Mobile Instant Messaging (M.I.M.) in Improving S.M.E. in Manufacturing: Case Study

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ABSTRACT

It is reported in the literature that there are widespread adoption and use of Mobile Instant Messaging (M.I.M.) among businesses. However, there is a lack of academic publication in this area that demonstrates by means of a case study that the M.I.M. implementation for S.M.E.'s can improve operational processes. In this case study, the company recently moved much of its Product Ordering (P.O.) processes to a freely accessible M.I.M. app. The paper uses a combination of qualitative and quantitative analysis to evaluate the impact of the change. Quantitative and qualitative analysis confirms that the introduction has enhanced the P.O. process. The analysis shows that the timeline for the full P.O. process is significantly shortened. The speed of communication allowed faster processing, approval and delivery. The paper presents the first case study that looks at how M.I.M. processes can enhance an S.M.E.'s operations.

Keywords: Mobile Instant Messaging, BPMN, Automation, System Enhancement.

INTRODUCTION

In the age of information, more and more small and medium enterprises (S.M.E.) are seeking ways to improve their communication channels and processes. A common concern to any company seeking to introduce a new system is the breakeven analysis of cost, including application, hardware, and training costs. However, the introduction of freely available and accessible Mobile Instant Messaging (M.I.M.) gives the option to more users to move some of their communication to M.I.M. (Church, & De Oliveira, 2013). According to Cameron and Webster (2005), even before M.I.M. became popular, there was already widespread adoption of Instant Messaging (I.M.) among Canadian companies. An efficient and effective electronic communication system is vital in the growing sector of manufacturing products based on Production Orders (P.O.), (Saniuk & Jakábová, 2012). These communication channels need to meet the managers and employees' needs and expectations who, in many cases, already have mobile devices and are using similar applications in their everyday communications. These characteristics encouraged some small to medium-sized businesses to consider integrating existing M.I.M. systems into their everyday business operations. This article looks at a particular S.M.E. case study and provides a means to compare before and after the introduction of M.I.M. into its business communications. The paper starts with a literature review, then the case study, the methodology, the results, the analysis, and finally the conclusion.

LITERATURE REVIEW

Traditionally, the focus of using mobile technology was on building commerce links with end consumers. Mobile commerce can enhance business efficiency by distributing information to the workforce remotely and offering new channels to interact with the consumer (Leung & Antypas, 2001).

Significant investments have been made to advance mobile technologies and applications. However, progress in the application of mobile technologies in business is slower than expected (Chapman, 2002). Mobile technologies have primarily been applied in consumer-oriented areas, while the business world still awaits larger-scale usage (Gebauer & Shaw, 2004). And while the study of Gebauer and Shaw may have been true in 2004, there is evidence that companies are starting to embrace mobile technologies in their operations. Evidence, going back to 2002, suggests that mobile technologies were being applied in business environments (Gebauer & Shaw, 2002; Singh & Thomson, 2002; Müller 2005). Yet there is no known case study published on how the introduction of M.I.M. would enhance key business processes, the implications of mobile technologies, or how to measure their impacts (Gebauer & Shaw, 2004). Varshney et al. (2002) further suggest that organisations capable of harnessing mobile technologies' power to automate and streamline business processes may reap the benefits of improved productivity, lowered operational costs, increased customer satisfaction, and improved decision making.

From the early days of I.T. innovation in business, research has long pointed out the importance of matching information systems with the organisational tasks to be supported or automated, as a precursor to system use and subsequent benefits (Nystrom & Starbuck, 1981, pp. 84-104; Tornatzki & Klein, 1982, 28-45).

M.I.M. was first described by Parviainen Parnes (2003) as Instant Mobile Messaging moving instant messaging from P.C. to mobile technology. At the time, the technology was marred with technical problems. But the desire to develop Instant Messaging (I.M.) to mobile phones has come from the perceived benefits of such portability. Quan-Haase et al. (2005) suggest that I.M. applications differed from emails primarily in their focus on the immediate delivery of message through (1) a "pop-up" mechanism to display messages the moment it is received, (2) a user-generated visible list of other users and (3) a mechanism for indicating when "buddies" are online and available to receive messages. These are the same characteristics one expects to see in M.I.M. application; only pop-ups are now replaced with notifications. Many of the M.I.M. include features that confirm message is sent, delivered, and read (Church, & De Oliveira, 2013). Thus, the literature agrees that M.I.M. can be the I.T. innovation tool for modernisation for some key S.M.E.s processes. M.I.M. represents a communication technology that allows users to send and receive text, images, videos, geographic location, real-time messaging, and to see who else is online. Add to these features the availability of image, passive acknowledgement of delivery, and voice messaging (Chang, Chen, & Zhou, 2009). Security and integrity of these apps represent another challenge for businesses. However, the confidence in the security delivered in apps has increased with the introduction of trusted app stores (Safieddine, 2017).

Use of Mobile Instant messaging in business:

Cameron and Webster's (2005) study on I.M. usage by 19 employees from four organisations suggests that critical mass is among the core explanations for the widespread adoption of I.M. I.M. is considered appropriate when senders wanted to emphasise the intentionality of messages, elicit quick responses and enhance effective communication. However, this study did not consider the process of integrating business operations using M.I.M.

