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Research Paper

Project Scheduling of the Garment Business Using CPM-Crashing based on the POM-QM Application for Windows

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Abstract

Taytay Rizal is known as the "Garment Capital of the Philippines" and is very popular among bargain-hunting shoppers. The garment industry is one of the major contributors to the municipalities' economic growth. The emergence of fast fashion trends made the garment business in the municipality very lucrative. The industry, however, is highly competitive necessitating efficient management of planning of costs, schedules, and resources. The Critical Path Method (CPM) is an operations research technique that is useful for managers in managing projects and creating accurate project schedules. It is very useful in making optimal decisions in scheduling and determining critical activities to ensure the project's earliest finish. This research aims to determine the project duration, costs, and critical path for a garment business startup using the POM-QM application for Windows. Descriptive research method was used where data was collected through literature reviews, direct observation, and interviews of garment shop owners and garment sub-contractors. Based on the results of the study, it can be concluded that the use of critical path method is necessary to complete the garment business project on time. The entire project will require 96 days of completion in normal time and a 15.67 percent increase in the garment business project costs was observed to shorten the project duration to 52 days. This study is limited to the garment shop owners and garment sub-contractors in Taytay Rizal and is further limited to garment business projects for ladies' blouses and dresses.

Keywords: *Critical Path Method (CPM); Garment Business; Project Scheduling; Crashing*

INTRODUCTION

Taytay is a municipality nestled in the province of Rizal in the CALABARZON region of the Philippines. Known as the "Garment Capital of the Philippines", it is a bustling municipality that has emerged as a thriving hub for the garment industry. It has earned a widespread recognition for its vibrant local fashion scene due to the popularity of the municipal tiangge. The deep-rooted skills in garment production of its locals have significantly contributed to the town's reputation as a fashion destination. At present, it is not only a favorite go to for bargain hunting shoppers of garments that are affordable and of good quality but also a haven for entrepreneurs. The municipal's targeted income for the year 2016 has been noted to have surged to more than P700,000,000 and this is because of the Municipal Tiangge, BAGPI, My Seoul alongside several multinational companies that in the past years have decided to make significant investment in Taytay (Municipality of Taytay, 2023). The boosts in the municipal tiangge harnessed entrepreneurial intent among many locals. The overwhelming number of shoppers became an incentive among many residents to start garment business in order to cater to the growing demand for ready to wear (RTW) apparels. However, this opportunity did not come without a challenge, the fast fashion trend in the industry necessitated efficient project scheduling in order to quickly respond to changing customer preference and market trends. The Taytay Municipal Tiangge started in the approval of Taytay Local Tax Ordinance No. 10 identifying Kalayaan Park as the first venue with as little as 400 stalls in 2011 to 4,830 in 2016. By 2023 the list of tiangge in Taytay includes Allstar Tiangge, BAGPI, IGPAI, EMF, Freedom Bazaar, Octagon Fashion Strip, Taytay Mega Tiangge, and Tiangge ng Taytayenos with numerous stalls to cater to the increasing number of shoppers. The boosts in the municipal tiangge harnessed entrepreneurial intent among many locals. The overwhelming

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number of buyers during tiangge days became an incentive among many residents to start garment business in order to cater to the growing demand for ready to wear (RTW) apparels. However, this opportunity did not come without a challenge, the fast fashion trend in the industry necessitated efficient project scheduling in order to quickly respond to changing customer preference and market trends.

As entrepreneurs and investors recognized the potential of garment industry, it necessitated the need for careful business planning as this dynamic market requires fast response and efficient execution of strategic plans. Project management plays a pivotal role on this aspect. Garment business became even more complex due to the popularity of fast fashion trend hence it requires a structured approach to ensure timely delivery so as to meet market demands. Effective project management methodologies provide necessary framework to streamline processes, allocate resources, and maintain a cohesive workflow from project conception to project completion. Project management tool such as POM-QM (Production and Operations Management-Quantitative Methods) application for Windows can be instrumental in streamlining garment business project activities to ensure smooth workflow and timely project completion.

While literature provides several research on project management using Critical Path Method (CPM) in different industries for optimization purposes there is a notable research gap in its application to the challenges of the fast fashion trend in the garment business. Addressing this research gap in the use of CPM for garment business projects in the context of fast fashion industry can positively impact garment business projects to improve operations, competitiveness and enhance ability to meet the consumer demands in this highly dynamic market. Addressing this research gap will help garment business operators in making informed decisions that leads to faster time-to market for new fashion products.

