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# Innovation process for the product development of germ-free air circulation in a vehicle

Diploma Thesis

Mechanical Engineering and Business Economics

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Faculty of Mechanical Engineering and Economic Sciences

Institute of Industrial Management und Innovation Research

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(Signature)

**Acknowledgement**

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**Abstract**

The world economy underlies a very fast change of needs and expectations from the customer. This results in the constant demand for new products to satisfy these needs and expectations. Therefore the companies have to focus on innovations to stay competitive in the global and local competition.

For this reason the company MAGNA established the “Winning Innovations” (WIN) initiative to motivate the employees to become creative and bring in their innovative ideas. After the submission of the innovative idea and a multi-level selection process the best ten WIN ideas will be selected due to the potential of success. This diploma thesis deals with one of these WIN ideas.

The structure of the diploma thesis consists of a theoretical and a practical part. The theoretical part provides the basis for the practical approach and deals with the topic innovation management. To be more specific it contains the basic information about the terminology of innovation, strategy and innovation, the diverse models of the innovation process, the description of the phases of the innovation process according to Thom and the management of an innovation project. The practical part is the execution of the innovation process according to Thom for the Winning Innovations idea “germ-free air circulation in a vehicle”. The idea describes a module which should be integrated into the climate system of a car to produce germ-free air for the interior of the car with the help of ultra violet-C radiation produced by ultra violet-C light emitting diodes. The conceptual formulation of the practical part includes the description of the idea and the state of technology, an economical feasibility study and the documentation of the results in a business plan. The criteria which are processed in the business plan give the basis for the decision about the realization of the idea.

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# 1 Introduction

*"Innovation is the central issue in economic prosperity."*[1]

Innovation is an important success factor to stay competitive in a worldwide competition which becomes more and more intense. Only those who are able to reproduce again and gain new competitive advantages will be able to survive. This is valid for organizations, teams and even for states.[2]

Successful organizations show some obvious characteristics; these are a safe financial structure, committed employees, efficient processes and a strong customer orientation. The continuous change of the global economics and the regular change of customer needs lead to innovations. Only organizations which adapt their products, processes, structures and performance to these changes and evolve themselves are able to compete in the future and gain a competitive advantage.[3]

*"A business that does not invest in research and product development will not be able to compete in the future. With this in mind, we at MAGNA are constantly thinking about ways to develop new products and technologies for our customers."*[4]

The quote shows that MAGNA always wants to stay at the pulse of time of automotive and innovative technology. One way to drive innovation is the establishment of the WIN initiative. It is a platform for the employees to get creative and present their ideas. In other words the initiative should actively promote innovation because only in a few cases innovation happens incidentally.[5]

This diploma thesis processes one of these innovative ideas. At the end there should be a recommendation about the realization of the idea based on

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[1] Porter, M.E., access date 20.04.2011

[2] Cf. Disselcamp, M. (2005), p. 11

[3] Cf. Disselcamp, M. (2005), p. 15

[4] Stronach, F., access date 20.04.2011

[5] MAGNA Europe Intranet (WIN), access date 20.04.2011

the information gained in the economical feasibility study done within the framework of this thesis.

## 1.1 About MAGNA

Frank Stronach was born in Weiz, Austria and immigrated to Canada in 1954. With the working background in tool and machine engineering he formed a tool and die company, named Multimatic Investments Limited, in 1957. The company subsequently expanded into the production of automotive components and received its first auto parts contract with General Motors to produce metal-stamped sun visor brackets in 1960. In 1969, Frank Stronach merged with MAGNA Electronics Corporation Limited and subsequently became MAGNA International Inc. in 1973. In 1971 Frank Stronach introduced his management philosophy, known as Fair Enterprise, to MAGNA. Fair Enterprise is based on a business Charter of Rights that predetermines the annual percentage of profits shared between employees, management, investors and society and makes every employee a shareholder.[6] Between 1976 and 1979 MAGNA implemented a major product diversification strategy and divisions were organized into product groups. The growth of the MAGNA continued during the 1980’s until the geographic expansion and the focus on innovations started in the 1990’s. Between 1996 and 1998 MAGNA underwent a major European expansion, acquiring a number of European-based automotive systems suppliers and acquired Steyr-Daimler-Puch, one of the world's leading automotive technology and engineering companies with complete vehicle assembly capabilities in 1998. In the 20$^{th}$ century MAGNA continued its success. The company continued to expand and made different formations. At present, MAGNA is divided in different independent groups with their own capabilities.[7]

[6] Cf. MAGNA International Inc., access date 18.01.2011

[7] Cf. MAGNA International Inc., access date 18.01.2011

*The groups of MAGNA:*[8]

- MAGNA Seating
- MAGNA Exteriors and Interiors
- MAGNA Mirrors & MAGNA Closures
- Cosma International
- MAGNA Steyr
- MAGNA Powertrain
- E-Car Systems (Joint Venture)

In 2007, Frank Stronach's established the idea of the WIN initiative. In the foreground was the idea of motivating the employees to bring in their ideas of new innovative products, technologies, services etc.[9]

In 2008 MAGNA announces the development of an electric vehicle and became the largest automotive parts supplier in North America on the basis of sales. The annual sales in 2008 were $23.7 billion US dollars.[10]

Today MAGNA is the most diversified automotive supplier in the world, designs, develops and manufactures automotive systems, assemblies, modules and components and engineers and assembles complete vehicles. The company primarily sells to original equipment manufacturers (OEMs) of cars and light trucks in North America, Europe, Asia, South America and Africa.[11] The headquarters of MAGNA International is in Aurora, Ontario in Canada and the headquarters of MAGNA International in Europe is in Oberwaltersdorf, Austria.

## Culture

MAGNA works after the philosophy of "Fair Enterprise". MAGNA's Corporate Constitution and the Employee's Charter outline the framework of how business is conducted, provide the roadmap for the Fair Enterprise culture

[8] Cf. MAGNA International Inc., access date 18.01.2011

[9] Cf. MAGNA Europe Intranet (WIN), access date 18.01.2011

[10] Cf. MAGNA International Inc., access date 18.01.2011

[11] Cf. MAGNA International Inc., access date 18.01.2011

and create a winning combination. The commitment of the employees is fundamental to the continued success of MAGNA and the company is committed to continuously improve the employee relations. Therefore MAGNA has introduced a number of programs, including the Hotline, Fairness Committee, Employee Opinion Survey, secret ballot voting on workplace issues and the Employee Advocate Program. These initiatives were put in place to assist the operating philosophy and increase employee participation in their workplace.[12]

**Global structure**

*North America:*

With global headquarters located in Aurora, Ontario, MAGNA International maintains a strong presence in Canada, the United States and Mexico as the largest automotive supplier in North America. MAGNA International North America includes 122 manufacturing operations, 28 product development, engineering and sales centers and 50,875 employees.[13]

*Europe:*

MAGNA International is one of the largest and most diversified suppliers in the European market. After significant growth in Western Europe through the 1990s, MAGNA is targeted on Eastern Europe and Russia as growth regions. The European operations currently consist of 36,150 employees at 96 manufacturing facilities and 35 product development, engineering and sales centers.[14]

*Other Regions:*

MAGNA International is actively pursuing strategic growth and an expanded presence in the new and emerging vehicle markets of the world. Through strategic activities (e.g. go into joint ventures etc.) MAGNA is growing in

[12] Cf. MAGNA International Inc., access date 18.01.2011

[13] Cf. MAGNA International Inc., access date 18.04.2011

[14] Cf. MAGNA International Inc., access date 18.04.2011

China and India as well as within the continents of Africa and South America. The operations of MAGNA in the rest of the world include 31 manufacturing facilities, 20 product development, engineering and sales centers and almost 7,025 employees.[15]

**Innovations**

Fields of innovation activities of MAGNA are:[16]

- Green Technologies
- Fuel Efficiency
- Process Efficiency
- Lightweight
- Safety
- Comfort/Convenience

## 1.2 Winning Innovations

The "WIN – Winning Innovations" initiative was initiated by Frank Stronach. The basic idea is to motivate the employees to become creative and give them a platform to present their innovative ideas.

*"A business that does not invest in research and product development will not be able to compete in the future."*[17]

The WIN initiative is a global competition across all groups of MAGNA and every employee and leased laborer has the same opportunity to participate. The ideas must not be bounded to the automotive sector. To boost the employees to reveal their ideas MAGNA offers valuable rewards and if the

[15] Cf. MAGNA International Inc., access date 18.04.2011

[16] MAGNA International Inc., access date 18.01.2011

[17] Stronach, F., access date 18.01.2011

idea is realized and successful the idea creator participates in the revenues.[18]

After the idea is created it will be developed professionally by the Frank Stronach Institute of the Technical University Graz, an engineering centre of MAGNA or with an external partner. As a result, a new product should be brought to the market either in cooperation between MAGNA and the creator of the idea or by the creator’s new company which would be established with the help of MAGNA.[19]

Steps of the WIN – process shown in Figure 1:[20]

1. Submission of the idea at WIN. This can be done via fax, email or mailing and online via intranet and internet.
2. The idea will be investigated by the MAGNA-Team and checked for realization. If they are not realizable due to any criteria or belong to the continuous improvement program of MAGNA they will be sorted out.
3. If the assessment is positive the idea will be transferred to a committee of experts, the so called WIN-Jury. After that the innovator will get a response regarding to what will happen to the idea.
4. The WIN-Jury evaluates the ideas regarding degree of innovation, economic efficiency, market potential, risk etc. After the evaluation the promising ideas concerning these criteria will be picked.
5. In the next step the idea will be developed by the Frank Stronach Institute, another research facility or MAGNA itself. The ideal case would be cooperation between the single possibilities. Additionally, the development can also be done by a capable project manager if it is desired.
6. At the end of this process a new product, an innovative technology or a new service will be generated and launched to the market by the idea creator and MAGNA or in the form of a new established company.

[18] Cf. MAGNA Europe Intranet (WIN), access date 18.01.2011

[19] Cf. MAGNA Europe Intranet (WIN), access date 18.01.2011

[20] Cf. MAGNA Europe Intranet (WIN), access date 18.01.2011

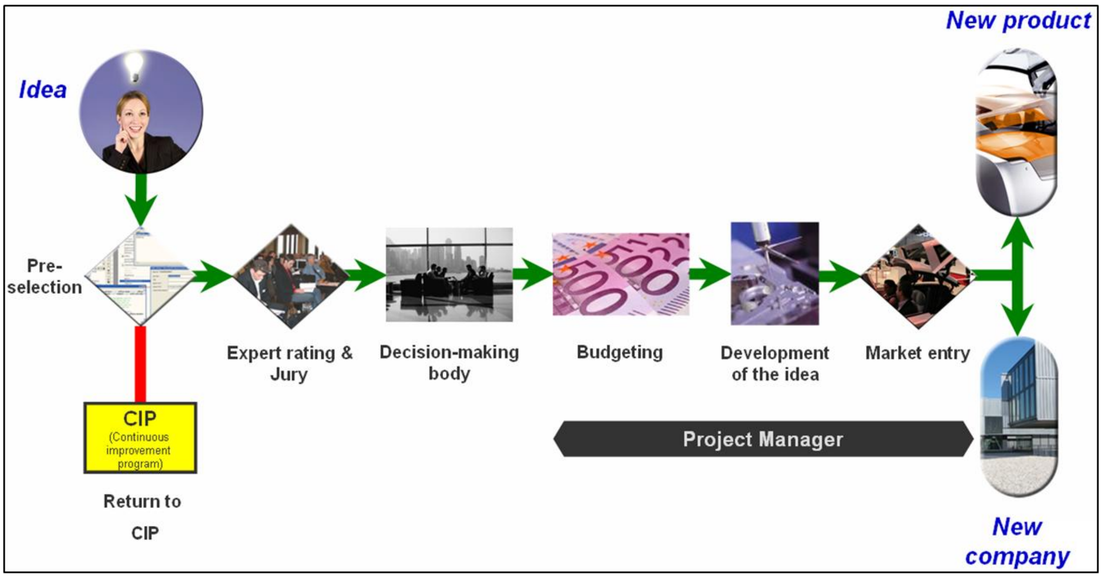


Figure 1: The WIN process[21]

## 1.3 Initial Situation

MAGNA International Inc. is the most diversified and one of the biggest automotive suppliers in the world. The product range stretches from designs over assemblies to the assembling of complete vehicles.

The WIN initiative was established by Frank Stronach to motivate the employees to get creative. They should hand in their innovative ideas even if they are not from the automotive sector and maybe establish their own company with the help of MAGNA.[22]

The idea of “germ-free air circulation in a vehicle” with the help of UV-C LEDs (Light Emitting Diodes) is one of these ideas born because of the WIN initiative. The inventor of the idea is Michael Welter from the group of “MAGNA Seatings”. The impulse for the idea came because of the discussions about the particulate matter problem in German cities. Michael Welter thought about the state of technology of filter media used today (e.g. in laboratories). Due to those thoughts the idea of germ free air in a vehicle with the help of UV-C radiation was born. At the moment only conventional

[21] MAGNA Europe Intranet (WIN), access date 18.01.2011

[22] Cf. MAGNA Europe Intranet (WIN), access date 18.01.2011

air filtering systems are used which cannot guarantee complete germ free air ventilation for the interior of a car. This would be possible due to an UV-C LED module which can be implemented in the climate or air ventilation system.

In this diploma thesis the economical feasibility of the idea will be investigated. The verification of the technical feasibility is not content of this thesis and has to be worked off in a continuative project or diploma thesis.

## 1.4 Objectives

The objective of this thesis is to make a statement about the possibility of the realization of this idea and what kind of continuative activities should be made, e.g. licenses, product development etc. Therefore an economic feasibility check has to be made and the customer value has to be detected. This information will be the basis for the decision about the realization of the WIN idea.

The results of the feasibility study should be documented in a business plan according to the pattern of MAGNA International. The MAGNA business plan pattern includes the points:

- Business Idea
- Market
- Competition
- Risks
- Financing and achievable price

The second part of the diploma thesis is the theoretical examination of the innovation management itself. It should give a basic understanding about what an innovation is, how an innovative idea should be handled until marketability of the idea and which strategic considerations have to be done.

## 1.5 Approach

At first, the theoretical background concerning the topic innovation and innovation management will be worked out. This includes a terminology, strategy and innovation and investigations about popular models of innovation processes. Additionally, the innovation process according to Thom will be investigated accurately because it is the basis of the approach for the practical work concerning this diploma thesis.

After the theoretical part of the diploma thesis is completed the practical approach starts with the analysis of the idea. This detailed analysis contains the analysis of the functionality of the idea and the advantages due to the innovation. The next step is to carry out the information about the state of technology, patent and legal permission concerning the idea. After this, an accurate market research will be done to detect the adequate car segments and target markets. Closing the potential yield and financing, the risks concerning the idea and the synergy/cooperation potential will be carried out to complete the feasibility study and fill in the information into the business plan pattern according to MAGNA.

# 2 Basics about Innovation Management and the Innovation Process

This chapter deals with the basics of the innovation management and the innovation process. It is an overview of different terms concerning innovation, strategy and innovation, different models of the innovation process, a detailed description of the three main steps of the innovation process according to Thom and the management of an innovation project.

## 2.1 Terminology

The term innovation comes from the Latin word "Innovatio" which means renovation as well as modification.[23] At present "Innovation" stands for something new, "technological progress" and "economical success" in our society and it is surrounding us everywhere.

*„Innovation that is the process of finding economic application for the inventions."*[24]

One name which is bonded with innovation is Joseph A. Schumpeter. His considerations about the term innovation done in the book "Theory of economic Development" have a huge influence on the development of the innovation theory, are up to date and are very close to the present situation on the market.[25] Schumpeter differentiates five possibilities of innovations:[26]

1. Production of a new product which is not known by the customer or a new quality of a product.
2. Implementation of a new production method which is not practical known in the respective branch of industry.

[23] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 2

[24] Schumpeter, J. quoted in: Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 2

[25] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 2

[26] Schumpeter, J. (1911), pp 100

3. Development of a new business market which means that the respective branch of industry is not implemented yet in the market of the respective country.
4. Capture of a new source of supply of raw material and semi-finished goods.
5. Execution of a restructuring like establishment of a monopoly position or to breach a monopoly.

Another possibility to describe innovation was defined by Serhan Ili who is the managing associate of ILI CONSULTING. He has the perspective that innovation is the commercial transformation of an invention into

- a new product or a new service
- a new process and/or
- a new business model

by what a significant valorization of the business and its customers develops.[27]

The recent past shows that innovation management is a very important component of the business management and can have a significant influence of the success of a business. To quote Steve Jobs, CEO and one of the founders of Apple Inc., *“Innovation distinguishes between the leader and the follower”*.[28]

The following sub-chapters should give an idea of what an innovation is, the different kinds of types and characteristics of innovations and the differentiation of innovation because of the degree of novelty.

### 2.1.1 Disambiguation

The term “Innovation” stands for something new and creative although not all new things are an innovation. There must be differentiated between the terms innovation, invention, modification and imitation.

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[27] Cf. Serhan, I. (2010), p. 24

[28] Jobs, S., access date 18.03.2011

### Innovation

Innovation is every kind of changing process. That involves a new product or service, a new implemented production method and every other operational changing process of an organization. The purpose of an innovation is to enlarge the firm's know-how and give the company an advantage in the worldwide competition.[29]

### Invention

The invention is a first time technical implementation or a new combination of existing scientific knowledge. Inventions can occur unplanned or be the result of research and development activities.[30] The innovation involves all processes around the invention and transfers it to the market.[31]

### Modification

A modification describes marginal changes of esthetical, physical, functional or symbolic components of a product whereat the basic functions of the product remain the same. It is used to for the repositioning of the product concerning the competitors and to enlarge the product life cycle.[32]

### Imitation

Imitation is the copy of something. They are based on an already existing problem solving. The cut-off to the term innovation can be made in three levels. Concerning the chronological level the imitation occurs after the innovation. In relation to the application spectrum and applicability the imitation and the innovation are similar. The decisive characteristic is the level concerning the technology. The imitation adopts the technology of an

[29] Cf. Wittmann, R.G.; Leimbeck, A.; Tomp, E. (2006), p.11

[30] Cf. Stummer, C.; Günther, M.; Köck, A.M. (2010), pp 10

[31] Cf. Serhan, I. (2010), p. 24

[32] Cf. Franken, R.; Franken, S. (2011), p. 195

innovation. Pure imitations just correct the failures of innovations whereat creative imitations adapt innovations to the customer needs.[33]

### 2.1.2 Types of operational Innovations

There are many different classifications of the types of innovations. There is the possibility to divide innovations into the groups of “Technical Innovations” and “Administrative Innovations”. Technical innovations are related to products, services and processes. Administrative innovations are all kind of changes in the organizational structure and the administrative processes.[34] Another classification refers to the definition of an innovation. An Innovation is a changing process and creates something new. For this reason the classification is done by dividing the types because of the changing processes a company did for the first time.[35] This result in a classification according to Thom N.[36] and Knight K.[37]:

- Product innovation
- Process innovation
- Structural innovation
- Social innovation

**Product Innovation**

Product innovations include all changes of material and immaterial products and therefore a reformation of the objective of the company. The important characteristic of the product innovation is the degree of novelty which is in this case to equalize with a new product in the production program of a company.[38]

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[33] Cf. Strebel, H. et al. (2007), pp 21

[34] Cf. Holt, K. (1988), p. 14

[35] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 6

[36] Thom, N. (1980), pp 32

[37] Knight, K.E.: A Descriptive Model of the Intra-Firm Innovation Process, in: The Journal of Business 40/67, pp 478 - 496

[38] Cf. Thom, N. (1980), pp 32

### Process Innovation

Process innovations are the implementation of rearrangements, improvements and optimizations of systems and processes of a company. The degree of novelty is in relation to the company. The objective of a process innovation is to increase the performance of the systems and processes (e.g. productivity, flexibility, customer-orientation or lower manufacturing costs). The process should also be designed user friendly and must not lead to a product innovation. If the process innovation has no impact on the manufacturing program the effect can be measured by the technicality.[39]

### Structural Innovation

Structural innovations (= organizational innovations) are the reformation of the process organization and organizational structure. They are closely connected to product-, process- and social innovations.[40] Examples are changes in the authority- and leadership conception.[41]

### Social Innovation

Social innovations are changes in the socio – technical system of the human field of an organization. These innovations affect the capabilities and motivation of the people in all organizational functions. They depend on the corporate culture and the leadership style. They can apply to the individual and the relationship among the workers.[42]

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[39] Cf. Thom, N. (1980), pp 35 and cf. Wittmann, R.G.; Leimbeck, A.; Tomp, E. (2006), pp12

[40] Cf. Vahs, D.; Burmester, R. (1999), p. 77

[41] Cf. Matz, S. (2007), p. 35

[42] Cf. Thom, N. (1980), p. 31

### 2.1.3 Characteristics of Innovations

The characteristics of innovations:

- Degree of novelty
- Insecurity and risk
- Complexity
- Conflicts

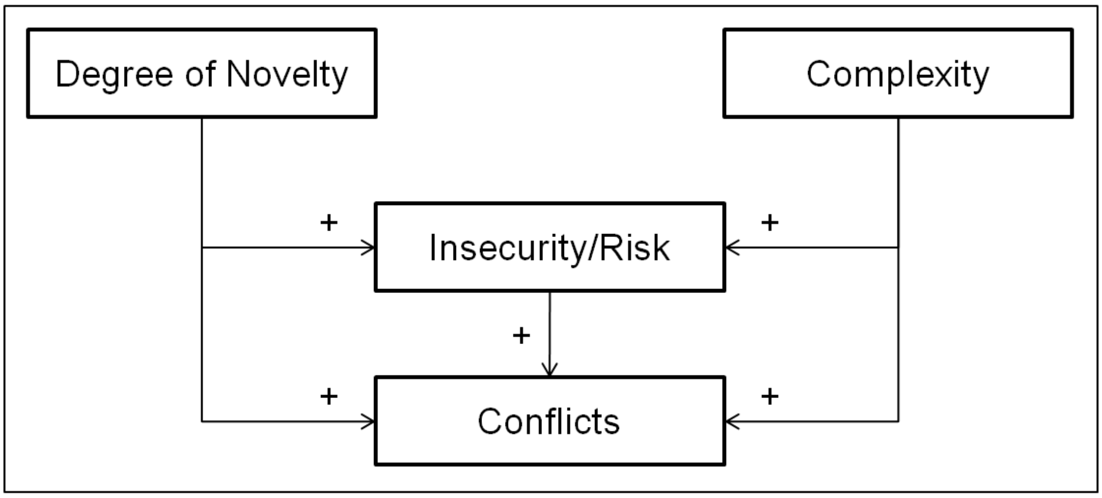


Figure 2: The relationship structure among the four characteristics of innovation challenges[43]

Figure 2 shows the mutual interaction of the four characteristics of an innovation.

