INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN ECONOMICS & MANAGEMENT SCIENCES

OPEN ACCESS JOURNAL

Vol 15, Issue 4, (2026) E-ISSN: 2226-3624

Best Practices for New Product Development: Insights from the Six Sigma Define Phase

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DOI Link: http://dx.doi.org/10.6007/IJAREMS/v15-i4/29263

Published Online: 15 November 2026

Abstract

The Six Sigma approach can be utilized to enhance the new product prototyping process at the ABC Stationery and the current paper is focused on the Define stage of the DMAIC framework. This stage is aimed at determining the main issues, learning customer requirements and defining the scope of the project before proceeding with the analysis. The research found three key problems to the prototyping process, which include, long process duration, poor process visibility, and lack of roles and responsibilities. The key of them is the long prototyping cycle, which may also take as long as 14 weeks to complete and postpones the product testing, introduction in the market and accommodation to market trends. Moreover, poor accountability and ineffective reporting also result in communication failures and siloing of departments. SIPOC diagrams, process maps and Voice of the Customer (VOC) tools were utilised to apprehend internal customer expectations and project scope definition. The results of the 30 stakeholders revealed that there is a necessity to achieve a better efficiency level in Preparation and Part Readiness stages, and enhance the reporting visibility in Build and Test stages. These results can serve as a basis of the further improvement of stages of DMAIC.

Keywords: Six Sigma, Define Phase, Prototyping, Stationery, New Product Development

Introduction

In the new product development process, prototyping process is essential to ensure a product sample can prove that the product has reached a level of maturity and engineering specifications before entering the market (Elverum et al., 2016). A series of design ideas, prototype construction and testing provide the data needed by engineers to improve the design ideas and find the best solutions to achieve the targets set mainly in specification, cost and time target factor before a product is able to enter the mass production phase and market. This study focused on to identify the relevancy of six sigma practises and to enhance the established DMAIC methodology for effective new stationaries product development prototype process flow and also to helps company to maintain the competitiveness of the product market.

Six Sigma is a management methodology which allows companies to use data to eliminate defects in any process (Escobar et al., 2024; Kumar et al., 2024; Tsarouhas and Sidiropoulou, 2024; Al Fauzi and Sari, 2025). For a process to have achieved Six Sigma, a process must not produce a defect - that is anything outside of customer specifications - more often than 3.4 times per million opportunities. Six Sigma works through the use of two sub methodologies; DMAIC which stands for Define, Measure, Analyse, Improve and Control and is used for existing processes, and DMADV which is used for new processes and stands for Define, Measure, Analyse, Design and Verify. Implementing Six Sigma within a business offers a number of benefits and key advantages such as improved customer loyalty, time management, reduced cycle time, employee motivation, strategic planning & supply chain management.

Six Sigma offers enhancements to business processes by defining parameters that facilitate improved value additions to the business such as through quality profit ratios, customer satisfaction, and the associated costs. By adopting the Six Sigma framework, the DMAIC model is used and executed which encompasses Defining, Measuring, Analyzing, Improving and Controlling. These model phases help steer the framework over a period to ensure cycle closure with effective processes from target beginning stages up to the advanced level. Six Sigma is systematic, so it is no surprise that the NPD stages have also been a target for many companies, considering that the objective is to reduce operational costs while increasing customer satisfaction through quality improvements (Strauss et al., 2024; Yang et al., 2022). Threat analysis shows the NPD as the most critical stage to capture, as it builds a strong position for the rivals, and offers the greatest edge for the company to orchestrate. There is no shortage for the value a company can capture from innovation so long as the only boundary is the imagination. With the parameters on the company's guiding philosophy, nimbleness, and operational ethos; a company can also become equally synonymous as the term Six Sigma can equally apply to an improved and a new model. NPD inconsistencies is the speed with which new and improved products have to be developed. A company is bound to improve their processes if they are eager to satisfy demand as the market as a whole dictates the competition. Consequently, this research has studied the use of the Six Sigma method in new product development.

Competitive advantage is one of the most important factors for a company to gain a larger market share. A company with competitive advantage able to keep their product demand at a high level for a period of time before other companies release their product (Maia et al., 2024). In this era, the world is changing rapidly and the latest innovative technology products come one after another. Many companies tried a lot of strategies to become the market leader and intended to gain competitive advantage by release the latest innovative technology product before their competitor. Some companies implemented Six Sigma practice into their research and development (R&D) department and the companies managed to gain the competitive advantage for their innovative products because of the Six Sigma practice. Process improvement strategy is one of the top focus for top management to stay competitive and that would result in the big difference between significant company revenue and profit gained or lost and also help top management determine where and where not to focus attention (Yanamandra and Alzoubi, 2022; Qayyum et al., 2021; Najafi et al., 2023; Bagherian et al., 2023).

New product development launching strategy and planning requires very clear direction of new product development processes and becomes ever more critical to the company growing success. Complex new products development requires an effective and efficient new product development process to ensure that the company can produce a product that meets customer requirements in accordance to the vision specifications, budget and project time frame. An improved new product development processes results in faster time to market and time to profit.

This research aims to conduct research related to the use of Six Sigma tools to improve the effectiveness of the new product development prototype process in a local company that produces stationeries product for the international market. The company is highly dependent on international exhibitions to show new stationeries product to their clients ranging from wholesalers who come from around the world to find new stationeries product for their national markets. For this company to remain competitive and profitable, new and attractive product stationeries need to meet very tight schedule of target new product launching so that the products can be exhibited internationally and attracting wholesalers from all over the world to come to the exhibition company booth. Launching a new stationeries product is very important to make sure the company is always able to attract customers to come to them and because of that new product development prototype process has become one of the major factors for the increase in overall sales during the international exhibitions. For the company to maintain their fitness to supply new stationeries product into the international market, they need to look seriously at their new product prototype process improvement activities and embedded the culture of process improvement activities in their organizations. Senior management need to continually assess and improve processes everywhere in the organization and emphasize the importance of prototype process consistency, reliability and efficiency which involve engineering, manufacturing, finance and operation.

