REDESIGN OF DRIVER ENVIRONMENT FOR RIGID INFLATABLE BOAT WITH FOCUS ON USER-CENTERED DESIGN

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ABSTRACT

REDESIGN OF DRIVER ENVIRONMENT FOR RIGID INFLATABLE BOAT WITH FOCUS ON USER-CENTERED DESIGN

This thesis focuses on designing some elements of a RIB (Rigid Inflatable Boat), NorthStar 910 RS is a high segment pleasure boat and has been manufacturing for two years by RIBTECH. The driver environment on today's boat did not design ergonomically, and this project has aimed to design a new driver environment with enhanced ergonomics, user experience and aesthetically compelling for the market. The objective was to produce a product that is implementable in 2018.

The project has been studied by using a user-centered design methodology, meaning that all team members have been involved through the product development process to add a design value for users with new solutions suit their needs. The result is a console, seating unit, and hardtop designed for that embraces the importance of ergonomics, user experience, and producibility. These elements have not only integrated all equipment in a user-friendly but also with easy maintenance and easy manufacture abilities. They additionally enable RIBTECH to modify electronic parts of the user interface through time to expand market opportunities as upcoming customers that they can upgrade or update.

By using international standards for design, features of ergonomics and ease of production are sufficiently considered throughout the process, that they improve the production process by means of decreased time.

This thesis aims to contribute a better understanding of the importance of design methods for the company's competence in the commercial world and the significance of integration design into the product development process in the early phases.

ÖZET

KULLANICI ODAKLI TASARIM İLE FİBER TABANLI ŞİŞME BOT SÜRÜCÜ ORTAMININ YENİDEN TASARLANMASI

Bu tez, kullanıcı odaklı tasarım yaklaşımının yeni ürün geliştirme sürecinin erken dönemlerine entegre edilerek uluslararası piyasada şirketlere sağlayacağı başarının RIBTECH'in ürettiği Northstar 910 RS isimli fiber tabanlı şişme botun bazı parçalarının yeniden tasarlanma süreci ile desteklemektedir. Daha önce yapılan ergonomi, kullanıcı deneyimi ve ürün geliştirme süreci ile ilgili çalışmalara ek olarak, bu araştırma, endüstriyel tasarım mesleği ve bu mesleğin diğer meslekler arasındaki konumuna da odaklanmaktadır.

Projede yer alan tüm ekip üyelerinin ve kullanıcıların sürece dahil edilebilmeleri, tasarım pratiğini kavramak ve geliştirmek adına araştırma yöntemi olarak uygulama odaklı araştırma yürütülmüştür. Saha gözlemleri ve görüşmelerle ürün gereklilik ve kullanıcı beklentileri belirlenerek kullanıcı ve ekip üyeleri ile ortaklaşa tasarım yaklaşımı kullanılmıştır.

Teze konu olan projede tüm ekip üyeleri ve kullanıcılar tasarım sürecine dahil edilerek, yeni çözümler ve ihtiyaçlarının karşılanacağı tasarım değerleri üretilmiştir. Proje de yeniden tasarlanan parçalar konsol, oturma ünitesi ve sert yüzeyli gölgeliktir. Bu parçalar ile botun sürücü ortamı daha ergonomik, kullanıcı deneyimi geliştirilmiş ve mevcut üretim yöntemleri ile rahatça üretilebilen, aynı zamanda kolay servis edilebilir bir şekilde tasarlanmıştır. Proje ile, RIBTECH'in zaman içinde elektronik kullanıcı arayüz parçalarını değiştirerek gelecekteki potansiyel müşterilerin satın alma sonrasında güncelleme/yükseltme yapabilmeleri için iş olanaklarını geliştirmesini sağlayacağı öngörülmektedir.

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LIST OF ABBREVIATIONS

CAD	Computer-Aided Design
CNC	Computer Numerical Control
HCD	Human-Centered Design
HMS	Human Machine System
ICSID	International Council of Societies of Industrial Design
IDSA	Industrial Designers Society of America
IEA	International Ergonomics Association
NPD	New Product Development
RIB	Rigid Inflatable Boat
UCD	User-Centered Design
WDO	World Design Organization

CHAPTER 1

INTRODUCTION

In the marine sector, rigid inflatable boats are often designed with a focus on the aesthetics and performance by the naval architects and marine engineers. The marine industry, in particular, is a massive industry where sea characteristics are dealt with such as waves, wind, current, sea water level, and salt, and specific concern is given to them. Before today, the boat design has been done with less attention on the user experience and ergonomics. Compared to other vehicles for example automobiles and planes, rigid inflatable boats (RIBs) are far away concerning user experience and ergonomics. As industrial design practitioners, it is needed to merge the user requirements, the industry demands and the proficiency of the producers for the design of the new products.

Rigid Inflatable Boats (RIBs) are lightweight marine craft that are constructed with a solid, planar shaped hull and flexible tube. They are stable, high-speed and high-performance boats with high capacity. There are four companies on the global market, Greek brands Technohull and Ribco and Ukrainian producers Grand and Brig.

RIBTECH is a SME of Turkey, competing with high quality and performance. It is the extension of the boat manufacturing business unit within Turkey's MARINTEK group of companies which has been taken apart in the marine sector since 1997. RIBTECH produces RIBs for Civil Defense, Police, Gendarmerie, Fire Brigade, Rescue, Coast Guard, Army, Air Force, and Navy units internationally. Additionally, it also offers high-quality leisure RIBs with Northstar Brand. Today RIBTECH produces approximately three hundred boats per year. It dominates %70 Turkish boat sector; additionally, it exports boats for Bangladesh and Pakistan Army and leisure boats for France market. Although, RIBTECH boats are among the most known on the Turkish market, and also with the long-run lifetime, performance and service, the management desire to be more competitive in the global market and wants to increase the number of countries to export. Even though some parts have been updated, the deck and the hull designs for all the boats have had the same design for over 20 years. To expand internationally and to be global as an exporter RIBTECH decided to revise some older models and add new models to their products ranges. Firstly, because of the high

investment cost of RIBs, the management aims to redesign some parts of new models that have problems in terms of ergonomics and production.

The main focus of this study is company's The NorthStar 910 RS model (table 1.1) that was constructed in 2015 by a designer focusing on style. According to feedbacks from dealers, users, and production, on contrary to its good performance, it has ergonomic, production and aesthetic problems resulted in low sales numbers. Considering customers today have more influence in the decision-making when buying a new boat and their experience of the user environment is essential, RIBTECH determined to resolve these problems by revising on the deck and changing some parts. By the results of the problem and need analysis, benchmarks, and interviews done with users, engineers, workers, and managers, some parts such as console, seating units and hard-top need to be changed.

The user environment of the Northstar 910 RS is extremely complicated, and more

Table 1.1. Specifications of Northstar 910 RS

Length Overall	9.25 m
Beam Overall	3.06 m
Fuel Capacity	500 L
Water Tank Capacity	80 L
Max. Engine Power	600 HP
Shaft Length	2XL - XXL
Light Weight	1.900 kg
Max. Loaded Capacity	10 per / 900 kg
Number of Air Chambers	6
Recommended Tube Pressure	0.22 Bar / 320 Psi
CE Design Category	B

production process and the assembly details of the console were time-consuming and open to errors for the production manager and the workers. The seats, similarly difficult to produce and high in volume because of its material, and uncomfortable for the user since they obstruct the movements while driving. The hard-top is made of fiberglass and stainless-steel profiles that are too heavy for performance and causes vibration on high speeds. Additionally, the console, the seating units, and the hard-top design are visually crowded through volumes and colors. Furthermore, these three parts mold's investment costs are lower than the deck, and they have a visual impact on the design of the boat.

To assure potential customers and be more competitive on the global market, RIBTECH aims to apply the latest design technology and techniques to construct a combination of efficient, easily driven and seaworthy RIBs with the distinct aesthetic and functional requirements of the customers. While the boats are prevailed between competitors, the user experience and ergonomics, so the design is becoming an important competitive factor.

In order to access the entire benefits of design, companies should integrate industrial design approaches into their new product development (NPD) process at early design stages. The process of NPD consists of some critical phases, including identifying customer requirements, generating a product concept, developing a detailed design, testing, and introducing the product to market. For the development of successful products, it requires interdisciplinary collaboration and effective communication at each of these phases, which functional departments are involved such as R&D, marketing, and manufacturing (Goffin & Micheli, 2010). As a full-time industrial design professional at RIBTECH, I took apart in a team that has influence and concern in the design including managers, engineers, users, workers and external suppliers. This project was carried on Izmir during fall 2017 to spring of 2018. It was proposed to continue the design of some parts, which are the console, the seating units and the hardtop and this thesis focuses on the redesign process of the new boat will be named Northstar Orion 9.

In Chapter 2 and Chapter 3, the literature review has been done, and a product has been designed. Additionally, filling and underlining certain gaps have been identified and proposed to expand understanding of user, design and engineering concepts and methods used in the products of the present day. Furthermore, tools for user-centered design and implementation of design as strategic management are addressed. As can be seen in Chapter 2, and 3, industrial design has paid considerable attention to the role of economic outcomes in manufacturing companies.

Conclusion chapter provides a final discussion by bringing together and synthesizing the literature review and case study in Chapter 2 and 3. Drawing on the links and conflicts between the user, design practice and collaborative processes, it concludes by underlining the value of design practice for NPD. The thesis ends with some recommendations for future research.

1.1. Aim of the Study

The primary objective of this study is to highlight the positive, long-term consequences of the user-centered design (UCD) process practiced in the early stages of the new product development process (NPD). NPD is performed in interdisciplinary teams were understanding of others competences is essential. Additionally, involving users to suggest ideas to create value through interaction to meet market needs has become a key focus in marketing literature.

User-centered NPD process applied from the beginning to the market launch of the boat in collaboration with the team consisting of managers, engineers, users, workers and external suppliers. The project was carried out through inspiration, ideation and implementation stages with the association of the stakeholders.

To achieve the primary purpose, this study aims answering the questions below with the support of the practice-led research:

- How can user-centered design (UCD) contribute to develop better designed products?
- How does industrial design practice shape the new product development process (NPD) in the workplace?
- What are the outcomes of applying user-centered design approach in early stages of the new product development process?

The case study in Chapter 3 provides a sample project to investigate the application of UCD in NPD process by aiming to answer following questions;

For the console design;

- How can I improve the physical and cognitive ergonomics?

- How can I improve the user experience?
- How can I contribute to producibility?

For the seat units design;

- How can I improve the physical ergonomics?
- Can I propose new materials and production techniques?
- How can I design visually more appealing seats?

For the hard-top design;

- Can I propose new material and assembly techniques?
- How can I design visually and physically stable hard-top?
- How can I design visually more appealing hard-top?

Three aspects figure out the project aim are ergonomics, user experience, and producibility. The users are driving and using the boat for most of their leisure with high speeds on the rough sea conditions. Therefore, the ergonomics is a central player in the design process. Physically, primarily the physical environment will be concentrated on, but also taken into account the sea conditions like wind, sun, waves, salty sea water. Cognitively, the interaction with the controls and electronics at the dashboard layout of the console will be addressed. The producibility features are dealt with the detailing design of the parts ready for molds, material selection and assembly of all parts.

By implementing Aneer and Hansols' (2016) design methodology through their master thesis, the project was managed in collaboration with users, engineers, marketing departments and workers with the user-centered design approach. Insights gathered that emphasize the contribution of a design-led approach with collaboration and value that is brought by design knowledge for boat design. It is a UCD process, and in this study, additionally, it was applied to optimize product development by considering on production abilities, costs, segmentation, and brand identity together as a way of realizing a concept through a physical product. UCD approaches were implemented to investigate the feasibility of early-stage design ideas across needs analysis and problem analysis with interviews, observations, and benchmarks. The opinions from these groups of people are the basis for developing the user experience for designing the new boat parts.

One limitation of this project is that the newly developed designs should be manufactured with company abilities without any extra investment except molds.

RIBTECH demands to obtain a new console, seating units, and hardtop for NorthStar 910 RS on the market through the end of 2018. The new boat concept will be a blend of new parts and the existing components such as deck and hull.

Consequently, design priorities and meaning of design change according to different professions. Although only a boat is mentioned in this study, there is the purpose of giving at least an idea about determining user, design, marketing, and engineering priorities and values according to the product. Additionally, this study will raise awareness about creating the economic value of industrial design. Instead of identifying design as an add-on and the temporary feature of a product, a design would be presented as a value that is a competitive tool to improve the company performance in the market.

1.2. Methods of the Study

Research of the thesis rooted in practice to consider about design and its roles in professional practice that is contextualized but not defined by history, it informed finding a way to comprehend practice, from the insider perspective of the designer. Positioned from the perspective of 'insider,' this study spreads out to investigate the activity of product design practice through practice-led research. Practice-led research plays a lead role in the exploratory process and draws on thirteen years of professional experience with the observations that are framed to investigate how practice can be enhanced or improved. One of the main characteristics of practice-led research is that it is highly personal, being centered on the creative practices of the self (Pedgley, 2007).

The outcomes of the research are analyzed by the thematic narrative approach, with the objective of understanding how industrial designers contribute value through the entire phases of new product development in a cross-disciplinary workplace. Even if not said aloud, it is clear that the development of products comprises knowledge connecting differing knowledge disciplines, from scientific knowledge of materials science and analyzing, electronics, to marketing and manufacturing expertise from industry. Interdisciplinary collaborations are progressively constructing among industrial designers and other distinct disciplines because of the understanding that broader knowledge is obligated while aiming to attend to technology-driven products. As a consequence, these products need cross-disciplinary research with shared knowledge.

In design research, the research topic is mostly carried out by research specialists

instead of design practitioners that can be defined as the nature of practice. The core of the research lies in achieving new information about the nature of practice, and it seeks answers on possible improvements rather than constructing and reflecting on new products (Candy, 2006). Nevertheless, there has been a critical transformation globally on the applied practice-led research accepted through project-based explorations over the past two decades that mainly focused on art, architecture and design disciplines. This approach offers effective outcomes on knowledge generation that embodied in both research and practice. (Allpress et al., 2012)

Toward extending this shared knowledge, there is a potential for professionals to make distinctive and meaningful contributions to research and that there is an opportunity for such people to develop both new methods of research and appropriate forms of communication which may be more direct and accessible than a traditional text (Rust and Wilson, 2001). Practice-led research in design has also been named 'research through design' (Archer, 1995) is interested in the nature of design practice and contributes to new knowledge that has practical meaning for that practice.

Furthermore, it is a method that design practice is used to create an evidence base for something demonstrated or found out (Pedgley, 2007). By its nature, Ken Friedman suggests that "design knowledge grows in part from practice, design knowledge, and design research overlap; the practice of design is one foundation of design knowledge" (Friedman, 2003). Practice grounded research are in a strong position to work with and understand knowledge as a practical action opening the way for creative research as a predictor and enabler of change. There is an increasing demand for research qualifications at masters and doctorate levels for exemplary art, architecture and design practitioners who are taking on professional leadership roles that bridge the academy and industry (Allpress et al., 2012).

By using practice-led research as a method, the structure of this study has three parts throughout the considered questions and the aims mentioned. After the introduction, this thesis will go on with a critical review of the relevant literature in Chapter 1. The first task is, which I address in Chapter 2, to elaborate on definitions design practice, new product development process besides the user-centered design in creating value that has been approached and investigated by ergonomics, user experience, and production contexts. Combining insights from other disciplines (anthropology, sociology, engineering), Chapter two starts to set out the definitional framework that underpins this study. Additionally, this chapter gives a broad understanding of user-centered design, and

the bridge between design practice, user, and production. Through the changing definition of design in other disciplines, this study seeks to show up the connections and the optimization techniques between design, product, consumer, brand identity, manufacturing, and economy.

Following this, Chapter 3 focuses on the case study of design project implemented in a company. It presents a user-centered design process of NPD and comparing older and newer designs of products in this perspective. Doing this, it highlights the significance of applying user-centered design process at early stages towards NPD, which remains the primary concern in the value of design practice.

Through the analysis phase of the design project qualitative data collected by field research (Table 1.1). The reason qualitative research was selected for the data collection is that it is most suitable for small samples, while its outcomes are not measurable and quantifiable. However, its advantage is that it offers a complete description and analysis of a research subject, without limiting the scope of the research and the nature of participant's responses (Collis & Hussey, 2003). According to this method, the research began with an observation on users and the boats. Four field trips were conducted, and five users were observed on the boat while driving. Also, the designer was an active researcher on the boat. Data collected through capturing and video recording with GoPro camera.

Furthermore, unstructured interviews were managed with these five users, two naval engineers, production manager, sales manager, three external dealer, owner of the company and four workers. Additionally, a phone interview was conducted with the marketing manager. Unstructured interviews are personal, that aim is to identify participant's emotions, feelings, and opinions regarding a particular research subject. The main advantage of unstructured interviews is that they involve personal and direct contact between interviewers and interviewees, as well as eliminate non-response rates, but interviewers need to have developed the necessary skills successfully carry an interview (Fisher, 2005; Wilson, 2003). A semi-structured questionnaire was used as a data collection tool which was an interview guide. Some specific questions were prepared for guiding the interview towards the satisfaction of research objectives, but additional questions were made encountered during the interviews. Moreover, the benchmark was carried out through the web and on six competitors' boats in Bodrum Marina and Istanbul Boat show. Small talks were managed with external dealers about other brands advantages and disadvantages.

Table 1.2. Qualitative data collection methods used through the design project

Type of Research	Research Methods	Research Techniques
Field Research	Observation	Action research on boat with photos and video recording on the boats while driving (as an active researcher) Action research of the users on the boat (as a passive researcher)
	Unstructured Interview	5 users, 2 naval engineers, production manager, sales manager, 3 external dealer, owner of the company, 4 workers (semi-structured questionnaire)
	Phone Interview	With marketing manager about the RIBTECH's expectations
	Survey	Benchmark through web Benchmark on 6 competitors' boats in Bodrum Marina and Istanbul Boat show Small talks with external dealers about other brands advantages and disadvantages

CHAPTER 2

USER-CENTERED DESIGN IN NEW PRODUCT DEVELOPMENT

2.1. Design Practice

Industrial design is defined in numerous times; however, none of these definitions are universally entirely accepted. As the function of industrial design evolves over time, its definition also has changed by different perspectives persistently. Besides, academics and practitioners agree that the role of industrial design is not only related with the aesthetics but also with the ease of production, the effective use of the material, the product performance and the interaction with the user.

"Industrial design is a professional service dedicated to creating and developing concepts and specifications that optimize the function, value and appearance of products and systems that mutually benefit both the user and the manufacturer" (IDSA, 2017 webpage). The World Design Organization (WDO), formerly known as the International Council of Societies of Industrial Design (ICSID) interprets "Industrial Design is a strategic problem-solving process that drives innovation, builds business success, and leads to a better quality of life through innovative products, systems, services, and experiences." Ulrich and Eppinger (2016) indicate that the products on the market can be developed in good industrial design; because the aim of the profession is devising aesthetic and ergonomic aspects of a product related to the user (Ulrich and Eppinger, 2016). Margolis and Pauwels (2014) argue that design practice is a cross-disciplinary approach because it is involved in craft and science, creativity and commerce, the humanities and the social sciences, art, and engineering. It requires productive, analytical and creative thinking and critical problem solving (Margolis and Pauwels, 2014). Undoubtedly, the qualifications of an industrial designer have been an essential value in product development by time.

The historical integration of design into business followed by fluxional periods concerning cultural changes and economic expansion. In the 1700s, entrepreneur Josiah Wedgwood paid attention to market needs. He has initiated the concept of design to

differentiate product lines and market segments to add value to the products (Perks et al., 2005; Lancaster and Reynolds,1998). Nevertheless, during the Industrial Revolution period, production process and diversity were more critical than refinement and human factors. Companies generally ignored craft finish as a waste of time or dismiss any hint of sophistication that they were focused on to sell large quantities of products instantaneously that they concentrated on improving production efficiency in an attempt to bring down costs (Lancaster and Reynolds, 1998). Products were designed by teams of non-expert workers and craftsmen who were generally unable or unwilling to adapt to the demands of industry (Cagan and Vogel, 2002; Heskett, 2005). Respectively, the producers had become more profitable with an expanding capacity of the market with varying tastes that a continuation of new ideas required to sell the products. Producers increasingly began to work with style consultants, engineers, artists' and drafters that were implemented the fundamental drawing skills for production specifications that they were responsible for generating forms of products, essentially on copying historical styles or the products of successful competitors (Heskett, 2005)

The economic recession of the 1920s and 1930s had important consequences on shaping the outline of the industry that companies required to concern on the demands of the changing needs of the markets. Eventually, World War II proceeded the material improvements, the innovative manufacturing processes, and philosophy of collaboration among artists and designers merging of style and technology started to appear in products resulted in that design generated a high point in design history (Cagan and Vogel, 2002). Designers extended their expertise beyond concerns with form and began to address problems of more constitutional emphasis on firms' competitiveness (Heskett, 2005). Respectively, the design was viewed as a crucial part of economic reconstruction that turned into a profession (Perks et al., 2005). During this period, consultant designers (such as Dreyfuss, Loewy, Bel Geddes, Von Doren) studied on user and product lines of producers to improve competitiveness in the market. Everyday objects designed more functional, usable and aesthetic (Gorman, 2000). All the while, to satisfy production specifications and market needs, consultancy studios composed their employees with diversity such as engineers and technicians, that forms cross-disciplinary practice. Dreyfuss became associated with every degree of the client organization that his studio experienced a method of 'total' design integration (Freeze and Powell, 1998). Sparke (2002) argues that this decade was the period of expanding professionalism and status in design that the formative elements of the consultant designer were synthesized into a

unique formula in which the role was to 'stand firmly in the center of these specializations and understand and synthesize them without specializing in any of them.'

