Reduction of Undelivered Items in the Service of Centron Energy Savings Technology Corporation

Ellaine C. Villegas, Kyra Patricia V. Tadina, Jenalyn Shigella Yandug , Nelrose D. Vidamo and Joanna Lou C. Mata
School of Industrial Engineering and Engineering Management
Mapua University, Manila, Philippines
elvillegas@mapua.edu.ph, kpvtadina@mapua.edu.ph, jsgyandug@yahoo.com,
ndvidamo@mapua.edu.ph, jlcmata@mapua.edu.ph

Abstract

Centron Energy Savings Technology Corporation markets competitive lights available for indoor, outdoor, commercial, and accessories. For indoor lighting class, they market LED lights that have the best features to offer used mainly for indoor. High quality LED lights with maximum brightness are designed for outdoor lighting class. For commercial lighting class, high-class performance LED lights suitable for commercial use are designed. Accessories market by GES are designed to have a special structure that is beneficial to heat dispersion. The company has incurred a penalty loss of PHP 155,771.05 in the year 2019. To remain competitive in today's service industry market, a plan is being evaluated for this annual loss of opportunity to recover the company's expected profit. Various analyzes have been used to diagnose the observed problem, including the why-why diagrams, stream diagnosis, and Kepner-Tregoe analysis. The company witnessed an increasing number of undelivered items due to inefficient record keeping and inefficient process of recording process orders. The researchers conducted a series of analysis on the proposed alternatives that are further tested using cost-benefit analysis and integrated by risk analysis and FMEA. With the solutions being evaluated, rectified for their execution with cost-benefit analyzes and risk assessed, a realistic approach to solving the steady lack of opportunity is considered a prime premise for a solution.

Keywords
Service industry, Technology Corporation, LED lights

1. Introduction

Light emitting diode lights or simply known as LED lights were introduced to address the need for energy saving. Its efficiency can be measured by the low amounts of power consumed by these lights compared to traditional lights used in households, commercial establishments, and others. Wen et. al (2011) proposed the advantage of LEDs illumination in general household lighting. According to their study, the power consumption and efficiency of traditional illuminated light sources and LED light source in lighting the household environment were analyzed and compared with each other at the same standard of average illuminance. The study resulted to advantage of using LEDS in household lighting. The demand for lighting products continues to rapidly increase as infrastructures, buildings, houses, and etc. continues to develop. Lighting industry all over the world produces more and more lighting products driven by the increase in demand. In this nature, the service industry is very broad. It covers a wide range of activities that add value to businesses and individuals, but the output is not physical product, rather this industry is enhancing, maintaining, repairing, shaping, and making various changes to physical items. A service dominated economy is a feature of developed countries. Service has been one of the Philippines economy's strongest and fast-growing industries. Philippines aims to position itself as a center of trade in services in Southeast Asia and the Asia-Pacific region. This study involved, Centron Energy Savings Technology Corporation, is a professional manufacturer of energy efficient lighting system under the brand GES (Green Energy Savings). Its business philosophy is an advocacy that aim to provide the Filipino consumers with economical energy-efficient lighting products and systems used for

home and industry. The company's product line consists of the 4th Generation LED but also solar lighting and renewable energy systems. Through the GES brand, it aims to provide a world-class lighting system that can compete with the leading global brands. Through the years, the company is experiencing some problems. Based on the SWOT analysis, historical data and review of documents of the company, there was one problem identified by the researchers. In the year 2019, Centron Energy Savings Technology Corporation has experienced a penalty cost of PHP 155,771.05. The study aims to reduce the undelivered items in the service of Centron Energy Savings Technology Corporation. The objective of the analysis is to identify the reasons for the undelivered items, quantity of each cause, and the penalty cost incurred by the company.