Materials And Methods

As required under the terms of confidentiality, the actual name of the company ABC Stationery and its corresponding pseudonym will remain undisclosed. The company was founded in 2005. The owner had prior experience marketing station functionalities with Schwan-STABILO. The owner has since made the choice to establish a company that manufactures stationeries to be sold worldwide, with a focus in the Middle East. He was forced to relocate from China to Indonesia and then to Bangladesh for the other locations lacking in affordable and stable infrastructure China had. The company currently fulfills orders in a number of countries, including Singapore, Taiwan, Saudi Arabia, Hong Kong, and China. Their products range from simple paper, office and student materials, crayons, and other arts and crafts supplies to more complex items, such as corporate souvenirs and gifts. The company continuously aims to ensure their customers receive the highest quality products through their stationeries sourcing. Major Manufacturing is stationed in Bangladesh, while the branch office in Malaysia works for the branch's daily sales activities-covered relationships with over twenty clients globally, retaining over 5000 varieties of different stationery products, as well as providing the OEM stationery products service.

ABC sale and marketing strategies is focusing on global stationery exhibition events with main focus is new product launching activities with lower product selling price compare to other competitors. ABC's main business challenges stem from the product's manufacturing cost,

the new product prototype development, global organizational management, sales and marketing strategies, and product branding. The most expensive part of the product is the cost of labor, which is manually assembled, so countries with lower costs to hire workers will be preferred. The new product development prototype process is the second profound concern, the direct impact is sale and marketing strategy. This research focuses on using six sigma tools to define the current state of prototype process flow.

Result and Discussion

The Define phase is one of the core elements of the Six Sigma DMAIC framework (Jou et al., 2022; Kurnia et al., 2021; De mast et al., 2022; Sodhi, 2023). Its focus is ensuring the feasibility of the project worth accomplishing. One of the goals is understanding all the requirements of the customers, articulating elements of the product or service, and determining the relations of the objectives of the project to the goals of the organization. This helps to ensure the focus of the objectives improves the organization and is beneficial for the customer. This phase has a more defined focus element for customer and project goals, and the scope for the initiative. There are other instruments which aid in understanding the process such as a SIPOC (Suppliers, Inputs, Process, Outputs, Customers). This helps in understanding the flow of information and identifying the major players in the process. Process mapping clarifies the area of focus by identifying the current situation, which has a disproportionate amount of unsatisfied demands and is a good candidate for improvement. Very importantly, the VOC helps in understanding the expectations, problems, and satisfaction of customers, therefore helping the team in determining the issues of focus to maximize customer value. These focus areas, and the problems to be solved, initiate the Define phase by enabling a strategy for the subsequent, value-driven analysis in the Measure phase. This article has a narrow focus on the Define phase and delineates the best practices essential for the successful completion of Six Sigma projects. This perspective allows for an appreciation of how customer requirements, project objectives, and an understanding of the processes intricately shape new product development activities.

Project Charter

The Project Charter is a foundational document in Six Sigma methodology that formally defines the purpose, scope, objectives, and team structure for a project. It serves as an official agreement between stakeholders and the project team, ensuring alignment on project goals, expectations, and deliverables. For ABC Stationery, the Project Charter provides a clear framework for addressing inefficiencies in the prototyping process, which has been identified as a critical component of the new product development cycle. By outlining the problem statement, project scope, key objectives, and critical-to-quality (CTQ) factors, the Project Charter guides the team through a structured improvement process while maintaining focus on customer needs. It also identifies project constraints, milestones, and timelines, which are essential for managing resources effectively and ensuring timely completion of the project. Moreover, the Project Charter defines the roles and responsibilities of team members, ensuring accountability and collaboration across functions, including design, engineering, prototyping, and project management. This formal agreement not only provides clarity and direction but also facilitates communication with internal stakeholders, enabling effective decision-making throughout the project lifecycle. In this case study, the Project Charter serves as the blueprint for systematically improving the prototyping process, providing a

foundation for the subsequent DMAIC phases while addressing the identified challenges of long process duration, low visibility, and unclear responsibilities.

Problem Statement

During 2024, numerous new product development initiatives encountered setbacks in adhering to their projected timelines and desired prototype specifications due to inefficiencies within the prototyping process. Recognizing the critical need for enhancement, the company pinpointed the prototyping process as a key area requiring immediate attention. Departments reported various challenges, including protracted completion times for the prototyping machinery, ambiguity surrounding part readiness status, and inadequate organization in managing prototype-related activities. Notably, the most pressing concern was the extended duration of the prototype construction phase, leading to delays in new product introductions. These delays not only disrupted project schedules but also diminished the company's competitive edge within the market.

Goal Statement

- To determine the type of measurement for prototyping process.
- To determine the main causes for delay completion of prototyping process.
- To reduce the total duration of prototype build process by 15 percent.

Project Scope

This case study will focus on analyzing the time taken to complete the prototyping process. The analysis will commence with the release of the Computer-Aided Design (CAD) drawing and conclude upon the assembly and readiness of product parts for testing. The ideation stage of new product development, where ideas are generated, will be excluded from this study as the time required for ideation cannot be standardized or reliably predicted. Furthermore, activities such as benchmark planning for standard prototypes, capacity enhancement, engineering build procedures, and governance management fall outside the scope of this project.

Project Team

A dedicated project team was formed to address the challenges outlined in this case study. The team comprised professionals from various departments: business process, product engineering, project management, design management, and engineering leadership. Each member possessed clearly delineated responsibilities, as detailed in Table 1.