Raihan Angni is a Muslim woman entrepreneur and is one of the many stall owners in the Taytay Municipal Tiangge. Having operated her stalls for more than five years, she was able to witnessed the growing demand for women's RTW garments. This sparked her interest in putting up a garment business that will not only cater to the demands of her customers but will also provide job opportunities for the unemployed women in their municipality. Employing women in the garment industry can contribute in the achievement of Sustainable Development Goal (SDG) 8. SDG 8 aims to "promote sustained, inclusive and sustainable growth, full and productive employment and decent work for all" (United Nations, 2015). Garment business projects can make significant contributions to the SDG 8 by promoting sustained and inclusive economic growth, creating more jobs, and providing decent work conditions. Establishing garment business in Taytay using the CPM techniques will help contribute in the attainment of SDG 8 because it helps in securing there is efficient allocation of resources wherein planning and scheduling of activities involved in garment production can be done in such a way that wastage is eliminated leading to cost savings and improved profitability. It can also help in job creation and promotion of decent work as garment business requires a diverse workforce that ranges from skilled tailors, pattern makers, and even administrative staff. Garment business can help attain SDG 8 by creating employment and decent work for women and young people.

This research aims to determine the project duration, costs, and critical path for a garment business startup using the POM-QM application for Windows. Further this study will determine the outcomes of crashing the activities in a garment business project using the POM QM application for Windows. The data used in the study was taken from the unstructured interviews conducted with the garments shop owners and garment subcontractors who during the interview are engaged in manufacturing women's blouses and dresses. Direct observation in the garment factories was also conducted to determine the activities involved in the garment business project.

LITERATURE REVIEW

Sustainable Development Goals

The Sustainable Development Goals (SDG) also referred to as Global Goals was introduced by the United Nations as a global call urging collective effort to eradicate poverty, safeguard the planet, and ensure that in 2030 everyone lives in peace and prosperity. The SDGs are comprised of 17 goals that has been adopted by United Nations as a part of 2030 Agenda for Sustainable Development. It provides a guideline for a collective action of the governments, organizations, and people to make positive impact on our planet. With the primary objective of eradicating poverty, promoting a life of dignity where no one is left behind, the 17 SDGs and 169 targets were formulated. One of the key milestones in the UN SDG's 2030 Agenda for Sustainable Development is the SDG 8. The SDG 8 calls for the promotion of decent work and full employment for all and sustainable economic growth with its 12 defined targets and 16 indicators. The targets clearly identify the goals while metrics are represented by the indicators that will serve as measurement of SDG 8's attainment. Garment business plays a pivotal role in advancing the SDG 8 agenda as it addresses concerns on safe working conditions and fostering socially inclusive job opportunities (Strydom & Kempen, 2021) (Louw et al., 2023). The launch of garment business startups helps in creating decent jobs by paying fair wages and provision of safe workplaces. Garment business can also promote employment of women and the minority sector of the society.

Garment Industry in Taytay Rizal

The garment industry in Taytay Rizal has been a great contributor to its economic development for the past decades. It is a home to skilled tailors and dressmakers who creates affordable RTW garments. The garment industry for the longest time has become a provider of employment opportunities to its locals. In the past, garment business operators in the municipality were already engaged in manufacturing RTW garments that were distributed in Divisoria and Baclaran that was then considered as the famous flea markets among residents of Manila and its neighboring municipalities. The establishment of Taytay Municipal Tiangge became an added source of employment and entrepreneurial opportunities among the residents (Ramos, 2022). Since the operation of the municipal tiangge through the initiative of Taytay local government in 2014, many local residents started to set up stalls to sell clothing apparels that is a great hit among shoppers due to its quality and affordability. The Taytay Tiangge that is situated at Club Manila East compound at present is actually a result of a failure in the initial plan of merely putting up an online shopping platform with the main goal of centralizing the operation of RTW and garment business operators (Taytay Tiangge, 2022). In more recent years, the popularity of tiangge drives many individuals from different places to visit the municipality and the increasing demand for affordable RTW garments provided incentives for many to put up garment manufacturing business among locals and many alike.

