

CHAPTER 2

BACKGROUND CONCEPTUAL STAGE OF THE PROJECT AND SPECIFICATIONS

The Ruck'n Roll Project is the result of the work of Lukas Meier, a mechanical engineering student, during the course Methodic product development, with the professor Eckehard Fozzy Moritz in the University of Munich. In this course students are given a task: to find a place of opportunity in the industry market and to develop a totally new concept that satisfies certain needs of a target market. Later on students deal with the design issue involved in this procedure, where they contact already existing industry business, headhunters or even create their own business. In the case of Lukas Meier, his work tendency is well defined: the sports field.

The background presented in this chapter is a brief recall to the previous work of Meier, giving main justifications, studies and definitions for the project.

2.1 Justification

From a statistical research in the previous work done by Lukas Meier, it was found that 12 million euros were spent during winter holidays (Meier, 2005¹), in the snow hills where tourists usually practice winter sports like skiing, snowboarding, and use some devices like sleds just as a way to have fun.

In the other hand, there's also a time-saving perspective, thinking about people that continuously have to climb and descend the hills in a routinary way. The search for a

less-weakening way of solving the transportation time problem is one aspect to consider in the target consumer characteristics.

Also it becomes an incentive to go to the mountains and do sports for those people who desire the descending experience without the risks of practicing an extreme sport.

A better and extended utilization of the already existent infrastructure through the whole year, even in seasons when snow is not present in the environment is one challenge that has been briefly taken before. To take advantage of the already existent resources like the cableways used by skiers can turn to an economic benefit for the community.

So a primary definition for the need that has been found is to develop a device capable of performing in concrete, the woods and the grass.

From surveys made in the referred previous work done by Lukas Meier, the device also should:

- a) Be easily transported
- b) Be very small
- c) Have the lighter weight as possible
- d) Be easy to use
- e) Be ideal for climbers
- f) Be capable of being used in every place with slopes in the scenery.

2.2 Status quo (benchmarking)

The products actually in market that present some of the features of the Ruck ´n Roll conceptual idea were documented and described in the previous work, to recognize what the sport market lacks of. The following results were taken from the previous studies of Lukas Meier (Meier, 2005²)

The investigation already at the market roll equipment present without own drive shows different solution variants. Chart 2.1 in appendix 1 shows weak points and good solution components that derived in the conclusions shown in the following lines.



Fig. 2.1 Easy, hand, the Bockerl (Meier, *Systematische Entwicklung eines Rollrodels für Bergwanderer*)

2.2.1 Operational principle

Most devices roll the upward gradient down, most of times with wheels, rarely with rollers. In order to reach offroad performance, air-filled barrow tires are used frequently, which are however very heavy and large. Off-fastened-ways well usable and easier alternative are the tires of the Bockerl (see figure 2.1). With a diameter of 200 mm one can drive offroad, large holes into meadows represents their borders.

The number and arrangement of rollers and wheels varied strongly, with one behind the other arranged wheels obtain the equipment large instability.

2.2.2 Humans – machine interaction

Nearly in all roll devices the person stands on the equipment. Reason for it is its conception, which is usually derived from skate and snowboard (figure 2.2).



Figure 2.2: User standing on Audax: Treads recommended

The comfort is neglected frequently, the idea and driving is the center of attention.

The roll devices are hardly transportable, both weight and building area are large. These devices can be transported easy with the car, for transport on the mountain, however, hardly proposals for solution are given.

Transportability is in this segment a market gap, whose fulfillment promises economic success, as evident by the example "Kickboard" (see figure 2.3). Folding or foldingness improves handiness and the dimensions. This foldingness is possible with "Kickboard" and "Trike" (Meier, 2005³).



Figure 2.3: folding and collapsible Kickboard improves transportability and luggage measure (*Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer*)

If the transportability is given and with it connected a certain practicability, the readiness of the customers rises to buy the product.

Most of the sport devices are uncertain - from the visual impression - and involve risk and extremes. Only 10 of 26 devices have a brake (chart 2.1). The feet fixed in connections become a problem. Thus the passenger is bound during uncontrolled travel to its equipment, cannot not jump off or brake thus. With other devices there is no foot file, which feet sharpen at the soil. One with anti-slide foil pasted or knurled foot file is recommendable and with some devices is used.

2.2.3 Costs

The prices vary between approximately 200 and 700 euros, relatively highly for target market.

