

University Of Trinity Saint David

Wales Institute of Science and Art



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Engineering Project Technical Report

Workshop and Practice (ACHA4011)

October 2022

Contents

1. Introduction.....	3
2. Engineering Team Structure.....	4
3. Product Development.....	6
4. Issues, Legislation and Standards.....	8
5. Personal Development.....	9
6. Conclusion.....	10
7. Reference List.....	11
Figure 1: hierarchical team structure(How is Your Team Structured?, no date).....	4
Figure 2: a product development process.(‘New Product Development Process Steps 2023 Guide TCGen’, no date)	6
Figure 3:a risk assessment matrix example(Product Development Risk Management & Mitigation Simplicity, no date).	8
Table 1:A table showing the possible sub teams and roles one might expect to find within a product development team	5

1. Introduction

This report will outline how one might go about the process of organising an engineering team and conducting a product development project from the perspective of the leader of said engineering team. You can expect to find information such as the layout and structure of the team, potential consultations from other departments or specialists, health and safety and what also could be some legislative issues and how the engineering team might navigate those issues. The steps needed to ensure a successful development of the project and problem-solving strategies will also be clearly outlined and demonstrated in this report, as well as risk assessments that may need to be carried out during the course of this project. This report will conclude with a segment on my own personal career aspirations and what might be needed to achieve that goal, as well as a conclusion to the product development project.

In this product development project, the engineering team in question are going to be producing an office chair, as it is a very widely utilised product for businesses around the world. A study conducted by (Parent-Thirion *et al.*, 2007) states that 47% of all work that takes place in the EU is white-collar work that takes place in offices, and this percentage is rising still to this day. One of the knock-on effects of this growing service sector in European society is that a vast amount of people now use office chairs in their daily life. A multitude of studies such as (Parent-Thirion *et al.*, 2007; Groenesteijn *et al.*, 2009) have demonstrated in the past that a good office chair increases employee productivity and reduces musculoskeletal strain.

2. Engineering Team Structure

Hierarchical Team Structure.

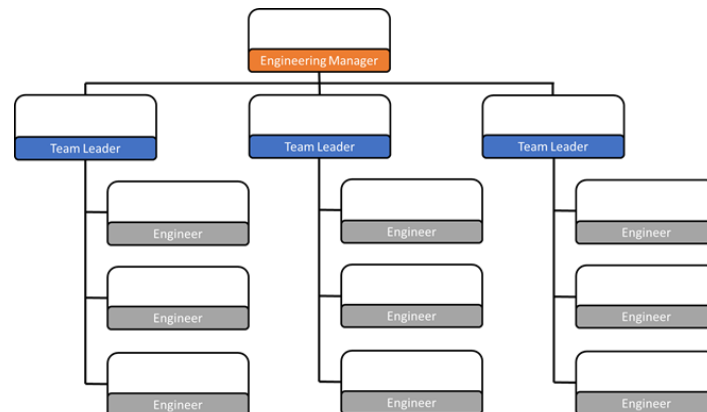


Figure 1: hierarchical team structure(How is Your Team Structured?, no date)

For this project, the product development team are going to be organised in a hierarchical fashion, one person working as a leader and instructing members beneath them means that decision making will not be so much of an issue since there are not multiple disagreeing individuals all attempting to implement their own ideas. The reason for this team selection is contradicted by (Koning et al., no date) suggests that decision making can be slower in hierarchical structures due to an inability for leaders to make up their mind, as one engineering leader will not always have the most optimum idea for every issue in the development process. (Poe, Zamora and Quinain, 2019) who's statement runs more along the line of what this team leader has decided, which is that hierarchical structures do cut down on decision making time as control over important decision making is left up to one person, and (Poe, Zamora and Quinain, 2019) also states that these decisions are more likely to be more quality efficient due to the disproportional control of decision making ability being granted to the top of the hierarchy where presumably more competent people would reside. That being said, feedback and communication of ideas amongst the team is encouraged, because in a hierarchical team composition, an engineering leader will be responsible for various team leaders who, in turn would be responsible for their teams that they manage, and information will flow down from the engineering leader and likewise feedback will flow up to the engineering leader from the individual teams. This constant flow of feedback will be needed as according to a study done by (Koning *et al.*, no date), information flow in hierarchical structured teams compared to a network team structure is lacking, and therefore consistent feedback is necessary, and communication is encouraged and will be a vital part of a scheduled meeting between all team leaders and members. This team structure was picked as it outlines a clear chain of command and clearly appoints the level of responsibility each team member has compared to one another and provides them with a role to focus on, which is believed to reduce internal conflict and power struggles. There is also one contact for team members, being the team leaders, for any potential issues that might occur.