Critical Path Method

The dynamic business landscape heightens the need for firms to optimize production and operational process. To cope to the ever-changing business environment, managers rely on available software for quantitative methods, management science, and operations research. POM-QM (Production and Operations Management-Quantitative Methods) for Windows is one of the many available software for operations research, quantitative analysis, and management science. POM-QM for Windows has been developed with the goal of providing students with a user-friendly package that can supplement any available textbook on Decision Science (Weiss, 2018). Since the introduction of its first version in 1989 it has undergone numerous improvements until its most recent version, it has gained popularity in terms of use even among project managers. It has become

a valuable tool that can assist managers in securing optimal operations and making informed decisions in the field of project management. It is also a very useful tool in managing a garment business project as it offers a wide range of functionalities that can help in scheduling activities and optimizing resources to make data driven decisions in a highly competitive industry.

Projects such as garment business requires efficient planning and management of resources to ensure optimal allocation of resources. CPM is a method widely used in managing small scale and largescale projects in different industries (Kusumadarma et al., 2020). CPM was developed in 1950s by mathematicians at Du Pont Company who at that time were trying to find ways to avoid the "costs of plant shutdowns and restarts that are brought about by inefficient scheduling" (Takebira & Mohibullah, 2017). It was originally designed for large complex projects but in later years, CPM has been widely used even in small -scale projects in various types of industries. In CPM, a network diagram or a visual presentation of the project is created, critical path is then identified which will help the project managers to determine activities that must be completed on time otherwise it will cause delay in the timely completion of the entire project (Wysocki, 2024). It is an indispensable tool for the highly dynamic and competitive garment industry that requires efficient project scheduling to ensure that the project will be completed on time. Fast fashion according to Niinimäki et al., (2020) pertains to "frequently offering consumers novelty in the form of affordable products". The fast fashion trend necessitated rapid production of high volumes of clothing which in turn brought about changes in the way clothes are produced and consumed. The rate at which new clothing apparel is produced it is vital for garment producers to ensure successful execution of projects so the finished products get to land on display racks the fastest time. CPM as a project scheduling method is a useful tool for garment business project management assuming a deterministic turnaround time and it also provide the minimum project time completion (Leach, 2005; Nurprihatin et al., 2021). In a study conducted by Abbas and Onsa (2023) in SUR Military and Civil Clothing Factory using CPM, it was posited that production and process analysis aids in improving productivity, efficiency and overall optimization of time management. In a similar study conducted by Hoque et al. (2019) it was posited that in using project management skills and tools, companies can benefit in terms of minimizing cost of production, reduction in lead time, and overall improved efficiency. CPM can be a reference project for construction project as exemplified in a study conducted by Atin and Lubis (2019) on the construction project of BUMN buildings in the city of Bali which suggested that project work network is vital in determining critical paths for the timely completion of projects. These studies were able to exemplify the use of CPM in efficient project management, however it can be noted that it limits in terms of exploration of the dynamic fast fashion trend in the garment business.

Crashing in Project Management

Crashing is the process of compressing schedules to shorten the projection completion period (Heldman, 2011). It is a "method commonly used in project management to shorten the schedule duration for the least incremental cost by adding resources" (Project Management Institute, 2021). Crashing involves the process of expediting to project's completion by adding resources to the critical path activities. In crashing a project, the additional cost incurred (crash cost) is evaluated against the benefits of finishing the project in a much shorter time (Patil, 2018). In the highly dynamic landscape of garment business where fashion trends and consumer tastes and preferences is rapidly evolving, streamlining production process allows agility in meeting the demands for latest styles and staying ahead of competitors.

RESEARCH METHOD

Efficient project management is vital for the success of any project undertaking in all types of industries. The use of project management tools like CPM will help project managers in securing that activities are started on time to avoid bottlenecks and possible delays in the total project completion. This research aims to determine the project duration, costs, and critical path for a garment business startup using the POM-QM application for Windows. Further this study will determine the outcomes of crashing the activities in a garment business project using the POM QM application for Windows. Descriptive research methodology was used in order to achieve the predetermined research objectives. Descriptive research design provides an accurate picture of the phenomenon and to describe relationships, patterns, and trends that exist in the data being studied (Shaquor, 2022; Cabarrubias et al., 2022; Sirisilla, 2023). It provides an avenue for an in-depth and elaborate exploration of the subject matter (Telaumbana et al., 2023). Descriptive research serves as a valuable tool for garment businesses in forecasting future outcomes, identifying risks, optimizing project duration, costs, and critical path method.