In recognition of the prototyping process as a core function of the organization and the need to postpone the new product launch for the sustained sales of the company, the business process team assumed a leadership position. Their assigned roles consisted of the project management, developing a work breakdown structure, assigning step tasks, and offering decision and action support guidance along all organization levels. Individual engagement of all team members was considered to be of primary importance for the primary goal of the project. Product engineers worked as co-leaders and, applying their experience, pored over the obtained information to solve the optimization of the prototyping process and offer recommendations. The efforts they made required a great deal of work. The project manager, design manager, and leaders of engineering as well acted as support. The project manager created the plan for the implementation of the process of prototyping and also organized the

data that pertained to the collection. The design manager functionally reviewed design guidance documentation for the design of parts and the assembly of products and as a result gave assurance of the fulfilment and the observance of the required conditions. The engineering leaders were charged with the release of the drawings of the parts and assemblies and the subsequent planning of the related operations. The team working together in this way was aimed at increasing the efficiency and the effectiveness of the whole process of prototyping.

Table 1
Project Team table

No	Position	Role	Responsibility	Commitment (%)
1	Business Process Team	Leader	• Research project management • Work breakdown structure and task assignment to team members • Provide direction and support to the whole team	100
2	Product Engineer	Co-Leader	• Analyse the data collected and develop a solution	50
3	Project Manager	Team member	• Prototype builds planning • Collect data	30
4	Design Manager	Team member	• Part and product assembly design consultation	30
5	Engineer Leader	Team member	• Part and assembly drawing and processes planning	30

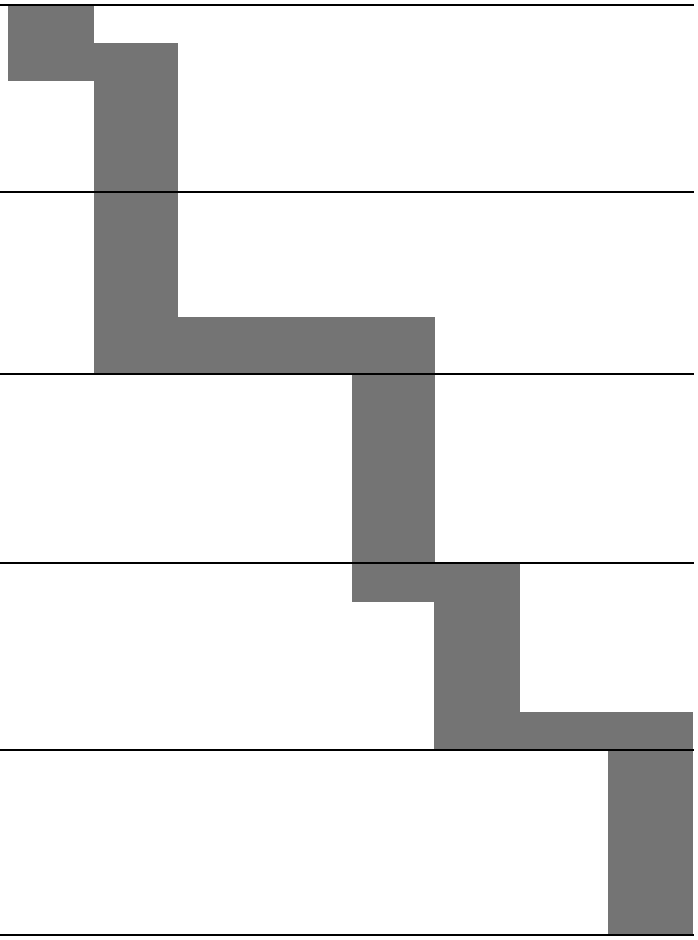
Project Plan and Schedule

To ensure a structured and timely approach to the case study, a Gantt Chart was employed as the primary project management tool. This chart visually represented the DMAIC methodology's distinct phases, assigning specific timeframes for completion and delineating the necessary activities within each stage. The project plan served as a roadmap for the team, fostering discipline and focus by outlining a clear sequence of tasks and deadlines. All team members were accountable for adhering to these timelines, guaranteeing that the improvement initiative progressed systematically and efficiently. Table 2 presents the project schedule visually as a Gantt Chart. The chart delineates activities, phases, and anticipated durations across the project timeline, spanning from September 2024 to April 2025. The plan will follow the five phases of the DMAIC process - Define, Measure, Analyze, Improve and Control, as the periods of the DMAIC process is divided into phases that include activities that need to be completed in a specific period of time to ensure that the process is completed in a step-by-step fashion.

Define Phase - The first step in the process is to Define Phase, in which the elements that the project will be based upon or built upon are set. This covers the project charter, project charter and SIPOC Construct and Participate in Meetings SIPOC diagrams, and customer requirements. These criteria help define what the project is about, what the customer wants and the limits of the process.

Table 2
Project plan Gantt Chart

Phase	Activity	Duration
DEFINE	• Develop project charter • Formulate project plan • Draw SIPOC • Collect customer requirements	
MEASURE	• Identify and define measurements • Data collection plan • Collect data	
ANALYZE	• Collect all possible causes • Analyse data • Verify root causes • Construct action plan table	
IMPROVE	• Collect possible solutions • Select solutions • Elaborate action plan for implementation • Test and implement solutions	
CONTROL	• Determine the efficiency of improvement • Finalize documentation • Implement effective, long-term monitoring	



- Measure Phase - The next step is to Define the project. After a project is defined, the next step is validation and quantification of the defined problems. This includes the definition and description of what is to be measured, creating a measurement plan, and the actual collection of planned information. It is necessary to point that the problems in the Define Phase are measures that are justified, in the sense that information collected is relevant to resolving the problems defined.

