A COMPARATIVE STUDY ON DIFFERENCES IN COLOR DETERMINATION PROCESS AND CRITERIA OF LEADING AUTOMOBILE COMPANIES

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Approval of the Graduate School of Natural and Applied Sciences.

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ABSTRACT

A COMPARATIVE STUDY ON DIFFERENCES IN COLOR DETERMINATION PROCESS AND CRITERIA OF LEADING AUTOMOBILE COMPANIES

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May 2004,

The present study was undertaken to indicate the differences and similarities in color determination process and color selection criteria of leading automobile manufacturers of the world. A comperative study was conducted in the light of relevant literature, interviews and questionnaires. A total number of 6 automobile company were selected for case study; Ford, Honda, Hyundai, Volkswagen, Renault and Toyota. Total 19 respondents, the majority of whom were automobile designers and color specialists answered questions related with color design of automobiles and selection criteria. Later, a total of 18 representatives, including at least one Color and

Trim designer, Product Engineer and Purchasing Manager from each company, completed the questionnaires. On the basis of findings, it can be said that each auto manufacturer has a particular color determination process. However, there are some similarities in color design process of Renault and Ford, Volkswagen and Toyota, Hyundai and Honda.

Key words: color criterion in automotive industry, automobile design, color and design

ÖZ

LİDER OTOMOBİL FİRMALARININ RENK BELİRLEME SÜRECİ VE KRİTERLERİNİN FARKLILIKLARI İLE İLGİLİ BİR KARŞILAŞTIRMALI ÇALIŞMA

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Tez Yöneticisi: Dr. Hakan Gürsu

Mayıs 2004,

Bu çalışma, dünyadaki lider otomobil firmalarının renk belirleme süreci ve kriterleri arasındaki benzerlikleri ve farklılıkları göstermek amacıyla hazırlanmıştır. Konuyla ilgili olarak literatür araştırmaları, görüşmeler ve anketler ışığında karşılaştırmalı bir çalışma yapılmıştır. Tez için görüşülen 22 firma arasında, yalnızca Ford, Honda, Hyundai, Volkswagen, Renault ve Toyota renk belirleme süreçleri hakkında gerekli bilgiyi paylaşmayı kabul etmişlerdir. Çoğunluğu otomobil tasarımcıları ve renk uzmanlarından oluşan olan toplam 19 kişi, otomobillerin renk tasarımları ve belirleme kriterleriyle ilgili soruları cevaplamışlardır. Daha sonra, her firmadan en az bir renk uzmanı, ürün geliştirme mühendisi ve pazarlam yöneticisi

seçilmek üzere toplam 18 kişi anketleri tamamlamışlardır. Anketlerle göre, her otomobil üreticisinin özel bir renk belirleme sürecinin olduğu gözlenmiştir. Ancak Renault ve Ford, Toyota ve Volkswagen, Hyundai ve Honda'nın renk belirleme sürecinde benzerlikler göstermektedir. Renault renk belirleme sürecinin elde edilen bilgilerle karşılaştırıldığında, tüketicilerin taleplerini ve farklı otomobil pazarlarının gereksinimlerini karşılamak açısından daha verimli ve başarılı bir sürec olduğu sonucuna varılmıştır. Ayrıca, araştırma sonuçları doğrultusunda, Renault'nun üretim aşamasında da insan faktörüne daha duyarlı olduğu anlaşılmıştır.

Anahtar Kelimeler: Otomobil tasarımında renk kriteri, otomobil tasarımı, renk ve tasarım.

This thesis is dedicated to:

My Dear Uncle Mehmet Sami Öksüz

His Dear Wife Ayşe Öksüz

And

My Dear Cousin Orhan Öksüz

Who were died at 2 February 2004 in Konya.

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When I was but a little lad,
Few were the colors that we had;
Then red was red, and blue was blue,
And that was all we ever knew:
But since they've made the motor car
Behold how many shades there are!

Today I draw about the town
In one dyed Piccadilly Brown.
"There's one," I heard the driver say,
"That's painted Arizona Gray.
While that one at the other stand
Is catalogued as Desert Sand."

They've named the colors for the streets,
For victories and great defeats,
For princes, presidents and kings,
Countries and states and endless things,
Fogs, mists, miasmas and the stars,
And painted them on motor cars.

There's London Fog, and Cactus Gray,
And Brewster Green, and few can say
Just which is which or what is what;
The name, I venture, matters not,
Give it a pretty phrase and nice,
The customer will pay the price.

Today I ought to be in bed,
My eyes with cold are Fireman's Red;
My food I cannot swallow down,
My mouth tastes Piccadilly Brown,
I'm feverish, faint, discouraged, too,
In fact, I feel Imperial Blue. (Edgar A. Guest, 1925)

CHAPTER 1

INTRODUCTION

According to the Greek philosophers, there were four elements in the world; earth, fire, water and air. Aristotle notified in *De Coloribus* that simple colors are the proper colors of those elements and he elucidated:

> Air and water when pure are by nature white, fire and sun yellow, and the earth is naturally white... Black is the proper color of elements in process of transmutation. The remaining colors, it may easily be seen, arise from blending by mixture of these primary colors (Birren, 1978).

As can be conceived from Aristotle's remarks, color is one of the most significant properties of environment. It defines the whole world and gives meaning to the objects around human being. Color is also emotional and inspirational.

Color can facilitate to fulfill many basic needs of individuals. It can emphasize and signifies objects such as animal or vegetable for living and/or fun. Moreover color helps to identify and specify personal space. Abstract concepts and thoughts are conceived by color in literature and art. Further, it constitutes ambience in a space and reveals or conceals figures or objects when surrounded by different backgrounds. Color is psychologically and emotionally important in order to show how individuals think about things. Above all, beauty and unity can be provided by

means of color arrangements. Also, ideas can be communicated with color (Eiseman, 1990).

On the other hand, it has major effects on plants and animals as well as the human being. For animals, color is vital for segmenting visual scenes, spotting predators and prey in a dappled environment, determining sexual availability, finding ripe fruit and aerial navigation (Hardin, 2001).

Linton (1991) explained the inherent power of color as: "Color is conceptual. There is no building technology for color, no hi-tech of color. Color is just pure idea, pure intellectuality, pure emotion"

Visual and emotional contacts with surroundings of human are provided by senses. Color both ensures vital information about the environment of individuals and undoubtedly provides pleasurable feelings to them. Using the sense of color in visual arts, fashion, marketing, architecture, interior and industrial design brings out remarkable benefits and advantages and influence the commercial value of object (Kuehni, 1983).

A careful and appropriate color planning in particular spaces like schools, offices, hospitals and houses increase the effectiveness of individuals' activities. As a subjective visual sensation, color is always considered in relation to other colors in interior spaces. Moreover, the convenient use of color is a valuable tool to designate most appropriate product from a pair of shoes to a sports cars. Dale Russell, the

Consultant Creative Director of the Colour Group, defines it in *Color in Industrial Design* as the "Cinderella of the industrial design process" (1991a) and she claims that it must be considered an integral part of design with form and function. With sufficient light and appropriate surface effect color can remarkably control the perception of shape of product.

Besides, the psychological and cultural effects of color should be taken into consideration in color specification process of product design. Colors have diverse meanings and associations in differing cultures (Russell,1991a). Also, in regard to marketing, researchers indicate that color not only help to emphasize the image of content of the product and establish corporate identity, but also influence the buying habits of consumers (Zelanski & Fisher,1989).

Color is also one of the most dominant and significant property of automobile design and it is a considerable factor in car sales. Reuwee (2001) mentioned in the *Concept Vision* article published in Ward's Auto World at 2001 that at the beginning of the 20th century, Henry Ford had told to his production manager, Charles E. Sorensen, that customers could have "any color they want as long as it's black." Afterwards, manufacturers had realized that different color alternatives could be offered concerning the tastes of customers. As a global product, automobile had to respond the consumer demands from different cultures. Finally red, blue, green and other colors were applied to new models. First colored cars had been launched by Chevrolet to attract attention of consumers. Consequently, amount of sales increased. Most of the automobile companies have market based color researches and

establishes the design departments today. Color and design specialists of companies have carried out comprehensive investigations concerning future color preferences and applications. Bill Kings, color marketing manager of Dupont Performance Coating Europe stated that “It is one of the first two things you notice in a motor car: shape and color” (Reuwee, 2001).

1.1. Objectives and the scope of the study:

Color creates a new marketing strategy and power and becomes one of the major objectives in automotive industry. Each automobile company follows a definite procedure in order to select most appropriate colors for new models and to meet the needs of automotive market properly.

The scope of this study is to **compare the color determination processes of leading automobile companies in order to reveal the relations of selected colors and market demands**. To obtain the necessery information, the dissertation will exploit several methods such as , literature search, interview and questionnaire.

For this purpose, the literature search and interviews are focused on:

- The Automobile Design Process
- The Color Determination Process in Automobile Industry
- The Color Determination Criteria In Automobile Industry

Based on these information, the objectives of this study are:

1- To gain a broader understanding of the color designing strategies used in automobile companies.

2- To compare the color determination processes of different automobile companies in design and production phases, based on the definite criteria.

In order to operationalize this study, the companies which manufacture “C” segment cars were selected. Due to the fact that they are produced for usage of middle class, the most preferred and used automobiles in the world are in C and D segment. They also called Intermediate Segment by paint suppliers.

1.2. Outline of the study:

The general approach of the research is first to indicate the importance of color in automobile design, and to focus on a comprehensive research, which comprises interviews and questionnaires.

First chapter of the study introduces the objectives and the scope, outline and methodology of the study. Second chapter, “Experience of Color”, is a critical review of the fundamentals and general use of color. Fundamentals and the systems of color are the vocabulary of it. In this chapter, definitions and vision of color are briefly explained. Also history of color theories and systems, symbolic and cultural values of color are presented with explanations, and examples. This chapter is completed by examples for use of color in marketing and architectural, interior, and industrial design.

Chapter 3, which is called " Automobile Design and Color", discusses the significant place of color in automobile industry. In the first part, history of auto design is briefly explained. Later, the usage of color in design process is elucidated with an extensive literature search. Also the most important color determination criteria such as color trends, consumer demands, studies of pigment manufacturers and paint suppliers are presented. Finally automobile segments and significant examples of them are indicated in this chapter.

Chapter 4 covers the evaluations of interviews and questionnaires filled out by related departments of the automobile companies. The findings are summarized and compared with the available literature in "Analysis and Discussions of Findings" part.

The final chapter is the "Conclusion" where the findings of this study will be summarized and tied to some remarks and comments.

1.3. Methodology:

As a first step in this dissertation, interviews were conducted with automobile designers, pigment manufacturers, paint suppliers and design schools in order to understand the color selection process and constitute the basic color determination criteria.

In the second step, total 22 automobile manufacturers which produces C segment cars were interviewed and six of them, Ford, Toyota, Volkswagen, Renault,

Honda and Hyundai, accepted to share specific information about color determination and application process of companies. Color and trim designers, production engineers and purchasing managers of six leading automobile manufacturer answered the questionnaires. At least 3 competent authorities for each company were responded. Resulting data were compared with the findings of interviews and the literature search.

CHAPTER 2

THE EXPERIENCE OF COLOR

2.1 COLOR BASICS:

2.1.1. Definitions of Color:

There are many different definitions and theories about what the "Color" is. Berit Bergtröm (2001) mentioned in the *Creative Color Education* article about interdisciplinary nature of color science. According to him, the physicists claim that it is a radiation and wavelength, whereas, the chemists think that it is a pigment and material mixture. The physiologists mention about transmission of color by means of receptors, nerves and brain. According to the psychologists, it is a sensation that influences human. The artists consider the impression of color in their works. On the other hand, according to the architects and designers it is an attribute of object and environment. G.A. Agoston (1987) defines color briefly in *Color Theory and It's Application in Art and Design* as "a property of material and light". C.L. Hardin (2001), Emeritus Professor of Philosophy at Syracuse University, describes the color as:

> Color is a quality fixed to the surface of physical objects. Perceiving the true nature of color consists simply in opening one's eyes and letting the right stream in. Physical color is a characteristic of a visible radiation, whereas perceived color is an aspect of visual perception.

2.1.2. Color Vision:

In order to utilize color in both space and industrial design appropriately, it is necessary to understand how light is transformed into color:

2.1.2.1. Light:

Light is basically a form of electromagnetic radiation. Visible light (or the color of light) is considered to extend approximately from 380 to 780 nm in the electromagnetic spectrum. This narrow interval comprises all spectral colors; red, orange, yellow, green, blue, indigo and violet (Ladau et. al.,1989). Every color is produced by different wavelengths of the light in the spectrum. The longest visible wavelength produces red, whereas the shortest one corresponds to violet. Rainbow is the most famous visible model of color order. They are arranged according to their wavelengths from red to violet. Whereas red constitutes the most wide arc of the rainbow, violet is located at the bottom of it (Eiseman & Herbert,1990).

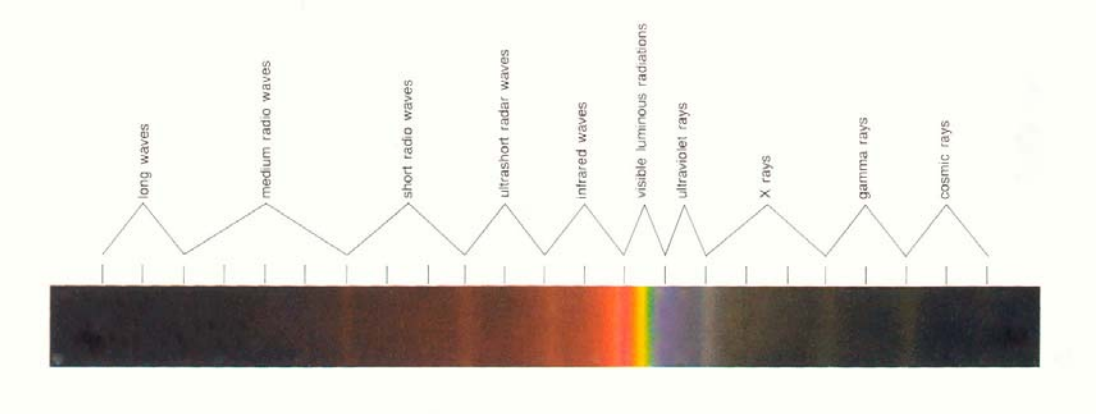


Figure 2.1. Spectrum of Electro-Magnetic Energy, (Source: De Grandis,1986)

As it is mentioned, color exists wherever light exists. Light diffuses and radiates directly from luminous objects such as incandescent lamp and it reflects

from non-luminous objects, if the object is illuminated with sufficient amount of light.

2.1.2.2. Perception of Color:

Color perception is composed of the interaction of three basic factors; light, surface and eye. When light wave reaches to the eye, it is absorbed by two type of sensitive photoreceptor cells which are called “rods” and “cones” located in the retina (Agoston,1987). Brightness, motion and low-intensity vision is transmitted by rods, whereas, vision at higher levels of illumination are transmitted by cones in the retina. The converted energy is send as electrical signals by means of optic nerves and is perceived as color in the brain (Eiseman & Herbert,1990). Briefly, light is the messenger and color is the message.

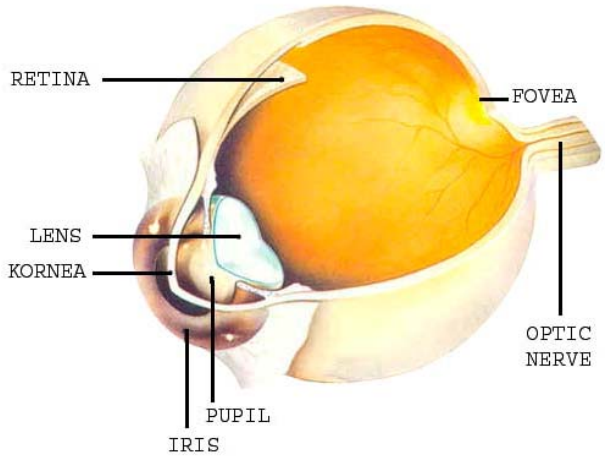


Figure 2.2. Parts of the Eye, (Source: Ed. Varley, 1983)

Color of objects influence the perception of apparent weight. This observation has been used by designers for many years. In general, it is accepted that warm colored objects appear more lighter and larger, whereas dark ones are

perceived dense and smaller (Eiseman & Herbert,1990). According to a study of IES Color Committee in US (1990), it is realized that black boxes seem to be heavier than green boxes according to the workers. To illustrate, darker automobile in the figure 15 seems to be more heavier than the lighter one even if the weights are equal. The relation of color and weight also influences the length of automobiles.

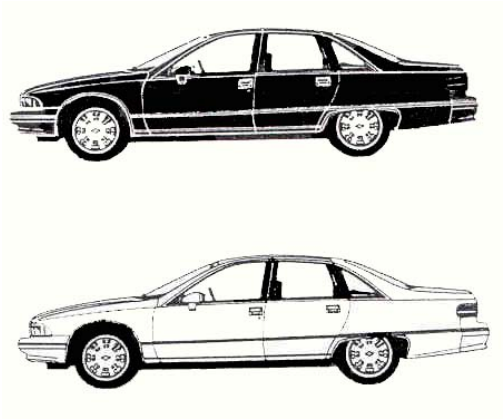


Figure 2.3. Darker and Lighter Object, (Source: IES Color Committee, 1990)

In a recent research, investigating the relationship between color and shape, unity of red and octagon, highest level of reminiscence is obtained. In spite of his assessments it should be accepted that "Color alone did not have a significant effect on subject compliance" (Braun et. al., 1995).