Whereas in the 1950s, handicraft production methods (existing) were changed to mass production (preferred) with the huge capital investment, large business accomplished with the accelerated market competition (Cagan and Vogel, 2002; Heskett, 2005). To stimulate markets, products needed to be continuously changed, with mass advertising campaigns persuading consumers purchasing product abundantly. Consequently, mass consumption was expanded by the constitution of the technological advances of mass production. Mass media, mass advertising, and mass marketing tools have become worthier than products themselves (Forty, 2005; Heskett, 2005). The struggle was to initiate products that function and that can be manufactured in large quantities with low prices, not to make products that were aesthetic or easy to use. As the products had similar features, there was a change in direction at the design and marketing hierarchy (Candi, 2010). It was a time when mass manufacturing potential was met by mass consumption. Consumers behaved inconsistent patterns of purchasing and could be grouped into large mass markets (Cagan and Vogel, 2002).

Furthermore, companies started to understand the notion of marketing orientation which emphasizes customers first (Lancaster and Reynolds, 1998). In the act of consumers were motivated to purchase on visual imagery advertisements, marketers and advertising agencies captured the control of the specifications of products (Bruce and Bessant, 2002). As follows, product quality declined, and design's role was for a cosmetic to be styled around the product ideas, by the individuals interprets themselves as 'designers' who dominated the market by surface-deep design until the early 1990s (Cooper, 1994; Walsh et al., 1988). Conversely, over the past two decades, the new changes encountering industries empowered to design and designers to retrieve important position (Press and Cooper, 2003). Meanwhile, competitive firms, such as IBM and Westinghouse worked with the external consultants Elliot Noyes and Paul Rand who emphasized on graphic identity, products, work environments, and architecture with precise guidelines to create comprehensive brand identity programs that merged their state-of-the-art products with the emerging International style (Cagan and Vogel, 2002). On the other hand, much of the training of designers still resided in the art and craft tradition, but by the late sixties, commercial art and industrial design courses surfaced (Perks et al., 2005).

In the 1960s, the population had expanded numerically with the higher individual purchasing power and a generally satisfied feeling of 'well-being' being experienced by the population as a whole as a result of war shortages. Consumers became more conscious that after being attracted by external style, they commenced evaluating products unsatisfactory in use. Companies tried to pursue customers with satisfying their expectations and then manufacturing products to suit these needs (Lancaster and Reynolds, 1998). Correspondingly companies diversified their design perspective at levels superior to aesthetics, expanding design as a "high-level strategic planning activity" to improve the product quality and user satisfaction (Lancaster and Reynolds,1998; Heskett, 2005).

By the 1970s consumer awareness raised which was the end of mass marketing that consumer motives started to change. Safety and quality were converted to evaluation criteria for the consumer in addition to aesthetics, function, and cost of the products. Meanwhile, consumers had more expectations from the products they bought and had very particular demands and a new range of interests that exceeded their personal needs, wants, and desires as a result of this new consumer awareness with the trend of demassification (Cagan and Vogel, 2002).

During the ''Designer Decade'' of the 1980s, the media and business worlds recognized design as a way out for all problems. On the condition that companies were frequently associated with the design and the designer label (Perks et al., 2005). Furthermore, in the early 1990s, a massive economic change caused the recession in a little while that design was depreciated and became a sub-process of a new product. Companies perceived design as an exaggerated activity and brought back into the company that followed extensive multidisciplinary design consultancies weakened on offering services. The design was not seen as an integrated process. (Perks et al., 2005). By the late 1990s, companies were dealt with to integrate separated functions in the NPD process (Griffin and Hauser, 1996; Kahn, 1996). Activities and skills that attended with the design developed through as separated functions from the whole innovation process. Designers were enforced to work closely with other functions with the implementation of the new knowledge of team-based and parallel NPD processes that sustained interest in the interactions between design and other functions (Jones and Cooper, 1994). Bruce et al. (1996) stated that the relationship between design and the marketing function was particularly critical as an outcome of success and failure studies.

In the early 2000s, companies started to compete globally in more diverse and demanding markets that concept of product development has changed at all of the economic levels (Cagan and Vogel, 2002). Consequently, design again gained value as a part of a business strategy that had severe competition with increased importance on creativity and innovation. Accordingly, designers initiated to undertake a leadership role, "such roles include an interpreter, coordinator, and facilitator," in NPD by expanding their support to the whole process (Stamm, 2003; Turner, 2010). Moreover, understanding the customer was essential for new product success that is argued designers should embrace traditional marketing tasks by integrating with the market to completely understand customers (Leonard and Rayport, 2011; Perks et al., 2005). In the business context, new market conditions such as improved knowledge of technologies, globalization, extended competition, and vital communication have considerably changed power dynamics (Kumar and Whitney, 2007). Regarding technology, current design work has influenced intensively by the eventual information on the accelerated improvement of design and production tools, mass personalization and sustainability (Borja de Mozota, 2003). Socially, consumers have more voice to say that their previous fellows (Kumar and Whitney, 2007), they have a much clearer sense of their own identity and whom they want to connect with (market segment), and they are also well aware of the range of products available (Cagan and Vogel, 2002). Through many media channels, consumers that can research and buy their products who are looking for products that are well made, safe, and match their lifestyle (Cagan and Vogel, 2002). Therefore, consumers have been contributed as a part of the development process of the products (Redström, 2006; Schreier et al., 2012). Under those circumstances, it is remarkably significant to be aware of, understand and observe customers to create more valuable products to answer their evolving needs and desires (Bloch, 1995). Moreover, products must be developed to respond to an ongoing set of factors that regulate what customers expect. (Cagan and Vogel, 2002). That is to say, there is a need for a new approach to business processes, especially in product development.

Social media accelerated the influence and interconnection of social, technological, commercial and economic interfaces (Kotler, 2011). At the same time, companies want to solve business problems and design to offer products, services and experiences that are more comprehensive, less complex and more complex than recent (Buchanan, 2001). So that, the design has the ideal integrative tools for the synergetic approach required for the business that roots in aesthetics, marketing and technology form

the beginning to create a significant impact in the industry today (Hertenstein et al., 2010; Cagan and Vogel, 2002). As a result of disciplinary boundaries and adaptable nature of design, cooperation with the marketing is increasingly relevant that have been implemented to business applications (Cooper and Press, 2005). By all means, Perks et al. (2005) suggested that the design may participate in different levels of product development and that in the course of a multidisciplinary process.

2.2. The Role of Industrial Designer in New Product Development

New product development (NPD) is the process of creating new ideas and transforming them into the new product which is more powerful and appropriate to market characteristics. At the same time, the design process is formed on increasing the value, benefit, aesthetic, and producibility, besides it is an outstanding tool to satisfy user expectations and to construct competitive products with distinct characteristics (Hertenstein et al., 2005; Micheli, 2010). Better designed products result in a more successful product which is providing a competitive advantage, and enhancing companies' success (Goffin and Micheli, 2010).

The role of industrial designers considering NPD can be defined in two categories that they assist the companies and national economic performance across the market competition, and employ a professional experience through the NPD process (Walsh et al., 1992). Pioneering studies show that the product design as a strategic tool that increases the competency of the companies resulting in expanding export potential (Rothwell and Gardiner, 1984; Walsh et al., 1992). Generally, studies on the role of design in NPD present that design provides micro and macro-level success for the companies.

Designers differentiate the new products by conforming product preferences and user expectations, and actively expand brand identity and awareness between the variety of products on the market. Also, they manage improvements for decreasing production costs in product development activities and assisting the competitiveness and economic performance of companies by increasing their market share and incomes (Bryson and Rusten, 2011).

NPD involves a specific multidisciplinary organizational structure including market research and development, production engineering, and industrial design which

the designer act as a bridge between marketing and engineering. Industrial designers are mainly responsible for developing functional, ergonomic, and aesthetic products to offer users new benefits by building up the interaction between the product and the user. As well as contributing product formulation, the industrial design also supports products' functional and technical features and visual identity to provide new product configuration (Crawford and Di Benedetto, 2008). Industrial designers do not only create new ideas, but they also initiate the roles of interpreter, coordinator, and facilitator concerning NPD (Turner, 2010). The industrial designers' role concerning NPD has to get importance and has converted from product maker specialist to leadership which understands existing, and future user needs in competitive markets (Perks et al.,2005). In progressive global markets, designers should strongly attend their active roles, which expand with daily changing needs from a broader perspective. It was pointed out the designer role should be improved for assisting efforts to develop new products (Turner, 2010).

2.3. User-Centered Design

Through the past six decades, designers have been getting closer to the potential users of the products and services. The manufacturing companies have been progressively open to developments defining the products that are based on users needs in areas particularly in areas which technologies cultivated, and the new features are no longer of value.

The user-centered design (UCD) approach that accepting user as a subject user has been originally a US-driven phenomenon since the 1970s. In the early design phases, consumers have been allowed to have more power and opportunity for the initiative roles participating in the advising, ideating, and conceptualizing activities. Following, Europeans have considered user as a partner means the participatory approach. These two approaches influence one another developing the current state of the user-centered design (Sanders and Stappers, 2008). UCD is frequently used as a synonym with the term Human-Centered Design (HCD), but there is a distinction addressing the UCD instead of HCD since UCD is more focused and concise version of HCD with the broader analysis of focus audience.

UCD is a term broadly used in the design practice currently that is an interdisciplinary design approach focusing on the users and their needs in each phase of

the design process. UCD involves users at the center of the design process for combining the product with the user needs and rise the practical use (Wilkinson et al., 2016). An extensive type of methods can be implemented by UCD, including stakeholders in diverse stages of the NPD process, critical point is their involvement (Abras et.al., 2004).

UCD has defined that design progresses in iterative cycles of analysis, design, evaluation, and implementation through the complete process (Figure 2.1) (Vredenburg et al., 2012). Gould and Clayton (1985) recommended that the designers should concentrate on users and tasks at early phases, carry out an empirical measurement, and implement the iterative cycle. Brown and Mulley's (1997) studies presented that UCD results in better quality products, and shortens complete development time and costs by decreasing the amount of modifications needed in the following stages of the design process.

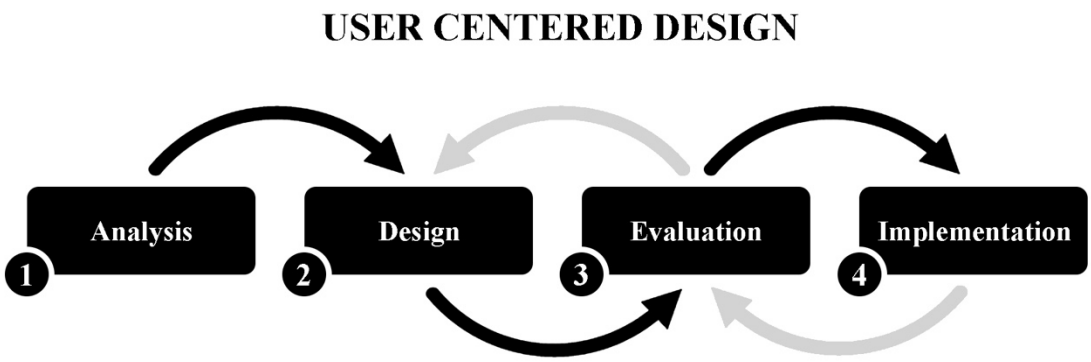

Figure 2.1. Iterative Process of UCD (Source: Weevers, 2016)

Through applying UCD in the product development process, it is important to involve users, designers, and stakeholders and get input from them at every stage to understand the real users and create more appropriate products and services (Lindgaard et al., 2006: Muller, 2002). By means of performing the participatory approach, more accessible and usable products can be developed for an expanded proportion of the population with the use of these ideas and insights (Etchell and Yelding, 2004).

Implementing UCD within the process of product development, it has been moreover described as interdisciplinary, value adding and accessible (Wilkinson et al., 2016). UCD is interdisciplinary that is requiring collaboration with experts from diverse

disciplines to study, analyze, define and synthesize user requirements and behaviors and convert these into designed products or services regularly in an iterative process (Mao et al., 2005). It is defined as value-adding in terms of enhancing design outcome by improving the user experience; creating greater economic achievement (Boztepe, 2007).

UCD methodologies and approaches have been suggested for guiding the development of usable products. The ISO 13407 (ISO/IEC 1999) standard is a broadly used as the common reference for UCD. The UCD focusing on product development process in accordance with the ISO 13407 standard consists of four stages (Wilkinson et al., 2016):

(1) Understand and specify the context of use

(2) Specify user and organizational requirements

(3) Produce designs and prototypes

(4) Carry out user-based assessments.

Design researches and practice have confirmed that the UCD approach can achieve the aim of better design. In this study, a UCD approach is implemented as the ground of the product development process. Aiming of designing a boat, this study is to apply a new method specifically, in combination with a standard design procedure that is better suited to boat design than previous models.

2.4. Ergonomics

Focusing on designing with a UCD approach, user satisfaction is the prevailing objective for the designers. To achieve this objective, one way is to implement the ergonomics theories to the products. The International Ergonomics Association (IEA) defines ergonomics as:

"The scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance." (IEA, 2016)

Ergonomics has three fundamental territories; physical, cognitive and organizational. Physical ergonomics concentrated on physical activity, with human anthropometric, biomechanical, and physiological characteristics. Designers should

consider the physical size and shape of focus users of products, environments, and systems refer to as designing for physical well-being (Garneau and Parkinson, 2016). Cognitive ergonomics is focused on the mental activities of human as perception, memory, reasoning affecting relations between humans and other features of a system. Organizational ergonomics is about to sociotechnical systems such as organizational structures, policies, and processes. Both physical and cognitive ergonomics will be the center for this project.

2.4.1 Anthropometrics

By implementing physical ergonomics through the NPD of new products and services, damages like musculoskeletal disorder could be decreased (Silverstein and Clark, 2004). Accordingly, it is essential dealing with user's body measurements that is defined as the anthropometrics. Anthropometrics has two accepted ways; design for all and design for average. Design for all means that there are adjustable parameters in the design process to ensure good ergonomics for 'all' users. Though designing for average is to use the average human anthropometrics. Studying anthropometrics in the design is vital to ensure good ergonomics for the user. The user population has different anthropometrics, often including both men and women. By designing with adjustability, the design is likely to fit most users. Anthropometrics for the 5th-95th percentile of operators will be implemented for the design of the driver environment in this case study, and the measurements of the previous boat designs will be used to ensure data for physical comfort.

2.4.2. Human Machine System

Human Machine System (HMS) is a subarea in ergonomics focusing on the cognitive ergonomics. Because a RIB can be classified as machinery, HMS is located in the middle of this project. The HMS can be defined in two parts, the human and the machine. The interface is a bridge between these two sections. The human perception defines the machine indications and presents an action, which is called the cognition process (Figure 2.2). The controls of the machine transform the human action to a

mechanical or electrical response. The machine requires to show that the action has occurred, accordingly the human comprehends that the action has been finalized.

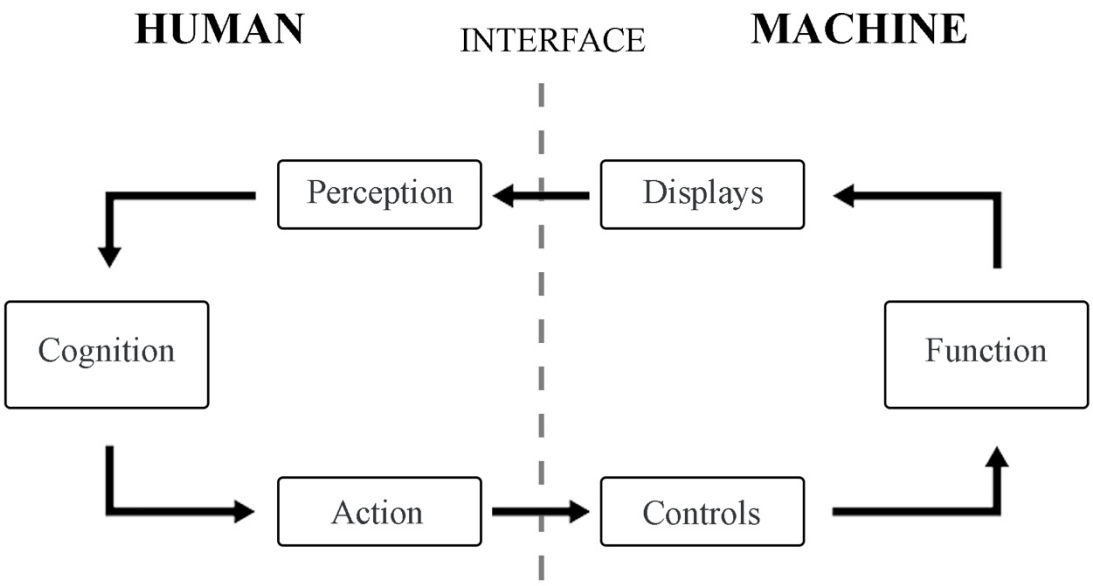

Figure 2.2. Human-Machine System Process (Source: Aneer and Hansol, 2016)

Today, considerable effort is expended the through designing of machines and technical systems that are effective, consistent, and safe through a technical viewpoint. However, if the human factor of the products and systems is not considered (Rasmussen, 1980), the products and systems cannot be entirely effective or safe. Several studies have illustrated that, if the products and the services are adjusted to human characteristics, abilities, and limitations, the possibility of human error and level of stress reduces whereas effectiveness rises (Wickens and Hollands, 1999).

Identifying and responding problems and failures in the interaction earlier to they result in severe problems for users is an essential step to creating efficient and safe HMS (Bligård and Osvalder, 2013). To identify the problems that can increase errors in handling a product, usability evaluation is usually made of the product's user interface with practical tasks. The interface information flow can be described as a part of 'the gulf of evaluation' (from display to human sensory) and "the gulf of execution" (from human action to control) which has to be linked for a system to work (Norman, 2013). The link between the proper interface and the human results in the high usability of HMS, and it also means good cognitive ergonomics that subsequently generates a better quality of life for the users.

2.5. User Experience

UCD is about comprehending human behaviors and needs by involving stakeholders in the design process. Users can be listened about the opinions about the product or observed according to their reaction while using the product by a designer. However, can do designers find out what the users feel while they are experiencing a product? The concept of considering the users' experience on a product arose in the mid-90s at Apple, and the term "User Experience" was figured out (Norman et al., 1995). Afterward, the term has been broadly extended to be used in each design process. User experience is mainly the whole or flow of feelings that the customer gets through using a product, a webpage, or a system. ISO standards define user experience as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service." User experience can be initiated from the first reaction, or it can also arise from positive and negative impressions experienced in the long-term (Kraft, 2012). The ideal user experience can be carried out by understanding the target users and their needs, by focusing on the design process across the core tasks, and the core interaction of the product. If the user experience is on the ideal state, the user feels pleased, fulfilled, proud or even in love with the product (Kraft, 2012).

Aiming at improved user experience, designers need to understand the difference between opinions, behaviors, and emotions of the users and find suitable methods for each of them (Sanders, 2002). Designers cannot design experience, because the experience is a profoundly individual outcome. However, they can understand from people's experiences and benefit from it being a resource for inspiration while designing a product or service (Sanders, 2002). By interviewing and observing users, designers can learn what they say, see and do. However, designers required to involve users in the design process, the definition that is called co-creation, if they want to develop user experience with a deeper level of their feelings and mindsets.