- Analyze Phase - This stage work is done by the project team, who define and test the probable causes of 'X' or a certain set of dependent processes, and derive what are known as action plans. It is in this step of the process that the 'X' is defined. The goal in this phase is to determine what processes in the process of creating a prototype are slacking, thus what processes in the stream of 'X' require modification and in what sequence.

- Improve Phase - This phase shifts the focus to the devising of solutions and also their application. This includes coming up with a list of feasible answers, choosing the most viable ones, detailing the steps to carry out these solutions to determine if they will

actually bring about a decrease to the delays that are defined in the prototype steps of the process, and monitoring or testing these solutions.

- Control Phase: The purpose of the last phase is to guarantee the permanence of the improvements made. This entails access control effectiveness evaluation, documenting the outcomes, as well as designing repeated measures to monitor the identified issues to guarantee the identified problems will not occur.

The Gantt Chart illustrates the duration of the tasks planned for each phase of the DMAIC. The project team should demonstrate that improvements are made in an organized manner. This will reduce the delays associated with prototyping, along with streamlining the new product development cycle.

SIPOC

The SIPOC diagram is important in this particular case study in order to illustrate the relationships in the system regarding the organization's prototyping process. SIPOC defining the important potions supply by sppliers is, design engineers, product engineers, prototyping engineers, Computer Aided Design CAD design procurement specialists and the external suppliers of standard parts. They provide design specifications, prototyping materials, and prototyping standard components which initiates the prototyping process in SIPOC. The process of prototyping in this organization follows five distinct stages:

- Prototyping is considered in-house when certain standard parts are bought from external suppliers and the company takes care of the external vendor liaising with regards to the quotations and purchase order.
- Individual components in this phase are bought from separate external suppliers.
- The process leading to assembly of sub components and the minor components is called pre assembly.
- All minor assemblies are joined to form the complete minor assemblies in the prototype build phase.
- The prototype is then evaluated and then tested by a certain department set in the organization to carry out this task.

The Outputs of these interconnected processes are prototype products that conform to predetermined specifications and are prepared for testing. The Customers who utilize these prototypes include test engineers, design managers, project managers, and design engineers. They rely on the prototypes for verification purposes and informed decision-making throughout the new product development cycle. In conclusion, the SIPOC diagram, as visually represented in Figure 1, provides a clear depiction of how Suppliers, Inputs, Processes, and Outputs interact to fulfill Customer requirements. It also underscores the critical flow of activities within the prototyping process, directly influencing the efficiency and timeliness of new product development.