2.1.3. Fundamental Aspects of Color:

Throughout the ages, many philosophers and scientists have been interested in color. In the fourth century in Greece, it is believed that eyes transmit rays to the objects like invisible fire. According to Greek philosophers, in this way human being gave life and spirit to color. Afterwards, Aristotle mentioned that all colors consist of

black and white and he determined seven color which are white, yellow, green, red, violet, blue and black (Eiseman & Herbert,1990).

First, Sir Isaac Newton (1642-1727) divided white light into a spectrum of colors, using a triangular prism, in 1676. He stated that "color is a perception and needs an individual to receive the rays of light and to interpret them as color" (Padgram & Saunders,1975). His conclusion is written in *A Theory of Light and Colors*:

> The spectrum did appear with this series of colours, violet, indigo, blue, green, yellow, orange, red, together with all their intermediate Degrees in a continual Succession perpetually varying so that there appeared as many Degrees of Colours as there were sorts of Rays differing in Refrangibility.

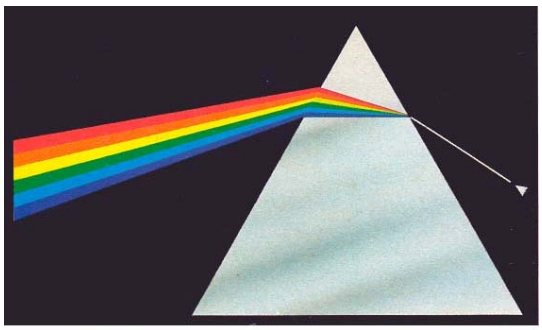


Figure 2.4. Newton's Prism Experiment (Source: De Grandis, 1986)

The other relevant studies were conducted by Thomas Young, James Clerk Maxwell and German physiologist Ewald Hering. One of the most simple and attractive development in color science and technology was provided by A. H. Munsell (1858-1918). His three dimensional color system which consist of hue, value and chroma has been still utilized for color specification by colorists, designers

and professionals (Padgram & Saunders,1975). In his system, each quality can be changed without effecting the other and measured independently (Munsell,1988). Three attributes of color are arranged into an irregular spheroid. The vertical axis of solid represents the neutral value and it scaled from black at the bottom to white at the top.

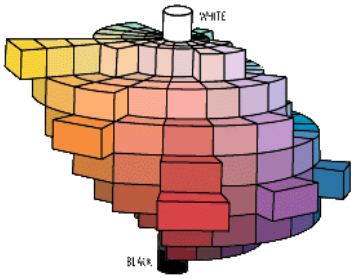


Figure 2.5. Munsell Color Solid, (Source: http://www.gretagmacbeth.com)

According to Munsell color system, color is defined by three scales; hue, value and chroma. Hue is the quality by which one color is distinguished from another such as red, yellow, blue, green and violet. Value is lightness or darkness of color and it is related to the quantity of light, which reflects from object. Croma/saturation is related with the intensity or the amount of gray in color.

2.1.4. The Color Wheel:

Arranging colors in logical sequences have been investigated since the 1600s. However, the first attempt to produce a color wheel was fulfilled by Sir Isaac Newton in the 1700s. It includes at least twelve distinct colors; primary, secondary and tertiary colors and their specific tints and shades. Constructed in an orderly circular arrangement, the color wheel enables the user to understand and combine new colors of the visible spectrum (Figure 2.6.). In the traditional color wheel there

are three primary colors; red, yellow and blue. Between them, there are secondary colors; orange, green and purple. The colors between the primaries and secondaries are called tertiary colors (Ladau et. al.,1989).

Colors ranging from red-violet to yellow are warm colors. Likewise, all hues that contain red are called warm colors and they associated with comfort and spontaneity. The colors ranging from blue to green on the color wheel are called cold colors that are associated with calmness and refreshness.

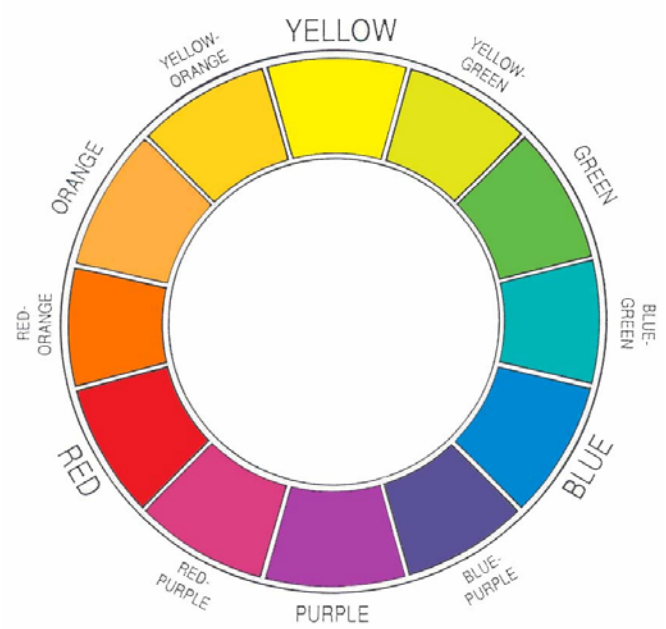


Figure 2.6. Color Wheel

2.1.5. Classification systems of Color:

Munsell (1988) was the initiator of many internationally accepted color classification and order systems. In time a number of color sample collections have been devised for working with colors in science, art and design. One of them was

Commission Internationale d'Eclairage (CIE). According to Agoston (1987) their system "based on the fact that the relative amounts of the three standard primary colors required in a mixture to match a color can be used to identify and specify the color".

Another color collection was constituted by Swedish SIS Colour Atlas NCS-Natural Colour System (1968-78). Ewald Hering's psychological color system is basis of Swedish Colour Atlas. Colors are identified according to the property of hue, black and full color content. Agoston (1987) clarifies their system as " Of great significance is the fact that anyone with normal vision can apply the NCS method of color judgment without the use of samples and color measuring instruments." DIN (Deutsches Institut für Normung) Color Chart is another collection system based on hue, saturation and relative lightness properties of color and it has 600 or 900 color.

The Pantone Professional Color System is one of them that recently developed specially for use by architects and designers. However, it is still widely used color specification collection from fashion to automotive industry. This classification system consists of 1001 opaque colors (Eiseman & Herbert,1990).

2.2. Cultural Values of Color:

Throughout the ages, in different cultures significant ritual and religious ceremonies and metaphysical phenomena are symbolized with color (Ladau et. al., 1989). Some of them are clarified in the following paragraphs. Each culture has its

own unique color heritage. Colors have very different meanings in different cultures and these meanings are transferred to the products.

East Asia and African Cultures are multi-colored. The use of bright colors significantly indicates that sunlight may indeed play a factor in color preferences and colorful life between Asian and African cultures. Bright lights of sun affect their mental health and clothes (Akagündüz,1999). Color has a significant place in Indian life and religion. Each color has specific meanings in Indian workship. Vivid colors tend to appear in Indian modern, traditional, decorative, practical, natural, stylized Arts and Crafts (Ed. Varley,1983).

Throughout the history, purple has been used by aristocrats, kings, queens and priests in Greece, Russia, Italia and England. Purple robes were symbol of authority and rank. Accepted as first official color, purple was utilized by Byzantine emperors and bishops (Akagündüz,1999).

Since, red is associated with future, fertility, life, purity and joy, it was the color of wedding ceremonies not only in India, but also in China and Turkey (Akagündüz,1999). According to *Culture and Color: Sacret green, Lucky Pink* article in Futurist Magazine (1997), in China, red and pink have a significant place that is, it is utilized as a symbol of good luck in cultural ceremonies and celebrations. On the other hand, red is associated with life an joy in Russia and symbolize chivalry in India. Conversely, it is accepted as a shame color in Iran.

With regarding to the color of sun, yellow, it is believed that it has divine associations. Egyptian God Ra and Greek Athena were illustrated by yellow in the ancient period. It is said to bring joy, happiness and new life in Western Cultures, whereas in France, it is associated with jealousy (Sun & Sun,1994).

For Egyptian people, blue has been said to express the divinity, honesty and wholeness. Moreover, all Virgin Marry images in the Christian cultures have been symbolized by blue. Besides, blue has some political connotations in England. It is associated with Conservative Party. Likewise, red symbolize Labor Party and orange is used to express the Liberals or Liberalism (Sun & Sun,1994).

The power of green is undeniably important both in Western and Eastern cultures. It has been recognized as a sign of spring and hope. Even if in 21. Century, forest green is the most favorite color for German and Austrian people. Owing to the fact that, for the majority of products different tones of green have been utilized in Germany (Ed. Varley,1983). In US, green is the color of money and jealousy. Furthermore, it is said that green was sacred color in the Islamic world. Ass. Prof. Nebi Bozkurt indicates that Islam has no specific color. The reason of this belief is caused by the Prophet Mohammed. He prefers to use green, because of green's natural and restful associations (Akagündüz,1999).

It is believed that black is the most malicious color. In many countries, black is considered as mourning color. Conversely, in Egypt black means rebirth (Russell,1991c).

In architectural and industrial design, cultural differences should be taken into account. Especially for global companies such as automobile manufacturer, color ranges of new models should be appropriate with the cultural properties of countries. For instance; color scheme of a Ford Focus produced for India market can be completely different from those of United Kingdom.

2.3. Psychological Associations of Colors:

Colors can be the expression of emotions, mood and energy. What individuals feel affect their color vision, in view of the fact that seeing and feeling are inseparable for colors. Personal experiences, interpretations, associations and perceptions stimulate the attitudes to color. According to Danger (1987), "Many of these reactions derive from tradition and long-forgotten experiences which have become buried deep in human nature." Besides, he added in *The Colour Handbook*;

> While physical reactions to colour can be scientifically defined, few of the responses, reactions and associations which are embraced within the term "psychological reactions" can be discovered from formal rules; they have to be discovered by research or study or learnt from experience.

Furthermore, psychological reactions differ with respect to age, race, nationality, gender, seasons, locations, economic conditions and personal characteristics. Attitudes of individuals to color are both subjective and objective. For instance; green associates with clean, fresh and pleasing in objective manner. On the other hand, green light on a fresh meat seems repulsive (Danger,1987). Human being have both negative and positive reactions to color according to them. Powerful colors like red and blue can evoke different connotations in same-size spaces.

Furthermore, some colors are conceived as accelerating recuperation in hospitals and thought as enhancing productivity in industry (Hoffmann,1998). In addition, the psychological interaction of any color is more powerful than the visual impression (Eiseman & Herbert,1990). Faber Birren (1988) argues that whole of human body is stimulated by color. He explains the importance of psychological and physical responses of color as:

> The physical effects of color on the human organism will induce psychological reactions... A person is likely to feel cheerful on a sunny day and glum on a rainy one. Conversely, psychological attitudes toward color will affect bodily responses. Red may seem exciting and blue subduing. In other words, the whole of man, his body, mind, emotion, spirit represents a coordinated unity, a microcosm, and color pervades all aspects of it.

Psychological and physical reactions of individuals to colors should be taken into account by design departments of automobile companies, because demands of target consumers can be affected by these connotations consciously or unconsciously.

The following positive and negative associations of each color are obtained according to studies of Lina Hoffmann (1998), Color for Business (2002) and Micro Academy (1998):

COLORS	POSITIVE ASSOCIATIONS	NEGATIVE ASSOCIATIONS
BLACK	Having class, sophisticated, sexy, dignified, serious, mysterious, concealment	Troubled state, death, ominous, depressing, danger, foreboding, evil
GREY	Conservative, practical, neutral, wisdom, dependaple	Ghosthy, somber, mousy
WHITE	Purity, peace, perfection, light, cool, clean, pure, innocent, simple	Sterile, surrender
RED	Warmth, hunger, excitement Resourcefullness, domination, conquest, hot, fiery, energy, active, love, Moral responsibility, morality, ethics,justice, rich, elegant, refined. Comfort, contentment, warm, elemential, primitive, snug	Seduction, panache or ritualistic dislay, subtle powers of discrimination, Rage, blood, danger, stop Symbol of shame and guilt,
ORANGE	Energetic, glowing, heat, harvest sunset Warm, inviting, ripe, juicy	Loud, overbearing
YELLOW	Entreprenuer, wisdom, enlightenment, experimental and emperical, warm, friendly, sunny, cheerful, life-giving tranquillant, warm, neutral, classical	Impulsiveness, ımpression of flair
GREEN	Wit, healing, Exuberanceof nature, confidence, self-expression, fertality, continuity, fruitfullness, productivity, creative, generative, generosity of nature, moist, eternal, victory, cool, refreshing, natural, restful, persistence, resilience, grit, self-defence mechanisms,	Unrelaxing, busy, sign of workaholic, symbol of jealousy, stubornness Envy, ınexperience, money, greed
BLUE	Freedom, liberation, open-mind, free spirit, breezy, genial, responsibility, compassion, authority, loyalty, quite, dependable, self-expressive, clean, aqueous, humid, pride, prestigious, elitist, cool, refreshing, heaven, wet, ice, hope, peace, relaxation, imagination, fantasy, sensitivity, creativeness, spiritual or idealistic motivations	Narcissism, conceit, somber, aloof, conservative
PURPLE	Royalty, mystical, artistic, delicate, nostalgia	Mourning, melancholy, endurance, penitence,
PINK	Feminine, sweet, tender, fun, attention-getting	Cloying, overly sweet cheap
BROWN	Earthy, dependable, secure, masculine, chocolate, autumn, sunset	Dirty, boring, decay, rusting, decayed

Table 2.1. Positive and Negative Associations of Colors

Red: Positive: Flame-Blood Red is a group of red often associated with hot, energy, speed, activity, love, resourcefulness, conquest, power and excitement. Wine Red, Burgundy can well be sign of moral responsibility, morality and ethics, justice, richness, and elegance. Terracotta, burnt umber and sienna symbolize comfort, contentment, wholesome, welcoming, warm, snug and familiarity.

Negative: Flame and blood red also can seem as if charged with aggression, domination, rebellion, violence, war, danger, stop, fire, seduction, discrimination, ostentation and rage. Wine red, however, is a token of shame and guilt.

Orange: Positive: Orange is reflector of vigorous and adventurous aspects of life and it is associated with energetic, demanding attention, balance, enthusiasm, vibrant, childlike, friendly, cheerful, glowing, autumn and harvest sunset. Peach can signify warm, inviting, ripe and juicy.

Negative: Orange can also reflect flamboyant, whimsical, crassness, tacky, danger and fire.

Yellow: Positive: Yellow makes good symbol of entrepreneur, wisdom and the joy of enlightenment in many cultures. It is also indicator of experimental and empirical, warm, friendly, sunlight, sand, cheerful, life-giving, imagination and expansion.Yellow ochre and beige can reflect recuperative properties, politeness, warm, neutral, classical and they can be described as deferential, respectful and tranquillant colors.

Negative: Yellow can give the impression of impulsiveness, egoism, jealousy, deceit, illness, hazard, dishonesty, betrayal, cowardice, urine, pus, jaundice, caution and sensational journalism. Beige can also be indicator of lifeness.

Brown: Positive: They are often associated with dependable, reliable, stable, simplicity, rooted, secure, earth, nature, realism, comfort, durable, rustic, masculine, chocolate, coffee. Negative associations of brown are dirty, boring, decay, tobacco and fecal matters.

Blue: Positive: Blue can symbolize freedom, liberation, light-hearted expression, open-mind, free spirit, genial, blithe. It is also sign of aspiration and sublimation, wanting to be free, responsibility, trustworthiness, and compassion. Ultramarine and royal blue can signify a dedication to an idealistic cause, authority, devotion, spirituality, loyalty, dependence and nautical matters,. Turquoise and sea blue can give the impression of clean, aqueous, humid, pride, prestigious, elitist, cool, refreshing and it can be a sign of self-consciousness in children's paintings. Sky blue can be used to reflect heaven, wet, ice, hope and peace.

Negative: Blue seems to have less negative associations such as conservatism, narcissism, conceit, somber, aloof, introversion, sometimes depression and melancholy.

Green: Positive: Green can often be the expression of wit, extratensive excitement, sense of striving, healing, lower stress and makes one feel at ease.

Further, they are sign of confidence of self-expression, fertility, continuity, fruitfulness, productivity, creative, generative, breadth and generosity of nature, eternal and victory. By the way, bluish green can be indicator of critical analysis and logic, persistence, resilience, grit, self-defense mechanisms and tenacity.

Negative: Green can well be sign of misfortune, envy, immaturity, illness, inexperience, busy, workaholic, money, greed, stubbornness and jealousy.

Purple: Positive: Purple is the most spiritual color, that is to say, it is associated with mysticism, magic, faith, transformation, wisdom, creativity, awareness, inspiration, sensitivity, enlightenment, royalty and aristocracy. Moreover, lavender can often symbolize delicacy and nostalgia.

Negative: Negative associations of purple are conceit, pomposity, cruelty, mourning, melancholy, endurance and penitence, suffering and aging.

Neutrals: Positive: This is a group of colors often used to reflect neutrality, reliability, staid, dignity, maturity, solid, intelligence, futurism, modesty, technology, wisdom, tranquility, concrete, practicality and dependence.

Negative: These colors are also used to express conservative, retirement, indifference, sadness, decay, smoke, shadows, ghosthy and somber.

