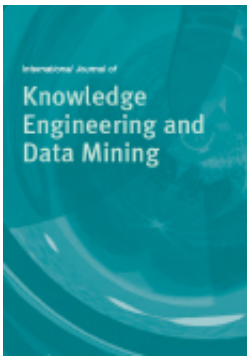

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Applying process mining to minimise order waiting time of FitBox

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Abstract: The main objective of the paper is to investigate the reasons why a lot of complaints (by customers) have been made against the quality of 'food delivery service' in one of the FitBox branches. During the COVID-19 pandemic, it is important for the FitBox customers to receive their (ordered) healthy food in-good-time to help them lose weight and get fit. To achieve the objective of the study, the whole dataset of the notorious branch was initially cleansed and then imported to the fluxicon disco platform, which is a process mining tool. Using several process mining techniques – such as automated process discovery (via frequency and time performance metrics), filtering (via follower, performance, endpoint and attribute metrics), clustering, process map animation/simulation and detailed statistics analytics – enabled us to find out the main reasons why the food delivery work has been piled up and handled improperly. The paper provides groundwork for future research.

Keywords: process mining; business intelligence; process discovery; bottleneck mining; handover of work analysis; process simulation; fluxicon disco.

Reference to this paper should be made as follows: Porouhan, P. (2022) 'Applying process mining to minimise order waiting time of FitBox', *Int. J. Knowledge Engineering and Data Mining*, Vol. 7, Nos. 3/4, pp.190–233.

Biographical notes: Parham Porouhan received his PhD and is a Full Time Lecturer in the Graduate School of Information Technology at Siam University. His areas of interest and expertise include artificial intelligence, data science, machine learning, process mining, data mining, process modelling, process simulation, process management, process improvement, business process intelligence, educational data mining, process discovery, conformance checking, process enhancement, learning analytics, etc. In 2015, he successfully completed (with distinction) the 'Eindhoven University of Technology' offering of 'Process Mining: Data Science in Action', which aimed to provide data science knowledge to analyse and improve processes in a variety of domains.

1 Introduction

Process mining is a rather new approach where data science and process management techniques are combined with each other. Process mining enables firms to properly understand the critical business process functions of their company as well as discovering

bottlenecks that are impeding the performance of the company. As a consequence, many sectors and businesses are rapidly applying process mining tools and techniques to investigate, comprehend, and evaluate business processes. Customer satisfaction is the key goal of every business since the customer is what drives the company. As a result, it is extremely important for businesses to provide accurate order processing to their customers with the intention of increasing customer satisfaction. Order processing systems should guarantee that customer orders are properly processed and delivered to the right place at the right time with the right goods. Depending on the sector, order processing can range from manual to much automated systems. FitBox is involved in the food industry and the success of this industry is largely affected by the customer satisfaction. Food is a sensitive and personal purchase so customers are always seeking something better every day in this business, thus FitBox needs to reach for optimum satisfaction. Order processing is a critical area in FitBox's performance indicator for ensuring customer satisfaction; higher the rate of order failure/ delayed, lower the rate of customer loyalty and retention. Therefore, FitBox needs to very serious and accurate on catering/providing its customers with the right meal order at precise time, or even earlier than the assigned/allocated time. For the case of the FitBox's branch investigated in this study, the order process is not smooth and precise, which has negatively influenced the branch's performance and increased system expenses. The problems in the above-mentioned branch of FitBox's system include:

- delayed orders
- high order cancellations
- slow output of the overall system.

These are all critical concerns that must be addressed right away for the sake of the branch's and the company's success. However, before we can plan our actions, we need to first understand what is causing the problems. Such problems may occur as a result of:

- unlikeable taste of the meals
- ineffective inventory management
- bad word of mouth
- inefficient order processing
- incompetent sales representatives
- incompetent delivery partner
- high price of meal
- food quality issues
- improper relationship between the success percentage of the order and the allocated sales representative
- bad customer service
- slow kitchen operation
- incompetent chefs.

As a result, fluxicon disco was chosen as a business intelligence tool for this report to undertake a process mining approach to examine the event logs of 100 cases (i.e., customers) who purchased meals from the notorious FitBox branch whose orders have not been delivered on time, mainly associated with delayed, or ever been cancelled. For more details and information about the FitBox dataset used in this study please refer to Appendixes 1–14). In this study, the fluxicon disco was used in order to identify the main roots of the delayed orders and order cancellations as well as helping the branch of FitBox to deliver the ordered meals to the right customers at the right locations and at the right time. Accordingly, the business intelligence tool fluxicon disco helped us in the following criteria:

- to examine and spot the possible bottlenecks in FitBox's various units
- to identify the 'abnormal' or 'odd' clusters by analysing various cluster types and associated cases
- to determine the average duration of time in which the branch of the FitBox delivers the meal orders
- to check who is the most productive employee (and vice versa) to improve the employees productivity
- to identify the most effective mediums or ways in which the customer pick up and receive the orders
- to find out the relationship between various FitBox activities such as delivering sample meals and handling customer queries and their impact on final order completion
- to find out the extend of the negative impact of the negligence activities such as restocking of order during work time on the final order completion
- to find out the efficiency of the delivery partner
- to find out the root causes of delayed orders, cancelled orders and slow output of overall system.

2 Literature review

Order processing management is a critical component of order fulfilment that occurs when a customer places an order. It starts when a company gets an order and concludes when it delivers it. There are numerous research papers on which they focus on the importance of order processing systems in manufacturing industry. According to Beckmann et al. (2020), one of the most important the key success factors when it comes too ordering process in food companies is 'on-time delivery'. About 65% of manufacturing companies state that on-time delivery is their leading logistics key performance indicator.

1 There is no doubt to say that whether it is a food delivery industry or a manufacturing industry, on-time delivery enhances customer relations and retention and improves the efficiency of the delivery of every business. But at the same time, only two-third of the companies reach on-time delivery rates higher than 85%.

2 As a result, the study concluded that delayed delivery has the most significant bottleneck in the manufacturing industry, and it recommends that executives and employees gain a better understanding of IT tools so that they acknowledge how process mining works to solve this issue (Porouhan, In-press). Another research paper that we found was about order fulfillment cycle time estimation for on-demand food delivery companies. According to this research, by providing customers with conveniences such as easy access to an extensive variety of restaurants, effortless food ordering and fast delivery, on-demand food delivery (OFD) platforms have achieved explosive growth in recent years.

3 The accuracy of predicted OFD time is important for customer satisfaction, as it needs to be communicated to a customer before he/she places the order, and is considered as a service promise that should be fulfilled as well.

4 As a result, the intensive order planning process highly influences predicted OFD time. Another research paper states delivery partner has a major influence in the order processing operation in takeout food service. These businesses have a number of operational issues, such as fluctuating client demand over time and area. In this regard, service providers may overlook the fact that some riders may remain idle for extended periods of time in certain places, while others may be in limited supply in other situations which delay the delivery.

5 Furthermore, to prevent or mitigate any adverse effects of the uncertainty associated with riders' delivery capacity, the service platform may also choose to have a scheduled delivery workforce that they can utilise more effectively.

6 The study shares that these businesses have process gaps in optimising delivery schedules and delivery riders.

Thus, for a smooth order processing system, this factor must be looked upon carefully. Hence, we may conclude that the order processing system is the primary focus of this report. Based on these three literatures, we can infer that on-time delivery, thorough order preparation, and delivery schedule optimisation are essential elements for an order processing system (Gunther et al., 2020; Lin et al., 2020; Xue et al., 2021; Ariffin et al., 2021; Beckmann et al., 2020; Behrens et al., 2020; Nick et al., 2021; Schuh et al., 2020; Xue et al., 2021; Porouhan, in-press).

3 Methodology

The primary need for conducting this research was business event logs. So, we acquired event logs from FitBox through our personal network. Fluxion disco, a business intelligence tool, was used to further analyse these event logs (Porouhan, In-press). Our data log contains ordering details of 100 cases/customers, which are collected in 576 rows and 7 columns (i.e., order number, activity, time stamp, resource, ordered food, quantity, and delivery address). Fluxion disco is an excellent process mining tool for

managing deviations, investigating variances, and optimising performance. Disco includes the most powerful log management and filtering framework, as well as the quickest process mining techniques. We imported the data given by FitBox in this business intelligence tool and configured the variables of each dataset i.e., customer ID, timestamps, activities, resources, and attributions. For more details and information about the FitBox dataset used in this study please refer to Appendixes 1–14).

a Case ID: An organisation or individual ordering a meal from FitBox is referred to as a Case ID.

b Time stamp: The time stamp records the date and time of different activities that are carried out in FitBox.

c Activity: The various activities carried out by the case id, as well as the employees, kitchen and delivery partner.

d Resource: Employees, delivery riders, and kitchen workers from FitBox are referred to as resources since they are in charge of managing all the orders.

e Attribute#1 (meals ordered by case IDs): The attribute includes different types of meals provided by FitBox; vegan meal, keto diet meal, low calorie meal and high calorie meal.

f Attribute#2 (ordered quantity): case ID's total number of meals ordered.

g Attribute#3 (delivery address): It is the case ID's location where the meals must be delivered.

To fulfil our project's purpose, we used the fluxicon disco techniques listed below:

a Clustering technique: We were able to discover 'odd' or 'strange' behaviour in the data due to the clustering technique. It assisted us in determining if the order processing unit of each case followed similar patterns or whether each order was a distinct case.

b Fuzzy miner modelling/algorithm: We used this filter to study the event logs and evaluate each set of data by filtering information that we really wanted to investigate.

c Animation/simulation: In a live view style, animation/stimulation is one of the simplest ways to identify potential bottlenecks and identify where process gaps are in the system.

d Filtering options:

- Endpoint filter: This filter assisted us in distinguishing the beginning and lending events in the workflow. The standard endpoints of this order processing procedure are 'order delivered' or 'order cancelled,' and utilising the endpoints filter, we were able to identify how many cases ended with 'order delivered' or 'order cancelled'.

- Follower filter: This filter helps in finding out interconnectedness among all divisions. It assisted us in defining a basic process pattern based on the follower relationship. With this filter, we were able to determine if different divisions at FitBox (kitchen, logistics and sales) had proper correlation with each other or not.
- Performance filter: FitBox promises its customer to deliver the meals within maximum 1 hour after receiving the order. Using a performance filter, we were able to filter the cases depending on their processing times. Thus, we were able to identify a customer order that took longer than an hour to get delivered.

4 Findings and results

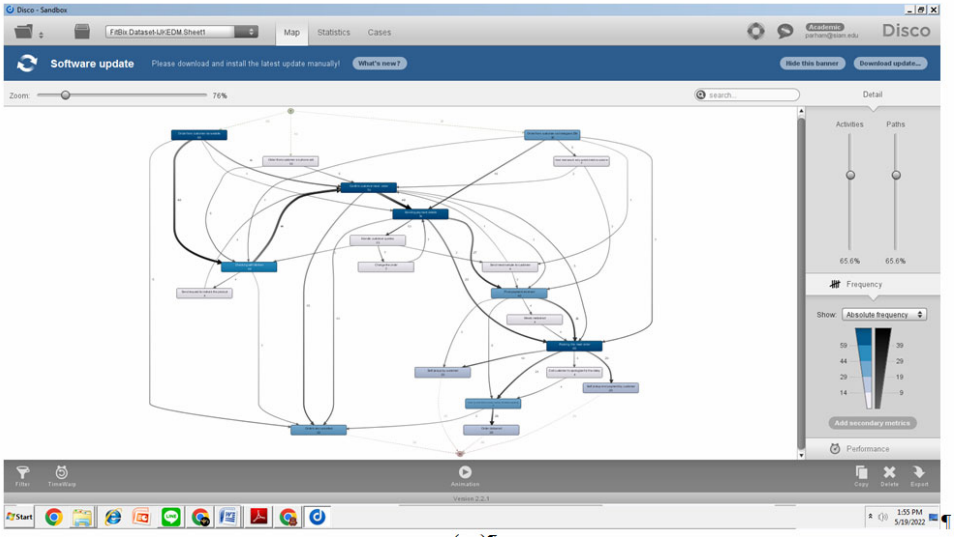
Figures 1(a) and 1(b) show the map view of the data used in this study with threshold of 65.6% of Activities and 65.6% of Paths, respectively. The customers have initially been provided with the three different options through which they can place their order. The options were:

- Order from customer via website
- Order from customer via Instagram direct messaging (DM)
- Order from customer via phone call

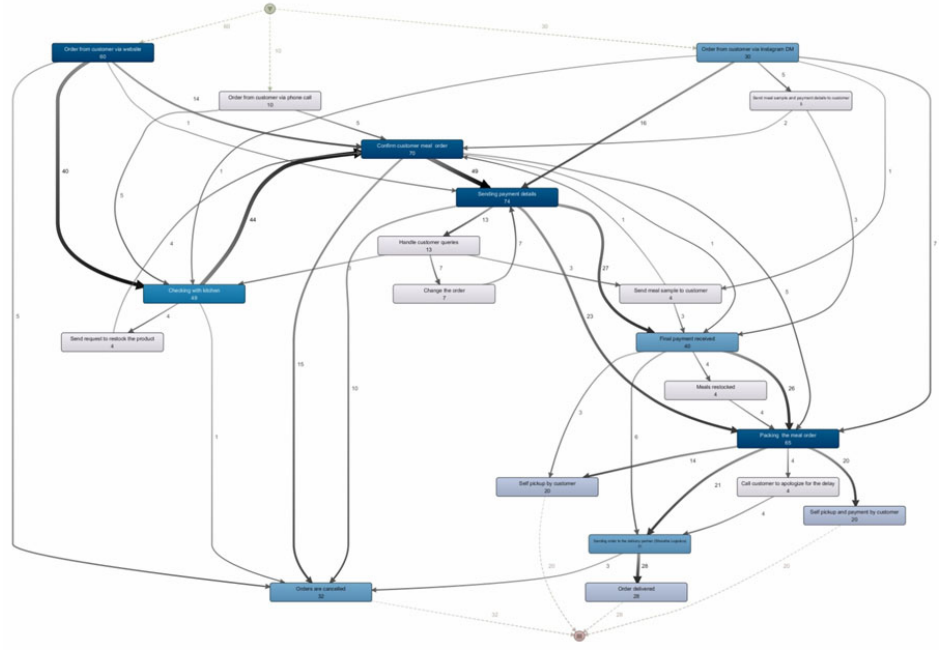
As shown in [Figure 1(a) and 1(b)] and Figure 2(a), ordering from customers via the Website has been the most popular way of ordering the foods, as the company has received 10.42% of its orders (i.e., frequency of order = 60 times) through website. On the other hand, the company has received 5.21% of its orders (i.e., frequency of order = 30 times) through Instagram DM, and 1.74% of its orders (i.e., frequency of order = 10 times) through phone calls.