Integrating a M.I.M. application in the business operations would bring changes to the process and outcome. Dewan & Kraemer (2000) suggest that any technological introduction to the company would impact the company's performance. However, the I.T. Business Value depends on a variety of factors, including the type of I.T., management practices, organisational structure, and the competitive and macro environment (Brynjolfsson et al, 2002). The term I.T. business value is commonly used to refer to I.T.'s organisational performance impacts, including productivity enhancement, profitability improvement, cost reduction, competitive advantage inventory reduction, and other measures of performance (Devaraj and Kohli, 2003; Hitt and Brynjolfsson, 1996).

Thus, the introduction of a M.I.M. application in the company's operations should impact the total performance. Furthermore, as mentioned beforehand, organisations obtain improved productivity, lowered operational costs, increased customer satisfaction, and improved decision-making if they can bind mobile technologies' power to streamline business processes (Varshney et al., 2002). M.I.M. can enhance the transmission of content in manufacturing companies leading to enhanced business efficiency (Leung & Antypas, 2001). The make-to-order (M.T.O.) sector of enterprises, which manufacture their products according to production orders, has grown. Low costs and short time of production order realisation have become critical success factors in M.T.O. (Saniuk & Jakábová, 2012). Manufacturing companies could strive to reduce the time of business processes that do not cause deterioration in the quality of the manufactured products.

CASE STUDY

For the case study, the team looked at Nakhoul Corporation (N.C.) sarl. Established in 1976, N.C. manufactures, supplies, and installs air distribution products in Lebanon, the Gulf Corporation Countries (G.C.C.) and Africa. A considerable part of the company's operations involves maintenance and repair calls. The company has a workforce that includes mechanical engineers, support employees, labours, computer-aided machine operators, management, and professional service staff. In total, the company employs around 120 persons (Nakhoul Corporation, 2018).

The company signs contracts for supplying the products and assign an operation manager. The operation manager appoints a site foreman for the project. In this context, the role of a site foreman is vital. The site foreman is responsible for getting the right information to the company, ensuring that the project is delivered on time and in good quality and reducing errors and speeding up the delivery process. A site foreman conducts tests and inspection of products and services to ensure it meets quality standards. It is the responsibility of the foreman to ensure that a project is completed to the acceptable standards. The foreman must understand from blueprints how the finished project looks, and thus, it is their responsibility for products take-off. A site foreman also communicates with others involved in the project to convey necessary information and facilitate production and delivery schedules.

The goal of production planning is to schedule production economically, so a company can ship goods to its customers as soon as possible, or at the promised delivery dates, in the most cost-efficient manner. The primary production approaches are make-to-order, make-to-stock and the assemble-to-order (Wagner and Monk, 2013).

- Make-to-order: items are produced to fill specific customer orders; companies usually take this approach when producing items that are too expensive to keep in stock or items made or configured to customer specifications.
- Make-to-stock: items are made for inventory or stock in anticipation of sales orders, or to make the later assembly or production faster.
- Assemble-to-order: items are produced using a combination of make-to-order and make-to-stock processes; the final product is assembled for a specific order from a selection of make-to-stock components. Furniture is a typical assemble-to-order product.

At Nakhoul Corporation, the conventional approach is the make-to-order and is as follow:

1. The foreman visits the site.
2. The foreman then takes-off as-built measurements and shapes, making sure that the product or the item fits.
3. Some items are to be produced for the first time; some items are missing because shop drawings are different than as-built drawings due to many reasons.
4. Site foreman comes back to the factory where he hands the production order to the production manager.
5. It is not always the case that the production manager agrees on the same assessment as the foreman. This may result in having another visit.
6. The operation manager is consulted with regards to changes.
7. The foreman either batches the orders by visiting multiple sites or drives back and forth after each visit to deliver the required forms.
8. Production commences as soon as the production manager approves the designs.
9. Delivery

Because of the lag between collecting the orders and passing these orders to production, the required parts cannot be manufactured or supplied until the next working day. And where this happens on the last day of the week, customers may end up with unrepaired or delayed delivery of up to three days.

The operation manager introduced M.I.M. to their operations, allowing the site foreman, operation manager, manufacturing, and sales direct access to the running of the operations, the process changed as follows:

1. The foreman visits the site.
2. The foreman takes-off as-built measurements and shapes, making sure that the product or the item fits.
3. The site foreman sends the request to the production manager directly via the M.I.M.
4. The operation manager approves, sends the confirmation for the production team instantly, and the production commences.

5. Where production manager disagrees, they are able to negotiate with the foreman on the phone. Where needed, video conference calls are also used.
6. The operation manager is always aware of developments and can get involved as they feel fit.
7. The production of orders would continue as needed.
8. The foreman arrives to work where in most cases all the orders have been completed.
9. The foreman delivers the orders.