White: Positive: White is generally associated with purity, peace, perfection, light, cool, clean, pure, innocent, truth, snow, winter, marriages, implicitly, humility, reverence and upper class. Being as a symbol for entering a new life, wedding gowns are generally white. Moreover, biologically, human brain tent to like bright colors.

Negative: In spite of being accepted a positive color, white also has some negative associations such as shyness, sterility, surrender, dishonesty, ungrounded, unfocused creative energy and unorganized thinking.

Black: Positive: Black is utilized to signify power, having class, formality, night, elegance, mysterious, heavy, basic, classic, strong, wealth, expensive, royalty, magical, invulnerable, prestigious, depth, sophisticated, sexy, dignified, serious and concealment.

Negative: Black is the most unfortunate color. It is believed to contain not only all other colors, but also malice. Whereas it associated with seriousness, heaviness and royalty, generally it utilized with bad and negative meanings such as fear, troubled state, the unknown, death, ominous, danger, death, foreboding, evil, anger, negativity, unhappiness, corruption, emptiness and depression.

2.4. Use of Color in Marketing:

Margaret Walch (2001), Director of the Color Association of U.S., suggests two possibilities for the question "What's color for?" the commercial value of color in the marketplace and the aesthetics of color in life. Color has an undeniable

importance in marketing and business world. It is the most instantaneous tool to emphasize the marketing message and sell products and create brand awareness. Color helps to create memorable, and identifiable products, in view of the fact that companies spend millions of dollars in order to determine right color choices. In the "Color 4 Business" web-site (2002), color is defined as "Silent salesperson to attract customer's attention" and Leatrice Eiseman, director of the Eiseman Center for Color Information and Training explains the importance of color in business:

> ...60 to 70 percent of the buying decision is made at the point of purchase. With so many products vying for the consumer's money and attention, the effective use of color is one way to capture their attention. Consumers are in an emotional mode when they shop. And when they are in an emotional mode, they are more visually attuned.

Color is effective as a vital marketing tool in various ways. For example: because of the eye catching property of red, it stimulates activity and energy. It influences both sexes and all ages (Russell,1991d). Pink and peach are accepted as feminine colors. Hence, these pastel colors are the obvious choice for cosmetics (Russell,1991e). On the other hand, cleanliness and effectiveness associations of blue make it useful for detergent and face cleanser packaging and advertisements. Moreover, blue is the most preferred color in products for man on account of it's masculine property. Further, being recognized as a sign of safety and reliability, blue is utilized for both transportation and financial matters (Russell,1991f). Yellow, green and brown associate with natural and country-style, so they are preferred for natural foods and hand-made products (Russell,1991b). Many health products make good use of freshness of green and white.

As mentioned in the "Cultural Values of Color" part, reactions to color may vary in different cultures. In this respect, product and brand colors should be chosen properly. For instance: purple associated with spirituality and aristocracy in the United States. On the contrary, it is associated with death and pomposity in Brasil (Color for Business,2002). Melanie Wood, the color and design consultant of Melanie Wood Color and Design Inc. mentioned that:

> Color is a dominant decision maker for us when we're making a purchase. We believe that color sells, but the right color sells better. The important thing is to take the right color putting it on the right product for the right consumer. So you have to be very careful when you produce that color and who your buyer is going to be and be sure that your color is right for the age group or the demographic group (Velshi,2002).

As could be understood from the observations of Melanie Wood, when the color scheme is chosen; gender, age range, culture, religion etc. of target group should be taken into consideration. Especially global companies should pay attention so as not to have undesirable results.

2. 5. Use of Color In Design:

Conducting both conceptual and psychological messages, color is an integral part of design process. At the same time, color can attract attention of users and enhance the corporate image of the design company. Edward Tufte in 1992 explain the importance of color in any design as: "Of all design elements, color most exemplifies the wholeness of design the necessity to reason globally" (Mandel,1994).

Color transforms space and "creates meaning". The physical properties of environment can be perceived differently by means of color scheme applied. Light, color and surface feature are three elements that architects and designers must take into consideration in order to create the most appropriate atmosphere and living space. Color is the fastest and most economical way to make a change especially for interior spaces and it can create a remarkable difference. Dark or warm colors compress space, whereas light or cool colors expand space (Eiseman & Herbert, 1990). To illustrate, the use of high-contrast colors and combinations can seem the space as if it is small. On the contrary, with small patterns, the space is perceived larger and they may make time seem longer. Location of color (floor, wall, ceiling) effects the perception of space's character differently. A specific color that is appropriate on the floor may not be suitable for wall or ceiling (Mahnke,1996).

Color also must be considered as one of the most essential visual variables of the user-centered design process. Color takes place at presentation level with layers, composition, regions of interest, form, tone and typography. It can enhance the usability of visual communications. As a consequence, user satisfaction and application needs can improve with the other visual variables such as value, size, shape, orientation and texture. Colors can be used as functional and decorative in the design of graphic displays. It is mentioned about the importance of color in interfaces in *The designer Guide To Human Computer Interfaces* that: "Properly used, color can be powerful tool to improve the usefulness of an information display system. The inappropriate use of color can seriously reduce the performance of such a system, however" (Mandel,1994). Using color in information displays contribute from

aesthetic appeal to changes in visual search time and cognitive processing. Since human memory is undeniably affected by color, it is seen to be the most effective type of information coding by researchers (Braun et. al., 1994).

Color express both hazard and attention in safety signs. Safety colors convey vitally important message to warn and attract attention of the user and reduce risk of hazard (IES Color Committee,1990). They are utilized in traffic signals, ships, aircrafts, all vehicles, factories, roads, commercial places. To provide the proper use of color and standardization in warning signs and label designs, a number of standards and guidelines have been developed by American National Standards Institute (ANSI) in 1991, Occupational Safety and Health Administration (OSHA), Society of Automotive Engineers (SAE) in 1987 and Westinghouse in 1981. According to these standards, for instance, red, orange and yellow associated with respectively danger, warning and caution (Braun et. al.,1994). Likewise, according to Faber Birren (1963) red, yellow and green colors in traffic signs are symbol of danger, caution and safety respectively.

CHAPTER 3

COLOR IN AUTOMOBILE DESIGN

3.1. The Automobile As A Cultural Product:

Graedel (1998) defines the automobile as "the epitome of emotionally-charged artifact of the Industrial Revolution". It is also a symbol of 20th century. Hardly any product influences the development of human civilization as them. In the advertisements, the reliability and durability of automobiles over horses were emphasized during the early 1900s. Early automobiles were designed according to functional usage of transportation. Rapid technological and business developments in industry have changed the representation of it in popular minds. Automobiles were adopted as the symbol of power, freedom in time and space, masculinity and sometimes sexuality. Also the psychological and personal freedom were reinforced by cars. Living and working patterns were changed in accordance with the advantages of automobiles. Offices, shopping malls and entertainment centers moved from city. As Graedel (1998) said, "the association of the automobile with individual freedom is both psychological and deeply embedded in the physical patterns of modern society."

3.2. History of Automobile Design and Production:

Until the 19th century, development of automobile was impeded due to the extensive use of railways, which had constituted a wide network in many countries. Most of the first automobiles were manufactured by hand craftsmanship as horse-drawn carriages. But, because of the developments and innovations in industry, cars contained plenty of pieces needed to be produced and assembled by craftsmen. In this manner, early mass production methods was developed and carried out by Henry Ford in 1913. Happian-Smith (2001) mentioned that he was also inventor of design standardization in automobile industry. The invention of Ford, assembly line, increased both productivity and sales. Before Ford's innovation, automobiles were expensive toys of wealthy people, but afterwards he made them available to purchase by a large number of people in the society.

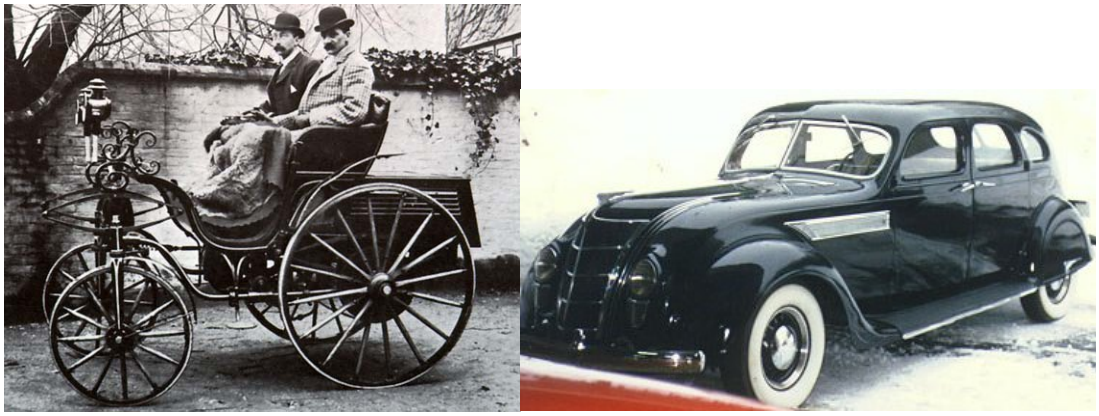


Figure 3.1. From the Horseless Carriages to the Luxury Sedan
(Source: first image; http://www.ausbcomp.com/~bbott/cars/lutzmann.jpg, second image; http://www.uh.edu/engines/epi255.htm)

Ford's Model T was the great leap of automobile design history. As Happian-Smith (2001) explained the importance of it: "Model T was one of the first cars

whose design was primarily dictated by the requirements of manufacture, and thus it represents an early major example of the application of the concept of design for production." Moreover, the production technique of Model T enabled to manufacture cheaper automobiles in comparison with the other early ones. Although the undeniable property of Model T, not only the bodywork of the Model T was said to be minimal and rudimentary and also the color scheme was restricted to black because of the fast drying property of black paint. Essentially, Model T had several color alternatives such as brilliant red from 1908 to 1914. After passing mass-production, the color of it was limited with only black. The reason of this changing was explained in official web site of Ford Motor Co. (2003), *Frills and Extras* article as:

> Starting in 1914 the introduction of the moving assembly line limited color choices since the speed of the new production process required a paint that would dry quickly enough to keep pace with the line. At the time, only particular black enamel met the necessary standards. The black-only policy continued until 1925, when pressure from consumers and the competition led the company to begin offering new colors again.

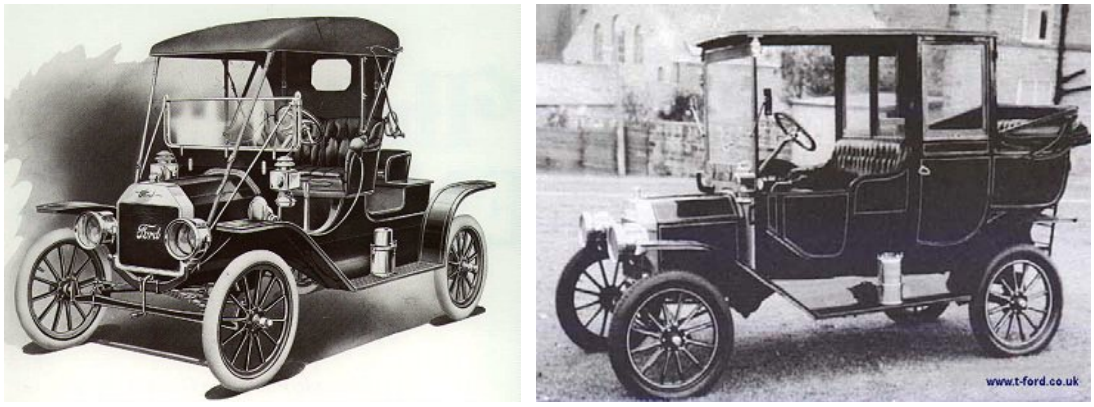


Figure 3.2. Two Examples of Model T, (Source: first image: http://www.users.wclynx.com, second image: http://www.t-ford.co.uk)

On the other hand, after the World War I General Motors, one of the two leading automobile manufacturer in the USA, contributed to the improvement of customer personal preferences. Moreover, other automobile manufacturers recognized the importance of body shapes and colors (Fenton, 1980).

Until the 1930s, the whole automobile bodies, including both popular Model T and sports cars, were shaped like horse-drawn carriages. The streamlining style triggered the modern age of automobile design and industry. As Lisle (2003) mentioned in *Modern Design and the Machine Aesthetic* article, from household appliances to toys of children many object were affected by the appearance of speed. Streamlining, the essence of modernity and speed, is accepted as a great leap in automobile design.

Figure 3.3. A Streamlined Cadillac from 1949,

(Source: http://www.texaschapbookpress.com/magellanslog7/crystalcarsintro.htm)

In spite of the importance of streamlining and aerodynamics in automobile design, the real scientific research was fulfilled by many engineers after the World War II. During the 60s and 70s, however, instead of aerodynamic designs, box-like automobiles and angular forms were popular. Especially manufacturers utilized them

due to the convenience and cheapness of production. According to Happian-Smith (2001) the Volkswagen Beetle, designed by Ferdinand Porsche, was one of the most considerable examples of box-like automobiles that were well known in Europe. Although it is said to be antiquated, incredibly amount of Beetle was sold throughout the world so far.

At the Peugeot-Citroën official web site, *Automobile Design, Style and Substance* article (2003) states that throughout the history, the rise of consumer society and the technological innovations in automotive engineering and manufacturing affected by design. Even, great architects, Le Corbusier and Gropius designed several vehicles in order to emphasize the relation between architecture and automobile design. Discovery of fast drying paint provided to shorten paint cycle and production process. Therefore, pigment industry introduced thousands different body colors. Well-known word of Henry Ford "Any color you want as long as it's black" lost its currency. Alfred Sloan, the president and chairman of General Motors offered many color alternatives for the same models. After the birth of streamlining, independent automobile design firms were established such as Battista Pinin Farina and Felice Bianchi Anderloni.

In 2002, the worldwide annual sales of automotive industry were approximately 64 million. It is expected that the sales will be increased in accordance with the rise of world population, because the automobile is a necessity of life in developed countries and a token of good life in developing countries. According to

Survey of Automobile Industry of May 2000, the five leading automobile company produced the 60% of the whole world production; these are:

- General Motors (8.7 million)
- Ford (7.2 million)
- Daimler Chrysler (6.5 million)
- Volkswagen (5.0 million)
- Toyota (4.9 million)

3.3. Understanding The Automobile Design Process:

Exterior and interior styling of an automobile has a significant place in whole design process. John Fenton (1998) mentioned that "Car buyers are likely to be enthusiasts who are concerned not only about the preformance but also by the sculptural shape of the product".

Takahiro Fujimoto (1999) in *The Evolution of A Manufacturing System at Toyota,* divided the automobile development process to the four phases; that is;

- Product Concept Generation
- Product Planning (Functional and Basic Designs)
- Product Engineering (Detailed and Structural Design)
- Process Engineering (Production Preperation)

In the first stage, necessary data about market demands are collected and technological requirements are investigated in order to respond the needs of

consumers. Moreover automobile concepts are constituded by designers. In this dissertation, first stage will be researched.

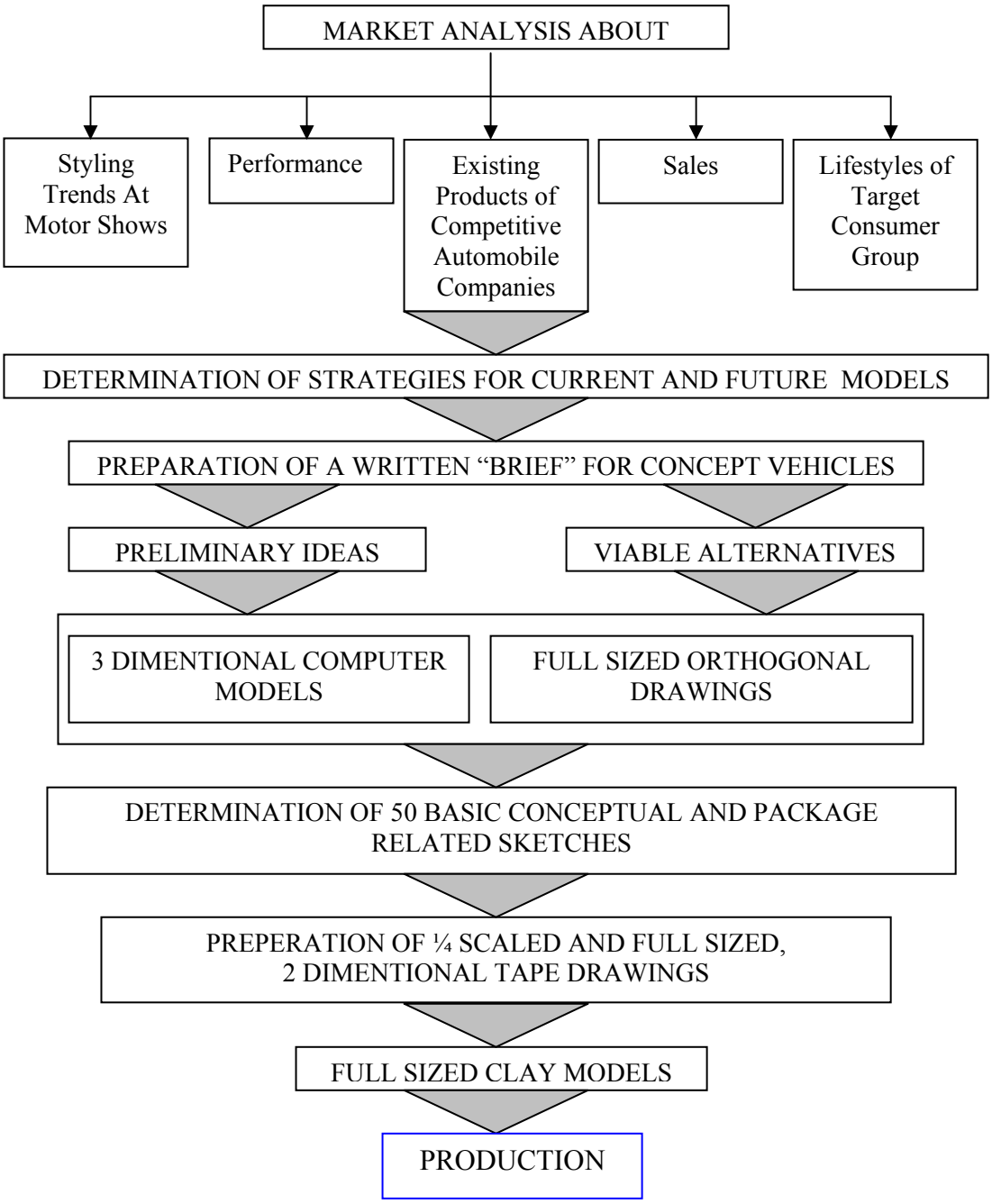


Figure 3.4. Automobile Design Process

The designing processes of automobile companies are similar in certain ways. Styling departments are generally surrounded by security in order to preserve commercial confidentiality. Some design and styling departments of automobile companies work under the engineering department, and some of them are directly under control of Senior Company Management. They are closely connected with engineering and product planning departments. Julian Happian-Smith (2001) clarifies the relationship between styling and engineering departments as:

> The stylists receive information and guidance from engineering, and engineering ultimately receive information from styling on the shapes they must then enable to be manufactured. Differences may affect the slant on decisions on styling issues to a greater or lesser extent. There are no companies in which an engineering department works under the control of styling, but the styling voice can be powerful, given the importance of its role in selling vehicles.