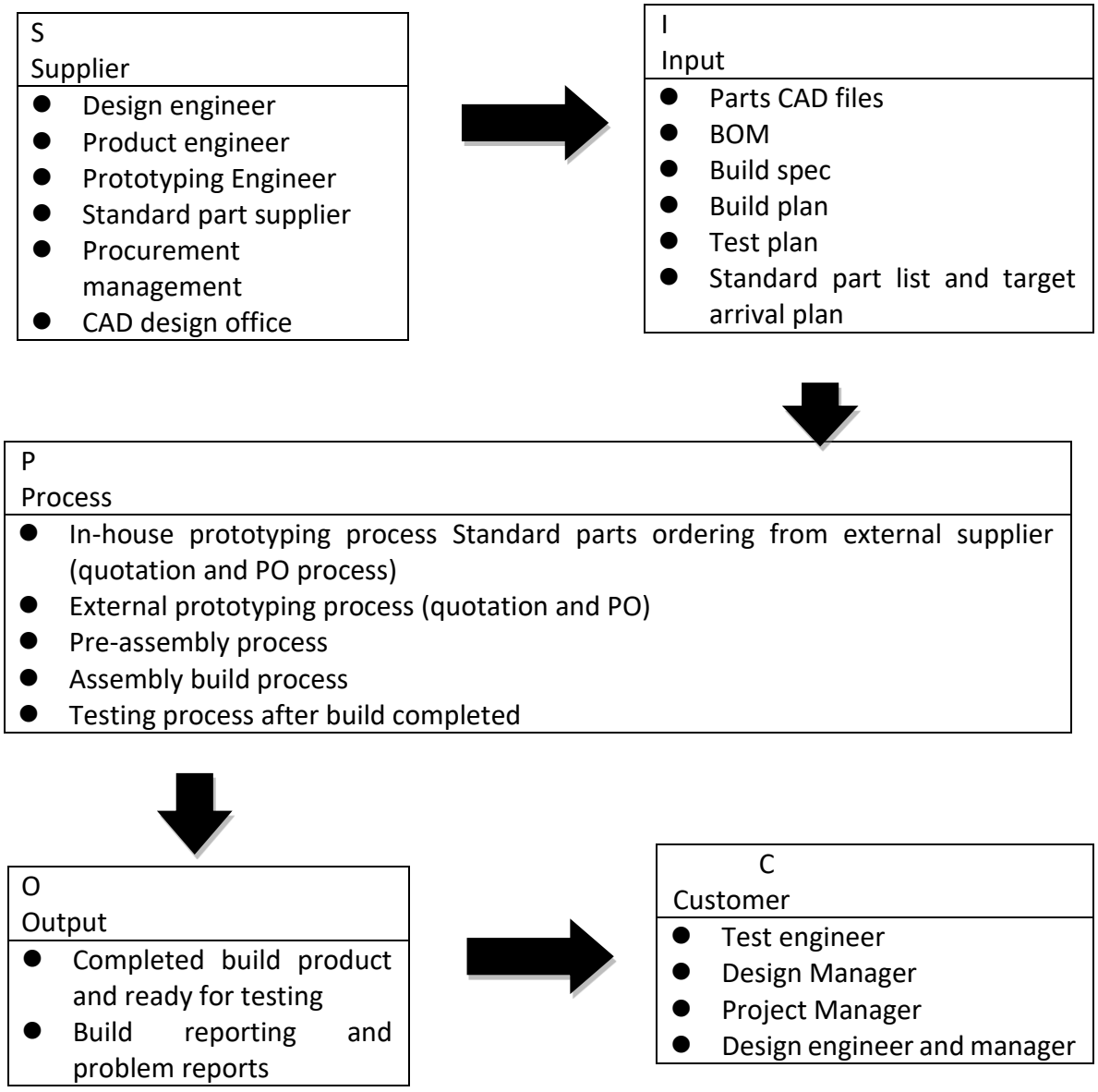


Fig. 1 SIPOC flow chart

Process Mapping

Figure 2 describes a top-level workflow which attempts to illustrate the interconnectedness of the NPD framework and the building of the prototype. The NPD framework is composed of three major components: the New Product Introduction (NPI), the New Product Development (NPD), and the Production (Product Launch) stages. Each of these components is important in the conversion of an idea to a marketable product. Within this framework, the prototyping is valuable, functioning as a process under the NPD stage, and is the link between an idea and a working product. The prototyping process is based on cycles of Design–Build–Test, which allows the refinement of sophisticated design plans and the identification of defects. This process also validates the functionality of the constructed prototypes. This process ensures that technical specifications are met and the prototype is in line with the expectations of the users and the context of utilization. In this specific case study, the major emphasis is placed on the "Build" process due to its emphasis on the core issues concerning the prototyping workflow, that is, delays and ineffectiveness. The Build process is further

subdivided into three major components which are interconnected and interdependent to one another: Preparation, Part Readiness, and Build and Test.

In the preparation phase, the plans are made, resources are distributed, and then the required activities to start building the prototype are set up. In the Part Readiness phase, components and sub-assemblies are available and verified and need to be integrated. This often requires additional coordination with suppliers and other private teams. The Build and Test prototype phase consists of the actual assembly of the prototype, functional testing, and then testing the prototype against the prototype design to check if it has passed the different phases of validation. These phases make sure that the conceptual designs are transformed into physical prototypes. The prototypes are then evaluated for performance, quality, and compliance and and then set aside for other stages of product development, for instance, for evaluation by the performance evaluation team and for setting the subsequent product market launch.

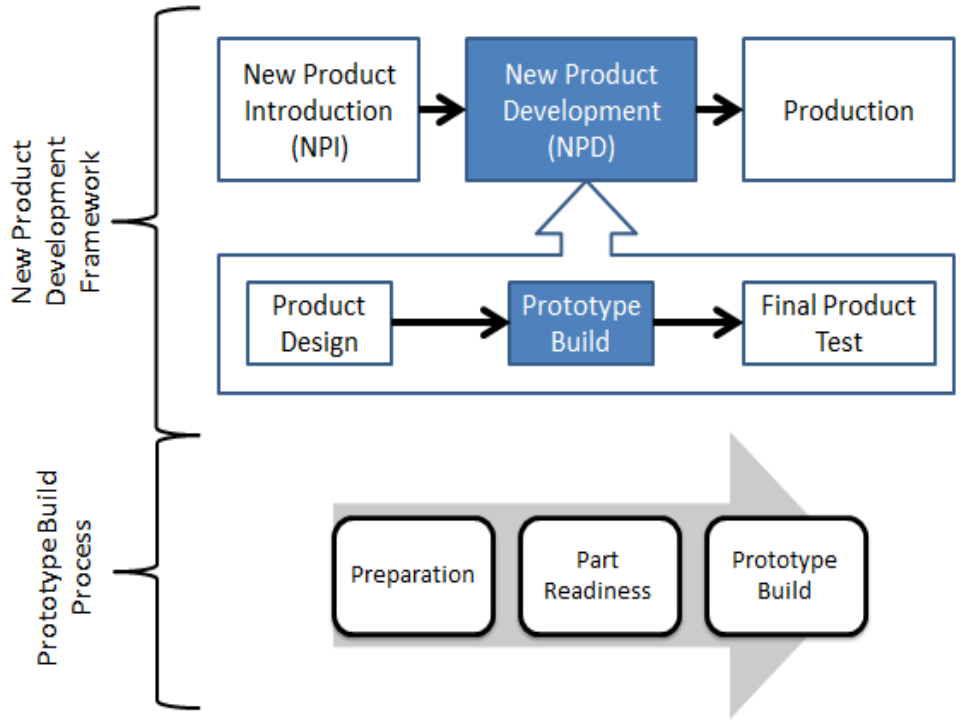


Fig. 2 R&D products current process mapping

Voice of Customers

Collecting customer feedback, termed VOC, is important in establishing customer needs and determining the product features. In this case, the study employed focus group discussions to understand the experiences, attitudes, and needs of internal customers like test engineers, design engineers, design managers, and project managers with respect to the prototyping process. Key customer requirements and issues were determined from thirty interviews. Analysis, perhaps, showed 47% of the respondents felt the overall prototyping process could be improved. Specific areas highlighted were Preparation (27%), Part Readiness (20%), and Build and Test (7%). The results suggest there is a general impression the prototyping phase is the taking too long. The respondents shared other interests too. All three phases need to

be streamlined in order to improved efficiency and completion time. Further analysis, presented in Figure 4, highlighted that 50% of respondents identified prolonged process duration as their primary concern. Unclear process visibility (30%) and ambiguous roles and responsibilities (20%) were also cited as issues. The extended duration of the prototyping process was recognized as a major obstacle, directly impacting costs and hindering the company's ability to launch new products competitively. Several contributing factors to these challenges were identified, including non-standardized procedures, unclear role delineation, and a lack of comprehensive documentation guidelines. Addressing these issues is crucial for improving the efficiency, reliability, and overall competitiveness of the prototyping process.