2. Literature Review

Companies of today experience high competition, both international and domestic. A result of this has been increased demands from customers and an increased focus on high quality within companies in order to meet the increased demands (Oakland, 2005). Service management is a way to understand and manage a company present in the service industry (Grönroos, 2007). It can be defined as "a total organizational approach that makes quality of service as perceived by the customer, the number one driving force for the operation of the business" (Grönroos, 2007 s. 224). The fact that a customer cannot experience a service in advance makes it important for a service company to try to live up to the expected quality standards from the beginning (Dotchin & Oakland, 1994; Ghobadian et.al., 1994; Haywood-Farmer, 1988). Before looking more into management control in service companies it is important to know some of the difficulties that comes with investigating services oppose to manufacturing regarding management of quality (HaywoodFarmer, 1988). All services are intangible and it is therefore not possible for a customer to look at a service and say if it is of good or bad quality (Dotchin & Oakland, 1994; Ghobadian et.al., 1994; Haywood-Farmer, 1988). When it comes to evaluating service quality, the tangible evidence is limited to a service provider's employees, physical facilities and equipment (Parasuraman et.al., 1985). Furthermore a customer will always have an attitude towards a service. If a service is connected to a tangible good such as a car, the customer will be able to look at the car and see if it fulfills the promised or expected quality standard. This will affect how the service is perceived. If the service is perceived as bad, it will be difficult to convince a customer otherwise (Dotchin & Oakland, 1994; Ghobadian et.al., 1994; Haywood-Farmer, 1988). Individual preferences will affect how a service is perceived which means that services are heterogeneous. It is not possible to store a service, and since different employees perform services they will most likely be performed in different ways. Furthermore customers will have different needs and expectations, which makes it important for the employees to be able 8 to take the right action in different situations. In some services the customer must or wants to participate in creating the service, an example of this would be a bus ride. If someone on the bus behaves badly, this will effect how the service is perceived (Dotchin & Oakland, 1994; Ghobadian et.al., 1994; Haywood-Farmer, 1988). Furthermore service management includes four general shifts of focus in management. There is a shift from product focus to focus on customer relationship, a shift from short to long term relationship, a shift from core product quality to a customers perceived quality and lastly there is a shift from the production of technical quality to development and management of total quality (Grönroos, 1990; Grönroos, 1994). Furthermore what Grönroos (2007) does not include in his definition of service management is the perspective of management accounting and control, in other words managers are not given a lot of guidance when it comes to planning and controlling services (Modell, 1996). Furthermore it can be argued that quality management can be seen as a control system as it seeks to control companies' processes and improve and change processes if needed. Therefore a model from the management control field is suited to use as a complement to the section of quality management (van Iwaarden et.al., 2006). Service quality can be defined as "to the extent services meet customers' needs and requirements and how well they match or exceed customer expectations", which means that an important part of service quality is how customers perceive performed services (Mukherjee, 2003, s. 329). This is a widely accepted definition (Behara & Gundersen, 2001; Edvardsson, 1998; Grönroos, 1984; Lewis, 1993). Since the customer is both the judge and the receiver of a service, it is not enough to have established specifications met in order to attain quality if the customers' perception has been negative (Edvardsson, 1998). If a company succeeds in achieving high quality, there are four requirements in order to attain that quality level. These requirements are: 1) Market and customer focus. In order to prevent problems the company should focus on the customer's needs and expectations and build their policies around those. 2) Empowerment of frontline employees. If the frontline employees are allowed to make important decisions this usually enhances the service quality. 3) Well-trained and motivated employees. Trained employees are able to perform their tasks more effectively which is also often noticed by the customer who will then have a better quality perception about the service. In order to keep the frontline employees motivated and supported it is of importance to have an appropriate and a clear career ladder, rewards, a measurement system and evaluation

procedures. 4) A clear service quality vision. If the employees do not get this from the company they will have their own 9 interpretation of what service quality is. This could lead to inconsistency amongst the employees and thereby also affect the customers' perception of the service (Ghobadian et.al., 1994).

3. Methodology

Various diagnostic and analytical approaches were used to diagnose the problem of why there is an increase in undelivered items in the company. One issue found by the researchers was focused on the SWOT analysis, historical data, and examination of the company's records. Analysis of Kepner-Tregoe was also used in the construction of the problem statement to form a holistic approach. It is a **problem analysis model** in which the "problem" is disconnected from the "decision". The researchers came up with an objectives for Improvement. Causal analysis was also used to figure out which measures are important for change in the transaction and the business models. By using alternatives or adding more efficient methods, the flowcharts formed from this analysis were used to strategize around the already existing model and augment it.

4.Results and Discussion

Centron Energy Savings Technology Corporation has incurred a penalty loss of PHP 155,771.05 in the year 2019.

CENTRON ENERGY SAVINGS TECHNOLOGY CORPORATION		
Details	**Quantity**	**Penalty Cost**
Items are not on the delivery receipt	472	108,949.65
Mistaken counting of lights in the physical environment of the site	56	18,017.00
Incorrect number of items prepared by the warehouse department	391	28,804.40
	919	155,771.05