Product planning department determines the strategies for current and future models according to short and long term market analyses about the sales, performance and existing products of competitive automobile companies, styling trends at motor shows and lifestyles of target consumer group (Figure 3.4.). At the Renault official website (2003) in the *Design and Development* article, it is indicated that the production methods, quality and the cost of competitors' automobiles are also carefully examined. Based on these information, product planning department prepares a written "brief" for the project, including of a description of an automobile needed, engines, options, model range, cost and other requirements (Happian-Smith,2001).

When the written brief is sent to the designers and modeling supervisors, they discuss to offer preliminary ideas and viable alternatives in brainstorming sessions to create the target car model. Afterwards, designers draw many idea sketches with colored pencils and markers to form concrete images of future automobiles. 80-90 % of the design directions are decided in this stage (Buonocunto,2000).

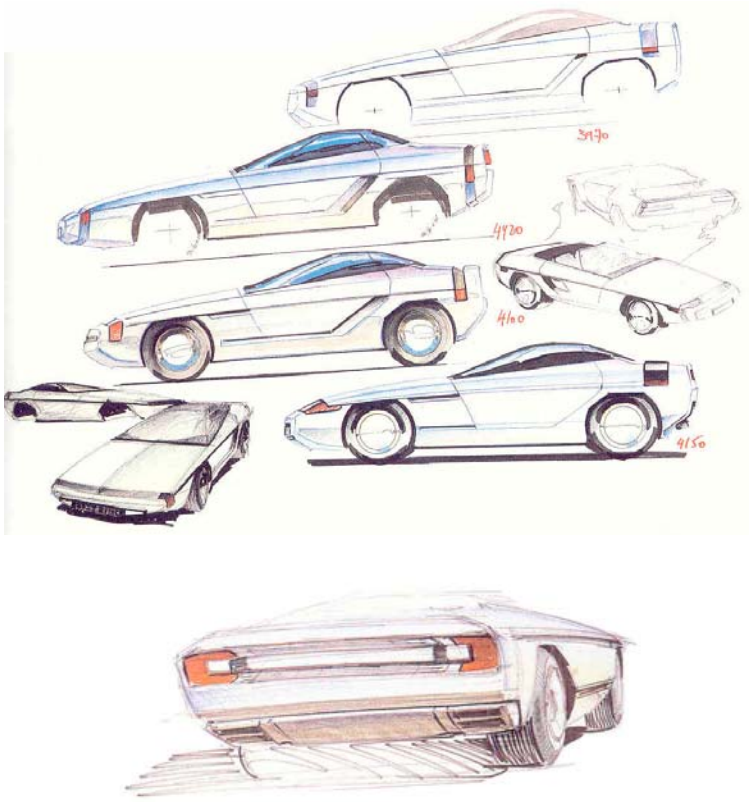


Figure 3.5. Some Sketches from Bertone Design Studio (Source: Tipler,1990)

Then, the three dimensional and full sized orthogonal drawings is prepared by engineers and ergonomists. They also build conceptual 3D computer models by using softwares like Alias and Wavefront AutoStudio. Renault (2003) and Subaru (2002) official websites stated that three dimentional computer technology has a growing role in automobile design and production. The side, front and rear views,

and all necessary ergonomical adjustments of automobile such as location and size of driver and passenger seat and sight lines are involved by design engineers to develop a usable design in the real world. Also, all mechanical requirements and other components are included to ensure the inherent dimensional control. Before the package-related sketches, many inspirational photographs and pictures from magazines, the automobiles of rival companies and existing models are scrutinized in order to achieve a desirable and effective design. More than 50 basic conceptual and package-related sketches are drawn. How attractive the images are is related to the creativity of the designers. At this phase, exaggerated and even caricaturized sketches can be produced freely. Many images are drawn until team of designers is satisfied with the ideas.

Figure 3.6. Tape Drawing,

(Source: http://www.hyundai-motor.com/eng/innovation/design/design1.html)

Later, the side elevation of the chosen design, which consist of only lines, are placed on a display board. As a two-dimensional representation, ¼ scaled and full sized tape drawings enhances to comprehend the size and the proportion of sections of automobile. Then, ¼ - scaled and full sized models are generated to turn a two-dimensional model to a three dimensional shape (Happian-Smith, 2001).

The most remarkable and time-consuming phase of the design process is the clay modeling for both interior and exterior of product. In *Design and Development* article at Renault official website (2003) it is mentioned that some small alterations on design can change the impression completely. Clay models provide to see them, which is not completed with the computer. A flexible and wax based clay is shaped by modelers and designers until they are pleased. All constant and physical components of automobile such as bumpers are implemented. When the clay model is completed, it is covered with Dinoc, a sort of adhesive, to reinforce the quality of paint.

Figure 3.7. Clay modeling of Mini Cooper, (Source: Arıburun, 2003)

In the color and trim departments of automobile companies provides not only the significant input that they need about paint color ranges but also the materials that will be used to cover interior and exterior of vehicle are studied (Happian-Smith,2001). After the necessary changes, three-dimensionally modelled automobile is manufactured and painted according to the directions of Color and Trim Department. Paint of automobiles protects its body and maintains value of it. A paint system consist of three basic element; pigment, binder and solvent. Opacity, and durability of color are obtained by pigment (Fenton,1998). During the paint process approximately five layer coatings are applied to the automobile. First two layers provide permanent protection against corrosion and provide a smooth surface for paint. Then, filler and finishing coat are applied not only to give the automobile its color but also additional protection. Lastly, vehicle is covered by a colorless layer which is luster against to sunlight deteriorations. Most applied methods of paint coatings is spraying by manual, mechanical and electrostatic ways. The purpose of each method is to enable a uniform coating thickness (Giles, 1971).

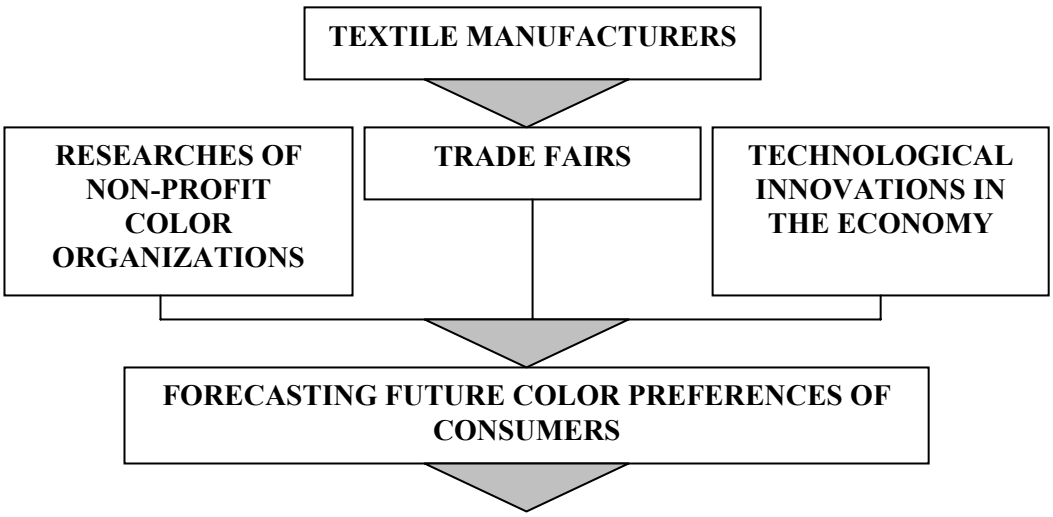
3.4. The Use of Color in Automobile Design Process:

Color is one of the fundamental components in merchandising all kinds of industrial products from pen to automobiles. Ketcham (1958) notified that after the World War II, companies recognized that color would help to sell much more automobiles. Many of them established wide and well-equipped color and trim departments to obtain new and attractive color schemes for both interior and exterior finishes. During 1930s, a pigment manufacturer, DuPont, offered thousands of colors to companies. Also new materials, plastics and fabrics provided new color

combinations to companies. After the war, styling executives of leading automobile manufacturers George Walter (Ford), Harley Earl (General Motors) and Virgil Exner (Chrysler) made extensive analyses of sales and preferred colors according to fashion and interior decoration trends.

Based on the relevant information in second and third chapter, to be successful in today's competitive automobile market, companies should give importance to the appearance and color. With the help of color effects, design and engineering departments create and differentiate automobile brand identity. Applying new and appealing colors raise the sales.

Buying behaviors of consumers are evidently influenced by color and color schemes. According to Walter Franz (2003), "For the automobile buyer, color design is increasingly seen as a mark of product quality in itself. Modern consumer encouraged in this way to be more aware of how product look –especially when buying a car- set ever higher aesthetic standards."



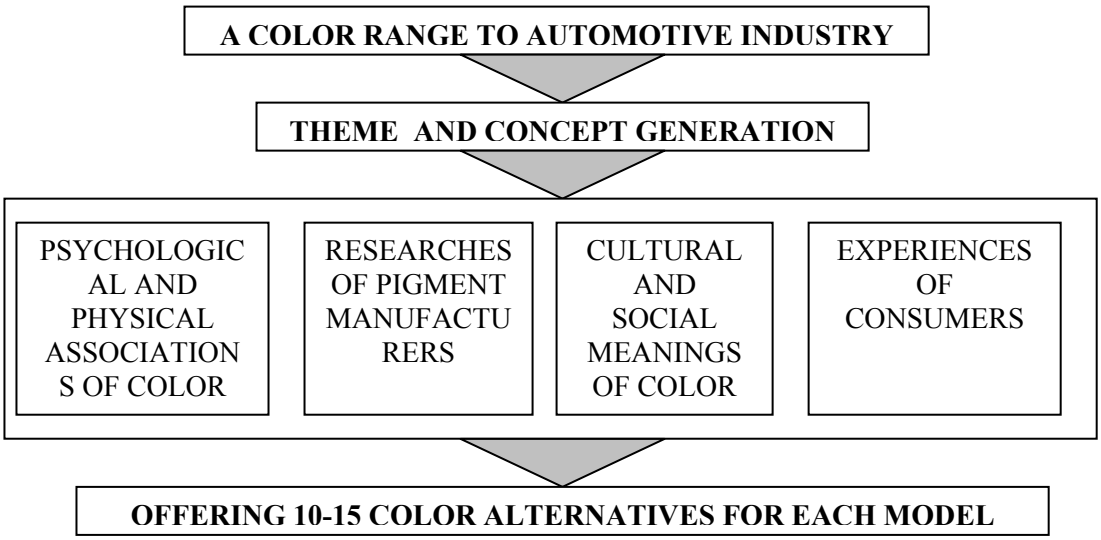


Figure 3.8. Color Determination Process in Automotive Design

Color design of automobiles starts with fashion shows. The most extensive fashion shows and fairs are held in Milan, Paris and Frankfurt by participation of textile manufacturers (Figure 3.8). Based on these fairs and the technological innovations in the economy, designers from automobile companies and pigment suppliers offer a specific color range. Color trends of fashion industry are also adapted to the domestic interiors in 2 years. A color series generally has a life of about six years. There is a close relationship between color and the model of automobile. Some colors affect the popularity of automobiles in positive or negative manner. Also they can reinforce the image of dignified or fast car. On the other hand, according to Richard Russell (2002) design departments of automobile companies work with non-profit international organizations including the Color Marketing Group (CMG) and International Color Authority (ICA) in order to forecast future color preferences of users.

In automobile design studios, color design begins with concept generation process. The relations of human being and automobile are investigated in the comprehensive preliminary research. After finishing the concept studies, more specific subjects such as interior design of automobile are considered. Çağla Işın (2003) who is an industrial designer works with automobile design studios in several times explained the design process. A new journey starts with the theme generation process. In this phase, first of all, whole studies about concept cars are freezed for a while. A number of images about themes are investigated to reach a new and unique one. Furthermore, the colors complete and reveal them are carefully determined according to the three basic property. First of them is cultural and social meanings of color. Second property is the physical and psychological associations of color. For instance: response of individuals to blue and red can be completely different. The last one is the experience of consumer.

Designers work with computer softwares to evaluate and create body colors of the automobile on a graphic display. For example Toyota car designers have been utilizing Color Cad System in the exterior color design process since 1990. Digital 3D systems enable to produce new color schemes and create realistic images of automobile, which designers need in all possible weather conditions. Once colors are determined by design team and pigment manufacturers, they are applied to concept cars and introduced at motor shows in order to show new color schemes. Generally 10 color alternatives are offered for a specific model. In accordance with the reactions of users, either they are manufactured or changed. Some colors may not be approved because of the type of automobile or user group (Russell,2002).

Once color alternatives are decided, each of them has given attention-getting names. Some companies have determined the color names of models with market surveys. That is to say consumers are invited to propose new and creative color names. So, color of that specific model attracts attention of consumers.

On the other hand, automobile designers have some difficulties. Drew Winter (1996) in *Ward's Auto World* article elucidated that painting constitutes one of the most expensive steps in production process. Manufacturers offered 16 color alternatives per model from 1950s to 1970s. In view of the fact that the cost of paint can vary from 50$ to 1000$ per gallon, both exterior and interior color choices were limited. In this manner, complexity of production was also controlled. When color alternatives are limited by automakers, globalization creates another problem. Color preferences of consumer are varied in accordance with geographical region and climate. For instance; popular car colors of France cannot be same with those of India. White is another example. While in U.S. it is one of the most popular colors, it associates with death in China. Correspondingly, the yellow- green, which is the favorite color in Germany, is considered disgusting in U.S.

3.4.1. Color Design of Automobile Interior:

Not only exterior but also interior color design of automobiles should be considered by design teams of companies. In spite of this, interior colors tend to replace less frequently than body of automobiles. The color harmony of the materials in interior designs of automobile such as plastics, textile and leather have become of the utmost importance. Interior design of automobiles contributes presenting

philosophy and the spirit of the company. They should be in harmony with exterior colors of automobiles. For instance; Black leathers and plastics, create a great contrast with the bright colors of a sports car, will associates dynamism. On the other hand, gray both combine with other colors and enable to blend. Beige, as a most used interior trim color, emphasize the openness, clarity and space. The interior color development process based on digital color samples, which are provided by paint suppliers. This constitutes a more creative and uniform conditions for color usage (Franz, 2003).

3.4.2. Safety Design and Automobile Colors:

Automobile colors are also considerably important from safety point of view. Unfortunately, the invention of automobile has caused much more accidents than any other inventions. In spite of many deaths and injuries, there was not any serious attempt to provide safety in automobiles until the 1950s. Safety is now one of the major considerations in automobile design.

According to Levent Köprülü (1999), colors can have a significant role in accidents. Visibility is a function of contrast and reflectence. Some colors can influence the conspicuity of automobiles. For instance; A red automobile can be seen clearly in a snowy weather. But reflectance of red and other dark colors is less than light ones such as white, gray, silver and light brown. Consequently, they could not be perceptible easily in foggy, rainy and overcast sky. Moreover, red cars can be perceived as black at night. Conversely, white is the most visible automobile color at night. On the other hand, properties of background such as trees, houses, traffic signs

have a great impact on visibility of automobile. Consumers have also gradually conceived the safety value of color.