Many companies today wish to be competitive in the global market with their products, and so does RIBTECH. While being competitive in the global market through design, companies should compete by satisfying distinct user expectations across diverse countries. Norman (2013) claims that if addressing the action by experiencing a product instead of tasks, designers are closer to improve the user experience. Experiences, aside from their abstract form that they are subjective and non-physical, can be defined as the

core value of a product (Cain, 2010). The designers should struggle themselves whether there is a way expressing the design in broader concepts rather than if it is an only physical product. Resulting in more than a physical product, the design process can be precious for the company on a more extended ground, and the crucial way for understanding users.

2.6. Advantages of Prototyping

The design process described as the mental manipulation of conceptual representations to examine complicated interactions between design features (Simon, 1986). Thus, the design work can be defined as a complicated activity resulting in a cognitive burden. Considering cognitive burdens, designers try to reduce their mental workload with iterative models or prototypes that keep current ideas that develop as the design process (Goldschmidt, 1995). Prototyping is integrated into the design process for analyzing concepts and enabling them observable.

Physical prototyping and digital prototyping practicing computer-aided design (CAD) are the two different ways that they have distinct advantages and complete one another through the design process (Horton and Radcliffe, 1995). Additionally, prototyping aims three purposes that are testing the performance of the design, communicating with users and reaching the functionality that gives the company the courage to invest in more for tooling (Chou and Breneman, 2018).

This project concentrated on physical prototyping that a physical model of the concept is one of the aims of this project. Indeed, computer modeling is practiced through the design process for the driver environment of the boat. Physical prototyping is actually more expensive than computer modeling concerning time and material costs, however, as an outcome of communicating with users and reaching the functionality, the investment for the prototype is more feasible in the long term. Likewise, analyzing concepts physically enables to avoid potential re-designs resulted in troubles that can be noticed at the early stages of the NPD process.

Several studies likewise presented the physical interaction with materials improved the creativity, performance, and originality of the product. Furthermore, one of the significant benefits of the physical prototyping is that they are undoubtedly useful communication tools between stakeholders and the products (Horton and Radcliffe, 1995), providing interaction between the users and the stakeholders, especially in an

interdisciplinary team with people from different areas is a big challenge in design and engineering (Will, 1991). Accordingly, the result shared among users, the stakeholders to evaluate and communicate them on equal ground in this project.

CHAPTER 3

CASE STUDY

3.1. Project Objectives and Aims

The project aim is to design a new console, seating unit and hardtop for NorthStar 910 RS with enhanced ergonomics, user-experience, production details, additionally aesthetically more appealing than today's boat. The project objective is to improve user-experience by developing their ergonomic requirements, besides evolving the conditions for other stakeholders who have a connection with the boat production. With the interest of the company, the aim is additionally to produce a new concept which will represent RIBTECH as competitive on the international market. Designing console, the seating unit and hardtop ergonomically is a substantial sales opportunity, and an enhanced aesthetics will make more powerful RIBTECH between its competitors.

The design concept will be modeled on the computer and completed with CNC milling and molds. The prototype of the new parts will enable to physically experience them which is not conceivable in a 3D model whether they satisfy users' ergonomic requirements. The 3D model, otherwise, will be the core for the upcoming development of new range boats to create the brand identity for future projects 8M, 10M,12M RIBs. Visual presentations will be the other outcomes of the project that they are describing the results from different phases of this case study. These visual representations are essential factors to share experiences with the company through the process.

3.2. Methods and Implementation

Vrendenburg et al. (2012) outlines the overall process of User-Centered Design (UCD) in four phases; analysis, design, evaluation, and implenetation. By emphasizing these four actions, the designer will define the problems and conclusively implement outstanding design features. The design organization IDEO proposes the process of UCD consisting of three phases; Inspiration, Ideation, and Implementation. IDEO (2015) Prototyping is suggested as an ordinary element for all phases rather than directing it

being a separated phase. The UCD approach in product development process in this project was implemented as stated in the four-phase model of Vredenburg et al.

The first phase is the analysis that is concentrated on discovering and collecting data concerning all which can have importance while designing the new boat parts. Because I had narrow knowledge about boats when I started to project, this phase was essential for comprehending and designing parts purposeful to the users and the stakeholders.

The second phase is the design, which concepts were developed for improving NorthStar 910 RS. The concepts were the outcomes of the ideas from analysis phase.

The third phase is the evaluation, in which phase that the designed parts, the new console, seating units, and the hardtop, was evaluated through ergonomics, user-experience, and producibility. When required the designer turned back the previous phase or move the next as a result of an iterative cycle of the UCD process.

The fourth and last phase is the implementation that the design of the parts was formed in 3D models and physical prototypes.

The industrial designer was based at the RIBTECH production area for all three steps of the process, inspiration, ideation, and implementation. The meetings were arranged with the naval and production engineers, and the managers from RIBTECH regularly through the project for gathering and giving feedback for all phases. The activities and outcomes of the phases will be explained later in this chapter.

3.2.1. Project Planning

The initiation of the project was to prepare a Gantt-chart form for the time planning (Appendix B). This phase was focused on understanding the project objective, the capacity of the company and the arrangement of the phases through time-plan. The project plans were practiced that all stakeholders accepted before continuing to the analysis phase.

In the project planning phase, the brainstorming sessions were conducted on crucial points of the designing a new boat console, seating units and hard-top. The points were sectioned into two key scopes; functional and emotional features. The functional features present points that are more objective, subjects that can be analyzed in solid values. The emotional features describe values with subjective emotions practiced by

human and will be personally criticized. The two features are essential for obtaining an outcome which is useful with the better user experience.

The features were combined in a mind-map (Figure 3.1) which is adaptable, and it could be transformed and updated throughout the process. The primary aim of the mind map is achieving a general comprehension of the project objective. This mind-map would be used as a reference for confirming that the critical features were not disregarded through the design process, from early phases to final product.

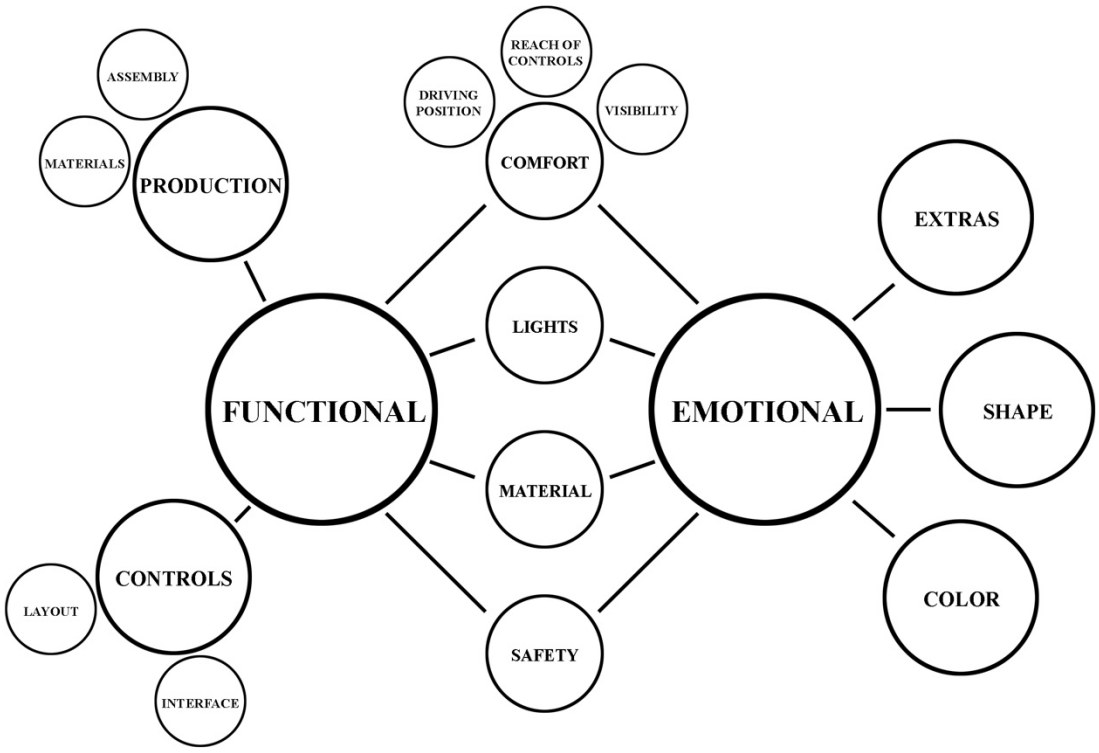

Figure 3.1. Mind map of important design aspects in the project (Asici, 2018)

3.2.2. Exterior-Product Adaption

Before starting the design process with the console, the seating unit and the hard-top, some areas of the deck design should be adapted to fit upcoming user and production requirements. From initiation, the product since 2015, the design of the boat had some structures which were too visually unpleasant to apply. The design of the deck was needed to modify for enhancing a reasonable structure that the other parts could be designed.

The two fundamental subjects about the deck were the robust fiberglass part at the head area and the upholstery design at the rear seat. With information from the production department in RIBTECH about modification possibilities on the molds and with some 3D models in Rhinocesros 5.0, the revized deck design was reviewed with the production manager at RIBTECH.

Applying the new deck design, some surfaces was cut out for the head part (Figure 3.2, 3.3) and adapted the CAD model that the proper lines was found to cut the best possible location for the mold.

To further design the rear seat upholstery the suggestions resembles new seating unit designs were discussed (Figure 3.4).

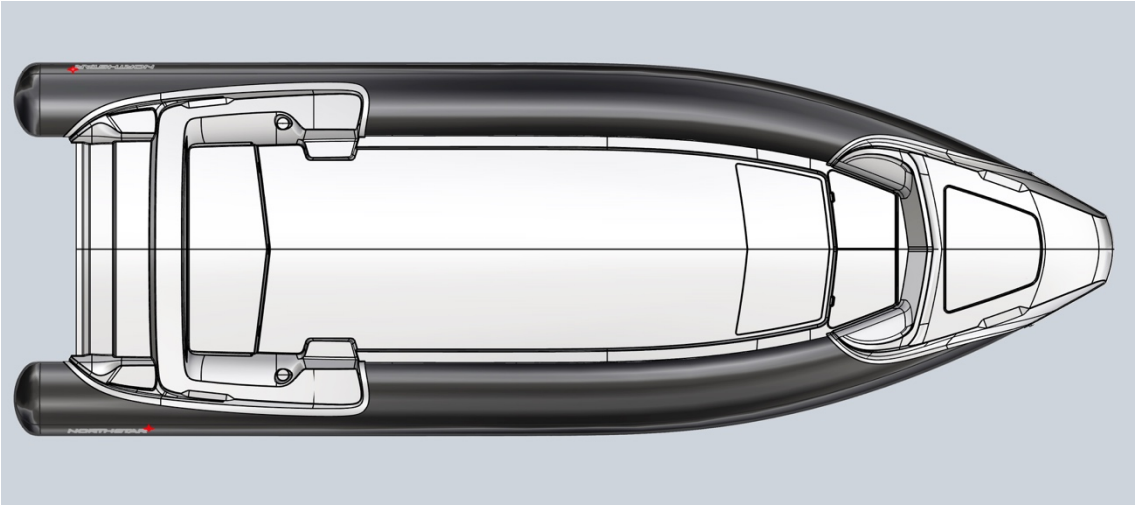

Figure 3.2. Northstar 910 RS Deck Design

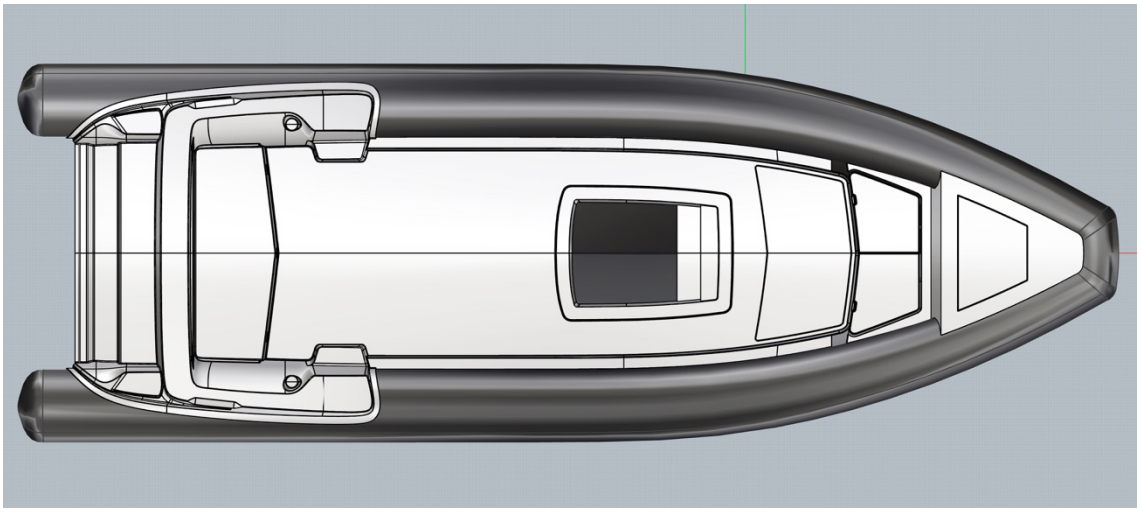

Figure 3.3. Northstar Orion 9 Deck Design

Figure 3.4. Northstar Orion 9 Redesigned Back Seats

3.2.3. Analysis

This section shows the results from the analysis phase aiming to comprehend the position and background of the boat and users and the stakeholders who were related to the project. To describe the problems and the understand user and the stakeholder needs about Northstar 910 RS, methods as benchmarking, interviews, observations, need analysis and problem analysis, have been used (Figure 3.5). The micro process supported the methods: define, learn and analyze (Figure 3.6).

The results consist of descriptions of all the identified users and the stakeholders and analyses about their opinions and ideas that will influence the whole process. Interview and observation results were outlined in ’stakeholder profiles.’

The users and the stakeholders profiles were the most crucial outcome of the analysis phase. Likewise, problem analysis and a needs analysis were conducted with in analysis phase. These results were used within the following phases of the project.

3.2.3.1. The Stakeholder Mapping

The stakeholders were associated into three different areas, exposing how they are related to the project in different ways. The three areas are vision, design, and practice.

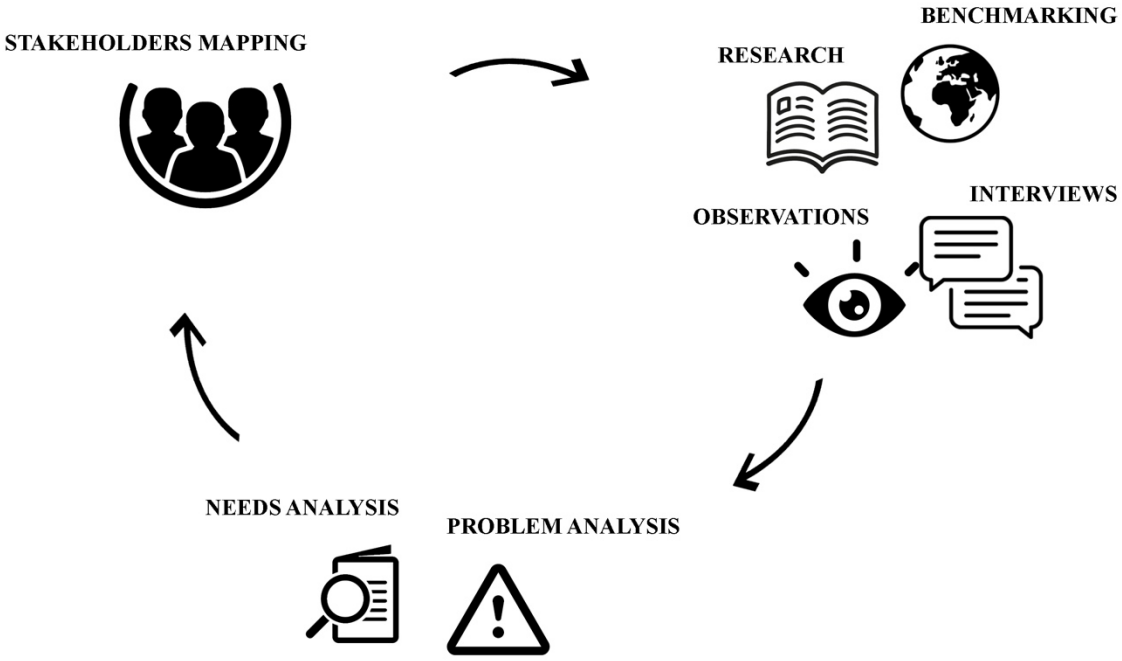

Figure 3.5. The methods used in the analysis phase

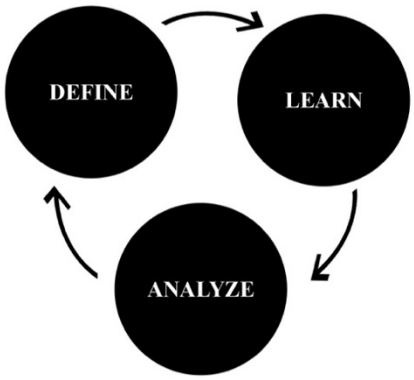

Figure 3.6. Workflow for the analysis phase

Each user and the stakeholder and their relation to the project are also explained in an overview (Figure 3.7).

The stakeholder connected to vision is RIBTECH, the producing and owning company. RIBTECH influence the project because the outcome has to be in connection with the company vision. The design concept involves the physical aspects of the product, how the parts are going to be designed. The stakeholders that have influence and concern in the design are the users, managers, external sellers, and service mechanics. The third area is defined as practice; this characterizes the factors that are of significance to

manufacture the product in reality, as an example what manufacturing methods could be used and what regulations had been to follow. The stakeholders connected to this area are engineers concerned with law and regulations, and the manufacturers at RIBTECH as well as external suppliers.

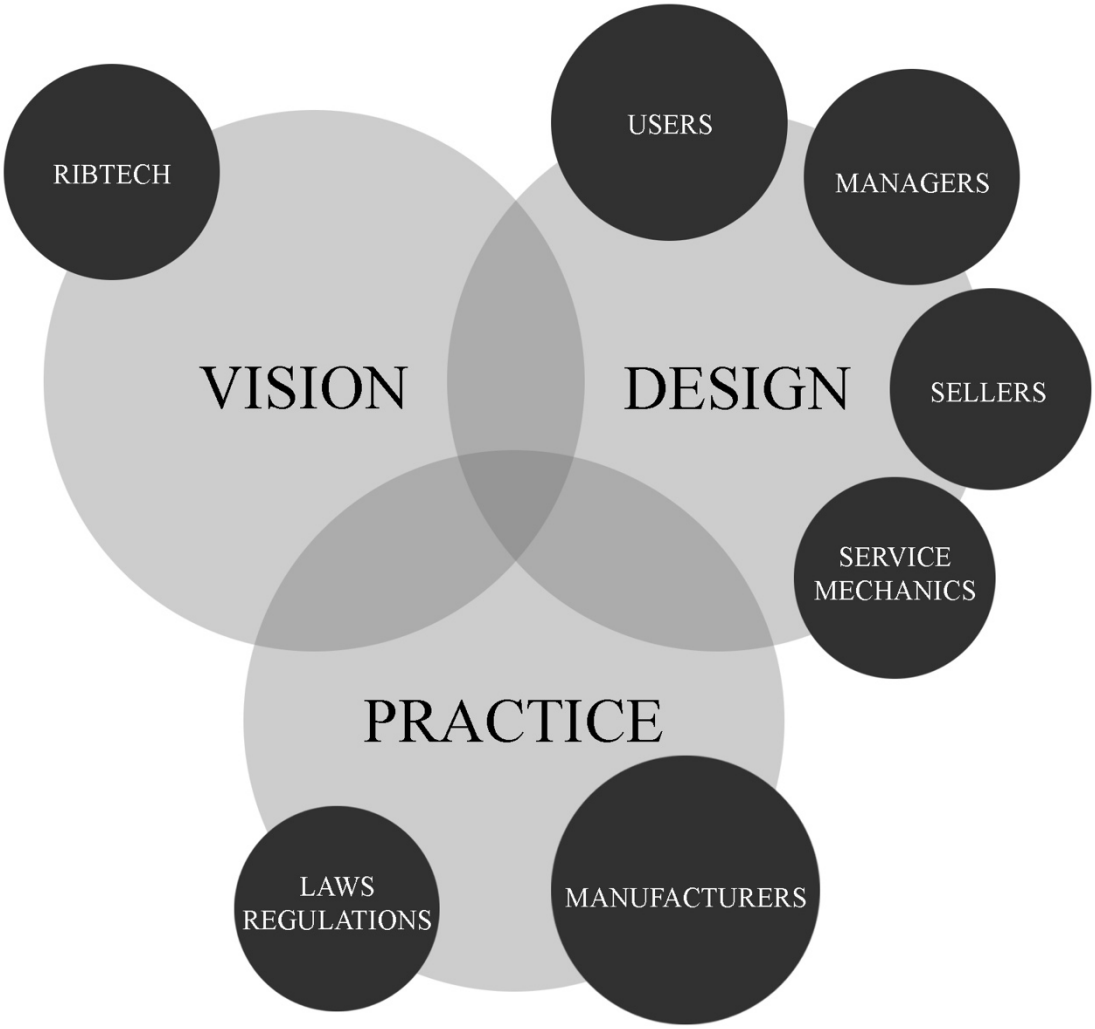

Figure 3.7. The Stakeholder map of the project

Through using an UCD approach in this project, it is essential to comprehend and involve that the product influences the stakeholders or have an effect on the design. To do this, firstly, the stakeholders were identified and how they were related to the project. The stakeholder mapping initiated with a brief discussion and brainstorm and all suggestion were noted (Figure 3.8).