**Degree of Novelty**

Innovations stand for improvement. The degree of novelty depends on the point of view. It can be seen subjectively or objectively. If an innovation is seen objectively the improvement did not exist before and can only be generated once on the world market. When an innovation is seen subjectively the innovation is just an improvement and something new for a company or the customers of a special market etc.[44] Due to the different

[43] Thom, N. (1980), p. 31

[44] Cf. Hensel, M.; Wirsam, J. (2008), pp 11

degrees of novelty there can also be three different kinds of innovations classified:[45]

- Basic innovations
- Improvement innovations
- Pseudo innovations

Basic innovations are value- and direction changing deviations from a problem solving. Due to these innovations, breakthroughs concerning the current state of knowledge occur. Basic innovations lead to new active principles and therefore to new products, processes and arrangements.[46] This leads to new branches of business and industry but basic innovations can also be non technical and open up new fields of activities in the culture sphere.[47] Improvement innovations are the further development of products or processes by changing parameters. Pseudo innovations are not real innovations. They are just a modification which means that there are no parameters added or improved concerning the existing problem solving (product or process).[48]

The degree of novelty of an innovation has a great importance and has two impacts on an organization. One impact is that the higher the degree of novelty is the higher are the management requirements and the design problems. The other impact affects the competitiveness of an organization. In other words, the higher the degree of novelty is the more likely it is to gain an advance compared to the competitors and therefore an advantage in competition.[49]

[45] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 6

[46] Cf. Haller, Ch. (2003), p. 69

[47] Cf. Mensch, G. (1975), pp 53

[48] Cf. Haller, Ch. (2003), p. 69

[49] Cf. Hensel, M.; Wirsam, J. (2008), pp 11

**Insecurity and Risk**

Insecurity means that there are no subjective or objective probabilities for the incidence of an environmental situation.[50] These situations are typically for an innovation process. The increasing degree of novelty makes it much more difficult to react on an incident which happens because of an innovation due to the fact that there is no existing experience. In other words the insecurity comes due to the nescience about the success and result of the innovations process.[51] The success and the result of the innovation process are influenced by different risks:[52]

- Technology risk
- Cost risk
- Time risk
- Risk of losing prestige
- Risk of losing the market position
- Revenue risk
- Risk of economical usability

The technology risk is based on the insecurity about the result of development. In other words it is insecure whether a technical solution can be found for a problem.[53] Time and cost risks are also crucial because there can be a lot of unpredictable problems during the process which leads to the non-compliance of deadlines or to the transgression of budget.[54] Thereby it is very difficult to get expected values for the sales volume as well as achievable prices which lead to the revenue risk.[55] This also leads to the risk of economical usability due to the insecurity whether the innovation can be placed successfully on the market and whether it is economical usable or

[50] Cf. Vahs, D.; Schäfer-Kunz, J. (2005), p. 55, in Hensel, M.; Wirsam, J. (2008), p. 12

[51] Cf. Hensel, M.; Wirsam, J. (2008), p. 12

[52] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 7

[53] Cf. Stummer, C.; Günther, M.; Köck, A.M. (2010), p. 101

[54] Cf. Hensel, M.; Wirsam, J. (2008), p. 12

[55] Cf. Thom, N. (1980), pp 27

not.[56] In order one of the most important jobs of the innovation management is to minimize and prevent those risks.[57]

### Complexity

Innovations are not isolated activities and they are a sequence of sub-activities and executive activities. They can proceed chronologically linear or non-linear (complexity due to non-linearity) and can be done parallel or sequential and there can always be feedback loops. Beside the complexity due to non-linearity Thom refers to the complexity because of the division of labor. This occurs due to the fact that innovations involve a lot of internal and external elements.[58] Thom also refers to the fact three dimensions have to be determined to cover the complexity of a system:[59]

- Number of elements
- Number of possible relations among the elements
- Diverseness of the relations

### Conflicts

Due to the appearance of the complexity of innovation processes the possibility for conflicts is very high.[60] There are three types of conflicts to differentiate:[61]

- Factual-intellectual conflicts
- Sociological-emotional conflicts
- Conflicts due to culture and personal values

Factual-intellectual conflicts occur due to the different perception of the importance of the available facts, the selection of the individual targets and

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[56] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 7

[57] Cf. Corsten, H. (1989), p. 6

[58] Cf. Thom, N. (1980), pp 28

[59] Cf. Thom, N. (1980), p. 29

[60] Cf. Thom, N. (1980), pp 29

[61] Cf. Thom, N. (1980), pp 29

the convenience of means to reach the diverse targets. The sociological-emotional conflicts appear because a lot of different people carry the innovation process. This for example leads to mistrust, tensions or reduction of communication especially between active and passive operating people. The conflicts due to culture and personal values refer to the different opinions, values and tenors of the involved employees because of which targets and actions are assigned.[62] There can be different kinds of conflicts:[63]

- Conflicts between the innovative product and an already existing product
- Conflicts between the innovation object and the corporate culture
- Conflicts because of the ethical and moral attitude of the public applied to the innovation object
- Conflicts due to the innovation object and the incompatibility with the legal situation
- Conflicts between the employees because of different groups of interest – social conflicts
- Conflicts between the innovation object and the standards of the company

Thereby conflicts must not always be negative. They can also be used as an ignition for reconsidering the present situation, the creativity to generate new ideas and the achievement of better cohesiveness.[64]

## 2.2 The Innovation Process

There are different kinds of process models for the innovation process. They describe the sequence of operations by means of dividing the process into phases or stages. The models describe the activities which should be executed and the outcomes of every process phase or process stage. At the end of every process model stands the innovative product or service.

[62] Cf. Thom, N. (1980), pp 29

[63] Cf. Vahs, D.; Burmester, R. (1999), pp 22

[64] Cf. Vahs, D.; Burmester, R. (1999), pp 22

In this diploma thesis the phase model according to Thom will be used for the practical approach.

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### 2.2.1 The Model according to Brockhoff

Figure 3 shows the model of an innovation process according to Brockhoff:

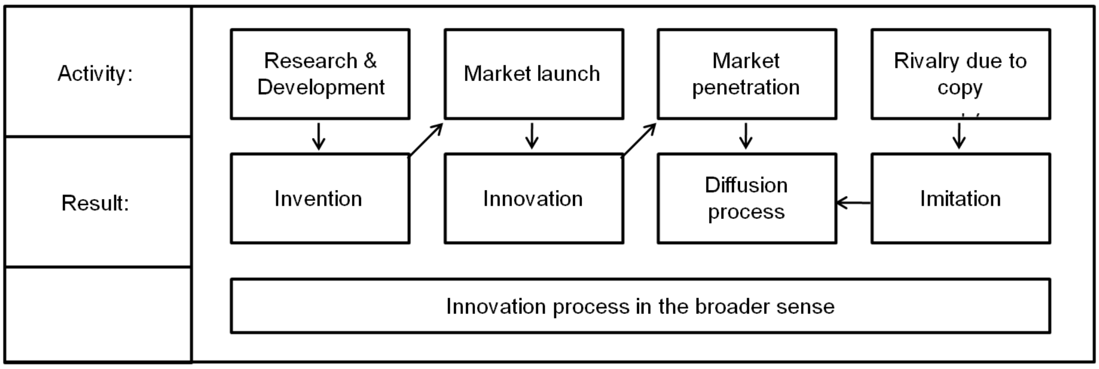


Figure 3: The innovation process in the broader sense[65]

Brockhoff refers to the different definitions and characterizations of an innovation process. He points out that the process, its steps and their extensions are not explicit standardized and differentiated in literature. He also mentions respective to the model that the activities performed for the process must not all be done inside the organization. The incorporation of the user for example can lead to advantages. The next remark Brockhoff concerns is the temporal procedure of the process. It must not be seen as a temporal sequence. The operating functional areas (e.g. marketing, production) can bring in their information parallel to each other. Additionally, the overlapping of the phases can be possible.[66]

[65] Brockhoff, K. (1992), p. 30

[66] Cf. Brockhoff, K. (1992), pp 28

### 2.2.2 The Stage-Gate Model according to Cooper

The stage-gate process is a model to guide a project efficient and effective from the idea to the market launch.[67]

The whole innovation process is split up into several defined stages, usually 4 to 6. Every stage consists of inter-divisional, prescribed and parallel activities. Between the stages are gates which are used as checkpoints where the decision about abortion or continuation is made. Therefore all the necessary information is gathered in each stage to pass the gate.[68]

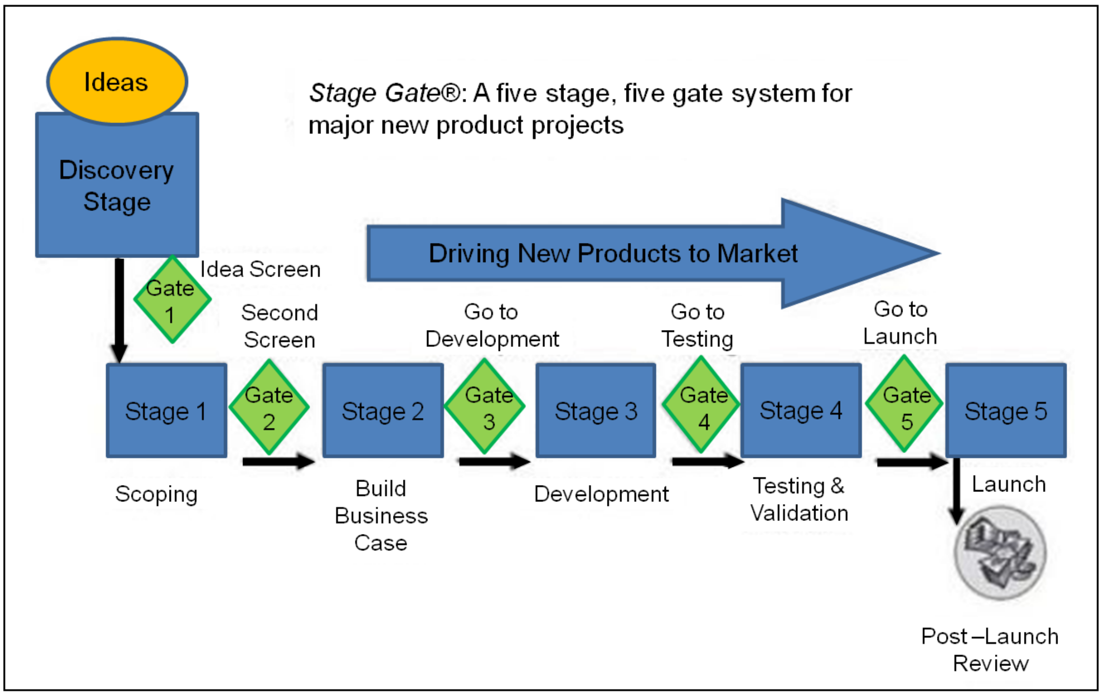


Figure 4: Stage gate model according to Cooper[69]

Figure 4 shows an example with the following stages:[70]

- Discovery stage (generating ideas)

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[67] Cf. Cooper, R.G. (2002), p. 145

[68] Cf. Cooper, R.G. (2002), pp 145

[69] Cooper, R.G.; Edgett, S.J. (2007), p. 189

[70] Cf. Cooper, R.G. (2002), p. 147

- Scoping (quick project analysis)
- Build Business (detailed investigations – include a definition of the product and the project, a justification of the project and schedule)
- Development (detailed design, development of the product, elaboration of execution and manufacturing processes)
- Testing Validation (testing and validation of the product, its marketing, manufacturing and the further elaboration)
- Launch (start of production, marketing and sales)

Figure 5 shows the common design of the stages:

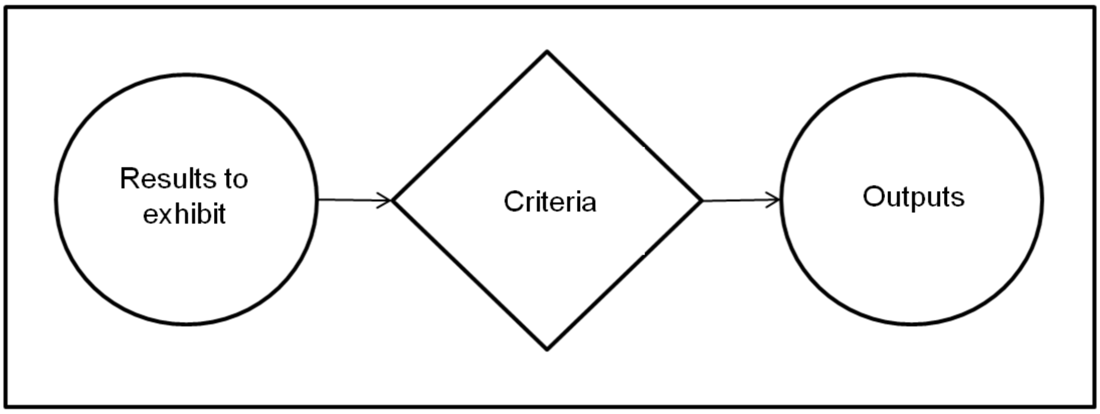


Figure 5: Build-up of the gates[71]

At every gate is a meeting of the whole project team. Thereby all information will be gathered together to make an accurate statement about the status of the project. This includes quality control, a decision about abortion or continuation, prioritization of the project and discussions as well as decisions about the further procedure in the next steps.[72]

[71] Cooper, R.G. (2002), p. 148

[72] Cf. Cooper, R.G. (2002), pp 147

### 2.2.3 INNOVATORS Phase Model

The "Innovators phase model" (shown in Figure 6) is based on the phase model according to Thom. It consists of the same three main phases but the sub-division of the phases is a little bit different. It is also build up on the aspect that an innovation process has to be initiated and realized systematically and targeted. Furthermore, it is mentioned that the innovation process is the sequence of activities in which the phases influence each other alternately or passed through iteratively.[73]

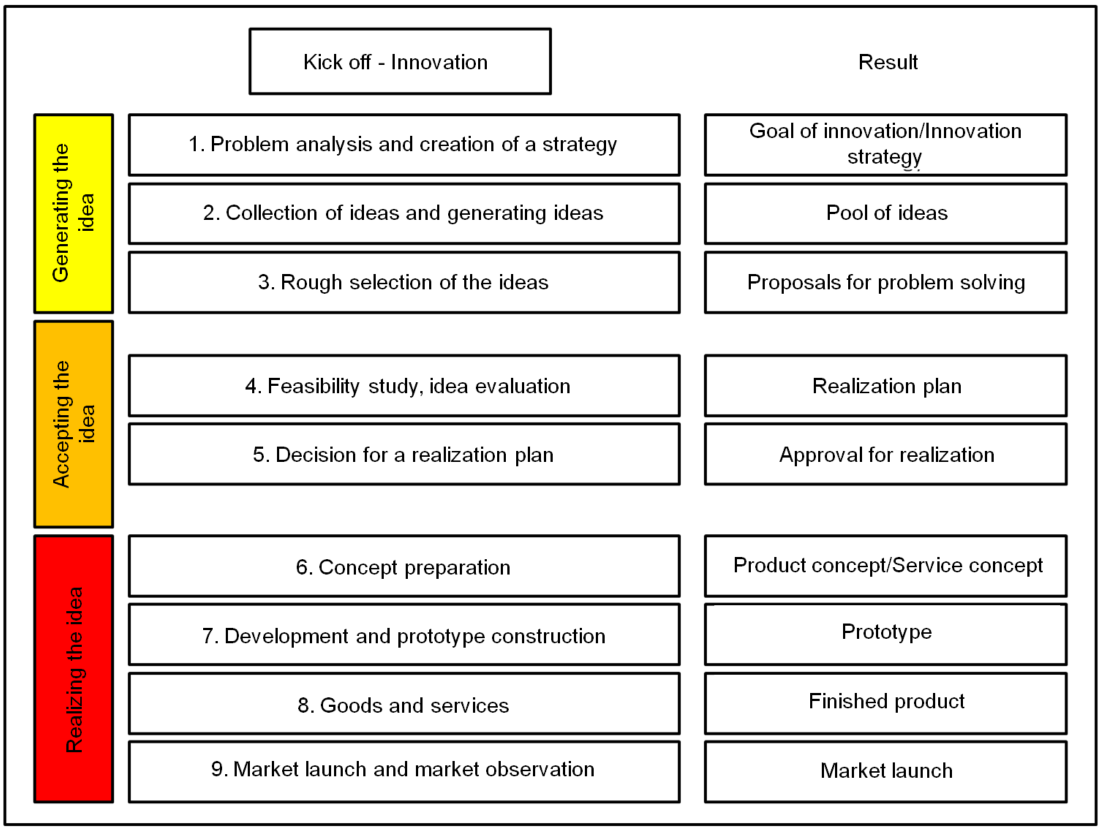


Figure 6: INNOVATORS phase model[74]

[73] Friesenbichler, M. et al (2004), p. 6

[74] Friesenbichler, M. et al (2004), p. 7

### 2.2.4 The phase model according to Thom

According to Thom, every innovation process consists of three main phases shown in Figure 7:

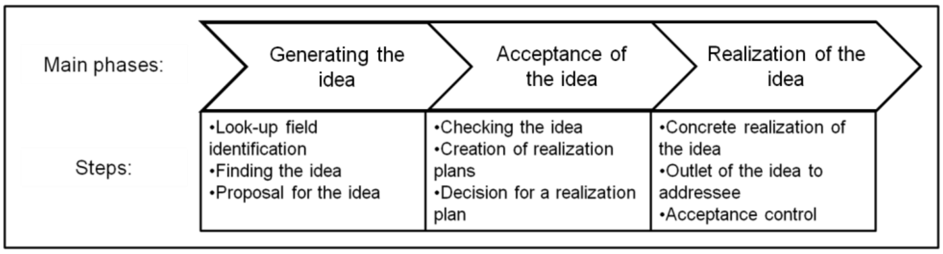


Figure 7: The phase model according to Thom[75]

Every main phase again consists of specific activities. Additionally, there are also internal and external factors to consider which support the kick-off of an innovating idea and will influence the phases shown in Figure 8. A detailed description of the phase model according to Thom is made in chapter 2.3.

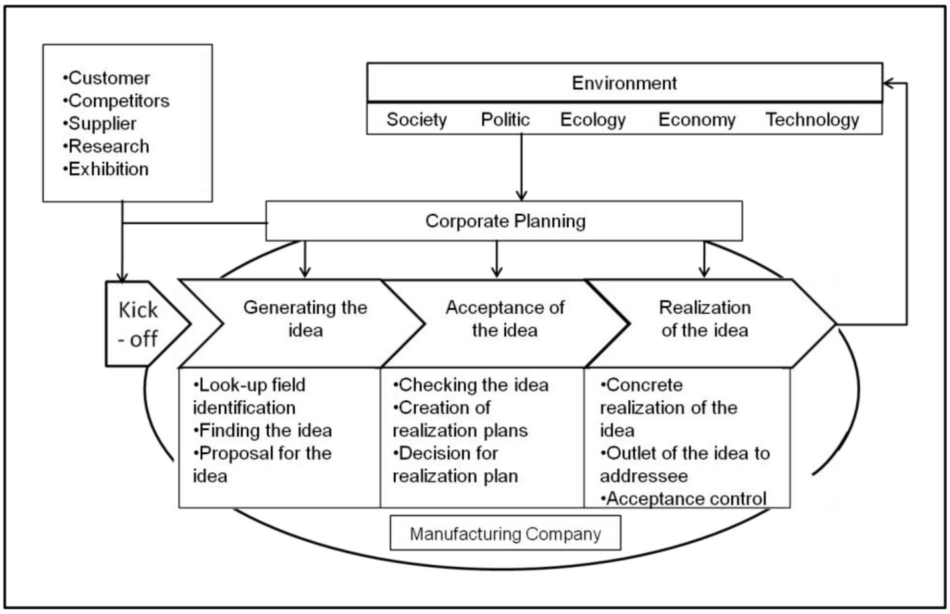


Figure 8: Phase model according to Thom for the operative innovation processes with internal and external factors[76]

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[75] Thom, N. (1980), p. 53

[76] Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 24

## 2.3 Description of the phases of the model according to Thom

The phase model according to Thom is used to process the practical part of this thesis due to the good structuring and the elementary execution. Therefore the phase model is described in detail in this chapter. As it is mentioned before the phase model according to Thom consists of three main stages which are divided into steps. In this chapter these phases and their sub-divisions will be described.

### 2.3.1 Generating the Idea

The first phase of the model is the generation of ideas. In the model according to Thom the phase is divided into three steps:[77]

1. Look-up field identification
2. Idea generation
3. Proposal for the idea

**Look-up Field Identification**

The first sub-division of generating the idea should have the result of a frame in which the innovation targets can be achieved and the innovation strategy can be implemented. On this result the second step is built up.[78]

The look-up field identification defines the direction of the idea generation and it is also guideline to prevent diverse failures which can be made during this step by what resources can be used targeted. The ideas can be generated due to innovation triggers from outside the company or in-house considerations. Concerning the look-up field for product innovations the focus must be set on the meeting of customer needs and the solving of customer problems because the customer is responsible for the success of a product.[79]

The procedure starts with the analysis of the firm and the environment to carry out the strengths, weaknesses, chances and threats. After this, the

[77] Thom, N. (1980), p. 53

[78] Cf. Gelbmann, U. et al (2003), p. 7

[79] Cf. Vahs, D.; Burmester, R. (1999), p. 139

results of the analysis will be used for further analysis to carry out potentials of success. After this, the look-up fields must be identified and evaluated based on the potentials of success to find the right look-up fields for the specification of the frame.[80]

The Tools which can be used for the analysis of the firm and the environment to achieve the potentials of success are:[81]

- SWOT-Analysis
- Check lists
- Gap-Analysis
- Scenario-Analysis
- Product-Market Matrix
- Portfolio Analysis
- Core Competence Analysis

**Idea Generation**

The phase of look-up field identification follows the second phase of the innovation process called “idea generation”.

The goal of the idea finding is to generate as many ideas as possible. The defined look-up fields help to concentrate on relevant problems and to reduce the chance to go off the desired direction of the idea generation. The focus is set on the quantity of ideas to cover the whole demand of innovation. During this step the quality of the ideas has no high priority. The outcome should be a huge collection of ideas which will be processed in the next step of the first main phase, the proposal for the ideas.[82] The chance that a strategic relevant and feasible idea will be produced is much higher if a huge amount of ideas was generated.[83]

Vahs/Burmester differentiate between idea collection and idea generation concerning the phase “idea generation”, this is shown in Figure 9.