Researches show that car colors could affect the safety factor significantly. Therefore, there are some studies examining the impact of automobile colors on accident rates. A comprehensive study about car color and risk of car crash injury was carried out by a group of scientists of George Institute for Internatioal Health University of Sydney, Autralia. Furness et al. (2003) explained the objective of research as: "We investigated the effects of car colour on the risk of a serious injury from a crash, using a population based case control study designed to identify and quantify modifiable risk factors". Some variables such as age, sex, educational level, ethnicity, alcohol consumption, road conditions and seat belt use were controlled. On the light of relevant findings, brown, black and green automobiles are the most risky car colors respectively. It was an unexpected result that silver automobiles significantly reduce the risk of serious injury. That is to say, a 50 percent reduction was found in the risk of accident compared to a white car.

3.5. The Factors That Affect The Color Design:

There are many variables that affect the color design of automobiles. The most essential ones are color trends and consumer color preferences. On the other hand, automobile companies have close relations with color organizations and pigment manufacturers, which offer thousands of color alternatives to them.

3.5.1. Color Trends:

As it is said in "Use of Color in Marketing" section 2, first 90 seconds of viewing the product influence the decision of buying completely by means of color. Color forecasting and trends have been considered more by a number of companies so as to stay fresh and different (Kuipers, 2000).

Fashion is the starting point and initial source of color trends. Fashion shows and fairs foreshadow the future color trends for both exterior and interior styling of automobiles. But, before reaching automotive industry, color trends are applied to the home interiors. This transition period carry on 11 to 18 mounts. Alan Eggly, Color and Trim Designer of Ford, elucidated in the *Hot New Colors For 2003 And Beyond* article, written by Eric Peters (2001) for Consumer's Research Magazine, that "Once a trend has been established in fashion, if it is successful for a period of time, it is expanded to durable, longer-lasting items such as automobiles". Because of the globalization of the world, color trends spread out and gain acceptance faster than a few years ago. The new technological advancements of media, television and Internet create new lifestyles and affects consumers way of living.

Technology has a major role on automobile color trends. When neon and fluorescence were popular during the 1980s, DuPont Automotive and other pigment manufacturers offered more lighter and brighter colors. Afterwards, pearlescent, luminescent, copper and bronze effects were developed by paint suppliers (Heath, 1997). Some pigment manufacturers such as BASF and automobile companies have studied on a special paint that is perceived different from various angles. Richard

Russell (2002) mentioned that Chrysler Crossfire Sport Coupe in Sapphire Silver and Pacifica in Satin Jade are exclusive examples of this paint.

Figure 3.9. Chrysler Crossfire Sport Coupe in Sapphire Silver, (Source: http://www.autointell.net/nao_companies/daimlerchrysler/concepts-2001/chrysler-crossfire/chrysler-crossfire-01.htm)

Predictions of color consultants and designers about color trends of 2003 were silver. As would be expected silver, associates with power and authority, has been the most popular color in the world since 1998. According to Margaret Hackstedde, Director of Color, Fabric and Mastering Design of Chrysler Group, stated in the Chrysler Pasifica article which is written by Richard Russell (2002) that:

> From automobiles to appliances, silver will be a strong for many mainstream products... In fact, one out of every four vehicles that we sell is silver. For the 2003 model year, we'll start to introduce fresh, new silver-influenced hues on our cars, trucks and minivans. Silver is a technical, refined colour that reflects the continuing technology boom. We'll also blue, along with a variety of blue shades, emerge as a popular colour choice in 2003.

On the other hand, *Automotive Color Approach 2000* (ACA, 2000) of CIBA Specialty Chemicals Inc, production of black and silver cars has increased rapidly

since 1987. CIBA (2000) is a world-wide company which monitor and analyze the trends and technological changes in automotive coatings. This raise of black and silver can be seen in Chart 1 which is prepared by CIBA:

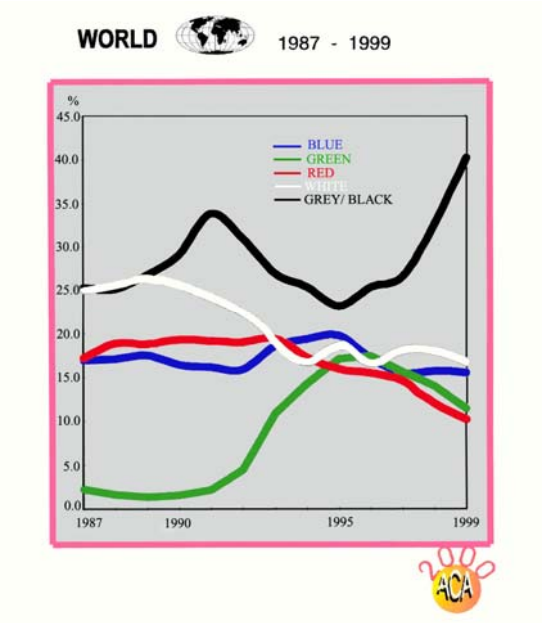


Figure 3.10. Car Production Color Popularity between 1987- 1999,

(Source: ACA, 2000)

In regard to future trends, the third millennium automobiles is said to be covered with fresh and bright shades. The cars of future will be in orange, yellow and gold tones irrespective of brand and model, in spite of being rare in the past. According to annual survey results of DuPont Automotive (2001), the reason of this will be the expression of "strong individualism of consumers". Such colors make good symbol of extroversion. Furthermore, gold evokes a sense of grandeur and luxurious lifestyles. They claimed that these colors would be popular especially on sport utility vehicles, truck and small cars such as Ford Ka and VW Beetles.

Figure 3.11. Yellow VW Beetle,

(Source: http://www.vw.com/newbeetle/photos_ext.htm)

3.5.2. Consumer Color Preferences:

When buying clothes, decorating a home or purchasing a car, personal color preferences have a significant place. Automobile colors express and influence the personalities of users and consumer color preferences. It is one of the essential purchasing criterion for customers and automobile color selection is a very emotional step. Larry Getlen (2002) mentioned that according to researches of Yankelovich and Partners, a marketing consultant, “As many as 40 percent of customers would switch car brands if unable to get the car color they desire” .

Consumer color preferences are influenced by many variables such as age, gender, education level, ethnic origin, nationality, geographical region, continent, memories, society, symbolization and perception of color, personal characteristics and experiences (Birren,1963). For example; Extraverts like warm colors, in contrast, introverts tent to prefer cool colors. As would be known, women generally tent to prefer warm hues that are ranged from red to yellows and men tent to choose cold or cool colors from green to blue (IES Color Committee,1990).

Moreover, ethnicity is another factor that when it is asked to choose the color that associated with power, whites preferred red, whereas African-Americans single out black and Hispanics chose bright blue (Heath,1997). With regard to geographical region, the color preferences of automobile depend partly on the continent.

Society can influence the color preferences of consumers. That is to say, automobile color selections based on economic situations, lifestyles of community and fashion trends in a society. For instance: in times of economic crisis, consumers tend to purchase neutral and dark colors (Heath,1997).

According to Barış Üner (2002) one of the designers of Tofaş Automobile Factory claims "Both Turkish and European automobile consumers are so conservatives that they tend to prefer more classical colors such as black, white and red than radical colors. Even though, they consider color as much as other properties of automobile, while purchasing consumers have not demand lively or radical colors so far." He exemplifies the reason of this as follows; "People indeed like the apparels which is presented in fashion shows, but they do not purchase them because of being too radical designs"

Regional conditions also effect the decisions of consumers. For example; in desert climate, lighter and earth tones are widely used not only on exterior colors of vehicles but also with clothing, home furnishings and exterior paintings of houses. The reason of that light colors reflect the heat more than dark colors. A black or dark blue automobile can be unbearably hot especially in summer. Conversely, dark

automobile colors are popular in cold regions. According to Zelanski (1989), warm and bright colors such as white, beige, off-white, silver and light gray are popular in sunny countries, because such colors reflect intense heat of sun whereas, cool ones are mostly used in cold countries.

The Bulin Group in United States analyzed the color preferences of automobile consumers based on their age (Table 3.1.). According to them, during the 2000-2003 the new generation, who born from 1979 on up, prefer the rebellious colors and olive, whereas the generation of Second World War prefer not trendy and timeless colors (Lienert,2002).

AGE GROUP	FAVORITE COLORS FOR AUTOMOBILE USERS BY AGE GROUP
23 year-olds	Most popular colors are olive draps, blacks. They hate purple and fuchsia; any vehicle colors their parents once bought.
24-37 year-olds	Hunter green, tan maroon and they prefer "boating and polo colors" that are practical.
38-56 year-olds	Generally they want black and silver and sophisticated colors that reflect personal power. Also they prefer colors that will impress their children.
57-67 year-olds	Blue and Khaki are preferred colors. they do not want to attract attention. They also prefer timeless and not trendy colors.
68-87 year-olds	White, which means elegance and wealth, is favorite of them. They influenced by clothing in depression era movies.

Table 3.1. Consumer Color Preferences Based on Their Age

Jennifer Harper (2001) states in *Auto Amour Out of Control* article that, according to The British Royal Automobile Club, automobile colors reflect

consumers' personality more than any other product. They also prepare a list about car color preferences of users. According to them the consumers who prefer black are ambitious and status seeking, whereas those choose green are traditional, elitist and gentle to the environment. Owners of blue colored automobile are defined as team player and social. On the other hand, red ones show that their owners are outgoing, impulsive and easily bored. Drivers of gold and silver colored automobiles seek sense of wealth and elegance. Another survey was done by Goodyear. As to the results of the research, 62 percent of 2000 automobile owner talk to their automobiles and 15 percent of owners accept them as a member of family. 32 percent of respondents give names and 53 percent of them carry a photo of their automobiles.

3.5.3. Design of Vehicle:

Exterior colors not only expose the personality of consumer but also the design and character of vehicle. Therefore, automobile designers should take into account the unity of themes and design of model and color. Some colors are identified with certain automobiles. For instance, red is always appropriate for sports car. In luxury ones as Mercedes and BMW, conservative colors are preferred such as black, white, dark green, and dark red. Small automobiles (Ford Ka, Fiat Palio and Honda Jazz) are generally colorful and trendy (Russell,2002). A fire red or canary yellow can be striking on a sports car such as Ferrari or Porsche, would look ridiculous on a Mercedes or BMW. Moreover, natural colors such as beige, white, light green, and brown can increase the outdoor feeling for SUV's (Sport Utility Vehicles).

According to Barış Üner (2003) red and opaque colors are most widely used in sports car. In fact, in many developing countries such as Turkey, some middle-class consumers prefer red automobiles. On the other hand the most preferred color for C segment automobiles is white.

3.5.4. Color Organizations:

Color Marketing Group (CMG) and International Colour Authority (ICA) are leading global non-profit associations. CMG consists of 1700 color designers, specialists and marketing professionals from all sectors who are involved in the selection, specification and application of color (Velshi,2002). They analyze the tendencies of the world from social trends to lifestyles, art, pop culture, fashion, politics, and technology and made future color predictions according to consumer's desires. Nada Napoletan Rutka, the past president of CMG, stated that "Color trends are a reflection of consumers' changing tastes and acceptance levels, so all sorts of cultural influences come into play when we talk about our forecasts." (Heath,1997). It is obvious that, color is the inseparable property of product in every industry from fashion, home furnishings to appliances. So, their working group comprises everything from automobiles to flowers. Based on economic, demographic and social trends, CMG and ICA generally choose a palette of about 35 colors from electronically produced 16.8 million colors. In the Financial Post (2002) *Get Ready for Tickle Red, Moondance White and Hopr Blue* article, the goal of them is explained as "Put the right color on the right product for the right consumer at the right time." CMG is also a trade organization, which is hold meetings twice a year,

and they select color palette for 18 to 24 months out. In their annual meetings they also focus on commercial color trends in different sectors.

3.5.5. Pigment Manufacturers:

Pigment suppliers are another major power behind the predicting color trends. They not only offer an unlimited color choice but also help to vehicle manufacturers forecast automobile design and color trends. They works with them on a two-to-three-year lead-time on a new automobile colors. They have also developed a wide range of colors in fashion apparel, interiors and graphics. Some of them have published an annual color popularity report in every year for every industry. DuPont, PPG, Akzo Nobel and BASF are the leading manufacturers in automotive industry. Many innovative and creative color designers have been working in order to create new appealing, and aesthetic coatings for future automobiles. Also trim materials and glass laminating products are designed and exposed to the industry. For instance; nowadays these four major paint and coating suppliers have made researches about both safe and aesthetic colors more visible at night (Weilgat, 2002).

3.6. Automobile Segments:

Segments are determined by the exterior sizes of vehicles, that is to say axle and length of car are the basic measurements of them. However, nowadays these dimensions have changed because of the technological innovations in automotive industry. The segmentation of automobiles has gradually changing and losing their popularity due to design and produce distinctive and unique vehicles which started in 90th (Üner,2003).

A (Mini) Segment: Segment of small city cars such as Fiat Panda, Volkswagen Lupo, Nissan Micra, Smart, Daihatsu Cuora and Mini Cooper. Target consumer of Mini segment is young generation. The color alternatives consist of trendy and lively hues. Figure:Mini Cooper, source:http//www.mini.com	
B (Small) Segment: They are defined as economical class with 1600 cc engine power. Some examples of small segment are Fiat Palio and Renault Clio. Target consumer of B segment automobiles are young generation and middle class. Figure: Fiat Palio, source: http://www.fiat.com.tr/modeller/palio6.htm	
C (Lower Middle) Segment: The segment of most economical family models such as Fiat Stilo, Opel Astra and Ford Focus. It is also the most produced and purchased segment in the world. Figure: Opel Astra, source:http://www.opel.com.tr/	
D (Middle) Segment: They are designed as family cars. Usually preferred by older member of family. Opel Vectra, Audi A4 and Fiat Marea are some examples. Figure: Audi A4, source:http://www.audiusa.com	
E (Upper Middle) Segment: The segment of prestigious cars. Audi A6, BMW 5 series and Mercedes E series are some examples. Figure: BMW 5 Series, source: http//.www.bmw.com	
G (Lux) Segment: The segment of the most expensive and prestigious cars. Color alternatives are generally boring and limited. Figure: Mercedes S Series, source: http://www.mercedes-benz.com	
H (Sport) Segment: Segment of Sports Cars. Figure: Porcshe 911 Targa, source: http://content2.us.porsche.com/prod/911/targa.nsf/usaenglish/targa	

Table 3.2. Automobile Segments

3.7. Color Ranges in Different Automobile Markets:

Economic conditions, lifestyles, buying habits of consumers and climate effect the color preferences of nations. For instance; the Japanese and the American automobile comsumers have different color preferences. In addition, social, technological and cultural developments have a great influence on color trends. Automobile companies offer different colors in different countries based on the desires of society. Consequently, color ranges of manufacturers vary considerably from Japanese markets to the European and American markets.

Silver made the most significant gains in popularity with consumers in America, Europe and in the Far Easthern countries. It has leaped from fourth place to first in C Segment cars category in United Kingdom, USA and Japan since 1996. In *Your True Colors* article written by Debra Beyer (2003), Keiichi Kitahara, product planning manager of Nissan Corp., said that "Silver, black and white are staples in the industry and make up the majority of sales" Pigment manufacturers claimed that silver will be the perennial leader of automobile industry. Although, white remained the most favorite color for luxury segment automobiles, it has lost it's popularity in C and D segment vehicles since 2000 except for some Asian countries.

United Kingdom Color Alternatives:

Renate Weber, one of BASF's color stylists, explained the factors that effect buying habits of European and English automobile consumers in the *Global Automotive Color Trends* Article (2003). According to Weber, "People today are facing a flood tide of information and therefore long for rest, seeking ways to retire

into themselves" Weber also claims that color alternatives of vehicle manufacturers are directly influenced by the theme of "longing for rest". Therefore, both bright and quite, subdued colors are launched by automobile companies for English consumers.

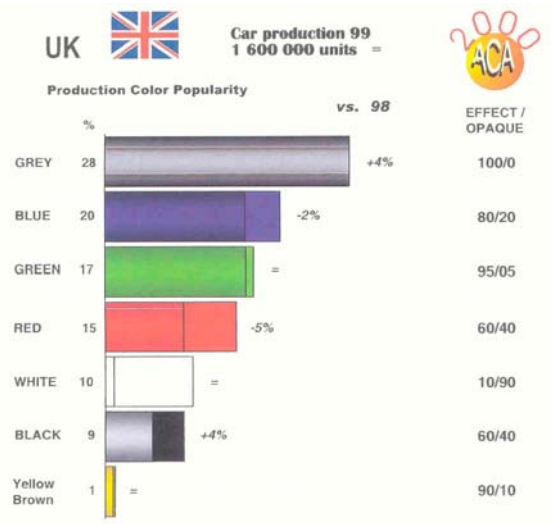


Figure 3.12. Automotive Color Approach 2000 of CIBA for United Kingdom, (Source: ACA, 2000)

According to the Automotive Color Approach (ACA) 2000 of CIBA for United Kingdom, silver shades, green-beige, blue, green and red are the most preferred car colors for English consumers. Pure white and black shades lose their attractiveness. Moreover, some companies such as Hyundai and Renault do not insert black and white to color ranges of C segment automobiles. Silver is the most popular automotive color for English consumers. As a consequence, color alternatives of many car manufacturers contain at least two tones of silver. Dark hues such as navy, green and dark red have some significant cultural and traditional associations for them. Hence, these colors are also preferred mostly. When color ranges of selected automobile manufacturers is investigated, it can be seen that Renault, Ford and

Volkswagen constitude the most appropriate color range for English automobile consumers.