Table 4.1 Summary of Penalty Costs

The summary table shows the reasons for the undelivered items, quantity of each cause, and the penalty costs incurred by the company. There are 3 identified reasons causing the late deliveries: (1) items are not on the delivery receipt, (2) mistaken counting of lights in the physical environment of the site, and (3) incorrect number of items prepared by the warehouse department. A total of 919 units were delivered late in the year 2019. Various diagnostic and analytical methods were used to diagnose the problem of why there is an increase for undelivered items in the company. Based on the year 2019, a total of 919 deviations from January to December occured between the items delivered and the client's order list. The undelivered items found during delivery totaled to an additional cost of PHP 155,771.05 given as discounts to the clients. The researchers focused on Centron Energy Savings Technology Corporation's present system of processing the purchase order and operations process. Actual procedures obtained by the company as what gathered during the interview will be represented through data analysis tools. Utilizing the tools for causal analysis, the sequential causes of issue experienced during the current process will be determined. Why-Why analysis will be used to analyze the reasons behind each errors occurred and Stream Diagnostic chart will be used to place the issues present in the Why-Why analysis to proper category which will enable the researchers to determine the fundamental or core problem.
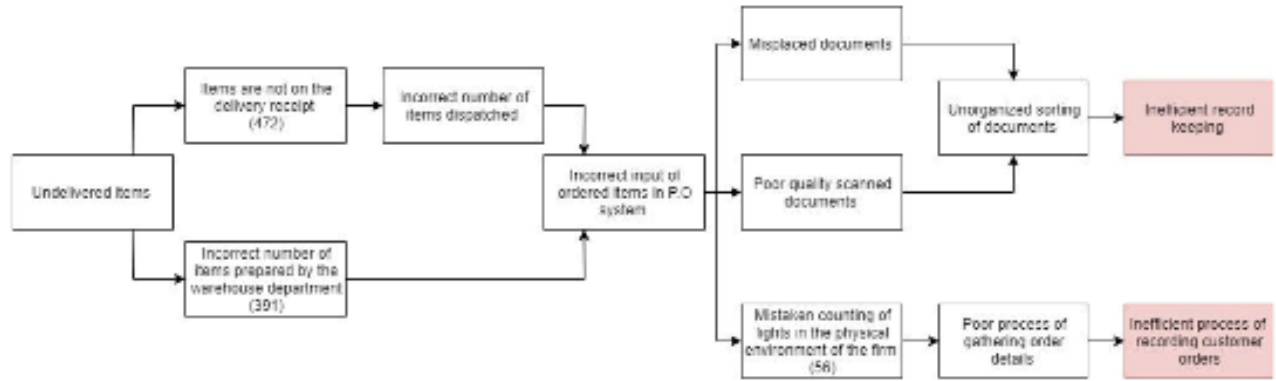
Figure 4.1 Why-Why Analysis

Based on the figure above, the undelivered items to the client is the main problem during the company's service. As represented, the main problem is branched out into two reasons which are the missing items on the delivery receipt and the incorrect number of items prepared by the Warehouse department. As further analysis, this reason is branched into three causal reasons which are misplaced documents, poor quality scanned documents, and mistaken counting of lights in the physical environment of the firm. The said misplaced and poor quality scanned documents as analyzed are due to unorganized sorting of handful documents which is caused by the inefficient record keeping as the root cause. On the other hand, the mistaken counting of lights during the ocular visit is caused by poor process of gathering the order details. This reason is caused by the inefficient process of recording customer orders.
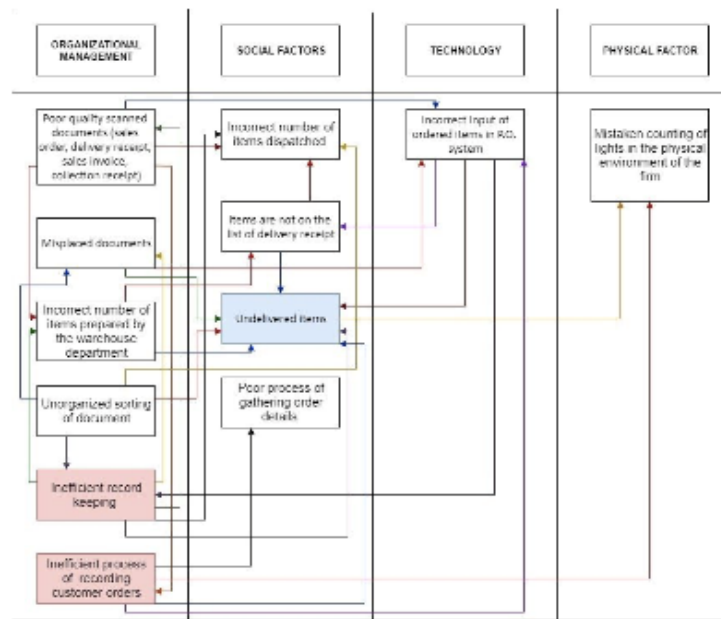

Figure 4.3 Stream Diagnostic Chart

Based from the data gathered, the company currently experiences 10 issues. The said issues are namely poor quality scanned documents (sales order, delivery receipt, sales invoice, and collection receipt), misplaced documents, dispatching order process, poor process of purchase order, informing the warehouse to prepare items for delivery, items are not on the list of delivery receipt, incorrect number of items delivered, conducts ocular visit inadequately,

incorrect input of ordered items in purchase order system, and mistaken counting of lights in the physical environment of the firm. The stream diagnostic chart in the figure above shows that the fundamental core problem of the company is the poor handling of the documents needed for processing the orders from the clients . The core problem of the company is its poor process of purchase order. The symptoms are incorrect number of items delivered thus, the actual profit are lower than expected.