The stakeholders were defined as all the people that are of significance for this project from my perspective as the designer. That consists of both stakeholders are noticeable for the product such as the users, and also others that affect the project like the

Figure 3.8. The stakeholders related to project

company (RIBTECH) and laws and regulations. When the stakeholders were identified, they were classified into a stakeholder map presenting their connection to the project. This method was guided by a method called ‘Audience’ from The Field Guide to Human Centered Design (IDEO org., 2015).

3.2.3.2. Benchmarking

By investigating design practice in rigid inflatable boats (RIBs) gave idea and inspiration to the design of the console, the seating unit and the hardtop in the NorthStar 910 RS.

Through benchmarks, it was figured out that the console of boats evokes a comfortable feel and that the dashboards look like automobile interiors. The essential upgrading feature in boat consoles throughout the last years are wider glasses (for expansive vision) and exceeded comfort concerning ergonomics. The dashboards in the recent models of the RIBs on the market seem to related to which was stylish for the automotive industry around ten years ago. As a result of benchmarking, it was noticed that well-organized specialized surfaces with curvy lines and application of diverse textures on them are making the console seem and feel attractive. Recent boats were visually different from the older ones on the way of their forms now are more straight. Additionally, some extra features were added which gave the user and the producer a possibility for installing high-end wider chartplotters, electronic switches, and storage compartments.

After visiting Bodrum Marina, benchmarking some competitors' boats reported and a presentation prepared for the RIBTECH for understanding pros/cons according to competitors (Appendix B). Besides, benchmarking through internet sources is presented in mood boards.

Through investigating related boats, it was figured out some feasible solutions that can be applied for further improvement. "Benchmarking can reveal existing concepts that have been implemented to solve a particular problem, as well as information on the strengths and weaknesses of competition." (Ulrich and Eppinger, 2012).

The boats from the competitors' boat was chosen that are similar scales with NorthStar 910 RS because the user experience areas for these boats are similar. Additionally, the bigger boats and automobile interiors were explored at to have an inspiration about conveying some ideas and user experience to NorthStar 910 RS.

Fundamental features of the dashboard were sight, comfort, materials, and safety. The boats were customized according to users expectations, meaning that the external sellers have a great relationship with the customers and broad comprehension of customer

needs. The dashboard and the seating units of new boats were designed with respect to the user needs, regarding ergonomics and producibility in the basis.

The reseller of boats selling three different brands in Bodrum Marina and Istanbul Boat Show was visited. By these visits, diverse models of recent boats were explored, by sitting in the user environment and capture some details. Following these visits, benchmarking online was continued to explore websites of boat manufacturers such as; Technohull, Ribco, Sacs, Brig, and Grand. Benchmark presentation was prepared to visualize data collected by the online benchmarking.

Other boat brands and their products had similarly been explored, some of the boats existing in the market are improved utilizing ergonomics, user experience, and material applications. Accordingly, these insights gathered from benchmarking was very inspirational through innovative thinking. Additionally, existing dashboard designs and placement of controls, displays and storage compartments evoke some ideas for the design phase.

3.2.3.3. Observation

Observation is a useful method for gathering an understanding of the reactions of people through daily events or finding out how people behave in certain conditions. As Love (2005) describes, the observation is especially valuable when the objective of the study is to get a natural behavior. To be able to understand the boat as a vehicle, how it works and how the users interact with the vehicle, four field trips were realized to four various occasions, two fishing tournaments in Alaçatı and one in Bodrum, one boat testing in Izmir and the Boatshow in Istanbul. All occasions had different boats, were as one of the fishing tournaments had the newest delivered Northstar 910 RS. The users in the boat were observed while driving in the boats during both slow or fast drives and also comfortable and rough sea conditions. This observation provided an exceptional knowledge of their driving processes and a chance to find out potential problems. Jorgensen (2008) defined a participant observation and the features as "Through participant observation, it is possible to describe what goes on, who or what is involved, when and where things happen, how they occur, and why – at least from the standpoint of participants – things happen as they do in particular situations."

Documenting the observations video recording with GoPro cameras enabled the designer to turn and look again the data gathered through the field trips and think about the details that were disregarded while experimenting the boat (Figure 3.9). This documentation was similarly crucial to allow the designer for using all the material. As Sharp, Rogers, and Preece (2007) state that observation is useful for conditions that it can be tough for users to define their behaviors. Besides, some time was spent on exploring the boat as examining dashboard, analyzing the users seating postures and capture pictures of the all the part that will be designed.

Figure 3.9. The screenshots from the GoPro camera in observation phase

During the observation and the analysis on the boats, some dimensions were measured of the parts in the boat for further ergonomic studies (Figure 3.10). The measurements were used throughout controlling data of the prototype and CAD model to ensure the design will be ergonomically correct.

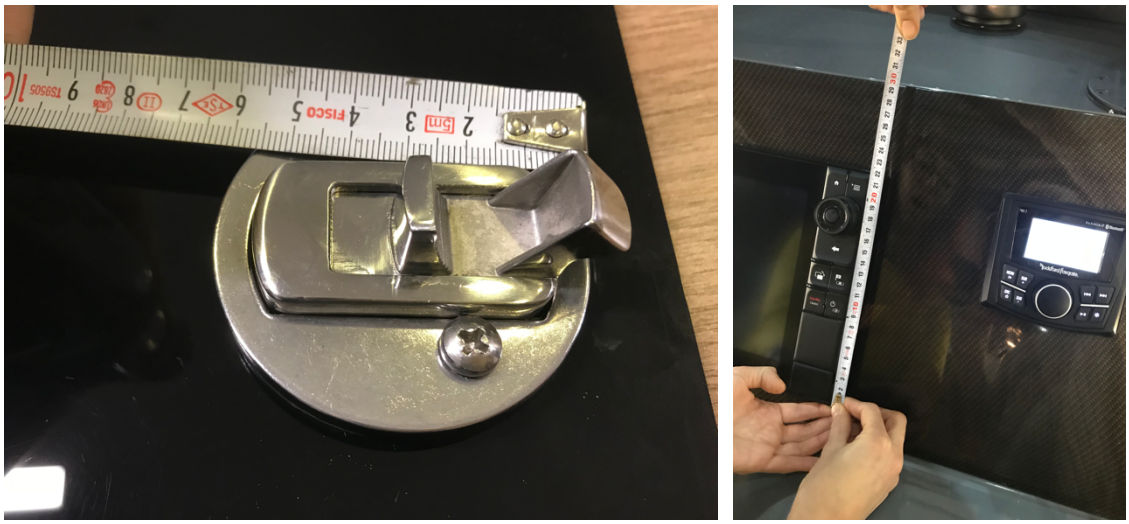

Figure 3.10. The mesaurements from other competitors boats

3.2.3.4. Interview

An interview is a reliable method for understanding the users and stakeholders communication and experience with the product that was used in the early stages of this project (Wikberg Nilsson et al., 2015). Interviews are useful while gathering knowledge of others emotions, feelings, ambitions, and values. Unstructured interviews like natural daily conversations are frequently created on subjects instead of specific questions, which the answers could be extensively clarified (Appendix A). The interviews can be organized unstructured through the conversations that the interviewer can clarify his thoughts through the interview and qualitative results can be gathered (Cicourel, 1996). For understanding users and the stakeholders' feelings and attitudes, unstructured interviews realized with them about the process and the project.

Throughout the benchmarking visits to resellers of boats and the fishing tournaments and tradeshow visits, the interviews were conducted with sales managers and service dealers. Some drafted topics were rooted for discussion during the visits. The opinions and responses were written down on paper during the showing of the boats. Throughout the visits, the semi-structured interviews were directed with users, the managers and mechanics to get a better understanding of what the condition of today's boat is, but also an understanding for what functions future boats may/must hold. The pre-set questions were prepared for the interviewees so that so that they could clarify their responses more.

The interviews with the users were carried out on their boats and took about 30 minutes. Interviews with the managers were conducted in a production area on the boats; these interviews took around 20 minutes. Interviews with workers were carried out in their workshop and took around 10 minutes.

To comprehend the vision of RIBTECH as the producing company and Northstar as the brand, the phone interviews were conducted with marketing department based on a pre-set of questions . The interviews took about 20 minutes to carry out. To obtain data on how to approach laws and regulations regarding the console design an unstructured interview was done with an engineer at RIBTECH who is responsible for CE marking of the products.

3.2.3.5. Needs Analysis

A needs analysis has used a tool to summarize the findings from the user studies (interviews and observations) and translate findings into needs and requirements for the product. The need analysis is suggested to be one of the early stages of a UCD process to approve that the design team understand requirements from users and different stakeholders and consider these in the process (Smith, 2011). Smith further identifies that needs are essential to outline in order to confirm the team is working towards the same goal and with the same vision of what the product is assumed to succeed.

Unlike the needs specification, which is often technical, describing the functional requirements of a product from the designer perspective, the needs analysis focuses on findings of how the users/ stakeholders think the process should work.

The needs analysis aimed to define the requirements expressed by different users and stakeholders so that the final result could seek to answers those needs as far as possible. Smith (2011) argues that requirements are complex and often inconsistent and that the challenge lies in satisfying those needs in the most appropriate way. A needs analysis can also help identify exchanges that need to appear in a development project.

The needs analysis describes and focuses on different users and stakeholders requirements and expectations from this project (Figure 3.11). It primarily concentrates on what users and stakeholders expect of the new design, but also what they expect as an outcome from this project. The manufacturers as an example require decent documentation of my findings and design decisions in order to implement the new boat

and launch it on the market. The users contrarily are not interested in how the new boat is manufactured; they precisely demand a better performing product.

3.2.3.6. Problem Analyzes and Design Opportunities

A problem analysis was described as a complement to the needs analysis. The problem analysis focuses on the problems that were highlighted in the existing boat design (Figure 3.12, 3.13). The identified problems were both observed through comments in the interviews, but also details were identified while watching the users at driving experience. The problems were listed in a poster with images showing each problem.

3.2.4. Design

The design stage is where the findings were processed from the analysis phase and transformed this data into concepts for the new design. The objective of this phase was to form a broad diversity of ideas that could be tested and refined to develop the final design. The methods in this phase followed the micro process: arrange, explore and create (Figure 3.15). The arranging method was component mapping and the explorative methods were early sketching, how might I?, mood board. The final creative methods were co-creation and brain sketching. The users and the stakeholders participated in the co-creation. The methods in this phase have been repeated, and the organizing documents have been refined continuously during the process.

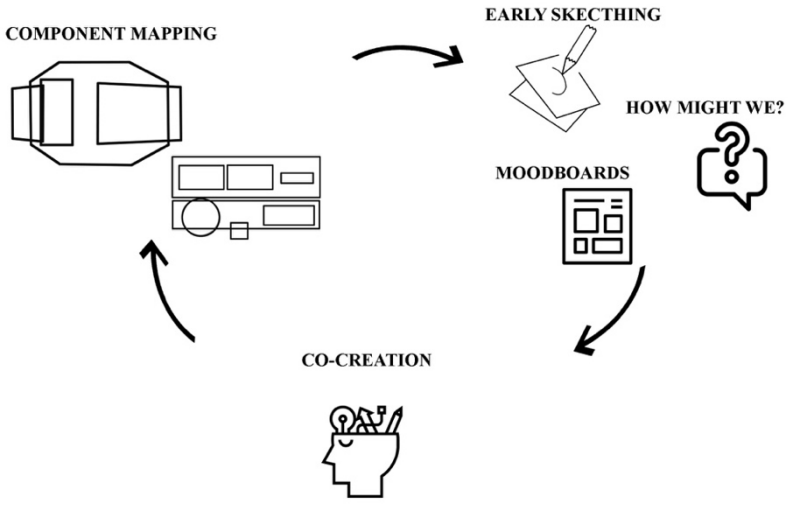

Figure 3.14. The methods used in the design phase

NEEDS ANALYSIS

REQUIREMENTS THAT WERE IDENTIFIED FROM USERS AND TEAM MEMBERS

Figure 3.11. Needs Analysis

PROBLEM ANALYSIS

SOME OF THE BIGGEST PROBLEMS THAT WAS IDENTIFIED IN TODAYS BOAT

VIEW

The users complain about the view angle while driving. Area above the dashboard is too high that blocks the view.

GRIP

There is not any grip area or handle for the person who stands near the driver. At high speeds, there is a safety problem for the second person.

STORAGE

There are no place to store loose items such as cell phones, keys, covers of electronic equipments, caps, sun glasses etc.

RESTRICTED MOVEMENTS

The users complain about the design of the seats because of restriction on their arm movements.

Figure 3.12. Problem Analysis 1

PROBLEM ANALYSIS

SOME OF THE BIGGEST PROBLEMS THAT WAS IDENTIFIED IN TODAYS BOAT

PRODUCTION

The production department complains about the production process of the seats because of two-sided mold and consumed time.

ASSEMBLY

The hard-top is assembled the outer side of the console that reduces the width of walking way.

WEIGTH AND VIBRATION

The hard-top is made of fiberglass and stainless steel profiles that are too heavy for performance and vibration on high speeds.

VISUALLY CROWDED

The console, the seating units, and the hard-top design are visually crowded through volumes and colors.

Figure 3.13. Problem Analysis 2

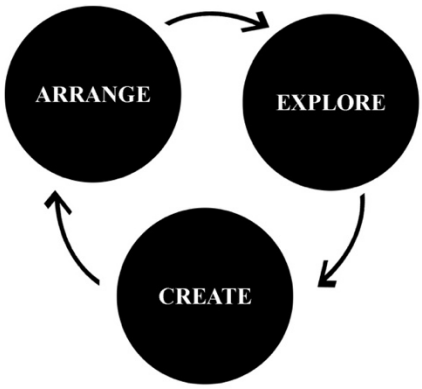

Figure 3.15. Workflow for the design phase

3.2.4.1. Component Mapping

Component mapping is a tool to outline the placement of different components on the boat. With components, I mean all the diverse devices that are assembled on the boat, such as console, seating units, hard top, wet bar and so on (figure 3.16). The boat was divided into two areas and components were mapped to the different areas placing on their functions. By this way, it was aimed to construct a logical, ergonomic and safe user environment for the drive. At the beginning of the design stage, 3D models of the components were used which I copied from former boat designs to quickly get a grip of different solutions. The mapping can be considered a list of requirements for where on the boat the different components are going to be positioned.

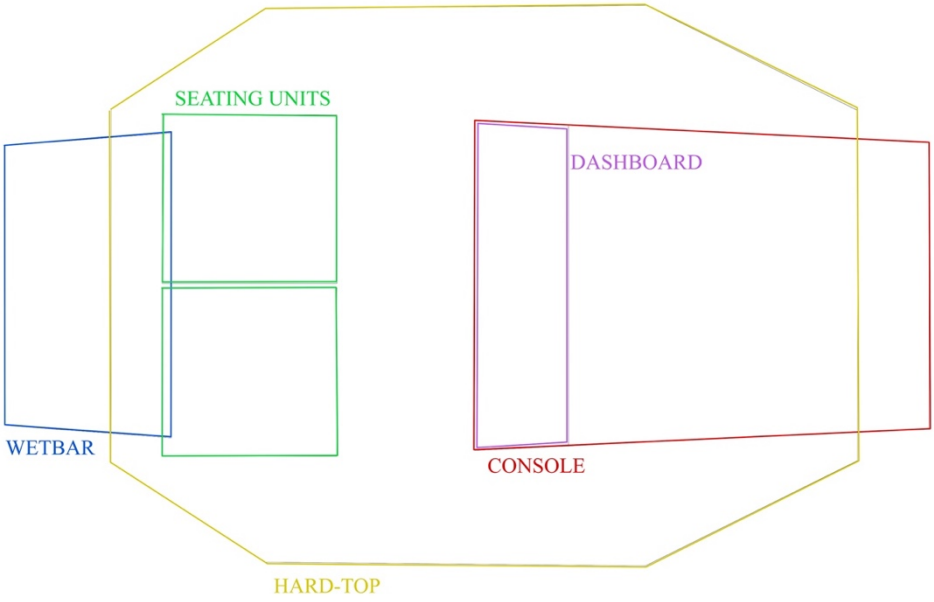

Figure 3.16. Component mapping of driver environment

To link the components to functions on the boat, also the electronic displays and controls were placed that were necessary and structured them in a document where the different functions were mapped with different components. The choice of components for the final product was then based on the list of electronic displays and controls and the mapping by results of the meeting with engineers and sellers (Appendix D). In this way, it was confirmed that the components would be implemented holding these functions.

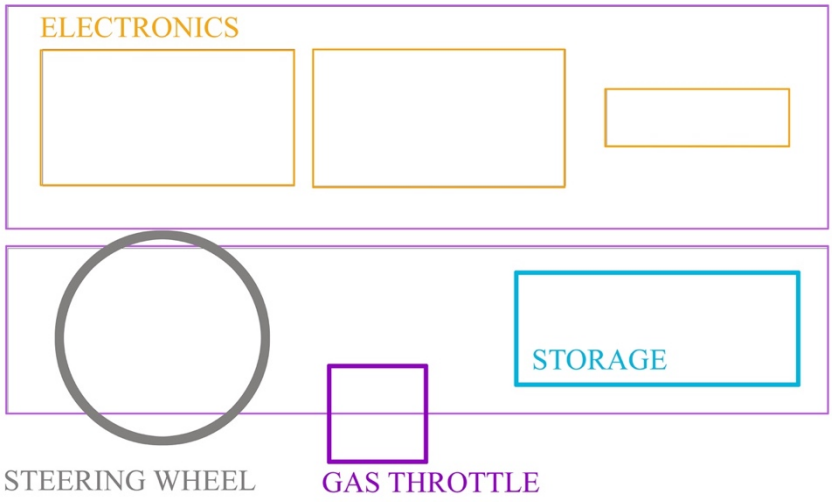

Figure 3.17. Component mapping of dashboard

Throughout the process, different possibilities were analyzed for most of the components to choose the most suitable one on the market finally. A close dialogue was held with different engineers, sellers, users, and suppliers, where the needs were cleared and tried to suggest reasonable solutions. Because the design is expected to be producible during 2018, it was essential to choose relevant components that exist on the market today. A document was prepared for all the components that were required, and the list was filled with appropriate components and suppliers constantly. The components were then ordered via the purchasing department in RIBTECH to be placed on the final product.

3.2.4.2. Early Sketching

In the design stage, primarily, different ideas were sketched that I had to get an initial point for the design. The early sketching session was made to let first ideas be pictured before numerous limitations and descriptions were addressed. Orthographic

views of the former boat were printed in low opacity and used as sketching templates. Sketching on printouts let the designer sketch freely and naturally but with the guidance of size and proportions (Eissen and Steur, 2013).

The objective of these early sketches is to develop and express ideas, so there is no need to refine the ideas further with details such as materials and colors in this stage (Eissen and Steur, 2013; Greenberg, Buxton, Carpendale and Marquardt, 2014).

3.2.4.3. How might we?

This is a technique that was achieved from The Field Guide to Human centered design by IDEO org. (2015). The idea is to define problems that have been described into questions asking: How might I solve this problem? As an example; if it was determined that the users don't feel comfortable on the boat, a question could be; how might we improve the ergonomic feel on the boat? The questions can be responded in numerous ways and identify different outcomes for the same problem. An advantage with the method is that the design project is defined in simple questions which can stimulate the creativity in a complex situation (IDEO org., 2015). This is useful when the aim is wide and the design challenge involves many different features as it does in this project.