The data that was used in the study was obtained through primary and secondary sources. In order to gather primary data, interviews of garment business owners and subcontractors were conducted and direct observations in their respective garment factories was done. For this study, ten garment business owners and subcontractors were interviewed in order to generate the necessary data in determining the garment business project activities so that network representation can be developed. Unstructured interview questionnaire was prepared and was used in the face-to-face interviews with garment shop owners and garment sub-contractors. In the interview, participants were asked about their background, how they started in the garment business, and what motivated them to start a garment business or become a subcontractor. In order to identify the project activities and duration, participants were asked what are the main products or services that they offer, who are their typical clients, and how do they typically plan and organize garment projects. They were also asked to describe the typical processes involved in manufacturing garments and the time allotted for each activities. In the course of the interview participants also shared the biggest challenges they face in the garment business and how they remained competitive in the market, especially with the rise of fast fashion and online retailers. Direct observation was conducted in the garment shops during operation period in order to determine the different activities involved in the production of ladies' blouses and dresses. Secondary data was gathered through review of available literature related to the study at hand to leverage on the existing information about the use of project management tools such as CPM in garment business projects.

FINDINGS AND DISCUSSION

Table 1 presents the profile of the participants that were tapped for the interviews, it can be gleaned from the results that majority of the garment business owners and subcontractors are within the age range 41 to 50 years old, most of them have been operating in the garment industry for 1 to 15 years. In terms of initial capital outlay majority of the participants disclosed that they shelled out minimum of P100,000 to P900,000 and above which were sourced from personal savings, help from families and friends, bank loans, some had to pawn their jewelries while others relied on loan sharks. Profile such as initial capitalization and number of years in business is significant in determining levels of operationalization in a study conducted (Martinez et al. 2022).

Table 1. Participants' Profile

Age Range	**Frequency**	**Percent**
30 – 35	1	10
36 – 40	1	10
41 – 45	2	20
46 – 50	4	40
50 and above	2	20
Number of Years in Operation	**Frequency**	**Percent**
1-5 years	1	10
6-10 years	4	40
11-15 years	3	30
16-20 years	1	10
21 years and above	1	10
Initial Capital Outlay	**Frequency**	**Percent**
P100,000 - P300,000	2	20
P300,001 - P500,000	3	30
P500,001 – P700,000	3	30
P700,001 – P900,000	1	10
P900,001 and above	1	10
Sources of Funds	**Frequency**	**Percent**
Personal Savings	1	10
Families and Friends	3	30
Bank Loans	2	20
Pawned Jewelries	2	20
Loan Sharks	2	20

Table 2 reflects the project schedule of the garment business project. It reflects the list of activities required to complete the garment business project with their corresponding activity symbol, immediate predecessor, and activity time. The entire garment project involves seventeen (17) activities. These activities are denoted as A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, and Q. Under the normal time, entire project would require ninety-six (96) days to secure full completion. The activities can be broadly categorized into five (5) stages.

Table 2. Garment Business Project Schedule

Activity Symbol	**Description**	**Immediate Predecessor**	**Time**
A	Develop garment samples		7
B	Submit proposals to prospective clients	A	10
C	Approval of proposals	B	7
D	Contract signing	C	4
E	Issuance of required garment designs from clients	D	7
F	Develop patterns	D, E	5
G	Develop samples based on client's design requirements	F	4
H	Submission of samples to the clients	G,F	3
I	Identification of subcontractors	D	4
J	Issuance of purchase orders	H	1
K	Look for suppliers of fabrics, embellishments, and other materials	D, I	4
L	Purchase of materials	J, K	5
M	Layout and cutting of fabrics	L	4

Activity Symbol	Description	Immediate Predecessor	Time
N	Distribution of garment patterns and cut fabrics to subcontractors	M	7
O	Sewing of garments	N	23
P	Quality control	O	5
Q	Delivery of finished garments to clients	P	4