The top-2 most commonly occurred activities through the entire dataset are 'sending payment details' and 'confirming the customer order'. After checking with the logistics/kitchen section to make sure that the customer's order can be made available, the 'packing the order' has been identified as the third most common activity performed in the dataset. 'Packing the order' process is done either by sending the order to the delivery partner (turbo logistics) for the final delivery or by asking the customers to pick up the order by themselves. These are the top-3 most frequently performed activities of the process as we can see them in Figure 3. One prominent area of concern we can see during this process is that in 5.56% of the cases (i.e., frequency of occurrence = 32 times) the orders have been cancelled, which mostly happened after sending payment details to the customers. On the other hand, we can see that many of the orders have been delivered with delay. The main objective of the study is to investigate and find out the reasons why such order cancellations and delays in delivery of the ordered items/foods have occurred. To do this, various process mining techniques (i.e., such as statistical view analysis, filtering and clustering) are applied on the dataset by means of the fluxicon disco tool/platform (Porouhan, In-press)

Figure 1 (a) and (b): Overview of pathway taken while handling customer order at FitBox (thresholds: 65.6% of activities and 65.6% of paths) (see online version for colours)



(a)

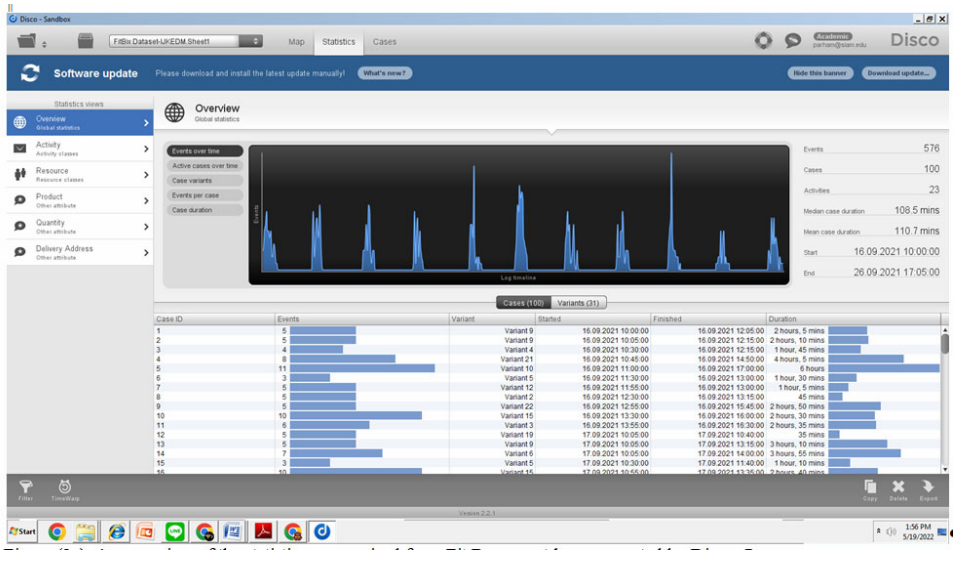


(b)

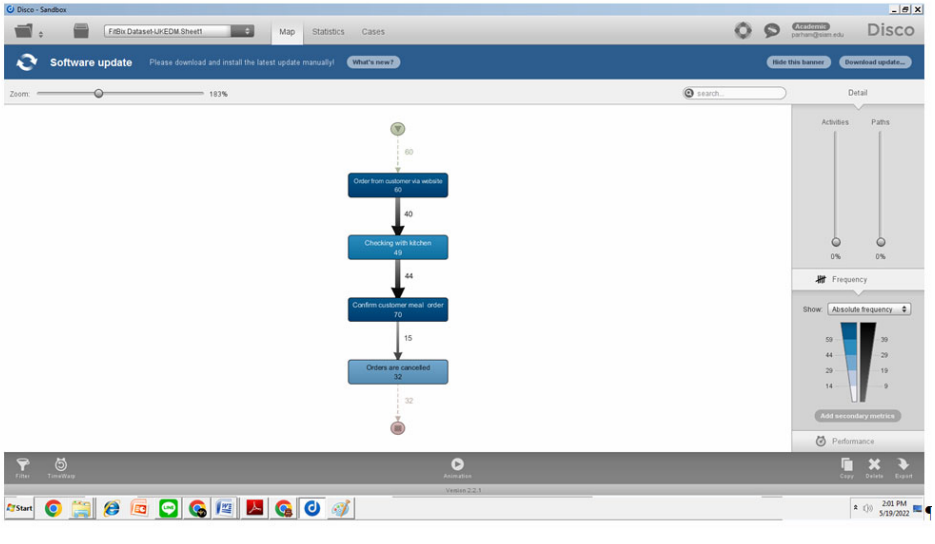
We obtained the primary data from a fitness meal delivery company named FitBox which has been operating for the past 5 years and delivers a range of healthy meal options such as vegan meal, keto meal, high and low-calorie option, etc. The data collection process of the event log used in this study starts on 16th of September 2021, 10:00 AM and ends on

26th of September 2021 05:05 PM. This means that the total time span of the data is taken over a period of 11 days. There are totals of 100 case IDs in our data, with 23 activities in which 576 events were recorded Figure 2(a).

Figure 2 (a) (b) and (c): An overview of the statistics summarised from fit box event logs supported by disco (see online version for colours)



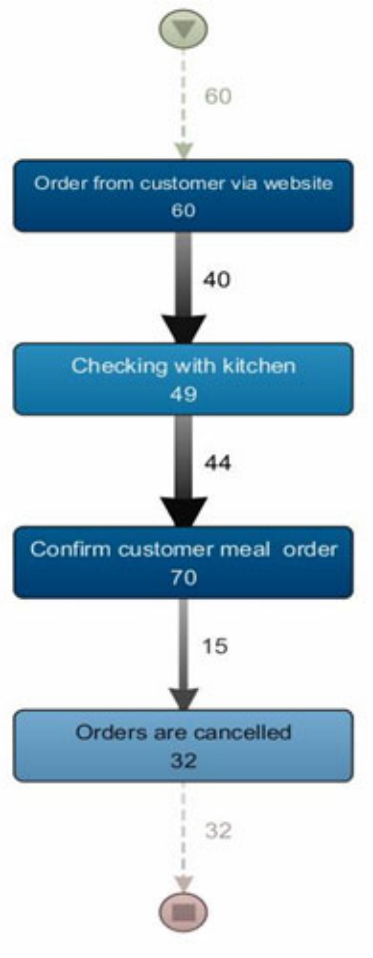
(a)



(b)

Note: thresholds: 0% of activities and 0% of paths.

Figure 2 (a) (b) and (c): An overview of the statistics summarised from fit box event logs supported by disco (continued) (see online version for colours)



(c)

Note: thresholds: 0% of activities and 0% of paths.

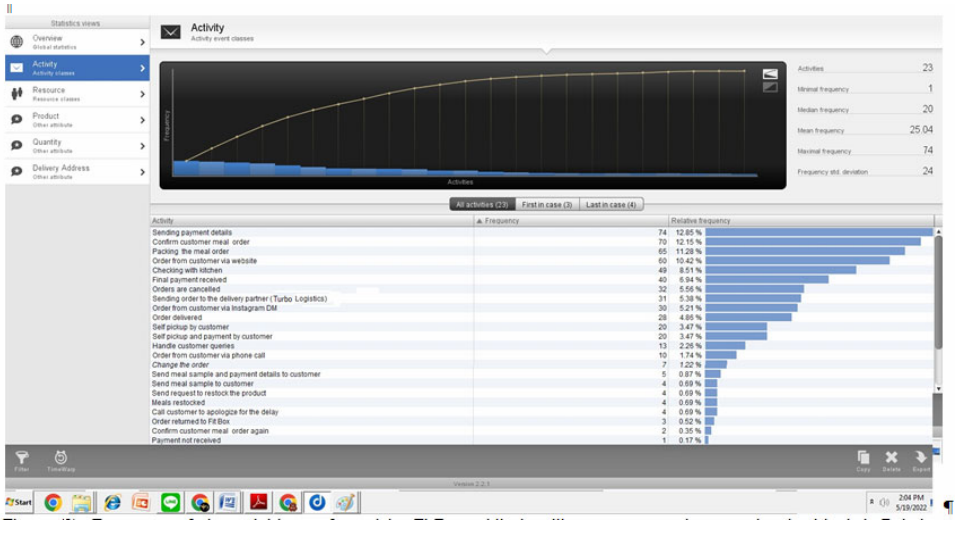
The given map view is of our data, it is presented with the minimum threshold, i.e., 0. So in order to describe this process, different steps are followed: The first step shows that via websites, the maximum number of orders have been placed by the customers. Then the second step shows checking with the kitchen that is being performed, followed by the confirmed customer meal order. But at the last step, we can then see that maximum time's order is getting cancelled. Therefore, to identify the causes behind this reason, we have run the data in the report. Likewise, if we simply look at the steps, there is redundancy in the steps related to checking with the kitchen and confirming customer meal orders. So these steps can be avoided by using few efficient techniques such as through food delivery software as shown in [Figure 2(b) and 2(c)].

In order to address any issues related to inefficient order processing and to ensure smooth and efficient order processing activity, FitBox tries to shorten down their order

processing time and activities. According to the statistics data, the branch of FitBox has received most of its orders from customers via Websites with a relative frequency of 10.42%, followed by Instagram DM with a relative frequency of 5.21% and via phone call with a relative frequency of 1.74%. The most frequent activity is 'sending payment details' (12.85 %), 'confirm customer meal orders' (12.15%) and also 'sending orders to delivery partners' (5.38%). All these activities are frequently repeated and consuming a lot of time, so they should be brought into one by the use of software. Therefore, FitBox should develop and make its ordering process more efficient and less time-consuming (Porouhan, In-press). The required developments need to include the following activities:

- fill in customer detail or log in
- display the available meal options
- confirm the order
- automatically send the payment details
- send FitBox and delivery partner a notification when these steps are completed.

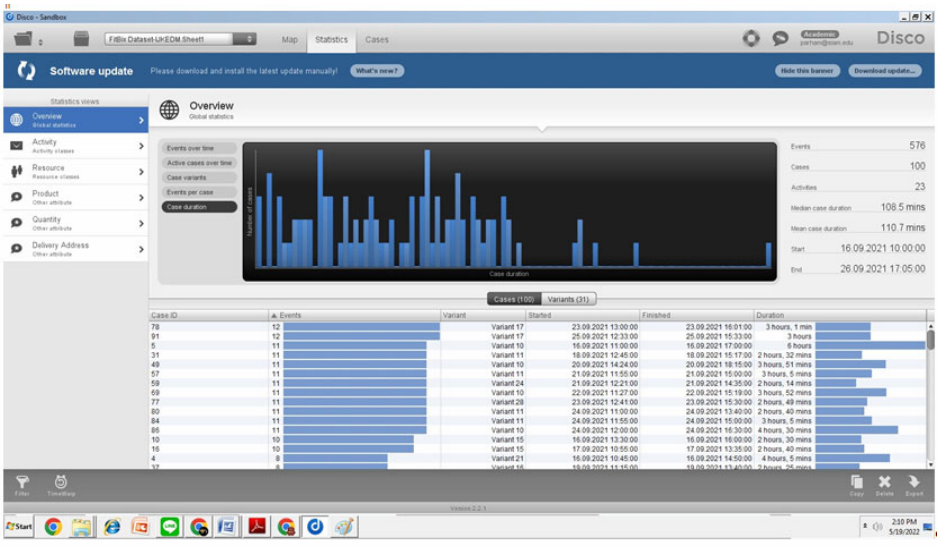
Figure 3 Frequency of the activities performed by fitbox while handling customer orders associated with their relative frequency (see online version for colours)



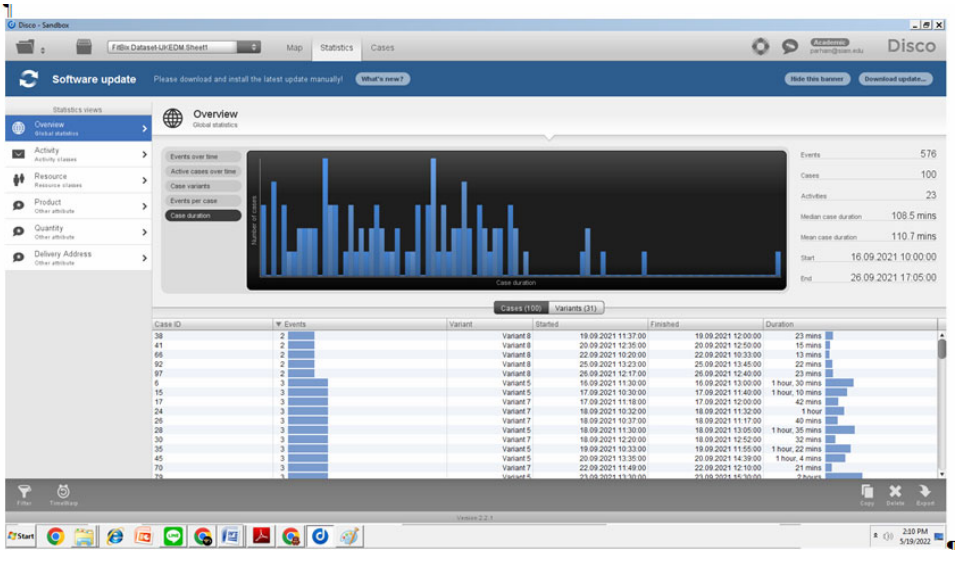
After the above-mentioned steps are completed, the order details will be sent to us. This would simplify the order processing process and help FitBox focus on its core operation which is preparing meals. This software would also minimise the human resource cost. Such software is already being used by the leading food delivery companies such as foodmandu and FYMO. FitBox should also use the 'menu for the day' system as this would save their time and effort as they do not have to go and check with the kitchen for each order placed by the customers. These implications can greatly reduce the human resource cost and make the process more efficient. In the case of this study, limited human resources are required to handle three tasks:

- customer queries
- orders from Instagram
- orders from a phone call Figure 3.

Figure 4 (a) maximum number of events executed per case (b) minimum number of events executed per case (see online version for colours)



(a)



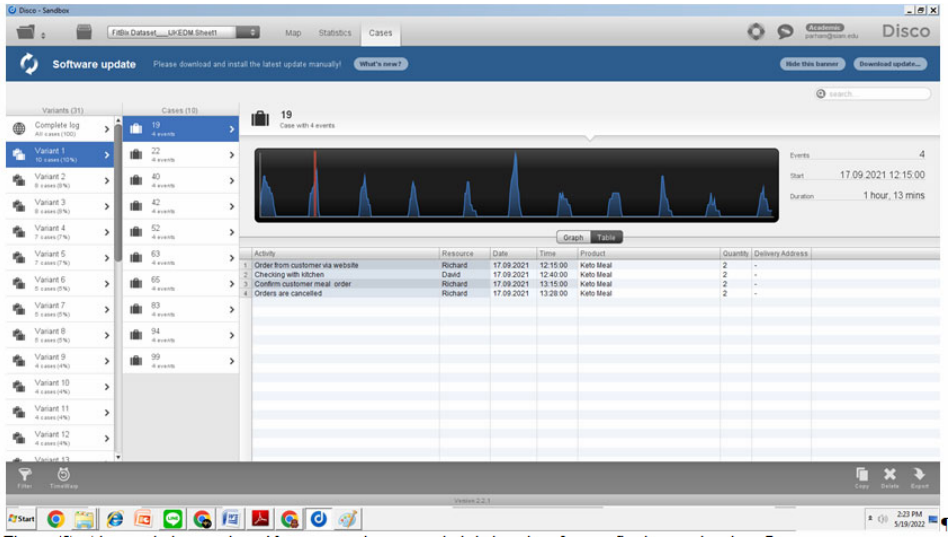
(b)

Looking at the clustering variants (i.e., 31 different clusters or variants have been identified by the fluxicon disco software), the maximum number of Events that are taking

place (in clusters) when it comes to FitBox is 12, which means in order to hand over an order to the hands of a customer, 12 different steps and activities need to be undertaken which is a lot in this case causing additional costs and waste of time. But the problem lies in the fact that the majority of the events took more than an hour to complete. Since, the main value proposition of FitBox is based on efficient delivery; this comes as a big threat to the entire brand. Furthermore, we also found out that, in some cases, even though the number of occurred Events is large, but it took less time to complete them compared to the Events with less number of events. This implies the fact that there are more issues with the order processing function of the FitBox branch, which soon will be examined and taken into account in this report Figure 4(a) and 4(b).

Furthermore, we also discovered something different in cluster 1. There are ten cases which account for 10% of the total customer orders (Porouhan, In-press). The problem here lies in the fact that the orders are getting cancelled after confirming customers' meal orders. There could be many reasons behind it. One particular reason that we assumed is, looking at the long duration between activities (which can be seen in the Figure 5) is that the salespeople who are responsible for taking the order have been having too much workload which is not allowing him/her to perform tasks like checking with the kitchen then confirming meal orders efficiently (Porouhan, In-press). This signals that FitBox requires more human resources in the kitchen department in order to solve these issues Figure 5.

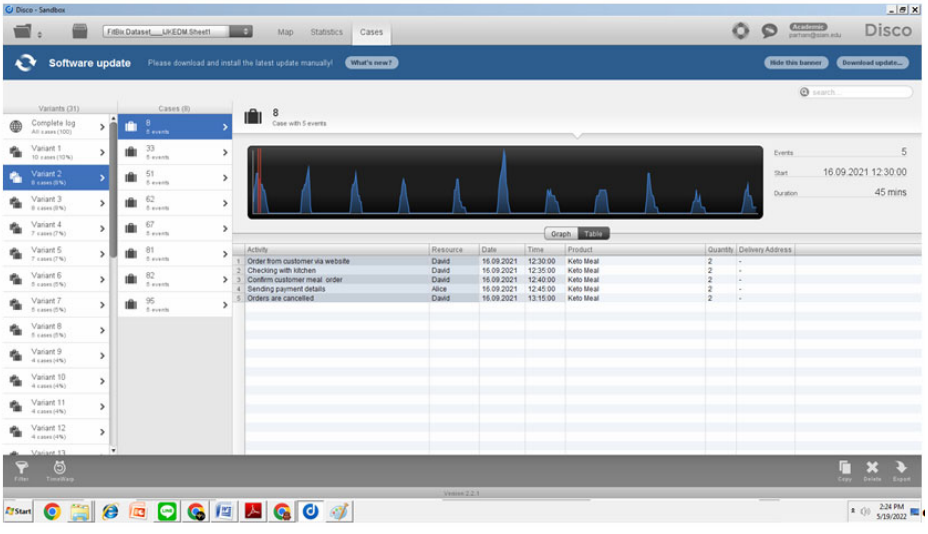
Figure 5 Abnormal cluster where 10 customers have cancelled their order after confirming meal orders (see online version for colours)



Furthermore, in the cluster 2, orders are being cancelled immediately after payment details were sent. Unlike the previous cluster, what's different here is the fact that the activities from taking customer orders from websites to send payment details are being done smoothly. There are only five minutes of difference between the activities which confirms the fact that the entire process is going smoothly. So, the problem behind cancelled orders is something other than an error in the human resource department. Since the orders are getting cancelled right after the payment details are sent, this

indicates the fact that the price that customers pay for FitBox's products might not be perceived well for the amount that they pay for it. Going outside of the data, we found a piece of information that further supports this point, i.e., Customers did not cancel their orders when the economic value to them was greater than the price that FitBox charged. This suggests that FitBox should start letting the customers know the value of their product before sending them the payment information in order to further incentivise them to buy the products Figure 6.