METHODOLOGY

In order to get a better understanding of the processes involved in the case study, the paper uses Business Process Modelling (BPMN) tool for before and after the introduction of M.I.M. system. The team did consider several of the business process modelling tools available in the market; Business Process Flowchart, UML Use case diagram and Activity Diagram, UML EDOC Business Processes, deployment flowchart, IDEF process mapping, Activity-Decision Flow (A.D.F.) Diagram, Event-Process Chains (E.P.C.s) and Business Process Model and Notation (BPMN). BPMN was first introduced in 2004 and has continuously developed since. BPMN is an easy to read modelling tool that has now achieved standardisation status (White, 2008). According to Aagesen and Krogstie (2010), BPMN has become the most established modelling tool to model business processes. BPMN is attributed to making the visualisation of the processes and facilitates significantly easier. According to Birkmeier and Overhage (2010), the modelling tool allows discussions among all stakeholders, including analysts, designers, and organisation, while still modelling complex processes. BPMN success is evidence of the modelling language ability to find common grounds that present the business needs for visualising processes, and I.T. needs to represent intricate processes (Rodríguez, Fernández-Medina, and Piattini, 2007). Moreover, BPMN is an adaptable modelling language, allowing the development of an excessive level of details in areas of business events (Decker, Grosskopf, Barros, 2007), costs analysis (Magnani and Montesi D, 2007), Semantics (Khlif, Ben-Abdallah, & Ben Ayed, 2017), security and business rules (Milanovic, Gaševic, and Wagner, 2008).

However, BPMN has been criticised as less effective when used in large-scale projects for the model could become complicated and challenging to read (Zur Muehlen, Recker, Indulska, 2007). Thus, the team determined that the model is suitable for our case study. The processes involved are specific to key procedural processes linked to communication aspects of the manufacturing and supplying of products for the given case study. Finally, the team included an extension to BPMN that explicitly represents the timeline as an actor in the processes.

The team used a combination of paper trail collection, interviews, modelling and verification of models before and after the introduction of M.I.M. In this case, the company choose WhatsApp as their choice for M.I.M. service. Key to the methodology is the input collected from the company's operational manager, foreman, and manufacturing supervisor. The team collected the paper forms used to track and manage orders. Interviews with the stakeholders followed this. The first BPMN model is then designed. A walkthrough process is presented to stakeholders, and feedback is collected with regards to any discrepancies. Three months after the M.I.M. process had been introduced, the team met with stakeholder to study the changes to the procedural processes impacted by the introduction of the M.I.M. A new BPMN model is then developed to reflect the current processes. The model is cross-checked with the stakeholder to ensure it is representative of these processes. The team then evaluated both models and processes to identify process changes. These are cross-checked to identify where efficiencies had been introduced. This is then tested against the following hypothesis:

H^1: There is a measurable improvement in the procedural processes after the introduction of M.I.M. system to a given S.M.E. manufacturing company.

H^0: There is no measurable improvement in the procedural processes after the introduction of M.I.M. system to a given S.M.E. manufacturing company.

The paper assessed the improvements by means of qualitative and quantitative analysis that would reflect any possible reduction in redundant processes, quicker delivery, improved security, reduction in cost, and reduction of mistakes. The team used a walkthrough analysis using BPMN to identify quantitative improvement in delivery speed, including theoretical estimates of the improvements to the service. A comparable approach in the reflective analysis combined with modelling tool such as BPMN is used in Pourghomi et al. (2017), Safieddine & Nakhoul (2018), and Ismail, Safieddine, & Jaradat (2019).

Then the paper examined a month where orders had been taken using M.I.M. and conventional ordering. The paper conducted four semi-structured interviews with twelve regular customers to gauge their experience being part of both systems. The following are questions used during the semi-structured interview:

1 What is your line of operations?
2 How many years of experience do you have?
3 When making orders or custom orders, what are your thoughts about using M.I.M. (WhatsApp) as business communication tool?
4 Do you trust your communications are safe?
5 Compared to the conventional way of production order, do you feel the usage of M.I.M. has speeded your orders delivery, or delayed them, or has you did not feel any difference?

Because of meetings restrictions, the interviews were conducted using video calls. The analysis from the interview looked at consistency in themes and codes.

Finally, collating the qualitative and quantitative analysis has helped build a picture and allowed convergent validation of the findings. The paper examines the impact of the change in support or rejection of the hypothesis.

MODELLING THE PROCESSES

The two diagrams below illustrate the activities, information and roles for handling the procedural processes to managing the communication between the foreman, operation manager, and manufacturing.

Table 1 shows the standard order processes before the introduction of M.I.M. followed the following sequence of events.

Table 1. Dataflow for N.C. P.O. process

Timeline	Operation Manager	Foreman (F)	Production Order (P.O) Notebook	Production Department

Day 1	Collate and report orders		O.M. writes a list of P.Os.	
Day 1		Collects appointments		
Day 1		Visits the site		
Day 1		Prepares a P.O.	F. writes needed products to be manufactured	
Day 1		Visits a different site		
Day 1		Prepares a P.O.	F. writes needed products to be manufactured	
Day 1		Visits a different site		
Day 1		Prepares a P.O.	F. writes needed products to be manufactured	
Day 1	Checks and approves orders	Comes back to the company		
Day 1		Gives the P.O. to the Production department		Receives Day 1 P.O.
Day 1				Checks Day 1 P.O.
Day 2	Collate and report orders		O.M. writes a list of P.Os.	
Day 2		Collects appointments		
Day 2	Approves and maintain records		O.P. records further visit to resolve issues.	Reports problems with some orders
Day 2		Visits the site		
Day 2		Prepares a production order	F. writes needed products to be manufactured	Schedules manufacturing orders Day 1
Day2		Visits a different site		Process Day 1 orders
Day 2		Prepares a production order	F. writes needed products to be manufactured	Completes the order for Day 1
Day 2		Visits a different site		
Day 2		Prepares a production order	F. writes needed products to be manufactured	
Day 2	Checks and approves orders	Comes back to the company		
Day 2		Gives the P.O. to the Production department		Receives and Checks Day 2 P.O.