Analysis of Figure 5 reveals that a significant majority (63%) of respondents identified the duration of the Preparation process as a key area for improvement, advocating for measures to expedite its completion and consequently shorten the overall Preparation phase. Furthermore, 17% emphasized the need to enhance Computer-Aided Design (CAD) readiness in support of parts prototyping build plans. A smaller proportion (13%) suggested improvements to the build planning process, while 7% highlighted the importance of consolidating build and test requirements. These findings underscore that optimizing the Preparation process duration and ensuring robust CAD readiness for parts prototyping are paramount to streamlining the overall prototyping workflow. Given its substantial impact on the timeframe of the Preparation phase, prioritizing enhancements to the Preparation process is crucial for mitigating delays and elevating prototyping efficiency.

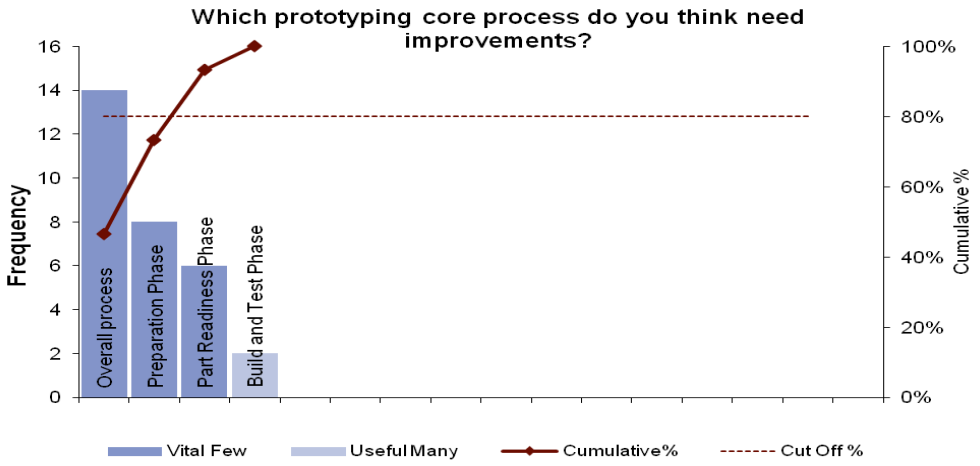


Fig. 3 The Pareto chart result for prototyping process that need improvement

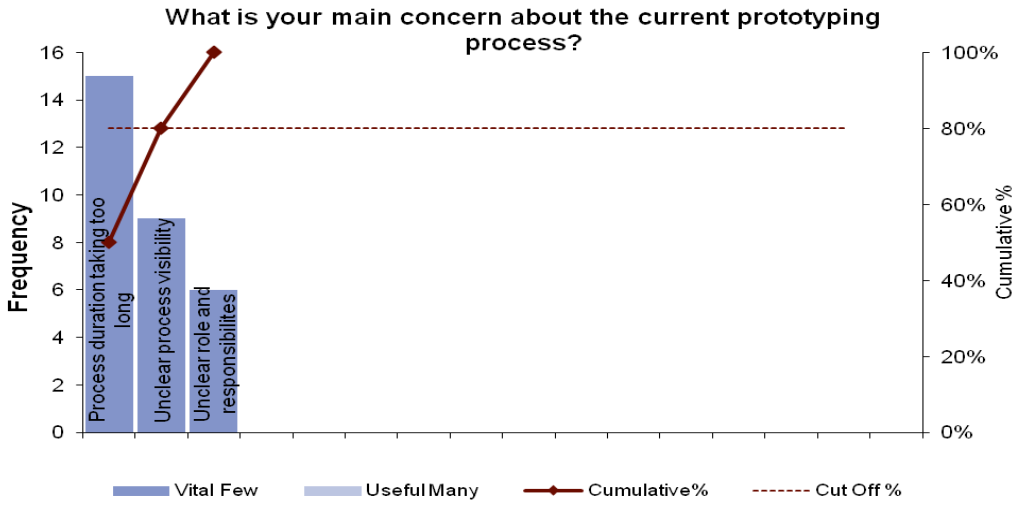


Fig. 4 The Pareto chart result of the main concern about the current prototyping process

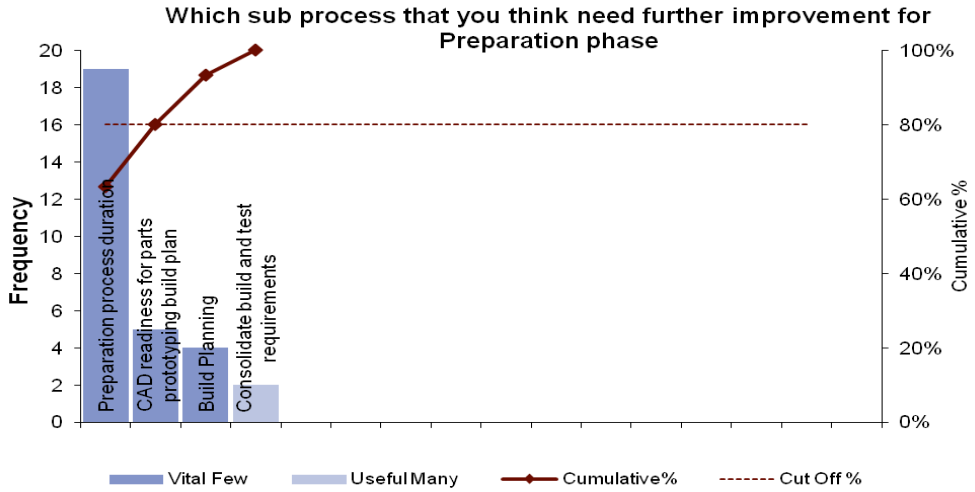


Fig. 5 Pareto chart result showing preparation process requires improvement

Analysis of Figure 6 reveals that a significant majority (60%) of respondents believe the duration of the Part Readiness process necessitates further optimization. Conversely, 40% advocate for enhancements to build tracking status and reporting mechanisms. Given that the Part Readiness phase comprises solely these two sub-processes, both are crucial to the phase's overall efficiency. The protracted timeframe associated with Part Readiness is primarily attributable to reliance on external suppliers. Delays in procuring purchased parts often hinder timely prototype completion. Consequently, implementing solutions to expedite the Part Readiness process is imperative for minimizing lead times. Concurrently, refining build tracking and reporting systems would bolster process transparency and facilitate improved inter-team coordination.