Figure 6 Abnormal cluster where customer order is being cancelled after payment details are sent (see online version for colours)



Packing meal orders is taking more than needed time maybe due to the insufficient human resource in the kitchen. Here we can see that although almost everything is in control and the process is smooth, there is a small issue in cluster 3 and that is the activity is taking more time to process than the allocated time. So to solve this problem we have to know the exact reason which is causing this problem to occur during meal order packing. Since there is more quantity being ordered in the kitchen in this cluster, it is taking more than needed time to process this activity which may be due to the insufficient human resource in the kitchen. Therefore, FitBox may require more human resources in this activity to process in the allocated time Figure 7.

In this cluster 5, we can see that when the customers are engaged in self pick up and payment, the process is really quick and little to no issues can be seen during the activity. The process is fast and is being completed within the allocated time. So, through this, we can conclude that when the customers are involved in the self-pickup and making the payments by themselves, there is an efficient process of the order in this cluster Figure 8.

Figure 7 Abnormal cluster showing excessive time taken to prepare and pack meal orders (see online version for colours)

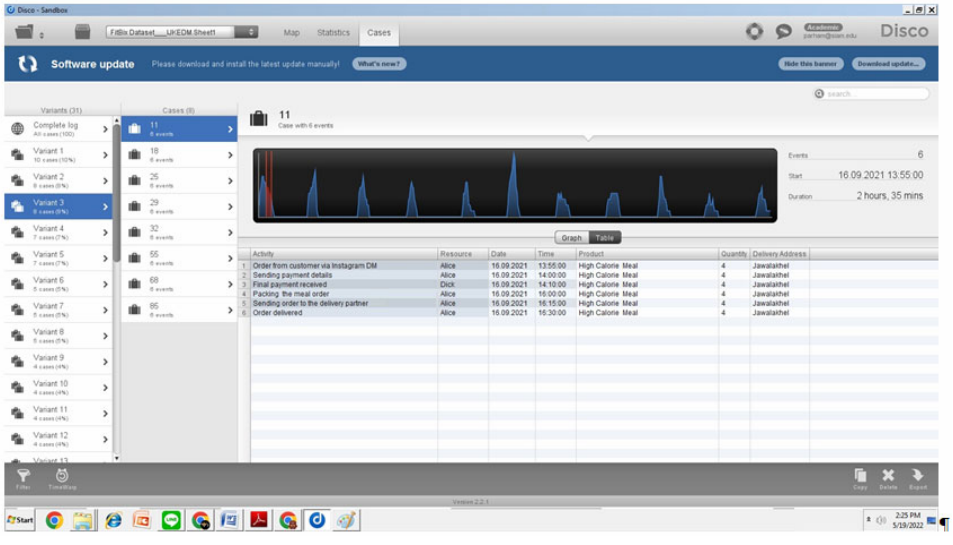
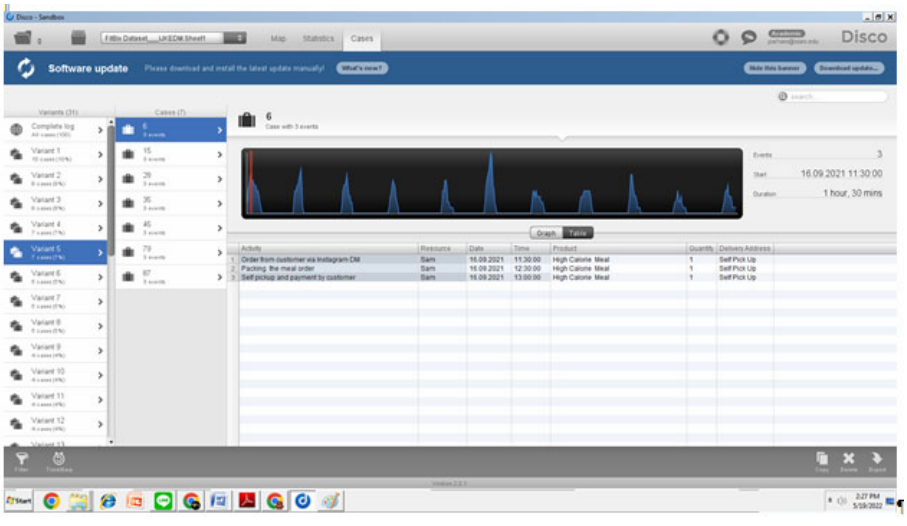


Figure 8 Abnormal cluster showing efficiency is process when self-pickup and payment by customer are done (see online version for colours)



In cluster 6, there is a delay between packing the meal order and delivery, which cannot be seen during self-pickup and payment by customers, the time duration for the delivery of order is taking very long, almost double that of the allocated time frame. This may be due to the lack of proper coordination and communication with the delivery partner (turbo logistics). So what FitBox can do is to make proper communication with their delivery partner so that the lead time from the order being placed to till it is received gets shortened Figure 9.

Figure 9 Abnormal cluster showing inefficiency is processing when orders are delivered (see online version for colours)

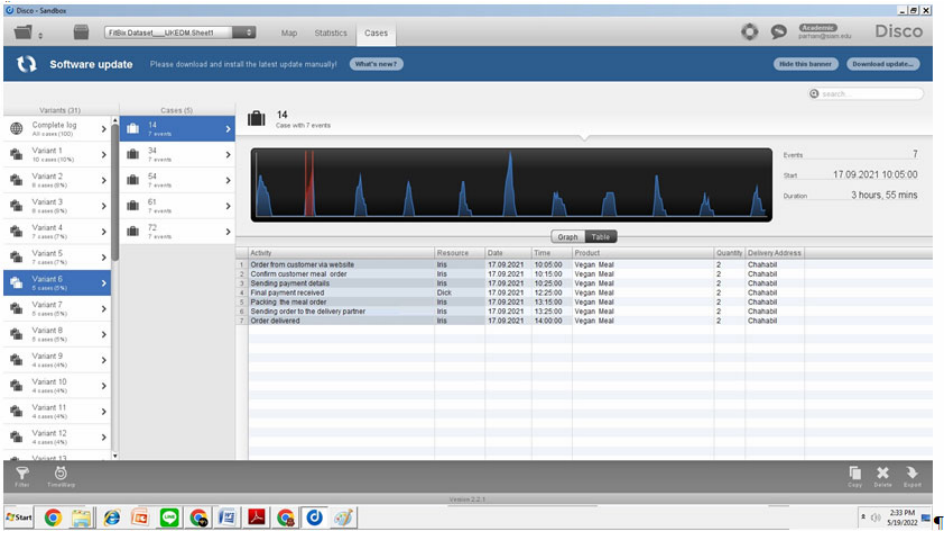
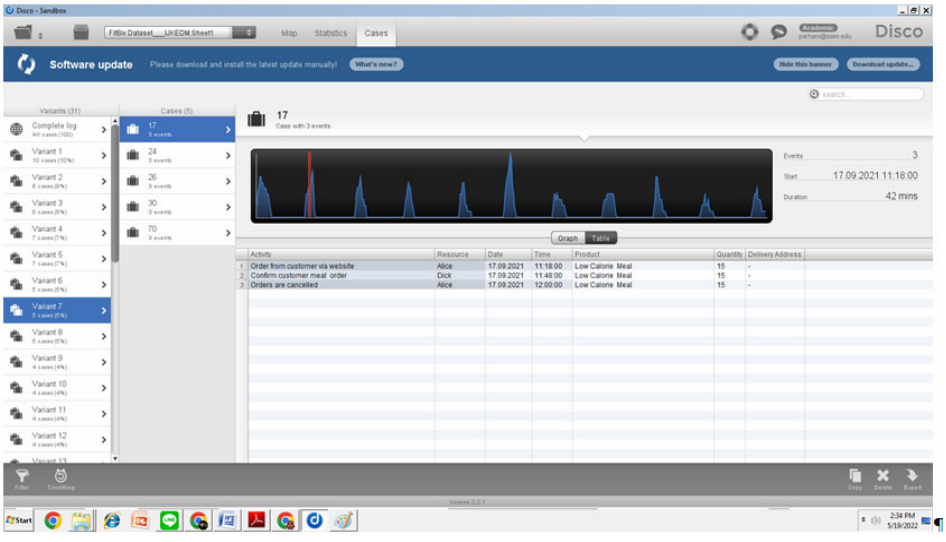


Figure 10 Abnormal cluster showing cancellation of order when more than one person is working on an order (see online version for colours)

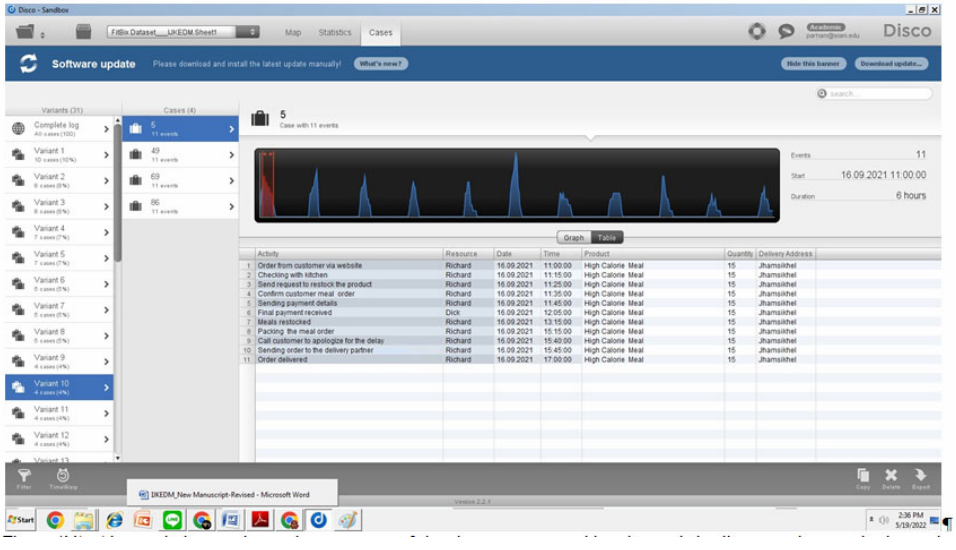


Looking at Figure 10, we can see that the cluster 7 points out a particular problem of orders getting cancelled. It also suggests the fact that the orders get cancelled when two people are working together for the same customer. The possible reason behind this is, when two people work on similar tasks, they get confused about their roles, it creates confusion between them which then leads to order processing taking time and as a result,

the customer has to wait for a longer period of time. Then, the customer gets dissatisfied because of waiting for so long. Hence, they cancel their order. The possible solution for this problem that FitBox can look upon is; either, properly communicating with the staff about their roles and responsibilities of hiring a supervisor who can look upon the staff in order to improve coordination between them (Gunther et al., 2020; Lin et al., 2020; Xue et al., 2021; Ariffin et al., 2021; Beckmann et al., 2020; Behrens et al., 2020; Nick et al., 2021; Schuh et al., 2020; Xue et al., 2021).

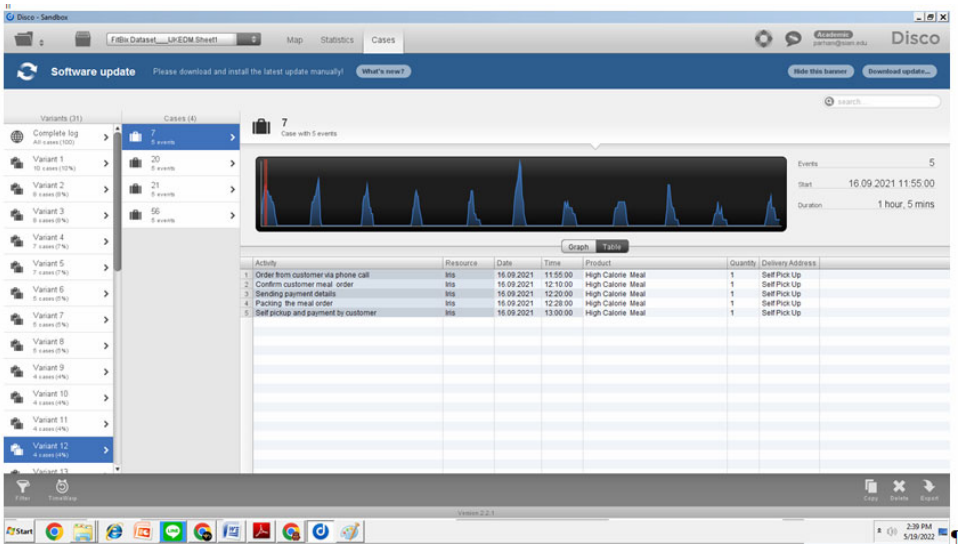
The cluster 10 shown in Figure 11 does not indicate the orders getting cancelled. However, it shows the cases that include a large amount of time are spent on restocking the meals. When large amounts of time are spent on restocking the meals, it makes the customer wait for a longer period of time and increases the probability of orders getting cancelled. In this case the order is not cancelled. However, the company has to reach out to the customer to apologise for the delay which led to a bad impression on the brand of FitBox. For this problem, FitBox can check and make sure if everything is in stock before they begin their day rather than restocking it while running their operation. If they make sure that everything is in stock during off hours, they will be able to package the meal order right after receiving the final payment. As a result, a chunk of time (1 hour time framework in this case) can be saved.

Figure 11 Abnormal cluster where a large amount of time is spent on restocking the meals leading to an increase in the total delivery time (see online version for colours)



Looking at the cluster 12 in Figure 12, we can point out the fact that every time when the customers are making their order via phone call, the order processing is being carried out within the time frame. This shows that this order processing via phone call is one of the most efficient ways to receive the orders almost half of the allocated time. Also, we can see that after the order is received via phone call, there is self-pickup of those orders from the customers directly.

Figure 12 Abnormal cluster where phone call is an efficient mode of placing an order (see online version for colours)



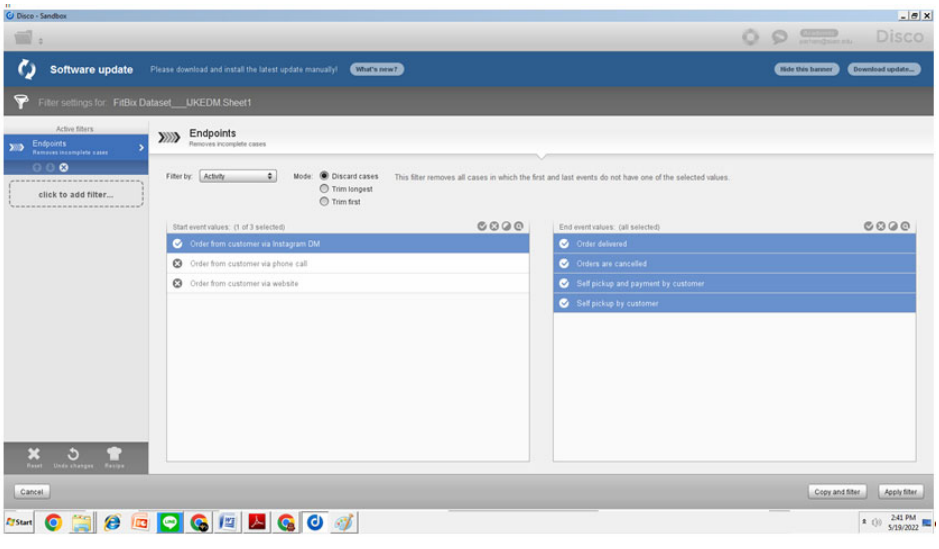
The endpoint filtering technique was run in order to see how many orders that came in through three different mediums (Google form, phone call, and message) ended in customers receiving their meals in hand and how many resulted in the cancellation. Customers could choose from three delivery options: self-pickup, self-pickup and payment, or merchandise delivered by a third party. By preserving all three possibilities as final finishing points, we intended to discover the optimal medium for taking customer orders Figure 13.

Figure 13(a) shows those cases/customers (30%) in which they have placed their order through Instagram direct messages. Running this filter allowed us to analyse the fact that when customers placed their orders through Instagram, they haven't faced any issues. As a result, no orders were cancelled.