Figure 3.13. Ford Focus Colors (U.K.), (Source: http://www.ford.com)

Figure 3.14. Toyota Corolla Colors (U.K.), (Source: http://www.toyota.com)

Figure 3.15. VW Golf Colors (U.K.), (Source: http://www.volkswagen.com)

Figure 3.16. Renault Megane Colors (U.K.), (Source: http://www.renault.com)

Figure 3.17. Hyundai Accent Colors (U.K.), (Source: http://www.hyundai.com)

United States of America Color Alternatives:

Silver is also the most popular car color in United States. According to Jon Hall, Automotive Color Expert of BASF, mentioned in the *Global Automotive Color Trends* Article (2003) that "In North America, people have seen the collepse of the technology bubble, the shock of terrorist attacks and the onset of recession" In order to get rid of negative effects of these events, they prefer light and bright colors. Hall also indicates that American automobile consumers generally liked to select colors from an wide range.

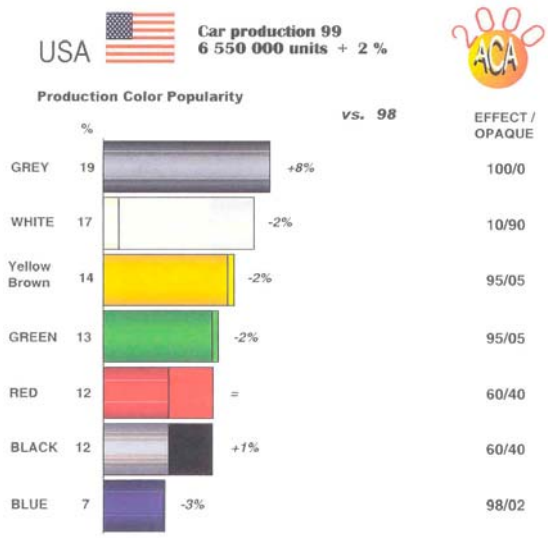


Figure 3.18. Automotive Color Approach 2000 of CIBA for USA,

(Source: ACA, 2000)

According to Jenn Hess (2004), Associate Editor of The Automotive Coatings Market, the European and North American buying habits of automobile consumers are completely different from each other. Hess mentioned “In North America, the majority of car sales are taken off the lot. Automakers tent to populate inventories with standard colors that everyone likes. In Europe, cars are ordered 100% of the time. They do not buy off the lot. There are more opportunities to sell different ranges of colors because customers are used to ordering their cars”

Although, according to Automotive Color Approach 2000 of CIBA for USA, blue which has been the most favorite color in 1996, declined to seventh place in 2000, Jon Hall claims that consumer demands for shades of blue will increase again. The reason of this is the stability and dependeble associations of blue hues.

Figure 3.19. Ford Focus Colors (USA), (Source: http://www.ford.com)

Figure 3.20. Honda Accord Colors (USA), (Source: http://www.honda.com)

Figure 3.21. Hyundai Accent Colors (USA), (Source: http://www.hyundai.com)

Figure 3.22. Toyota Corolla Colors (USA), (Source: http://www.toyota.com)

Figure 3.23. Volkswagen Golf Colors (USA),

(Source: http://www.volkswagen.com)

Japan color alternatives:

In Japan automotive market, solid colors such as silver, white, blue and black, are launched by vehicle manufacturers. Eiji Fujimori, BASF color stylist claims in the *Global Automotive Color Trends* Article (2003) that: "Facing prolonged recession and social unrest, people are longing for piece of mind, humanity ans security" Furthermore, Fujimori mentioned that nowadays Japanese automobile consumers prefer nostalgic, traditional and technological colors.

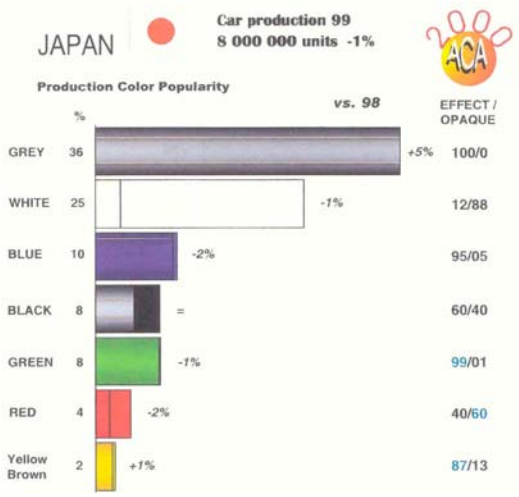


Figure 3.24. Automotive Color Approach 2000 of CIBA for Japan,

(Source:ACA, 2000)

According to ACA 2000 of CIBA for Japan, the most popular automobile colors are silver and white in 2000. Neutral colors such as black, white and silver are popular not only in C segment vehicles, but also in all segments. In addition, Nearly 70% of automobiles used by Japanese people are silver, white and black caused by having technologic and futuristic connotations. Moreover, a variety of tinted blues are also required significantly by Japanese automobile consumers. In spite of demands of consumers, there is no white alternative in color ranges of C segment cars of some companies for 2004 models. Compared to the other countries such as United Kingdom and USA, in Japan automotive market, more limited color range are offered by car manufacturers. According to the desires of Japan consumers, Volkswagen, Renault and Hyundai are the most sensitive companies in this market.

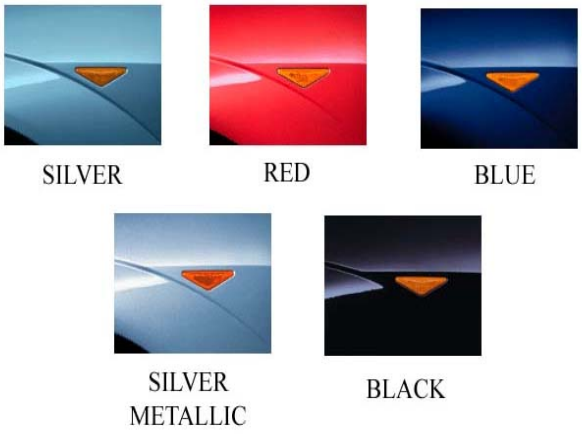


Figure 3.25. Ford Focus Colors (Japan), (Source: http://www.ford.com)

Figure 3.26. Hyundai Accent Colors (Japan), (Source: http://www.hyundai.com)

Figure 3.27. Honda Accord Colors (Japan), (Source: http://www.honda.com)

Figure 3.28. Renault Megane Colors (Japan), (Source: http://www.renault.com)

Figure 3.29. Volkswagen Golf Colors (Japan),

(Source: http://www.volkswagen.com)

CHAPTER 4

CASE STUDY

4.0. Case Study:

This chapter comprises a comparative study on color desicion procedures of automobile manufacturers. Although, the importance of color criteria have been realized remarkably, there has been hardly any study conducted on color usage in automotive industry. The reason of this can be to have difficulty in providing necessary information from vehicle manufacturers. The intention of this study is to reveal the similarities and differences in color determination processes of major automobile companies that affect their success in automotive market.

The objectives of the study are:

1. To gain a broader understanding of the color designing strategies used in automobile companies,

2. To compare the color determination processes of different automobile companies in design and production phases, based on the definite criteria.

4.1. Methodology:

The research of this dissertation consists of three sections. The first part contains literature search. Interviews and questionnaires were conducted in the

second part. Literature search was completed by not only the related books, auto and design magazines. Besides, various internet sources concerning car styling and color were searched. In the second step, several interviews were completed to determine the hidden dimensions of color selections of company strategies. Furthermore, color selection criteria of leading automobile companies are determined. Questionnaires were composed to understand how the color selection process works in the third step.

COMPANIES	ACCEPT	REJECT
GENERAL MOTORS		*
FORD	*	
TOYOTA	*	
SUBARU		*
VOLSKWAGEN	*	
RENAULT	*	
NİSSAN		*
PEUGEOT		*
CITROEN		*
HONDA	*	
HYUNDAI	*	
KIA		*
FIAT		*
SUZUKI		*
MAZDA		*
AUDI		*
SEAT		*
DAEWOO		*
OPEL		*
SKODA		*
DAIHATSU		*
VOLVO		*

Table 4.1. List of Automobile Companies Who Accept and Reject The Interview Request

Both international and local authorities of 22 automobile companies were asked to share information about color design processes. But, only 6 of them accepted the questionnaire request. The list of them is given in table 4.1.

A total number of 6 automobile companies; Ford, Hyundai, Honda, Renault, Volkswagen and Toyota took part in the study of "Color Determination and Application Criteria in Automotive Industry". The results of this study clearly demonstrate that car companies have specific color selection and application processes. This procedures affect the approaches of them to target consumer demands and needs of different automotive markets.

For this study C segment cars were selected. This automobiles constitude the most produced and purchased vehicles in the world. They were preferred by middle class. On the other hand, differences in automobile segments affect the color ranges of companies. Based on the ACA 1996 report which is prepared by CIBA, bright and lively colors such as white, red and blue are mostly preferred for small (Mini) segment. Whereas, black and grey are hardly any used for A segment automobiles. Conversely, they are favorite colors for automobiles in large (Upper-Middle and Lux) segment. According to the ACA South Korean color preferences, medium (Lower-Middle and Middle) class cars are mostly puchased in gray, silver, white, blue and other colors respectively.

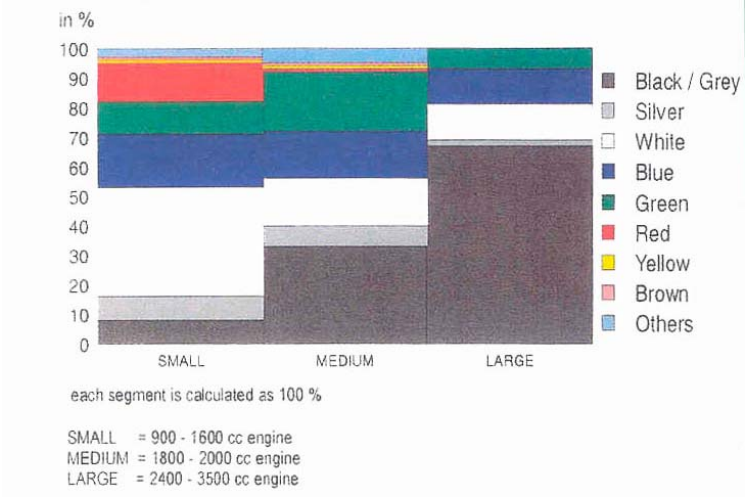


Figure 4.1. Color Popularity By Size of South Korea, (Source: ACA, 1996)

4.2. Interview:

In this thesis, the major objectives of the interviews are:

- To understand how color affects the design and production of automobile,
- To constitute the factors which affect the color determination process.

Interviews were conducted personally via phone calls and e-mail. Before starting the survey, the aim of the research was briefly explained as written or verbally. It is observed that the most satisfying data was gathered by face to face and e-mail interviews. To reach the required information, the structure of the interview were formed by following questions:

- How do manufacturers determine vehicle colors?
- Which factors affect the color determination process?

Concerning validity and reality of the provided information, interviews were held with the representatives of leading pigment manufacturers in automotive industry; DuPont, BASF, PPG and Akzo Nobel. On the other hand, Color Marketing Group and Color Association of United States (CAUS), which are the major international organizations, answered the interview questions. Moreover, vehicle designers and color specialists such as Kenan Erdinç, designer of MAN Bus and Truck Factory, Barış Üner, designers of Tofaş Automobile Factory, Özlem Yurtcu, Color and Trim Representative of Ford Otosan and Maria Thunberg, color designer of Saab provided comprehensive contributions on color determination process. In addition to them, lecturers from two design schools, Eastern Michigan University (EMU) and South Bank University (SBU) responded the questions. The numbers of respondents are given in Table 4.2.

RESPONDENTS	RESPONDENT NUMBER
Vehicle Designers	9
Pigment Manufacturers	2
Design Schools	6
Organizations	2

Table 4.2. Respondents of Interviews

4.3. Questionnaire:

Questionnaire is the most appropriate way to collect the necessery data from respondents. In addition, a well-designed survey can be very effective in order to reach the specific information of the companies. Consequently, the questionnaire

method was preferred in this study. Questions were prepared according to the results of the interviews and the data, which is gathered by literature search. The objectives of the questionnaire are:

- To provide information about color determination process of automobile companies,
- To compare the color determination and application process of 6 leading automobile companies.

Based on the lights of the objectives, in the questionnaire phase, 10 questions were directed to companies. After the questions about name of the company and position of respondents, they were asked to choose the percentage of vehicle which are produced by their company. Further, to comprehend the differences between automobile segments, subjects were asked that how they differ according to the segments in color design process.

In the fifth question, the color preferences for C segment automobiles of companies were asked in order to reveal the differences and similarities in color ranges of manufacturers. Moreover, in the sixth question, subjects were asked to select departments which have contributions on color determination procedure of companies.

On the other hand, the color determination criteria, which were revealed in the interview phase, were asked to arrange according to the importance of usage in design process. These criteria are given below:

- Color Trends,
- Researches of Pigment Manufacturers,
- Sales and purchasing input which are send from dealers,
- Consumer demands,
- Cost of Color,
- Colors applied by other automobile manufacturers,
- Color application capacity of factory,
- Feasibility of color,
- Concept of automobile.

Four significant steps of automobile design and production process were given in the next question and respondents were asked in which step color considered initially. These several steps are as following:

- Data research and analysis,
- Idea generation,
- Modeling,
- Production.

Finally, the subjects were asked to write the color determination processes of C segment automobiles according to their design strategy. Also, this question is in

the open-ended form and they were given a brief space in which to write their answers.

Subjects were asked to be frank in their answers, because reliability of the data is major concern for analysis. Özlem Yurtçu (2003), who is the Color and Trim Designer od Ford Otosan, mentioned that car colors are determined by a crowded team which is comprised of designers, stylists, engineers, suppliers and purchasing managers. Every representative group of design team assess alternatives and scheme in respect to their fields. Therefore, at least one Color and Trim Designer, Production Engineer and Purchasing Manager were selected as a target population for each company. In other words, 18 individuals from Ford, Hyundai, Honda, Toyota, Volkswagen and Renault answered the questionnaires. As Figure 4.1. illustrates, selected companies are the most ranking automobile manufacturers of the world.

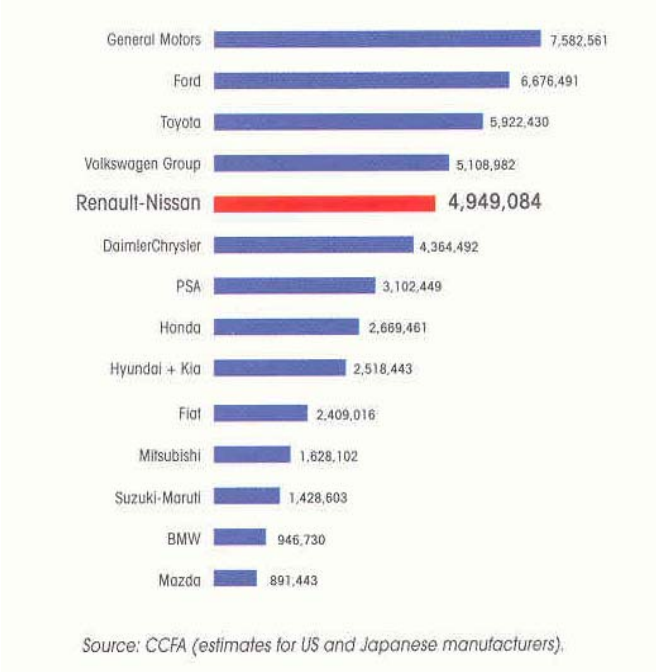


Figure 4.2. 2001 World Ranking Automobile Manufacturers,

(Source: Renault 2002 Atlas)

4.4. Results of Interviews and Questionnaires:

4.4.1. Results of Interviews:

First question of interview was related with the color design process of automobile manufacturers. In this case study, 9 vehicle designer completed the interview. The most detailed information for this research was provided by Maria Thunberg, Chief Designer of Color and Trim at Saab Automobile, Barış Üner, designer of Tofaş and Kenan Erdinç, designer of MAN. Maria Thunberg (2003) explained the process clearly as given below:

Exterior color development has approximately one year cycle time in Saab. All relevant inspirational materials are collected by product design magazines, fashion and furniture fairs, internet sources, the studies of exterior paint suppliers and trend shows. The first selected 50 color samples have been reduced to 30. In next phase, the paint suppliers have painted A4 size electrostatic metal plates of these 30 shades. Then, design team decide to continue with 9 colors painted on full size production cars, in different body styles. When all cars are ready, they are controlled in daylight and different light conditions. Finally the best of them are selected. Thunberg stated that Saab has approximately 13 colors in their program. Every year 3 old colors are replaced with 3 new one. She also stated that in this phase, they have to make sure that each color is appealing. On the other hand, all of them have to support the design and the characteristics of automobile such as sporty, progressive or dynamic.

Afterwards, the new colors are recommended for company management; within design, project and top management. If there are no technical or commercial concerns, the colors of the future models are accepted and the process was completed. Almost one year has gone since it is started, but there is still two more years of testing and technical development until it's in the market.

Interior colors are designed to match well with the exteriors. For this reason, designers are responsible for both exterior and interior colors. The balance and unity of exterior and interior colors is important especially in convertible cars. Thunberg (2003) remarks that:

> Interior colors have not been very colourful the last 15 years. Hopefully this will change! We see a lot of beige, gray and black interiors in cars. Our new Saab 9-3 Sport Sedan has got one of the most interesting interior colours now existing in the market. In my eyes!!!