The Stage one (1) is comprised of four (4) activities that includes Activity A development of samples, Activity B submit proposals to prospective clients, Activity C approval of proposals, and Activity D contract signing. Stage two (2) is composed of six (6) activities including Activity E clients' issuance of required garment designs from clients, Activity F develop patterns, Activity G develop samples based on client's design requirements, Activity H submission of samples to the clients, Activity I identification of subcontractors, and ultimately Activity J issuance of purchase orders. Stage three has four (4) activities which include Activity K look for suppliers of fabrics, embellishments, and other materials, Activity L purchase of materials, Activity M fabric layout and cutting, and Activity N distribution of garment patterns and cut fabrics to sub-contractors. Stage four (4) deals with two activities Activity O the actual production of the garments and Activity P quality control. The final phase is Stage five (5) which involves the delivery of finished garments to the clients. The table also reflects the immediate predecessor/s and the activity time reflected in days for each of the identified activities for the garment business project. The immediate predecessor/s are activities that must be complied before an activity can be started.

Figure 1 reflects the network diagram based on the data presented in Table 1 that has been prepared using POM-QM application for Windows. There are seventeen (17) listed activities for the garment business project. The activities are denoted as A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, and Q. Activity A (develop garment samples) with activity time of 7 days does not have an immediate predecessor so it can be started at the very day the project is launched. Activity B (submit proposals to prospective clients) can only be started once Activity A is completed. The Activity C (approval of contracts) can start the soonest time Activity B is completed and Activity D (contract signing) will start as soon as contracts has been approved by the clients. After the contract signing, Activity E (issuance of garment designs from clients) will then follow. Activity F (develop patterns) can only start if Activity D (contract signing) and Activity E (issuance of garment designs from clients) has been completed. Activity G (sample development based on clients' design requirements) can be started the moment that Activity F has been complied. The submission of samples to the clients Activity H can start after the completion of Activity G and F.

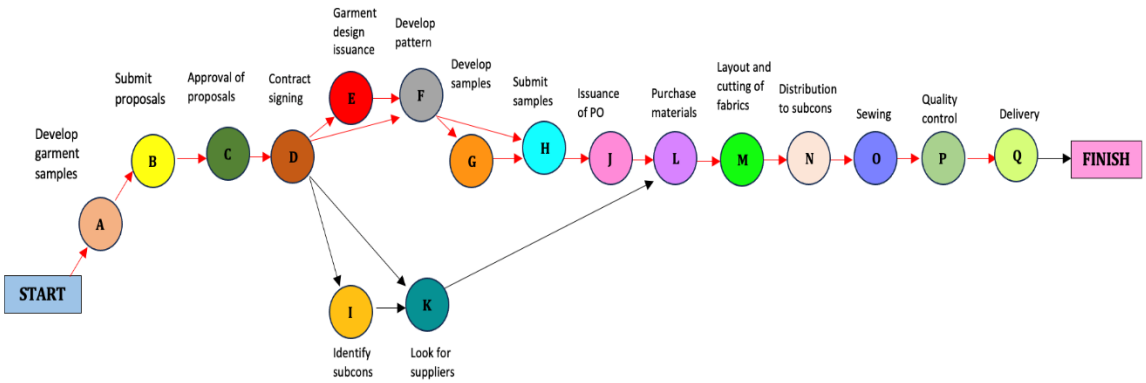

Figure 1. Garment Business Project Network

The identification of sub-contractors, Activity (I) can start as early the completion of contract signing activity. The issuance of purchase orders Activity J proceeds once Activity H is finished. Activity K (search for suppliers of fabrics, embellishments, and other materials) can be started as soon as the contract signing is done and sub-contractors are identified. Activity L (purchase of materials) can be started once purchase orders are secured and suppliers of fabrics and embellishments are identified. Activity (M) the layout and cutting of fabrics can be secured once materials are already purchased Activity (L), after which the cut fabrics and garment patters will be distributed to the sub-contractors Activity (N). The Activity O (sewing of garments) will take place once Activity (N) is completed and once done with the garment production, it will then undergo quality control Activity (P) before the finished garments can finally be delivered to the clients Activity (Q).