Day 2		Collects day 2 orders		
Day 2		Delivers day 1 orders		
After that, every day is a repeat of day 2 except for the last day of the working week where the delivery delays are extended beyond the weekend.				

This process is modelled into BPMN, as shown in figure 1.

As shown in table 1, there is, on average, a one-day lead time for most orders that extends to three days on the last day of the week. Statistically, this means that a 5 days order takes a total of 8 days to be delivered, giving an average turnover of 1.6 days.

Fig. 1. BPMN for NC Standard P.O. Process

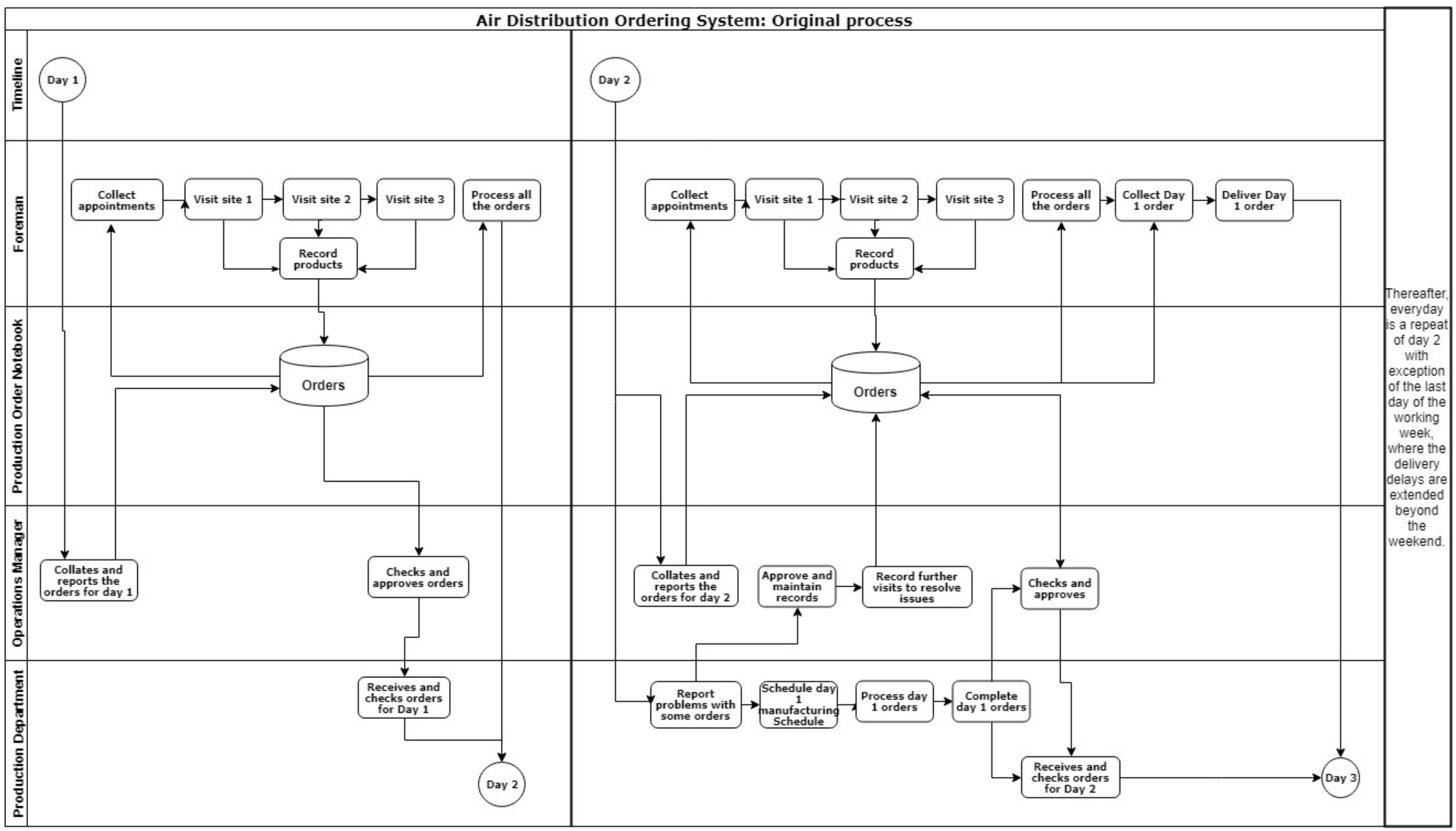

Air Distribution Ordering System: Original process
Timeline
Foreman
Production Order Notebook
Operations Manager
Production Department
Day 1
Collect appointments
Visit site 1
Visit site 2
Visit site 3
Process all the orders