2.2.4 User

Users of the devices are - to judge by the pictures and the scene - almost exclusively extreme sportsmen and people, who possess experience with skate or snowboards. This is because of converted boards as starting point for the devices and the inventors, which mostly come from a skate and snowboard background(Meier, 2005⁴). Problems for normal average users are to the standing body position in the switching lacking of security -unstable standing does not firmly embody brakes, feet by ground-remote body emphasis -, on the roll equipment, the high price and the transportability lacking.

A goal is it to develop a solution alternative for average non-extreme sporting people since for this people's group nearly no product exists. The results are based partially on Internet search, partially on driving attempts and subjective estimates (Meier, 2005⁵)

2.2.5 Issues

Issues form the basis for the fundamental attitude of social groups. These issues can be ecological, economic, social or cultural nature and occur than ideals, visions or mental conceptions (Meier, 2005⁶).

Concerning the development of roll equipment only few relevant examples are to be called here:

- a) Lasting development
- b) Fundamental distrust opposite new/other (in Germany)
- c) Nature protection

The distrust is to be overcome by co-operation with well-known institutions, e.g. the DAV (German alpine association). In connection with such institution it is to be made certain that nature is not damaged by the use of the devices, disturbed nor endangered.

d) User: On the basis of the critical view of the *status quo* mainly extreme sportsmen or prepared-to-take-risks people use the existing roll equipment. Therefore one should try to offer to a broader user circle an alternative (Meier, 2005⁷).

- The persons of the target group should be - naturally independently of the sex - normal average people between 12 and 50 years, which are on the average sporty and prepared to take risks. The age stands here for the subjective age. If a 60-year-old person feels fit, he should be able to likewise use the device. With 12 years the persons gained already first experiences in the traffic, which are necessary on moving ways also. Consideration for others is absolutely important.
- The large user circle represents naturally also a large group of buyers with large purchasing power, which can help also economically the roll equipment to success.
- The family status does not play a role in the reference to a group experience, since one can undertake the device experience with friends or with the family.
- Also the "Bockerl™" (see figure 2.1) wants to address a broad layer of normal humans. The fact that it becomes more stable with rising speed is irrelevant thereby since many persons, due to fear, will never take it to this speed (Kunz, 2004⁷). In order to increase the readiness to try the equipment out at all, that roll equipment must exhibit, while stationary state to slow speeds clear stabilities and security characteristics.

From this derived requirements and restrictions:

- Security and stability starting from stationary state , better if feet do not drive ahead (distance to soil and obstacles).

- Device may not tilt, thus device "broadly sets up".
- Safety devices made visible (e.g. brake).
- Readiness increase to let drive also children.
- Pleasant transport arrange.

2.2.6 Stakeholders

Stakeholders are all persons and institutions, who are affected by the existence of the roll equipment. Project attention is to be limited first to the alps and the alpine neighborhood. Owing the most important consequences from a view of the stakeholder, they are summarized as follows (Meier, 2005⁸).

a) Turn off's for roll equipment:

It is to be made certain that by the use of the devices, nature is not destroyed ; a group of the stakeholders is thus the environmentalists. Protests for their part can harm the project. Therefore team recommends driving the roll equipment only on fastened ways. As the further consequence underground-careful tires are blocked. Likewise the DAV (German alpine association), which is represented with a large number of association huts in the alps, is anxious around the receipt of nature. It reaches its members, that correspond to our target group at the same time, by means of its member magazine. The DAV can become with early contact also the supporter (Meier, 2005⁹).

b) Turn on's for roll equipment:

First the municipalities and thus also their inhabitants can profit from the conversion of new summer ideas, since many places are aligned to winter sportsmen and wanderer and live on the tourism. Naturally winter sports represents the main source of income, in

the summer the business abates somewhat. Therefore the fight for the visitors and attractive offers must be put to confront demand. The roll equipment will not increase the numbers of visitors; it will supply however a further argument why a family is to spend, straight in this place, their vacation.

People or dealers, who lend carriages and skis in the winter, can maintain their business in the summer by the rental business of the roll devices

Major consequences in product development are:

- Costs kept as small as possible.
- Rental business model develop.
- Size + for weight in the framework hold fits in car space-saving storable transportable.
- Preserve underground (if wheels: air-filled, not too small or too thinly).
- DAV integrate

2.3 Requirements of the product

From the development of the innovation context system requirements must be derived.