[80] Cf. Gelbmann, U. et al (2003), p. 12 and cf. Wohinz, J.W.; Embst, S. (2010), chapter 2 p. 3

[81] Cf. Gelbmann, U. et al (2003), p. 12

[82] Cf. Kupsch, P.U.; Marr, R.; Picot, A. (1991), p.1110 in: Haller, Ch. (2003), p. 88

[83] Cf. Haller, Ch. (2003), p. 88

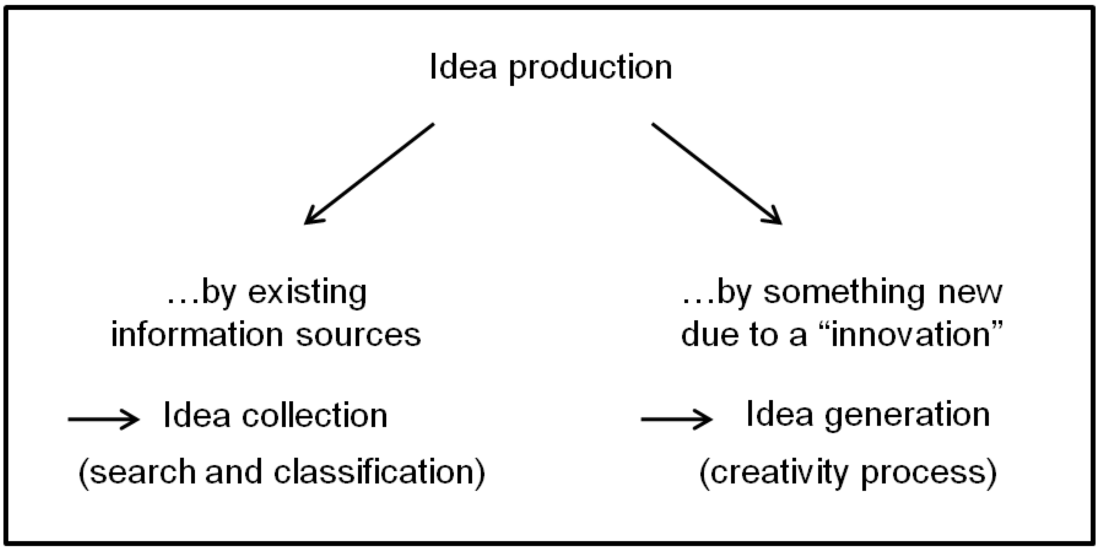


Figure 9: Idea generation and idea collection[84]

The idea collection describes the systematic recording of coincidentally formed ideas due to exploration, detection or development for example. The idea generation is the target oriented creation of problem solving approaches concerning the innovation demand.[85]

Thom refers to the operational suggestion scheme for the collection of ideas and to the use of different kinds of creativity techniques to generate the ideas.[86] Examples for creativity techniques are:[87]

- Brainstorming
- The morphologic case
- 635 – Brainwriting
- Method for systematic integration of problem solving elements
- Inverse Brainstorming
- Destructive – constructive – Brainstorming

[84] Vahs, D.; Burmester, R. (1999), p. 137

[85] Cf. Graumann, M. (1994), p. 396 in: Haller, Ch. (2003), p. 89

[86] Cf. Thom, N. (1980), pp 472

[87] Gelbmann, U. et al (2003), p. 29

Beside the in-house resources like R&D, marketing or production exist also external resources for the idea generation, e.g. customers, exhibitions or supplier.[88]

**Proposal for the Idea**

The goal of this step is to reduce the number of ideas generated in the second step. The assessment of the ideas is not a decision about the idea which should be realized.[89]

After the idea generation there are a lot of different innovation ideas which have to be recorded and saved. The company is responsible to provide appropriate tools to ensure the homogenous illustration and documentation of the ideas. Therefore standardized forms or computer-aided possibilities of data collection can be used. After this the substantial amount of data has to be saved. Therefore a computing solution would be suitable which can be the basis of the further processing.[90]

The next step after the data collection is the rough selection of the innovative ideas in order that no resources are wasted on unprofitable ideas. These selected ideas will be assessed accurately in the next main phase of the innovation process.[91] Possible tools which can be used for this rough selection are:[92]

- Screening
- Categorization of the ideas concerning product innovation and product modification

Due to the lack of information of the ideas it is not possible to make an opposing assessment. Therefore the firm can use a look-up field oriented screening. Thereby all ideas which don’t pass the knock-out criteria will be

[88] Cf. Haller, Ch. (2003), p. 89

[89] Cf. Gelbmann, U. et al (2003), p. 43

[90] Cf. Vahs, D.; Burmester, R. (1999), pp 176

[91] Cf. Gelbmann, U. et al (2003), p. 43

[92] Cf. Gelbmann, U. et al (2003), pp 43

rejected. The knock-out criteria are developed with the help of a brainstorming. [93]

### 2.3.2 Acceptance of the Idea

The second main phase of the model is the acceptance of the idea. Thom divides it into three steps which are:[94]

- Checking the idea
- Creation of realization plans
- Decision for a realization plan

In this phase the idea should be checked and evaluated for its feasibility. After that follows the creation of realization plans which are the basis for the last step, the decision for a realization plan.[95] The goal of this phase is to find the idea which would have the highest potential of success for the company.[96]

**Checking the Idea**

In this step the ideas found in the last main phase should be analyzed and evaluated to find out which idea is very promising and which idea is not useable. Therefore the ideas should be evaluated in an objective and comprehensible way. The success of the company and the business objectives define the diverse criteria for the evaluation. It is necessary to take account of several qualitative and quantitative criteria which in series co-determine the valuation methods.[97]

Quantitative assessment criterions are referring to monetary, capacity and time duration related criteria.  Examples are costs, expected financial

[93] Cf. Gelbmann, U. et al (2003), p. 43

[94] Thom, N. (1980), p. 53

[95] Cf. Gelbmann, U. et al (2003), p. 8

[96] Cf. Haller, Ch. (2003), p. 91

[97] Cf. Haller, Ch. (2003), p. 92

revenue or the duration of the innovation process. Qualitative assessment criterions are technology-, market-, environment- and customer criteria. Examples are image, governmental regulations, technology know-how and significance of the target group or ecologic impact.[98] There are diverse assessment methods to evaluate the innovative idea. The appropriateness of the evaluation methods depends on whether to consider quantitative or qualitative criteria and the maturity of the innovative idea.[99] Some assessment methods for the first step are:[100]

- Function analysis
- Market analysis
- Quality function deployment
- Target costing

**Creation of Realization Plans**

The goal of the second phase is the decision for a realization plan of an idea. Therefore the innovative idea must be exactly described concerning the topics feasibility, realization alternatives and economical and technological chances and risks.[101] The result is the detailed description of the realization plan with the help of a performance specification, functional specification, a concrete task packet and time-, capacity- and cost plans.[102] These realization plans are the basis for upcoming last step of the second main phase.

Basically there are the following four alternatives for the realization of an idea:[103]

- Realization of an innovation project by the company itself
- Realization by others and when indicated buy it in addition
- Realization through cooperation
- No realization

---

[98] Cf. Bürgel, H.D.; Haller, C.; Binder, M. (1996), p. 102

[99] Cf. Haller, Ch. (2003), p. 92

[100] Cf. Gelbmann, U. et al (2003), pp 46

[101] Cf. Haller, Ch. (2003), pp 93

[102] Cf. Domsch, M.; Ladwig, D. H.; Siemers, S.H.A. (1995), p.19 in: Haller, Ch. (2003), p. 93

[103] Haller, Ch. (2003), p. 93

One useful activity to collect all important and desired information for the realization plan and to give a basis for the decision making about the realization of the idea is a feasibility study. The gathered information of the study makes it possible to find conflicts between the objectives and existing conditions. A feasibility study should be done for every project and is especially used in the field of research and development projects. The evaluation of the feasibility of a project is done according to several criteria which are set at the beginning of the study.[104] Due to this feasibility study, the characteristics of the project and the project environment should be detected which make a project uneconomical or the project execution impossible.[105]

There are different kinds of partitions where a feasibility study can be made:[106]

- Technical study
- Economic study
- Legal study
- Ecological study
- Social study
- Risk study

The practical part of this diploma thesis contains an economic feasibility study to prepare the basis for the decision making about the realization of the idea. The criteria for the evaluation are given by MAGNA International which will also make the decision about the realization of the innovative idea.

### Decision for a Realization Plan

The last step of the second main phase is the decision for a realization plan. Therefore different methods are used to evaluate the innovation project with the highest potential of success. If the risk of a realization plan is very high the assessment methods have to be very effective and consequential these

[104] Cf. Angermeier, G. (2005), p. 221

[105] Cf. Bea, F.X.; Scheurer, S.; Hesselmann, S. (2008), p.88

[106] Cf. Bea, F.X.; Scheurer, S.; Hesselmann, S. (2008), p.88

methods are also more extensive than those of realization plans with lower risks.[107] Some of the methods for valuation are:[108]

- Point rating system
- Argument balance
- Cost-utility analysis
- Systematic paired comparison

Until now the results of the innovation process are immaterial and not many investments were done. If a step has to be replicated the costs of change are low. Therefore the company has to find the right balance between strategic and operative consequences concerning the decision. In this decision making process analytical skills are very important. They are needed to include the information about chances, risks and strategic needs as well as given corporate preconditions or corporate preconditions which have to be modified into the decision.[109]

### 2.3.3 Realization of the Idea

The third main phase of the model is the realization of the idea. Thom divides it into three steps which are:[110]

- Concrete realization of the idea
- Outlet of the new idea to addressee
- Acceptance Control

The outcome of the last main phase is the launch of the new product or service combined with the acceptance control.

[107] Cf. Gelbmann, U. et al (2003), p. 69

[108] Gelbmann, U. et al (2003), p. 69

[109] Cf. Haller, Ch. (2003), pp 94

[110] Thom, N. (1980), p. 53

**Concrete Realization of the Idea**

Based on the rough economical and technical investigations (rough development concept) of the phase “Acceptance of the idea” an improved concept will be developed as a first step. Therefore market potential analysis and refined technical feasibility studies will be done in parallel. The market potential analysis is used to carry out information about the market (e.g. competitors, demand etc.) and to find potential customers. The technical feasibility studies should fix the performance characteristics of the innovation. The marketing concept defines the suitable marketing mix to achieve the marketing goals for the respective innovation. The result of these operations is a detailed product- and accordingly performance concept.[111]

Beside these project goals, the project itself must be planned in respect to structure, dates, procedure and resources. The project management goes along with the innovation through all phases of the development and structures the activities which are necessary for the development of a performance. On this basis a time schedule, a capability planning and a cost- and investment schedule can be developed. After planning and describing the technical and economical goals and tasks accurately a specification sheet will be established which contains all these important information. The outcome of this conception is the development plan which will be implemented in the innovation project.[112]

Another result of this step is the final product or service. Because of the temporal and contentual dependency of the work steps the development process must be structured and the activities must be done parallel to reduce the total development time. With the start of the development its goals will be concretized continuously.[113]

The prototype is the first physical realization of a product or a product component. The construction of the prototype also includes the design of the prototype as well as the testing activities. With the help of the prototype technical questions can be clarified, the development risk can be reduced.

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[111] Cf. Friesenbichler, M. et al (2004), pp 7

[112] Cf. Friesenbichler, M. et al (2004), pp 7

[113] Cf. Friesenbichler, M. et al (2004), p. 8

Additional, the continuous improvement activities can be accomplished. At the end of prototype construction procedure is the final product.[114]

When there is a working model or prototype the next step is to think about the performance preparation for the customer. The documents for the production of the new product have to be established and there has to be a focus on the rearrangements of the production because of the new product. Even an external production can be considered because of financial or capacitive reasons. The project management has to supervise the compliance of the costs, deadline and performance goals. The quality management has to ensure that the quality features can be transferred from the construction of the prototype to the production line.[115]

### Outlet of the New Idea to Addressee

The next step is the launch of the innovative product on the market and to establish it.[116]

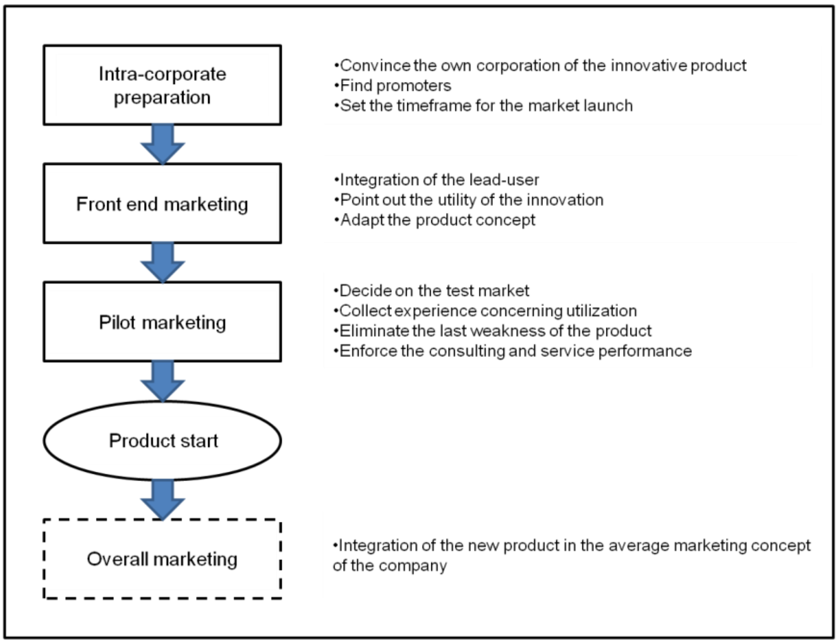


Figure 10: Step model for the market launch of innovations[117]

[114] Cf. Friesenbichler, M. et al (2004), p. 8

[115] Cf. Friesenbichler, M. et al (2004), pp 8

[116] Cf. Friesenbichler, M. et al (2004), p. 9

[117] Vahs, D.; Burmester, R. (1999), p. 263

To cope with the diverse problems of the market launch the step model according to Vahs/Burmester, seen in Figure 10, can be very helpful for the market launch of innovations. In this step the market launch plan which was generated in the first step (see chapter 2.3.3) will be realized and the marketing management concentrates on the outward directed communication policy (e.g. promotion, exhibitions etc.).[118]

**Acceptance Control**

After the market launch the reaction of the customer must be analyzed to initiate a continuous improvement process. Besides the final costing, the whole process will be analyzed concerning realization of the goals, problems and gained experience at the end.[119] However, the acceptance control is not only a process step at the end of the innovation process, it is a process which occurs periodically in the product life cycle to find possibilities for improvement from the point of view of the customer.[120]

## 2.4 Strategy and Innovation

Strategies are used to achieve the goals of the corporate-policy. That is why the innovation strategies have to be set with respect to the corporate strategy. They direct the process activities in an effective way to stay within the given time and cost frame in order to achieve the company's goals.[121] The strategies describe:[122]

1. The development of the technologies of the respective production processes
2. The situation on the buying market and the sales market, the value of the accomplishable market share as well as the expansion rate
3. The possible strategies of the competitors on the respective market

[118] Cf. Friesenbichler, M. et al (2004), p. 9

[119] Cf. Friesenbichler, M. et al (2004), p. 9

[120] Cf. Haller, Ch. (2003), p. 99

[121] Cf. Hinterhuber, H.H. (1975), pp 204

[122] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 1 p. 9

4. The attitude of the institutions in matters of the achievement of the desired market share
5. The system of the social relations in which the firm has to be inserted
6. The productivity of the firm and the critical resources which can be used
7. The influences of the new products on the existing products of the company, the consumer and their possible strategies and growth needs

An innovation strategy can be developed by the three simple questions:[123]

1. What is our status?
2. Where do we want to get?
3. How do we get there?

The development process starts with answering the question of the status. There are internal and external factors to consider for analyzing the status. The strengths and weaknesses of the organization are the internal factors and the opportunities and threats the external factors. Due to this investigation the goals for the future can be set and several strategic options will be developed, evaluated and chosen.[124] The strategy types can be classified like in Table 1:

| **Classification Object** | **Strategy Type (Basic Strategy)** |
|---|---|
| *Competition factor (according to Porter)* | Cost minimization – Differentiation strategy (Quality- and price leadership) |
| *Mode of competition behavior* | Aggressive strategy – Alignment strategy |
| *Market range* | Globalization strategy – Focus strategy – Niche strategy |
| *Market area* | Local strategy – Regional strategy – National strategy – International strategy – Worldwide strategy |
| *Temporal orientation (Strategic Timing)* | Pioneer strategy – Second-to-market strategy – Follower strategy – Dolly strategy |
| *Work-dividing approach* | Solo attempt – Cooperation strategy |
| *Growth direction* | Market penetration – Market expansion – Product innovation – Diversification |
| *Strategic key factors* | Performance oriented – Cost/price oriented – Market oriented – Time competition |

Table 1: Classification of the types of strategies[125]

[123] Cf. Thom, N. (1980), p.174

[124] Cf. Porter, M.E. (1999), pp 24

[125] Sabisch, H. (1991), p. 141

Afterwards the last step of this strategy development is the implementation of the strategy.[126]

Consequently, there are four strategic partial decisions to make:[127]

- Conscious not-innovation
- Intercompany innovation management
- Internal innovation management
- Design of the innovation system

Figure 11 shows the partial decisions and their consequences.

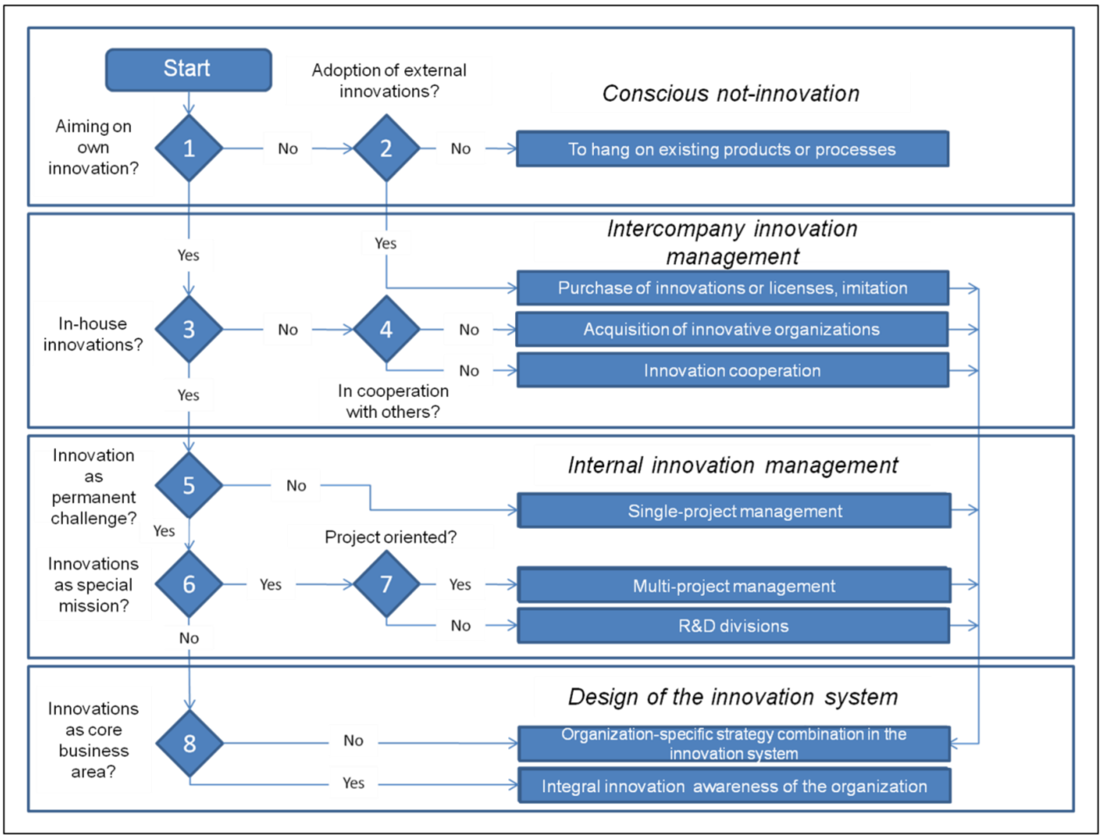


Figure 11: Innovation strategies and their structural consequences[128]

[126] Cf. Porter, M.E. (1999), pp 24

[127] Cf. Hauschildt, J.; Salomo, S. (2007), p. 64

[128] Hauschildt, J.; Salomo, S. (2007), p. 64

### 2.4.1 Important Basic Strategies concerning Innovations

Three important basic strategies are:[129]

- The Competitive Strategies according to Porter,
- The Product-Market Strategies and
- Strategic Timing.

**Competitive Strategies according to Porter**

As it is mentioned before the starting basis is an accurate analysis of internal and external factors (seen in Figure 12).

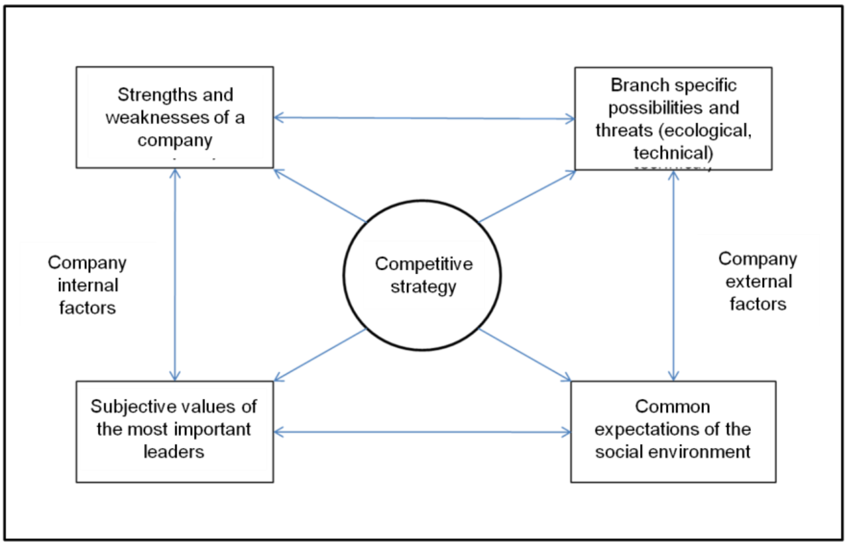


Figure 12: The context of the formulation of competitive strategies[130]

The internal factors are strengths, weaknesses and subjective values. The strengths and weaknesses are the firm's assets and skills combined with the assets and skills of the competitors including financial means, status of technology etc. The subjective values are the motivation and the needs of the people accomplishing the strategy.[131] The environment and the branch

[129] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 1 pp 12

[130] Porter, M.E. (1999), p. 26

[131] Cf. Porter, M.E. (1999), pp 26

influence the firm from the outside. These are the external factors to consider in the analysis. The risks and the chances of profit are counted among the possibilities and threats of the branch. Another factor of the environment is the social expectation of the governmental policy and new social streams.[132] The intensity of the competition of a branch is defined by the forces shown in Figure 13:

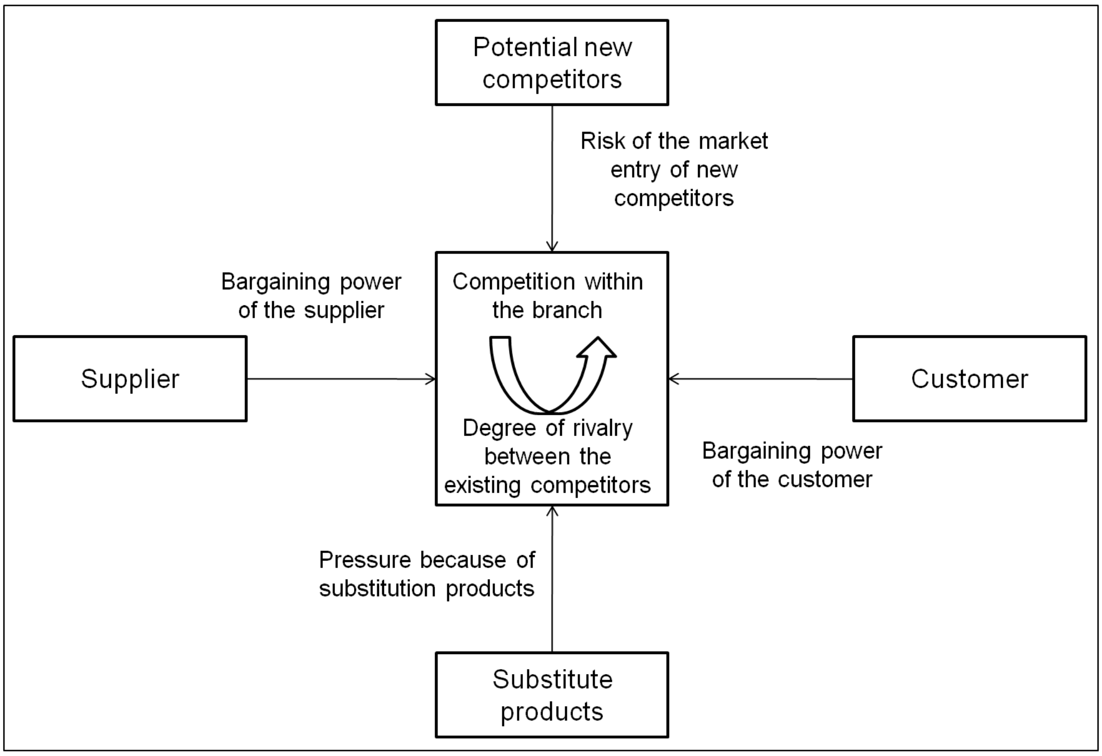


Figure 13: Forces of the branch competition[133]

A structure analysis of the branch is the basis of the decision for a competitive strategy. Consequently, the organization has to choose the right competitive strategy to protect itself from the competitive forces or to use them for their own favor.[134] Table 2 explains the three competitive strategies according to M.E. Porter.