Record products
Orders
Collates and reports the orders for day 1
Checks and approves orders
Receives and checks orders for Day 1
Day 2
Day 2
Collect appointments
Visit site 1
Visit site 2
Visit site 3
Process all the orders
Collect Day 1 order
Deliver Day 1 order
Record products
Orders
Collates and reports the orders for day 2
Approve and maintain records
Record further visits to resolve issues
Checks and approves
Report problems with some orders
Schedule day 1 manufacturing Schedule
Process day 1 orders
Complete day 1 orders
Receives and checks orders for Day 2
Day 3
Thereafter, everyday is a repeat of day 2 with exception of the last day of the working week, where the delivery delays are extended beyond the weekend.

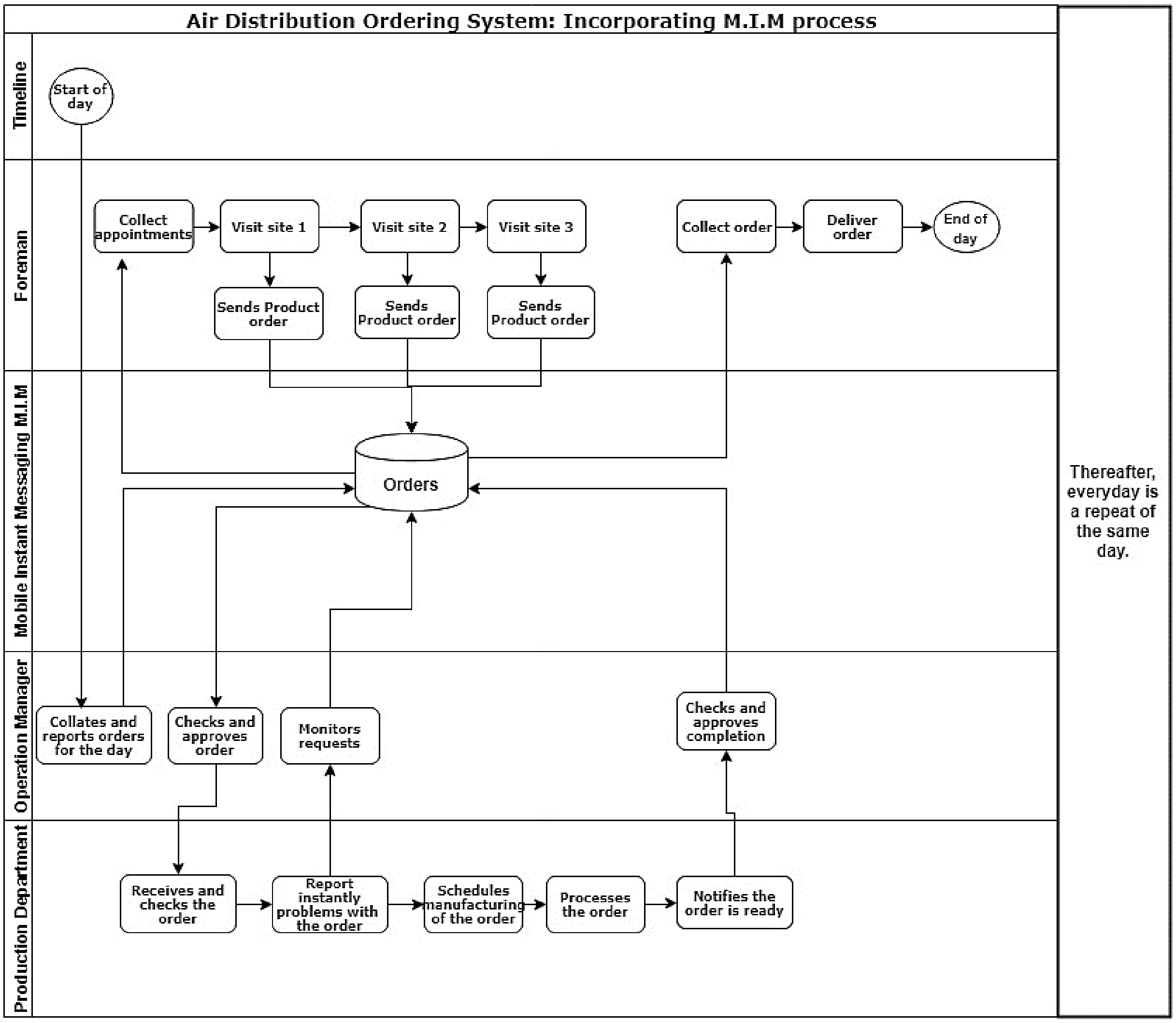
Table 2. Dataflow after the introduction of M.I.M. app to N.C. P.O. process.

