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Motorcycle Helmet Safety Improvement

Workshop and Practice ACHA4011

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1. Introduction

Motorcycling is considered one of the most dangerous activities an individual can do. Generally, motorcyclists are exposed to a lot of hazards while driving, be it on the streets, motorways, or even on race tracks. Therefore, high-quality riding gears are highly desired to protect the rider and decrease the chances of death or getting serious injuries during a crash. Here are a few examples of motorcycle riding gear: leather suits, padded gloves, knee pads, boots, and most importantly helmets. The helmet is very important because it is the only thing that protects the rider's head and absorbs most of the impact in case of an accident. This study will be considering a new problem-solving approach toward product development projects and discuss professional codes of conduct, as well as the relevant team structure that will be needed to complete the project.

1.1 Aim

The aim of this study is to organise an engineering team structure that will be demonstrating a new approach to the development of motorcycle helmet safety and make sure that industry legislations are followed and carried out while standards are not compromised.

1.2 Objective

Upon successful completion of the product development project, the team leader must reflect on the topics discussed and must implement what has been learnt on how to effectively lead a team, in addition, a clear career path has to be set up as to where would the author wants to be professionally in career progression aspect and create a better perspective as to what should the author do to achieve the goals that have been put up.

2 Engineering Team Structure

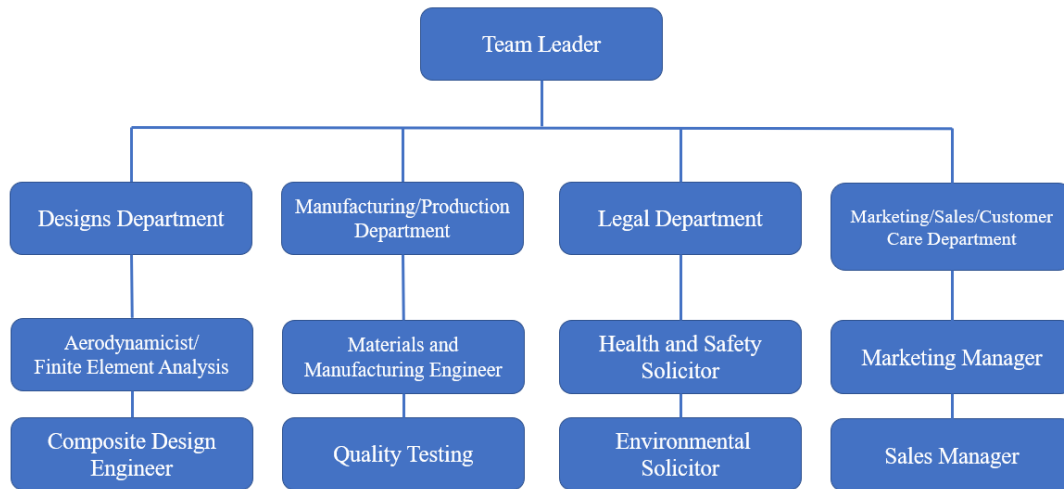


Figure 1. Team Structure for Motorcycle Helmet Project (Aganon, 2022)

2.1 Formal Hierarchical Structure

There are six common different types of hierarchical structures these are Pyramid, Leaderless Team, Hourglass, Rectangle, Diamond, and Inverse Pyramid (Wellman, N. *et al.* 2020). The chosen structures for this study are Pyramid and Leaderless Team or “the self-managing team”, both will be discussed briefly to make a comparison as to which type of team structure suits best for the motorcycle helmet team project to meet the goals that have been set to achieve.

The pyramid type of structure exists in an organisation where only a few individuals hold a high level of authority and a large number of team members have a minimal or moderate extent of authority. Wellman, N. *et al.* (2020) mentioned that pyramid hierarchy affects individuals with their performance and behaviour, and also state that individuals who have lower authority are easily influenced by those who have a higher level of authority. Superior roles can also dictate the assigned workload for their subordinates whether it is desirable or not, as well as giving salary increases and promotions (Wellman, N. *et al.* 2020).

The leaderless team or “the self-managing team” on the other hand, shares equal levels of authority. Wellman, N. *et al.* (2020) stated that theories of this type of structure suggested that it can improve work performance due to the participation of everyone during a decision-making process, as well as increase productivity because of the collaboration of ideas. However, Wellman, N. *et al.* (2020) argued that this structure is dependent on a few circumstances such as the type of project the team needs to work on.

2.2 Professional Code of Conduct

Nichols and Weldon (1997) stated that engineers have to emphasize the practice of professional responsibility such as public and clients' health and safety, professional conduct, constitutional responsibility of engineers, environmental responsibilities, quality, and communication. To identify problems with the proportion of engineering design and interactions, an engineer must examine various engineering design methodologies. Nichols and Weldon (1997) have presented in their article the key elements of the engineering design foundation are; awareness of the current state of the market, design requirements, design concept, design elements, manufacturing, and sales. This will give engineers a chance to incorporate ethical and relative matters into the decision and design-making process. Which improves the possibility of finding alternative solutions that could eliminate problems (Nichols, and Weldon, 1997).

Engineering organisations have identified that professional responsibility is not the only way for engineers to work efficiently towards solving complex problems, the practice of social ethics which is related to an engineer's attitude such as honesty, concern for others, fairness, tolerance, and understanding also showed effectiveness (Canney, and Bielefeldt, 2016). The acknowledgment of social ethics could also lead an engineer towards involving a broader range of ideas and opinions from team members during a decision-making process (Canney, and Bielefeldt, 2016).