The perceived interior color is carried through by a lot of different interior materials; Plastics, textiles, leather, vinyl, carpets, door panel foil, instrument panel foil, headliner, parcelshelf etc. The challenge is to make them exactly alike. When all interior and exterior components of automobile came to almost the same shade, a full-scale car is painted and dressed up. If the design is approved by management, the design phase is over. Afterwards, the technical department takes over the responsibility to industrialize new model.

Saab Color Design Process can be summarized as below:

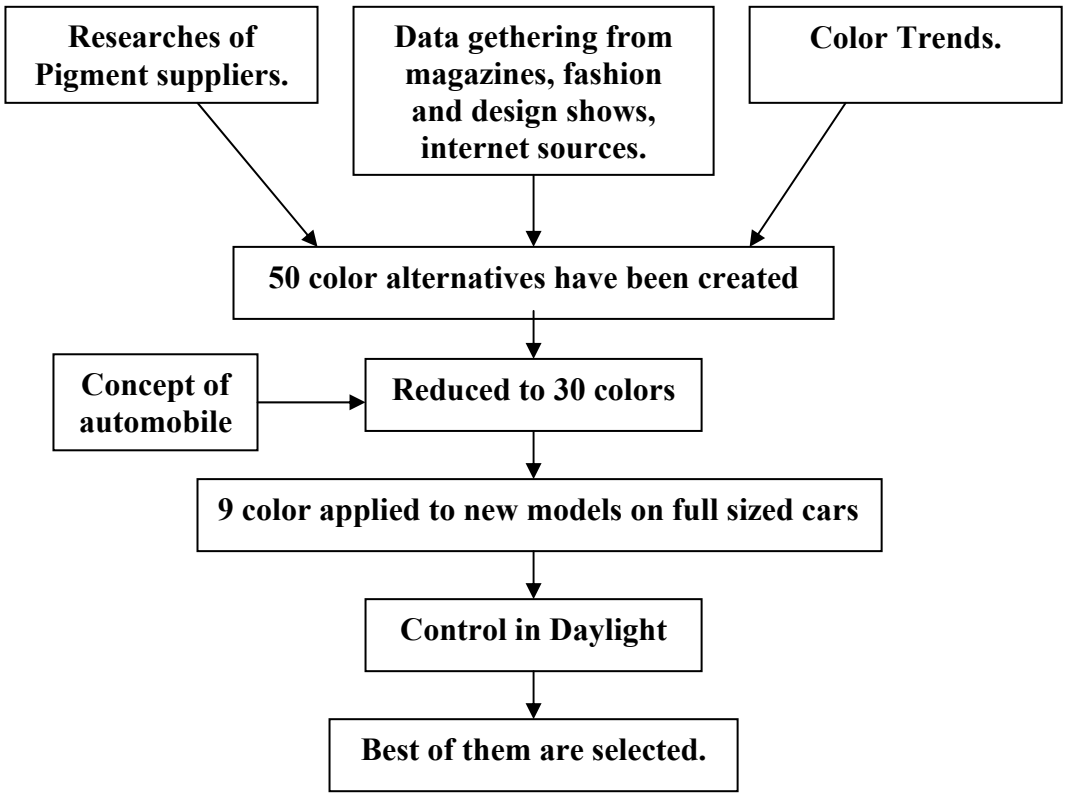


Figure 4.3. Saab Color Design Procedure

According to the interview results of Maria Thunberg, Saab Color and Trim Designer, the most important design criteria are data gathering from written or visual media and several fairs, researches of pigment manufacturers and color trends. Moreover, design and characteristics of automobile are essential for creating most appropriate 30 color alternatives.

Another Color and Trim Process information was provided by Barış Üner (2002), the automobile designers of Tofaş:

The colors of the automobiles are determined in accordance with the application capacity of the factory and the consumer demands, which are the first two essential criteria. Then, , which are provided by dealers, are assessed. According to the outcomes of the results and the characteristic of automobile, Tofaş run approximately 12-15 body color alternatives. Color trends in fashion and interior design are significant sources for Tofaş designer team. The innovative and creative color alternatives of pigment manufacturers are also required for Tofaş designers.

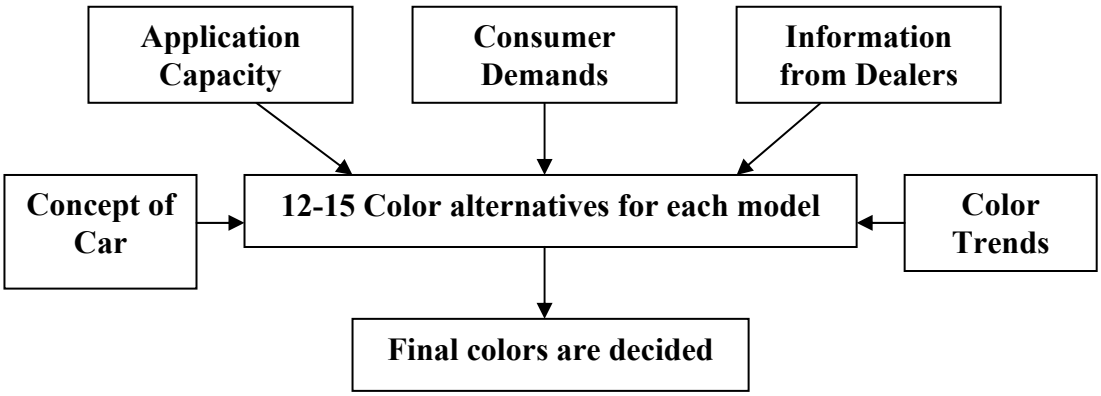


Figure 4.4. Tofaş Color Design Procedure

Automobiles are launched with trendy colors in order to attract attention. Even if these colors are involved in color catalogue, only one or two per thousand are sold. Besides, Üner (2002) mentioned that related with the design of automobile, mostly 5-6 color alternatives between 10-15 of them are sold for one model. For example; Fiat Palio were launched by light and lively green to the Turkish market. But only 2 to 1000 of green Palio were purchased. He also indicated that Turkish and European consumers have tend to prefer silver and white automobiles since 1998.

On the other hand, another vehicle designer Kenan Erdinç (2002), who respond the interview questions, mentioned that color ranges of automobiles are determined by collected data about properties of related markets, characteristics of target consumer and concept of car. Erdinç also stated that some technical issues such as paint application capacity of factory, feasibility and cost of color can be significantly important for automobile companies. Furthermore, sale percentages of new models are closely followed by competitive manufacturers. If a color provides a great leap in certain type of vehicle, it is started to be used by other manufacturers. As a consequence, colors applied by other manufacturers is an important criteria for them.

It can be inferred from the results of the interviews which were held by vehicle designers and color specialists of companies that the most important criteria are target consumer, data analysis of market demands, color trends and researches of pigment manufacturers. Besides, they believed that feasibility and application easiness of color are also necessary and vital as much as the other criteria. Moreover, they added that the conceptual design of vehicle also influence the selection of color.

On the other hand, according to the design schools, color trends also should be taken into consideration in automotive development process. The most required sources for color trends are fashion shows, periodicals, trade journals, lifestyle magazines. Also, they underlined that researches of exterior coating suppliers are essential for color design. Furthermore, studies of color forecasting services such as CMG provide convenient information for automobile manufacturers. Bill Longley

(2002) from EMU notified that cost, surveys, sales, marketing and dealer inputs and orders also should be considered.

Paint suppliers and various national and international color organizations emphasized that observing color trends and analysis of their researches are essential factors in determination process. On behalf of the DuPont, Ern (2002) responded the interview questions. Ern elucidated that color design of automobiles is extensively related with the trends. The relevant color trend analysis can be obtained by detailed and profound investigations. Observations of trends can be carried out by attending trade fairs and exhibitions such as fashion, textile and interior design fairs. Ern also indicated that evaluations of information published in trade media such as View on Color, Textile View, Design Report and Textile Deco also have great contributions on color design of automobiles. On the other hand, in order to constitute the most appropriate car color scheme, automobile designers should not only participate to general design workshops but also to observe the other design fields such as ceramic and graphic industries and music scenes. With regard to consumer demands, comparative analyses of color priorities of customers can be derived from studies of Federal Motor Vehicle Office in USA, consumer-specific data of pigment manufacturers and international organizations such as CIBA Automotive Color Approach.

RESPONDENTS	RESPONDENT NUMBER	CRITERION/CRITERIA MENTIONED BY RESPONDENTS
Vehicle Designers	9	• Researches of Pigment suppliers • Data gethering from magazines, fashion shows and internet sources. • Color Trends • Concept of automobile • Application Capacity • Information from Dealers • Feasibility of Color • Cost of Color • Color applied by other companies
Design Schools	2	• Color Trends • Researches of Exterior Coating Suppliers • Studies of Color Forecasting Services • Cost, • Surveys, Sales, Marketing and Dealer Inputs and Orders
Pigment Manufacturers & Organizations	8	• Color Trends, • Analysis of Their Researches, • Consumer Demands

Table 4.3. Criteria Determined by Interview Results (Summary)

According to the results of interview 9 most essential color design criteria were determined.

4.4.2. Results of Questionnaires:

Based on the results of interviews, questionnaire was constituted. Six automobile manufacturer, which are listed in Table 4.1., accept to share information about color determination process in their companies. All of them agree with the dominant power of color in car industry and it cannot be undervalued in design and production phases of automobiles.

	FORD	TOYOTA	HYUNDAI	VOLKSWAGEN	RENAULT	HONDA
Bright & Lively Colors	✓	✓	✓	✓	✓	
Natural Colors	✓	✓	✓	✓	✓	✓
Dark Shades				✓	✓	✓

Table 4.4. Color Ranges of Companies for C Segment Automobiles.

In the fifth question, color ranges for C segment models of six automobile companies were questioned. Competent authorities of Volkswagen and Renault mentioned that their color scale comprise not only bright, lively and natural shades, but also dark tones such as black, navy blue and dark green. On the other hand, Ford, Toyota and Hyundai schemes is covered by both bright & lively and natural colors. However, Honda designers stated that bright colors are not preferred as much as other tones and shades. The results of fifth question is given in Table 4.4.

Determination of color schemes of a new model depend on many variables such as consumer demands, data gathering, trends and some technical properties of manufacturing plant. On the other hand, as mentioned in the second and third chapter, cultural characteristics and social structure of countries influence the color alternatives of global automobile manufacturers. Therefore, in the color references of companies, there can be some differences according to the markets. For instance, altough it is stated that Ford prefer bright and natural color for C segment cars, dark

tones are dominant in Ford Focus colors of English market. It can be seen in the Figure 3.13.

In the sixth question, the subjects were asked to select the departments which contribute to color determination process. All companies were stated that Color & Trim, Marketing and Production Departments work together in order to select most appropriate colors for their models. Color design studies are conducted by a qualified team in each company. For example: Ford Color Design Team is assigned by Chief Program Engineer and team comprised by representatives from Purchasing, Color and Trim, Vehicle Center Engineers, Vehicle Operations, Manufacturing Operations Engineers, Global Paint Engineers, Material and Color Timing Workplanner, Texture Source, Material Engineers. Suppliers also participate the color design studies and they control the produced exterior and interior parts whether they match with the master color plaques or not. In Toyota, a Chief Engineer is assigned to each new model and the CE is charged with both conducting the development and color design of automobile. CE should also make sure that it is appropriate with design of vehicle and customer demands as well as the philosophy of company. Similarly, The colors of Renault are determined by a project team that includes designers, engineers and marketing managers in Technocentre at Guyancourt.

Color design is a process, which starts from the concept studies and continue up to the production of vehicle. This process consists of four specific phases; data research and analysis of gathered information, idea generation and creation of concept vehicles, modeling and testing automobiles and finally production. Color is

considered intensively in the first two steps by Ford, Hyundai, Honda, Volkswagen, Renault and Toyota. According to the Color and Trim Designers, Production Engineers and Purchasing Managers of Honda and Toyota, color is considered initially in the data research and analysis phase. Whereas, those of Ford, Hyundai, Volkswagen and Renault stated that the essential step in order to constitute body and interior colors is the idea generation and designing phase. The color designing steps of companies are shown in Table 4.5.

COMPANY / PHASE	Hyundai	Honda	Volkswagen	Toyota	Renault	Ford
Data research and Analysis						
Idea generation						
Modelling						
Production						

Table 4.5. Color Designing Phases of Companies

According to the results of interviews, color trends, sales and purchasing input which are send from dealers, consumer demands, the researches of pigment manufacturers, feasibility and cost of color, colors applied by other automobile manufacturers, color application capacity of factory, the unity with design of automobile and color were selected as color determination criteria. Arrangements of the respondents are shown in the Table 4.6.

CRITERIA	Hyundai	Honda	Volkswagen	Toyota	Renault	Ford
Color Trends	5	3	2	5	4	2
Researches of Pigment Manufacturers	9	9	5	4	5	4
Sales and purchasing input which are send from dealers	2	1	4	3	3	3
Consumer demands	1	2	1	1	1	1
Cost of Color	8	5	6	6	8	8
Colors applied by other automobile manufacturers	3	8	7	7	9	9
Color application capacity of factory	7	7	8	8	6	6
Feasibility of color	6	6	9	9	7	7
The Design of Automobile	4	4	3	2	2	5

Table 4.6. Arrangements of Color Determination Criteria of Companies

The results of the questionnaires indicate that there are some significant differences on color determination processes of leading automobile manufacturers. Arrangements of criteria and selections of color designing phases of companies reveal these differences. Moreover, brand identity of them, which is essential to the commercial success, has a direct influence on this process.

In the light of questionnaires, the arrangements of color determination criteria of six automobile companies are explained below. The companies that have very similar processes were considered together. For example: first three criteria are the

same in Renault and Toyota. Last four criteria are the same in Ford and Renault, Toyota and Volkswagen.

Ford initially considers consumer demands such as better and faster product quality and low cost. Then, color trends are concerned. Color and Trim designers of Ford mentioned that they spend approximately 11 to 18 months to research color trends in fashion, furniture and other industries. At the beginning of the process, Ford made a comprehensive global market research and develop a strategy in color, trim, mastering and harmony process in order to meet customer expectations. Also, the information provided by Ford dealers from all over the world is taken into account. With the help of paint manufacturers, new color alternatives are created and translated into automobiles.

The Color and Trim Process of Ford, which starts 35-37 months ahead of production, is divided into three basic steps; Vehicle Line Strategy (Image Phase), Global Palette Strategy Phase, Vehicle Line Specific Strategy Phase. First image for color and trim product letter is offered in the meeting of Vehicle Line Strategy phase. Then, based on regional desires and demands of customers, a global color palette for exterior and interior colors, finishes and material such as leather, vinyl and fabric is determined at several meetings in the Global Palette Strategy Phase. Regarding to the last step, specific exterior and interior color palette are decided in senior management meetings. After a comprehensive market research, the design of automobile is considered in accordance with consumer desires and color trends.

Correspondingly, Toyota, Renault, Volkswagen and Hyundai have carried out color and trim studies based on the approach of "Customer demands always come first". Toyota constitutes special showrooms to make consultation with customers on their desires and tastes. A special consulting staff gathers opinions of them related with exterior and interior color combinations and the other features of vehicles in these showrooms. Also, customer evaluation data about specific components of automobile are prepared by staff. In other words, the relationship between customers and company are maintained by dealers. Regarding to Renault, on the basis of detailed analysis and predictions about color preferences and behaviors of target customer segment, many color alternatives which is appropriate with the design of automobile are constituted by product planning and engineering departments. That is to say, the second important criterion for Renault and Toyota is design of car in color determination process. Thirdly, both of them evaluate the sales and purchasing information received from dealers.

The fourth factor that effect the color determination process of Toyota is that researches of paint suppliers. They offer new body finishing alternatives in accordance with the technological innovations. Moreover, Toyota works with international color research and development organizations so as to meet the future and current market trends and regional preferences. Toyota has three main researches and development center in Japan, USA and Europe. Exterior, interior and color design studies have carried out according to the consumer color demands in these centers. Color preferences of European and Japanese customers can be completely different from each other because of the regional and cultural factors. Consequently,

Europe and Japan Development Centers exhibit remarkably different design and application strategy to select color combinations for their regions. The vital information they need is obtained by research and organizations such as CMG.

On the other hand, Renault is intended to combine the design of vehicle and developments of coating industry and future color trends. In other words, color trends are the fourth important criteria for Renault, whereas it is the fifth factor for Toyota.

As mentioned before, Hyundai is another consumer-oriented automobile manufacturer. After evaluating the demands and desires of customers, dealer inputs are assessed by Research Center. Later, based on design of automobile a number of color alternatives are determined. Another step of Hyundai color design process is to follow and analyze successful color schemes of rival companies. The most purchased colors of competitive automobile manufacturers are adapted to new model in accordance with the design of it.

On the other hand, every color determination project of Honda starts by gathering and analyzing information received from dealers in order to constitute a theme on which the design of automobile based. According to them, secondly consumer demands should be taken into account to reinforce the image which is wanted to be created. Afterwards, innovations in color trends are investigated by design team of Honda. Hence, the concept can be translated into real automobiles. The third step is observing color trends to meet the needs of the target consumers. In

addition to this, Honda concerns the unity between design and color like Hyundai in the fourth step and cost of color for new model is considered in the fifth step.