It represents the crucial factors from user view, which are important for the success of the product.

For the product the following three functions are fundamental (Meier, 2005¹⁰)

- Controlled change of direction.
- Security perception.
- Comfortable transport quick and utilization.

These points are more near lit up and justified in the following lines.

2.3.1 Controlled change of direction

As a first function, the controlled change of direction is a necessary condition for a successful concept. Change of direction is in principle necessary, in order to be able to drive on the ways desired at all. An uncontrollable change of direction would be conceivable, but in the sense of the revision that the sport equipment should be usable for non-extreme-sporting people, unreasonably. If this would be the case, only few extreme sportsmen would be interested in the vehicle and that is exactly the product range, for which there are already many solutions in the market (Meier, 2005¹¹).

As stated before, the comprehensive user layer wants - which also children and older adults enclosure - avoid any physical risk. This is also in the sense of the lenders, who wish an accident-free operational sequence. Thus one can address the broad user layer better and increase the readiness for driving.

A condition for a controlled change of direction also for inexperienced users is the simple use. This is recognizable also as technique trend. A simple and intuitive driving along curves makes fast learning, fast for use, fast purchase and gives more security perception. The alternatives on the market of the roll equipment offer usually for these devices specific special constructions. Must devices have usually a shock absorber combination, which lead to a resetting of the wheels on zero position. This resetting is crucial for control of the device. Such reset is more likely to perform a safe driving along curves

2.3.2 Security perception

With the demand for control during the change of direction the urge is closely connected to feel safe on that roll equipment.

Security covers several ranges:

- The device with a safe-estimated first look.
- Security while stationary - with sample seats - already notice.
- Secure travel - straightforward and in the curve, safe braking.
- Safe transport.
- Secure storage.

This feature proves as special market gap. Most of the regarded roll equipment in market study is extreme and a close offroad equivalent to the skateboard. Security is usually located in the background, then only approximately 38% of the regarded devices have a brake, mostly one must stand on the equipment and often the user is fixed over a connection at the sport equipment (Meier, 2005¹²). An exception of it is the "Bockerl™": It has a hydraulic brake, the user can sit and it is particularly stable at high speeds. However its three wheels are one behind the other arranged, so that it tilts during slow travel. This fact prevents many people to try it out at all (figure 2.1), because the desired user layer wants, as mentioned already above, to avoid any physical risk.

2.4 Overview on the market of products present

The following figures resemble an overview of further products, which serve with and without steering device (Meier, 2005¹³).



Figure 2.4 : Audax (segway)
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.5 : Bockerl
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.6: Carveboard
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.7 : Crosskate
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.8 : Dirtboard
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.9 : Dirtsurfer
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.10 : Downhillroller
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.11 : Flowboard
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.12 : Freeboard
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.13 : Grassboard
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.14 : Grassski
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.15 : Hillracer
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.16 : Kanterl 1
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.17 : Kanterl 2
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.18 : Kickboard
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.19 : Loko
freeboard(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.20: Luge
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.21 : Monster, x-board
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.22 : Mountainskate
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.23 : Stowboard
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.24 : BMW Streetcarver
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.25 : Tierney Board
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.26 : Trike
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)

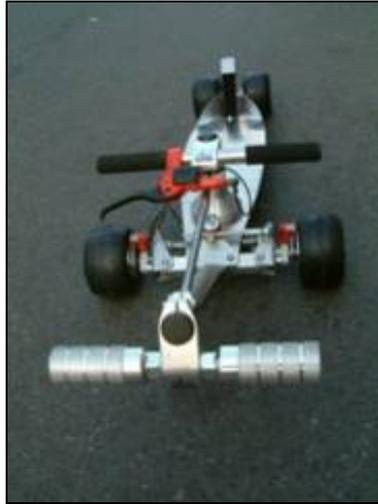


Figure 2.27 : Acaneos downhill cart 200
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)



Figure 2.28 : Acaneos G-OnE XTpro 200
(Meier, Systematische Entwicklung eines Rollrodels für Bergwanderer)

2.5 Defined target

Based in the results of the benchmarking study done in the previous work, the following requirements where found:

- a) To develop a device for the average non-extreme-sporting user.
- b) Device must be secure and stable even without any motion
- c) Head of the user must be located above the rear part of the device while riding.
- d) It must count with a hand operated braking system to increase security perception.