Table 3. Activity Schedule for Garment Business Project with Earliest Start, Latest Start, Earliest Finish, Latest Finish, and Slack

Activity	Activity Time	Earliest Start (ES)	Latest Start (LS)	Earliest Finish (EF)	Latest Finish (LF)	Slack	Critical Path (Yes/No)
A	7	0	0	7	7	0	Yes
B	10	7	7	17	17	0	Yes
C	7	17	17	24	24	0	Yes
D	4	24	24	28	28	0	Yes
E	7	28	28	35	35	0	Yes
F	5	35	35	40	40	0	Yes
G	4	40	40	44	44	0	Yes
H	3	44	44	47	47	0	Yes
I	4	28	40	32	44	12	No
J	1	47	47	48	48	0	Yes
K	4	32	44	36	48	12	No
L	5	48	48	53	53	0	Yes
M	4	53	53	57	57	0	Yes
N	7	57	57	64	64	0	Yes
O	23	64	64	87	87	0	Yes
P	5	87	87	92	92	0	Yes
Q	4	92	92	96	96	0	Yes

In determining the completion time for the garment business project, a thorough and careful analysis of the project network has been done in order to determine the critical path of the garment business project. CPM is a network-based approach in project management that is typically used to determine the longest sequence of dependent activities and the minimum time needed to complete a project (Zareei, 2018; Takakura et al., 2019). Using POM-QM application for Windows, the initial conditions (Early Times) and final conditions (Late Times) have been identified. The critical path uses an algorithm which has two parts, forward and backward pass. To determine the forward pass, the earliest start (ES) and the earliest finish (EF) for each of the activity in the garment business project is used. The ES time of an activity is the earliest time that an activity can be started once its predecessor activities have been accomplished. The EF time of an activity on the other hand is the earliest time an activity can be completed. The LF is the latest time an activity can be completed while LS is the latest time an activity can be started without causing delay in the project. The ES of an activity is the EF of the activity before it. To compute for EF, the formula is **ES + t** where **t** is the duration of activity while in determining the latest start (LS), the formula is **LF-t** where **t** is the duration of activity (Project Manager, 2024). In the backward pass, the EF of the last activity is also

its latest finish (LF). The forward and backward calculations are reflected in the Table 3 along with the slack. Slack in CPM refers to the amount of time a project can be delayed using additional resources without delaying its overall completion time (Abbasi & Mukattash, 2001).

The node display for critical path calculation of activity-on-node is reflected in Table 4. The slack time (S) for an activity can be computed using the formula S = LS – ES or an alternative expression is S = LF – EF. In CPM the critical path is determined by the activities that have zero slack, any delay on these activities will have a great impact on the project completion (Ren & Li, 2023).

Figure 2 below reflects the garment business project CPM network model. There are 15 critical activities in the garment business project. Activities A, B, C, D, E, F, G, H, J, L, M, N, O, P, and Q are considered to be critical. The activities that lie on the critical path must be carefully managed as any delay on these activities will cause a delay on the completion of the garment business project.

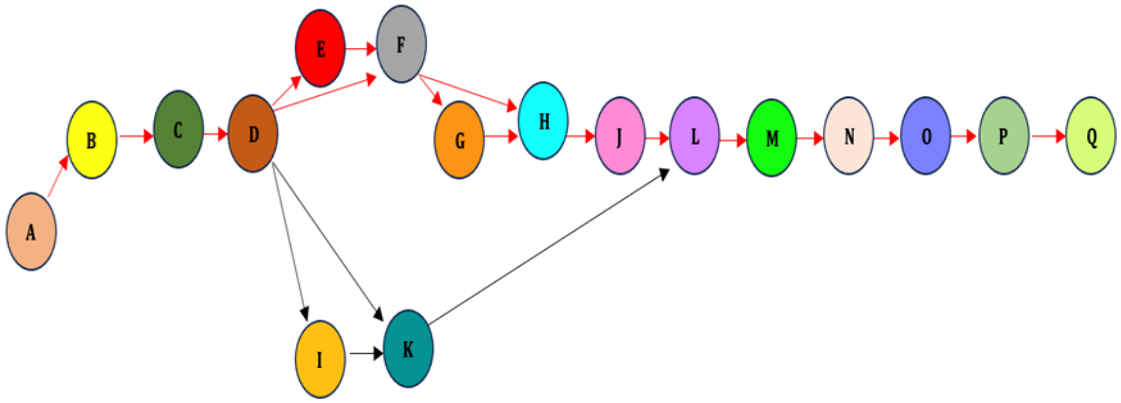

Figure 2. Garment Business Project CPM Network Model

Figure 3 reflects the crafted project network for the garment business project with corresponding start and completion time for each activity. The Activities A, B, C, D, E, F, G, H, J, L, M, N, O, P, and Q lies on the critical path, in order to finish the garment business project within the 96 days target, no delay must be experienced in any of these activities. Activity I and K can be delayed up to 12 days without having to delay the completion of the garment business project. The identification of subcontractors (Activity I) and searching for suppliers of fabrics, embellishments and other materials (Activity K) can be delayed both for 12 days without having to extend the project completion because both activities can be secured much more easily since the project is situated in Taytay Rizal.