There is a code of conduct that is to be adhered to as engineers and it must be considered at all levels in all elements of the developmental team throughout the developmental process. These codes of conduct that the team must undertake includes points such as a duty to uphold the best standard of professional conduct, promoting fairness, honesty and integrity. As stated in (*Engineering Council*, no date), engineers must behave in a way that is reliable and trustworthy, furthermore engineers must be always mindful of the way that their work might impact the privacy, rights and reputations of individuals and other parties involved. The engineers code of conduct also makes an emphasis on having the utmost respect for the environment, the law and the good of the public, which delves into aspects such as the duty to prioritise the health and safety of others and the reservation of built and natural environments. ('STATEMENT OF ETHICAL PRINCIPLES for the engineering profession', no date) also expresses the importance of all of these principles when discussing the engineering codes of conduct.

Table 1: A table showing the possible sub teams and roles one might expect to find within a product development team

<u>Department Titles.</u>	<u>Department Description.</u>
Concept Development.	Concept development takes place early on in the development process and this department are responsible for the analysis of crucial consumer needs and desires for the development of the product. This department would develop a descriptive image of the idea, from the point of view of the consumer, considering all consumer needs, things like price, useability, functionality, convenience and quality. (<i>Concept development and testing</i> nibusinessinfo.co.uk, no date).
Research and Development.	Research and Development is a department responsible for keeping up to date with the latest market requirements, they also perform research and innovate to maintain improvement in existing products and concepts. R&D is usually a widespread approach to investigative improvement of a product. (<i>Research and Development (R&D) Definition, Types, and Importance</i> , no date).
Product Strategy and Line Management.	Product Line Management Department is responsible for overseeing a product line as a whole, and is responsible for uncovering, enhancing and utilizing product opportunities wherever they might arise. The role typically focuses on near-term and long-term profit and loss for a product line. (<i>What is Product Line Management - The Adept Group</i> , no date).
Manufacturing.	Manufacturing is the creation of a product from raw materials through the use of tools, machinery, labour and/or chemical processing. This department typically is the department that builds the products in question, and manufacturing (sometimes referred to as fabrication), has a close connection to the engineering or product design teams. The raw materials are altered using machinery and labour by this department to create components for the product that is going to be produced. (<i>What is Manufacturing? (Definition, Types and Examples) - TWI</i> , no date).
Marketing and Sales.	(<i>What's the Difference Between Sales and Marketing? A Simple & Easy Primer</i> , no date) states that "Marketing informs and attracts leads and prospects to your company and product or service. Sales, on the other hand, works directly with prospects to reinforce the value of the company's solution to convert prospects into customers". It is not unusual for marketing and sales to be rolled into a single department, despite their different functions, since they often are very much in communication with one another. Both sales and marketing share the same common objectives, to entice clients and convert them into customers, hence increasing financial returns for the product and company.
Customer Service.	Customer service is the communication between representatives of a business and consumers. It is considered a crucial aspect of ensuring customer satisfaction, which in turn encourages repeat business. (<i>What Is Customer Service, and What Makes It Excellent?</i> , no date) says that " Good customer service is critical to business success, ensuring brand loyalty one customer at a time".