A group of how-might-we questions were defined to transform the insights from the analysis stage of the project into potentials for design (Figure 3.18). The questions were written on cards so that they could be chosen randomly. The how-might-we cards have been used throughout many brainstorming sessions and in the co-creation with the team at RIBTECH.

3.2.4.4. Mood Board

Mood boards are design technique that they are commonly used in nearly all design processes (Keller, 2005); they express the general feeling and moods of experiences through pictures or other communicative aids (Muller, 2001). These visual collages were used to inspire and develop ideas during the design process. Additionally, they have also been used within the stakeholders while brainstorming. Mood boards were created to define the visual design criteria of the new console, seating unit, and hardtop and give inspiration for the aesthetics of the boat design. They present the hull, deck and

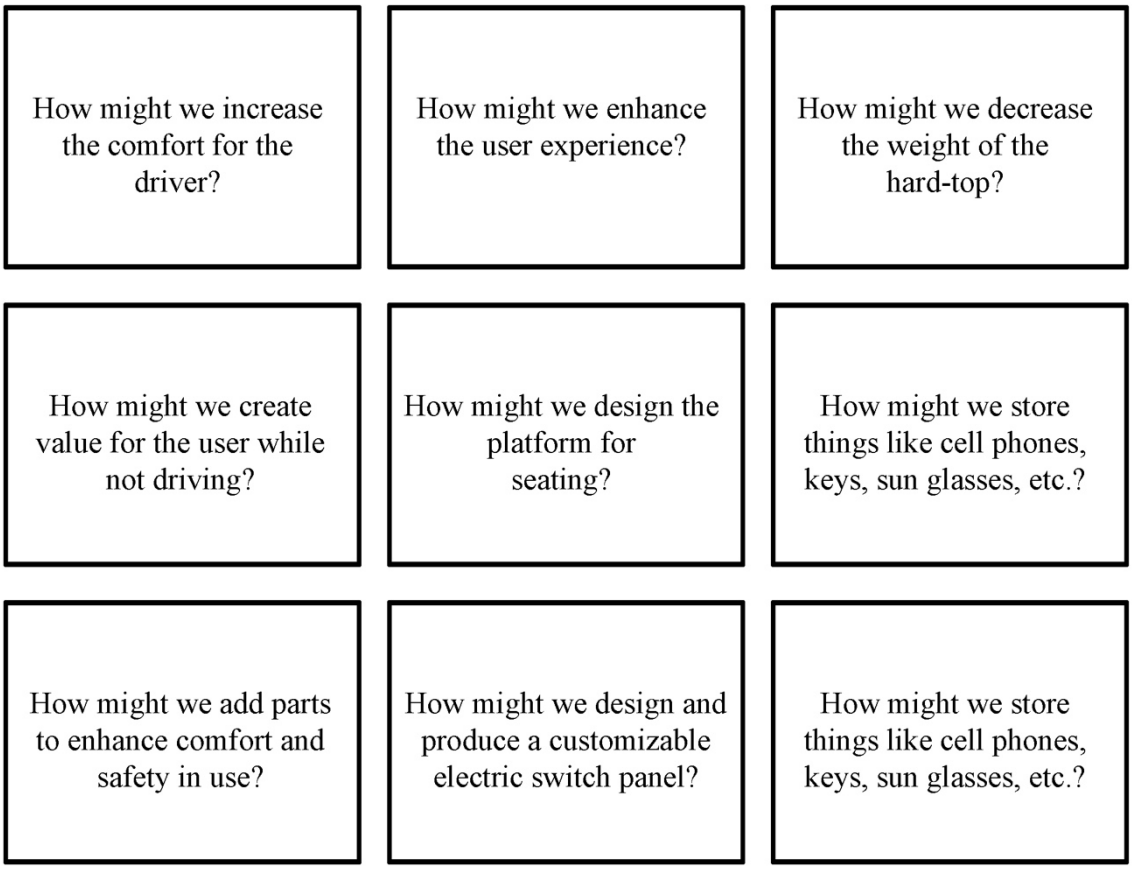

Figure 3.18. How might we-questions for brainstorming sessions

wet bar design and details of the 910 RS that are characteristic for the design expression. It also displays examples of materials for the console, seating units and some assembly techniques with different materials. The aim of using the mood board is to get a common understanding of what I aim to design concerning looks and feeling of the boat.

3.2.4.5. Co-creation

About halfway in the project, a meeting was held with the stakeholders at RIBTECH in the meeting room to hold a co-creation session. The co-creation process lets some of the people you are designing for in the process and them be part of the design. This method is a valuable way to get feedback on early ideas and bring the stakeholders concentrated into the process (IDEO org., 2015). The participants were the owner of RIBTECH, the manager production, the manager of sales and a senior engineer.

The meeting was started with enabling the contributors to look at all my sketches and draft 3D modeling. The sketches were put on a wall, and the contributors were

encouraged to speak out with comments on ideas that they responded to. The aim was to motivate them for the involving brainstorming meeting but also to get valuable feedback on ideas this far in the project. Subsequently, three brainstorming meetings were conducted based on three questions that were prepared;

• What are the strengths of RIBTECH Boat Manufacturer compared to competitors?

• How might we design the console, seating unit, and hard-top to satisfy both service mechanics and assembly workers?

• How might we create added value to NorthStar 910 RS by implementing optional add-ons?

Meanwhile the brainstorming sessions, all ideas were written down on the whiteboard and later documented. The co-creation session ended with a feedback-method called I wish I like. The objective of this method is to allow the stakeholders' encouragingly give feedback by remarking views that they consider requires additional development (I wish) and things that they find positive (I like).

The result from the co-creation meeting with the owner of RIBTECH, the manager production, the manager of sales and a senior engineer can be seen below. The contributors also had to comment on ideas and sketches that I had done so far. The result from the I-wish I-like session can also be seen below. The answers to the questions are direct translations of what was written on notes in Turkish.

1. What are the strengths of RIBTECH compared to the competition?

• The customer can feel quality choosing RIBTECH

• We are good at performance

• We have a broad competence (mechanic design, materials, production and workshop/maintenance)

• We work with customization and listen to the customer wishes

• Our boats make their way through on most grounds

• Many of things are built and constructed "in-house."

• You get answers in time

• We have an excellent spare parts handling

• We are available

2. How can we design the console, seating unit, and hard-top to facilitate for both assembly/production personnel and service mechanics?

- Think fewer mold parts
- Ensure that the design is adapted for production
- Make sure that the design is up to date, and easy to adjust to new demands. Remove unnecessary features if not used.
- Everything should be easy access for maintenance, either from the inside of the console or through a service hatch.
- Try to standardize the design, "all holes fit-thinking."
- Simple and ergonomic layout for electronics and gas throttle when the boat has to be driven.
- Up-to-date documentation

3. What features would be possible to sell as new choices, something that the customer pays extra to get?

- Extra storage on the console for particular demands
- The seats, different levels of exclusiveness. However, important that the most fundamental choice still is a functional and ergonomic seat
- Chart Plotter and display
- Music system
- Extra lights on the deck
- Extra holders for tools
- Extra outputs, a necessary range of boats, but the possibility to choose extra USB, AUX, etc.

Notes from the I wish/I like:

I wish:

- That you look more at sun protection and visibility. Look at other boats and see what they use.
- That we use modern tools (digital) and are up-to-date with drawings and documentation
- Consider the color choices for the boat
- Integrate the led spotlights on the hard-top

• Design a sleeker boat

I like:

• The idea with giving the customer optional choices and the possibility to sell extras

• Power outputs and USB etc.

• Locking of the seats in two positions, standing up, and sit down

• We like black

• Molds of fewer parts

• Safety details close the passenger

• Storage for documents and instructions

• Drink/cup holder

• Storage of tools

3.2.5. Evaluation and Implementation

The final step of the design process was to develop a full concept for the new console, seating unit, and hard-top. Different versions of these parts were first drafted in CAD; consequently, it was decided on a final design that was produced in a full-scale prototype milled in CNC by using MDF at the one of the suppliers IZMOD. The workflow for this stage consisted of the micro process: design, refine and produce (Figure 3.20). All work in this process stage was done at the RIBTECH workshop and IZMOD workshop in Izmir. The development and build of the prototype were done in close cooperation with naval engineers and production employees at RIBTECH.

3.2.5.1. CAD Modeling

All Cad modeling has been done in Rhinoceros 5.0. The development of the final concept started with exploring shapes and layout of the boat by quick modeling of surface models to explore shapes and different possibilities to form the whole boat. One manikin called iMan was used, this is based on the Military Handbook, Anthropometry of US. Military Personnel (1991). The physical dimension of the manikin was compared to the5th to the 95th percentile from ISO 15536-1:2005 and assessed to give a valuable

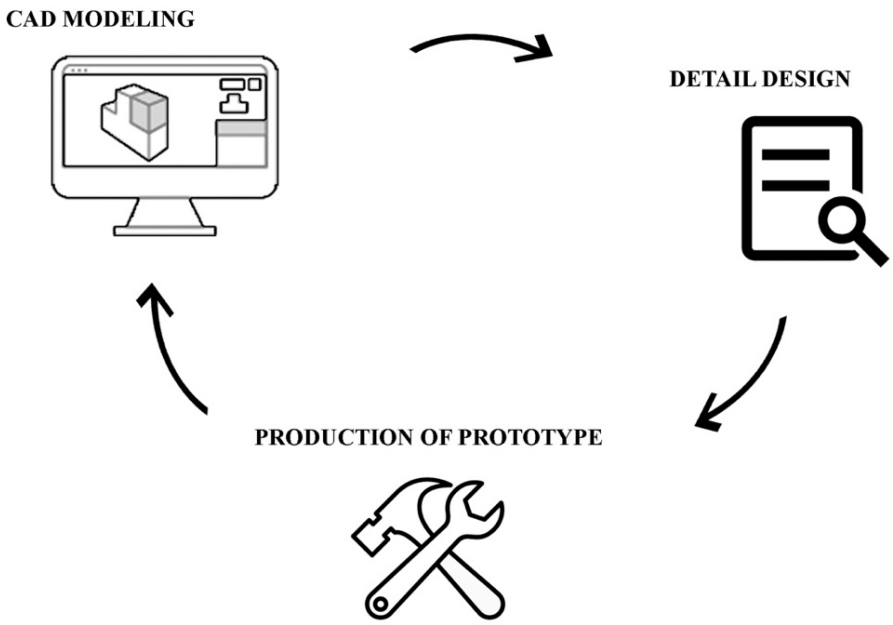

Figure 3.19. The methods used in the evaluation and implementation phases

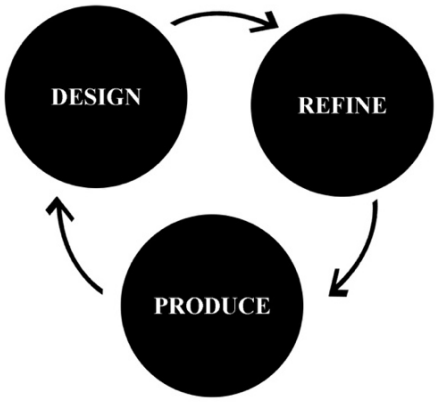

Figure 3.20. Workflow for the evaluation and implementation phases

demonstration of these measurements for a visual assessment of the boat layout and size. The manikin was used to control that the console, seating unit and hard-top dimensions (Figure 3.21).

Essential parts such as the chart plotter, steering wheel, throttle lever, and other electronic equipment were placed in the CAD assembly to see that everything could fit. The conceptual 3D models were showed regularly to engineers and managers that were discussed if and how they could be manufactured. The models were further developed until having final shape that all were liked and that were realistic to produce with existing techniques in RIBTECHs production line.

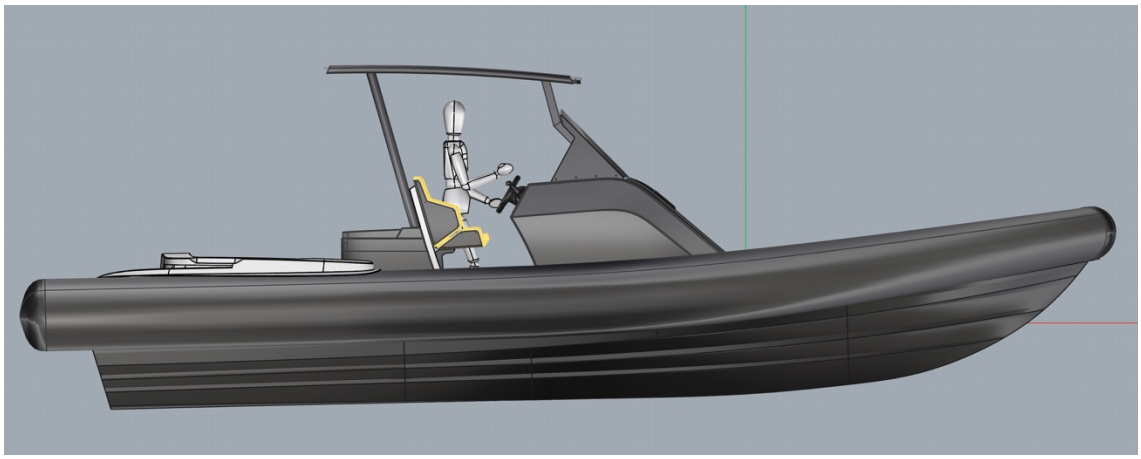

Figure 3.21. CAD modeling of Northstar Orion 9

Through the CAD modeling, the first concepts were generated in the form of surfaces to shape the parts (Figure 3.22). Starting with only curvy lines and solid shapes, it was realized that the design looked kind of boring and outdated. It was obvious that the project was constrained by the previous hardtop design and unsure of what possibilities, different design concept with different assembly methods were created.

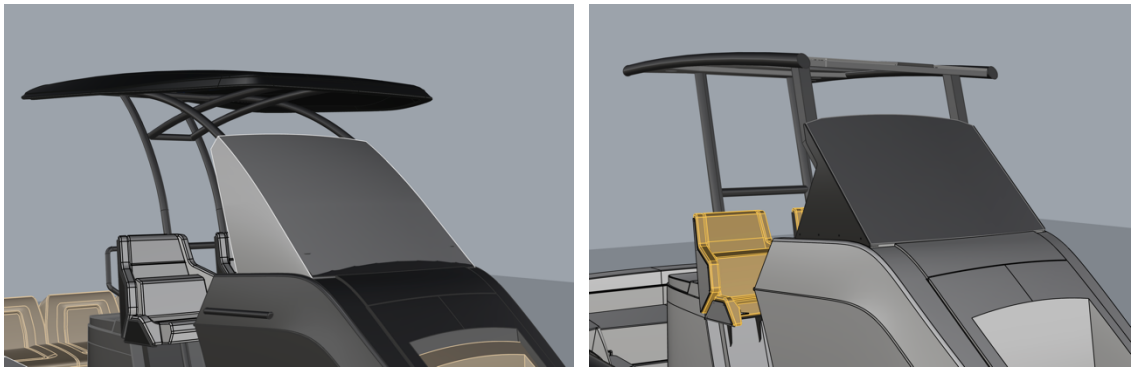

Figure 3.22. Northstar Orion 9 hard-top concepts

After some experimenting, it was realized that if straight and curvy lines with sharp edges could be created, a sleeker design could be got by collaboration with the supplier that would produce the hardtop and asked the production them if it was possible to laser cut the stainless-steel sheet and weld it with other profiles. They answered “yes” that it was realized the hardtop could be designed this way was a ‘breakthrough’ for the project, and the design was changed according to this information. This decision also gave some challenges to face in the detail design and production of the prototype.