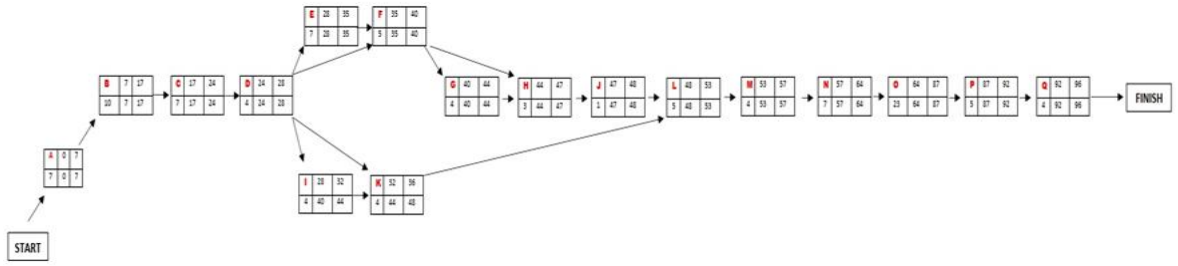

Figure 3. Garment Business Project Network with Earliest Start, Earliest Finish, Latest Start, and Latest Finish Shown in Each Node

Since the municipality has a long-standing tradition of garment manufacturing, over the years it was able to develop and sustain expertise in producing a wide range of clothing items. Many locals have acquired expertise in sewing, pattern making and other garment operations, it will be easier to secure subcontractors within the area upon acceptance of purchase orders from clients.

Table 4. Node display for critical path calculation of activity-on-node

Activity	ES	EF
Time	LS	LF

Table 5 shows the garment business project acceleration cost. Crashing is the process of assigning additional resources to shorten the project's completion time (Sunita & Snigdha, 2012). Crashing is vital in the garment business as it responds to the challenges brought about by fast fashion trend. Accelerating production process is necessary in order to meet the tight deadlines of the clients in the very dynamic garment industry. Since fast fashion trend demands quick turnaround time to meet customers' demands, crashing allows garment business to compress their project schedule enabling them to bring new designs to market faster and capitalize on emerging trends before it goes out of style. Activity A can be crashed by two (2) days with additional cost amounting to P1,000 per day. Activity B can also be crashed by two (2) days and it would incur additional cost of P500 per day. Activity F can be crashed by three (3) days with crashing cost amounting to P600 per day. Crashing Activity G for two (2) days will incur additional cost amounting to P1,400 per day while crashing Activity H for the same number of days would have a total cost of P1,000. Activity L can be crashed for two (2) days and it would incur crashing cost of P50,000 per day. To crashed Activity M and Activity N for two (2) days will incur additional cost amounting to P8,000 and P1,500 respectively. Activity O can be crashed for five (5) days and it will incur P14,000 per day, while Activity P can be crashed for two (2) days with cost amounting to P650 per day, while crashing Activity Q for one (1) day would incur P1,000 crashing cost.

Table 5. Garment Business Project Acceleration Cost

Activity	**Normal Time**	**Crash Time**	**Normal Cost in Php**	**Crash Cost in Php**	**Crash Cost/Day**	**Crash by**	**Crashing Cost**
	96	**52**					
A	7	5	5,000	7,000	1000	2	2000
B	10	8	2,000	3,000	500	2	1000
C	7	0	0	0	0	7	0
D	4	0	0	0	0	4	0
E	7	0	0	0	0	7	0
F	5	2	6,500	8,300	600	3	1800
G	4	2	5,000	7,800	1400	2	2800
H	3	1	2,000	3,000	500	2	1000
I	4	0	0	0	0	3	0
J	1	0	0	0	0	1	0
K	4	3	3,000	4,500	1500	0	0
L	5	3	950,000	1,050,000	50000	2	100000
M	4	2	15,000	23,000	4000	2	8000
N	7	5	3,000	4,500	750	2	1500
O	23	18	220,000	290,000	14000	5	70000
P	5	3	2,500	3800	650	2	1300
Q	4	3	4000	5000	1000	1	1000
Totals			1,218,000				190,400

The normal time to complete the garment business project is ninety-six (96) days and crashing it for fifty (52) days will require additional cost amounting to P190,400. Rukayat et al., (2023) defined project cost as the accounted cost during project completion. The normal cost for this garment business project is P 1,215,000 and its accelerated cost is 1,405,400.