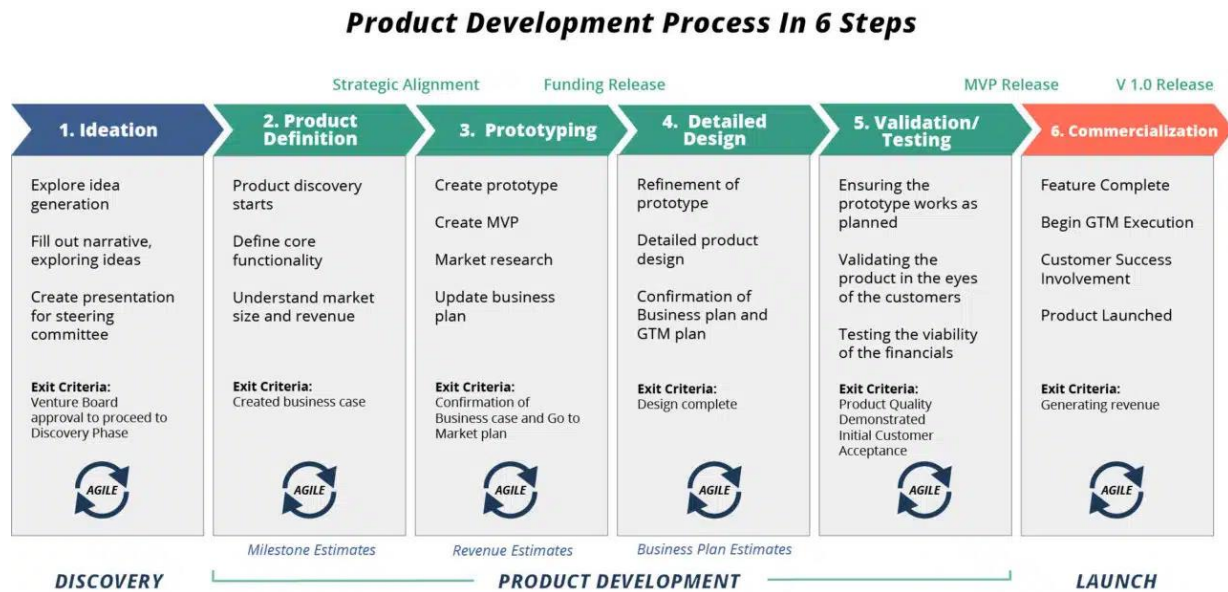


Figure 2: a product development process. ('New Product Development Process Steps | 2023 Guide | TCGen', no date)

In the project undertaken by this engineering team, a product development process will be undertaken and broken down similar to the product development process demonstrated by ('New Product Development Process Steps | 2023 Guide | TCGen', no date).

1. Idea exploration.

In this phase of the product development process, there would be a variety of ideas surrounding the project expressed, an abstract demonstrating some reasons to move into producing for this market and why it may be a good idea, and all of this would be presented in a meeting with the team so that every member would understand this idea and the motives and reasons behind developing it.

2. Defining the product.

At this phase of the development process, research into the product begins, and information on the functionality and purposes of the product should be compiled together to inform what will be later produced for the prototype. At this stage, the size of the market should be heavily detailed, similar to how (Parent-Thirion *et al.*, 2007) stated that 47% of all EU work is white-collar jobs. Information such as this helps to define the vastness and the specificity of the market. As well as research into market size, market revenue should also be researched, this can be taken from information from competitors or elsewhere. (At 4.60% CAGR, Global Office Chairs Market Size & Share Will Hit US\$ 17387.13 Million by 2028 | Industry Trends, Demand, Growth, Value, Analysis & Forecast Report by Zion Market Research, no date) states that the according to their research analyst, the office chairs market is expected to grow at a compound annual growth rate (CAGR) of 4.60% between 2022 and 2028 in the US. The market research will lead to ways we can help our marketing so that we can market to the fastest growing and largest markets, which can help increase the return on investment (ROI), of producing our product so that we can maximize the profitability of the product.

3. Prototyping.

When the prototyping phase is reached, the engineering team will be expected to utilise the previously conducted product functionality research to create a criteria that can be used to produce a prototype that meets a minimum viable product (MVP) standard. In this stage additional market research is conducted, and based on the findings of that research, the strategy for developing the product can be modified to fit the requirements. Once the minimum viable product has been developed, the prototype can be advertised to the market in order to gain feedback, which is necessary to improve the quality of the product to a competitive level. Developing this prototype and advertising it in this way will help to minimize errors and costs on a larger scale and means that the team can adapt to any necessary changes at an earlier stage, which will prevent the development team from dedicating its work to a less than ideal product, this case for prototyping is also made by (*What is Prototyping?* | IxDF, no date). It is stated by (Affairs, 2014) that the largest degrees of improvement from a consumer experience standpoint, stem from early usability research, and the earlier that research can be conducted into the functionality of the product, the better.

4. Detailed design.

At this stage of the development process, members of the engineering team would utilise the feedback and research conducted from the prototyping phase and previously to innovate and design various different and improved iterations of the product, and work with manufacturing departments to develop a plan of manufacturing for each different innovation, the product which includes and improves the most based on feedback and research will theoretically be the most desirable product to produce, however if manufacturing costs are too high it may reduce the profitability of the product, the product which will be selected moving forward will be the design that has the greatest balance of cost to consumer satisfaction as laid out by previous research and feedback.