Decision Analysis is a systematic process based on the thinking pattern we all use in making choices. Its techniques represent expansions and refinements of the elements in this thinking pattern. The researchers were able to identify the two root causes of undelivered items using Why-Why analysis which are inefficient record keeping and inefficient process of recording customer orders. The objectives of the first root cause are to be able to access to documents by going paperless, for future research and other administrative reasons to ensure records are kept, to be able to lessen the overhead cost of the company and to avoid misplaced documents. The researchers proposed two alternatives for the root cause. One is to introduce a database system. Make a policy for data recording and data storage. This is to standardize the protocols for record-keeping that the employee will obey. This ensures effective and reliable record keeping. Develop a database system that will help in processing orders accurately. Second is to review and digitize business process. It will take time to move to a paperless workplace. It should be a steady, slow process. The slow integration would allow you to properly implement new policies and allow time for adjustment for your employees. During the adjustment period you may need to have some paperless system work in tandem with your old system. They can digitize many parts of your business model. Within each organization, however, there are typically a few processes which account for the majority of wasteful printing. With the alternatives being presented, consequences to it is also proposed. There are three consequences present, first is the additional expense. The development of the said software will incur additional fees for employee training and system acquisition and deployment. Second is the hardware and software issues. When all is digitally stored, there is the potential for a system to crash and then all information becomes lost. Lastly, the customer habits. There are plenty of clients out there who prefer paper documents to a lot. For example, a business client might prefer you to give them paper invoices because they want to keep archived records of all their purchases, and some clients might prefer their contracts to be printed on paper rather than just having a digital document to represent it. As a consequence, your printer may still need to be held so you can make exceptions for certain clients and present a high quality scanned documents. For the second root cause which is the inefficient process of recording customers orders. The objectives for this root cause are to be able to avoid mistaken light count in company's physical environment, to be able to update order policy and procedure and to improve the process of gathering order details. There are   alternatives proposed in this root cause. The first one is process implementation. The company's order policy and procedure should be updated-requiring the customer to provide a lighting layout with an electrical plan to eliminate the need for an eye visit. Second is to introduce a new ordering system. Providing a new ordering system that will help both customers and the company in placing and receiving job orders. There are also consequences present in this root cause. One is the additional investment, although the establishment of policies and procedures has clear advantages for your company, there are inconveniences associated with these elements being implemented. You will need to hire someone to develop these policies, or assign that responsibility to trusted managers and administrators. Policy and procedures need to be evaluated and evaluated over time for effectiveness, as inefficient procedures can impede the growth of the company. Lastly, the restrictions. Since these processes are formalized, having policies and procedures in place restricts the ability of your company to make quick decisions, shift strategies, make promotions or fire ineffective workers. Policies and procedures restrict the discretion of an organization as its aim is to create processes that prevent spontaneous actions and decisions. After identifying the alternatives for the two root causes, a cost-benefit analysis. A cost-benefit analysis is the process used to measure the benefits of a decision or taking action minus the costs associated with taking that action. The first root cause, inefficient record keeping. The first alternative is to introduce a database system. The Alternative in the cost-benefit analysis is the implementation of process standardization by introducing a new database system. The company will cost PHP 28,000 for this alternative due to project allowance and training cost needed to fulfill the process implementation. The benefit alternative for this is the additional sales which is equivalent to PHP 137, 745.05. The second alternative is to review and digitize your business process. For the second alternative for this root cause, Transition to a paperless office via eFile Cabinet is suggested. This software makes it easy for the organization to download, store, retrieve data and track all sorts of documents. This will help the company to easily keep track of their inventory. The company has a project allowance worth PHP 121, 717.55 in order to purchase the eFile Cabinet software. The benefit alternative for this is the additional sales worth PHP 137,745.05. For the second root cause which is the inefficient process of recording customer orders. The first alternative is the process implementation. The alternative in this cost-benefit analysis is the hiring a Human Resources professional. Human resource professional plan, direct and coordinate the administrative functions of the company. The project allowance of the company for

this alternative is PHP600,000.00. The benefit of this alternative is to avoid mistaken order collection process of recording customer orders which is equivalent to PHP 46,821.40. For the second alternative for this root cause, introducing a new ordering system is proposed.For the last alternative, it is suggested to introduce and implement a new ordering system to help the customers in placing and receiving job orders. This system will reduce or eliminate penalty costs for late deliveries due to poor processing job orders. The company will incur a cost of PHP 28,000.00 which is equivalent to the project cost of PHP 18,000.00 and a training cost of PHP 10,000.00. The benefit for this alternative is eliminating costs due to late deliveries of job orders which has an additional sales of PHP 46,821.40. Based from this tables, choosing the best alternative for each root cause is easy.