[132] Cf. Porter, M.E. (1999), p. 27

[133] Porter, M.E. (1999), p. 34

[134] Cf. Porter, M.E. (1999), pp 33

| Strategy Type | Essential Competences | Advantages | Risks |
|---|---|---|---|
| *Overall-Cost-Leadership* | • High financial power<br>• Ability for process innovation<br>• Production of simple products<br>• Cost-saving distribution system<br>• Clear organizational structure<br>• Distinctive cost controlling<br>• Incentive system with quantitative demands | • Protection against competitors – assets even during price war situations<br>• Protection against powerful customer – price cutting only to the level of the second best<br>• Protection against new competitors due to high entry barrier<br>• Protection against powerful suppliers – higher flexibility concerning price increases | • New technologies devalue past investments and learn processes<br>• Cost cutting due to imitation<br>• Disregard of marketing- and innovation activities due to the focus on the costs<br>• Cost increase which has a bad influence on the differentiation concerning the competitors |
| *Differentiation* | • High innovation power<br>• Distinct marketing abilities<br>• Quality- and technology image<br>• Long time branch tradition<br>• Cooperation with acquisition- and distribution channels<br>• Creative employees<br>• Innovation supporting organization structure | • Engagement of the customer to the product – therefore reduction of the price sensitivity<br>• Creation of entry barriers for potential competitors due to customer loyalty | • Too huge cost difference concerning discounter and therefore loss of brand loyalty<br>• Imitation reduces differentiation characteristic<br>• Demand of the customer decreases |
| *Focus* | • Combination of the competences mentioned above concerning a certain strategic target field | • More effective and more efficient acting in a narrow defined strategic target field – therefore the combination of the advantages mentioned above is possible | • Cost difference compared to a general provider reduces differentiation or annihilates the cost advantage<br>• Competitors find sub-markets inside the strategic target |

Table 2: Utilization of the Strategic Types[135]

[135] Cf. Porter, M.E. (1999), pp 70

Figure 14 shows the differences between the strategic types:

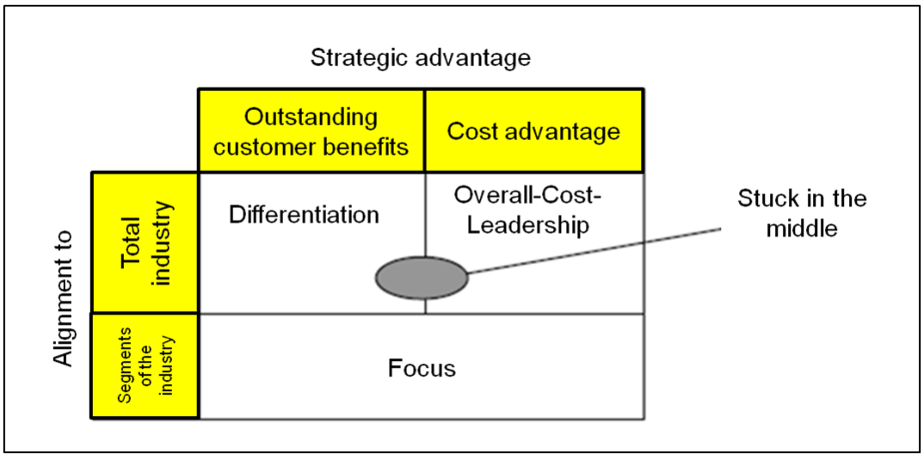


Figure 14: Strategic Types[136]

Companies which are stuck in the middle are in a disadvantageous strategic situation. These organizations have a need of market share, investments and the motivation to achieve the status of "Overall-Cost-Leadership". They also have no differentiation attribute to circumvent low costs and no organization system to achieve a differentiation or cost advantage in a limited market segment.[137]

**Product – Market Strategies**

Figure 15 shows the product-market matrix according to Ansoff which shows the four product-market strategies:

| | Existing Product | New Product |
|---|---|---|
| Existing Market | Market Penetration | Product Development |
| New Market | Market Development | Diversification |

Figure 15: Product-Market-Strategies[138]

[136] Porter, M.E. (1999), p. 75

[137] Cf. Porter, M.E. (1999), pp 78

[138] Ansoff, I.H. (1965), p. 109

- Market Penetration:

Market Penetration uses product modification, product differentiation and the increased assignment of marketing activities to achieve a higher market share and market volume with existing products on an existing market.[139] This should lead to the increase of the product utilization of existing clients, recruitment of non-users and customers of competitors.[140] For example the market penetration can be the launch of a new and innovative type of an existing vehicle model.[141]

- Market Development:

The goal of the market development is to enter a new market with the existing products to achieve an increase in sales. It’s possible to expand geographically or to develop a new market segment as well, e.g. to launch an existing vehicle model in a new market like Japan. [142]

- Product Development:

Product development involves the activities to ensure or increase the sales volume in an existing market. That will be done with the help of new products or new product features or quality, e.g. to launch a short version of a vehicle model in Europe and a long version of a vehicle model in the US.[143]

- Diversification:

Diversification is the entry of new products in new markets. The type of diversification differs in the degree of the risk spreading.[144]

[139] Cf. Kotler, P. et al (2011), p. 180
[140] Cf. Runia, P. et al (2007), pp 76
[141] Cf. Kotler, P. et al (2011), p. 180
[142] Cf. Kotler, P. et al (2011), p. 180
[143] Cf. Kotler, P. et al (2011), p. 180
[144] Cf. Runia, P. et al (2007), p. 77

There are three types of diversification:[145]

1.) Horizontal Diversification: The entry of products which are on the same manufacturing level as the present production program.
2.) Vertical Diversification: The entry of products of the upstream and downstream economic level.
3.) Lateral Diversification: Between the new and the present product exists no direct factual coherence.

**Strategic Timing**

Figure 16 shows the moment of the market entry of the three strategic types concerning the market entry. Additional to the market entry time, the strategic focus is a criterion for the assignment of the strategic types. The pioneer has the focus on a customer oriented market development concerning the marketing strategy and the follower types focus on the competitor orientation.[146]

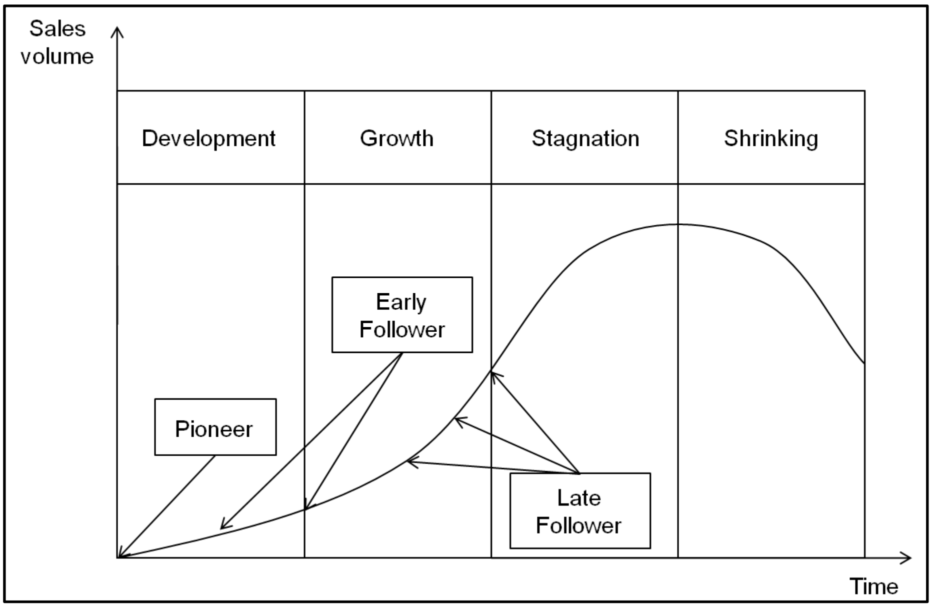


Figure 16: Market entry time in the market life cycle[147]

[145] Cf. Brockhoff, K. (1999), pp 72

[146] Cf. Buchholz, W. (1996), p.167

[147] Buchholz, W. (1996), p.167

Table 3 shows advantages and risks of the three strategic types concerning the moment of the market entry:

| Strategy Type | Advantages | Risks |
| --- | --- | --- |
| *Pioneer* | • Development of technological image<br>• Establishment of industrial standards<br>• Establish good relationship with the customer and supplier<br>• Premature market know-how<br>• Premature usage of the learning curve effect<br>• Largest scope for the use of the marketing instruments<br>• Skimming-Pricing/Penetration Pricing | • Risk due to the economic and technological development<br>• High market opening costs<br>• Lack of experience concerning the product technology on the market<br>• Market entry with a premature product concept<br>• Opening of a market inure to the benefit of followers<br>• Possible obsolescence of investments |
| *Early Follower* | • Alleviated form of pioneer advantages (the earlier the entry the better)<br>• Utilization of the advance performance of the pioneer<br>• Enough scope for the design of the marketing instruments<br>• Utilization of the pioneer experience technology- and business market development | • Temporary offer monopole cannot be used normally<br>• Product of the pioneer is industry standard<br>• Entry barriers |
| *Late Follower* | • Long time span to investigate technology- and market situation and learn<br>• Alignment concerning the competitors and direct the own strategy according to the known weaknesses<br>• Highest possible participation at the investments of the precursors | • Market entry too late<br>• High market entry barriers<br>• Preferences of the customers<br>• Marketing activity parameter cannot be set by the company itself anymore |

Table 3: Strategy Types[148]

[148] Cf. Buchholz, W. (1996), pp 168

### 2.4.2 Formulation of a Strategy

Figure 17 shows the procedure of the target group marketing. First the market will be divided into the different groups of customers with their needs, characteristics and behavior. These different market segments need different products and a differentiated marketing mix.[149]

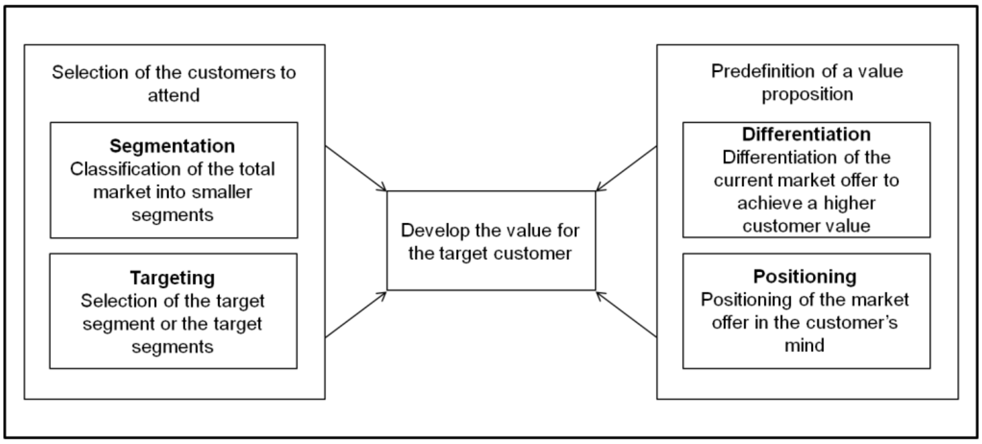


Figure 17: Market segmentation, market selection and market positioning[150]

To achieve the different profiles of the resulting market segments the common methods of market segmentation are used.[151]

Procedures to execute the market segmentation:[152]

- Demographic market segmentation
- Geographic market segmentation
- Psychographic market segmentation
- Time-oriented market segmentation
- Industrial goods

[149] Cf. Kotler, P. et al (2011), p. 454

[150] Cf. Kotler, P. et al (2011), p. 454

[151] Cf. Kotler, P. et al (2011), pp 454

[152] Friesenbichler, M. et al (2004), p. 31

An additional possibility to define the market segments is to divide them into macro segments and afterwards break them down into micro segments:[153]

- Macro segmentation: allocation of the customers which are relevant concerning the innovative product due to criteria like innovation type or branch affiliation etc.
- Micro segmentation: search for people in organizations or customers who boost the use and implementation of innovations

After the segmentation process the next step is to choose the right market segment/s for the product. Therefore the market segments will be evaluated because of the market attractiveness. In the last steps the company has to decide about the value proposition to make to the customer, how to develop the value for the customers and what possibilities to convey it to them are possible. Within the framework of the differentiation and the positioning a clear classification and positioning of the product concerning the competition will be established for every target segment. Thereby a detailed marketing mix can be developed which can resolve the market entry barriers carried out by the market research before.[154] Market entry barriers are:[155]

- Existing preferences of the target customer
- Access to the distribution channels
- National restrictions (tariff policy, regulations)
- Competitive strength of the competitors

Criteria for a successful product launch:[156]

- Technically mature products which are free from defects
- Unique selling proposition = clearly defined product utility
- Coordination of production and distribution to ensure the ability to deliver to the customer
- Identification of the distribution body with the product

[153] Cf. Friesenbichler, M. et al (2004), p. 31 and cf. Wohinz, J.W.; Embst, S. (2010), chapter 4 pp 22

[154] Cf. Kotler, P. et al (2011), p. 455

[155] Wohinz, J.W.; Embst, S. (2010), chapter 4 p. 23

[156] Cf. Wohinz, J.W.; Embst, S. (2010), chapter 4 p. 24

**Marketing Mix**

The marketing mix shown in Figure 18 consists of controllable and tactical tools to increase the demand of the product. A company uses the marketing mix to achieve a desired reaction on the tools. The division of the possibilities is done in four groups called the "4 P's" which are product, price, placement, promotion.[157]

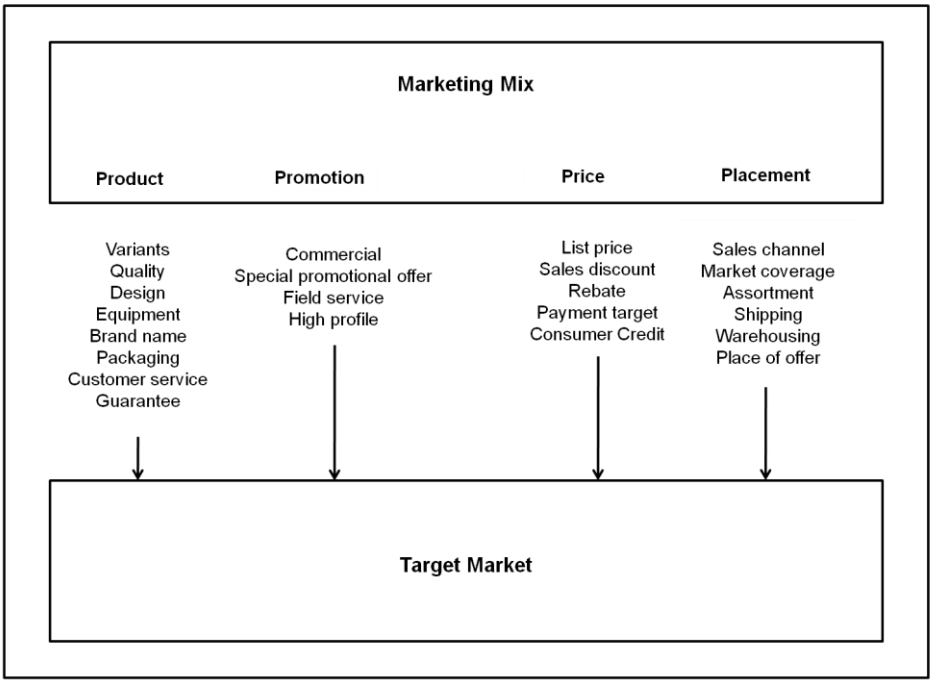


Figure 18: The „4 P's“ as the instrument of the marketing mix[158]

- Product:

The product is the collectivity of all products (hard-, soft- and orgware) and services a company offers. The product includes all assembled parts of a product, all variants of the product and product parts, the guarantee and maybe a financial package.[159]

[157] Cf. Kotler, P. et al (2011), pp 191

[158] Cf. Kotler, P. et al (2011), p. 192

[159] Cf. Kotler, P. et al (2011), p. 192

- Price:

The price is what the customer pays for the product. It is fixed by the price setting factors. Thereby better payment practices and discounts are given to deal with the competition and to offer a price according to the value perception of the customer.[160]

- Placement:

The placement includes the all activities to make the product available for the customer. In other words the placement is the design of distribution channels.[161]

- Promotion:

Promotion includes the all activities which can be made to communicate the preferences of the product to the customer. Therefore new customers should be acquired and the disposal should increase.[162]

### 2.4.3 Strategic Considerations concerning the practical Work

For the economic feasibility study in the practical part of the work first strategic considerations have to be taken into account. The feasibility study will include a market survey where the segmentation of the market has to be done and the right target segments must be chosen. Due to this segmentation the product-market strategy according to Ansoff's product-market matrix can be detected. Derived from this market survey, the marketing mix will be established and can be used in a target-oriented way to achieve the marketing goals of the company.

[160] Cf. Kotler, P. et al (2011), p. 192

[161] Cf. Kotler, P. et al (2011), p. 193

[162] Cf. Kotler, P. et al (2011), p. 193

## 2.5 Management of an Innovation Project

A project can be divided into four main phases:[163]

1. Project definition
2. Project planning
3. Project controlling
4. Project close-out

### 2.5.1 Project Definition

During the phase of the project definition the project targets and the project organization must be selected. At the end of this phase the project order has to be fixed in written form. It contains the most important data for the procedure of the project. The project order is a contract between sponsor and contractor.[164]

**Project Targets**

The project targets are needed to concretize the project idea after the first evaluation. They support the desired results, the given timeframe and budget restrictions and the finite state of the innovation project.[165] There are three types of targets:[166]

- Performance and quality targets
- Deadline targets
- Cost targets

The targets have to be concrete as possible. Furthermore, it is helpful to distinguish between “Must-Goals”, “Wish-Goals” and “Not-Goals”. Must-goals are unconditional preconditions for the success of the project. Wish-goals

[163] Friesenbichler, M. et al (2004), p. 10

[164] Cf. Friesenbichler, M. et al (2004), pp 10

[165] Cf. Friesenbichler, M. et al (2004), pp 10

[166] Friesenbichler, M. et al (2004), p. 11

would increase the success of the project but are not necessary. Not-goals are used for the classification of performances which do not belong to the project.[167]

**Organization of the Innovation Project**

Projects are successful when the right arrangements are made.[168] This must be done for:[169]

- The Project (integration into the organization with the help of the different organization styles) and the
- Allocation of the roles for involved personnel, competences, tasks and areas of responsibility inside of the innovation project.

Due to the integration of the project into an organization, overlaps and cut surfaces occur between the project teams and the permanent staff organization.[170] For the regularization of these situations the typical styles of organization can be used:[171]

- Pure project organization

The project specific decision competence is assigned to the project leader. The personnel of the project team are directly responsible to the project leader and will be divested from the permanent staff organization. Consequently, the whole process will be accelerated due to the fact that the coordination of the project is easier and other reasons. The disadvantages are that the participants of the project team are cut off from the development and colleagues in the permanent staff organization during the project and it also can be very difficult to divest the participants from and reincorporate them into the permanent staff organization.

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[167] Cf. Friesenbichler, M. et al (2004), p. 11

[168] Cf. Friesenbichler, M. et al (2004), p. 11

[169] Cf. Friesenbichler, M. et al (2004), p. 11

[170] Cf. Friesenbichler, M. et al (2004), p. 11

[171] Cf. Friesenbichler, M. et al (2004), pp 11

- Impact project organization

The project decision competence is assigned to the supervisor of the project leader in the permanent staff organization. The project leader himself/herself only has a staff function without any directive authority. A significant disadvantage of this organization style is that the project leader has no necessary competences to solve conflicts and problems during the project process.

- Matrix project organization

The organization style of the matrix project organization is often used today. In this organization style the project specific and functional competences are combined. This means that the project staff is not fully divested from the permanent staff organization. Tasks for the project and the permanent staff organization will be worked off in parallel. Therefore a good organizational understanding is needed but the problems with divestment and reincorporation drop out. Even the communication between the two parties is better.

### 2.5.2 Project Planning

A successful project needs good, detailed project planning. A reasonable planning is a guideline for the project staff and reduces the complexity of the innovation project.[172] The project planning develops the:[173]

- work packages to work off,
- allocation of the work packages to a responsible person,
- schedule of the needed resources,
- needed capital,
- timeframe for the processing of the work packages as well as the
- chronological and logical sequence to work off the work packages.

[172] Cf. Friesenbichler, M. et al (2004), p. 13

[173] Cf. Friesenbichler, M. et al (2004), pp 13

Especially innovation projects need a detailed and accurate planning due to the insecurity and risk with which they are afflicted with.[174]

To enforce an accurate and structured planning a few tools can be helpful:[175]

- Project structure plan
- Bar chart
- Estimate-talk-estimate

### 2.5.3 Project Controlling

The controlling of the innovation project is necessary due to the possibility of target changes, disturbance values, planning failures and deviations of the approximation.[176]

During the project controlling the actual values are contrasted to the planned values under the aspect of the elapsed time span. The project factors are quantifiable factors like costs, time or effort. The earlier deviations can be indentified the higher is the possibility that there do not have to be corrective actions for the planning.[177]

The project supervision and the project control have the job to observe the provided performances, the costs and the compliance with deadlines. The project control deals with the changes of the project planning and the project execution. The project supervision indentifies the deviations between the actual values and the planned values. In the framework of the data collection the actuality of the data has higher priority than the accuracy of the data. The goal is to go against deviations as soon as possible.[178]

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[174] Cf. Friesenbichler, M. et al (2004), p. 14

[175] Cf. Friesenbichler, M. et al (2004), pp 13

[176] Cf. Friesenbichler, M. et al (2004), p. 19

[177] Cf. Friesenbichler, M. et al (2004), p. 19

[178] Cf. Friesenbichler, M. et al (2004), p. 20

**Performance Progress Measurement**

The performance progress is measured by the comparison of the finished activities with the total activities. The indicator for the measurement is the degree of completion of all activities of the innovation project. Therefore the degree of completion of the project has to be determined regularly because of the finished work packages, the started work packages as well as the not-started work packages. To relieve this task, large work packages can be break down to smaller work packages due to the fact they are easier to observe.[179]

**Deadline Monitoring**

There has to be a detailed deadline monitoring if the success of an innovation project strongly depends on the compliance with the deadlines. The time schedule has to be updated regularly to ensure the usefulness for the project controlling. If there are requests for modifications of persons in charge for work packages there have to be meetings about the possibilities to meet the endangered deadline with the help of diverse actions like additional personnel or improvement of the operational procedure. A useful tool to indentify deadline deviations early is the cornerstone-trend- analysis.[180]

**Cost Control**

The management board has a strong focus on the project budgets. Therefore the costs have to be observed accurately during whole project. Methods to observe the costs throughout the project are the cost comparison in relation to the cut-off date and the budget forecast to end of project.[181]

In the case of the cost comparison in relation to the cut-off date the actual and desired costs and their causes are analyzed. Based on this analysis, appropriate control activities should be developed.[182]

[179] Cf. Friesenbichler, M. et al (2004), p. 20

[180] Cf. Friesenbichler, M. et al (2004), pp 20

[181] Cf. Friesenbichler, M. et al (2004), p. 21

[182] Cf. Friesenbichler, M. et al (2004), p. 21

Compared to the cost comparison in relation to the cut-off date, the budget forecast to end of project is future oriented. The cost comparison is related to the project end and not to a cut-off date. This means that the already incurred costs of a work package are added to the estimated residual costs. After that the sum of these costs will be compared to the planning costs to identify appearing deviations.[183]

**Integrated Project Control**

To ensure an efficient project control all three areas mentioned above (see chapter 2.5.3) must be observed. The totality of these activities is combined in the integrated project control. Therefore a costs-time-curve is often used to display the deviations between the actual, planning and desired costs from cut-off date to cut-off date until the end of the project.[184]

### 2.5.4 Project Close-out

The following aspects are to consider for the project close-out:[185]

- Performance acceptance and accordingly acceptance of services rendered

The acceptance of services rendered has to take place internal and external. Therefore it can be required to consult certification organizations.

- Project closing Analysis

In the framework of the project closing analysis the diverse deviations (e.g. costs, quality etc.) and their reasons will be documented. After this, appropriate activities will be developed to avoid these deviations in the future.

[183] Cf. Friesenbichler, M. et al (2004), p. 21

[184] Cf. Friesenbichler, M. et al (2004), p. 22

[185] Cf. Friesenbichler, M. et al (2004), p. 22

- Recording of experience

Recording of all kind of experience related to the work on the project, e.g. facts or manner of teamwork.

- Closing of the project

At the end of the innovation project must be a project closing meeting. With the closing of the project also the project organization will be broken up and the bounded resources will be deallocated.

# 3 Germ-free air circulation in a vehicle

This chapter deals with the practical part of the diploma thesis. It contains a detailed description of the idea “germ-free air circulation in a vehicle” and the eradication of the phase model according to Thom mentioned in chapter 2.3. Concerning the phase model according to Thom, only the first and the second phase of the model will be executed in this thesis.

