their judgement to predict the anticipated demand, which is a form of qualitative (or judgemental) forecasting [13]. However, the predictions are in the form of unaided judgements and are not made by experts, which affects the accuracy and reliability of the predicted demand.

5.7. Human factors

Various human factors affect production systems, such as people's psychology, relationships between people and machines, and societal changes [14]. With the emergence of Industry 4.0, there are advances in the control tools that are used to plan models and aid the decision-making process. Bakery X is a small business, and cannot afford to use advanced tools in their planning process. The employees at the bakery do not have the expertise to use the tools and technology that are used in forecasting and in managing processes. Therefore, the leadership and management of Bakery X need to explore new management approaches that would be appropriate for their type of business and that would improve its production processes. The current manager at the bakery is the only person who is responsible for replenishing the raw materials. However, the manager has a day job to which they need to attend, and is not always available at the bakery. This leads to shortages in raw materials, thus slowing down production and resulting in a shortage of the goods that are being sold. Implementing a push system that uses a reliable forecast would help the manager with the replenishment process. However, the manager needs to delegate tasks to the employees who are always available at the shop, to assist in the replenishment process when the manager is not available. The parameters of logistics and supply chain management that could be included in the planning process involve having an inventory management system to avoid shortages in raw materials, and creating relationships with suppliers to ensure that the supply needs of the bakery are met. Creating relationships with suppliers is important in demand management.

The absence of employees is one of the human factors that affect production in the system. Inefficient human resources increase the workload for other employees who are at work; and that overburdens employees, causing exhaustion. Employee absenteeism slows down production, resulting in a decrease in output. This causes employees from other activities to have more responsibilities added to their tasks as a way of closing the gap managing the process. This puts a strain on the employees who take up extra tasks to compensate for the absence of their colleagues. The bakery currently has one cashier, and they have taken up more work than they can handle because of the number of customers visiting the establishment. As a result, the cashier is under pressure because they are unable to cope with the work that they have: they cannot efficiently serve all of the customers who visit the establishment during peak hours. This creates a slow transaction process between the cashier and the customers, increases the customers' waiting time, and causes a long queue to form outside the shop. This causes employee exhaustion; and exhausted employees cannot fully commit to their work and carry out their duties efficiently. The level of customer service that the bakery provides is negatively affected, as exhausted employees cannot serve customers at

the optimal level. Employee exhaustion can also lead to employee dissatisfaction, which has a negative on the business. This also affects the quality of the bakery's products. The employees perform tasks manually, and do not have machines that assist in the baking process because the bakery is small and cannot afford those machines. This contributes to employee exhaustion and slows down the pace at which they operate. However, this may not be the case for most small businesses, which have enough revenue to purchase machinery that could aid their processes [15].

6. CONCLUSION

The purpose of this research project was to implement a hybrid push/pull production system at Bakery X. The bakery currently operates on a pure pull system. The hybrid production system was developed to reduce the current average waiting time of 30 minutes per customer during the peak hours of 06:00 to 10:00 and 12:00 to 14:00. In this system, the ingredients required for fat cakes are transformed into semi-finished products (rolled fat cakes) based on a forecast, and these are stored in a cooling unit. The production of finished products is triggered when the products that are kept at the counter to be sold are below the safety stock level. The model thus developed will be implemented in three phases, and the system will be monitored continually to check its performance. Once implemented, the model is expected to reduce the waiting time to an average of 15 minutes per customer, and eliminate shortages in baked goods.

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APPENDIX

Interview Protocol

I have found that the bakery experiences long queues at certain times of the day and shortages of some goods throughout the day. This research aims to evaluate demand management practices that can be implemented in small businesses to ensure that demand is met effectively. Therefore, I would like to interview you regarding the demand management practices that are currently being implemented at the bakery.

Before we commence the interview, I would like you to provide consent by signing the consent form. Note that the interview will be recorded for the purpose of analysis for this research. We value privacy and confidentiality, therefore, we will not be asked any personal questions during this interview. This interview will be solely used for the research project and will be terminated at the end of the research project. Please note that your participation is entirely voluntary and you may withdraw at any time.

Background Information

1. What is your position in the company & the associated responsibilities?
2. How many years of experience within the company?
3. Can you tell me more about the day-to day operations and planning activities within the company?

Theme 1 - Demand management practices

4. What services does the company provide?
5. What are the essential processes that are required for the baking process? Are they any processes that you perform that may not necessarily add value/ are not necessary?
6. As part of demand management practices, how do you plan out how the company meets the daily, weekly, or monthly demand?
    a. How do you make an estimation of how many goods to produce in a day?
    b. Do you monitor the levels of goods throughout the day so that you decide whether or not to make more, or you make a once of decision?
    c. Do you monitor the demand of goods on a day-to-day basis/weekly basis and adjust supply accordingly?
    d. Do you change the processes according to how the demand changes?
7. Are the goods produced continuously produced throughout the day?
8. Does the business have enough equipment, raw materials and employees to meet the current demand?
9. How much of the baked goods can be produced in a day?
10. How often do you experience shortages in the goods that you make?
    e. What is the main cause of the shortages & how does the company respond to this?

Theme 2 - Factors affecting the demand management process of the business & Ability to Respond to demand

11. What are the factors that disrupt the production process of the business? For example, running out of raw materials for the goods, wastage, machine breakdowns, machine maintenance, absence of employees, poor cash flow management, shortages in equipment etc
12. What are the interruptions that the business experiences in the delivering process of the goods that might have an impact on the long queues?
13. Do you have any contingency measures in place for the interruptions highlighted?
    a. What measures do you have in place?
14. When are the busiest times during the day at the bakery?
    b. How do you prepare to ensure that demand is met effectively during that time?
15. How flexible are the bakery measures in responding to the high demand?
16. When is the least busy time of the day?

c. What are some of the activities that are done during this period of time? For example, prepping to bake for the next batch of goods

17. Is the demand the same throughout the month?

Theme 3 - Stock management

18. Tell me about the strategy that you have to plan for demand.
    a. How does the company currently forecast sales?
    b. How do you decide how many goods to produce in a day?
    c. Which of the goods are made in higher quantities and why is that the case?
19. Is the staff trained in managing stock and managing demand?
    d. What training does the staff have regarding the management of stock?
    e. How does the training take place at the job?
20. Do you keep track of every product that is sold in the business?
    f. How are the goods being sold monitored?
21. To wrap up the interview, is there anything else that you would like to share with me regarding what we discussed?

Thank you very much for your participation in this interview. We have reached the end of the interview. Feel free to contact me for any enquiries. Details are available on the participant form. Note that they may be subsequent contact in case there is a need to clarify any information. Thank you once again.