3 Product Development

With the help of today's advanced computer software, engineers have become more efficient in developing engineering designs, solving problems, and producing more reliable products (Ryberg, Bäckryd, and Nilsson, 2015). Computer software such as Computer-Aided Design *CAD*, Computer-Aided Engineering *CAE*, and Finite Element Analysis *FEA* are just a few of the tools engineers use to create designs and create simulation models which significantly lower the chance of failure of the end product (Ryberg, Bäckryd, and Nilsson, 2015).

Virtual testing shows significant efficiency in the assessment of the influence of various parameters. Precise component geometry, properties of the material, connection/interaction, etc. are just some of the advanced Finite Element *FE* models developed to integrate with *FE* head models with the objective of predicting critical brain damage and finding the solution that will produce optimised helmet design (Fernandes, F. *et al.* 2020)

Numerous attempts have been performed in search of progress in protection against tangential impacts, namely dropping a helmeted dummy against a rotating steel platform, also oblique impact test was performed on a free hybrid III dummy by dropping its head vertically on a horizontally propelling plate (Bourdet, N. *et al.* 2016). Bourdet, N. *et al.* (2016) also mentioned the new laboratory test using a mobile anvil to analyse the responses of the head and neck under oblique motorcycle helmet impacts.

For the most part of the CAE development stage, the design department is required to work closely with the materials department to achieve an optimum design that matches the required standards, a CAD model will then be used to create a simulation. The results from the simulation will be synchronised with applicable data to create a baseline for the model's virtual evaluation. The helmet model would also have to undergo bench testing, which will consist of different levels of impact severity.

4 Problems, Legislation, and Standards

Road accidents in the EU during 2017 have accumulated 25,300 deaths, 14% of which are motorcycle-involved accidents. The European helmet safety standard ECE R22.05 is the only helmet safety standard that is authorised for motorcycle helmet certification in the EU, which has been the most prevalent helmet standard for over two decades, the ECE R22.05 is also recognised outside the EU with over 62 countries that use it as their helmet safety standard (Fernandes, F. *et al.* (2020)

Fernandes, F. *et al.* (2020) stated in their research that an effectiveness-observation on the ECE R22.05 has made a positive impact, and motorcyclists involved in an accident that suffered head injuries only account for 18% all of whom are wearing standard-approved helmets. However, ECE R22.05 has received criticism from some studies due to the inattention to rotational acceleration, the direction of impact, the size of the head, as well as irrelevant units, and being highly biased on the maximum value of linear acceleration *PLA* and linear acceleration-time data based on head injury criterion *HIC*. Fernandes, F. *et al.* (2020) also added to the argument that testing uncertainties using finite element simulations relative to the equivalent standards revealed a 30% change in HIC value brings questionable credibility because a 30% deviation does not meet the satisfactory range for a safety issue.

Although rotational acceleration is often neglected during the testing period, it is a constant in motorcycle accidents and has a massive impact on accident-sustained brain injuries. Severe injuries resulting from helmeted impacts in an accident are repeatedly linked with rotational forces. The results of these forces when applied to the head could burst vein bridging, and break neuronal axons in brain tissue which all lead to extreme traumatic brain injury (Fernandes, F. *et al.* 2020)

Overall, helmets are designed, assembled, and tested all in line with the general agreement to achieve the required safety standards, with less concern for biomechanical findings (e.g., shear strain, intracranial pressure, etc.). At present, helmets are known for their positive impact on increasing motorcyclists' safety and significantly decreasing accident-sustained head injuries (Fernandes, F. *et al.* 2020)

5 Personal Development Plan

My ideal career plan after finishing my degree is to gain experience in the motorcycle/motorsport racing environment. Ideally, after five years of experience in the racing industry, I would really like to specialise and focus the next five to ten years on becoming an aerodynamicist and composite design engineer and setting up my own company creating composite performance products for car and motorcycle racing. To achieve this goal I would have to undergo further learning in fields that are heavily based on Physics, simulations as well as composite material training, I believe that learning these essential fields of study not only will it help me to achieve my goals but would also help me to become a better engineer and my future company being able to produce top quality products.

6 Conclusion

As a summary of this report, the author considers the pyramid-shaped hierarchical structure suits best for this particular theoretical team-leading exercise and also for a future real-life team-leading opportunity because it has a good systematic way of delivering commands to the members of the team coming from the superior to the people at the bottom of the structure. In such a structure, it will be easier to track progress because there will be department leaders assigned to their specific expertise who will be overseeing the tasks that need to be done to achieve goals. It would also be beneficial to emphasize the practice of social ethics such as treating others with respect, sensitivity, fairness, honesty, and thoughtfulness to create a good work environment and help to become a successful team.

Ideally, to be an effective team leader for a product development project, an engineer or an individual should gather a wide range of data on the chosen product to better understand what is the current problems, determine what is causing such problems and develop a design that will potentially eliminate the problems. In addition, investing in continuous learning not only focuses on intellectual and technical development but also considers other relative aspects such as improving communication skills, how to work better as part of a team, and developing a better understanding of professional responsibility, another good aspect to consider is building a good team which includes choosing the right people for the tasks with the relevant set of skills and good attitudes.

7 References

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