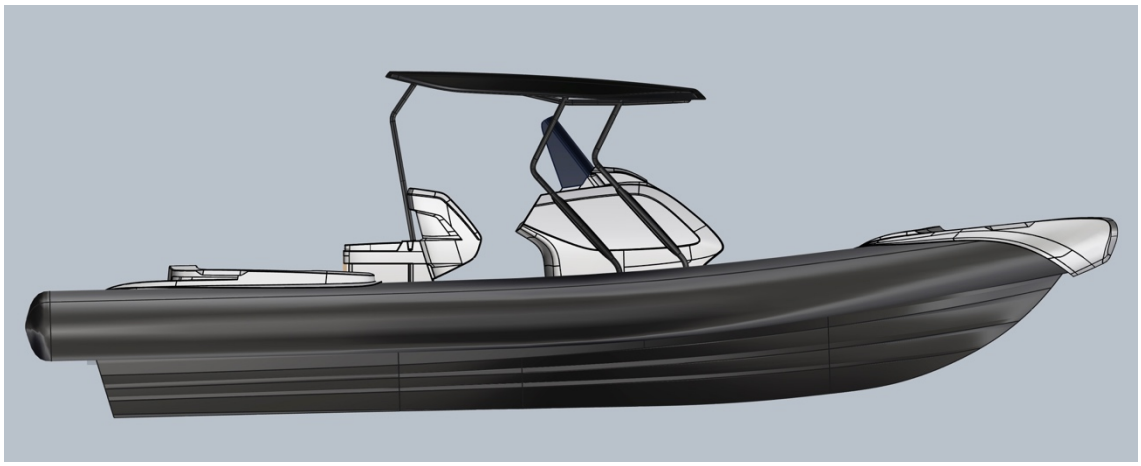

Figure 3.23. Northstar 910 RS front view

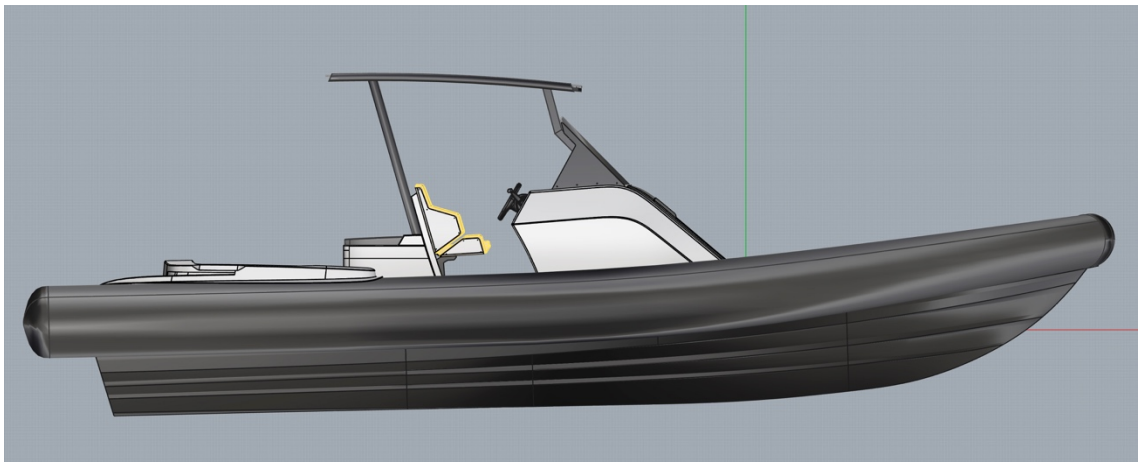

Figure 3.24. Northstar Orion 9 front view

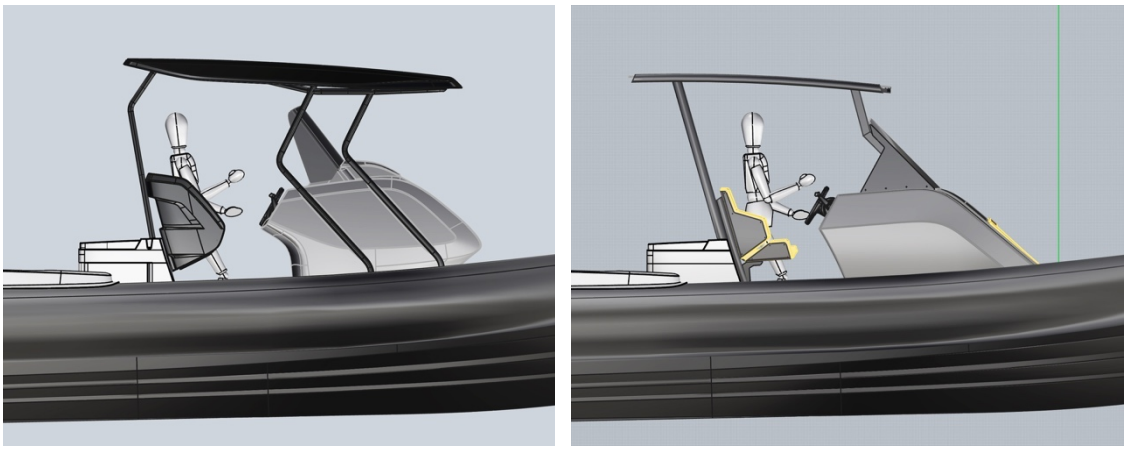

Figure 3.25. Northstar 910 RS and Northstar Orion 9 front views with manikin

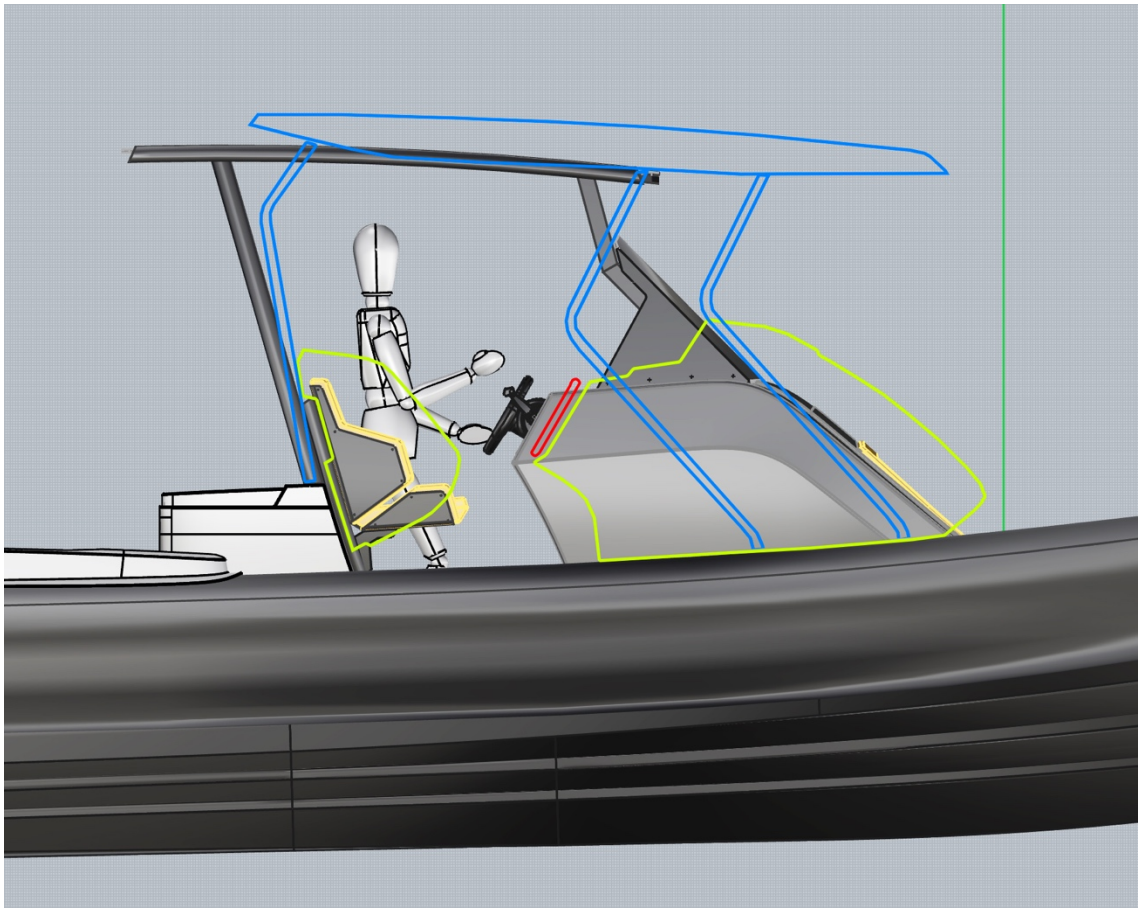

Figure 3.26. Northstar 910 RS and Northstar Orion 9 front views juxtaposition

Figure 3.27. Northstar 910 RS and Northstar Orion 9 back views with manikin

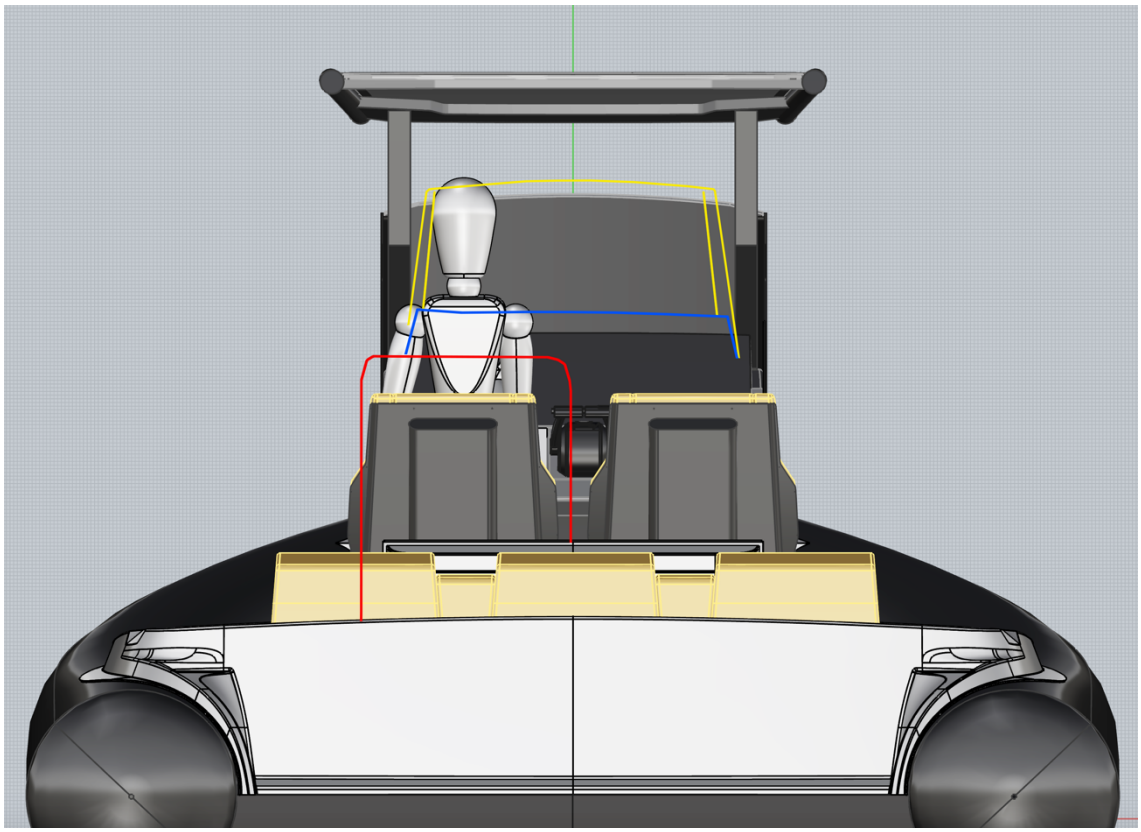

Figure 3.28. Northstar 910 RS and Northstar Orion 9 back views juxtaposition

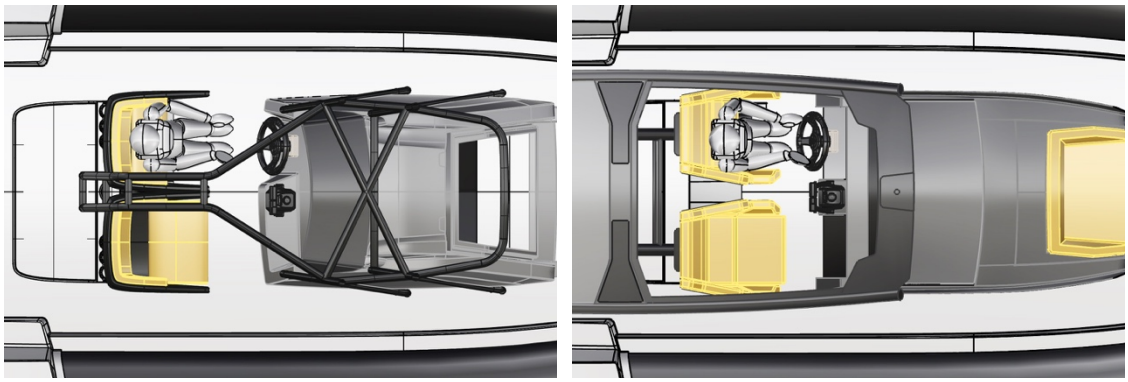

Figure 3.29. Northstar 910 RS and Northstar Orion 9 top views with manikin

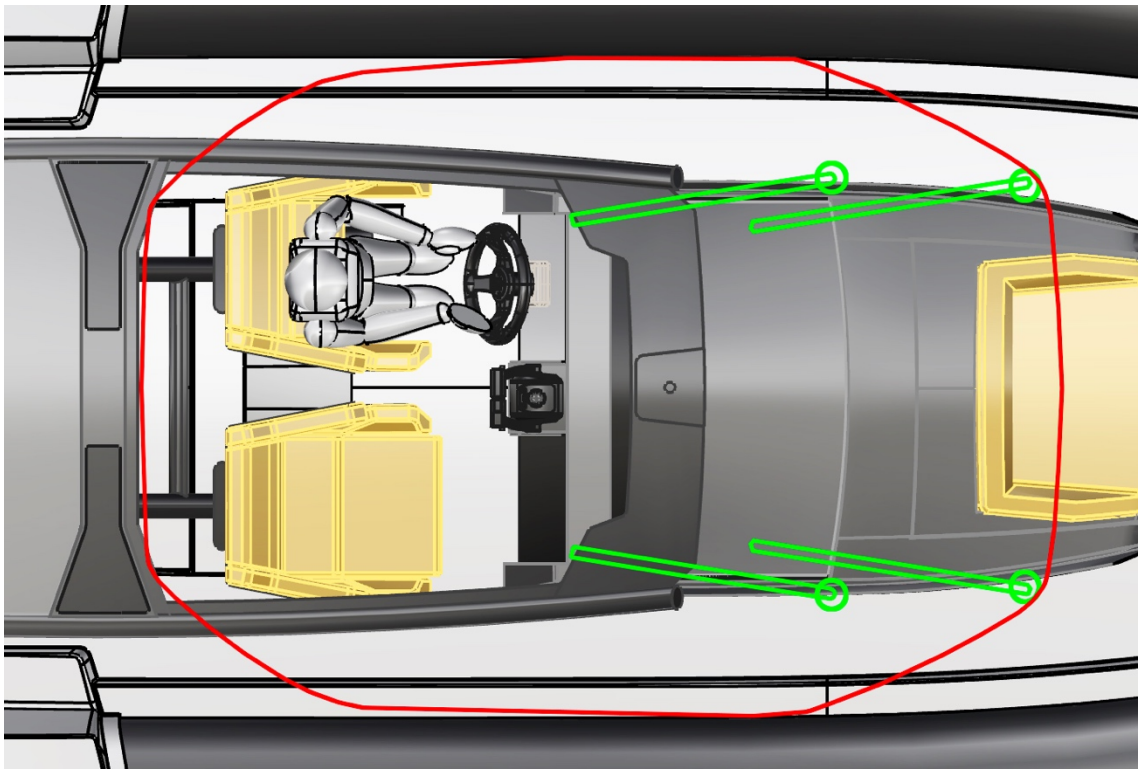

Figure 3.30. Northstar 910 RS and Northstar Orion 9 top views juxtaposition

The design was subsequently developed, and drawings were made for all the parts that were needed to produce (Figure 3.31, 3.32). Most of the components, such as steering wheel, electronic equipment, stainless steel parts, upholstery and storage boxes were ordered from suppliers since the final prototype was supposed to look realistic. RIBTECH reasoned that all these components could be used in a future boat and that the investment consequently was motivated.

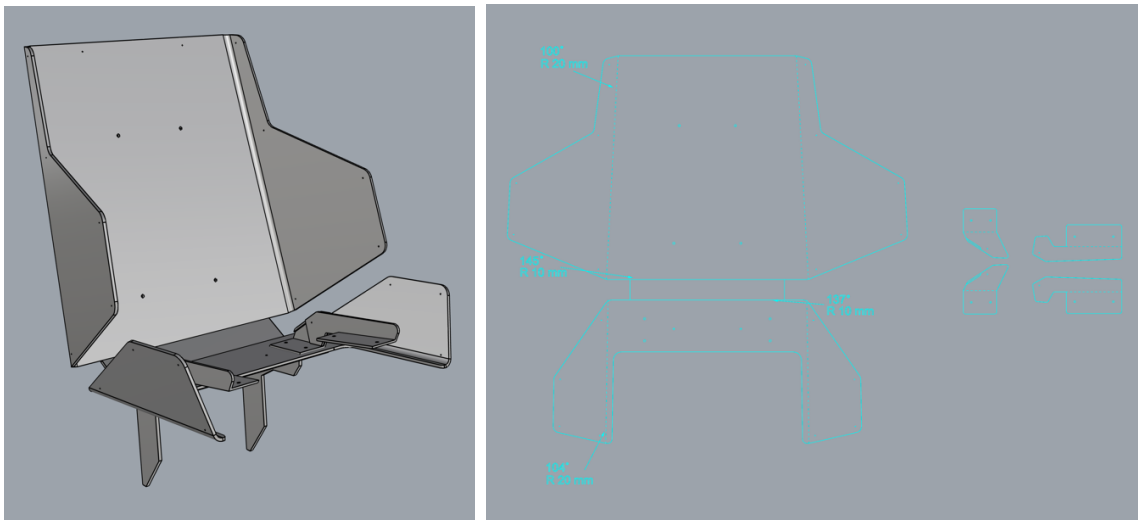

Figure 3.31. Northstar Orion 9 seat detailed production data

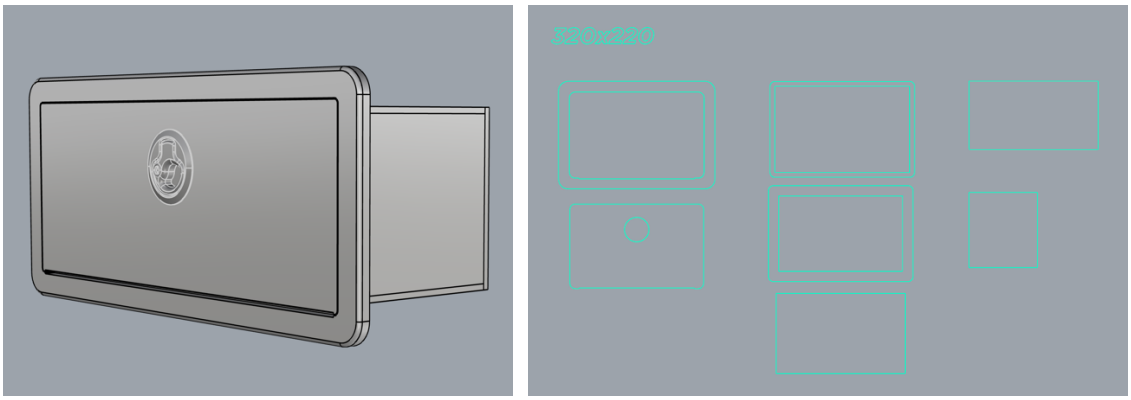

Figure 3.32. Northstar Orion 9 console storage box detailed production data

After discussions with the stakeholder, most of the design was solved with molded fiberglass and lasered and bent sheet stainless-steel. All drawings from the detail design will be handed over to RIBTECH in digital format and are not attached to this report. An example of how the drawing looks like can be seen above (Figure 3.31, 3.32).

3.2.5.3. Production of Prototype

A close dialogue was holded with the production workers when refining the assembly details of the parts and trying to find out what possibilities for working with the fiberglass, stainless steel and glass (Figure 3.33). Additionally, the production methods were CNC milling, laser etching.

During this last part of the project, the designer shifted between sitting at the computer designing parts and being in the production line assembling the prototype, this stage of the project was a very iterative stage. An example of how details were refined during the production is when the body of the console was already designed and built in medium density fiberboard by CNC milling while I developed the acrylic visual parts with the laminated film. Suppliers helped for producing stainless steel parts for seating units and the hard-top (Figure 3.34, 3.35).

Drawings were sent to the production continuously, and parts were produced as the prototype developed. The construction started with assembling the console and the seats with the hard-top, the prototype has thereafter gradually filled the deck of the boat. Many design decisions were taken along with the building process, as the prototype took shape.

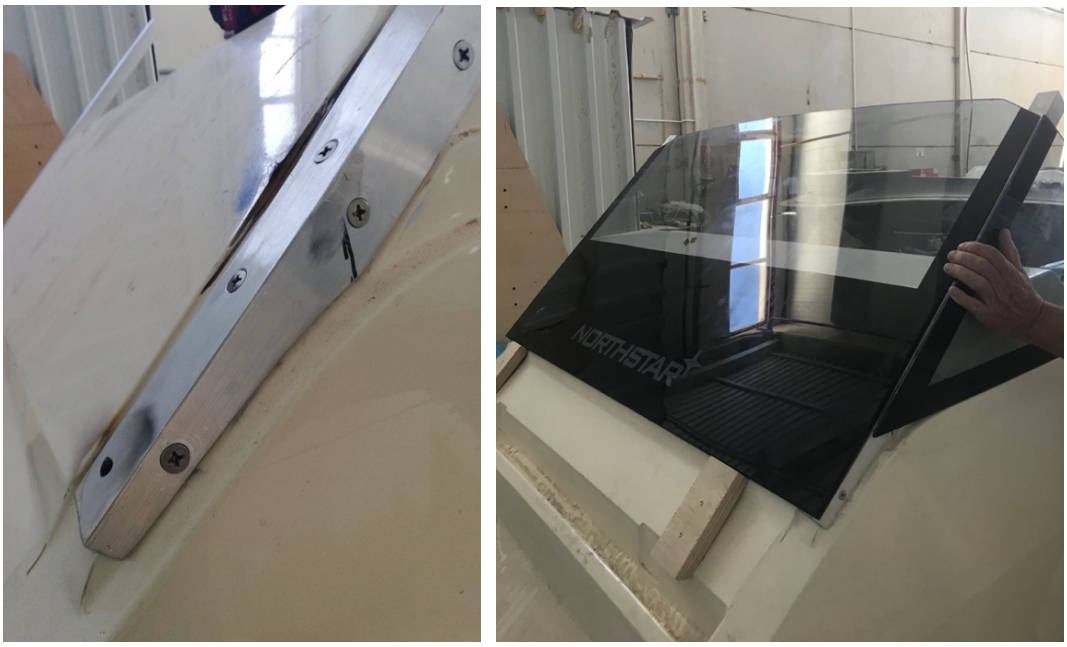

Figure 3.33. Northstar Orion 9 console glass prototype

Figure 3.34. Northstar Orion 9 seat prototype

Figure 3.35. Northstar Orion 9 hard-top prototype

Figure 3.36. Northstar Orion 9 console prototype

3.3. Final Design

The result of this project is a new console, seating units and hard-top design for the NorthStar 910 RS and a full-scale prototype of the concept. The driver environment and deck layout have been designed with the main focus in three areas; ergonomics, user experience, and applicable production techniques. This section will describe the final design following those three focus areas.

3.3.1. Final Design Results

This section gives detailed information about the new console, seating units and hard-top design for the NorthStar 910 RS.

3.3.1.1. Final Result Console Design

The design of the console has been done with consideration of ergonomics, user experience, and style. The console is divided into two areas that are dashboard and interior. The primary aim to design dashboard is easy to access, giving opening for changes over time and customization. The dashboard has layered flat surfaces (Figure 3.38), making it easy to customize it for the exact customer needs. If something is updated or changed, the surfaces can be redesigned with holes that fit the new devices, avoiding modification of the console.

Average run time for a boat is around ten years, customer demands regarding the boat will likely change over this period. Thinking in customizable surfaces enables RIBTECH to offer the customer updated consoles, changing the driver environment over time. To get a perspective of the overall design change that this project has resulted in follows a comparison of today's boat and the new console design (Figure 3.37, 3.38) on next page spread. The old console can be seen to the above and the new console to the below. The new console has improved vision with a large front window. Applied single darker color for the boat creates a more aggressive and sportier look, while at the same time being practical and durable. The old console has the grey and the white color on the outside.

