



Functional Decomposition

1.3 Functional Decomposition

1.3.1 Introduction

The Functional Decomposition serves as a method to break a project down into its simplest components. These simple components each perform an action that effects the outcome of the project. The purpose of this breakdown is for the team to gain a better understanding of how the product should be developed.

The sponsor's goal for this project is to create a product that protects the user from blunt force impacts in an athletic environment. To achieve this goal a hierarchy chart and a cross-reference table were created. The hierarchy chart divides the project into two major functions, protect and form which are then broken down into more specific minor functions. These functions were then placed into a cross-reference table to determine the relationship between the major and minor functions.

1.3.2 Data Generation

Data generation started when the team's sponsor Mike Holloway discussed the goals for the project. After discussing in further detail with the advisor, Dr. Christian Hubicki, research was done to clarify the best way to accomplish the goals given by the sponsor. After researching, these goals were interpreted into needs. These needs were further broken down into the "what" the project will accomplish. This "what" are the major functions and minor functions.

1.3.3 Hierarchy Chart

A hierarchy chart was created to present the breakdown of tasks into systems and functions. There are two systems that we have concluded are vital: protecting the user and forming to environment. These basic, yet essential major functions are necessary for incorporation into the design. Minor functions branch from each system in the figure below.

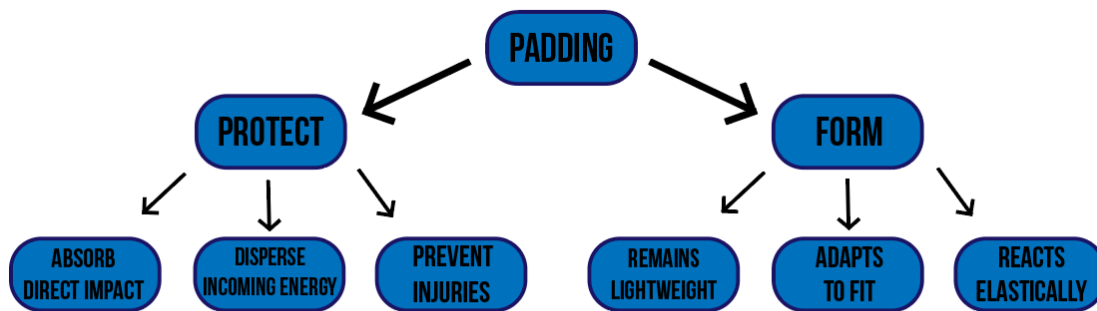


Figure 1. Functional Decomposition Hierarchy Chart

1.3.4 Actions and Outcome

Identifying the minor functions relies on the simplification of the actions that occur to reduce the effects of a single physical impact our outside force. Form is related to the physical nature of the infused product and a reaction from outside forces. The sub systems that stem from this function goes in depth into the forming nature. This product remains lightweight; thus, it does not gain any extra loads overtime such as soaking up sweat. The ability to adapt to fit allows this product to not have a set shape or structure which aids in the versatility of incorporating into other existing products. Another sub system is reacting elastically. The elastic nature is necessary for the product to avoid destruction when facing a strong force, allowing the



product to be reused. The impact physically alters the shape of the product, described within the form sub-functions, but the product alters the impact for protection through energy transference.

Protect is a function the product does for the user when interacting with its surroundings. The minor function that interacts with the impact is the absorbing of energy. Absorbing the energy within the protective product reduces the amount of energy that the user absorbs, also described as shock-absorption. Another sub system is the dispersion of energy which is concurrent with the absorption of energy. Utilizing the nature of energy dispersion allows the product to guide the spread of energy in a controlled way. The methods of elastic reaction, shock-absorption, and energy dispersion differ from an energy cost barrier method that is used on car windshields. Preventing injuries is a minor function branching from the protect function. The project nature requires the user to clash with a dangerous force rather than avoiding the impact all together, injury prevention for this product focuses on the reduction of injury severity.

1.3.5 Cross Reference Table

The cross-reference table shown in Table 2 shows the main function in the top column, while the minor functions are displayed in each row. The main functions are linked with their minor function with an X in the row. This cross-reference table allows us to compare and/or combine minor functions with the major functions to see if there is overlap.



Table 2. Cross Reference Table

	Protect	Form
Absorb Direct Impact	X	X
Disperse Incoming Energy	X	X
Prevent Injuries	X	
Remains Lightweight		X
Adapts to Fit		X
Reacts Elastically	X	X

1.3.6 Connection to Systems

The systems of this project are divided into two categories, Protect and Form, the primary functions the product will serve. The systems are then further divided into minor functions. The function-subsystem relationships were defined in the cross-reference table. As seen above four of the minor functions fall underneath the protect system while five minor functions fall underneath form. This indicates that the form system may take higher priority as it contains more function relationships. However, one of the project’s key goals is to reduce the likelihood of injuries and the prevent injuries function only falls underneath the protect system. To achieve the project’s objective the product must be able to reduce the likelihood of injury. Therefore, the success of the project is directly proportional to how well the product prevents an injury from occurring.

1.3.7 Smart Integration

Absorb direct impact can be placed into the protect and the form function. This is because direct impact will change the form of the material through some blunt force. Since the



force will continue to travel through the material, it must be limited to prevent injury. Dispersing Incoming energy can also be placed into both main systems of the project. Initially it was thought to be strictly under the protection system however the form of the pad can also help disperse the energy if shaped or designed in a certain way. The material will need to react elastically to protect the user. This elastic deformation will cause a change in the materials shape, effecting the form system.

1.3.8 Function Resolution

After going through our data generation, the hierarchy chart and the cross reference table, this product must protect the user from blunt force trauma and form accordingly to prevent injury.

1.4 Target Summary

1.5 Concept Generation

Concept 1.

Concept 2.

Concept 3.

Concept 4.

Team ##: 519

10

2021