- e) It must be free of any feet operation involved in the use of the device, to increase the security perception in case that the driver feels the urgency of braking with his feet.

2.6 Conceptual design of the project

Ruck'n Roll team came to the following crossover after all the work done: to develop an easy-to-carry device that can be transported as easy as a backpack, even with a size capable of being reduced while carrying, that at any moment can be turned to an effective gravity-operated vehicle to descend slopes (figure 2.29).

The Idea...



Figure 2.29 : Conceptual cross-over: backpack and vehicle in one (courtesy of SportKreativWerkstatt)

2. 6.1 Main definition

The Ruck'n Roll, in the words of the project team members Björn Lath and Benjamin Ohmer , is *an innovative sports product combining the advantages of a backpack and of a sled (with tires). The target group is not only people fascinated by mountains, but also those, who just looking for fun and downhill action. For alpinists, it features the possibility to scale a mountain, carrying all the needed stuff in the backpack (figure 2.30). But the descent won't be exhausting or painful for the joints (figure2.29).*

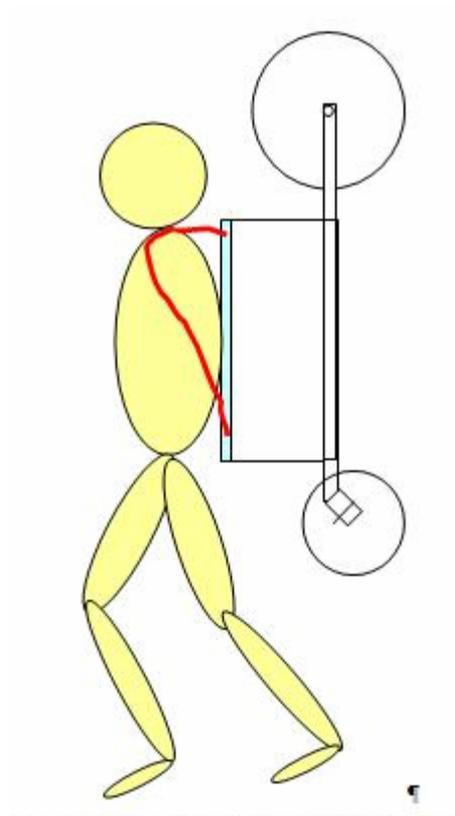


Figure 2.30 : Backpack features an extra advantage for user
(courtesy of SportKreativWerkstatt)

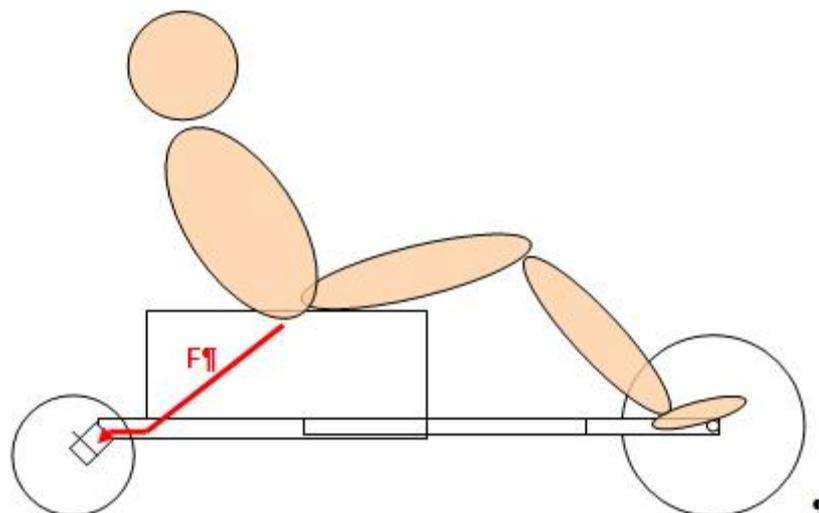


Figure 2.31 Position of rider in the Ruck ´n Roll
(courtesy of SportKreativWerkstatt)

2.6.2 Existing prototype

During the previous work of this project, the prototype shown in figure 2.32 and 2.33 was built.