The content of the second phase of the model, the “Idea acceptance”, will be an economic feasibility study. It is the basis for the business plan (see appendix B) and the basis for the decision about the realization of the idea by MAGNA International. Therefore the content of the feasibility study is bounded to the desired specifications of MAGNA. These specifications involve a market survey, a first cost determination, the detection of the achievable price with the help of a short customer survey, the marketing mix, the product life cycle, the possibilities of the utilization of the idea, a rough patent research, the legal permission, the possibilities for internal and external cooperation and a risk assessment.

The objective of the eradication of the feasibility study is that MAGNA International can make a decision about the realization of the idea due to the gathered information. The decision will start the third phase of the phase model according to Thom which is not content of this thesis.

## 3.1 The Idea

The idea of germ-free air circulation in a vehicle was handed in by Michael Welter respective to the WIN initiative. For this reason some facts about the idea, the state of technology and possible advantages and disadvantages are mentioned in this sub-chapter.

### 3.1.1 State of Technology

To get an idea of how UV-C LEDs can be used to produce germ-free surroundings the following points give some information about LEDs in general, the construction of UV-C LEDs and their usage to produce germ-free surroundings today.

**LEDs**

Light emitting diodes use the occurrence of electro-luminescence which means that they are able to produce light because of electricity with the help of direct atomic animation and no necessary warming. They are semiconductor diodes which emit light by applying the adequate voltage and operating in the conducting direction.[186]

The generation of radiation occurs because of the recombination of pairs of charge carriers in a semiconductor with respective band gap. The band gap and therewith the wave-length of the emitted light is defined by the semiconducting material in combination with the doping material.[187]

The light emitting diodes are used to produce narrow-band radiation in the area of visible light, near UV light and infra red. They are insensitive to mechanical impact and are a punctual radiation source.[188]

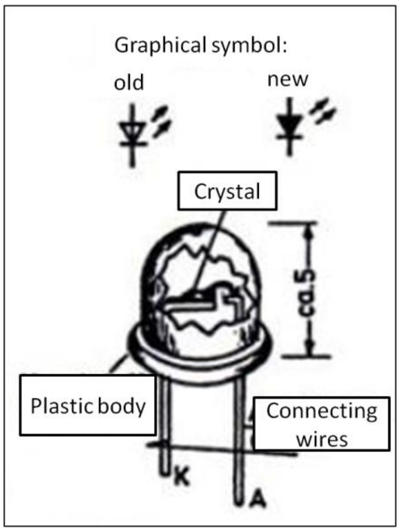


Figure 19: Construction of a LED[189]

[186] Cf. Böhmer, E.; Ehrhardt, D.; Oberschlep, W. (2007), p. 40

[187] Cf. LED-Info Rechercheportal, access date 15.02.2011 and cf. Böhmer, E.; Ehrhardt, D.; Oberschlep, W. (2007), p. 40

[188] Cf. LED-Info Rechercheportal, access date 15.02.2011

LEDs are used in several fields because of their preferences like smallness, steadiness, high efficiency or long life time. Fields of utilization are:[190]

- Lightening and illumination
- Displays
- Indicators and warning lamps
- etc.

The advantages and disadvantages of LEDs can be divided into four sections:[191]

- Environment
- Technical
- Economical
- Design

Advantages are for example the low energy requirement, high life time, no maintenance costs, impact and vibration resistant, safety because of extra-low voltage, small body and variable color of the light. Disadvantages are for example no standardized design available for high performance LEDs, control gears are necessary, high amount of LEDs are necessary to produce the desired luminous intensity, high costs per unit and development costs for boards.[192]

The aging of all kind of LEDs and therefore the lowering of the light intensity is caused by degradation. The decrease of the intensity of the emitted radiation is faster if the LED is used at a high operating temperature. The phenomena of degradation is not defined clearly yet but probably depends on the migration and expansion of defects in the crystal.[193]

[189] Böhmer, E.; Ehrhardt, D.; Oberschlep, W. (2007), p. 41

[190] Cf. LED-Info Rechercheportal, access date 15.02.2011

[191] Cf. LED-Info Rechercheportal, access date 15.02.2011

[192] Cf. LED-Info Rechercheportal, access date 15.02.2011

[193] Cf. LED-Info Rechercheportal, access date 15.02.2011 and cf. Böhmer, E.; Ehrhardt, D.; Oberschlep, W. (2007), p. 40

## UV-LEDs

The general build-up of a LED was already described in before and shown in Figure 19. The different wave lengths of the radiation occur because of the different semiconducting materials.

Due to that fact there are three different kinds of UV-radiation:[194]

- UV-A (wave length 315 – 380 nm)
- UV-B (wave length 280 – 315 nm)
- UV-C (wave length 100 – 280 nm)

The characters A, B and C are only used for the classification and have no further meaning. UV-C radiation has a wave length between 200-280 nm. Materials which can emit radiation with this desired wave length are shown in Figure 20.[195]

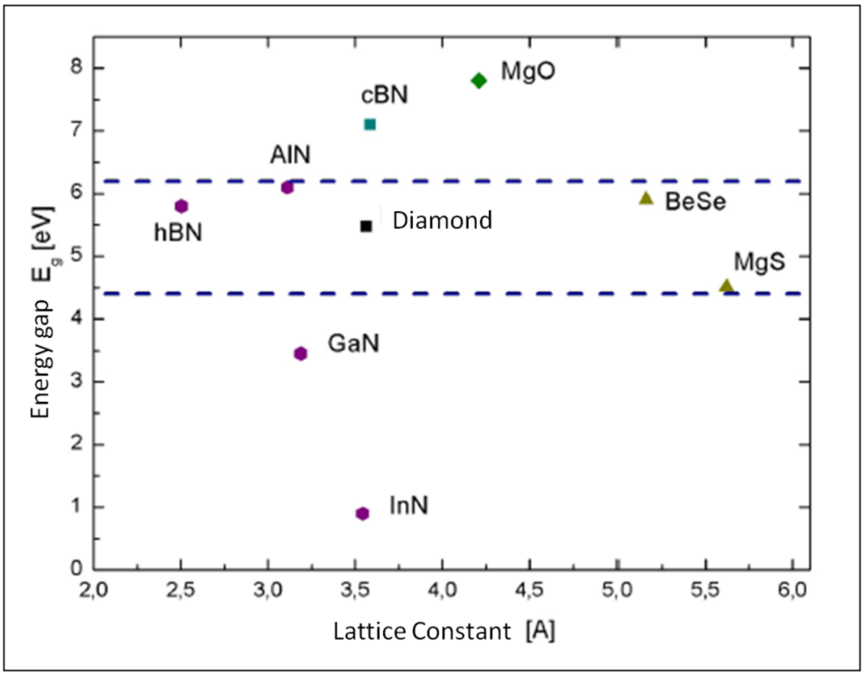


Figure 20: Semiconductor materials which can produce the UV-C wave length[196]

[194] Cf. UV Strahlung Internetportal, access date 30.05.2011

[195] Cf. Sedlmeier, K. (2008), p. 7 and cf. LED-Info Rechercheportal, access date 15.02.2011

[196] Sedlmeier, K. (2008), p. 7

The section between the dashed lines shows the semiconductor materials with the ability to produce UV-C radiation.

**UV-C Disinfection**

Virus and bacteria were not able to develop a resistance against UV-C radiation because UV-C rays are absorbed in the atmosphere. Therefore UV-C radiation is highly qualified to produce germ-free surroundings (e.g. air, water or surfaces).[197] Figure 21 shows that the perfect wave length to inactivate bacteria is between 200 and 280 nm.

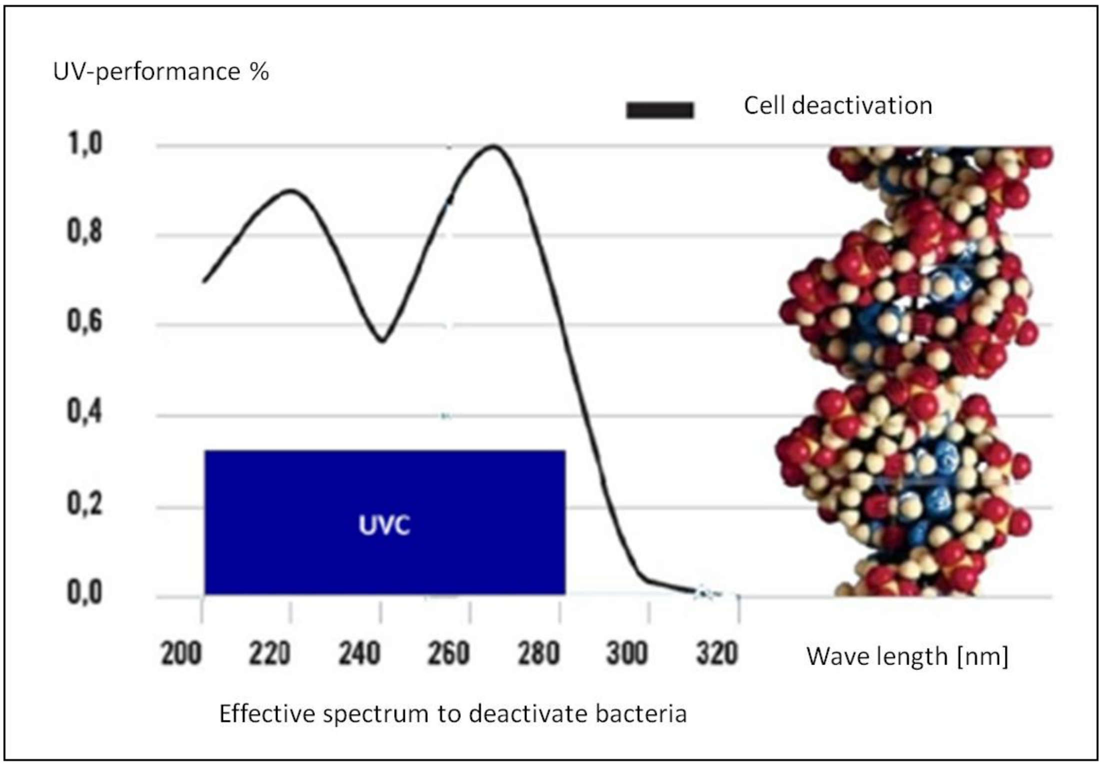


Figure 21: Effective spectrum for inactivation of bacteria[198]

[197] Cf. Sedlmeier, K. (2008), p. 2

[198] Sedlmeier, K. (2008), p. 3

Advantages are:[199]

- Permanent reliability of the production process = less failures because of quality problems
- High product quality
- Longer remaining period = higher and lasting yield stability
- Best hygiene of the surroundings

The technology of UV-C disinfection does not need any king of chemicals or toxic compounds. There is no formation of resistance and undesired micro-organisms will be deactivated within seconds. Additionally, the process of UV-C disinfection satisfies the high standards of the consumer protection, the HACCP-concepts and the VDI 6022.[200] Today the UV-C disinfection is used for water technology, medical technology, odor removal, surface sterilization, air conditioning- and ventilation technology, food technology and fat elimination.[201]

**State of Air Filtration Systems in Vehicles**

The modern air ventilation in a vehicle has an air flow rate of 5 – 12 liters/second according to the vehicle type and the blower position. Due to the utilization of filter for the interior air of vehicles solid like pollen, spores and sooty particles can be filtered up to almost 100%. Some of these filters also contain active carbon and filter up to 90% of toxic substances like nitrogen oxide, ozone, bacteria and odors. These active carbon filters can prevent the vehicle occupant from headaches, irritated mucous membrane or allergic reactions. The construction of the cabin filters is shown in Figure 22.

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[199] Cf. Sterilsystems GmbH, access date 15.02.2011

[200] Cf. Sterilsystems GmbH, access date 15.02.2011

[201] Cf. Sterilsystems GmbH, access date 15.02.2011 and cf. OSRAM GmbH, access date 15.02.2011 and cf. BÄRO GmbH & Co. KG, access date 15.02.2011

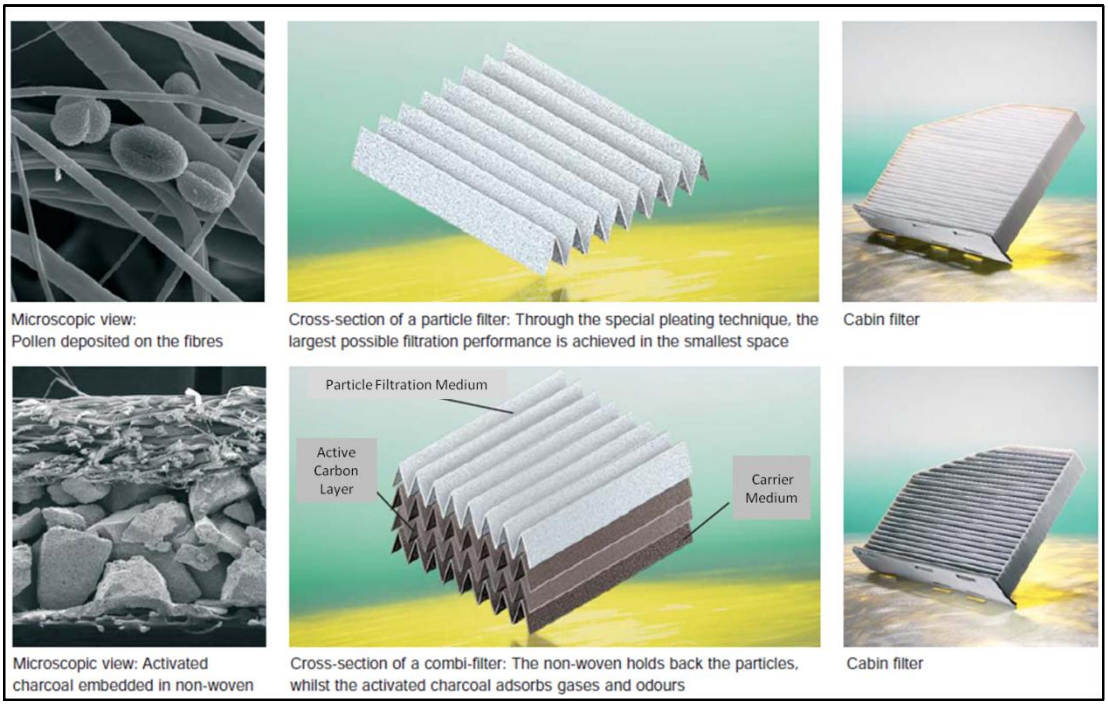


Figure 22: Cabin filters[202]

A contaminated filter interferes the air flow which causes insufficient air ventilation and fogged up windows. The maintenance interval is given by the manufacturer but the car owner should do regular visual checks on the filter. Most manufacturers recommend changing the filter every year or 15000 km. Every normal particle filter can be exchanged by an active carbon filter and vice versa. Filters for the interior air are standard equipment for almost every new vehicle. Old vehicles have the possibility to get refitted.[203]

### 3.1.2 Description of the Idea

The inventor of the idea of “germ free air circulation in a vehicle” is Michael Welter from the group of “MAGNA Seatings”. The impulse for the idea came because of the discussion about the particulate matter problem in German cities. Michael Welter thought about the state of technology of filter media

[202] Mann&Hummel GmbH, access date 14.03.2011

[203] KFZTech, access date 14.03.2011

used today (e.g. in laboratories). Due to those thoughts the idea of germ free air in a vehicle with the help of UV-C radiation was born.

At the moment only conventional air filtering systems are used which cannot guarantee complete germ free air ventilation for the interior of a car. This would be possible due to an UV-C LED module which can be integrated in the climate or air ventilation system. There would also be no appreciable additional energy consumption due to the UV-C LED module.

## Construction of the Idea

Figure 23 shows the first sketch of the UV-C module. It consists of two half-shells which are jointed with the help of a clip. The material of these half-shells will be polyamide which will be possibly strengthened with fiber glass. The UV-C LEDs are arranged circularly around the notch of one of the half shells.

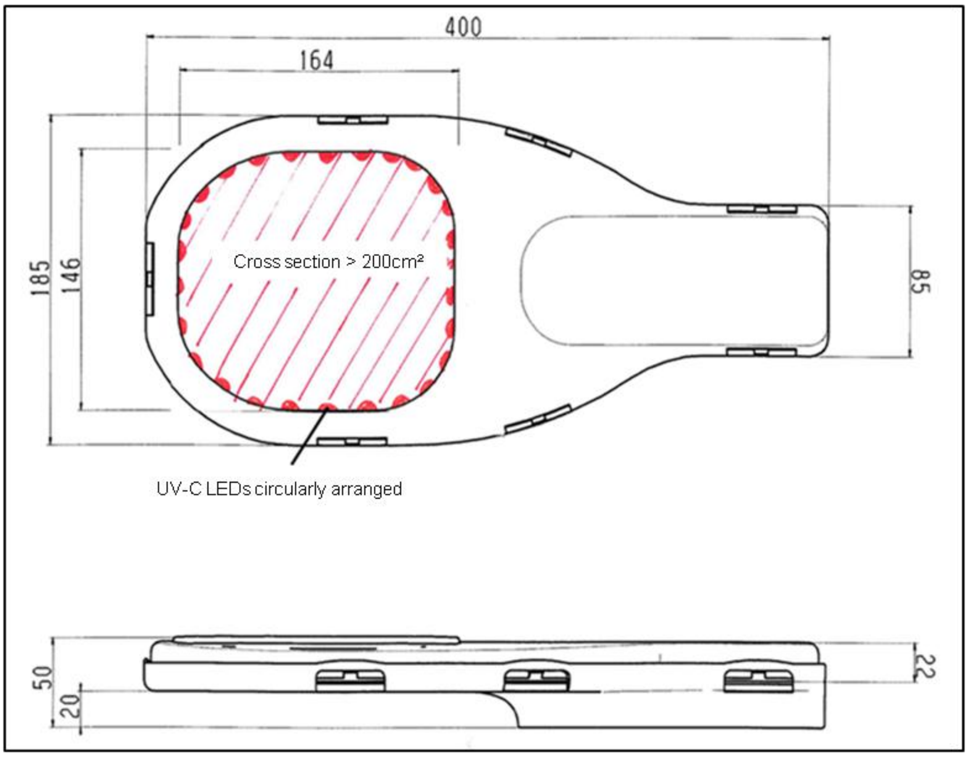


Figure 23: First sketch of the UV-C module[204]

[204] Welter, M. (2011)

Additional electronic components (e.g. a control board) are taken into account with freeboard inside between the jointed half-shells shown in Figure 24. The overall weight of the module including the electronics is about 150 – 200 grams.

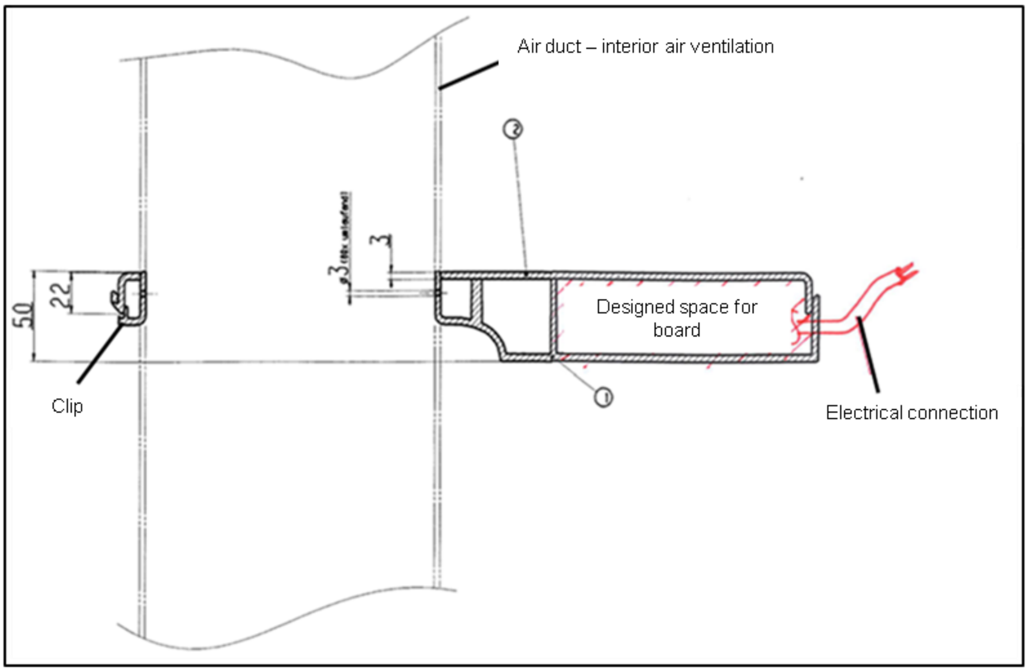


Figure 24: Integration of the UV-C module[205]

A vaporization of the notch of the half-shell with the UV-C LEDs with aluminum or chrome can help to increase the radiation intensity. The current dimensions are just first reference values for the determination of the manufacturing- and development costs (see point “Cost Determination and achievable Price”).

### Possibilities of the Integration

The UV-C module should be integrated at the air duct of the air ventilation of the vehicle (see Figure 24 and Figure 25). It should be easy to assembly and maintain via the engine compartment. The cross-section needed for the UV-

[205] Welter, M. (2011)

C module is insignificant according to the general estimation of a MAGNA expert. Therefore there do not have to be any changes in the engine compartment construction to make room for the module. As it is mentioned above, there are two kinds of filters for vehicle:

- Particle filter
- Active carbon filter

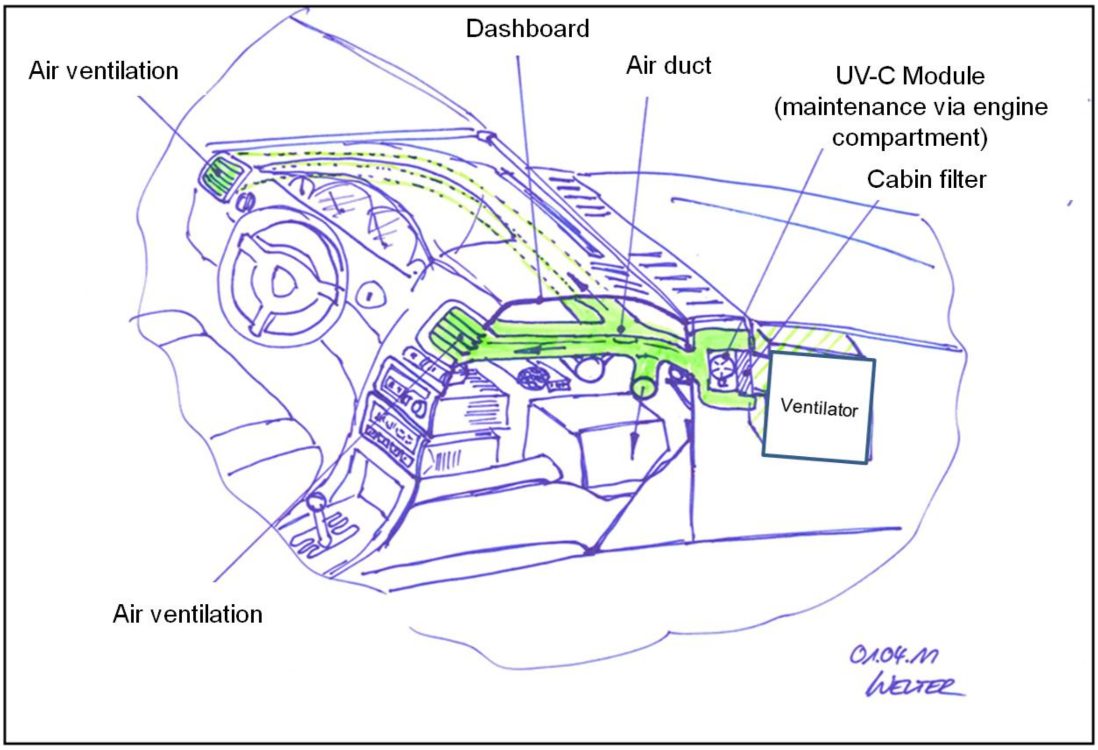


Figure 25: Prospective position of the UV-C module[206]

The UV-C module with the UV-C LEDs can be used for both possibilities. The active carbon filter filtrates almost 100% of particles and up to 90% of toxic substances. With the help of the UV-C module the filtration system would reach a higher percentage of decontamination of the air. The Particle filter can only filter solids. In this case the UV-C module will lead to complete disinfection of the air but the filtration of gases will not be possible without active carbon.