5. Validating and Testing.

This phase of the process is one of the final ones when it comes to product development, the new design would be readvertised to the market and rigorous testing would be carried out in order to fine tune aspects of the product, and to ensure consumer satisfaction, producing some prototypes of the design will provide a way of testing the financial aspect of producing the product on mass, when this design is advertised to the market, the outcome that is desired would be approval and acceptance of the product. Steps that could be carried out to validify the product may include things like making some sales ahead of release, conduct competitive analysis in comparison to other businesses products, gauge the interest of consumers via social media, create a feedback survey again and meet the consumers in person to discuss the product. These methods for testing and validation are covered by (*5 Steps to Validate Your Business Idea* | *HBS Online*, no date) also.

6. Launch and commercialisation.

At this point, the marketing department would begin to execute a Go To Market (GTM) strategy, the strategy would include a marketing plan, sales strategy all directed towards the target audience of the product. According to (*What Is a Go-To-Market Strategy? And How to Create One* | *Coursera*, no date), a good GTM strategy is focused on the customer, the value of the proposition/ product has to be clearly demonstrated a pricing strategy as well as a promotion strategy has to be clearly outlined and the channels for sales and distribution have to be selected.

4. Issues, Legislation and Standards.

When developing a product, welfare to employees is of utmost importance, and therefore it must be ensured that the company undertaking this development project adhere to all required legislative standards that relate to their work. One very common piece of legislation that makes demands of working condition standards for employees that is often encountered by most businesses, is the 1974 Health and Safety at Work Act. There are a variety of restrictions and demands made in this act, for example it states within the legislation “It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees” (‘Health and Safety at Work etc. Act 1974’, no date). The legislation then leads on to describe a number of areas in which that duty must be upheld, such as the supply and maintenance of systems of work that are safe and “without risks to health”. Its also listed in the legislation that it pertains to “arrangements for ensuring, so far as is reasonably practicable, safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances”, this point is referring to the handling of any equipment, chemicals and such is done so in a way that is risk assessed and deemed safe enough to satisfy the terms of the Act. Risk assessments are a crucial part of product development designed and utilised by businesses to ensure the wellbeing of its employees. In product development, it is unlikely that risks won’t be taken during the development process, as more often than not, risks must be taken to make certain the venture leads to market success, and as stated by (*Product Development Risk Management & Mitigation | Simplicity*, no date), “To also achieve business success, it’s critical for a design firm to assess and address risks as early and affordably as possible”, there are a variety of ways businesses conduct risk assessments, some use matrices such as the one shown in Figure 3 (below).

RISK = SEVERITY X PROBABILITY

Severity of Consequence	Probability of Mishap			
	Remote	Occasional	Probable	Frequent
Catastrophic				
Critical				
Marginal				

Figure 3: a risk assessment matrix example (Product Development Risk Management & Mitigation | Simplicity, no date).

Other legislation that has to be adhered to which is encountered commonly, particularly where manufacturing is involved (as with machinery tends to be noisy), is the Control of Noise at Work Regulations Act (2005), (*Noise: Employers responsibilities - legal duties*, no date). The regulations state that employers must assess the risk to employees from noise at the workplace, and that employers must act wherever necessary to reduce the risks associated with noise in workplaces. Action taken can include things such as soundproofing large machinery, providing safety equipment such as ear defenders, as well as proper training on the use of safety equipment and machinery, and to ensure that the legal limits on noise exposure are not exceeded. In areas where there is an undeniable risk to health from noise, health surveillance must be carried out. All of these requirements from legislation on businesses have many implications on the decisions and implementation processes chosen for many aspects of the product development process, which have to be carefully analysed to ensure that businesses are meeting regulations without incurring too many costs or losses.

5. Personal Development Plan

In this segment, I am going to discuss my own personal development plan and career aspirations. I would really like to be a suspension dynamicist for a WRC team, preferably for M-Sport, who are based in the UK. In order to achieve this, I would have to enter one of their graduate schemes, and to increase my chances of getting onto a scheme for them, I would like to get as good of a grade in my course as possible. If I were to gain entry to a graduate scheme, I would work tirelessly to perform at a high standard, accepting additional responsibilities where necessary to improve my desirability as an employee. My career aspirations don't involve much progression beyond that, my vision for my life doesn't revolve around career, although it is an important aspect, I would be satisfied with well-paying jobs that I have an interest in, and there is no particular job I have dreamt of.