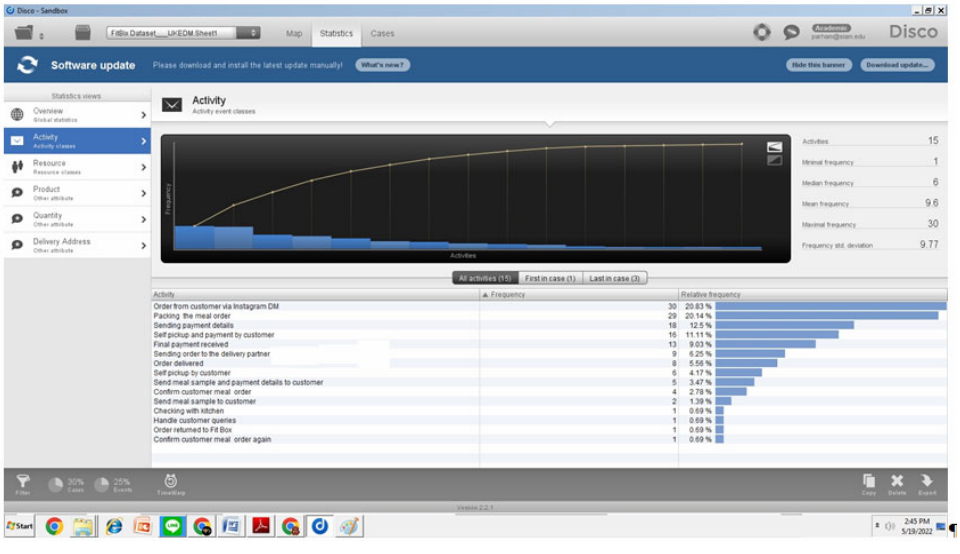
[Figures 13(b) and 13(c)] show the statistics of orders that were placed by the customers through the phone. So only 10% of the customers have placed their orders through phone out of which, 2% of the time customers had cancelled their orders. The possible reasons behind it could be: unavailability of the stocks for the required product, unavailability of the customer, and so on.

[Figures 13(d) and 13(f)] show that 60% of the customers have placed their orders through FitBox's website which does not come as a big surprise due to the growing use of technology. Unfortunately, the statistics showed that 30% of the customers have cancelled their orders. The possible reasons behind it that should be checked are; unstable server of the website, lack of clarity, meaning, something that they saw on the website might be different than what they expected when they inquired about the product to the employees before making the final payment (Porouhan, In-press).

Figure 13 (a) Running endpoint filtering to see how many orders that came in through three different mediums (Google form, phone call, and message) ended in customers receiving their meals in hand and how many resulted in the cancellation (b) identifying the number of cases that were submitted via Instagram DM and resulted in delivery, self-pick up or order cancellation using endpoint filtering (c) (d) identifying the number of cases that were submitted via phone and resulted in delivery, self-pick up or order cancellation using endpoint filtering (e) (f) identifying the number of cases that were submitted via website and resulted in delivery, self-pick up or order cancellation using endpoint filtering (see online version for colours)

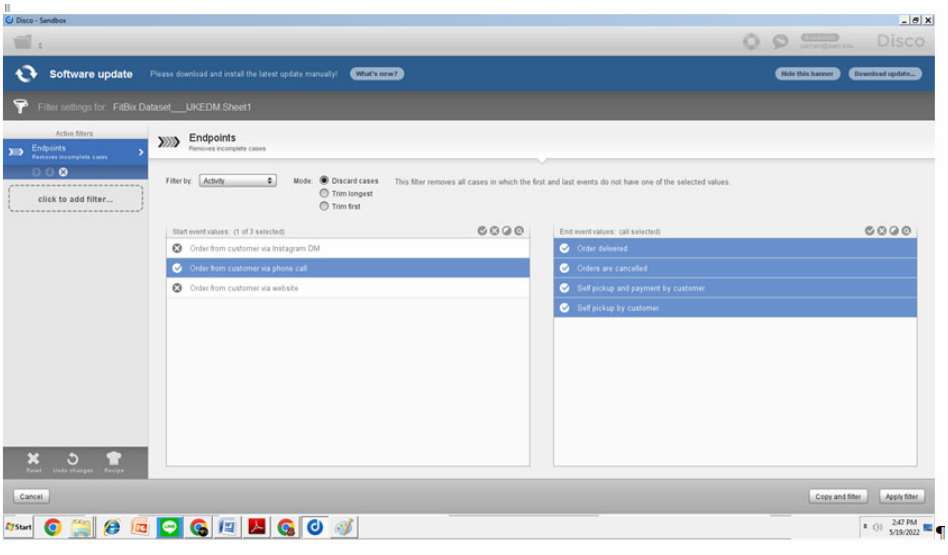


(a)

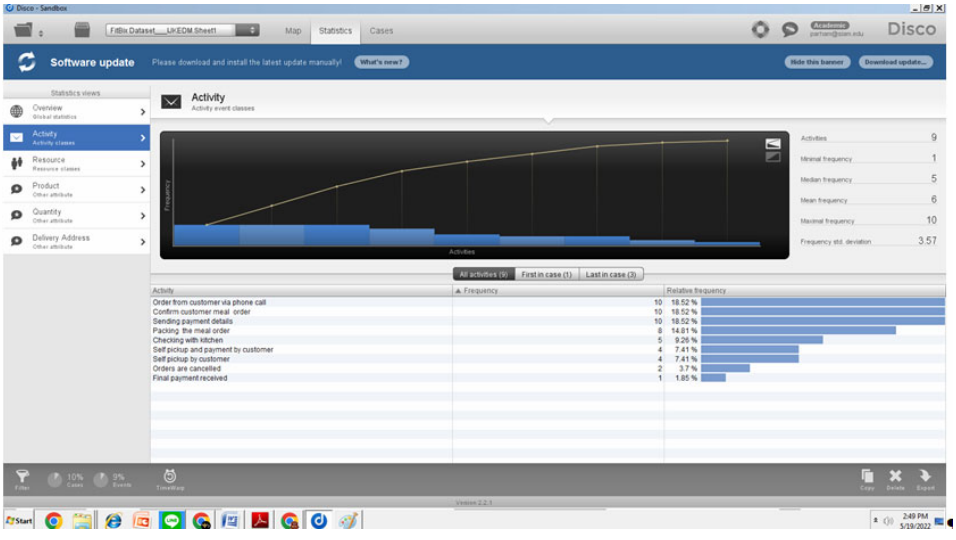


(b)

Figure 13 (a) Running endpoint filtering to see how many orders that came in through three different mediums (Google form, phone call, and message) ended in customers receiving their meals in hand and how many resulted in the cancellation (b) identifying the number of cases that were submitted via Instagram DM and resulted in delivery, self-pick up or order cancellation using endpoint filtering (c) (d) identifying the number of cases that were submitted via phone and resulted in delivery, self-pick up or order cancellation using endpoint filtering (e) (f) identifying the number of cases that were submitted via website and resulted in delivery, self-pick up or order cancellation using endpoint filtering (continued) (see online version for colours)

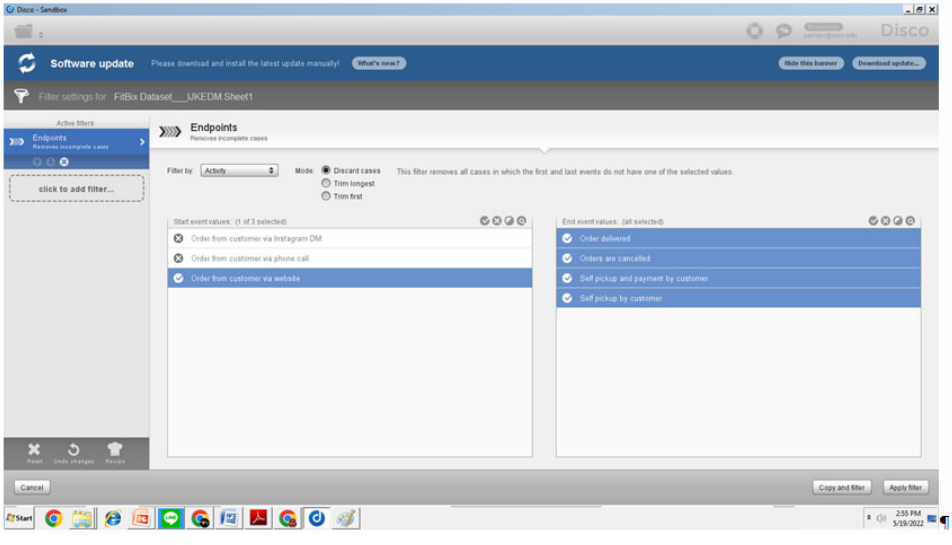


(c)

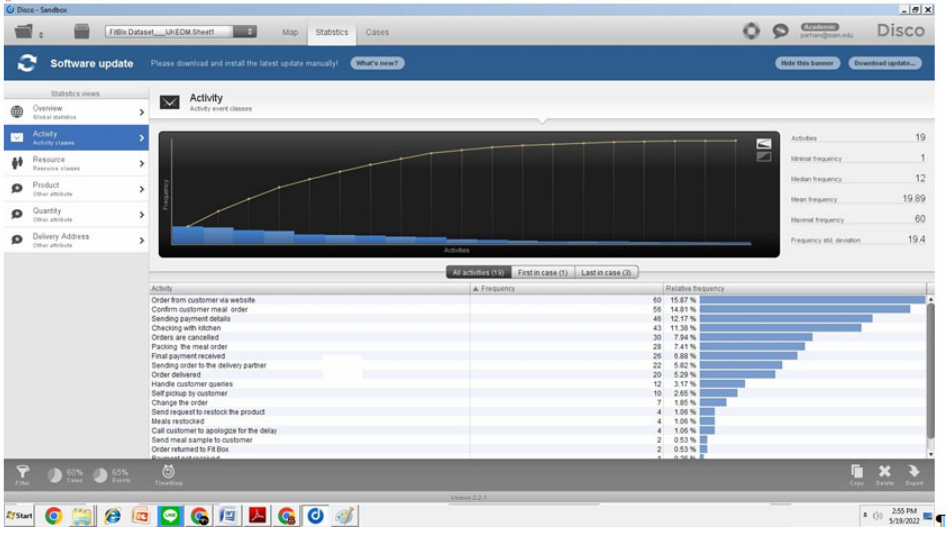


(d)

Figure 13 (a) Running endpoint filtering to see how many orders that came in through three different mediums (Google form, phone call, and message) ended in customers receiving their meals in hand and how many resulted in the cancellation (b) identifying the number of cases that were submitted via Instagram DM and resulted in delivery, self-pick up or order cancellation using endpoint filtering (c) (d) identifying the number of cases that were submitted via phone and resulted in delivery, self-pick up or order cancellation using endpoint filtering (e) (f) identifying the number of cases that were submitted via website and resulted in delivery, self-pick up or order cancellation using endpoint filtering (continued) (see online version for colours)



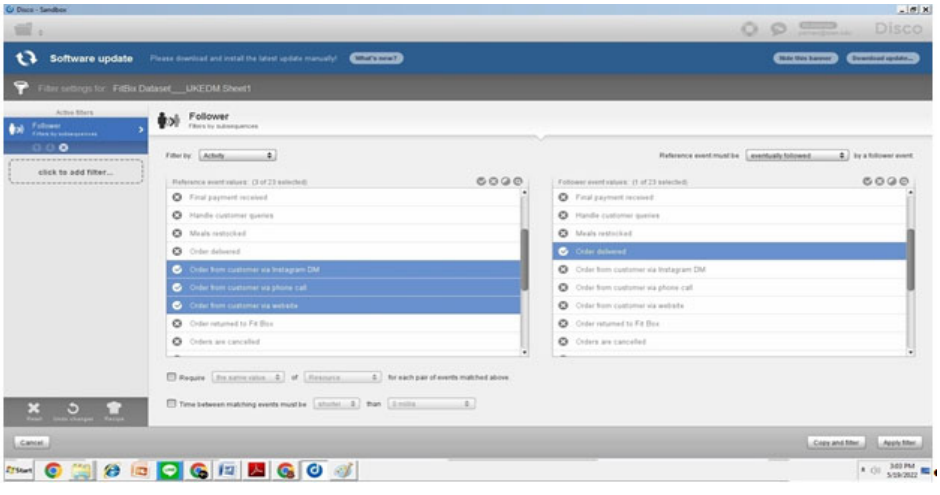
(e)



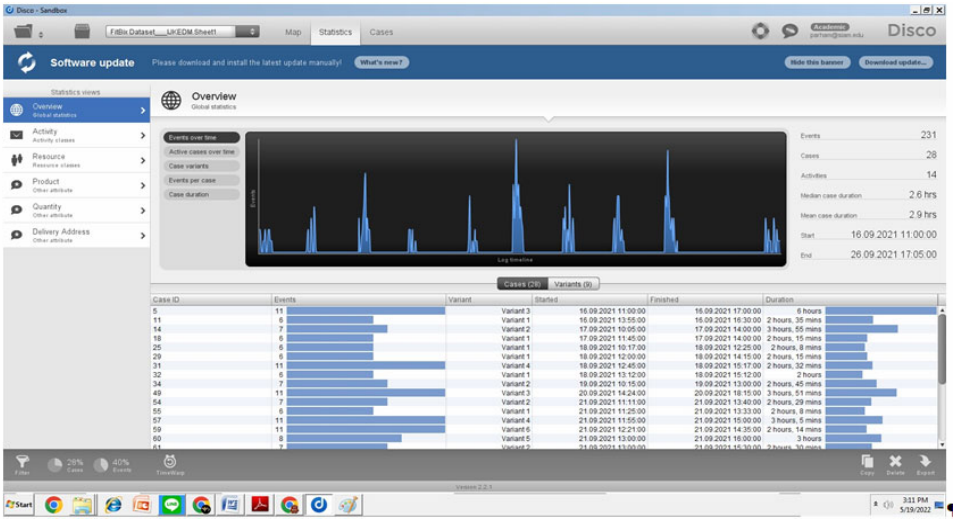
(f)

As we, all know how important and valuable it is to have a proper communication for a business with their customer. In order to see whether or not FitBox handles customer queries well, we have used follower filtering technique to see if the orders were delivered successfully or not by the FitBox staff. If they were handled well it would let customers place orders and vice versa. Figure 14(a) shows how Follower Filtering technique can be applied in such a way to investigate how many customer orders (i.e., made through Instagram DM, phone call or website) has been successfully (and eventually) delivered to the customers.

Figure 14 (a) Using follower technique to investigate how many times the customer orders (i.e., made through Instagram DM, phone call or website) has been successfully (and eventually) delivered to the hands of the customers (b) only 28% of the customer orders (i.e., made through Instagram DM, phone call or website) has been eventually delivered to the hands of the customers (see online version for colours)



(a)

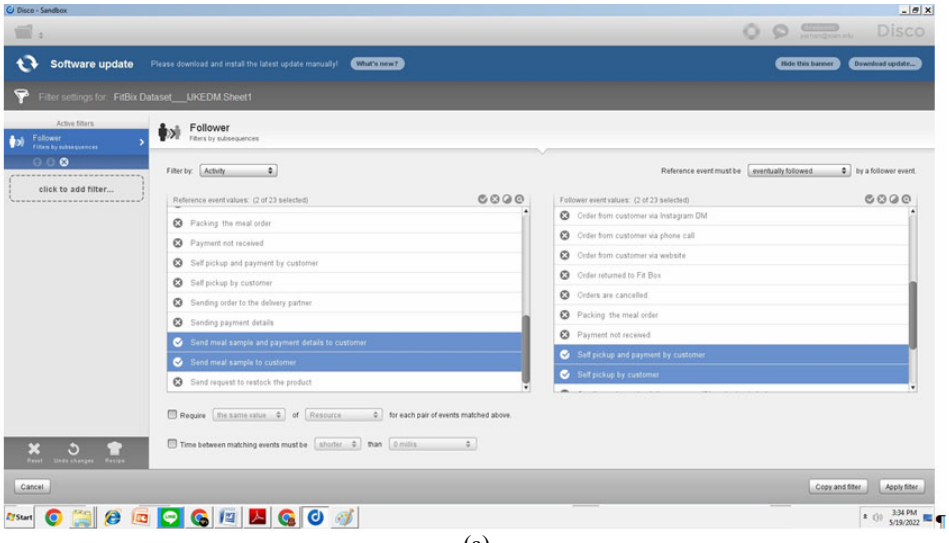


(b)

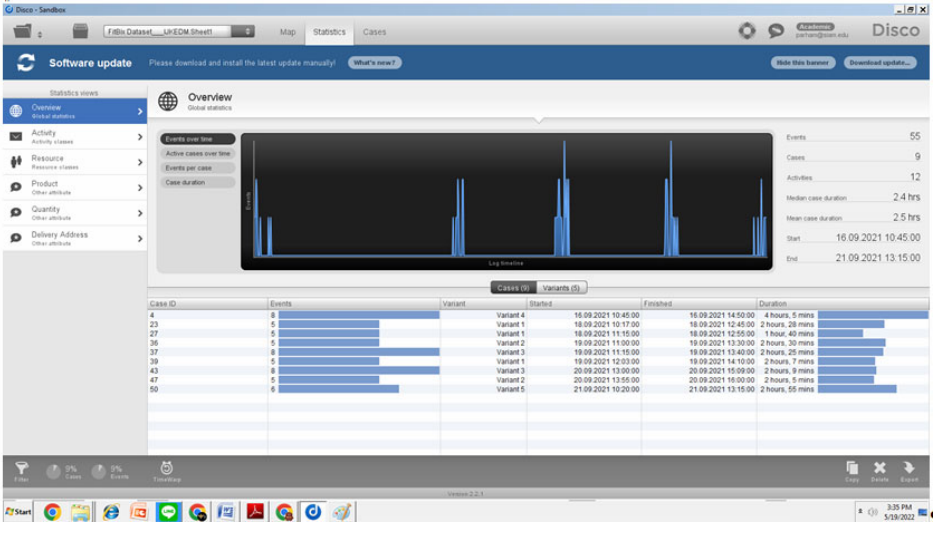
As shown in Figure 14(b), only 28% of cases (i.e., 28 customer orders made through Instagram DM, phone call or website) has been successfully (and eventually) delivered to the hands of the customers, which is not a big amount and indicates the company's problem in dealing with the received orders.