Timeline	Operation Manager	Foreman	Production Order Notebook	M.I.M. App	Production Department
Day 1	Collate and report orders		Write a list of P.Os.		
Day 1		Visits the site			
Day 1		Prepares a P.O.	Writes needed products to be manufactured	Send them via WhatsApp. Viewed by O.M. and P.D.	
Day 1	Checks and approves P.O.			Message shared by O.M., P.D., and Foreman.	Receives & Checks P.O.
Day 1	Monitors requests			Message shared by O.M., P.D., and Foreman.	Reports P.O. problems
Day 1					Prepares Manufacturing orders
Day 1					Schedules manufacturing orders
Day 1					Starts the manufacturing process
Day 1	Checks and approves completion.			Reports to foreman the product is completed	Completes manufacturing
Day 1		Visits a different site			
Day 1		Prepares a P.O.	Writes needed products to be manufactured	Send them via WhatsApp. Viewed by O.M. and P.D.	
Day 1	Checks and approves P.O.			Message shared by O.M., P.D., and Foreman.	Receives & Checks P.O.
Day1	Monitors requests			Message shared by O.M., P.D., and Foreman.	Reports P.O. problems
Day1					Prepares Manufacturing orders
Day 1					Schedules manufacturing orders
Day 1					Starts the manufacturing process

Day 1	Checks and approves completion.			Reports to foreman the product is completed	Completes manufacturing
Day 1		Visits a different site			
Day 1		Prepares a P.O.	Writes needed products to be manufactured	Send them via WhatsApp. Viewed by O.M. and P.D.	
Day 1	Checks and approves P.O.			Message shared by O.M., P.D., and Foreman.	Receives & Checks P.O.
Day1	Monitors requests			Message shared by O.M., P.D., and Foreman.	Reports P.O. problems
Day 1					Prepares Manufacturing orders
Day 1					Schedules manufacturing orders
Day 1					Starts the manufacturing process
Day 1	Checks and approves completion.			Reports to foreman the product is completed	Completes manufacturing
Day 1		Comes back to the company			
Day1		Collects P.O.			
Day 1		Delivers P.O.			
After that, every day is a repeat of the same day.					

Table 2 shows there is, on average, a half a day lead time for most orders. What is more, the lead times do not extend on the last day of the week. Statistically, this means that a 5 days order takes 2.5 days. This is a reduction of 50% reduction on the delivery, giving an average lead time of 0.5 days. Compared with the process before introducing M.I.M. element an average lead time of 1.6 days, the new process has significantly enhanced production delivery of orders or a reduction of 68%.

Fig. 2. BPMN after incorporating M.I.M to N.C. P.O. process



The data collected for November 2020 showed the following differences in order processing, between conventional and use of M.I.M. orders.

Table 3. Comparison of turnaround time between Conventional and M.I.M. orders.

	Order date	Order received	Order Scheduled for Production	Order Delivered	Turnaround
Conventional	09 November 2020	10 November 2020	10 November 2020	13 November 2020	4
	09 November 2020	11 November 2020	11 November 2020	16 November 2020	7
	10 November 2020	11 November 2020	11 November 2020	16 November 2020	6
	10 November 2020	12 November 2020	12 November 2020	17 November 2020	7
	11 November 2020	13 November 2020	13 November 2020	18 November 2020	7
	11 November 2020	16 November 2020	16 November 2020	19 November 2020	8
	12 November 2020	16 November 2020	16 November 2020	19 November 2020	7
	12 November 2020	13 November 2020	13 November 2020	18 November 2020	6
	13 November 2020	16 November 2020	16 November 2020	19 November 2020	6
	13 November 2020	17 November 2020	17 November 2020	20 November 2020	7
				Average:	6.5
	Order date	**Order received**	**Order Scheduled for Production**	**Order Delivered**	**Turnaround**
Using M.I.M.	09 November 2020	09 November 2020	09 November 2020	11 November 2020	2
	09 November 2020	09 November 2020	09 November 2020	11 November 2020	2
	10 November 2020	10 November 2020	10 November 2020	12 November 2020	2
	10 November 2020	10 November 2020	10 November 2020	12 November 2020	2
	11 November 2020	11 November 2020	11 November 2020	13 November 2020	2
	11 November 2020	11 November 2020	11 November 2020	13 November 2020	2
	12 November 2020	12 November 2020	12 November 2020	16 November 2020	4
	12 November 2020	12 November 2020	12 November 2020	16 November 2020	4
	13 November 2020	13 November 2020	13 November 2020	17 November 2020	4
	13 November 2020	13 November 2020	13 November 2020	17 November 2020	4
				Average:	2.8

It should be noted that the data was collected during the COVID-19 pandemic, and thus there was a reduction in the number of working days. The reduction in the turnaround is slightly wider in the actual data collected than the theoretical analysis. Where the theoretical analysis suggested a reduction of 2.5 days, the data shows 3.7 days. This could be explained as the theoretical analysis does not consider errors that using conventional ordering may take longer.

Finally, the interview with twelve of the company's regular customers yelled a near-unanimous agreement on key findings and themes. The cohort is well skilled, with an average of 12.3 years working experience ranging from 5 to 25 years. The perception of using M.I.M. is unanimously as faster and more convenient, with the suggestion that it has helped process orders 2 days fasters appearing six times (50%). There is also agreement that safety, in this context, is fair as no financial transactions are being used part of the communication trail. This could be an area to explore in the future.