ROOT CAUSE	DECISION
Root Cause 1: Inefficient record keeping	Alternative: Introduce a database system
Root Cause 2: Inefficient process of recording customer orders	Alternative: Introduce new ordering system

Table 4.2 Selection of the Best Alternative

The table above shows the summary of decisions that must be made in order to solve the root cause of the problems for Centron Energy Savings Technology Corporation. For the root cause of Inefficient record keeping, there were 2 alternatives presented. One is to introduce a new database system and the other is to review and digitize the business processes. It was found out that based on the Cost-Benefit Analysis, the best alternative in solving the root cause is to introduce a database system. The company will incur PHP 28,000.00 due to a project allowance and training costs needed to accomplish by the company. With the benefit of eliminating penalty costs for late deliveries due to the items not listed on the delivery receipts and the incorrect numbrt of units prepared which has an additional sales equivalent to PHP 137,745.05. For the root cause of Inefficient process recording of customer orders, it is recommended to introduce and implement a new ordering system. This new ordering system will lessen or eliminate the penalty costs for late deliveries due to poor processing of job orders. The company will need to fulfill a project allowance worth PHP 18,000.00 and a training cost of PHP 10,000.00. The benefit of this alternative is to minimize penalty costs for late delivery due to poor work order processing with an additional sales of PHP 46,821.40. The solution for both the root cause will save the company PHP 184,566.46.45 from the cost-benefit analysis which would decrease the additional cost of the company.

From the results of the cost-benefit analysis, the researchers conducted a How-How diagram to answer the Why-Why diagram presented above.

Figure 4.4 How-How Diagram of Root Cause 1

The first root cause found by the researchers was the inefficient record keeping of the company. This lead to the inaccuracy of the order information, especially the items and its quantity as the company is still using manual system for their ordering process. To fix the root cause, the company should adapt paperless system. There are many options available for document management, however efile cabinet can easily store, monitor and maintain documents. A paperless document management system is more efficient because it is faster and more agile than managing files on paper. It saves time in searching documents.
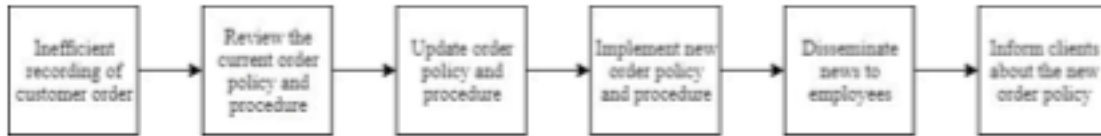
Figure 4.5 How-How Diagram of Root Cause 2

The figure above shows that the second root cause identified by the researchers is the inefficient recording of customer order. Currently, the company does not have a particular policy that requires clients to provide electrical plan. So whenever the client fails to provide the order quantity, technicians do ocular visit to manually count how many items should be ordered. The current system is flawed since it is prone to human error. Therefore, to solve this problem, the order policy and procedure of the company should be updated - requiring the client to provide an electrical plan with lighting layout to eliminate the need of conducting an ocular visit. The company will use the improved order policy and procedure to help lessen the discrepancy in obtaining the quantity of items to be ordered.

With regards to the adaptation of the paperless system, a database software called eFile Cabinet is proposed to solve the poor record keeping of the company. The management have all their employees trained in eFile Cabinet training program. All ongoing projects such as new orders, job orders bound for delivery and installation, finished job orders with pending payments, future job orders, etc. will be entered in the database. The EMC department will be in charge in doing so since they handle receiving of new orders and monitoring of the ongoing job orders. An order complete with order details, customer details, and other needed information will be shown automatically in the company's database and can be accessed initially by the EMC Department for checking . All accounts with pending payments are also entered in the database by the accounting department. If in any case a customer has pending payment, the transaction will appear on the database under incomplete transaction showing the client's pending balance. However, if the client doesn't have pending balance, the order will be approved, the client will receive the collection receipt via email, and details regarding the order (item and quantity) will be sent to the database accessible by the warehouse department. When the order is ready for dispatch, the technical services department will be notified by the system. Sales invoice, delivery receipt, and P.R. invoice will be accessible using a mobile device.
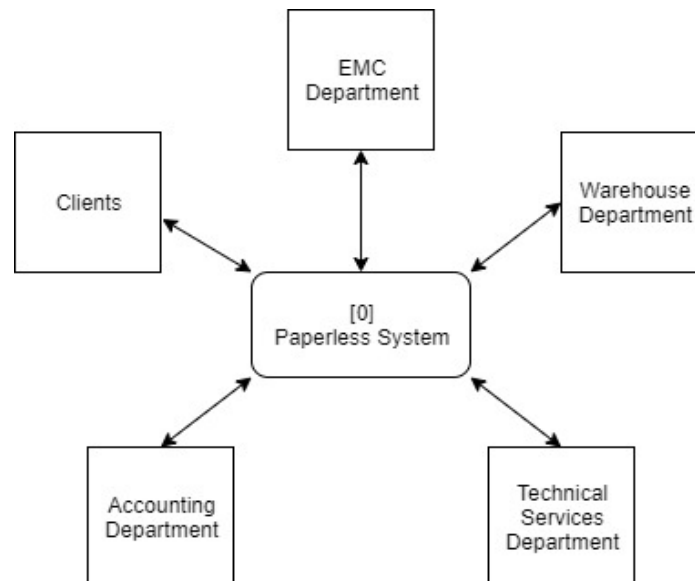