As shown in [Figure 15(a) and 15(b)], using the follower technique, we found out that only 9 cases (or 9 meal samples) have been successfully (and eventually) picked up by the customers and on average it has taken 2.5 hours to be delivered.

Figure 15 (a) and (b) only 9% of the meal sample customer orders has been eventually picked up (with delay) by the customers. on average, this process has taken 2.5 hours which is too long (see online version for colours)

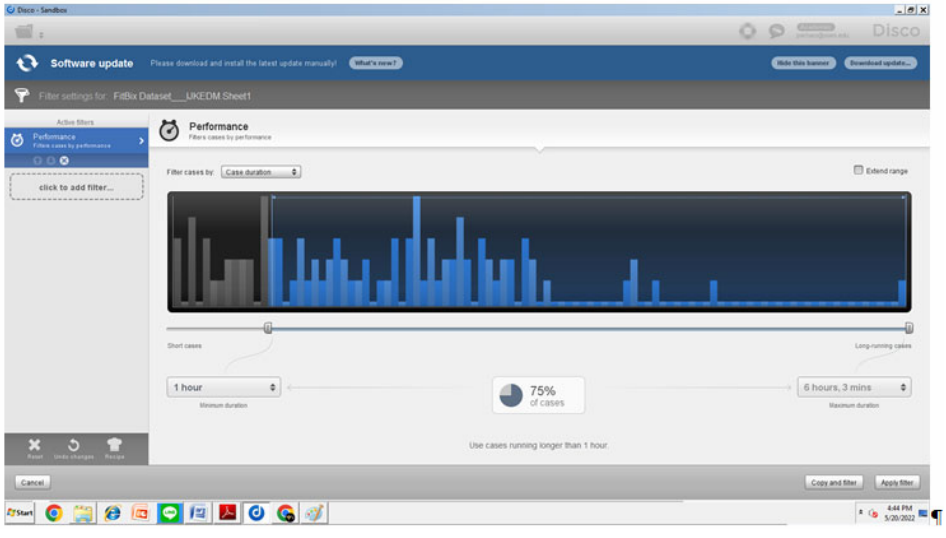


(a)

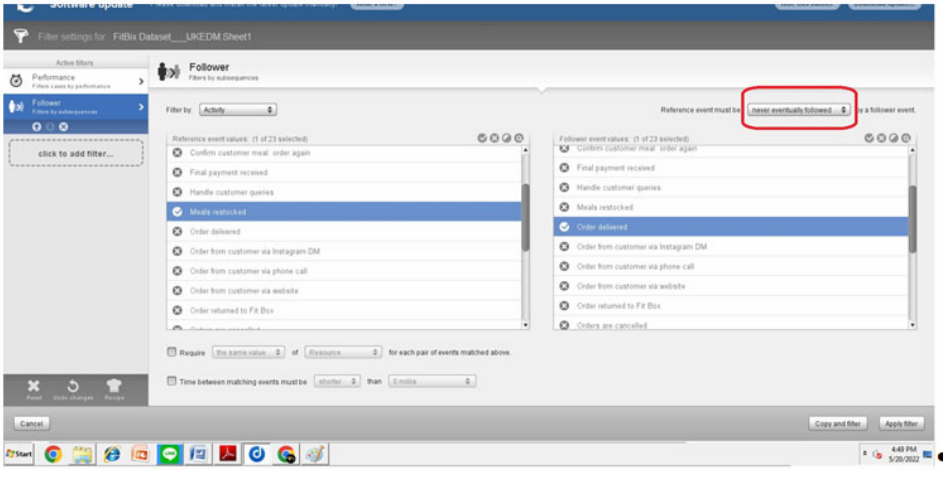


(b)

Figure 16 (a) (b) and (c): identifying if restocking of product is contributing to order delays using follower technique (see online version for colours)



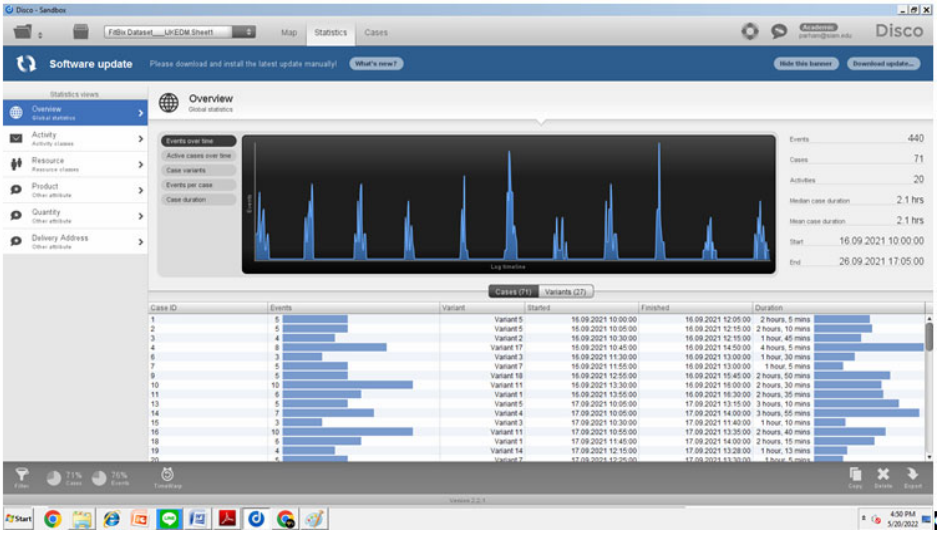
(a)



(b)

Note: The results show that in 71% of the cases, the restocking process has not eventually followed by the full delivery of the food items.

Figure 16 (a) (b) and (c): identifying if restocking of product is contributing to order delays using follower technique (continued) (see online version for colours)



(c)

Note: The results show that in 71% of the cases, the restocking process has not eventually followed by the full delivery of the food items.

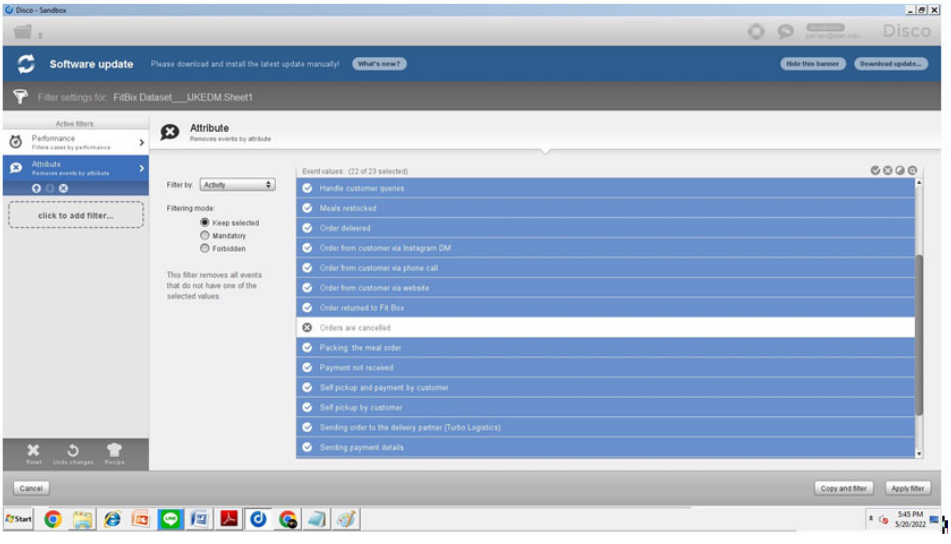
As shown in Figure 16(a), by looking at the statistical overview and after using the follower technique, it is obvious that 75% of the ordered meals have been delivered with delay. One possibility for delays is that the restocking process is not (eventually) performed before FitBox goes for the delivery. Even though there were no signs of cancelled orders, the customers still had to wait a long time to get their meals. This could lead to customer dissatisfaction and then lead to negative brand image for the company. For this reason, FitBox needs to regularly monitor their inventory and manage accordingly such that they do not need to restock in between as shown in [Figures 16(a) 16(b) and 16(c)].

We also applied both attribute filtering and performance filtering techniques on the entire process. Not taking the 'cancelled orders' into consideration, we found out that 22% of the cases/orders took less than an hour to be completed. In fact, the maximum 1-hour delivery time is the goal of the company, to make the delivery process smooth and efficient since FitBox's value proposition is based on the smooth delivery. But the concerning fact is that 78% of the total orders took more than an hour to be completed. These types of late delays will lead to customer dissatisfaction and as a result, the company will not be able to retain their customers (Porouhan, In-press). So, this issue should be taken into deep consideration and changes shall be made as soon as possible [see Figures 17(a) 17(b) and 17(c)].

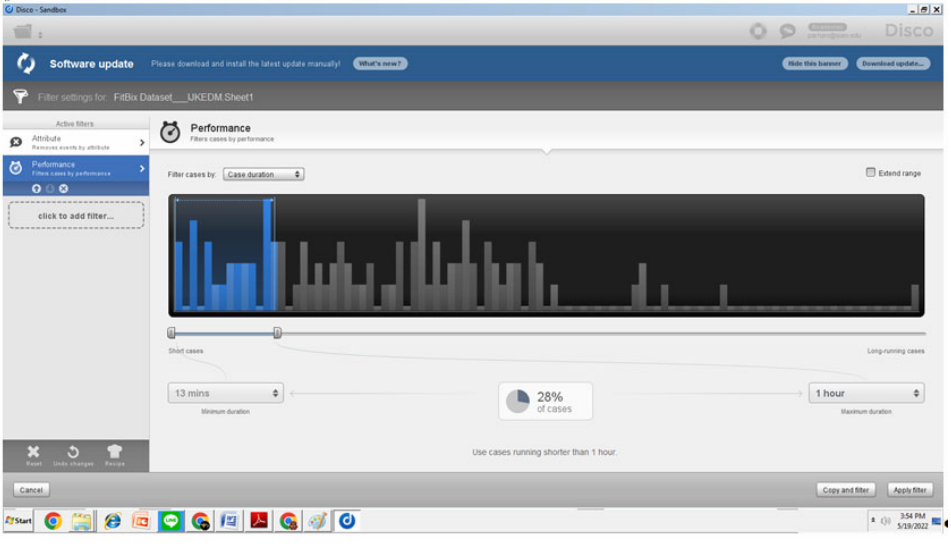
One of the interesting parts of the study is the organisational behaviour (or workload performance) analysis of the resources or the staff who have been in charge of handling each of the received customer orders. As shown in Figure 18, we can see that Iris has been the most hardworking employee of the FitBox as he has been involved in handling of 145 activities with a relative frequency of 25.17%. Quite opposite, Dick has been the least hardworking employee of the FitBox because she has been involved in handling of

only 39 activities with a relative frequency of 6.77% compared to her other coworkers. Similarly, the other employees who have been involved in handling of the received orders are: Sam, Richard, David and Alice, respectively (Porouhan, In-press).

Figure 17 (a) (b) and (c): identifying what percentage of total orders was delivered within 1-hour time framework based on the policies of the FitBox company (see online version for colours)



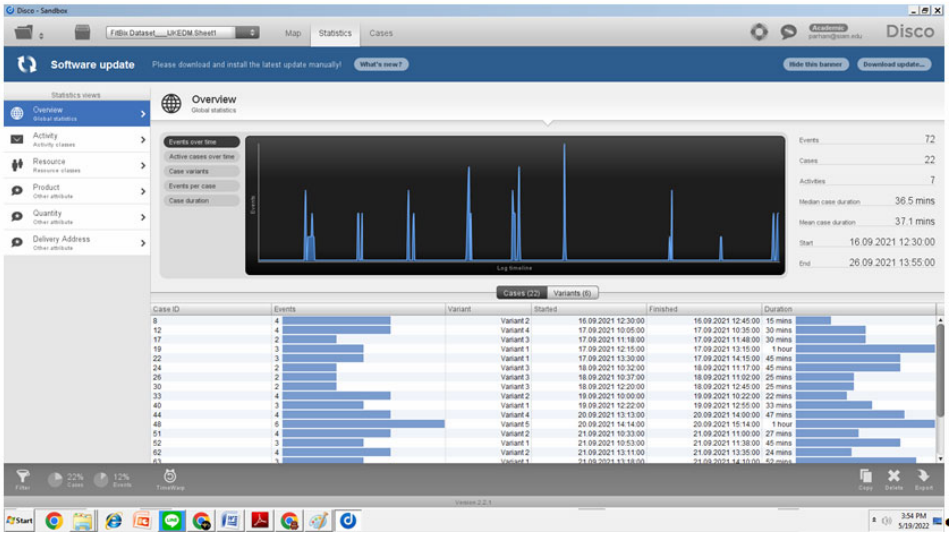
(a)



(b)

Note: To do this, the attribute filtering and performance filtering techniques were used, while excluding the 'cancelled orders'.

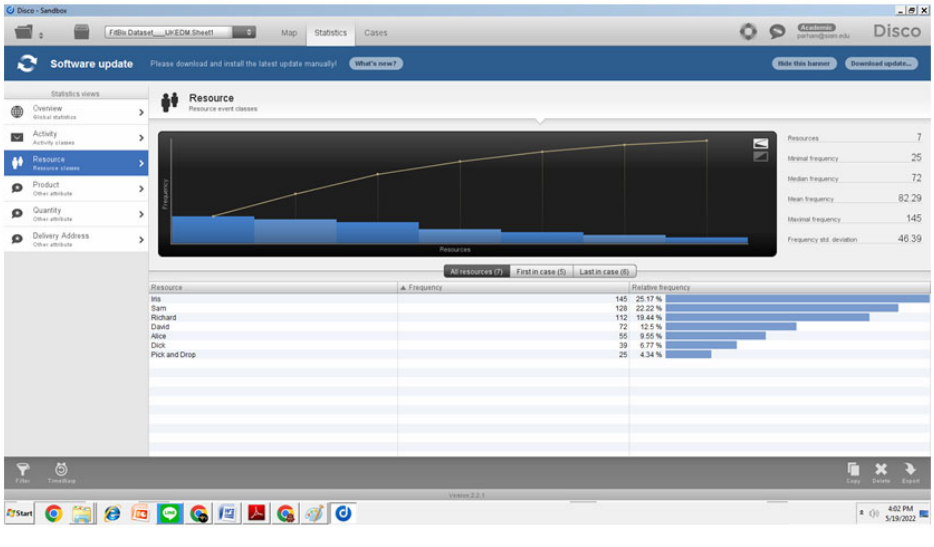
Figure 17 (a) (b) and (c): identifying what percentage of total orders was delivered within 1-hour time framework based on the policies of the FitBox company (continued) (see online version for colours)



(c)

Note: To do this, the attribute filtering and performance filtering techniques were used, while excluding the 'cancelled orders'.