ANALYSIS

When making a comparison, the authors can see that the production order sent using M.I.M. technology reaches the company faster. And this is where the paper demonstrates the example of a site foreman who is usually responsible for more than one site and gets to visit more than one site before going back to the factory and handing the production orders.

In addition, M.I.M. enables live feedback that can occur between the Production Manager capable of giving lively updates regarding the inquired item's readiness. The Operations Manager also monitors the operations, on or off-site, thus allowing faster approval and processing. Therefore, the use of M.I.M. as an enabler implies enhancing make-to-order and assemble-to-order business activities. While the M.I.M. application used in this case study is not tailored for business use, it has provided a secured means of communication, tracking, and managing orders. This case study suggests that the use of already developed free to use M.I.M. systems to provide viable alternative systems to off the shelf or tailor built M.I.M. systems. Custom M.I.M. systems add upfront costs and operations costs that out prices many S.M.E.s.

From the interview and observation notes made during the process of studying the change, the authors noted that the introduction of the M.I.M. eliminated some errors in defining the correct product to be produced. The Production Manager using the live video calls with the foreman has helped reduce the incorrect diagnosis of problems by bringing in the collective knowledge of key participants directly to the cite.

The introduction of M.I.M. to this case study has helped enhance the production cycle (make-to-order or assemble-to-order).
Operations management suggests three key factors contributing to enhancing production cycle as linked to improving speed, quality, and/or reducing costs (Stevenson, 2005). In this case, the team considered the impact of M.I.M. on the production cycle:

- Based on the time
- Based on better production management
- Better production schedule

Based on time, it is evident from the model that the introduction of M.I.M. has, on average lead time is reduced by 68%. The theoretical and data collection also demonstrated a reduction in the turnaround time of 50% and 57% respectively. The speed in processing orders is also acknowledged as a key incentive among those project managers engaged in the process. The new model has improved quality by introducing better production management that eliminated communication errors. Finally, the module has improved production schedule. In the first model, the downtime and when the business is slow, the production manager taking longer to start on-time production. The on-time production is not an issue when considering the M.I.M. model.

The introduction of the M.I.M. model to the case study backs the work of Goodhue and Thompson (1995) on task-technology fit whereby it is argued that task characteristic should be linked to the make-to-order and assemble-to-order in order to improve product quality, reduce execution time, and reduce costs of order. When considering the impact of the M.I.M., it can be argued that it represents a task-technology fit.

The qualitative analysis from the diagram analysis, interviews findings, as well as the quantitative data from orders are agreeable on some key findings. The use of M.I.M. improved communication and reduced errors. The analysis points to a significant reduction in delivery time. Thus, the team concludes that the $H^1$is validated in this case. For there is a measurable improvement in the procedural processes after the introduction of M.I.M. system to a given S.M.E. manufacturing company.

CONCLUSION

The objective of this paper is to examine the impact of the use of M.I.M. in business operations. As demonstrated, this study shows that the introduction of M.I.M. in operations enhances the process of manufacturing. It was achieved by studying the case study of Nakhoul Corporation, an air distribution products manufacturer in Lebanon. The team acknowledges key limitations in their findings linked to the use of data collected during the pandemic, and the data is limited to one case study and one month. Thus, the team used a collective convergent validation of the multiple findings, which still pointed to a significant reduction in orders' turnaround.

Further research is needed to compare the outcome from different sectors and companies. Based on this research paper, can more companies adopt the use of M.I.M. to speed up their operations in different processes? Will S.M.E.s, with limited I.T. budget, use the M.I.M. to enhance their sales force automation? Another view would consider involving the customers, enhancing the process by using B.P.M. as suggested by Gersch, Hewing, and Schöler (2011). There are opportunities to look at the financial impact and environmental impact of introducing M.I.M as a means of business communications, explicitly reducing paper use or part of the paperless initiative.

Of course, there are risks associated with using M.I.M., not least linked to what one would expect with any outsourcing of business process. The works of Mahmoodzadeh, Jalalinia, & Nekui Yazdi, (2009) considered the risks associated with this form of Business Process Outsourcing (B.P.O.) and could be incorporated in future research.

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REFERENCES

Aagesen, G., & Krogstie, J. (2010). *Analysis and design of business processes using BPMN*. In Handbook on Business Process Management 1 (pp. 213-235). Springer, Berlin, Heidelberg.

Birkmeier, D., & Overhage, S. (2010). *Is BPMN really first choice in joint architecture development? an empirical study on the usability of BPMN and UML activity diagrams for business users.* In International Conference on the Quality of Software Architectures (pp. 119-134). Springer, Berlin, Heidelberg.

Brynjolfsson, E., Hitt, L. M., & Yang, S. (2002). *Intangible assets: Computers and organisational capital.* Brookings papers on economic activity, 2002(1), 137-181.

Cameron, A. F., & Webster, J. (2005). *Unintended consequences of emerging communication technologies: Instant messaging in the workplace*. Computers in Human behavior, 21(1), 85-103.