Figure 4.6 Level 0 DFD

Figure 4.56 above shows the level zero data flow of the proposed database system. Clients will have interactions with the paperless system, specifically when ordering online. EMC Department, Accounting Department, Warehouse Department, and Technical Services Department will have interactions with the paperless system.
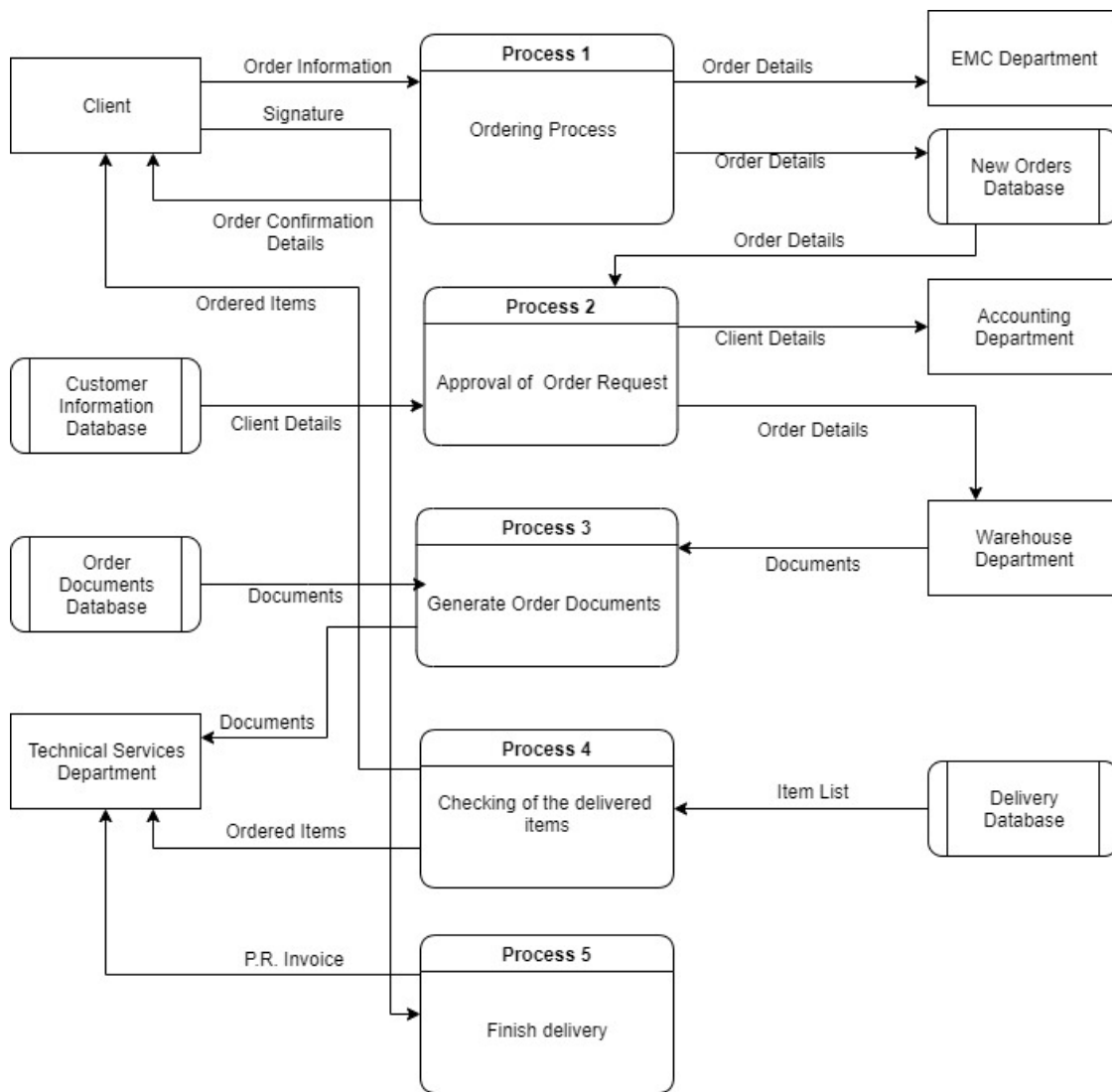

Figure 4.7 Level 1 DFD

Figure 4.7 displays the first level data flow of the paperless system. The proposed system has 5 processes: Client ordering processes, approval of order request, preparation of items ordered, delivery of orders to the client, checking of items ordered (upon arrival of delivery), and installation of ordered LED Lights. First system process is to obtain an order placed online through the company's website; order details, customer details, and other requirements will be transmitted to the database. Second process of the system is to get approval of the order in order to proceed with the next step. Third process is to generate order documents such as: delivery receipt and sales invoice to be used for when the items will be delivered. Fourth process is to check the delivered items in the presence of the clients. And last process is to obtain client's signature on P.R. invoice to finish delivery. Once the client has fully paid the order, the order status will be updated.