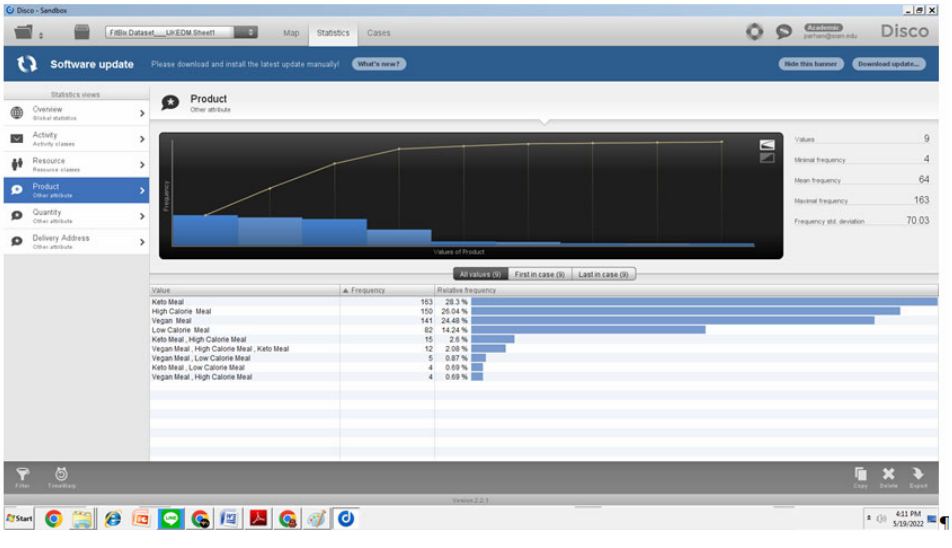
Figure 18 Identifying the workload of each employee based on the number of activities handled by them (see online version for colours)



The process in Figure 19 shows that keto meal is the most popular meal compared to all other meals. keto meal has been ordered 163 times which contributes to 28.3% of the total orders. On the other hand, both low-calorie (kato meal) and high-calorie (vegan

meal) seem to be the least popular meals in demand, while each of them has been ordered only 4 times by the customers with the lowest relative frequency of 0.69% compared to other meals. So in order to increase the orders of low-calorie (kato meal) and high-calorie (vegan meal), the FitBox Company needs to carry out diet related promotions. As there are also not very different varieties of meals that are being ordered by customers, meaning that they are not regularly consumed as a meal during lunch break at schools, offices and so on, for example. As a solution, some promotions such as product bundling, bringing out exclusive group packages, etc. might be practices and tested by the FitBox company.

Figure 19 Identifying popularity of the different meals offered in FitBox based on the number of customer orders for each type of the meals (see online version for colours)



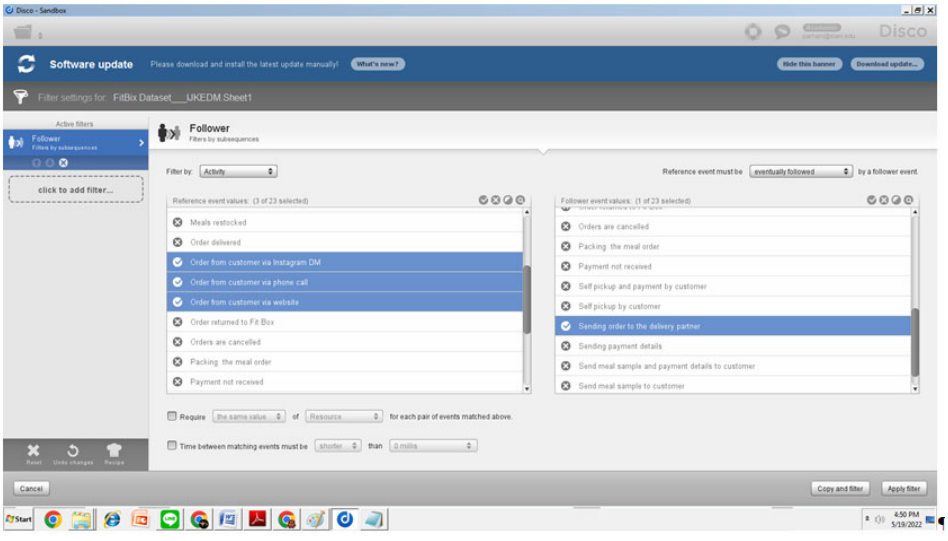
Using the follower technique, we can see that in 31% of the cases, the meals have been delivered to the respective customers through a logistics partner. So what happens is, orders get confirmed, meals are prepared and then in 45% of events (see Figure 20) the meals are sent out through a logistics partner. Here, the main concerning fact is that it takes a long to deliver the meals to the hands of the customers. To be precise, it takes 2.8 hours (on average) to just deliver the meals, which is completely against the company's goals and policies of having maximum 1-hour time framework. This causes the entire order management process to be longer than planned and required. The possible reasons (and scenarios) behind the long waiting times could be:

1 the lack of coordination and proper communication flow between FitBox and its delivery partners

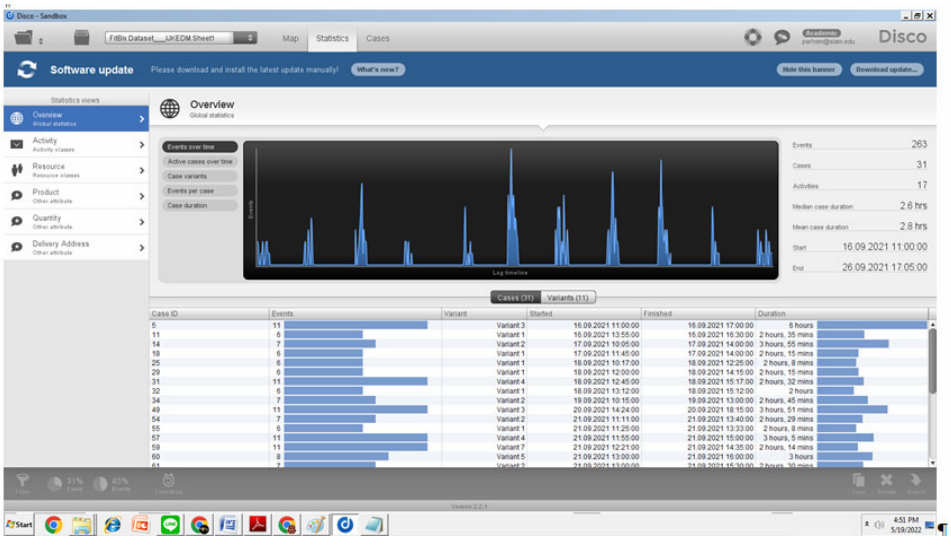
2 the customers' location (i.e., long distance) which may make the delivery process longer than expected.

In order to solve the problem, the FitBit company may pre-inform the customers about it so that they do not keep on waiting and get dissatisfied (Porouhan, In-press).

Figure 20 Identifying delivery from delivery partner leading to delayed completion of order using follower technique (see online version for colours)



(a)



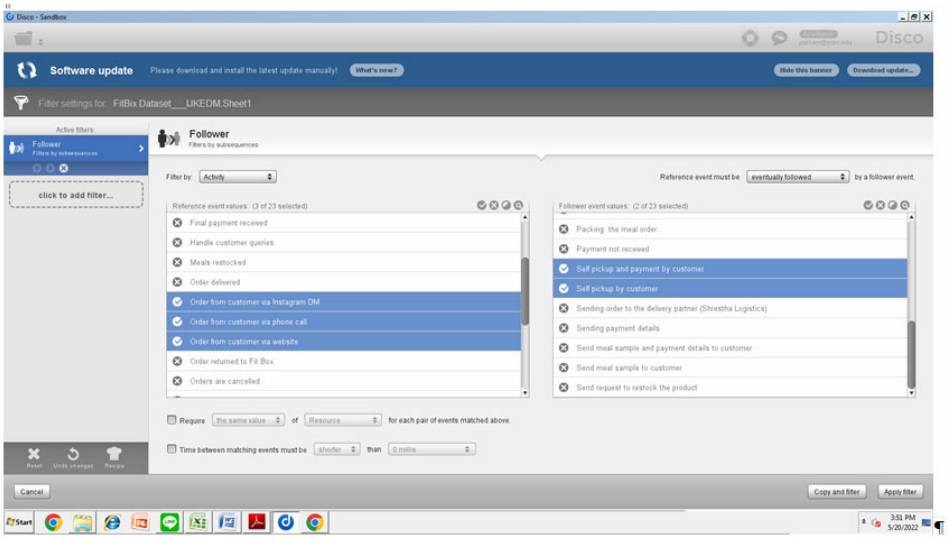
(b)

Figures 21(a) and 21(b) show that 40% of the time, customers picked up their orders on their own. Another major fact that can be drawn from this statistical view is the fact that the time taken for the completion of delivery is relatively low, just 119.5 minutes (on average) to be precise, indicating that the problem lies with the lack of coordination between FitBox and the delivery partner (Porouhan, In-press).

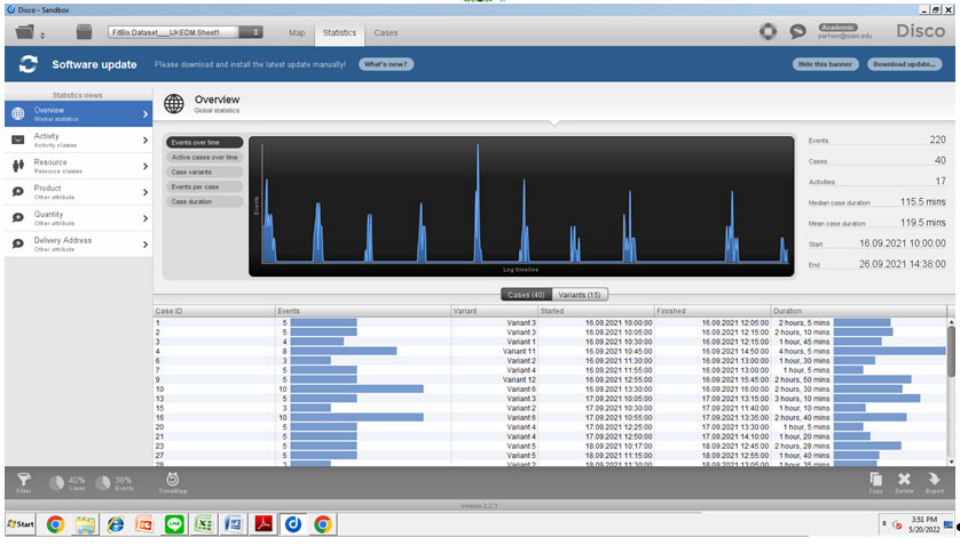
In order for us to identify the existing bottleneck in the process, we added a performance filter on the pre-existing process to focus on the long-running process (i.e., cases that ran for more than 1 hour but less than 2 hours) and we found out that 30% of

the cases has taken placed between a timeframe of 1-to-2 hours. However, their initial activities like taking customers, checking the kitchen, confirming the order, and sending payment details had no issue and they all went smoothly [see Figures 22(a) and 22(b)].

Figure 21 (a) and (b): Identifying self-pickup from customer leading to quick completion of order using follower technique (see online version for colours)



(a)

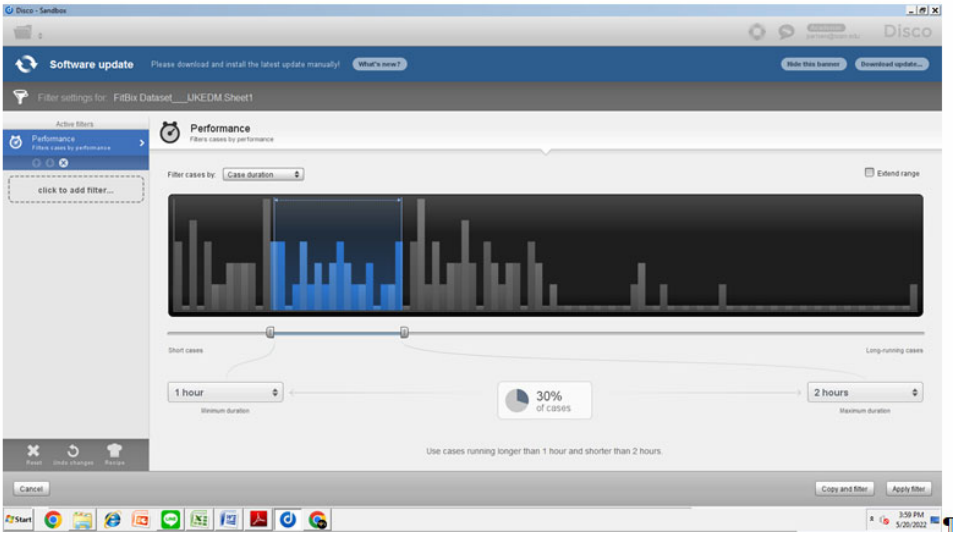


(b)

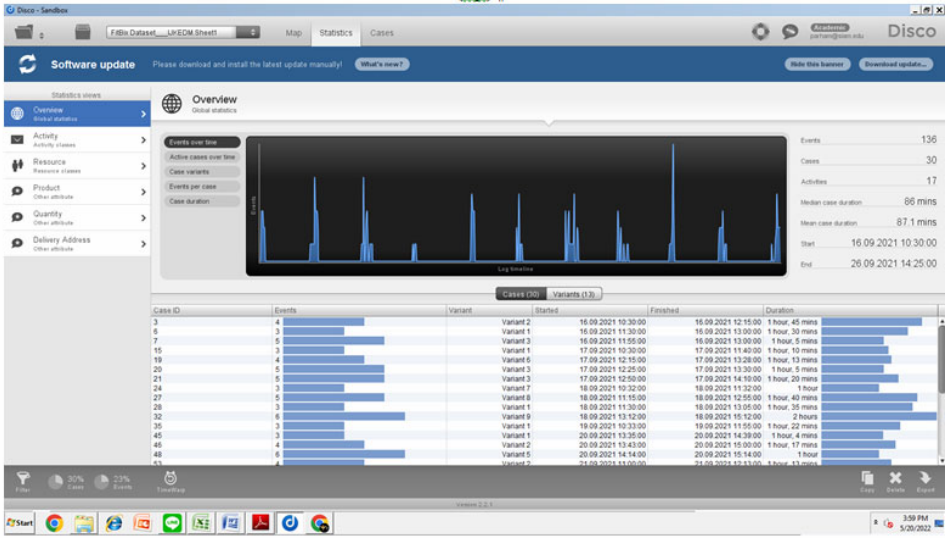
After switching from the 'performance view' to the 'frequency view' and by looking at the mean duration, we played the animation; we can see clearly that the time taken to send payment details in order to pack the meal is taking really long, causing delay in the delivery process (Porouhan, In-press). We can see the delay accumulating in the

packaging activity and this is clearly considered as a bottleneck in this particular process [see Figure 23(a) and 23(b)].

Figure 22 (a) and (b) Identifying what percentage of orders was delivered within a timeframe of 1 to 2 hours using the performance filtering technique (see online version for colours)



(a)

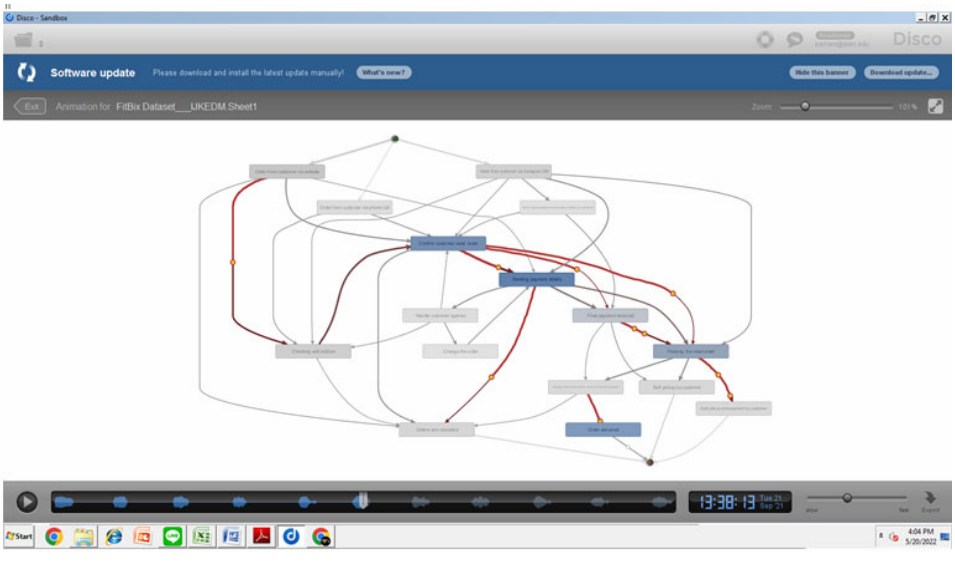


(b)

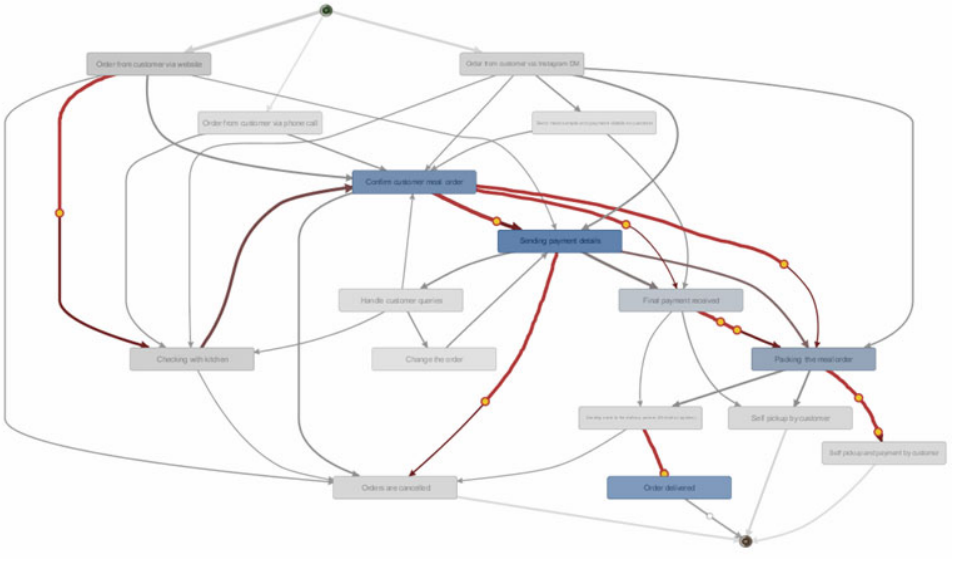
Furthermore, we looked at the handover of the performed tasks completed by the human resources of FitBox to investigate any possibility of human workforce problems leading to the bottleneck in the process. It was found out that the reason why sending payment details –after confirming the customer's meal order– is really long is due to the fact that Iris, Sam and Richard are having too much workload to handle. By taking into

consideration that only three of these people are the only ones in charge of the financial activities, then the occurred delay makes sense and it is not surprising anymore. Handling many tasks has probably made them to forget sending the payment receipts to the customers as shown in Figure 24.