[206] Welter, M. (2011)

The function of the module can be guaranteed because of the life time promised by the manufacturer and controlled by a radiation sensor. Sensors for the automatic switch from external air supply to recirculating air can be still used to guarantee the good air quality in the inside of a vehicle.

The UV-C module will be embedded into new vehicles because it is not possible to refit old cars without high costs. This module has to be considered in the design of the climate system of a vehicle. If this is done, the module can be offered in series or optional depending on the OEM and the model of the vehicle.

### 3.1.3 Possible Advantages

There are three possible advantages with the help of the UV-C module:

1. The combination of an active carbon filter with the UV-C module can achieve a better decontamination of the air inside the vehicle and a better comfort for the vehicle occupant.

2. The combination of a normal particle filter and the UV-C module will lead to an additional disinfection of the air inside the vehicle beside the filtration of the particles. Additionally, the customer will have less costs concerning the maintenance of the filter (maintenance interval is mentioned in “State of Air Filtration Systems”). Active carbon filter are 1,5 to 2 times more expensive than particle filter.

3. The module effects a better decontamination of the air in the climate system. Thereby it will be difficult for moulds and other germs to settle in the climate system. Therefore the maintenance interval of the whole climate system would be extended.

## 3.2 Idea generation

As it is mentioned in chapter 2.2.4, the idea generation is the first main phase of the innovation process. The whole process of the idea generation was done by the WIN initiative of MAGNA. Therefore this chapter contains a short description how the steps of the main phase were done by this initiative.

### 3.2.1 Look-up Field Identification

According to the description of the WIN initiative in chapter 1.2, WIN is used as a platform for the employees of MAGNA to be creative and develop innovative ideas because MAGNA’s opinion is that innovation has an important influence on the success of a company.[207]

MAGNA did not specify a special look-up field for the employees due to the fact that the innovative idea must not belong to the automotive sector. The company only mentioned the key words environment protection, communication technology, alternative power train, energy efficiency and vehicle safety to inspire the employees.[208]

The only restriction is that every idea which belongs to MAGNA’s continuous improvement program or the employee suggestion system won’t be considered in the WIN initiative and will be worked on in these two programs.[209]

### 3.2.2 Generating/Finding of Ideas and Collection

The WIN initiative was established to generate and collect ideas of employees of all MAGNA groups and give them a platform to develop them. A systematic idea generation with the help of the mentioned tools in chapter 2.3 is not purposed. The number of ideas generated by each group is shown

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[207] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

[208] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

[209] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

in Figure 26. The idea of “germ free air circulation in a vehicle” was found in the group MAGNA Seating.[210]

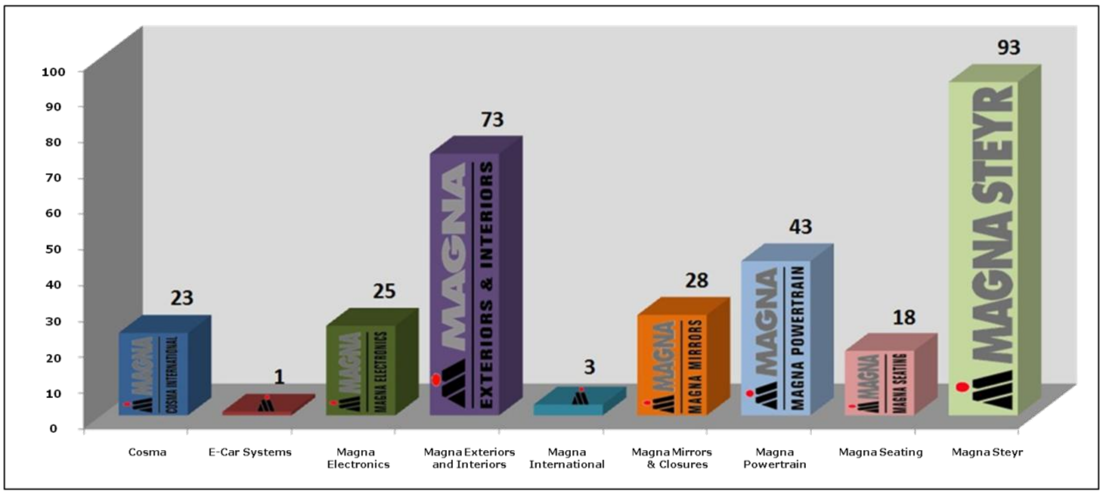


Figure 26: Number of handed in WIN ideas of the MAGNA groups[211]

To introduce the WIN initiative to the employees, diverse information material was send to the several groups of MAGNA. Every employee and leased laborer of MAGNA is allowed to hand in his/her idea. The idea has to be formulated accurately and should be described with a sketch.[212]

When the idea is generated the founder of the idea has to hand in a complete filled in schedule via fax, email or mailing. There is even the possibility to do this process online via the MAGNA intranet and the internet. Support during the hand in process is given by the WIN line which is available from Monday to Friday between 9:00 am and 4:00 pm and which is free of charge. After the handing in and the storing of the idea in the WIN idea-pool the founder receives a response via email. Because the WIN initiative is not public, the founder has access information to check the status of his/her idea online all the time.[213]

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[210] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

[211] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

[212] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

[213] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

The number of ideas handed in between the 01.02.2010 and the 31.08.2010 for WIN 2 was 307.[214]

### 3.2.3 Rough Selection and Proposal for the Idea

The first step after the idea generation and collection is a rough selection because of several criteria. For example ideas which were not novel or innovative enough were eliminated directly. Or ideas which belong to the employee suggestion system are sorted out and will be processed in the continuous improvement program.[215]

After this first rough selection 179 ideas of the WIN 2 were sorted out due to the fact that they did not meet the criteria mentioned before. The other 128 ideas of the WIN 2 made it through this first rough selection to get analyzed by a team of specialists. They should reduce the number of ideas because of criteria like market attractiveness, feasibility, cost effectiveness, converter costs, innovation potential and the individual attractiveness for MAGNA itself. The next step is the evaluation of the ideas by an expert committee, the WIN jury. This is done for every idea with respect to the criteria mentioned before and after that evaluation the committee should decide on the ranking of the 10 TOP ideas. These 10 TOP ideas will be refined by a university, research facilities or MAGNA internal. The idea of "germ free air circulation in a vehicle" is one of these ideas.[216]

After the step of the idea generation done within the WIN initiative the next main phase of the innovation process, the acceptance of the idea, will be processed in the framework of this diploma thesis.[217]

[214] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

[215] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

[216] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

[217] Cf. MAGNA Europe Intranet (WIN), access date 15.03.2011

## 3.3 Acceptance of the Idea

As it is mentioned in chapter 2.2.4, the acceptance of the idea is the second main phase of the innovation process according to Thom. In this phase a feasibility report will be executed and this report will be the basis for the further procedure respective the realization of the innovative idea.

### 3.3.1 Feasibility Study of the Idea

The following chapter is dealing with the several points of the feasibility study specified by MAGNA International. As it is mentioned before the points of the feasibility study to work off are:

- Market Survey
- Marketing Mix
- Product Life Cycle
- Utilization of the idea
- Cost determination and achievable price
- Patent
- Legal Permission and political promotion
- Synergy potential and possibilities for cooperation
- Risk assessment

The outcome of this feasibility study should give the basis for a decision about the realization of the idea and show whether the idea can be realized in relation to the guidelines of the MAGNA innovation process.

**Market Survey**

First of all a broad market research was done to gain information about the state of technology of cabin filters, competitive products, UV-C LEDs and the potential of the idea. Therefore manufacturer of air conditioning technology, several OEMs, filter manufacturer, LED manufacturer, LED supplier and internal experts of MAGNA were interviewed. Due to the gathered information of filter manufacturer and air conditioning technology experts it was exposed that the state of technology of filter systems is the main competitive product on the market. At the moment there are no research activities concerning the field of germ free air in a vehicle with the help of UV-C technology. As it is mentioned before in chapter 3.1.2, this attitude occurs due to the fact that the UV-C LEDs are not fully developed yet. There have to be research activities to increase the radiation efficiency and to achieve a cheaper price for the LEDs.

The technology is mainly interesting for the urban and suburban areas because health awareness and germ exposure are important and regularly discussed topics in these areas. That is why cabin filters are much in demand for the end customers in areas of high population density. The result of the inquiry (see appendix C) of the OEMs points out this customer behavior and shows that it is very uncommon that cars without a cabin filter are produced or sold. Good examples are the OEMs BMW, Audi and Daimler Mercedes. According to the information from Daimler every Mercedes has a cabin filter in series, only the type of the cabin filter depends on the type of the vehicle. To be more specific the A-class and the B-class have normal particle filters. The C-class and vehicles in a higher segment have an active coal filter. The same practice is used by BMW and Audi. The 1-series of BMW and the A1 or A3 of Audi are the only cars of these OEMs which can be bought with particle filters. All the other vehicles have active carbon filters in series. The OEMs Volvo and Alfa Romeo not even have a vehicle type without an active coal filter. The idea of the UV-C disinfection with the help of UV-C LEDs can lead to a better decontamination and healthier air in the interior of the vehicle whatever cabin filter is used.

The module has to be implemented by the OEM into the construction of the climate system and the equipment of the vehicles first and after some time an aftermarket can occur. Due to the construction of current climate systems the backfitting of old cars is possible but not reasonable because of the high prices. Based on the early state of the idea and the technology of UV-C LEDs it is difficult to estimate a price for the module at the moment. For this reason a technical expert of MAGNA Steyr and an expert of the department “Marketing & Communication” of MAGNA Steyr think that it is more likely that at first the acceptance of the premium brands will be higher because of the additional costs and their attitude to innovative technology. The middle class brands will have the role of a latecomer. Additional, the experts have the opinion that there will be a lot of marketing work to do because the idea only increases the air quality in the interior of the vehicle but cannot replace conventional cabin filters in a vehicle.[218]

- Market segmentation

The market segmentation is an essential part of the market survey. At first the most important decision criteria concerning the idea have to be found in order to make a decision about which vehicle segments should be implied into the market survey. In case of this innovation two important criteria could be found. These two are the usage of the vehicle types in the traffic of city areas due to the urban and suburban growing problem with particulate matter and germs and the probability of the serial implementation of the module in a vehicle type. After an investigation concerning the types of vehicles which meet these criteria it is possible to compare the results with the characteristics of the glossary by the CSM Worldwide GmbH. The characteristics of the glossary are used to classify the vehicle types in segments. These characteristics are the construction of the vehicle, the wheelbase of the vehicle and a specifically calculated index. Due to the CSM Worldwide glossary and under the agreement with the MAGNA departments “Research & Planning”, “Innovation & Technology” and “Marketing & Communications” the vehicle segments A to E were chosen and implied into the market survey. The classification of the vehicle types is shown in Table 4.

| Segment | Examples |
|---|---|
| A – Segment | Peugeot 107-series, SMART fortwo |
| B – Segment | Audi A1, BMW Z4, Mini Cooper, VW Polo |
| C – Segment | Audi A3, BMW 1-series, Mercedes A-class, VW Golf |
| D – Segment | Audi A4, BMW 3-series, Mercedes C-class, VW Passat |
| E – Segment | Audi A6 – A8, BMW 5 – 7-series, Mercedes S-class, VW Pheaton |

Table 4: Vehicle segments

[218] Interviews with Mr. Sumann and Mr. Steiner, company MAGNA Steyr, 28.03.2011

- Market potential

After the segmentation of the vehicle types the market potential has to be detected to finish the market survey. Therefore the right target markets must be found and selected. Again it was important to find several criteria first to select the right target markets for the detection of the market potential. The criteria concerning the target markets are the existence of megacities and areas of high population density, interest in technology and innovation and the importance of health awareness for the people in the investigated regions. The outcome of this investigation was discussed with the MAGNA divisions “Research & Planning”, “Innovation & Technology” and “Marketing & Communication” and Europe (including Russia), Greater-China, Japan/Korea and North America appeared to be the most attractive target markets in relation to the criteria mentioned before.

As it is mentioned before0 and according to the prior agreement with the MAGNA divisions involved, the market entry was divided into two steps. The first step deals with the German premium brands Audi, BMW (including MINI) and Mercedes (including SMART) which are long term clients of MAGNA. They are technology and innovation driven brands and for these reasons they have higher acceptance for new innovative products and associated costs. The product should be offered to them first to get information about the acceptance of the product and to make necessary corrections. Compared with the product-market matrix according to Ansoff mentioned in chapter 2.4.1 the first step is a product development. This means to launch a new product in an existing market. The second step of the market entry is to offer the product to volume brands with significant business contact to MAGNA. In other words the second step deals again with existing clients of MAGNA and is also a product development compared to the product-market matrix according to Ansoff. An additional advantage in both steps is that existing distribution channels and relations with the clients can be used. That was an additional criterion for the selection of the volume brands for the second step. Figure 27 should illustrate these two steps integrated into the product-market matrix according to Ansoff.

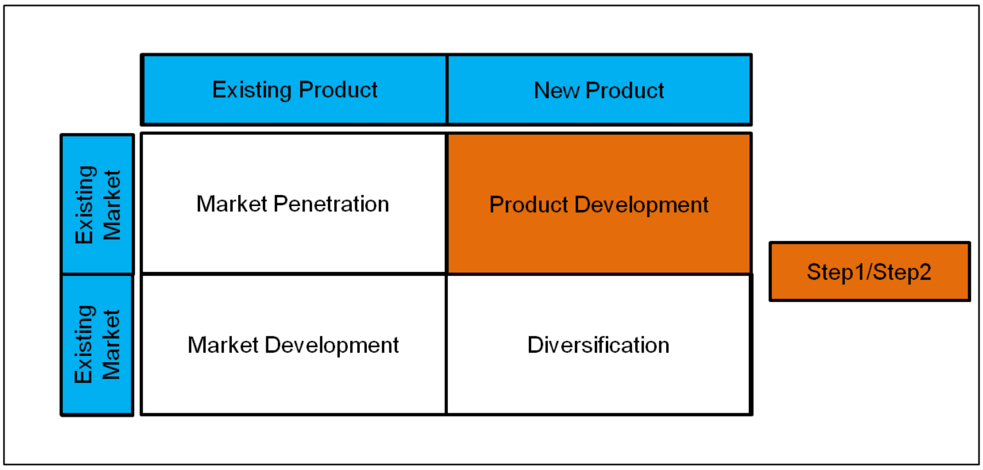


Figure 27: Step 1 and step 2 inserted in the product-market matrix[219]

The calculation of the market potential was done on the basis of the production prognosis data from CSM Worldwide for the time span from 2012 to 2016. The reason for the 5 years time span forecast is that after 5 years the prognosis data won't be accurate enough for a good assessment of the market potential. The database with the production prognosis data was configurated with the help of a "Pivot Table". Thereby the criteria respective to the two steps mentioned before could be set and the market potentials could be detected.

The production values were chosen for the determination of the market potential due to the fact that the OEM is the direct customer and is served with the UV-C module. The OEM produces its cars in a specific country/market and not in every country a car is ordered. For example an Audi A8 is ordered in Saudi Arabia or Australia but it is only produced in Europe. Consequently, the customer is not in Saudi Arabia or Australia but in Europe and belongs to the European market. Additional, the cars with the integrated UV-C module which are stored in a warehouse are also taken into account in the production values but they are left out in the sales figures. Therefore it is more reasonable to determine the market potential with the help of the production values. The outlet of the UV-C module can be determined with the help of estimated take rates if it is desired.

[219] Ansoff, I.H. (1965), p. 109

1) Share of the target markets in the world production of the vehicle segments A to E

Figure 28 shows the production of vehicles of the segments A to E in the target markets compared to the whole world production of vehicles of the segments A to E. They have a percentage of 81,64% and consequently a huge potential for the implementation of the module.

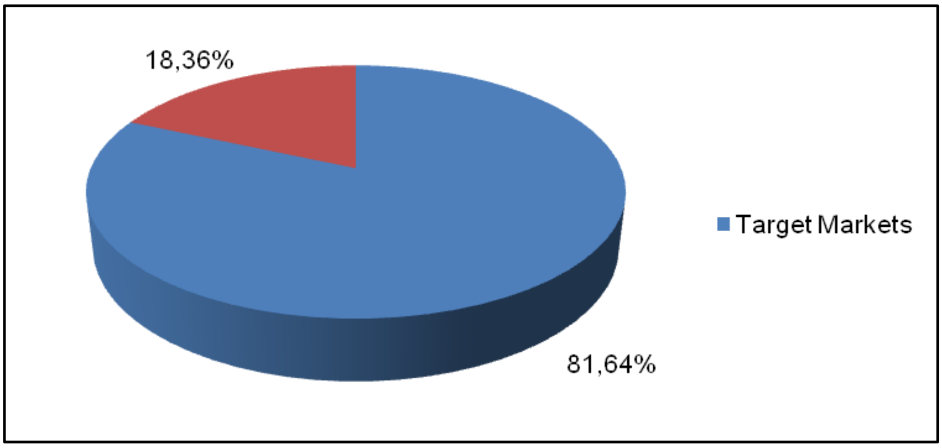


Figure 28: Share of the target markets in the world production

Table 5 shows the production values of the world production compared to the production values of the target markets. “PF” is the production forecasting for the several years.

| | PF 2012[#] | PF 2013[#] | PF 2014[#] | PF 2015[#] | PF 2016[#] | Average #/a |
|---|---|---|---|---|---|---|
| World Production | 69.900.237 | 75.701.540 | 79.648.594 | 82.369.485 | 84.077.732 | 78.339.517,60 |
| Production Target Markets | 57.371.677 | 61.965.545 | 64.979.912 | 67.156.562 | 68.289.083 | 63.952.555,80 |

Table 5: Production forecasting of the world production and the target markets until 2016

The average production value of vehicles in the target market is about 64 million cars. That is a huge amount of vehicles to deal with and not attackable in one step. This is an additional reason why the market entry is divided into two steps.

2) Step 1: German premium brands

The first step concentrates on the German premium brands and their vehicles of the segments A to E. These brands are Audi, BMW (including MINI) and Mercedes (including SMART). The yearly market potential was determined due to an average value of the production values per year of the desired time span. Thereby the yearly market potential mounts up to about 4,8 million produced vehicles in which the UV-C modules can be embedded in.

The percentaged assignment of the market potential is shown in Figure 29. The result shows that 80% of the production is done in Europe (including Russia). The markets of Greater-China (9,7%) and North America (10,3%) have almost the same percentage concerning the whole market potential. The figure also shows that the market of Japan/Korea is not relevant for the first step because Audi, BMW and Mercedes don’t produce their cars there.

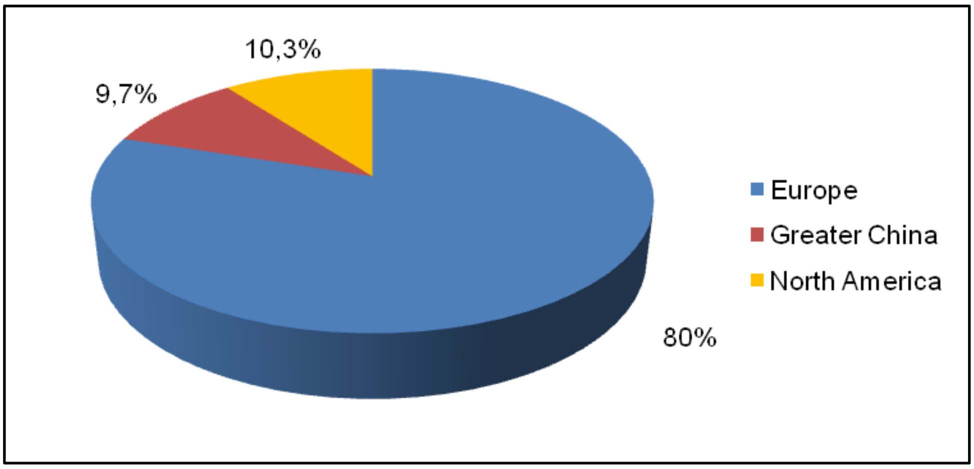


Figure 29: Percentage assignment of target markets concerning the market potential according to the German premium brands

Table 6 shows the production values of the three markets concerning the German premium brands. “PF” is again the production forecasting for the several years.

| Region | PF 2012 [#] | PF 2013 [#] | PF 2014 [#] | PF 2015 [#] | PF 2016 [#] | Average #/a |
|---|---|---|---|---|---|---|
| Europe | 3.488.586 | 3.597.578 | 3.838.448 | 4.041.369 | 4.208.117 | 3.834.819,6 |
| Greater China | 388.740 | 431.020 | 458.078 | 492.699 | 544.997 | 463.106,8 |
| North America | 389.938 | 406.457 | 521.106 | 572.560 | 579.919 | 493.996,0 |
| Total Production | 4.267.264 | 4.435.055 | 4.817.632 | 5.106.628 | 5.333.033 | 4.791.922,4 |

Table 6: Production forecasting for the target markets concerning the German premium brands

3) Step2: Volume brands with significant business contact to MAGNA

The second step deals with the volume brands VW (without Audi), General Motors, Chrysler, Renault/Nissan, Ford and Peugeot/Citroen. These brands are volume brands and existing clients of MAGNA. Again the yearly market potential was determined due to an average value of the production values of the desired time span. This time the yearly market potential mounts up to about 26,6 million produced vehicles in which the UV-C modules can be embedded in. Together with the 4,8 million vehicles of the first step there is a potential of 31,4 million vehicles where the product can be integrated.

The percentaged assignment of the market potential is shown in Figure 30. The outcome is that 46,3% of the production is done in Europe (including Russia). The market of North America has a share of 25,7% and the market of Greater-China 20%. However this time also the market of Japan/Korea appears. It has the percentage of 8% and share in market potential.

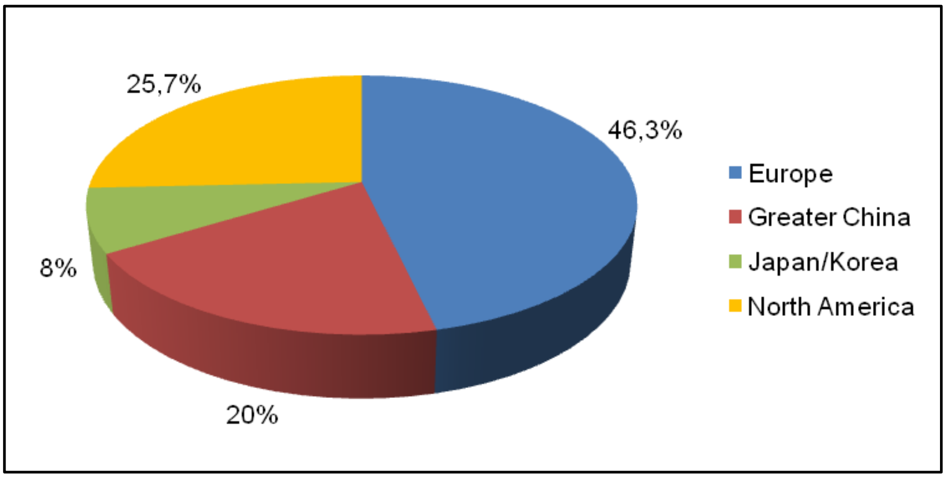


Figure 30: Percentage assignment of target markets concerning the market potential according to the volume brands

Table 7 shows the production values of the four markets concerning the volume brands.

| Region | PF 2012 [#] | PF 2013 [#] | PF 2014 [#] | PF 2015 [#] | PF 2016 [#] | Average #/a |
|---|---|---|---|---|---|---|
| Europe | 11.227.672 | 11.804.051 | 12.360.849 | 12.979.686 | 13.254.597 | 12.325.371 |
| Greater China | 4.491.527 | 5.013.604 | 5.395.792 | 5.686.911 | 5.946.504 | 5.306.868 |
| Japan/Korea | 2.165.885 | 2.138.512 | 2.144.383 | 2.111.978 | 2.062.773 | 2.124.706 |
| North America | 5.996.247 | 6.640.825 | 7.044.898 | 7.258.848 | 7.286.234 | 6.845.410 |
| Total Production | 23.881.331 | 25.596.992 | 26.945.922 | 28.037.423 | 28.550.108 | 26.602.355 |

Table 7: Production forecasting for the target markets concerning the volume brands

To sum up the gained information the European market has the highest share in market potential in both steps. Europe is followed both times by North America on the second place and Greater-China on the third. These two markets have almost the same share in market potential in the first step and 5% difference in the second. In comparison to the others the market of Japan/Korea just takes part in the second step.