Chapman, J. (2002). *Mobile network infrastructure: Vendor overviews*. Research Report, Gartner Group.

Decker, G., Grosskopf, A., & Barros, A. (2007, October). *A graphical notation for modeling complex events in business processes.* In Enterprise Distributed Object Computing Conference, 2007. EDOC 2007. 11th IEEE International (pp. 27-27).

Devaraj, S., & Kohli, R. (2003). *Performance impacts of information technology: Is actual usage the missing link?.* Management science, 49(3), 273-289.

Dewan, S., & Kraemer, K. L. (2000). *Information technology and productivity: evidence from country-level data.* Management Science, 46(4), 548-562.

Gebauer, J., & Shaw, M. J. (2004). *Success factors and impacts of mobile business applications: results from a mobile e-procurement study*. International Journal of Electronic Commerce, 8(3), 19-41.

Gersch, M., Hewing, M., & Schöler, B. (2011*). Business process blueprinting–an enhanced view on process performance.* Business Process Management Journal, 17(5), 732-747.

Goodhue, D. L., & Thompson, R. L. (1995). *Task-technology fit and individual performance*. M.I.S. quarterly, 213-236.

Hitt, L. M., & Brynjolfsson, E. (1996). *Productivity, business profitability, and consumer surplus: three different measures of information technology value*. M.I.S. quarterly, 121-142.

Ismail, R., Safieddine, F., & Jaradat, A. (2019) *E-University Delivery Model: Handling the Evaluation Process*. Business Process Management Journal, https://doi.org/10.1108/BPMJ-

10-2018-0281
Leung, K., & Antypas, J. (2001). *Improving returns on m-commerce investments*. Journal of Business Strategy, 22(5), 12-12.
Khlif, W., Ben-Abdallah, H., & Ben Ayed, N. E. (2017*). A methodology for the semantic and structural restructuring of BPMN models.* Business Process Management Journal, 23(1), 16-46.
Magnani, M., & Montesi, D. (2007, September). *BPMN: How much does it cost? An incremental approach.* In International Conference on Business Process Management (pp. 80-87). Springer, Berlin, Heidelberg.
Mahmoodzadeh, E., Jalalinia, S., & Nekui Yazdi, F. (2009). *A business process outsourcing framework based on business process management and knowledge management.* Business Process Management Journal, 15(6), 845-864.
Müller, G. (2005). Success factors and impacts of mobile business applications: Results from a mobile e-procurement study. Wirtschaftsinformatik, 47(4), 298-299.
Nakhoul Corporation. (2018) Homepage. Retrieved December, 14, 2018, from http://www.nakhoulcorp.com/
Nystrom, P. C., & Starbuck, W. H. (1981). *Handbook of Organizational Design: Remodelling organisations and their environments (Vol. 2)*. Oxford University Press, U.S.A.
Pourghomi, P., Safieddine, F., Masri, W., & Dordevic, M. (2017, May). *How to stop spread of misinformation on social media: Facebook plans vs. right-click authenticate approach.* In Engineering & M.I.S. (ICEMIS), 2017 International Conference on (pp. 1-8). IEEE.
Quan-Haase, A., Cothrel, J., & Wellman, B. (2005). *Instant messaging for collaboration: A case study of a high-tech firm.* Journal of Computer-Mediated Communication, 10(4).
Recker, J. (2010). *Opportunities and constraints: the current struggle with BPMN.* Business Process Management Journal, 16(1), 181-201.
Rodríguez, A., Fernández-Medina, E., & Piattini, M. (2007). *A BPMN extension for the modeling of security requirements in business processes.* IEICE transactions on information and systems, 90(4), 745-752.
Safieddine, F. (2017). *M-commerce.* In Innovations in E-Systems for Business and Commerce, C.R.C.: Tailor and Frances. pp.116.
Safieddine, F., & Nakhoul, I. (2018). *Generic Business Process Model for S.M.E.s in M-Commerce Based on Talabat's Case Study.* In Conference on e-Business, e-Services and e-Society (pp. 264-278). Springer, Cham.
Saniuk, A., & Jakábová, M. (2012*). Key Performance Indicators for Supporting Decision-Making Process in Make-To-Order Manufacturing*. Research Papers Faculty of Materials Science and Technology Slovak University of Technology in Trnava, 20, 182-190.
Singh, M., & Thomson, D. (2002). *eReality: Constructing the eEconomy*. In Proceedings of 15th Bled Electronic Commerce Conference (pp. 293-307).
Stevenson, W. J. (2017). *Operations Management*. McGraw-hill (pp.732-733).
Varshney, U., Mallow, A., Jain, R., & Ahluwalia, P. (2002). *Wireless in the enterprise: Requirements and possible solutions.* In Proceedings of the Workshop on Wireless Strategy in the Enterprise: An International Research Perspective (pp. 15-16).
White, S. A. (2008). *BPMN modeling and reference guide: understanding and using BPMN*. Future Strategies Inc.
Zur Muehlen, M., Recker, J., & Indulska, M. (2007). *Sometimes less is more: Are process modeling languages overly complex?.* In EDOC Conference Workshop, 2007. EDOC'07.

Eleventh International IEEE (pp. 197-204). IEEE.