Figure 23 (a) and (b): identifying the potential bottleneck in the order management process (see online version for colours)

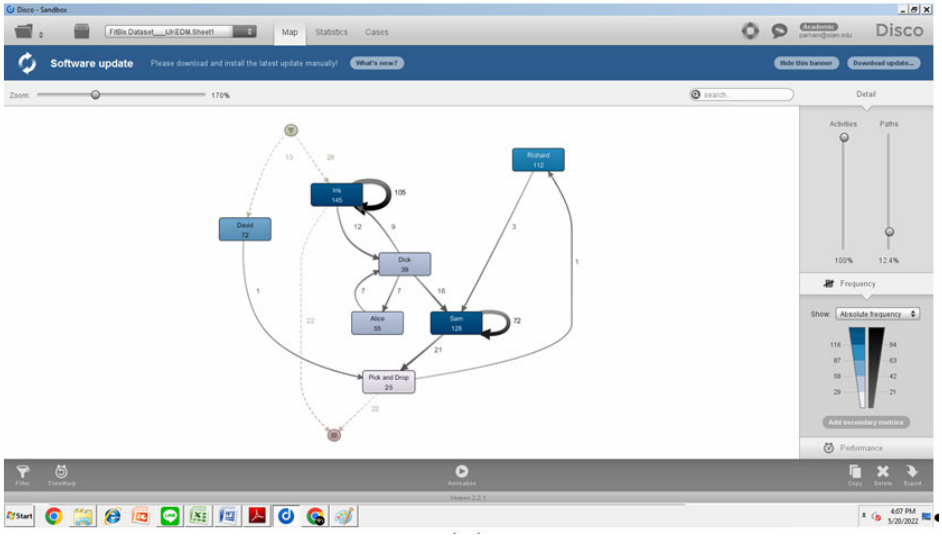


(a)

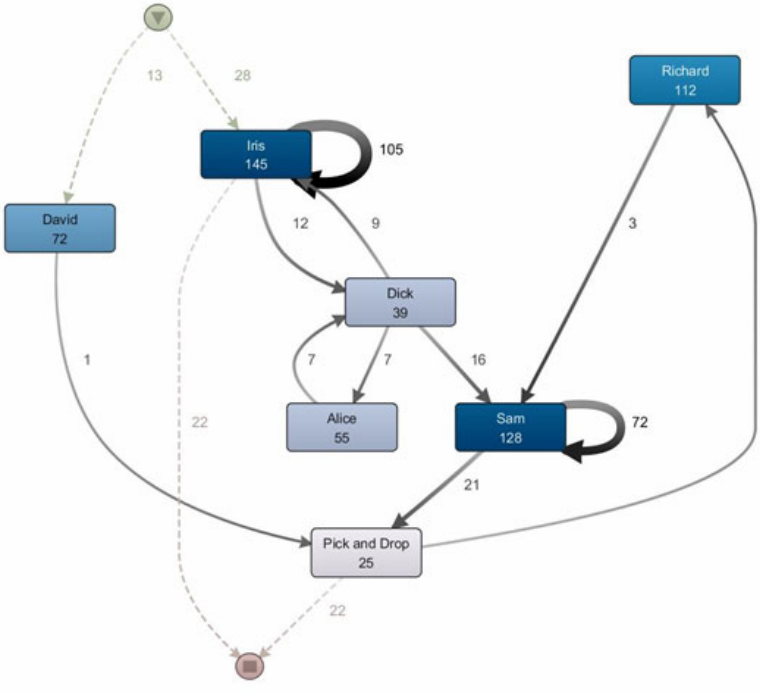


(b)

Figure 24 (a) and (b): identifying the workload of each employee in FitBox (see online version for colours)



(a)



5 Conclusions

As mentioned earlier, the main purpose of the study is to investigate the reasons why a lot of complaints (by customers) have been made against the quality of 'food delivery service' in one of the FitBox branches. Especially in this era and during the COVID-19 pandemic, it is extremely important for food retailers such as FitBox to handle the orders received from their in a timely and efficient manner. In order to achieve the objective of the study, the whole dataset of the notorious branch, which was previously stored and collected with an Information System in the branch's shop, was initially cleansed and then imported to the process mining tool/platform; fluxicon disco. Using several process mining techniques –such as automated process discovery (i.e., supported by fuzzy miner algorithm and in terms of frequency and time performance metrics), filtering (through follower, performance, endpoint and attribute metrics), clustering, process map animation/simulation and having access to detailed statistics analytics– enabled us to find out the roots of the problem in terms of any violations from the company's policies, and the mean/average waiting times spent by the customers, through spotting bottlenecks where the food delivery work has been piled up. The study also includes an analysis of handover of tasks in the course of who did what in accordance with each employee's job description and organisational duties/assigned tasks and roles (Gunther et al., 2020; Lin et al., 2020; Xue et al., 2021; Ariffin et al., 2021; Beckmann et al., 2020; Behrens et al., 2020; Nick et al., 2021; Schuh et al., 2020; Xue et al., 2021). For more details and information about the FitBox dataset used in this study please refer to Appendixes 1–14).

After processing the data supplied by FitBox, we came to know that there are a lot of issues regarding delay in orders as well as cancellation of orders. Some of the discovered problems and issues are listed below:

- The data collection process of the event log used in this study starts on 16th of September 2021, 10:00 AM and ends on 26th of September 2021 05:05 PM. This means that the total time span of the data is taken over a period of 11 days. There are totals of 100 case IDs in our data, with 23 activities in which 576 events were recorded.
- According to the statistics data, the branch of FitBox has received most of its orders from customers via websites with a relative frequency of 10.42%, followed by Instagram DM with a relative frequency of 5.21% and via phone call with a relative frequency of 1.74%. The most frequent activity is 'sending payment details' (12.85 %), 'confirm customer meal orders' (12.15%) and also 'sending orders to delivery partners' (5.38%).
- Furthermore, in some cases, the orders have been cancelled immediately after payment details were sent. The results of the study show that 60% of the customers have placed their orders through FitBox's website which does not come as a big surprise due to the growing use of technology. Unfortunately, the statistics showed that 30% of the customers have cancelled their orders. On the other hand, only 28% of Cases (i.e., 28 customer orders made through Instagram DM, phone call or website) has been successfully (and eventually) delivered to the hands of the customers, which is not a big amount and indicates the company's problem in dealing with the received orders.

- By looking at the statistical overview and after using the follower technique, it is obvious that 75% of the ordered meals have been delivered with delay. One possibility for delays is that the restocking process is not (eventually) performed before FitBox goes for the delivery. Even though there were no signs of cancelled orders, the customers still had to wait a long time to get their meals. This could lead to customer dissatisfaction and then lead to negative brand image for the company.
- In addition, packing meal orders also has taken more than needed time maybe due to the insufficient human resource in the kitchen.
- According to the findings of the study, Iris has been the most hardworking employee of the FitBox as he has been involved in handling of 145 activities with a relative frequency of 25.17%. Quite opposite, Dick has been the least hardworking employee of the FitBox because she has been involved in handling of only 39 activities with a relative frequency of 6.77% compared to her other co-workers. Similarly, the other employees who have been involved in handling of the received orders are: Sam, Richard, David and Alice, respectively.
- In addition, keto meal has been the most popular meal compared to all other meals. keto meal has been ordered 163 times which contributes to 28.3% of the total orders. On the other hand, both low-calorie (kato meal) and high-calorie (vegan meal) seem to be the least popular meals in demand, while each of them has been ordered only 4 times by the customers with the lowest relative frequency of 0.69% compared to other meals. So in order to increase the orders of low-calorie (kato meal) and high-calorie (vegan meal), the FitBox company needs to carry out diet related promotions. As there are also not very different varieties of meals that are being ordered by customers, meaning that they are not regularly consumed as a meal during lunch break at schools, offices and so on, for example (Porouhan, In-press).
- In addition, in 31% of the cases, the meals have been delivered to the respective customers through a Logistics Partner. So what happens is, orders get confirmed, meals are prepared and then in 45% of Events the meals are sent out through a logistics partner. Here, the main concerning fact is that it takes a long to deliver the meals to the hands of the customers. To be precise, it takes 2.8 hours (on average) to just deliver the meals, which is completely against the company's goals and policies of having maximum 1-hour time framework. This causes the entire order management process to be longer than planned and required.

Subsequently, we come to a conclusion that the company has to improve all areas of the order processing function. Since, the follower filter suggested the fact that majority of orders are placed by customers through the company's website, FitBox should make sure that their server is always stable, the website should be appealing and it should be regularly updated in order to let the customers know what meals FitBox has available for them. Also, running through the data and analysing them through filters, we found that the majority of the errors are made not because of technical errors but human errors. This suggests that a food company like FitBox can go digital and start providing service to their customers through automation in order to lessen the delays caused by mishandling of order placement, delay in sending receipts and payments and so on. Apart from those issues, we also found that there were huge delays in delivery problem because the company had to restock their supplies. For this, the company needs to keep a digital track of how much supply they have and make meals available to the customers accordingly on

their websites on an everyday basis. Even if they adapt to the automated system, they will still require human resources. For instance, in the case of FitBox, they will require additional staff in the kitchen in order to accelerate the meal preparation and packing process since this is one of major issues causing bottlenecks in the process. So, in order for the human resources to perform their tasks diligently, they will require a supervisor who can allocate their work properly and keep track of them in order to help them from getting confused with their tasks. Aside from this, they can even build a proper service blueprint to ensure proper delegation and standardisation of work. Lastly, FitBox can send feedback forms to their customers in order to know what they need to improve on and what they are doing better (Porouhan, In-press).

The data processing has provided gaps that the company needs to work on. However, there may still be some issues which were left unseen in the data so it would be best if the company reached out to the customers by themselves and heard them out. Moreover, we analysed the fact that some of the orders were getting cancelled because the customers felt like the price didn't resonate with the value which the meal was providing. For this, FitBox can conduct marketing schemes and communicate their value for customers accordingly. If this still does not work, they will need to rearrange their products or the price points for their products and then market it again to their target customers in order to make sure that last moment cancellations do not occur.

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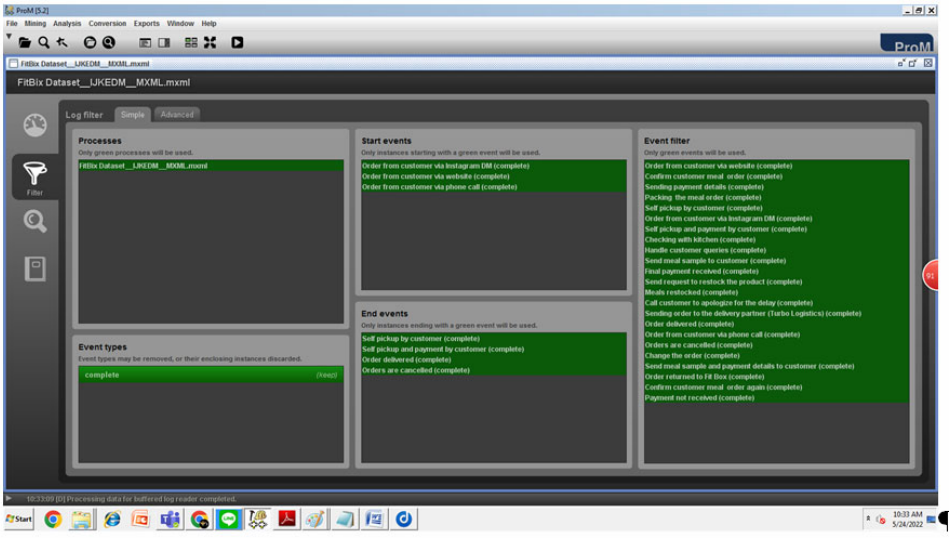
Appendix 1

An overview of the FitBox dataset used in this study supported by ProM [5.2], process mining tool (see online version for colours)



Appendix 2

Log summary/source of the FitBox dataset used in this study

Log summary	
Number of processes: 1	
Total number of process instances: 100	
Total number of audit trail entries: 576	
Name: FitBix Dataset__IJKEDM__MXML.mxml	
Description:	
Attribute name	*Value*
Source	
Name: Fluxicon disco	
Description:	
Attribute name	*Value*
program	Fluxicon disco

Appendix 3

Process instances of the FitBox dataset used in this study

Process instances		
Number of process instances entries: 100		
Process instance	*Occurrences (absolute)*	*Occurrences (relative)*
1, 10, 100, 11, 12, 13, 14, 15, 16, 17, 18, 19, 2, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 3, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 4, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 5, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 6, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 7, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 8, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 9, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99	1	1%

Appendix 4

Log events of the FitBox dataset used in this study

Log events			
Number of audit trail entries: 23			
Model element	*Event type*	*Occurrences (absolute)*	*Occurrences (relative)*
Sending payment details	Complete	74	12.847%
Confirm customer meal order	Complete	70	12.153%
Packing the meal order	Complete	65	11.285%
Order from customer via website	Complete	60	10.417%
Checking with kitchen	Complete	49	8.507%
Final payment received	Complete	40	6.944%
Orders are cancelled	Complete	32	5.556%
Sending order to the delivery partner (Turbo logistics)	Complete	31	5.382%
Order from customer via Instagram DM	Complete	30	5.208%
Order delivered	Complete	28	4.861%
Self pickup by customer	Complete	20	3.472%
Handle customer queries	Complete	13	2.257%
Order from customer via phone call	Complete	10	1.736%
Change the order	Complete	7	1.215%
Send meal sample and payment details to customer	Complete	5	0.868%
Send meal sample to customer	Complete	4	0.694%
Send request to restock the product	Complete	4	0.694%
Meals restocked	Complete	4	0.694%
Call customer to apologise for the delay	Complete	4	0.694%
Order returned to FitBox	Complete	3	0.521%
Confirm customer meal order again	Complete	2	0.347%
Payment not received	Complete	1	0.174%

Appendix 5

Starting/ending log events of the FitBox dataset used in this study

Starting log events			
Number of audit trail entries: 3			
Model element	*Event type*	*Occurrences (absolute)*	*Occurrences (relative)*
Order from customer via Website	complete	60	60%
Order from customer via Instagram DM	complete	30	30%
Order from customer via Phone Call	complete	10	10%
Ending log events			
Number of audit trail entries: 4			
Model element	*Event type*	*Occurrences (absolute)*	*Occurrences (relative)*
Orders are cancelled	complete	32	32%
Order delivered	complete	28	28%
Self pickup by customer	complete	20	20%
Self pickup and payment by customer	complete	20	20%