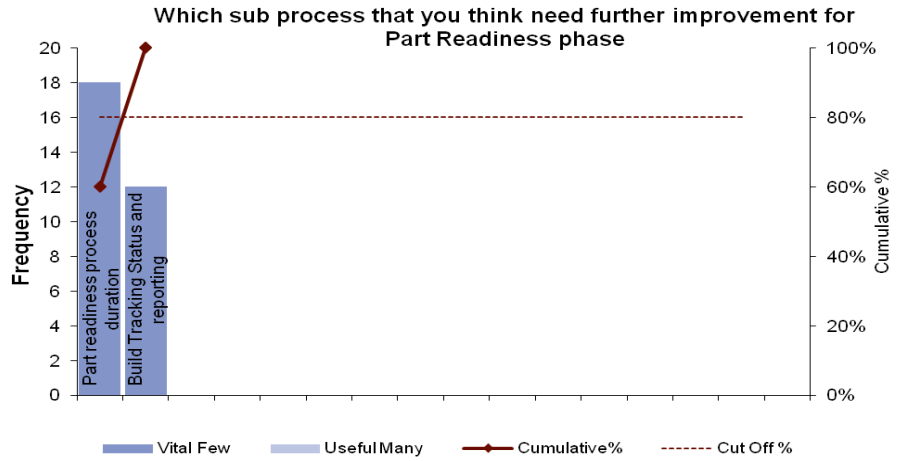


Fig. 6 The Pareto chart result for the sub process of Part Readiness phase that need improvements

Analysis of Figure 7 reveals a significant need for improvement within the Build and Test phase's reporting infrastructure. A substantial majority (73%) of respondents identified build status reporting as requiring enhancement, while a smaller proportion (27%) suggested improvements for the duration of the build process itself. Despite consisting of only two sub-processes – build status reporting and the build process – the former emerges as a primary bottleneck. This is largely attributed to recurring delays in reporting caused by human factors. While the actual build process duration remains relatively concise, inefficient status reporting ultimately prolongs the completion time of the entire Build and Test phase. Therefore, optimizing the reporting mechanism is crucial for mitigating these delays and fostering enhanced transparency within the process.

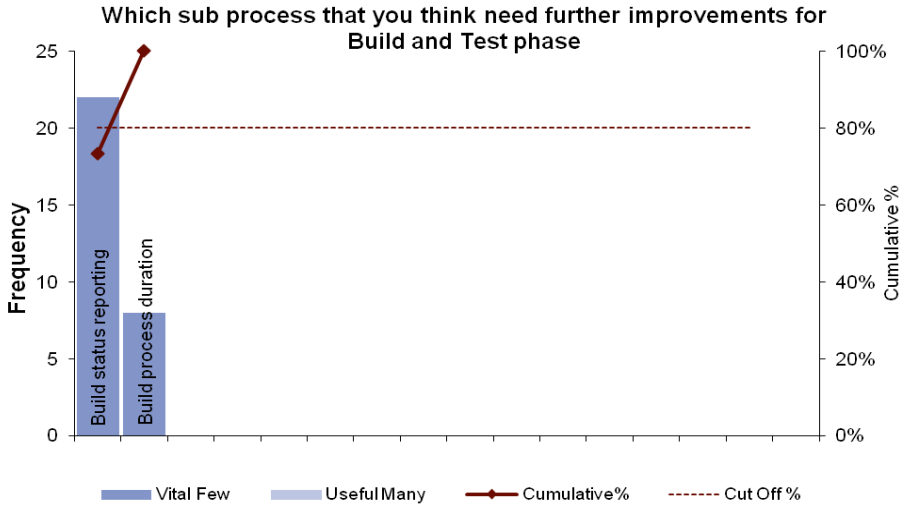


Fig. 7 The Pareto chart result for the sub process of Build and Test phase that need improvements

The analysis of prototyping timelines within new product development reveals a significant trend: approximately half of respondents indicated that prototype completion typically takes 13–14 weeks. This duration precedes performance and stability testing, further delaying the product launch process. While a smaller percentage estimated shorter durations (23% at 11-12 weeks and 17% at 8-10 weeks), the overall findings highlight an extended prototyping

phase that negatively impacts time-to-market. Such delays diminish a company's competitive edge by postponing product availability. Therefore, it is crucial to implement strategies aimed at reducing the prototyping timeline. Expediting this stage will enable earlier product launches and ultimately strengthen market competitiveness.