6. Conclusion.

In conclusion, in making this report, It's been discovered that there are many subtle nuances and details that must be monitored at all times, the list of considerations needed by a leader is endless, from team structuring to development plan, as well as legislation and risk assessments. In future, if one were to lead a project, beyond hypothetical levels, one might consider other team structuring layouts, as most research leads one to believe a simple hierarchy had more flaws than advantages, and for all the things that leaders have to monitor, it is a lot of stress and responsibility for one person alone, and therefore perhaps multiple leaders who convene to make decisions and monitor areas of the business venture would work better in that respect.

7. References

- 5 Steps to Validate Your Business Idea* | HBS Online (no date). Available at: <https://online.hbs.edu/blog/post/market-validation> (Accessed: 21 November 2022).
- Affairs, A. S. for P. (2014) 'Prototyping'.
- At 4.60% CAGR, Global Office Chairs Market Size & Share Will Hit US\$ 17387.13 Million by 2028* | Industry Trends, Demand, Growth, Value, Analysis & Forecast Report by Zion Market Research (no date). Available at: <https://www.prnewswire.com/news-releases/at-4-60-cagr-global-office-chairs-market-size--share-will-hit-us-17387-13-million-by-2028--industry-trends-demand-growth-value-analysis--forecast-report-by-zion-market-research-301599135.html> (Accessed: 20 November 2022).
- Concept development and testing* | nibusinessinfo.co.uk (no date). Available at: <https://www.nibusinessinfo.co.uk/content/concept-development-and-testing> (Accessed: 26 November 2022).
- Engineering Council (no date). Available at: <https://www.engc.org.uk/standards-guidance/guidance/statement-of-ethical-principles/> (Accessed: 21 November 2022).
- Groenesteijn, L. *et al.* (2009) 'LNCS 5624 - Usage of Office Chair Adjustments and Controls by Workers Having Shared and Owned Work Spaces', LNCS, 5624, pp. 23–28.
- 'Health and Safety at Work etc. Act 1974' (no date).
- How is Your Team Structured?* (no date). Available at: <https://www.kb-controls.io/post/how-is-your-team-structured> (Accessed: 20 November 2022).
- Koning, L. *et al.* (no date) 'Information Sharing During Crisis Management in Hierarchical vs. Network Teams'.
- 'New Product Development Process Steps | 2023 Guide | TCGen' (no date) <https://www.tcgen.com/>. Available at: <https://www.tcgen.com/product-development/process/> (Accessed: 20 November 2022).
- Noise: Employers responsibilities - legal duties* (no date). Available at: <https://www.hse.gov.uk/noise/employers.htm> (Accessed: 26 November 2022).
- Parent-Thirion, A. *et al.* (2007) 'Fourth European Working Conditions Survey'. Eurofound.
- Poe, M. O., Zamora, L. L. and Quinain, K. T. (2019) 'Team Performance in Hierarchical Versus Self-Managed Work Teams in Selected Electronics Manufacturing Company in Cebu'.
- Product Development Risk Management & Mitigation* | Simplexity (no date). Available at: <https://www.simplexitypd.com/blog/product-design-risk-mitigation-1> (Accessed: 26 November 2022).
- Research and Development (R&D) Definition, Types, and Importance* (no date). Available at: <https://www.investopedia.com/terms/r/randd.asp> (Accessed: 26 November 2022).
- 'STATEMENT OF ETHICAL PRINCIPLES for the engineering profession' (no date). Available at: www.engc.org.uk/professional-ethics (Accessed: 21 November 2022).
- What Is a Go-To-Market Strategy? And How to Create One* | Coursera (no date). Available at: <https://www.coursera.org/articles/go-to-market-strategy> (Accessed: 21 November 2022).
- What Is Customer Service, and What Makes It Excellent?* (no date). Available at: <https://www.investopedia.com/terms/c/customer-service.asp> (Accessed: 26 November 2022).
- What is Manufacturing? (Definition, Types and Examples)* - TWI (no date). Available at: <https://www.twi-global.com/technical-knowledge/faqs/faq-what-is-manufacturing> (Accessed: 26 November 2022).
- What is Product Line Management - The Adept Group* (no date). Available at: <https://adept-plm.com/what-is-product-line-management/> (Accessed: 26 November 2022).
- What is Prototyping?* | IxDF (no date). Available at: <https://www.interaction-design.org/literature/topics/prototyping> (Accessed: 21 November 2022).
- What's the Difference Between Sales and Marketing? A Simple & Easy Primer* (no date). Available at: <https://blog.hubspot.com/sales/sales-and-marketing> (Accessed: 26 November 2022).