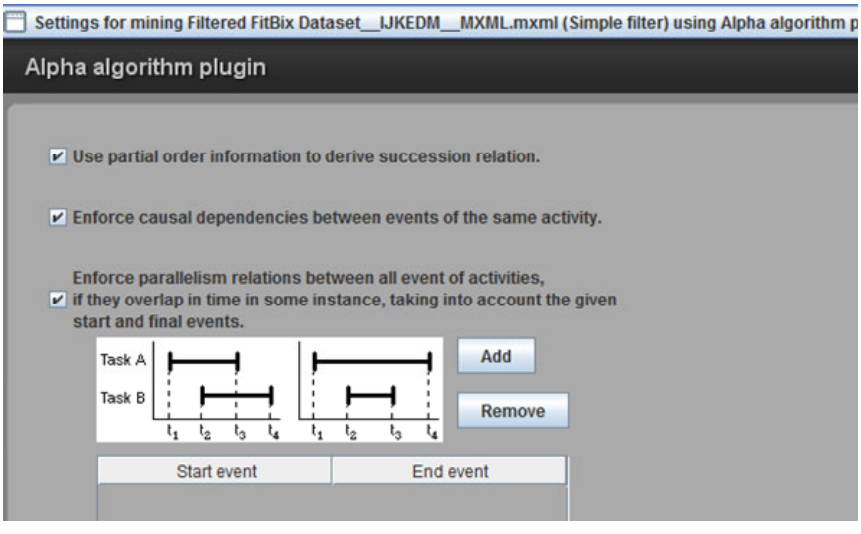
Appendix 6

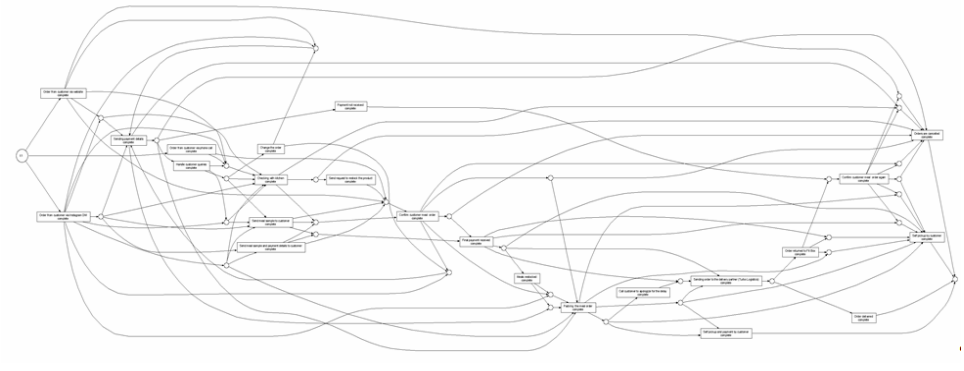
Originators/resources of the FitBox dataset used in this study

Originators		
Number of originators: 7		
Originator	*Occurrences (absolute)*	*Occurrences (relative)*
Iris	145	25.174%
Sam	128	22.222%
Richard	112	19.444%
David	72	12.5%
Alice	55	9.549%
Dick	39	6.771%
Pick and drop	25	4.34%

Appendix 7

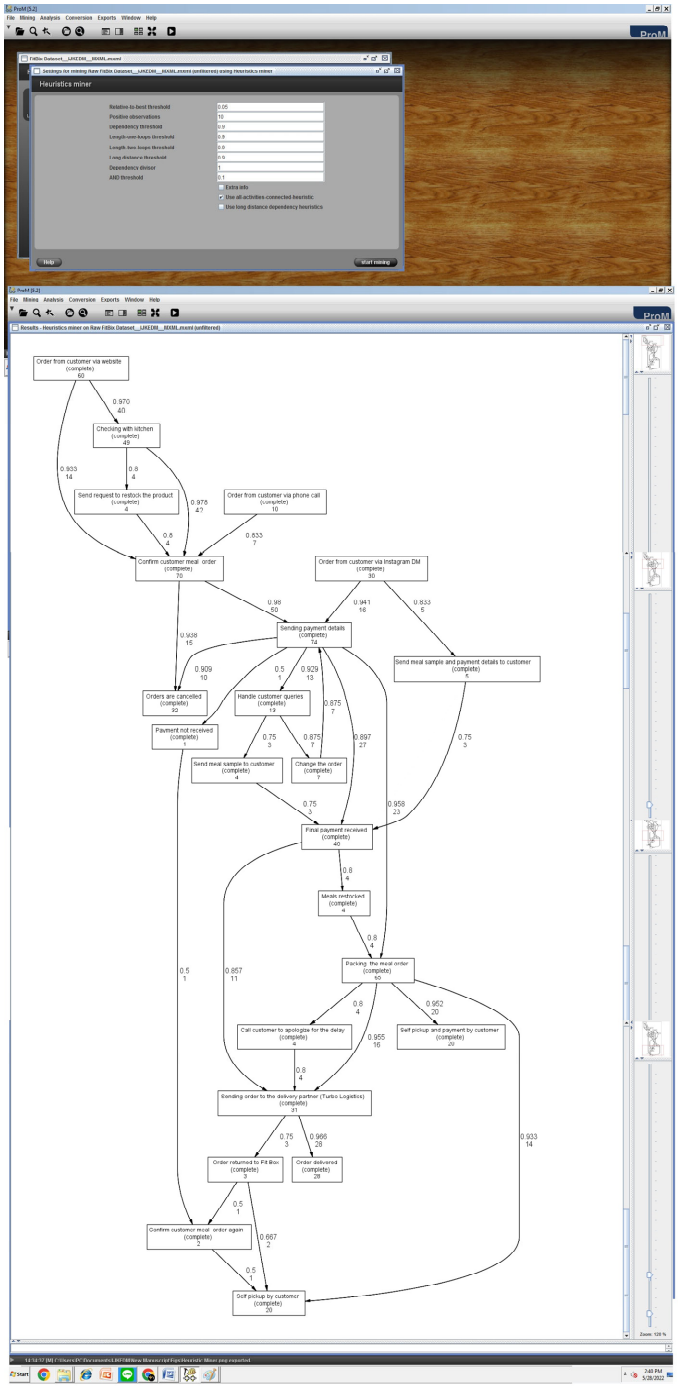
The resulting 'Alpha miner graph/model' applied on the FitBox dataset through ProM [5.2] process mining tool (see online version for colours)





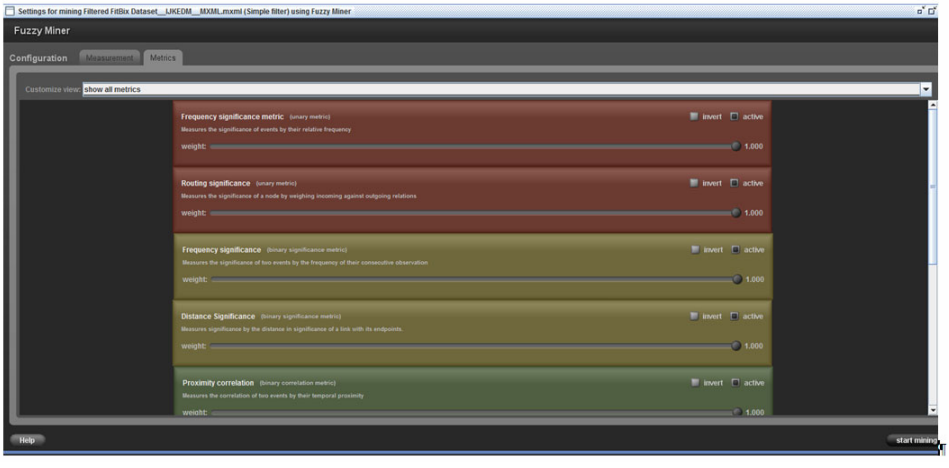
Appendix 8

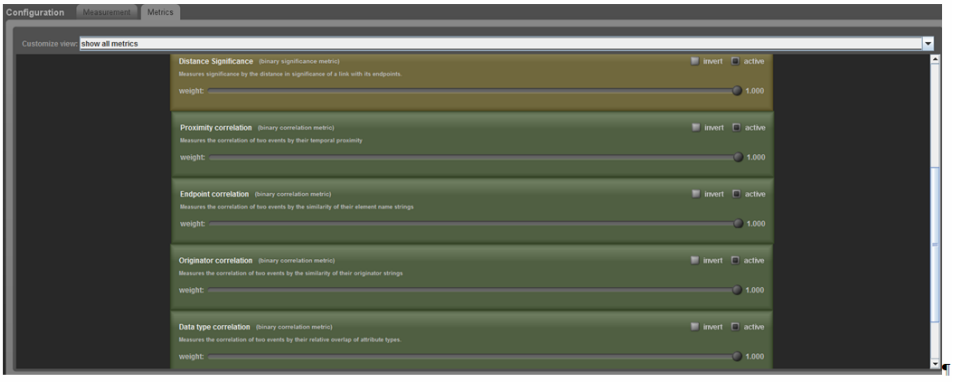
The resulting 'Heuristic miner graph/model' applied on the FitBox dataset through ProM [5.2] process mining tool (see online version for colours)

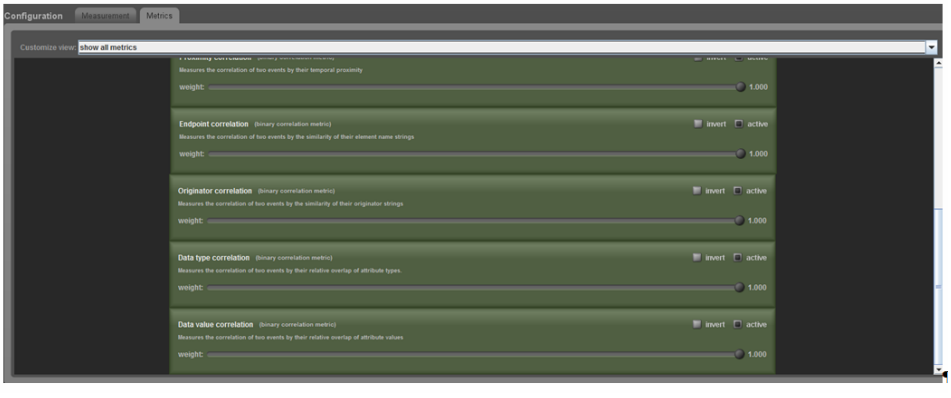


Appendix 9

Configuration settings of the 'fuzzy miner algorithm' applied on the FitBox dataset through ProM [5.2] process mining tool (see online version for colours)

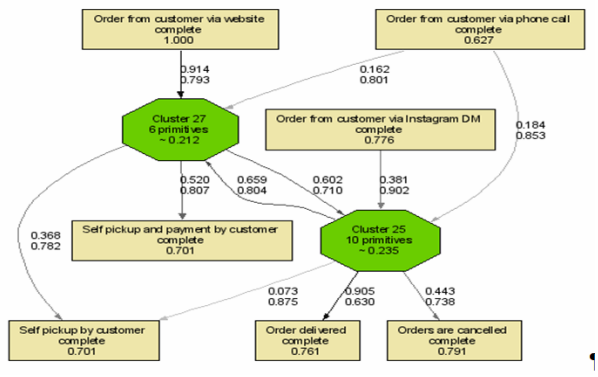


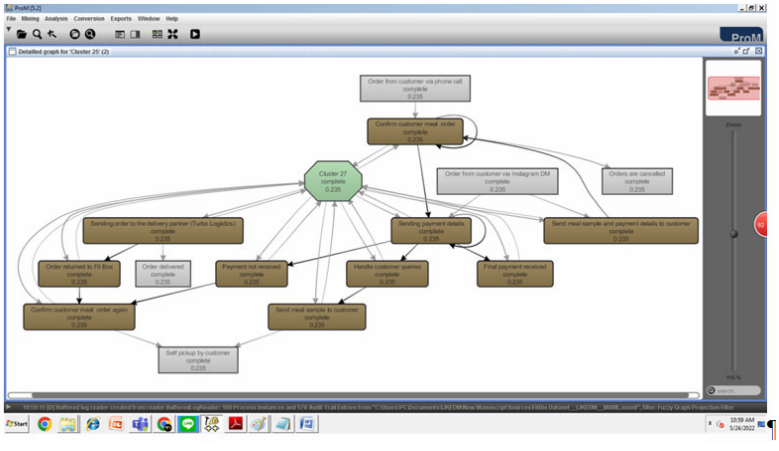


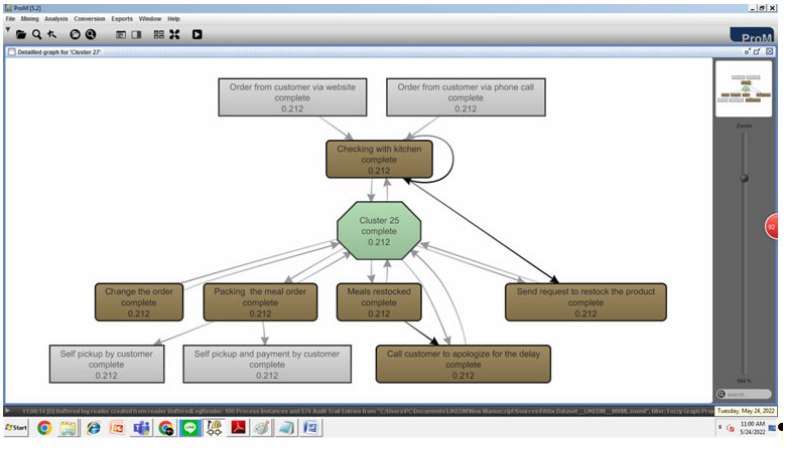


Appendix 10

Three resulting 'Fuzzy miner graphs/models' obtained from the FitBox dataset through ProM [5.2] process mining tool (see online version for colours)

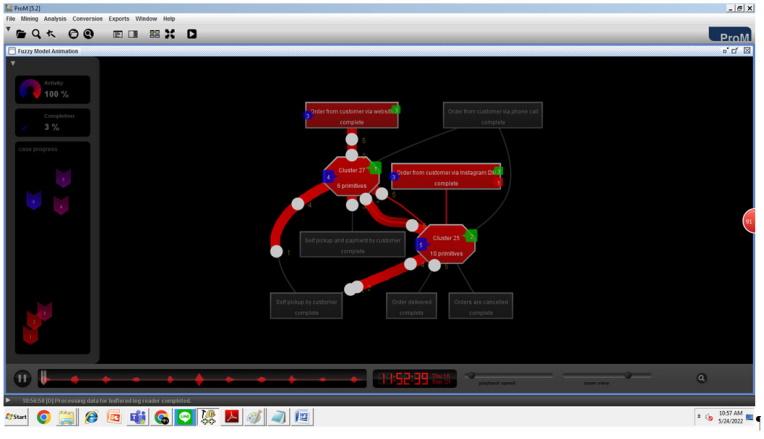






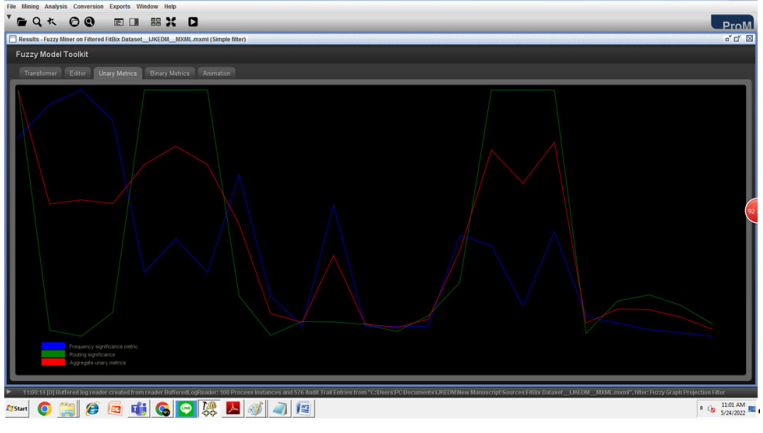
Appendix 11

The resulting 'Fuzzy miner animation/simulation' to spot and discover the bottlenecked areas, applied on the FitBox dataset through ProM [5.2] process mining tool (see online version for colours)



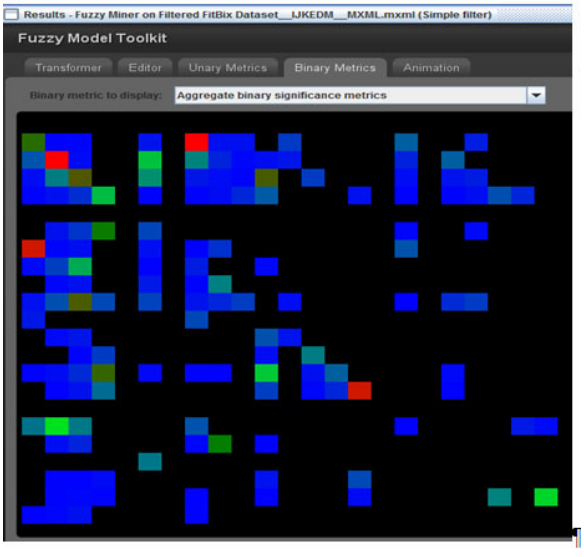
Appendix 12

'Unary metrics' of the FitBox dataset generated by ProM [5.2] process mining tool (see online version for colours)



Appendix 13

'Binary metrics' of the FitBox dataset generated by ProM [5.2] process mining tool (see online version for colours)



Appendix 14

Statistical details of the 'delivery address' of the orders in the FitBox supported by the Fluxicon disco process mining tool (see online version for colours)