Figure 2.32 Back view of the built prototype
(courtesy of SportKreativWerkstatt)



Figure 2.33 General view of the built prototype
(courtesy of SportKreativWerkstatt)

The built prototype presents the following features

- a) The black one is the support for the back. It is possible to see the straps for carrying the Ruck'n Roll on your back in figure 2.33.
- b) While driving, the big wheel is in front. It features a rack for the feed.
- c) The beam, which fixes the front wheel, can easily be stuck together to body of the backpack in order to reduce the size.
- d) The axle in the back with the two smaller wheels allows the steering by shifting of weight.
- e) The brown wooden body features room for carrying things.
- f) The breaking system is fixed on the side of the body and slows down the front wheel.



Figure 2.34 View of the built prototype showing the backpack stripes(courtesy of SportKreativWerkstatt)

The constructed prototype has achieved the following capabilities.

- a) Susceptible of being driven.
- b) Susceptible of being steered.
- c) It counts with a braking system.
- d) It can be carried as a backpack.
- e) It features room for carrying object.

The disadvantages that it presents are mainly:

- a) A mass of 14 kg
- b) Functions must be optimized

2.6.3 Module 1: rear axle

The project has been divided in three modules (figure2.35)

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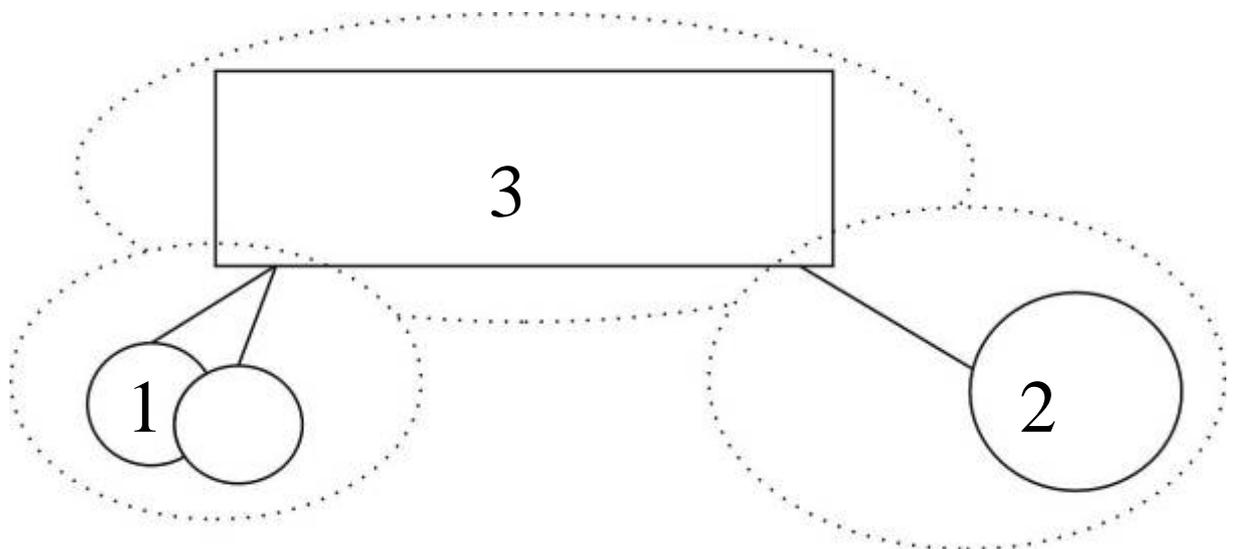


Figure 2.35 : Modules of the Project (courtesy of SportKreativWerkstatt)

2.6.3.1 Module 1: Rear axle

The rear axle must be constructed in a 3D program. Afterwards there will be simulations of the kinematics and a finite elements analysis.

The axle should be a roll axle, comparable with a skateboard axle. It has 2 tires and features the steering of the Ruck'n Roll. The steering needs a spring-based-system to guarantee a directional stability.

If it is possible, a knuckle is needed to fold the axle in order to reduce the size while carrying the backpack.

Module 1 is the main topic of this thesis project.

2.6.3.2 Module 2: Front axle/tire

The front axle only has one tire. It has no function for the steering; it is fixed to the body. It is equipped with a brake system and bars to put the feed on.

If it is possible, a knuckle is needed to fold the axle in order to reduce the size while carrying the backpack.

2.6.3.3 Module 3: Body

The body provides the platform where the axles will be fixed.

2.7 Tasks in module 1: Rear axle

The main tasks in this thesis project are:

- a) To design a steering device for the Ruck'n Roll
- b) To design the rear axle in module 2
- c) To make a finite elements analysis of the rear axle during static and dynamic conditions.