Regarding to Volkswagen, initially consumer preferences and tastes are researched. VW employs creative designers and forecasters which works on solely color trends to find the most appropriate ones for automobiles. Rüdiger Folten (2003) explained that instead of following color trends unconsciously, Volkswagen creates their own trends in accordance with the theme of car and Volkswagen Design philosophy. Volkswagen design strategy can be summarized as "Form Follows Function." like the basic principles of German Bauhaus Movement in the early 20th century. Therefore, the integrity of design and color is another significant consideration for them. Furthermore, customer desires are conveyed by over 11.000 Volkswagen dealers in the world and combined with the researches of pigment suppliers. New automobile is launched to the market with a two or three year life frame by design and engineering team.

After the fifth step, the color determination processes of Ford and Renault, Volkswagen and Toyota are quite similar.

With regard to the color determination process of Ford and Renault, color application capacity of factory is the most significant one among the last five criteria. Both companies have a large number of semi-production centers in different countries. Consequently, selected colors should be applicable to all products in every factory so as to sustain the brand identity and company strategy. Afterwards,

feasibility and cost of color is concerned in color harmony phase which is defined as "Consistent appearance color, texture and gloss coordinated parts in adjacent locations throughout the vehicle." by color design team of Ford. In this process, the complexity and number of colors are reduced and limited in accordance with the feasibility of them. Renault also follows a similar process. After searching and deciding the feasibility and cost of color, the final color scheme is compared with the color alternatives of other competitive automobile manufacturers in the related segments. Similarities of Ford and Renault designing process can be seen in Figure 4.7.

	Color	**Sales and purchasing input**	**Researches of Pigment Manufacturers**	**Consumer demands**	**Cost of Color**	**Colors applied by other automobile manufacturers**	**Color application capacity of factory**	**Feasibility of color**	**The unity of design of automobile and color**
FORD	2	4	3	1	8	9	6	7	5
RENAULT	4	5	3	1	8	9	6	7	2

Table 4.7. Color Determination Criteria of Ford and Renault

Mastering Process is the final phase of the Color & Trim program of Ford Motor Company. Yurtcu defined the process as "The process of visual color approval and durability approval of raw materials" Appropriate color masters for exterior materials are prepared and submitted by raw material suppliers. Moreover, color standards are constituted for each new exterior body. The process starts 25 months later then the Global Palette Approval. Finally, the body colors, which painted in

assembly line, are controlled and approved by Global Paint Engineers from durability point of view. Furthermore, each body component is checked and a Appearance Approval Report is filled out. A copy of it is given in Appendix 2. Meanwhile, interior colors are tested max. 7 weeks, those of exteriors are tested max. 9 weeks. When all parts are ready, a color day is held in order to get approval of managers for appearance and the other properties on total vehicle.

Automotive manufacturers require several color quality control systems so as to establish specific standards for every colored component. They have utililized spectrophotometer which measures the color and generates numerical data for analyses. In the *Color Quality of Automotive Finishes Goes High Tech* Article in Pfonline website (2003) is mentioned that this process provides to check consistency and quality of final color. In the color matching system of Ford Motor Company, spectrophotometers are utilized to determine pigments and dyes at mastering process and to create a "fingerprint" for every color. Conversely, it is remarkable that in Renault, still a visual color evaluation has been carried out. Selected colors are applied to every model. Afterwards, the convenience of designed and painted colors is controlled carefully by Eric Mougeolle, color specialist of Renault, without using any electronic device. Approved colors are signed as plates and send to the all Renault assembly-centers in the world.

Volkswagen and Toyota also follow the same phases. Cost of color that effect the design process properly is the sixth criterion for both of them. Cost of paint can vary from 50$ to 1000$ per gallon and the price of metallic coatings is more

expensive that opaque ones. Therefore, it is taken into account by color designers of both Volkswagen and Toyota. After analyzing models and colors of competitive manufacturers, painting capacity of factories and feasibility of color which are the critical steps before the production line are considered. Similarities of Toyota and Volkswagen color determination process is given in Figure 4.8.

	Color Trends	**Sales and purchasing input**	**Researches of Pigment Manufacturers**	**Consumer demands**	**Cost of Color**	**Colors applied by other automobile manufacturers**	**Color application capacity of factory**	**Feasibility of color**	**The unity of design of automobile and color**
TOYOTA	5	4	3	1	6	7	8	9	2
VW	2	5	4	1	6	7	8	9	3

Table 4.8. Color Determination Criteria of Toyota and Volkswagen

Feasibility of color, which means application easiness of paint, is taken into consideration by Honda and Hyundai as sixth criteria. Also, application of color influences the color design process. For example; in metallic paint system, the spraying angle of mica pieces affects the quality of paint. Same angle must be utilized while repairing automobile so as to protect the color unity in whole body. Moreover, it is revealed that color application capacity of factory is the seventh criterion in color determination process of both company strategies. Later, successful color alternatives of rival manufacturers are concerned by Honda. Whereas, cost of color is considered as the following criterion by Hyundai design and research team.

Finally they mentioned that the researches of pigment suppliers are investigated to complete the process.

4.5. Analysis and Discussion of Findings:

Color determination is inseparable component of entire automobile design process from concept generation to production. The economic consequence of any mistake is so serious that automobile manufacturers should leave nothing to chance. Designing a new car is formed by a complex decision making process. In the light of relevant findings in this thesis, differences and similarities on color design process of six leading automobile manufacturers are investigated and compared.

On the basis of comprehensive interviews with automobile designers and color specialists, the most necessary criteria in color selection process is determined. Then, color & trim designers, production engineers and purchasing managers of selected companies were asked to arrange them frankly. The results of interviews and questionnaires indicate that there are some similarities and differences in arrangements of criteria and color determination processes of companies. Moreover, these differences can influence the appropriateness of product to te market needs.

Determination criteria were grouped in two sections. Color trends, researches of pigment manufacturers, sales and purchasing input which is provided by dealers, color applied by rival companies and consumer demands are customer related criteria. Cost and feasibility of color and application capacity of factory are technical related factors.

Based on the results of interviews, first five criteria arranged as below;

1. Consumer demands,
2. The design of automobile,
3. Sales and purchasing input,
4. Color trends,
5. Researches of pigment suppliers.

It is observed that first five criteria constitute the color strategy of automobile manufacturers. Ford, Toyota, Volkswagen, Renault and Hyundai select the consumer demands as first criteria. Therefore, all selected firms can be defined as consumer-oriented companies. This approach reveals the dominant power of color preferences and desires of customers. Manufacturers continually face the challenge of differentiating their automobiles and their brand within the minds of target consumers. In order to achieve this, companies have to evaluate their expectations and transfer them to the automobiles.

In the color determination process, second important criterion is integration of design and color. According to the results of questionnaires, only Renault and Toyota considers this factor as important as consumer demands. Volkswagen color design team mentioned that this criteria is concerned after trend analysis. Trendy color scheme of VW New Beetle is a successful example of color and design harmony. On the other hand, it is considered as fourth criteria by Hyundai and Honda, two giant Japanese automobile manufacturers, and considered as fifth criteria by Ford, second leading car company of America.

Besides, companies have to conduct comprehensive market studies and gather information to assess how well their automobiles perform in the related segment groups. Dealers of companies provide the essential information for design and development departments. For this reason, Honda color determination process starts by evaluating the data which is send by dealers and continues with consumer demands. Other Japanese company, Hyundai, mentioned that they concern this detailed information as second criteria. Renault, Toyota and Ford stated that they consider this criteria to gather and evaluate the information received by dealers in order to improve customer satisfaction and utilize the most appropriate color combinations.

Assessments of color trends that are obtained by national or international color organizations and researches of pigment manufacturers should also be taken into consideration. Future color trends are observed and evaluated by both non-profit organizations and automobile designers. Besides, paint suppliers have investigated the innovations in painting technology and have developed new pigments to produce attractive and low-priced exterior paints for companies. They also intended to create next-generation body colors for automotive industry.

Trendy colors and new pigments are introduced by concept cars. They also offer a perfect platform to indicate the innovative technologies on vehicles. These are necessary to satisfy the changing tastes and expectations of consumers. Therefore, future color forecasting is second criterion for Volkswagen and Ford, third criterion for Honda, forth criterion for Renault and fifth criterion for Toyota and Hyundai. The

researches of pigment manufacturers are in the first five criteria for Renault, Toyota, Volkswagen and Ford. According to questionnaires, Hyundai and Honda consider researches of suppliers at the end of the color determination process.

The last four criteria can be arranged according to literature search and the results of interviews:

6. Color Application Capacity of Factory,
7. Feasibility of color,
8. Cost of Color,
9. Colors Applied By Competitive Manufacturers.

The last four criteria are not as vital as the other criteria. The arrangements of them can change according to the color determination strategies of automobile companies. Color application capacity of factory effect the color determination process and it is sixth factor for Renault and Ford, whereas seventh for Hyundai and Honda and eighth for Toyota and Volkswagen. Moreover, as given in the Table 4.3., Volkswagen and Toyota, Renault and Ford, Hyundai and Honda have very similar arrangements.

On the basis of relevant findings, color selection process of Renault is the most appropriate and sentitive procedure to the market needs when compared to those of other automobile manufacturers. Color scheme is determined according to demands of target consumers and design of automobiles for each model. As explained in the second and third chapter, cultural and traditional accociations of

color influence the design and color of automobiles. By the help of it's color design procedure, Renault can meet the needs of different markets such as Japan and United Kingdom. This approach of Renault exposes the value of consumer and design. Toyota designers and representatives also concern same factors. On the other hand, Renault color approval is carried out by color specialist. Whereas, this process is conducted by some devices such as spectrometer in other companies. Consequently it can be claimed that the most human-oriented color design process is conducted by Renault.

CHAPTER 5

CONCLUSION

In this thesis, the value of color in automotive industry was investigated by conducting a comparative research and major differences and similarities in color selection process of six leading automobile manufacturers were underlined. To operationalize this study, selected manufacturers, Ford, Toyota, Volkswagen, Renault, Honda and Hyundai were responded questionnaires to provide researcher with a richer level of knowledge about the color design and determination process of them in accordance with nine essential color design criteria.

As it was elucidated in the Chapter 1, the main structure of the thesis is comprised of two parts, literature search and case study. They are focused on:

- The Automobile Design Process
- The Color Determination Process in Automobile Industry

In the second and third chapters, the influence of color on product and automobile design was investigated and main research questions were constituded for the fourth chapter.

In the previous chapters, it was clearly stated that color is of the vital property of automobile design. The use of color can profoundly impact the brand accomplishment of product as much as shape and performance in the global and local markets. Consumer demands, psychological connotations and cultural associations of color may indeed play a factor in color design of each model.

Based on the results of case study, the color determination processes of automobile manufacturers are similar in certain ways. Their color design strategy are mainly based on three basic principles; customer desires, design of vehicle and technology. Consumer demand fact is obtained by short and long-term market researches. Moreover, dealers, international color organizations and major paint suppliers also provide the required information and feedbacks to color design teams of companies.

On the basis of case study, in accordance with the three basic principles, each company follows exacting methods. Questionnaires reveal that Renault follows the most appropriate and sensitive color determination process to the desires of consumers and market, when compared with the other companies. The reason may be that their process not only concerns the cost but also ensures faster response to changing customer tastes and facilitates to catch the current trends and desires for a global market.

Moreover, according to the results of case study, it was concluded that Renault considers the different color preferences of different markets by means of its

color determination process. Also, Renault developed a new unique color evaluation system. Although visual color approval procedure of Renault is accepted as a new subjective method, it reveals the importance of human factor in color design. Toyota, Ford and Volkswagen have following some similar stages with Renault in accordance with the arrangements of determined criteria. Furthermore, the processes of Hyundai and Honda also have similar phases.

Total 22 companies, which already produce automobiles in C segment, were interviewed to obtain information about specific color selection processes. Only six of them accept to share the information about their company strategies. The ones which rejected the interview request mentioned that their color design process is one of a significant component of design policy and undercover brand philosophy. In other words, the required information is, classified, completely confidential and cannot be shared. The reason of this secrecy can be the current financial problems of global automobile manufacturers face with.

The results of interviews indicate that companies realized that production costs should be reduced within the customer preferences, regional and cultural differences in market affect the cost of manufacturing. In this context, they have developed specific design methods and expand the production strategies to decrease the cost and increase the quality of vehicle. Color determination process is also one of the most significant sections of the entire design process.

The findings of this study indicate that the color design strategy influence the performance, image of automobile and brand in the market. Also it reveals that the consumer demands are essential ingredient of automotive industry. In spite of having some difficulties in collecting data from automobile manufacturers, this study contains significant information and comparisons about six leading automobile companies. Alhough this dissertation was not accurate enough to reach definite conclusions about color designing process of whole automobile industry, this study provides initial guidence for automobile designers and color specialists about how to select colors and determine color design strategy within in automotive industry.

5.1. Further Studies:

In this dissertation, the integration of color design and automobile manufacturers was investigated. For the further studies, the researchers may reveal the power of color from consumer preferences point of view. Such a study would be advantageous for car designers in order to comprehend the relation of customer habits and color criterion in automotive industry. Consequently, future color alternatives would meet the needs of users.

On the other hand, they should take into consideration the difficulties to obtain required information. The color and design process data has a direct influence on marketing policies of automobile manufacturers. It symbolizes power and money for them. Consequently, they do not want to share this strategic information, which can affect the future of company.

Based on these findings concerning color design of automobiles, it is recommended that pigment suppliers, color organizations and subsidiary companies of automobile manufacturers for the further studies can provide the necessary information about design procedure of them.

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APPENDIX 1

QUESTIONNAIRE SAMPLE (TURKISH)

Bu anket dünyada önde gelen otomobil firmalarının tasarım ve üretim sürecinde, renk kriterini nasıl ve hangi aşamada kullandığını incelemek amacıyla hazırlanmıştır. Zaman ayırdığınız ve sorulara mümkün olduğu kadar doğru cevaplar verdiğiniz için şimdiden teşekkür ederim.

Sena Öksüz

1- Firma Adı:

2- Firmada Yürütülen Görev:

Renk Uzmanı	
Ürün Mühendisi	
Pazarlama Müdürü	
Diğer.....	

3- Firmanızda Hangi Segmentlerde otomobil üretilmektedir ?

SEGMENTLER	%0-30	% 30-60	%60-100
Mini Sınıf (A Segmenti):			
Küçük Sınıf (B Segmenti):			
Orta Alt Sınıf (C segmenti):			
Orta Sınıf (D Segmenti):			
Üst Sınıf (E Segmenti):			
Lüks Sınıf (G Segmenti):			
Spor Araçlar (H Segmenti):			

4- Otomobil tasarımında, renk belirleme ve uygulaması segmentlere göre değişir mi?

EVET	
HAYIR	

5- Firmanız tarafından üretilen C segmentindeki araçlarda hangi renkler kullanılmaktadır?

Parlak ve Canlı Renkler	
Doğal ve Natürel Tonlar	
Koyu Tonlar	

6- Renk belirleme sürecine firmanızın hangi birimi yada birimleri katkıda bulunur?

Renk ve Tasarım Bölümü	
Pazarlama Bölümü	
Üretim Bölümü	

7- Hangi aşamada renk ilk olarak düşünülür?

A	Veri araştırma ve analiz	
B	Ürün geliştirme	
C	Modelleme	
D	Üretim	

8- Please select the citerion/criteria which is important in the color determination process for your company.

A	Renk Trendleri	
B	Pigment Üreticilerinin Araştırmaları	
C	Bayiilerden Gelen Satış Bilgileri	
D	Müşteri Talepleri	
E	Rengin Maliyeti ve Ekonomik Kullanılışı	

F	Diğer Firmaların Uyguladıkları Renkler	
G	Boyahanenin Renk Uygulama Kapasitesi	
H	Rengin Uygulama Kolaylığı	
I	Rengin Aracın Tasarımına Uygunluğu	

9- Lütfen kriterleri tasarım sürecinde kullanılışına göre sıralayınız.

APPENDIX 2

QUESTIONNAIRE SAMPLE (ENGLISH)

This questionnaire is prepared to investigate the approachs of leading automobile companies about how and in which step they consider color criteria. Thank you so much for your interest and answer the questions frankly...

Sena Öksüz

1- Company Name:

2- Position in the company:

Color and Trim Designer	
Product Engineer	
Marketing Manager	
Other.....	

3- Which segment does your company manufacture ?

SEGMENTS	%0-30	% 30-60	%60-100
A Segment:			
B Segment:			
C Segment:			
D Segment:			
E Segment:			
G Segment:			
H Segment:			

4- Are there any differences in color determination and application according to the segments?

YES	
NO	

5- Which colors do you prefer for C segment automobiles in your company?

Bright and lively Colors	
Natural Tones / Shades	
Dark Tones / Shades	

6- Please select the department(s) which contribute(s) to color determination process?

Color and Trim Department	
Marketing Department	
Production Department	

7- In which step does color considered first?

A	Data research and analysis:	
B	Idea generation:	
C	Modelling:	
D	Production:	

8- Please select the citerion/criteria which is important in the color determination process for your company.

A	Color Trends	
B	Pigment Manufacturers research	
C	Sales and purchasing input which is send from dealers	
D	Consumer demands	
E	Cost of Color	

F	Colors applied by other automobile manufacturers	
G	Color application capacity of factory	
H	Feasibility of color	
I	The unity of design of automobile and color	

9- Please list the criteria below according to the importance of usage in design process.