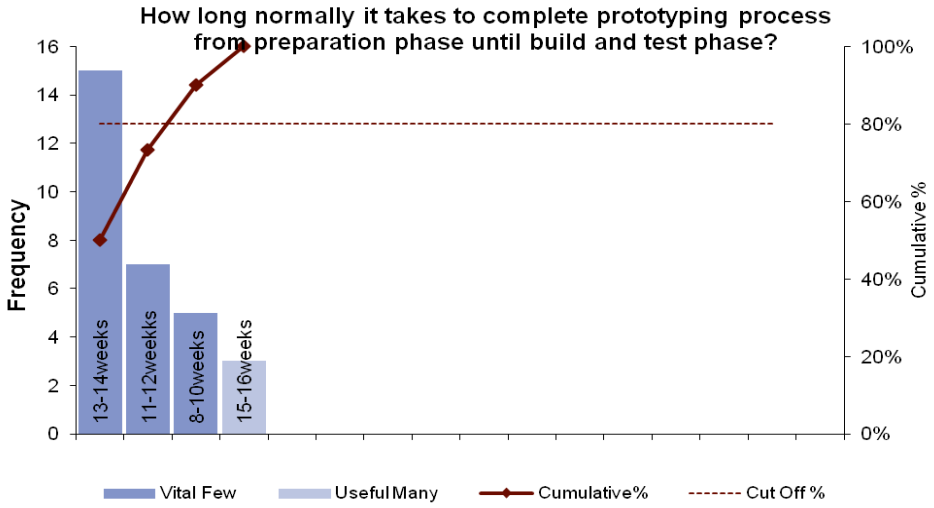


Fig. 8 The Pareto chart result shows the average time used to complete for the prototyping process

Implications

The data presented in Figures 3-8 highlighted three major CTQ factors affecting the prototyping process. The first of which is the overall duration of the prototyping cycle. As indicated by the respondents, the average duration is 13-14 weeks under normal circumstances. Such an extended duration is primarily due to slippages in the Preparation and Part Readiness phases which overall contributes to the long lead time. As a result, the increase in the time spent in prototyping phase results in a direct decrease in the time available for conducting tests on the product and allows for the launch, which the company may lose its competitive edge in today s market. The second is a lack of process visibility and reporting. These respondents who focused in on the lack of process visibility as well as the build status status reporting as a bottleneck to the Build and Test Phase. These reporting delays are primarily the result of system- and human-related process inefficiencies, which, as a result ultimately stalls the entire prototyping process. The third and final lack of role and responsibilty clarity was mentioned to me by 20 percent of the respondents. This lack of role and responsibility results in confusion, which contributes to work duplication and misalignment among various teams. These CTQs must be resolved in order to improve the prototyping process. To achieve this, the high cycle duration, lack of reporting visibility, and poorly defined team roles aimed at process execution must be addressed.

The Defining stage of this Six Sigma project revealed multiple key problems with ABC Stationery's new product development strategy. These problems have been classified as CTQ, which are important issues to the company's competitive positioning, cost structure, and overall productivity efficacy.

The main issues are as follows:

- Prolonged Cycle Times: Current Cycle times valid in the Book Industry Prototyping cycle have shown 20-30% variances compared to other Industries Previously. This results in increased time to market which in turn loses market share and is less responsive to the evolving customer needs.
- Gaps in the Process: Absence of clear boundaries leads to the lack of control and possible logs which seriously hinders optimum usage of time and brings down the overall productivity.
- Collaborative Inefficiency: No clear strategy leads to step duplication and as such a weak framework to manage the project is created. This, in turn, brings down the productivity and morale of the employees.

These also bring with them a cost.

- Cycle times are more and as such the loss of prototype is of a greater value, leading to loss.
- Failure to meet coordination also results in wasted work which leads to costly expenditure.
- Failure to launch results in the loss to the company's overall market positioning and profit ratio.

ABC Stationery needs to tackle challenges by focusing on the refinement of the processes through detailed Six Sigma initiatives. Important processes include:

- Developing and putting into use work instructions for the prototyping of SOPs.
- Improving the process visibility by establishing reporting structures.
- Assigning specific tasks to the various stages of the prototyping process to improve accountability and teamwork.

In addition, the use of technology and software for reporting and tracking may improve the speed of decision making, and consequently, reduce the amount of delays. ABC Stationery will be able to improve the speed of the prototyping process and the overall operational clarity of the firm, which will ultimately improve the competitive advantage of the business.

Conclusion

The first phase of the Six Sigma project brought to the surface several actionable weaknesses of the ABC Stationery's prototyping process which will inform the basis for improvements moving forward. The analysis gave rise to three CTQ issues, which are a long process, a lack of adequate handling process reporting, and confusion over role functions. Firstly, the duration of the prototyping cycle is of paramount concern, dominated by a lengthy period of 13–14 weeks. Prolonged periods during these cycles stagnate ABC Stationery’s tight schedule for market readiness, a critical factor for surviving in a very dynamic industry. In addition, the during the Build and Test phase, there is a contracting absence of reporting and activity monitoring which forces process visibility and reporting gaps. This is the first step to poorly informed decisions, confusion, and disorder during the project phase emphasis of the development cycle. In addition, lack of role clarity creates duplicative work, gaps in accountability, and breakage of collaboration, which in turn increases the overall cycle time and underperformance. ABC Stationery needs to lift its governance and reporting effectiveness to resolve these plethora of issues within the process. Having a controlled

convergence of these pagination will help ABC Stationery to lower the cycle time to other phases of the development, increase agile governance during cross departmental issue, and overall responsiveness to critical shifts in the market. The Define phase has superbly positioned the project, and has understood the needs of customers and the zones of improvement, serving as the groundwork for the next steps within the DMAIC framework.

Acknowledgements
The authors would like to express their gratitude to Universiti Teknikal Malaysia Melaka (UTeM) for funding support for the research under the research grant, INDUSTRI (URMG)/PRYM/FTKIP/2025/I00108.

Authors' Note
The authors declare that there is no conflict of interest regarding the publication of this article. The authors declare that they used AI-assisted tools to check and improve the grammar, sentence structure, and overall clarity of the manuscript, to ensure it meets the journal's standards for language quality. Authors confirmed that the data and the paper are free of plagiarism.

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