CONCLUSIONS

This study tried to determine the project duration, cost and critical path for a garment business project. The critical path in Raihan Angni's Garment Business Project is Activities A, B, C, D, E, F, G, H, J, L, M, N, O, P, and Q. The normal time to complete the project is 96 days and would typically cost P1,215,000. Similarly, this study determined the result of crashing the activities for a garment business project. If the project will be accelerated, there will be a need to reduce lead times that will enable Raihan Angni to design, manufacture, and deliver to her clients faster than other garment firms. The crashing of the activities will help the firm produce the trendy garments while they are still in fashion or in demand. Activity (A) develop garment samples can be crashed to 5 days and it will have a crashing cost amounting to P1,000 per day. Activity B (submit the proposals to the clients) can be reduced to 8 days which will incur additional cost of P500 per day. Activity F (pattern development) can be expedited to 2 days with a crashing cost of P600 per day.

After the development of patterns, the next step is developing initial samples of the design requirements of the clients, accelerating this activity to 2 days will require additional cost of P1,400 per day. Activity H (submitting the samples to the clients) typically requires 3 days completion, if this will be reduced to 1 day, it will have an additional P500 cost per day. Activity L (purchasing raw materials) in normal time takes 5 days to complete, if it would be crashed to 3 days, it would mean lesser time to canvass sources and negotiate prices of materials as well as additional costs on expediting the delivery process. Crashing this activity will incur a cost amounting to P50,000 per day. Activity M (layout and cutting of fabrics) requires 4 days to complete and accelerating it to 2 days would increase activity cost of 23,000 or an additional P4,000 per day. The crashing cost will cover for hiring additional fabric pattern cutters and their overtime pay. The crashing of Activity N (distribution of garment patterns and fabrics to subcontactors) will reduce the 7 days activity to 5 days but that will come with additional crashing cost of P1,500.

The actual production of garments (Activity O) will require the longest time, crashing the activity for 5 days will cut the activity time to 18 days and this will have an additional cost of P14,000 per day. The said cost will cover for the labor cost of additional sewers and their overtime pay to make sure that the garments will be ready in within 18 days. Activity P (quality control) usually takes 5 days which includes checking the quality of the finished garments, pressing, attaching the clients' hangtags, and packing. This activity once crashed for 3 days will incur cost of P650 pesos per day hence increasing the normal cost of P2,500 to crash cost of P3,800. Activity Q (delivery of the finished garments) is the final activity to complete the project, in the normal time it will take 4 days to deliver all the finished garments to the clients, it can be crashed only for 1 day. The crashing of activities in the garment business project will accelerate the production of the garments to 52 days with additional cost of around 15.67% of its normal time cost. This study contributes to the theoretical understanding of project management by providing insights on how project scheduling, critical path analysis, resource allocation and crashing can be applied in the garment business project. The use of CPM in the context of garment manufacturing project in this study also offers practical contributions that can help garment businesses in terms of optimized scheduling, resource allocation, and project monitoring that can lead to enhanced operations and achieve better outcomes in terms of timeliness and effectiveness.

LIMITATION & FURTHER RESEARCH

While this study provided valuable information about the project duration, costs, critical path, and crashing cost for a garment business startup using the POM-QM application for Windows, there are some limitations that may impact the general findings of the study. This study is limited to the production of blouses and dresses for women. The data presented was provided by the garment business owners and subcontractors who at the time are engaged in production of ladies' garment. To process the data the software POM-QM application for Windows was used and it was limited to CPM process only. To address the said limitations, it is recommended to conduct further research that will explore the production of other types of garments that are also in demand in the Taytay Municipal Tiangge. Further it is recommended to include in further research garment business owners and subcontractors in different parts of the Philippines to determine variances in terms of production schedule, cost, and production requirements. Ultimately it is recommended for future researchers to use more sophisticated and new software that has been recently released in the market as well as use other application other than CPM to further improve the findings of the study related to business garment projects.

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