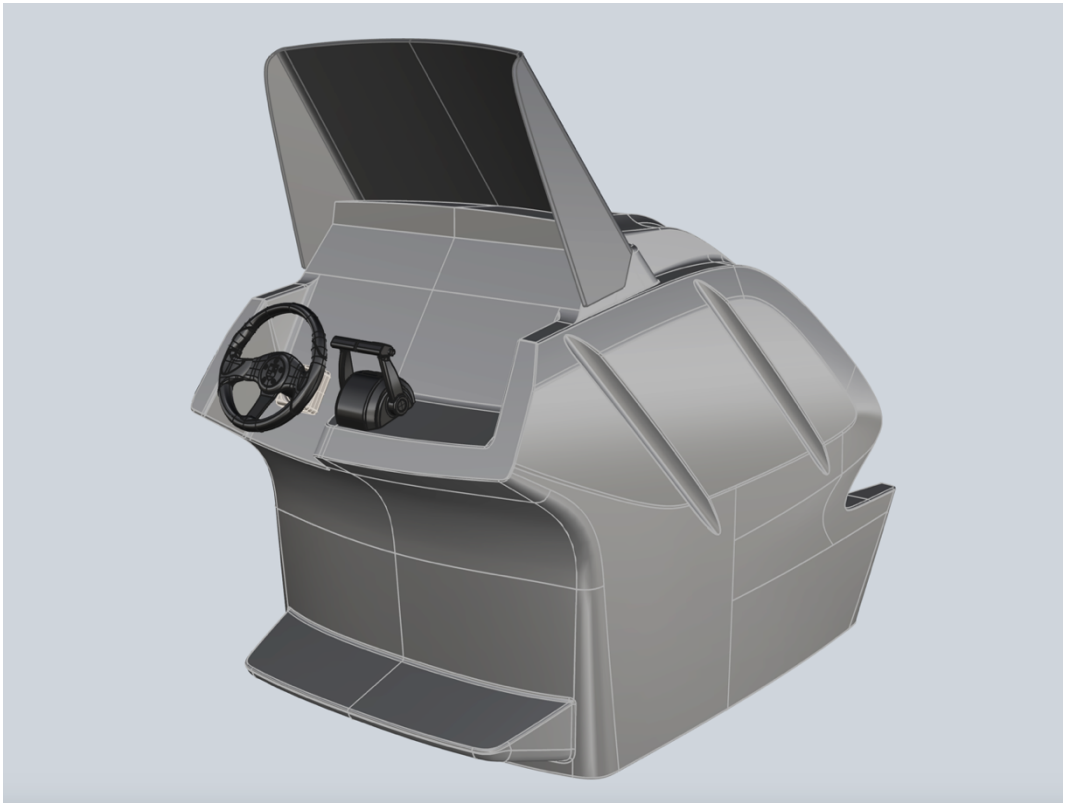

Figure 3.37. Northstar 910 RS console design

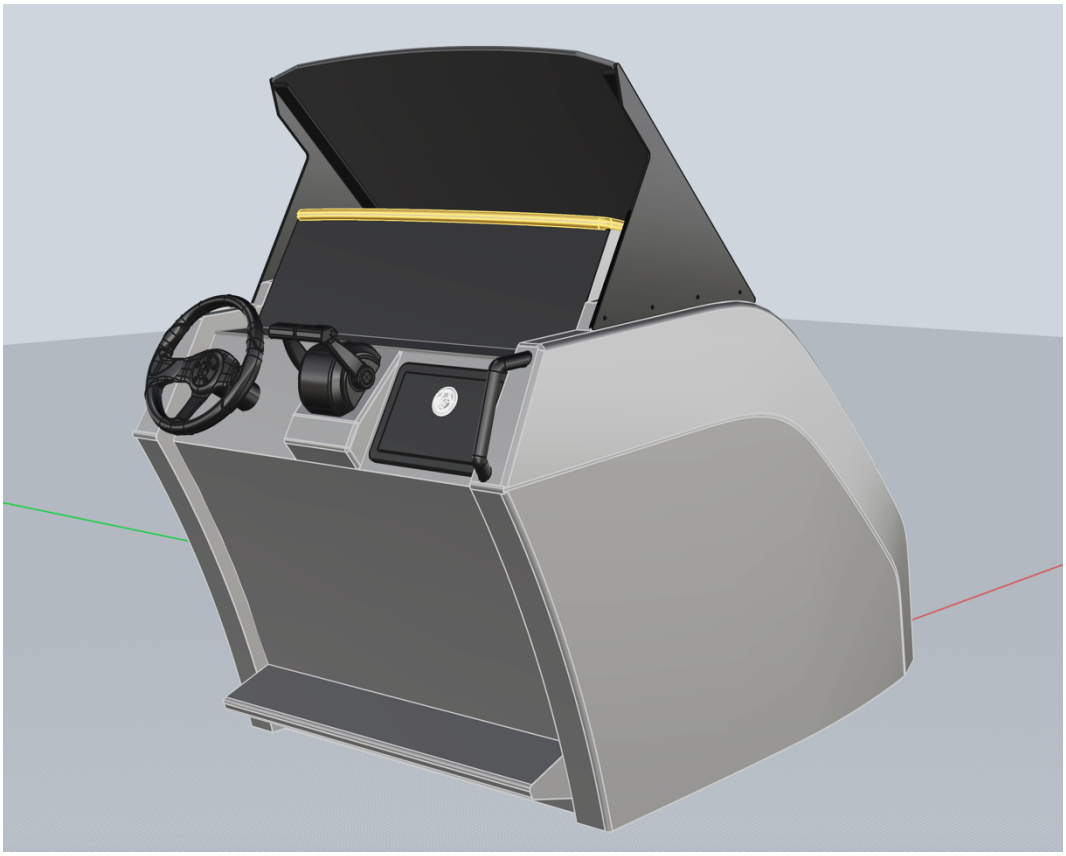

Figure 3.38. Northstar Orion 9 console design

The dashboard is well-planned with a customizable layout for chart plotter, engine display, and electric switches. Additionally, storage box in front of the passenger seat, with USB and AUX outputs into to it, perfect for charging the phone and playing music. A handle for a passenger for safety while driving is placed in the right close to the passenger. A carbon fiber film laminated decorative acrylic part highlights the shape of the dashboard, forming a specialized area for electronics.

3.3.1.2. Final Result Seating Unit Design

The design of the seating unit also has been done with consideration of ergonomics, style, ease of production, and safety. The seating unit is divided into two areas that are seats and the assembly part between seats and the wet bar. The primary aim to design seating unit is comfort in use with enabling free arm movements. Additionally, the production process of the seats simplified from double-sided mold to bent laser-cut stainless steel. The upholstery of seats has changed to the more sophisticated fabric that is textured and patterned presenting elegant look. On the assembly part of the seating unit handles located for the safety while walking around or standing while driving.

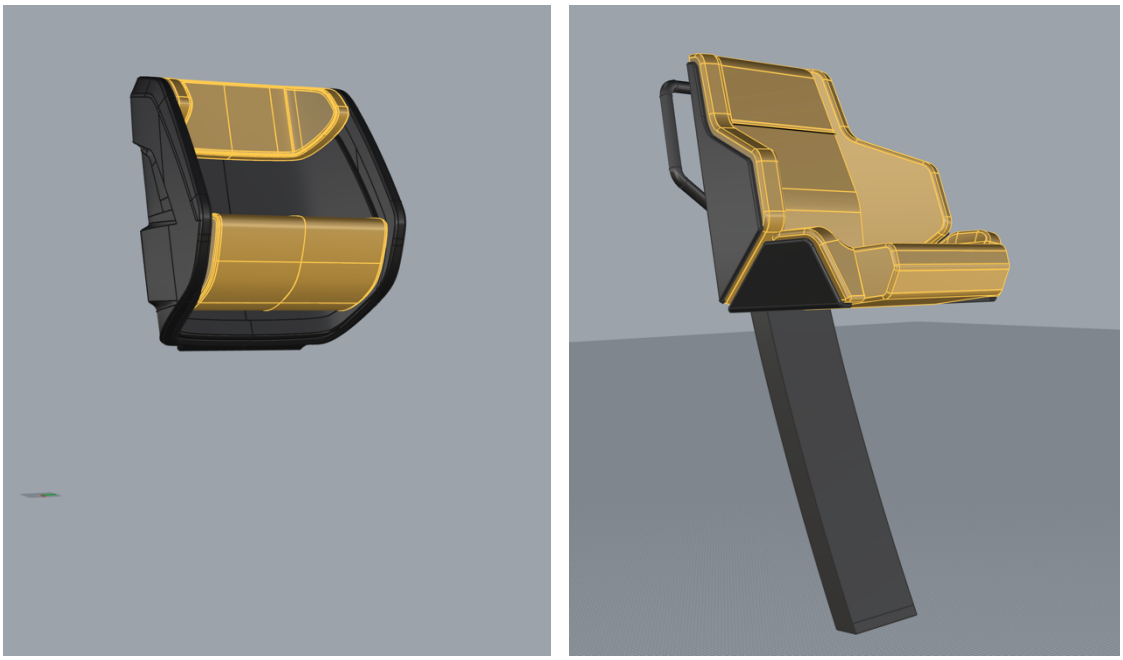

Figure 3.39. Northstar 910 RS and Northstar Orion 9 seating design

3.3.1.3. Final Result Hard-top Design

The design of the hard-top has been done with consideration of performance, style, ease of production. The hard-top is divided into two areas that are welded laser-cut stainless steel and the dark-colored plexiglass sheets for shading (Figure 3.41). The primary aim to design hard-top is reducing the weight with a more stable design that affects the performance of the boat at high speeds. Moreover, the production process of the hard-top simplified from double-sided mold to welded laser-cut stainless steel. Also, the design of the hard-top is more spacious and well-lighted with the use of plexiglass sheets. The hard-top assembled on the console which enables the widening of the walking way. The style of the hard-top is up-to-date with clean lines and textured powder coated paint. The assembly of hard-top considered while designing that allows workers easy installation and maintenance.

3.3.2. Ergonomics

The new drivers' environment is designed to fit a wide range of users all over the world. Dashboard and seats are adjustable to fit most users and provide an ergonomic

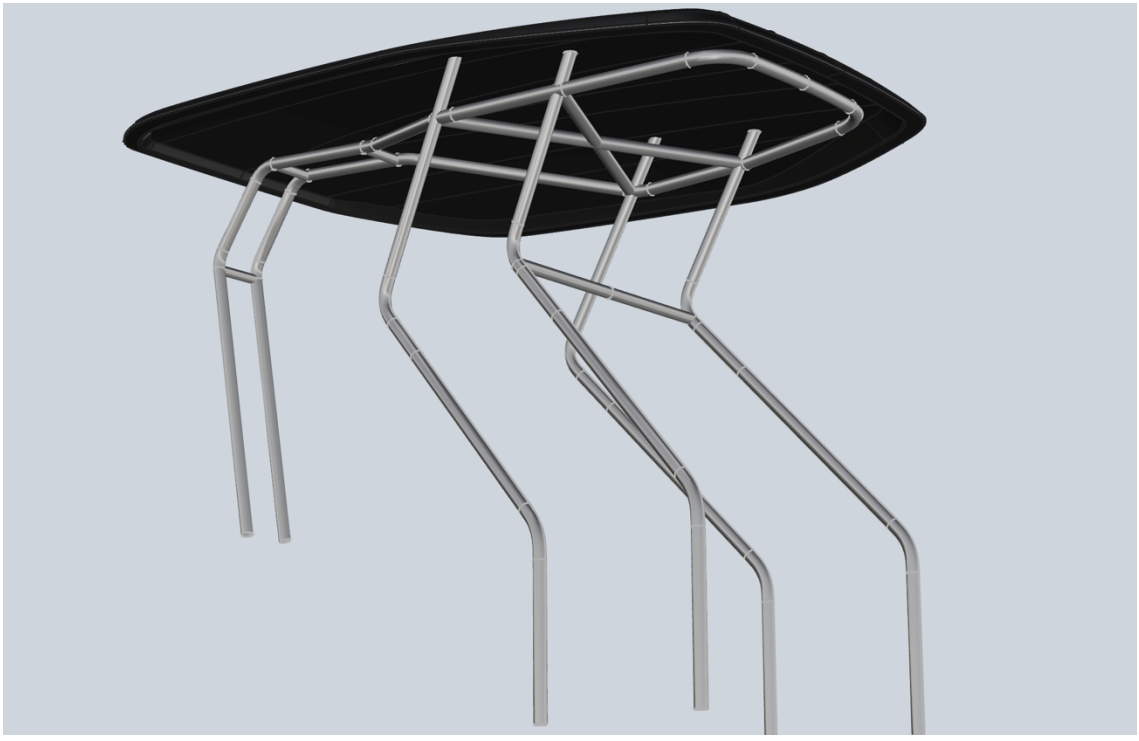

Figure 3.40. Northstar 910 RS hard-top design

Figure 3.41. Northstar Orion 9 hard-top design

driving environment for different sized drivers. The new placement of console, seats and the hardtop are spacious and gives much room for the driver and passenger without compromising with comfort, reach of controls and safety.

Control components for the boat driving process have been placed on a linear surface in front of the drivers' seat. In this way, it was ensured that controls are within good reach, good visibility and zone of comfort for all drivers. A steering wheel and gas throttle are placed in the front zone for driving in the right and for ankles.

A dashboard is placed in front of the drivers' seat. This area is reachable and visible from both driver and the passenger to control units such as chart plotter, engine display, stereo, and electric switch pane panel. The dashboard components are removable with screws for easy access and maintenance, providing ergonomic working conditions for service mechanics. In front of the passenger area, there is a storage box for customer needs such as placing cell phones, keys, and any other objects.

3.3.3. The First Product

The first product enables the testing and demonstration of different features of the boat. That is means that RIBTECH can test end evaluate the design and layout with team members such as users, mechanics, and engineers. A physical product enables anyone to

understand the design, and it is easy to get feedback from customers by inviting them to see the boat.

The first product can also serve as selling material to future customers. The company appreciated the result and the product and Cengiz Arsay the owner of RIBTECH stated; “The result is above expectations, I enjoy driving the new boat. It will be a product, and in 2018 so customers will get a boat with this appearance.”

Figure 3.42. Northstar Orion 9 first product

In this section follow some pictures of the first product (Figure 3.42, 3.43, 3.44). The wider windows provide an extensive field of vision for the driver and the passenger. The foldable seats allow users drive comfortably while standing or seating. A dark colored transparent hard-top gives spacious and well-lighted feeling.

The new driver environment is designed to fit most users with different anthropometrics, seat and steering wheel are adjustable so that any driver can sit comfortably. The front storage boxes provide space for extra equipment such as tools or anything the drivers might want to bring. A simple thing such as drink holders improves the comfort of the driver and the passenger letting them bring water or soft drinks during a drive.

Figure 3.43. Northstar Orion 9 electronic control switches

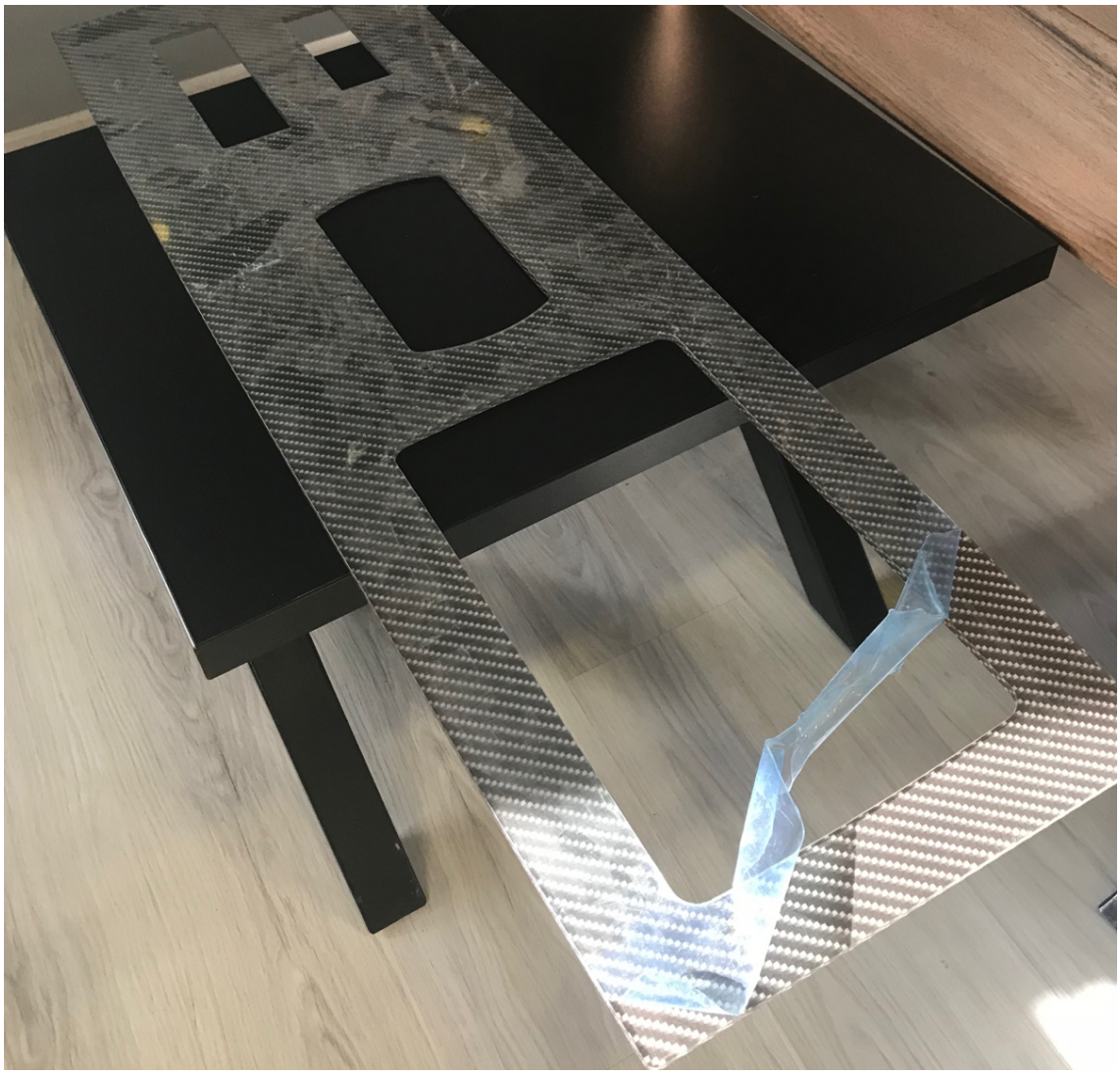

Figure 3.44. Northstar Orion 9 console carbon-fiber film laminated plexiglass

3.4. Discussion

This section will discuss the project result concerning the theory. It will also be discussed the contribution of this project towards users, RIBTECH and the field of industrial design practice. Finally, some recommendations and suggestions are given concerning continued work after this thesis.

3.4.1. Result

The result is a user-centered design that is constructed with the needs and preferences of the users and the stakeholders. The work in the project demonstrates the advantages of juxtaposing the fields of industrial design and engineering as argued by Smets and Overbeeke (1994). The industrial designer has been the bridge between the company, with design and mechanical knowledge, and their users. One of the employees said something close to; 'We knew that we required to update the boats, and we replaced the engines and the electronics to start with. However, then we realized that we needed to do something about the user environment'.

The RIBTECH company has lots of competence in naval engineering, fiberglass production and other essential subjects of its products, but RIBTECH has less knowledge about user needs and design thinking. Involving an industrial designer in the product development process has helped RIBTECH achieve a result based on the needs of the users and improving some of the existent problems with today's boat. The industrial designers competence within design thinking has been vital to being able to communicate with diverse stakeholders and merge different fields of research for awareness the context as Buchanan (2001) underlines. The crucial step of the design process is to comprehend the existent problems before even starting the design of a new concept (Cain, 1998; Glomann, 2015; Norman, 2013). RIBTECH requested to design a new and better-looking product, addressing the 'outdated look' of the boat. RIBTECH was asking for a more modern and attractive boat to show their customers. The result of the project does not only have a modern and attractive look, more importantly; it is designed with users, stakeholders, and production methods in mind. Additionally, ergonomics and usability have been implemented. Even if the designer knew very little about the rigid inflatable boats at the beginning of the process, the project presents that it is possible to achieve a

satisfying result with the collaboration of the industrial designers utilizing a product development process adapted for the specific situation with well-applied design methods. As exploring the context was an essential part of the project, it was ensured to discover the "existing problems" and construct design decisions grounded on that exploring. Although the design process may seem chaotic, this project contains properly considered methods that are adjusted to the situation to ensure the finest outcome (Friedman, 2000).

3.4.2. Contribution

By designing a more ergonomic driver environment, both physically and cognitively, this project will provide a better experience, both users and production workers. By applying ergonomics into the console and the seat design, the design will likely develop organizational performance and health of the users in a long-term (Demirel and Duffy, 2013). Moreover, a well-designed driver environment is not only a selling argument because it looks attractive, but it can also be claimed to provide a better economic outcome in the long run literally.