Figure 4.8Proposed Recording of Order Details Process
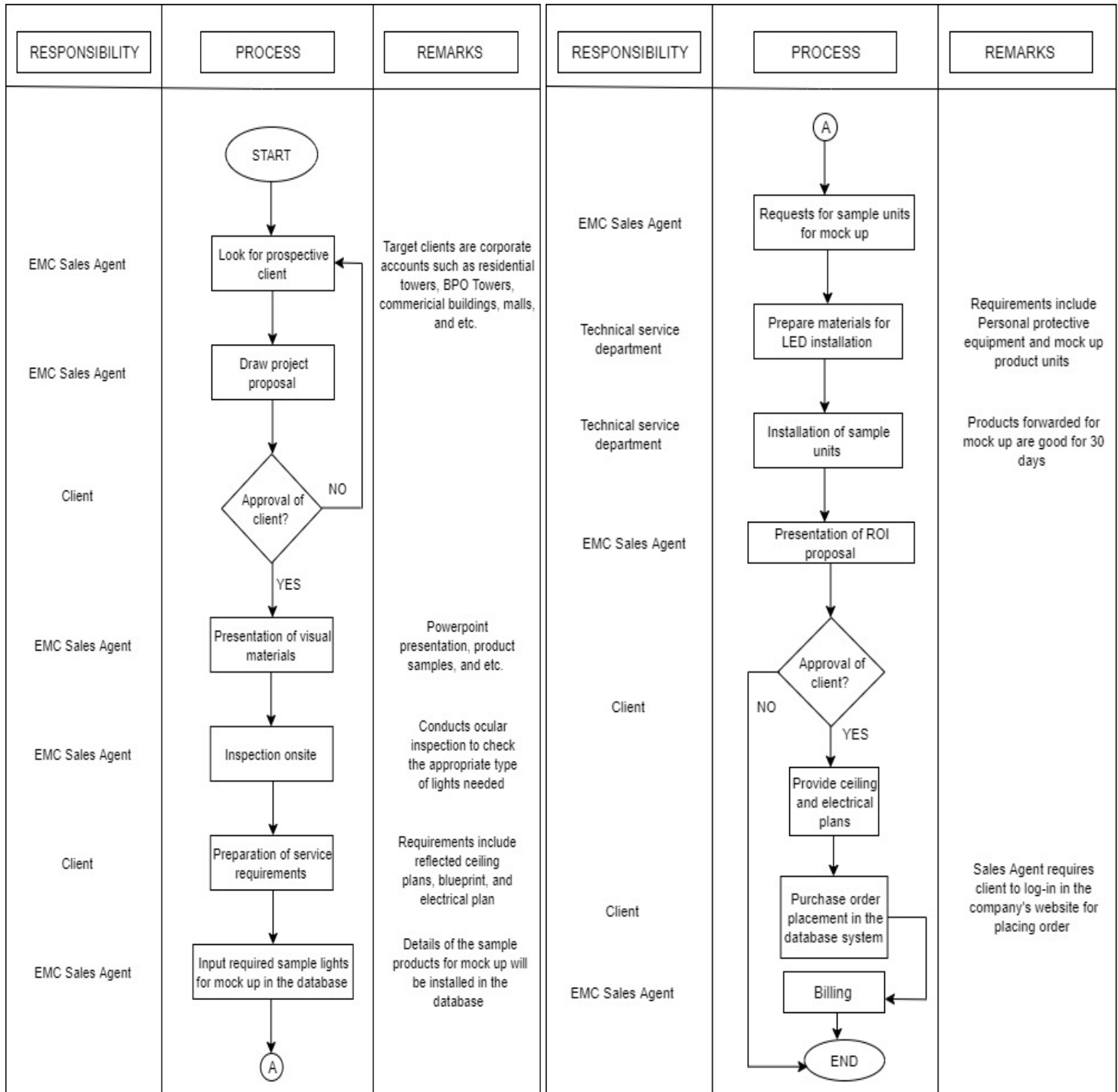
The inefficient recording of customer order contributed to the mistaken counting of lights as one of the branched out causes of the main problem occurred in the company's service. During the ocular visit of the sales executive in the client's firm, some instances involved them to perform the process of manual counting of the current lights which the firm wishes to be converted to LED. To eliminate the process of manual counting, the researchers proposed an order policy and procedure.

For the implementation of the proposed alternative for inefficient record keeping, the company uses a manual record keeping for all their files, in order to reduce or eliminate misplaced documents and mistakes in encoding of records, the EMC will use a new database system design to keep and track all company files. The company will conduct dry-runs and provide trainings for their employees for 2 months. An evaluation will be made after 6 months of operation. While for the implementation of the proposed alternative for inefficient process of recording customer orders, The current ordering system of the company experiences problems when it comes to accuracy. The new ordering system will allow the company to view client details, check for unsettled payments, check product availability, and verify order list. It will also help customers in placing job orders by providing an accurate ordering system where they can check the availability of each product. The initial implementation of the new ordering system will take about 3 months for both customers and employees to be familiarized and trained. The company will conduct dry-runs and provide trainings for their employees for the whole implementation period. An evaluation will be made after 6 months of operation. In introducing and implementing new procedures and systems into an organization, risk assessments shall always be made. This will allow the project team consider factors that may be harmful to the company upon implementing changes. Analysing possible risks at an early stage gives the company a heads-up on what to expect to the plan of action, which to prioritize, and the alternatives on how to address those risks.