**Marketing Mix**

As defined in chapter 2.4.2 the marketing mix is used to cause a desired reaction on the target market and to increase the demand. The “4P’s” are product, price, placement, promotion.

- Product

The product is the UV-C module described in chapter 3.1.2. It should be integrated into the climate system and guarantee a germ free air in the interior of the vehicle with the help of UV-C radiation produced by UV-C LEDs.

- Price

The price of the module would be much too high due to fact that the UV-C LEDs are not cost-effective yet. For this reason an achievable price is estimated with the help of a customer survey. In the survey the test person were asked what they are willing to pay for such a module. The average price which was detected by a customer survey (see “Cost Determination and achievable Price”) is approximately 65 EURO. However, it has to be taken into account that only 1/3 of the probands would pay more than the average price. The other 2/3 would pay less.

- Placement

The distribution activities of the product depend on the state of cooperation with other companies. If the product is developed and produced with the cooperation of another firm the job of the distribution has to be allocated to one firm. If there is no cooperation with another firm the distribution is of course done by the own company. However in all possible cases the customer is the OEM because it has to implement the module into its climate systems first. An advantage would be the utilization of the existing relationship to the OEMs and the associated existing distribution channels mentioned before in the market survey. As Figure 29 and Figure 30 show, the first market which should be served is the European market. It has the highest potential, it is technology and innovation oriented and health awareness is a very popular topic. After the entry in Europe the markets of North America, Greater China and Japan/Korea can be served in the next step.

- Promotion

Just as the distribution, the promotion depends on the degree of the cooperation. The job of the promotion is bounded to the job of the distribution. The firm which delivers the product to the customer has to make the promotion for the product. The promotion must be oriented on the OEM and should awaken its interest for the product. The OEM itself is responsible for the targeted promotion concerning the end customer.

Common communication channels which can be used to awaken interest and promote the product are exhibitions. Exhibitions of great interest are auto shows, e.g. the “North American Auto Show” in Detroit, the “Geneva International Motor Show”, the “Auto Shanghai” or the “Auto Salon” in Tokyo.

Other exhibitions can be all kind of trade fairs. A special possibility for targeted promotion concerning every single OEM is a “Tech-Show” like MAGNA practices it. The company can show all new products and services direct to the desired target customer at the customer’s firm. On every event where the product will be presented like the two mentioned before, a prototype of the UV-C module should be exposed and the function of the product should be displayed with the help of an animation on a screen. Additional, the results of measurements and tests should be displayed to point out the benefit of the product compared to a climate system without the embedded UV-C module. Another possibility to create interest and acceptance for the product is to contact automobile associations and specialist magazines and present the product, the measurements and tests results to them. Maybe they should even be invited to the final tests. That is also a way to awaken the interest of an OEM.

**Product Life Cycle**

Figure 31 shows the present position of the current cabin filters according to the statement of the “MANN+HUMMEL GMBH”.

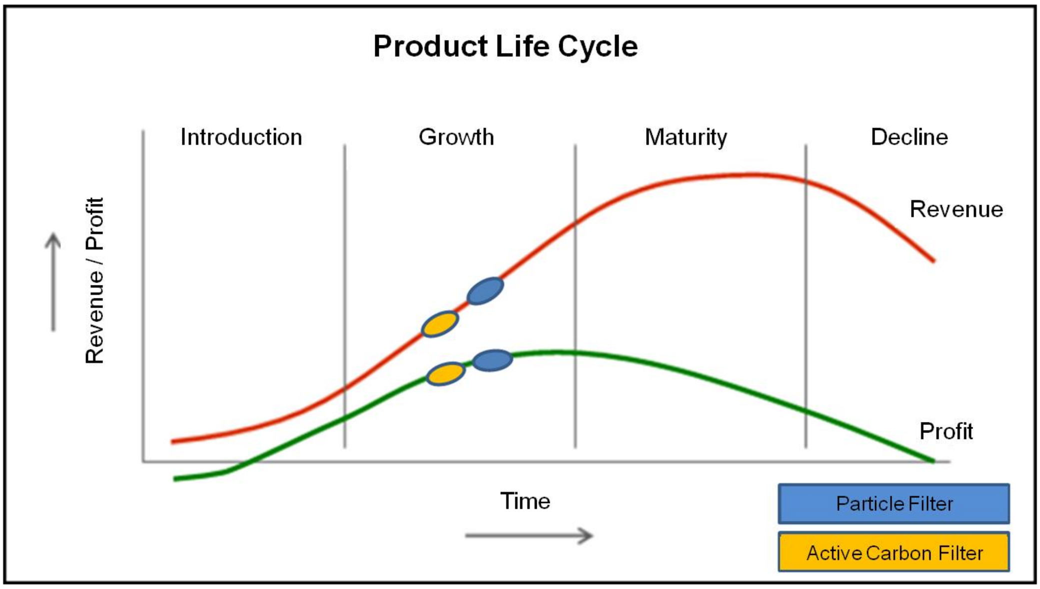


Figure 31: Product life cycle of cabin filters[220]

[220] Cf. Excel4Marketing, access date 12.04.2011

Although these products are on the market for a while these filters can be found in the growth stage and move slowly towards the maturity stage. This is due to the fact that there are no substitute products at the moment. The only difference between the particle filters and the active carbon filters is that the particle filters are a little bit beyond in the product life cycle.

The product life cycle of the UV-C module will depend on the development time, the acceptance for the product on the market and the appearance of substitute products. The end of the product life cycle will be reached when a product can be developed which can adopt the filter effect of the cabin filter and the disinfection effect of the UV-C module. Improvements and further development can enlarge the product life cycle. The enlargement can also occur due to price reductions of UV-C LEDs and the appearance of an aftermarket.

**Utilization of the Idea**

In the case of full patent protection a decision about the utilization of the idea has to be made. In this case there are two possibilities to consider, the indigenous production and the assignment of licenses.

The indigenous production has the advantage to enlarge the product portfolio of MAGNA. Beside that the company could also gain ground in other branches like the passenger traffic industry, e.g. aviation industry or overland-bus industry. In this branch germ free air is also an important topic. However MAGNA did not operate in the sector of filter systems for vehicles until yet. Furthermore, the know-how in the area of UV-C LED technology is narrow. That is why MAGNA would have to establish itself in the sector of filter systems. Therefore it would be very important to carry out very accurate tests and measurements to confirm the usefulness of the product. Otherwise the clients will stay with their old filter systems and suppliers and will not integrate the module into their vehicles.

As it is mentioned before, the other possibility is to assign licenses. The license allows other manufacturers to produce the UV-C module. The price for the licenses depends on the transaction value of the product and on the patent protection. The best case for this scenario would be that the UV-C module would be regulated by law and every affected manufacturer has to buy a license. Possible clients in the case of the assignment of licenses could be OEMs, air filtration systems manufacturers and climate system manufacturers.

If there will be no patent protection there is only the possibility of indigenous production. In this case MAGNA has to be first to the market to make use of benefit of the innovation. Otherwise the competitors can copy the product without a problem and the strategic advantage will be lost. Additionally, there is almost no possibility for cooperation except the company has a very trustworthy partner.

**Cost Determination and achievable Price**

The determination of the potential yield in the framework of the economic feasibility study was abandoned in this thesis. That was decided due to the fact that the UV-C LEDs are not cost-effective at the moment. The optical power of one LED is much too low with 0,65 milli Watt and the price per unit is 70 EURO which is much too high. The detailed data sheet of the UV-C LED for further information can be found in appendix G.

In exchange the diverse costs for the UV-C module should be determined and the achievable price should be detected with the help of a customer survey.

- Cost determination

The costs consist of the development- and manufacturing costs and the patent costs. Table 8 shows a cost overview of the several cost fractions.

| Cost Type | Amount [€] |
|---|---:|
| Development Costs | 250.000 |
| Tool Costs | 140.000 |
| Manufacturing Costs per Module | 15,50 |
| UV-C LED Costs per Unit | 70 |
| Patent Costs for 20 years | 142.000 |

Table 8: Cost Overview

The development costs for the product development and the tests involve the construction, the test facility, the prototype etc. The accumulated costs for the product development are about 250.000 EURO.

The tool costs are related to the die casting process which is used for the production of the half-shells. The tool is made of steel due to the fact that the product is made of polyamide which is strengthened with fiber glass. The yearly production is 100.000 units. The product has clips for the opening and closing and there are no plate slides designated for the LED adapter. Both half-shells are manufactured in one tool. Additionally, the hanger for the vaporization is taken into account (15.000 EURO). This leads to a total of 140.000 EURO for the tool costs.

The manufacturing costs per unit were estimated under the following parameters:

- Material: PA 6.6 (polyamide), strengthened with fiber glass (current price: € 3.90.-/kg)
- Die-casting
- Vaporized at the air duct area (about 30mm broad)
- 100.000 units/year
- UV-C LEDs are inserted in one half-shell and fixed due to the assembly with the other half-shell
- Cables and control board (1 – 2 EURO)

Concerning these parameters the price per unit amounts to about 15,50 EURO. As it is mentioned before, the amount of the UV-C LEDs integrated into the UV-C module is not reasonable yet. The amount of LEDs to guarantee a full disinfection is about 1500 units which leads to the costs of 105.000 EURO. The UV-C LEDs have to be included into the cost determination after their development is finished.

The patent costs consist of different kinds of costs for example research costs (hourly rate), costs for the text for the patent application, agency fees, annual fees (after the third year), operating costs, lawyer fees etc.

Before the text for the patent application can be prepared the patent division has to make a full patent research to clarify whether there is an existing patent for this idea or whether there are existing patents which resemble the own idea.

After the research the patent costs consist in the first year in large part of the costs for the text for the patent application and the application costs at the patent office. Due to rectification of defects concerning the patent application additional costs (e.g. lawyer fees) can appear. After three years annual fees are to discharge which increase every year. That is why the patent costs decrease at first and then start to strongly rise again after 10 to 12 years. There are also patent costs to discharge for every country in which the patent protection should exist.

In the case of the UV-C module there should be a patent application at the Austrian and German patent office first. In the following years the patent protection should be extended on the most important industrial countries in the world where the OEMs are located. The assumptions about the patent costs for the UV-C module after the first year are related to the most important markets of Europe. After this the markets of North America, Greater China and Japan/Korea should follow. For this reason the estimated patent costs for the first five years concerning the determination of the potential yield and the development- and manufacturing costs are about 46.000 Euros. In respect to the considerations about the costs made before the total patent costs for 20 years in all markets are about 142.000 Euros.

Altogether it is hard to estimate the patent costs very accurately without the concrete construction sketch and a broad accurate patent analysis.

- Financing

As it is mentioned in chapter 2.5.1, an innovation project is carried by various divisions or maybe groups. Due to that fact one of the first steps is to establish a project team to allocate the available budget rightly and in case to share the costs between the several MAGNA groups. Afterwards the possibilities for cooperation with other companies can be checked. Thereby the costs for the innovation project can be shared and the risk of the financing can be decreased. Additionally, the potential for subventions of the government or other institutions can be investigated.

- Achievable price

The achievable price for the UV-C module was detected with the help of a customer survey. To gain a homogeneous result, a questionnaire was given to every proband.

The probands had to answer 4 questions which were:

1. How important is the topic “health” for you?
2. How important is the topic air contamination for you?
3. How important is germ-free air in the car for you?
4. How much would you pay for a product which produces germ-free air for the inside of the car?

The questions 1, 2 and 3 could be answered with the help of a scale from 1 to 4. Thereby 1 stands for “not important” and 4 stands for “very important”. The percentaged assignment of the probands concerning their answers for the first question is shown in Figure 32.

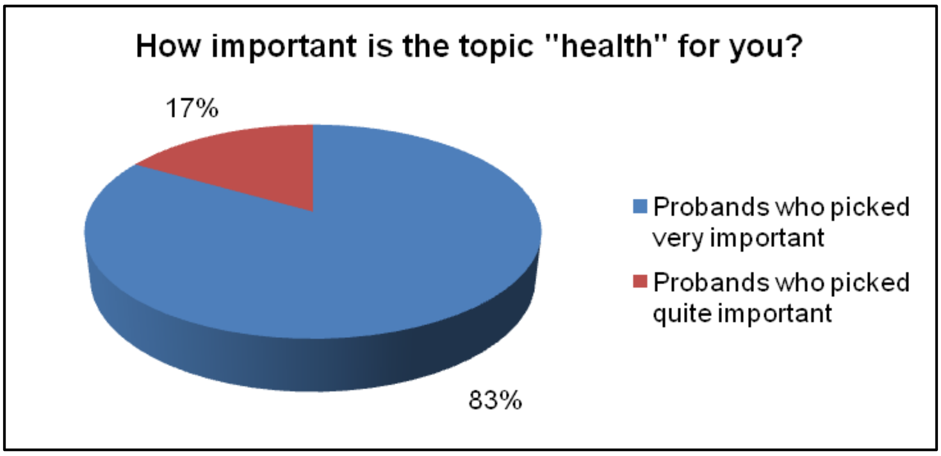


Figure 32: Percentage assignment of probands – Question 1

Figure 33 shows the percentage assignment of the probands concerning the answer to the question about the importance of the topic air contamination.

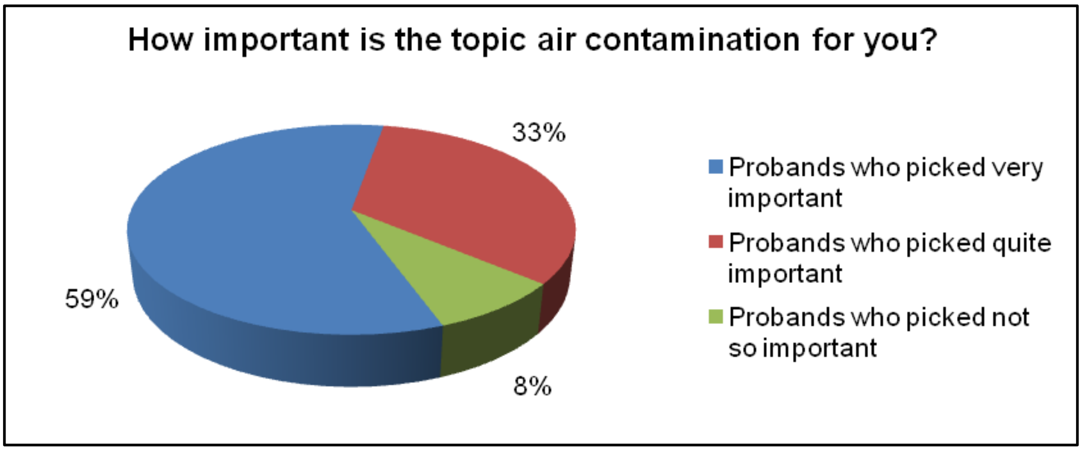


Figure 33: Percentage assignment of probands – Question 2

Figure 34 shows the results of the questionnaire to the third question concerning germ-free air in a vehicle.

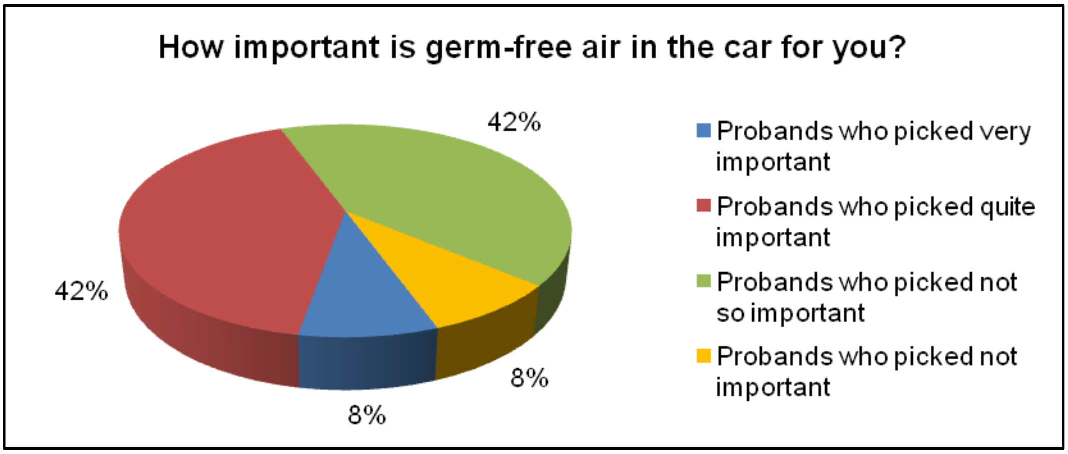


Figure 34: Percentage assignment of probands – Question 3

For the last question the probands had to think of a price they would be willing to pay for the UV-C module. After this, the several prices were used to calculate the average price. This price is the achievable price for the UV-C module which amounts to about 65 EURO. Thereby it should not be disregarded that only 1/3 of the probands would pay more than the average price. The other 2/3 would pay less. The detailed results can be seen in appendix D.

**Patent**

A rough patent research was done within the framework of the WIN initiative and the diploma thesis. Concerning the diploma thesis, the two free patent data bases DEPATIS and ESPACENET were used. After searching the two data bases one patent was found which draws near the innovative idea:

Patent Number: US 7,175,814 B2

Inventor: James L. Dionisio

Prior Publication Data: US 2006/0263272 A1

Abstract: A cartridge device containing UVC for air disinfection that comprises individual ultraviolet bulb, HEPA/Carbon filter, LED for detection of replacement, ballast and electrical components; cartridge is plugged into a backplane which allows for easy installation and servicing of all components. The backplane powers the device and can be encased in various configurations which can be used in multiple applications, including portable and permanent air treatment devices. The rest of the patent can be found in appendix E.

A detailed patent research must be done in a continuative project and accordingly the found patent has to be analyzed by the responsible patent division. There also has to be a patent research in the target markets. After this it will be clear whether a complete patent protection for the idea can be achieved or not.

**Legal Permission and political Promotion**

As a result of a research and discussions with the cabin filter manufacturer "MANN+HUMMEL GmbH" and technical experts of MAGNA Steyr there are no special regulations and no governmental permissions for cabin filters. MANN+HUMMEL GmbH only referred to a TÜV-Certificate which approves that the company works according to the ISO/TS 16949 standards.

*"ISO/TS 16949:2009, in conjunction with ISO 9001:2008, defines the quality management system requirements for the design and development, production and, when relevant, installation and service of automotive-related products.*

*ISO/TS 16949:2009 is applicable to sites of the organization where customer-specified parts, for production and/or service, are manufactured.*

*Supporting functions, whether on-site or remote (such as design centers, corporate headquarters and distribution centers), form part of the site audit as they support the site, but cannot obtain stand-alone certification to ISO/TS 16949:2009.*

*ISO/TS 16949:2009 can be applied throughout the automotive supply chain."*[221]

The automotive industry stands for excellent process quality, continuous improvement and innovation. The ISO/TS 16949 standard affects the quality management systems of the supplier of this industry. It was developed by the "International Automotive Task Force" (ITAF) with the concern to improve the quality and the whole certification process within the supply chain.[222]

Additional, the company "sterilAir Austria" and MAGNA internal sources refer to the identification marking of products which produce radiation with a reference note for the radiation class. But there are no more safety standards to think about. The customer itself is responsible to introduce its employees and customers to avoid direct eye contact with UV-C radiation.

To win the government over for the idea of the air disinfection with the help of UV-C radiation the benefits of the product should be crossed out. Due to the particulate matter and germ problems of the megacities and area of high population density the politicians will be pleased to see developments in this sector. Therefore it is possible to get subventions for the researches because of dealing with the mentioned problem. This happened in the case of the cooperation mentioned at the end of the point "Synergy Potential and Cooperation Possibilities".

**Synergy Potential and Cooperation Possibilities**

Inside of MAGNA the division "Thermal- and Energy Management" of MAGNA Steyr has shown interest concerning the innovative idea. The

[221] ISO/TS 16949:2009 quoted in: International Organization for Standardization, access date 01.04.2011

[222] Cf. DQS GmbH, access date 01.04.2011

engineers have some knowledge about tests respective the production of germ free air in a vehicle with the help of UV-C radiation. There were already meetings within the framework of the diploma thesis concerning this topic. In these meetings details and information about the idea and its implementation were discussed and interchanged. They also would have ideas to modify the product so that the module could perhaps also filter particles in the future.

As the case may be, there is also the possibility to cooperate with firms of other branches after a broad patent protection for the idea.

One cooperation possibility which should be considered is the cooperation with an air conditioning technology firm which already works with UV-C disinfection. In this case the existing know-how and maybe also laboratories, test facilities and equipment can be used. Consequently, the product could be constructively and technically realized in an attractive manner.

An additional possibility for cooperation is a UV-C LED manufacturer. They have know-how in the LED technology and can make important remarks for the implementation of the UV-C LED and the construction of the module so that the LEDs will not overheat. One problem concerning this cooperation possibility is that within the research activities of this diploma thesis only two UV-C manufacturers could be detected. These companies are located in South Korea (Seoul Semiconductor) and the United States (Crystal IS). Seoul Semiconductor also only has a division for UV-LEDs compared to Crystal IS which has its focus on UV-LEDs. Additionally, Crystal IS is only located in the United States and Seoul Semiconductor has only a few branch offices all over the world concerning UV-C LEDs.

The last possibility for cooperation is a filter manufacturer. Maybe it would be easier to cope with the entry of the interior air filtration market. They have existing distribution and promotion channels but less know-how in the area of UV-C LEDs.

However a good example for cooperation in this field is the cooperation between the Friedrich-Schiller-University Jena, the helsa-automotive GmbH (now part of the MANN+HUMMEL GmbH) and the Innotas Elektronik GmbH.

They made tests to terminate harmful gases with an air circulation treatment system which contains UV-A LEDs.[223]

**Risk Assessment**

There are different risks which can appear during the realization of the innovative idea. These risks could be carried out with the help of discussions with the inventor and diverse experts of different divisions. The risks are classified after "technical risks" and "non-technical risks". After the classification the risks were ranked with the help of a systematic paired comparison.

The systematic paired comparison was done by MAGNA internal experts with respect to the consequences of the risk concerning the realization of the idea. The percentage values of each risk of every single systematic paired comparison were summed up and an average value was calculated. The risk with the highest average percentage value was ranked first and consequential the risk with the lowest average percentage value was ranked last. The average percentage values and the single systematic paired comparisons of the experts can be seen in appendix F.

- Ranking of the "technical risks"
  1. Long-winded or stagnating research on UV-C LEDs and therefore continuing high prices
  2. Unsatisfying test and measurement results
  3. Long-winded development of the product – high costs
  4. Problems with the durability and lifetime (no experienced data available) – service interval
  5. Problems with the integration into the climate system
  6. Problems with the constructive feasibility
  7. Problems with the cooling of the UV-C LEDs

[223] Cf. Springer Fachmedien Wiesbaden GmbH (ATZ Online), access date 08.04.2011

- Ranking of the “non - technical risks”
  1. Lack of acceptance of the OEMs due to additional costs, high price, no substitute product for filters etc.
  2. Inaccurate or wrong strategic decisions (utilization of idea etc.)
  3. Problems with the financing of the project and the idea
  4. Competitors make their own researches and apply for a patent, competitive products
  5. Problems concerning the patent (e.g. no possibility of circumventing an existing patent etc.)
  5. Lack of know-how of Magna – no core competence
  7. Unclear budget allocation due to the fact that there is no existing project structure yet

- Counteractions concerning the risks

The risk of the missing know-how of MAGNA can be decreased with the help of cooperation. An additional advantage of cooperation would be that the cost to finance the product can be shared. If the cooperation partner has a high reputation the acceptance of the OEM for the product will also be higher. Another way to share the costs and risks would be to use the synergy potential of suitable MAGNA groups.