Cain (1998) argued about experience-based design; the objective of comprehension the company's emotions and attitudes towards the product and relating it to the users' experience of it. The influence of user-centered design is broader than only the physical expression of the product; also, it prevails a strong effort of understanding the users. Furthermore, by the knowledge about its customers was provided with the stakeholder profiles, RIBTECH comes closer to the users. Essential knowledge for the company lies in the source of their customers and users. If RIBTECH succeeds to gain knowledge, feelings, and experiences from the users, the company will have the opportunity to improve successful products. My work has hopefully helped RIBTECH to learn from their users.

By the perspective of industrial design practice, this project has confirmed that user-centered design methods can strategically be applied in a conservative industry with slight experience of such methods. Managing a product development process requires an extensive understanding of both methodology, objectives and the context in which the process takes place. It similarly needs that the methodology is adapted to the context to provide satisfying outcomes and these are skills that the industrial designer continuously improves.

The prototyping in this project has shown that the prototype illustrates both company (RIBTECH) and their customers what new boat parts could look like. The result of the prototype process verified that it is a useful tool for communicating ideas like Horton & Radcliffe (1995) presents. The physical model helps observers comprehend the design, without requiring any technical skills or ability to describe a 2D drawing or 3D model. Moreover, the visual presentations was used as a tool for communication between people from diverse backgrounds. The use of moodboards and benchmark posters have been useful to show results as recommended by Wikberg et al. (2015).

3.4.3. Further Development

The next step for RIBTECH is to adjust and apply the design solutions to other boats that will be developed further to create and emphasize brand identity. The console, the seats, and the hard-top should also be adapted to fit other boats in the RIBTECH range. The modularity of the design eases the process of adapting the driver environment for the different boats, such as Northstar 1200 OP and Northstar 7.20. Additionally, some technical challenges lie in solving details such as the hinges, the assembly instruments and the electronics for all the functions and controls in the design.

Even though the boats have different consoles, seats, and hard-tops, similar ergonomic features should be implemented for all boats. What RIBTECH require to evaluate and develop is the mapping of functions and placing of instruments in the other boats. That could be done with the inspiration process in this project, and it is recommended that users be involved in the process concerning design the other boat parts with respect to user needs.

3.4.4. Recommendations

This study recommend RIBTECH to continue to utilize the knowledge, experience and involvement of users in the product development process of their boats. The contact with users of the boats have already been established and it is recommended that RIBTECH continues the dialogue for the initiation of a new boat series.

Furthermore, it is suggested that RIBTECH preserve contact with their customers after a new boat has been delivered. Feedbacks from the customers are essential

contribution for developing the product further. It is recommended employing a client questionnaire on the website of RIBTECH which starts the process by asking key questions about project requirements. Only by fully understanding user problems, goals, strengths, weaknesses, target demographics, products, services, competitors, unique selling points, brand, and so many other things can be ensured that design project is a success.

As management and the industrial designer see potential in thinking newly about how to sell this boat parts. Referring to good customer relations and a dialogue with the customers, it would be possible to sell a separate console, seats and hard-top with a new upholstery for existing customers that already has Northstar 910 RS from RIBTECH for better look and user experience without having to invest in a completely new boat.

Conclusively, this thesis can be restructured as a 'Design Manual' for the further new product development process of RIBTECH that will be provide guidance for design, development and improvement projects. Because of good design practice always require a combination of engineering principles, experience and judgment in order to contribute the best possible structure to suit a reasonable economic limitations, this manual would be the baseline document and operating procedure for all projects.

CHAPTER 4

CONCLUSION

In relation to the designers have been getting closer to the potential users of the products and services, companies have been started to emphasize defining the products that are based on users' needs. As a result of the increased interest in users' needs and their experiences, the user-centered design approaches have been implemented the product development processes of the products at early stages by involving users and stakeholders into the process.

As stated in Chapter 1, the questions of this study have aimed to address were:

- How can user-centered design (UCD) contribute to developing better-designed products?
- How does industrial design practice shape the new product development process (NPD) in the workplace?
- What are the outcomes of applying user-centered design approach in the early stages of the new product development process?

The initial objective of this study is to highlight the positive, long-term consequences of the user-centered design (UCD) process practiced in the early stages of the new product development process (NPD).

Considering the impact user-centered design has on new product development requires a synthesis of the debate on NPD and the role of design in industrial society. The concept of new product development targets introducing a new product to the market and ensuring the growth or survival of the company. Moreover, the current economic situations we face today show us developing a successful new product requires special attention to marketing focused on users and their needs. The idea of applying UCD approach for NPD process should take into consideration for the usable and commercially viable products in the strong competition of the market.

The main reason for the collaboration between designers and companies is to create added value through design. Related to this reason, the role of designers such as

developing new products via applying rapid changing technological and aesthetic trends is the crucial factor for the competitiveness between companies. Even if the product-oriented solutions are not sufficient for marketability, the industrial design could be seen as complementary to user-centered development strategies with its role in both economic development and also the production of non-material solutions to the usage of products. The role of industrial design and the aim of product development could be complementary as far as design's territory is broadened further the limits of product design.

The ideological, social and economic context of the industrial design discipline is based on propagating the production line via provoking consumption, making it more efficient, reducing cost but increasing sale figures. In the present market conditions, the products are mainly expected to improved user experience with understanding their expectations. Because of its function to support quantitative industrial production and its link with material production, the industrial design could be considered as a solution of the present marketing expectations and company survival.

To this objective, the first task of Chapter 2 was to do a review of how the industrial design practice, new product development, user-centered design approach, and ergonomics has been theorized and investigated in the literature. In this review, design, engineering, and marketing studies were brought together, proposing that the UCD process should be implemented iteratively with the involvement of the users and stakeholders through new product development processes. In other words, for a comprehensive analysis of implementing UCD, we need to deal with the design practice, users and the NPD process.

This research on UCD and NPD process has led the designer towards designing a product, which has offered opportunities to improve the ergonomics, user experience, and producibility. The UCD approach has been followed, which is supporting the involvement of the users that allows the ground for a promising project for the transformations through the product development process. In UCD indeed, the user needs become more dominant than marketing considerations. In researchers opinion, shaped by the literature review presented here, the co-production of value has more potential to build stronger ties within products and users. After gaining insights on the designer's role in UCD, it was focused on research through the users' and stakeholders' involvement to design process which offers a more satisfying way of developing a product.

Chapter 3 showed in a case study that, some parts of a rigid inflatable boat (RIB), Northstar 910 RS was redesigned in the light of ergonomics, user experience, and the

producibility. A new console, seating unit and hardtop for NorthStar 910 RS were designed that is more ergonomic, has a better user experience, ease of production and aesthetically more appealing than today's boat. The combination of NPD with UCD has generated the case study because this approach fulfills a need of the user and encourages their involvement and their sense of ownership of the solution. Through the interviews and observations, the problems, needs, and design opportunities were searched for and had therefore were sought to redesign the product on co-created values that already existed.

Furthermore, as a designer, it was tried to improve the experience for the users by enhancing their ergonomic requirements. Also, other stakeholders that are related to the boat such as production engineers, worker, service mechanics, and external seller were considered and involved through the process. On behalf of the company, the objective is also to deliver a new design that makes products competitive on a global market. Designing console, the seating unit and hardtop ergonomically is a strong sales point, and an improved aesthetics will strengthen RIBTECH among competitors.

The concept was built in a CAD model of the design and completed with CNC milling and molds. In addition to understanding what RIBTECH, users and other stakeholders thought and how they acted via the concepts that were created, also experienced prototyping and modeling techniques that could have been supported the co-creation of value. The rough prototype enabled to physically experience the new console in a way that is not possible in a computer model for experiencing drivers' ergonomic requirements. The CAD model, on the other hand, will be a basis for the further projects of new range boats to create the brand identity for 8M, 10M,12M RIB; then, it is also an essential outcome of the project.

This represents a contribution to knowledge in the field of design in so far as the methods and tools used in the case study can be replicated in the different product development process.

This was just a project that did not cover all the possible strategies designers can propose to support user-centered development; however, the project enables the designer a hands-on experience in which is a chance to use some design tools and methods that were not used before in the RIBTECH's former design projects.

Working on a project that will be produced immediately was also an excellent opportunity to verify the feasibility and the acceptability of the strategies that were mentioned in the first part of this work, which was based on a different role of designers

in supporting user experience, rather than product or technological change. This hands-on experience covers just a few aspects of the problem of the redefinition of designers' role and tools to support UCD. Nevertheless, this has been an excellent opportunity to work on different product and team, from theoretical reflections to concrete problem-solving activities in the area of UCD.

The originality of this study lies in the use of user-centered design tools in the new product development process in order to answer the specified research questions regarding the producer. The information gained by interviews is particular to the boat users, producers and sellers and also composed of the specialized product information. Thus, the redesign of boat parts is specific to RIBTECH. Another original part of the thesis is the construction of it. It was not pre-defined sub-topics for this research, but the sub-topics (e.g., user experience, ergonomics, and co-creation) became clear when searching for the most suitable approaches. The pathway that was used to develop the thesis is based on seeking the alternatives, developing ideas, evaluating them and redefining the conditions for the specific area.

The designers contribution to the study area of Industrial Design is based on a critical view of the mainstream design approaches to UCD, based on user expectations on products. Starting from this view, diverse ways and tools were applied to design user satisfied products. The point of view has led designer towards new solutions with production techniques and materials, besides the ergonomic and aesthetical improvements.

Outcomes of the project can be presented in two categories: material benefits and immaterial benefits. Material benefits can be defined as quantitative activities resulted in the application of UCD into NPD which are the improvement of ergonomic driver environment, aesthetically more appealing product, enhancement on the production process, better material usage, creating brand identity with further product designs.

The immaterial benefits of the project are the qualitative benefits that cannot be evaluated easily. The actual aims of this project are also based on these immaterial outcomes. As founded in the research study immaterial outcomes that come to foreground redesign of driver environment for rigid inflatable boat with focus on user-centered design are; development of link between users, stakeholders and product, increase in the awareness about importance of applying UCD approach in NPD process at early stages and looking at the products from design perspective.

The thesis showed that companies could benefit from the involvement of users and stakeholders in the design process. They find an opportunity to look over their products from a different perspective and create a stronger link between team members with the collaboration of different disciplines.

Regarding overall benefits and outcomes of this thesis, it can be claimed that the project of the case study has achieved its primary goal which is to highlight the positive, long-term consequences of the user-centered design process practiced in the early stages of the new product development process. RIBTECH are positively influenced by the redesign project for NorthStar 910 RS in that they started to plan further design projects.

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APPENDIX A

GANTT CHART OF THE PROJECT

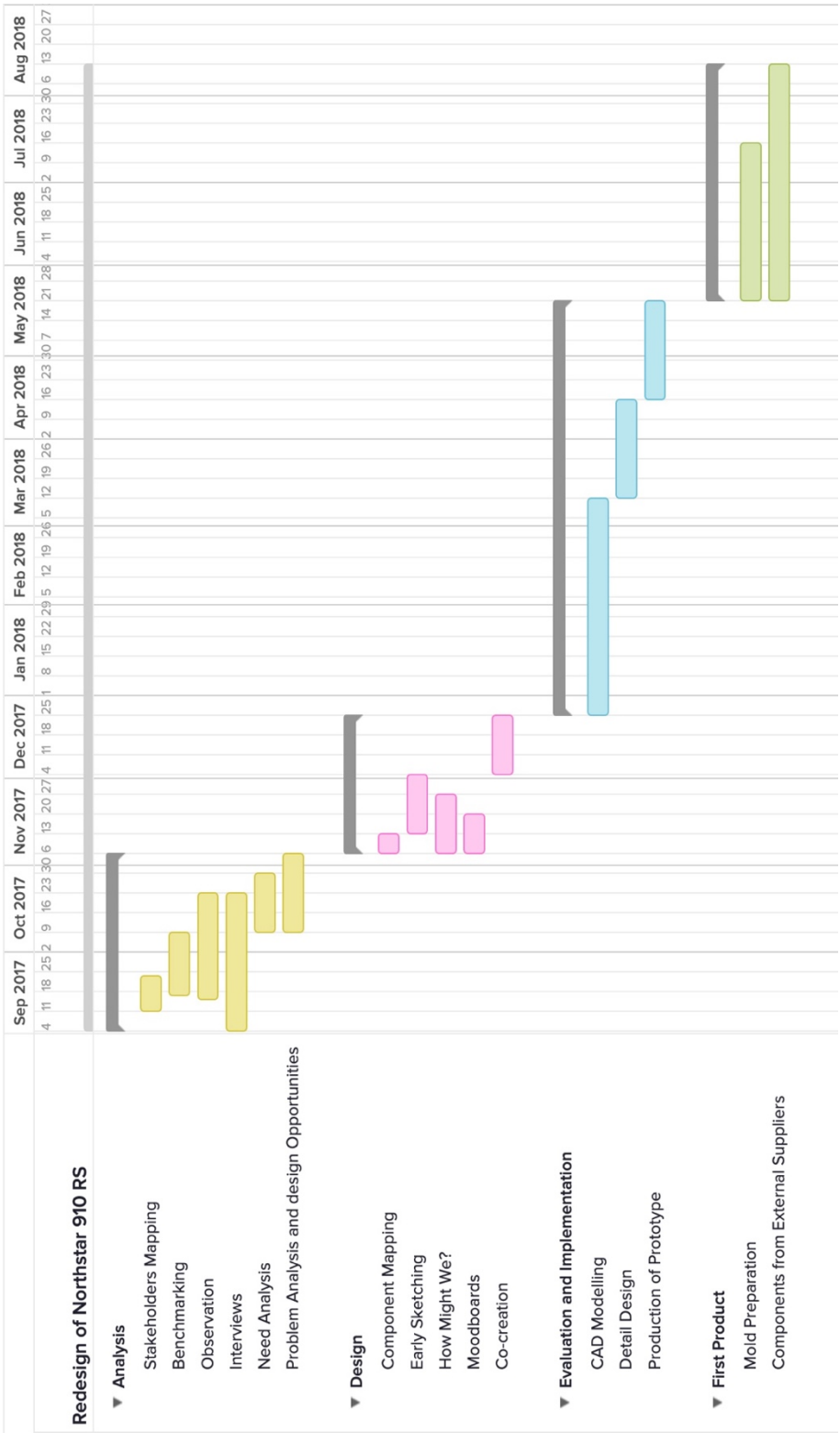

Figure A.1. Gantt chart of the project

APPENDIX B

INTERVIEW SCRIPT

This is the script that was used for the interviews with users, managers, engineers and workers when visiting the fishing tournaments, boat show and factory plant. The interviews were unstructured and supplementary questions were asked if necessary.

Interviews with Users, Managers, Engineers and Workers

- What are the main problems and challenges of today's boat?
- Have you driven different types of boats? If yes, what models?
- What is comfort for you?
- Do you consider todays driver environment of the boat as comfortable? Why/why not?
- Is there anything annoying about the boat today? What and why?
- What do you think are the biggest potential for improvement in the driver environment for the boat?
- What do you think of the seats on the boat? Are they comfortable while using?
- What do you think of the displays and controls on the boat? Are they easy to understand?
- What information do you look at the most?
- What do you bring into the boat? Where do you put loose stuff?
- Have you ever felt unsecure boat? What happened and why did you feel that way?
- What do you think are the most important factors when buying a boat?
- What kind of boats have you been using? What was good and bad about the different models from your perspective?

Interviews with President and Managers of RIBTECH

- What are the core values for the company?
- What are your visions for the company's future?
- Why do you think the customers choose RIBTECH?
- How do you build new customer relations?
- Why should the customer choose RIBTECH boats instead of competitors?
- What markets are you primarily aiming for?

APPENDIX C

INTERVIEWER PROFILES

Table C.1. Interviewer profiles

Interviewer 1 is the President at Marintek Group for twenty-nine years. He has B.B.A. on Marketing. He is willing to produce and sell good quality products for the marine sector. Additionally, he desires to be more competitive and increase the export potential of RIBTECH in international markets. He also has been using Northstar 910 RS for three years.	**Interviewer 2** is the production manager at RIBTECH, and he is working for the marine sector for twenty-four years. He is a naval architect and marine engineer. His demands for the boat are easier production and assembly details, and shortened and more efficient production process.
Interviewer 3 is the special projects manager at RIBTECH, and he is working for the marine sector for eleven years. He is an experienced naval architect and marine engineer. He has been working on different marine craft production areas for years.	**Interviewer 4** is the sales manager at RIBTECH, and she is working for the marine sector for seventeen years. She is in a close relationship between dealers and user. She has deep knowledge of production and the usage of the boats, also feedbacks and comments coming directly to her from the customers and dealers.

Interviewer 5 is the marketing and export manager at RIBTECH, and she is working for the marine sector for eight years. She is mainly responsible for brand identity and recognition, additionally, increasing the export potential of RIBTECH on international markets.	**Interviewer 6** is the dealer of RIBTECH from Bodrum Marine. He is selling marine crafts from many different brands and giving maintenance and repair service for twenty-one years. He is in a close relationship with customers, users and service workers.
Interviewer 7 is the dealer of RIBTECH from Izmir. He is selling marine equipment and boats of RIBTECH, also giving maintenance and repair service for nine years. He is in a close relationship with customers, users and service workers.	**Interviewer 8** is the worker from RIBTECH. He is responsible for tube production department for eight years. Additionally, he is working as a maintenance and repair service for RIBTECH.
Interviewer 9 is the worker from RIBTECH. He is responsible for assembly of carbon fiber parts, electronic rigging and control equipment for ten years. Additionally, he is working as a maintenance and repair service for RIBTECH.	**Interviewer 10** is the user of 9M RIB for twelve years. He is living in Bodrum and uses the boat for leisure. He stores his boat in Bodrum marine and uses in summers for visiting the beach clubs with his family around Bodrum. He likes driving the boat with high-speeds.
Interviewer 11 is the user of 6.8M RIB for three years. He is living in Alaçatı for summers and uses the boat for leisure. He stores his boat in Alaçatı Marine and uses in summers for visiting the beach clubs with his family around Çeşme. He likes driving the boat with high-speeds.	

APPENDIX D

BENCHMARK POSTERS

These are some of the benchmark posters that were used as the communication tool with other stakeholders which were organized from the presentations.

Benchmark/Ribco 28 ST Outboard

Figure D.1. Ribco 28 ST Outboard Benchmark

Benchmark/Goldfish Seasport 28

Figure D.2. Goldfish Seasport 28 Benchmark

Benchmark/Technohull SeaDNA 999

Figure D.3. Technohull SeaDNA 999 Benchmark

Figure D.4. Detailed Benchmark from competitor brands

Dashboard and Seating/Automobiles

Figure D.5. Detailed Benchmark of dashboards and seatings from automobiles

APPENDIX E

NORTHSTAR ORION 9 OPTIONS LIST

Notable Standart Equipment:

- Manual toilet with holding tank with pumpout
- Sink in WC compartment (in console)
- Fresh water shower
- Navigation lights
- Automatic bilge pumps(2)
- Swim platforms with
- Electric air pump
- Steering wheels (wheel only)
- Compass
- Nova Bolster Seats
- Silvertex Upholstery
- Glove box
- Remote control battery switches with auto charging relay
- Electric windlass
- USB ports in console glove box

Options List:

- Black powdercoated hard-top frame with acrylic top
- Teak decking
- Simulated teak decking
- Marine starting batteries (182 AH) or as required by engine OEM
- 25A battery charger with shorepower
- Electric fridge (62 lt)
- Second electric fridge (62lt) (requires below 2 options)
    - 40A battery charger
    - House battery (in addition to 2 starting batteries)
- Sink in wetbar (avaible with single fridge only)

- Electric cooker (includes A 1200W inverter and requires house battery option)
- Wetbar floor LED lighting
- Deck floor LED lighting
- Fusion Stereo System- Dock/Subwoofer/4 Speakers/AMPS
- Bow thruster
- Humminbird10” Chartplotter/GPS/Fishfinder
- Humminbird 12” Chartplotter/GPS/Fishfinder
- VHF Radio
- Other electronics (as required-per quotation)
- Underwater lights (2 with 3 engines, 3 w,th 2 engines)
- Planus vacuum toilet with holding tank and vacuum pumpout
- Toilet holding tank macerator pump
- Remote control searchlight on hard-top
- Bimini top with carbon masts
- Ullman suspension seats (Model Echalon)
- Pop-up deck lights AFT
- Windsheld wiper
- Windshield wiper washer system
- Boat cover
- Flag pole
- Thermal fabric (black only)
- Fabric with carbon design
- Electric rear hatch opening
- Flashing strobe light on pole
- Electro hydrolic jack plates
- Boat name on tube (priced per letter)