5.Conclusion

The researchers conducted a study at Centron Energy Savings Technology Corporation. It is a qualified energy efficient lighting system manufacturer under the GES (Green Energy Saving) brand. Its business philosophy is advocacy aimed at providing consumers in the Philippines with economical, energy-efficient lighting products and systems used in the home and industry. Using their current systems and procedures, the researchers were able to understand and analyze the company's problem. During company visits, interviews, data and current system reviews, it was found that the company had issues with record keeping and the inefficient method of tracking customer orders. Four alternatives for the root cause found were considered. The four alternatives were analyzed using cost analysis-benefit analysis and came up to the best alternative to fix the root causes of undelivered items. To help determine the factors that affect the increase of undelivered items in the company, introducing a database system to solve the inefficient record keeping process. A new ordering system is also proposed to fix the inefficient process of recording customer orders. In addition, the chosen alternative is possible, and entails a significant risk. Centron Energy Savings Technology Corporation has solved the issue by addressing the root cause. Clear consideration of possible risks gives the company a head-up on what to expect from the action plan, which to prioritize, and the options on how to handle those risks.

References

Grubel, H. G., & Walker, M. A. (1989). *Service Industry Growth and Productivity* (Vol. 4).
Jasinskas, E., Streimikiene, D., Svagzdiene, B., & Simanavicius, A. (2016). Impact of hotel service quality on the loyalty of customers. *Economic Research-Ekonomska Istrazivanja* , *29*(1), 559–572.
https://doi.org/10.1080/1331677X.2016.1177465

Subramony, M., & Douglas Pugh, S. (2015). Services Management Research: Review, Integration, and Future Directions. *Journal of Management*, *41*(1), 349–373. https://doi.org/10.1177/0149206314557158

Belmonte, R. Murray, R. (1993): Getting Ready for Strategic Change: Surviving Business Process Redesign. Information Systems Management, summer, 23-29

Bhatt, G. D. (2000): Exploring the Relationship between Information Technology, Infrastructure and Business Process Re-engineering. Business Process Management **6**(2), 139-163

Leo Burnett. 2014. "The Sharing Economy: Where We Go From Here",
http://originqps.onstreammedia.com/origin/multivu_archive/ENR/Leo-Burnett-The-SharingEconomy.pdf, last accessed January 27, 2015.

Modell, S. 1996. "Management accounting and control in services: structural and behavioural perspectives", International Journal of Service Industry Management, vol. 7, no. 2, pp. 57- 80.

Biography / Biographies

Jenalyn Shigella Yandug is an Assistant Professor of School of Industrial Engineering and Management at Mapúa University in Intramuros, Manila, Philippines. She has earned her B.S degree in Industrial Engineering and Masters of Engineering Program major in IE from Mapúa University, Intramuros, Manila, Philippines. She is a Professional Industrial Engineer (PIE) with over 10 years of experience. She has taught courses in Methods Engineering, Systems Simulation, Engineering Economy and Systems Engineering. She has done research projects in systems simulation and systems engineering. She is a member of Philippine Institute of Industrial Engineers (PIIE).

Kyra Patricia V. Tadina is a 5th year undergraduate of Mapúa University taking up Bachelor of Science in Industrial Engineering. She is a member of Philippine Institute of Industrial Engineers (PIIE) and Operations Research Society of the Philippines (ORSP). She has strong data-analysis, problem solving, and communication skills gained through research studies of various courses from Mapua University. Her research interest includes Operations Management, Ergonomics, and Systems Engineering.

Ellaine C. Villegas is a 5th year undergraduate of Mapúa University taking up Bachelor of Science in Industrial Engineering. She is a member of Philippine Institute of Industrial Engineers (PIIE) and Operations Research Society of the Philippines (ORSP). With her skills in problem analysis, she is capable of solving problems in an effective approach. Her research interest includes Lean Production and Systems Engineering.

Nelrose D. Vidamo is a 5th year undergraduate of Mapúa University taking up Bachelor of Science in Industrial Engineering. She is a member of Philippine Institute of Industrial Engineers (PIIE) and Operations Research Society of the Philippines (ORSP). She is self-motivated and highly reliable. She shows passion and dedication in everything she does. She takes interest in Operations Management, Ergonomics, and Systems Engineering researches.

Joanna Lou C. Mata is a 4th year undergraduate of Mapúa University taking up Bachelor of Science in Industrial Engineering. She is a member of Philippine Institute of Industrial Engineers (PIIE) and Operations Research Society of the Philippines (ORSP). Efficient student who is driven to developing skills and team contribution. With skillset and knowledge, she is known to be trustworthy and work with other groups on project. She gives interest on researches that divulge on systems engineering and simulation studies.