Another risk which could be decreased because of cooperation is the stagnating or long-winded development of the UV-C LEDs. MAGNA can help to drive the development of the UV-C LEDs with this project. Therefore it is possible to get all kinds of information at first hand, e.g. durability, service interval etc. An additional advantage could be that the UV-C LEDs are suitable for the module and MAGNA could even get a cheap price for the LEDs because if the UV-C LEDs are fully developed there will be a huge run on them according to the statement of UV LED manufacturers.

Another way to decrease the risk of financing and budgeting the project is to promote the UV-C module at the government. Maybe there is a possibility to get subventions for the research.

A very important point to decrease the risk of non-acceptance of the product is the marketing. There has to be a lot of marketing activity due to the fact that it is no substitute product for the conventional filter systems. That is a very important strategic decision and consideration.

The cooling of the UV-C LEDs should not be a very high risk. This problem should be handled with the help of the air stream of the climate system according to the statement of technical experts. The only problem can be that the air stream does not cool the LEDs enough and the need of an additional cooling system is given. That would mean higher costs to guarantee the durability of the LEDs and maybe problems with integration of the UV-C module.

In the case of any changes on the product in the development or conception phase a patent document with the changes done has to be handed in later at the patent office to ensure the full patent protection before the publication of the patent. Thereby competitors will have more problems to create a similar product or even copy it.

According to experts of MAGNA, the risk of a long-winded development of the UV-C module will not be very high. It is a simple module with the development costs of less than 1 million Euros. However, a following technical feasibility study should clarify this point.

The risk of constructive feasibility and the risk with the integration of the module go hand in hand. The constructive considerations always have to be made with respect to the feasibility of the integration. However, the desired small size of the UV-C module should be realizable according to the interviewed climate system manufacturers. With this size the module should be easy to integrate in the climate system.

The risk of unsatisfying test and measurement results can have two reasons. On the one hand the reason could be constructive failures which should be easy to fix. On the other hand the problems occur due to the insufficient radiation intensity of the UV-C LEDs. This can be a more significant problem because if there is no possibility to solve it the project maybe has to be aborted.

### 3.3.2 Business Plan

As it is mentioned before the gathered information from the analysis must be documented in the form of a business plan. For this reason the department of Innovation & Technology of MAGNA International developed a guideline of a business plan to ensure the complete coverage of all necessary criteria and a standardized documentation of the WIN ideas (see appendix A and B). This guideline includes five fields:

1.) The idea
2.) Market
3.) Competition
4.) Risks
5.) Financing and achievable price

The first point of the business plan deals with the description of the idea and all important information concerning the idea, e.g. development status or legislation. The second point is about the market overview, the market segmentation and the market entry. The third point treats the competition on the market and the marketing strategy. The fourth point contains the risk analysis and the description of the counteractions to deal with them. The fifth point is originally called "potential yield and financing". In the case of the idea of "germ-free air circulation in a vehicle" the determination of the potential yield would make no sense because of the high prices of the UV-C LEDs. This is the reason why in this diploma thesis only the development- and manufacturing costs, the financing possibilities and the target price which the customer is willed to pay are taken into account.

### 3.3.3 Decision for a Realization Plan

After the economical feasibility study and the documentation of the results in a business plan a decision about the realization of the idea has to be made on the basis of the information gathered in this thesis. If the idea should be realized the next step of the WIN process would be a technical feasibility study.

This diploma thesis only contains the information and recommendations for the decision making. The decision itself will be made by MAGNA International.

### 3.3.1 Interpretation of the results

Due to the selection of the vehicle segments A to E according to the CSM worldwide glossary and the selection of the right target markets because of several worked out criteria, the market potential could be detected. It was decided to enter the market in two steps. At first the German premium brands Audi, BMW (including MINI) and Mercedes (including SMART), which are existing clients of MAGNA, should be served. Afterwards the volume brands VW (without Audi), General Motors, Chrysler, Renault/Nissan, Ford and Peugeot/Citroen, which have a significant business contact to MAGNA, should follow. Based on the production values of the brands until the year 2016, the European market has the highest share in market potential in both steps. Europe is followed both times by North America on the second place and Greater-China on the third. These two markets have almost the same share in market potential in the first step and 5% difference in the second. In comparison to the others the market of Japan/Korea is just a minor part in the second step.

Table 9 shows the overview of the different cost fractions determined before.

| Cost Type | Amount [€] |
|---|---:|
| Development Costs | 250.000 |
| Tool Costs | 140.000 |
| Manufacturing Costs per Module | 15,50 |
| UV-C LED Costs per Unit | 70 |
| Patent Costs for 20 years | 142.000 |

Table 9: Cost Overview

The tool costs and the manufacturing costs are determined for 100.000 modules per year. Therefore the total costs for one UV-C module without the UV-C LEDs result of the summation of the manufacturing costs per module and the particular percentage of a module on the development costs, the tool costs and the patent costs. Consequently the total costs of one UV-C module without UV-C LEDs mount up to 20,82 EURO.

The significant problem of the idea is the development status of the UV-C LEDs. The LEDs are not cost-effective due to the fact that the UV-C LEDs have a optical power of 0,65 milli Watt and cost 70 EURO per unit. This means that a full disinfection of the air would be only possible with about 1500 LEDs which leads to costs of 105.000 EURO. Even the cross-section for about 1500 LEDs would not be given in the engine compartment. According to this information, it is clear that the UV-C LEDs are the cost driver of this idea and as long as they are not cost-effective the idea cannot be realized.

Another problem concerning UV-C LEDs is that within the research activities of this diploma thesis only two UV-C manufacturers could be detected. These companies are located in South Korea (Seoul Semiconductor) and the United States (Crystal IS). Seoul Semiconductor also only has a division for UV-LEDs compared to Crystal IS which has its focus on UV-LEDs. Additionally, Crystal IS is only located in the United States and Seoul Semiconductor has only a few branch offices all over the world concerning UV-C LEDs. Due to that situation, problems concerning the distribution or the cooperation can appear because of the internal line-up and global placement.

Additionally, the achievable price the customer is willing to pay was detected with the help of a customer survey. In average, the customer would pay approximately 65 EURO for the UV-C module. But it has to be taken into account that only 1/3 of the probands would pay more than this price and 2/3 of the probands are willing to pay less. Furthermore, the probands were asked questions about how important the topics health, air contamination and germ-free air in the car are to them. The results show that the topics health and air contamination are very important to them. In contrast, the topic germ-free air in the car only was more or less important to the probands. Only 50% were interested in this topic and therefore it will be a challenge in the future to increase the interest and acceptance for the module. To achieve this goal a lot of marketing activities will have to be done.

Detailed results of the market survey, the cost determination and the achievable price, the marketing mix derived from the market survey and the achievable price, the product life cycle of the idea, the possibilities of the utilization of the idea, a rough patent research, the analysis of the legal permission, synergy potential and the cooperation possibilities and the risk assessment including counter actions can be looked up in chapter 3.3.1, “Feasibility Study of the Idea”.

## 3.4 Realization of the Idea

If MAGNA International decides for the realization of a WIN idea the last phase of the innovation process starts. Like mentioned in chapter 2.3.3, the realization of an idea contains a conception of the product, the development of a prototype with further development until the marketability is reached and the market entry with the marketing of the product.

In the case of the idea of “germ-free air circulation in a vehicle” it will take some time for the realization. The price per unit is much too high at 70 EURO per unit and the optical power much too low with 0,65 milli Watt. Until now there are no technical advancements concerning the UV-C LEDs and no price reduction and therefore this idea is not cost effective in this form. If the UV-C LEDs are fully developed the conception can be established and the prototype development can start.

In the framework of the conception the performance specification must be developed. The performance specification contains all information about the several requirements concerning the product. The next step is to develop the requirement specification. It includes all information about how the realization of the product should be done. This information includes technical as well as economical and ecological requirements.

As it is mentioned in chapter 2.3.3, the prototype has to meet the requirements of the conception established before. The first step of the development includes an accurate estimation about all the activities and efforts which have to be done in the framework of the prototype development due to the conception to establish the development plan for the product. After this the product can be designed and manufactured. The development of a prototype also includes the use of adequate test procedures to ensure the full functionality of the developed prototype. To develop are the casing of the module, the right appointment of the UV-C LEDs to achieve a disinfectant effect and the connection method for the UV-C LEDs.

The development time of the UV-C module is approximately between 1 and 2 years. The detailed specification of the estimated costs for the development and manufacturing can be seen in chapter 3.3.1.

As it is mentioned before, if there is no full patent protection for the product, MAGNA has to use the knowledge of internal experts in the phase of the realization in order that no information about the product can attain outside the company and used by competitors. After the patent protection is given external experts can be included in the product development.

# 4 Conclusion and Outlook

The world economy underlies a very fast moving and dynamic change of needs and expectations from the customer. For this reason it is very important for companies to stay creative and innovative to compete and survive in the global and local competition. However, it is a long way from the innovative idea to the marketable product. For this reason an economic feasibility study for the WIN idea “germ-free air circulation in a vehicle” with the help of UV-C LEDs was done within the framework of this diploma thesis.

The feasibility study started with a market survey. At first a segmentation of the vehicle types concerning the idea and the determination of the market potential had to be done. The vehicle segments A to E were chosen on the basis of the CSM Worldwide glossary and several worked out criteria. After the segmentation the right target markets for the determination of the market potential had to be found. Based on several worked out criteria and the production values until 2016 the target markets Europe (including Russia), North America, Greater China and Japan/Korea were chosen. The entry of the markets should be done in two steps. At first the German premium brands Audi, BMW (including MINI) and Mercedes (including SMART), which are existing clients of MAGNA, should be served. Afterwards the volume brands VW (without Audi), General Motors, Chrysler, Renault/Nissan, Ford and Peugeot/Citroen, which have a significant business contact to MAGNA, should follow. Based on the production values of the brands until the year 2016, the European market should be conquered first followed by North America, Greater China and Japan/Korea.

One significant problem of the idea which occurred is the development status of the UV-C LEDs. The LEDs are not cost-effective due to the fact that the UV-C LEDs have a optical power of 0,65 milli Watt and cost 70 EURO per unit. This means that a full disinfection of the air would be only possible with about 1500 LEDs which leads to costs of 105.000 EURO. Even the cross-section for about 1500 LEDs would not be given in the engine compartment.

For this reason the determination of the potential yield was abandoned from this diploma thesis and a cost determination for the patent costs and the development- and manufacturing costs was done. The costs for the product development and tests amount to about 250.000 EURO. The tool costs are about 140.000 EURO and the manufacturing costs per UV-C module (without UV-C LED) mount up to about 15,50 EURO. The patent costs for 20 years concerning the most important industry countries are about 142.000 EURO. According to this information, it is clear that the UV-C LEDs are the cost driver of this idea and as long as they are not cost-effective the idea cannot be realized.

The achievable price was detected with the help of a customer survey. In average, the achievable price for the UV-C module is approximately 65 EURO. But it has to be taken into account that only 1/3 of the probands would pay more than this price and 2/3 of the probands are willing to pay less. Furthermore, the probands were asked questions about how important the topics health, air contamination and germ-free air in the car are to them. The results showed that only 50% of the probands were interested in germ-free air in the car and therefore it will be a challenge in the future to increase the interest and acceptance for the module.

Furthermore, a marketing mix derived from the market survey and the achievable price, the product life cycle of the idea, the possibilities of the utilization of the idea, a rough patent research, the analysis of the legal permission and the possibilities for cooperation and synergy were generated. In the end these points lead to the several risks which are bounded to this idea. For this reason the risks were assessed and the counter actions to reduce or prevent this risk were worked out.

However, at the moment the UV-C LEDs are the main problem to realize the idea. It is very difficult to find a supplier due to the fact that the UV-C LEDs are in the middle of the development. At present the UV-C LEDs are not cost-effective because of their optical power (0,65 milli Watt) and their price per unit (70 EURO/unit). It would need a huge amount of LEDs to generate the needed radiation intensity to disinfect the air. In other words there is a lot of research and development work to do on the UV-C LEDs in the future to make them economic relevant. As long as this procedure takes the UV-C module is also not affordable for the customer. In relation to the assumptions of LED manufacturer and supplier the development will take approximately 1 to 2 years from now. Afterwards the development of the UV-C module will take additional about 1 to 2 years.

A possibility to drive the further development of UV-C LEDs is to cooperate with a UV-C LED manufacturer. Furthermore, there is also the possibility to share the costs for the development of the UV-C module. As it is mentioned before there is a problem concerning this cooperation possibility can be the place of location of the UV-C LED manufacturers. Within the framework of the researches done for this diploma thesis only two companies which produce UV-C LEDs could be found. Seoul Semiconductor is located in South Korea and Crystal IS is located in the United States. Crystal IS has no branch offices and Seoul Semiconductor only a few all over the world concerning UV-C LEDs. Additionally, Seoul Semiconductor also only has a division for UV-LEDs compared to Crystal IS which has its focus on UV-LEDs. Another possibility for cooperation which should be taken into account is the cooperation with air conditioning technology firms which are already in the business of UV-C disinfection. They have a lot of experience and maybe also own needed resources like laboratories or test facilities.

Concerning MAGNA, the department “Thermal- and Energy Management” of MAGNA Steyr has shown great interest concerning the idea to produce decontaminated air with the help of UV-C radiation. The engineers have some knowledge about tests respective the production of germ free air in a vehicle with the help of UV-C radiation and already an idea for a product (see appendix B – “Possibilities for further development”).

Before cooperation can start, there has to be a full patent protection for the idea. Based on the fact that there was only a rough patent research done within the framework of this diploma thesis, the patent application process must be pushed forward in the case of the realization of the UV-C module to guarantee the protection of the idea. Even there is no sign that the idea will be realized in the early future it should be considered whether to apply for an appropriate patent protection or not. Consequently, it must be balanced whether the idea should be protected or kept secret not to awaken interest of the competitors. In both possibilities it should be the goal to have a leading position in this sector.

When the UV-C module will be fully developed the next challenge will be to achieve the acceptance of the customer, the OEM. As seen in the results of the customer survey and the risk assessment, the idea holds a high risk due to the fact that it is no substitute product relating to the conventional cabin filters. Therefore a lot of sophisticated and targeted marketing activities must be done to achieve the acceptance of the OEM and awaken the interest of the end customer to buy it. Additional, it will be very important to have accurate test and measurement results to point out the advantages of the product due to the fact that the customer cannot see or feel the benefit it creates.

The product can also create a huge opportunity to gain ground in the passenger traffic industry. The means of transportation are always used by a lot of people, e.g. airplanes or overland buses. The ventilation system is designed to serve every single passenger with air-conditioned air. Due to the fact that it is one large ventilation system, it is easy for germs to fan out in the whole means of transportation and contaminate the passengers. Based on this fact the disinfection of the air with the help of UV-C LEDs could solve this problem.

As a final statement it can be said that the UV-C module is an idea with a lot of potential. The idea is a precursor for further development and research in the field of providing excellent air quality in the interior of a vehicle.

# References

ANGERMEIER, G.: Projektmanagement – Lexikon, München 2005

ANSOFF, I.H.: Corporate Strategy, New York 1965

BEA, F.X.; SCHEURER, S.; HESSELMANN, S.: Projektmanagement, Stuttgart 2008

BÖHMER, E.; EHRHARDT, D.; OBERSCHLEP, W.: Elemente der angewandten Elektronik, 15. Auflage, Wiesbaden 2007

BROCKHOFF, K.: Produktpolitik, 4. Auflage, Stuttgart 1999

BROCKHOFF, K.: Forschung und Entwicklung, 3. Auflage, München 1992

BUCHHOLZ, W.: Time-to-market-Management: zeitorientierte Gestaltung von Produktinnovationsprozessen, Stuttgart 1996

BÜRGEL, H.D.; HALLER, C.; BINDER, M. (1996): F&E – Management, München 1996

COOPER, R.G.: Top oder Flop in der Produktentwicklung: Erfolgsstrategien: von der Idee zum Launch, Weinheim 2002

COOPER, R.G.; EDGETT, S.J.: Generating Breakthrough New Product Ideas: Feeding the Innovation Funnel, Canada 2007

CORSTEN, H.: Die Gestaltung von Innovationsprozessen, Berlin 1989

DISSELKAMP, M.: Innovationsmanagement - Instrumente und Methoden zur Umsetzung im Unternehmen, Wiesbaden 2005

FRANKEN, R.; FRANKEN, S.: Integriertes Wissens- und Innovations-management, Wiesbaden 2011

FREISENHUBER, M. et al.: Innovationsleidfaden – „Ideen systematisch umsetzen“, Graz 2004

GELBMANN, U. et al.: Innovationsleidfaden – „Der Weg zu neuen Produkten“, Graz 2003

HALLER, C.: Verhaltenstheoretischer Ansatz für ein Management von Innovationsprozessen, Dissertation, Universität Stuttgart, 2003

HAUSCHILDT, J.; SALOMO, S.: Innovationsmanagement, 4. Auflage, München 2007

HENSEL, M.; WIRSAM, J.: Diffusion von Innovationen: Das Beispiel Voice over IP, Wiesbaden 2008

HINTERHUBER, H.H.: Innovationsdynamik und Unternehmensführung, Wien 1975

HOLT, K.: Product innovation management, 3rd Edition, Camebridge 1988

KNIGHT, K.E.: A Descriptive Model of the Intra-Firm Innovation Process, in: The Journal of Business 40/67, p. 478 - 496

KOTLER, P. et al.: Grundlagen des Marketing, 5. Auflage, München 2011

MATZ, S.: Erfolgsfaktoren im Innovationsmanagement von Industriebetrieben, Wiesbaden 2007

MENSCH G.: Das technologische Patt. Innovation überwindet die Depression, Frankfurt 1975

PORTER, M.E.: Wettbewerbsstrategie – Methoden zur Analyse von Branchen und Konkurrenten, Frankfurt, 10. Auflage, New York 1999

RUNIA, P. et al.: Marketing – Eine prozess- und praxisorientierte Einführung, 2. Auflage, München 2007

SABISCH, H.: Produktinnovationen, Stuttgart 1991

SCHUMPETER, J.: Theorie der wirtschaftlichen Entwicklung, Berlin 1911

SEDLMEIER, K.: Wasseraufbearbeitung mit UV LEDs, Seminarvortrag, Technische Universität Berlin, 2008

SERHAN, I.: Open Innovation umsetzen – Prozesse, Methoden, Systeme, Kultur, Düsseldorf 2010

STREBEL, H. et al: Innovations- und Technologiemanagement, 2. Auflage, Wien 2007

STUMMER, C.; GÜNTHER, M.; KÖCK, A.M.: Grundzüge des Innovations- und Technologiemanagements, 3. Auflage, Wien 2010

THOM, N.: Grundlagen des betrieblichen Innovationsmanagements, 2. Auflage, Königstein 1980

VAHS, D.; BURMESTER, R.: Innovationsmanagement, Stuttgart 1999

WITTMANN R.G.; Leimbeck, A.; Tomp, E.: Innovation erfolgreich steuern, Heidelberg 2006

WOHINZ, J.W.; EMBST, S.: Betriebliches Innovationsmanagement, Graz 2010

# Online References


Sterilsystems GmbH: Die Technologie, Bad Hall 2011,

http://www.sterilsystems.com/de/technologie, access date 15.02.2011

OSRAM GmbH: UVC Entkeimung, Wien 2011,

http://www.osram.at/osram_at/Professionals/Allgemeinbeleuchtung/UVIR/UVC_Entkeimung/index.html, access date 15.02.2011

BÄRO GmbH & Co. KG: Trilogie der Lufthygiene – UV-C Entkeimung, Fettvernichtung, Geruchsbeseitigung, Hilden 2011,

http://www.baero.com/lang_de/entkeim/seminare/lueftung_klima.htm, access date 15.02.2011

MANN & HUMMEL GmbH: MANN-FILTER cabin filters, Ludwigsburg 2011,

http://www.mann-hummel.com/mannfilter/upload/doc/HBRPBK8aqzp.pdf, access date 14.03.2011

MAGNA International Inc.: Our Founder, 2011,

http://www.magna.com/magna/en/about/founder/default.aspx, access date 18.01.2011

MAGNA International Inc.: Our History, 2011,

http://www.magna.com/xchg/en/1168-1219/group_sub-sites/Facts+%26+History/Our+History, access date 18.01.2011

MAGNA International Inc.: Groups, 2011,

http://www.magna.com/xchg/group_sub-sites/XSL/standard.xsl/-/content/224.html?rdeLocaleAttr=en, access date 18.01.2011

MAGNA International Inc.: About MAGNA, 2011,
http://www.magna.com/magna/en/about/, access date 18.01.2011

MAGNA International Inc.: Our Culture, 2011,
http://www.magna.com/magna/en/about/culture/default.aspx, access date 18.01.2011

MAGNA International Inc.: Global Structure, 2011,
http://www.magna.com/magna/en/global/, access date 18.04.2011

MAGNA International Inc.: Innovation, 2011,
http://www.magna.com/xchg/group_sub-sites/XSL/standard.xsl/-/content/1144_1334.html?rdeLocaleAttr=en, access date 18.01.2011

MAGNA Europe Intranet (WIN): Winning Innovations, 2011,
http://win.magna.com/Default.aspx?menueid=996&open=996&umenueid=996&lng=en, access date 18.01.2011

MAGNA Europe Intranet (WIN): Winning Innovations, 2011,
http://win.magna.com/Default.aspx?menueid=1009&open=1009&umenueid=1009&lng=de, access date 15.03.2011

International Organization for Standardization: ISO/TS 16949:2009, Geneva 2011, http://www.iso.org/iso/catalogue_detail?csnumber=52844, access date 01.04.2011

DQS GmbH: ISO/TS 16949, 2009,
https://de.dqs-ul.com/zertifizierung/qualitaetsmanagement/automotive/isots-16949.html, access date 01.04.2011

SCHRÖDER, C.: ATZ Online - Chemiker der Universität Jena entwickeln Umluft-aufbereitungssystem für neue Fahrzeuge, 2008,

http://www.atzonline.de/Aktuell/Nachrichten/1/7787/Chemiker-der-Universitaet-Jena-entwickeln-Umluftaufbereitungssystem-fuer-neue-Fahrzeuge.html, access date 08.04.2011

WIESINGER: KFZTech – Klimaanlage Grundlagen, 2010,

http://www.kfztech.de/kfztechnik/sicherheit/klima/klimaanlage.htm, access date 14.03.2011

HALLER, H.: LED-Info Rechercheportal – Leuchtdiode (Light emitting diode – LED), 2011,

http://www.led-info.de/grundlagen/leuchtdioden.html, access date 15.02.2011

Fines Quotes: Quotes of Steve Jobs, 2011,

http://www.finestquotes.com/select_quote-category-Innovation-page-0.htm, access date 18.03.2011

Fines Quotes: Quotes of Michael E. Porter, 2011,

http://www.finestquotes.com/select_quote-category-Innovation-page-0.htm, access date 20.04.2011

Excel4Marketing: Product Life Cycle, 2011,
http://excel4marketing.com/Product_Life_Cycle.htm, access date 12.04.2011

Traumportal Webdesign Wien: UV Strahlung Internetportal, 2011,
http://www.uv-strahlung.at/arten_von_uv_strahlung.html, access date 30.05.2011

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# List of Abbreviations

**CEO**: Chief Executive Officer

**LED**: Light-emitting diode

**OEM**: Original Equipment Manufacturer

**UV**: Ultra violet

**WIN**: Winning Innovations

# Appendix