

# Innovative artefacts for sustainable mobility systems- the example of the “Mitka”

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## *Introduction*

In the last decade mobility issues are becoming a big topic. The great benefits of transportation systems are nullified by negative externalities. The main undesirable effects are well known: vehicles' emissions, noise, land use, virtual intrusion and congestion. The phenomenon has been studied from different angles and on different levels. The efforts are made to have a sustainable mobility in the next future, changing the system towards a more efficient, reliable, safe and less environmentally harmful. In order to have this change, the system should be modified guaranteeing a radical improvement in the social and environmental sphere without penalizing the economy: a system innovation<sup>1</sup> is needed<sup>1,2</sup>. The Dutch ministry of transport referred to system innovations as *transition management*, where changes in technology, structure and in culture and intentions occur simultaneously<sup>3</sup>. The literature about this topic is quite scarce and often concentrated on very specific aspects having as background for example policy perspectives, technological opportunities, managerial solutions and user behaviours without a comprehensive integration. Integrating visions and perspectives of different actors is necessary to cope with the challenge of sustainable development and to develop new solutions in direction to system innovation. For this reason, several experiments should be started by governmental institutes and business organizations in order to understand how they can contribute to system innovation<sup>4</sup>. In this contest the Mitka case is an important step in direction of system innovation. Some aspects are relevant:

- The goal of the project: to develop a new product/service combination for a more sustainable mobility system.
- The coalition formation: different actors from government, business organizations and research institutes working together for a common goal.

A fundamental question is what the role is of the different actors like government, research institutes, universities and business entrepreneurs in sustainable concept development. Studying the Mitka process and the roles of the actors, the paper can give a contribution to the topic.

## *Background*

The Mitka is three wheels' human powered vehicle with an electric engine, surrounded by additional services like 24-hour service assistance and route information. It is meant to become a solution for the short distance commuters, as a sustainable alternative to the car. The Mitka will be ready for testing in the September 2002.

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<sup>1</sup> Systems innovations are defined as major changes, towards sustainability, in the way societal functions such as transportation, communication, energy supply, housing, water management are fulfilled. Such major changes involve a co-evolution of a number of related elements, including technology, infrastructures, regulation, scientific knowledge, industry structures etc.

The paper describes the role of the actors focusing on the very first stage of the process: from the very beginning of the exploration phase to the coalition formation. It does not take into account all the product-service development process<sup>11</sup>, but only the first part of the process, the exploration phase. The choice was made for an analytical reason: each phase of the process can be studied by different perspectives. Focusing on singular phases of the project a clearer picture comes out. Every phase has the own peculiar characteristics, which could be analysed by different theoretical frameworks. This paper explores in two different directions:

- *The role of the actors.* In the very beginning of the process, some actors have been crucial for the start of the Mitka project. We can identify both the role of human actors and the role of the institution behind them.
- *The coalition formation.* The development of a new vehicle concept between a bicycle and a car did not start in a technological laboratory of some R & D centre unit. It started as a problem statement, as a lack in the mobility system that was difficult to recognize and to express into a concept.

The paper will contribute to answer to the following questions:

- *What has been the role of the actors in the exploring phase?*
- *How the network was created?*
- *Why these actors and not others have built the network?*

The reason to investigate in these directions lays in the uncertainty to set up experiments and in their outcomes. A marginal knowledge of what happened in the very beginning of the exploration phase is known, when clear policy strategies are not developed yet. This paper tries to address the complex interaction among the actors along the exploration phase. In our case study the process is carried out by different organizations, which form a network. In the network different interests, expectations, meanings, norms and cultures cohabit and interact in order to develop a new sustainable technological concept.

In order to be able to analyse the process, it is better to split the exploration phase in two parts.

The first part concerns the dynamics, which have led to the current network. The actions of different actors and their roles in building the network are considered and the reasons why some actors left the coalition and others were not taken into account are investigated.

These issues are investigated by different perspectives.

- A rational actor perspective to illustrate the rational choices of actors.
- A socio-technical point of view where the technological development is pictured as a process of artefact development influenced by a multitude of relevant social actors, which give a certain meaning to the artefact<sup>5</sup>.
- An institutional perspective, actors use structural properties consisting in rules and resources. These rules and resources mediate the human action actors<sup>6</sup>.

The second part illustrates the current network, where interests, expectations, norms and problems definitions of actors are investigated. According to:

- A Socio-technological perspective.
- An innovation network theory perspective to explain the coalition formation.

The paper is structured as follow: first the Mitka and the coalition behind it are presented, in order to give a broad picture of the Mitka. In the second section, the history of the Mitka during the exploration phase is described. The third section takes into account different theories in order to explain the actions and the roles of the actors involved.

The last part synthesises the main findings of the research.



Figure 1, The Mitka-vehicle (May 2001)

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<sup>11</sup> The product-service development process is here based on the Kathalys method. The Kathalys method is an approach for developing Sustainable Product Services. Five project phases are mentioned: “future exploration”, “System design”, “product/service specification”, “drawing in detail and testing” and the “implementation” phase. For reference see the footnote number 8 at the end of the paper.

## 1 The Mitka system

### 1.1 What is The Mitka? Artefact & Function

The Mitka is a three-wheels vehicle supplied by pedals with a power assistance that doubles the pedalling power. When this paper has been written the Mitka was still in a prototype stage (scale 1:1) and ready to be tested. The Mitka has an innovative shape with a natural position when body is seated (see fig. 1). It is equipped with a roof and it is able to steer and tilt simultaneously.

The Mitka was created and designed for a specific function: to transport commuters from home to work with a range of 20-25 km, reaching a speed of 30-40 km/h. Its main characteristic lays in the potential to be an environmental friendly vehicle. Comparing with the car, it could reduce by factor 3 the environmental impact<sup>7,8</sup>.

### 1.2 Who is involved?

Several actors have contributed to make the Mitka concept feasible and they are ready to continue for a future implementation. They are listed below.

- The Sustainable Product Innovation group of the TNO Institute of Industrial Technology is the project leader. Their core business is the product development with a considerable reduction in environmental impact. As part of the Mitka's design group, there are *Peter van der Veer Designers* (product development and design) and *Freewiel Techniek* (engineering).
- The *Gazelle* bicycle company is the market leader for The Netherlands: business developer for the Mitka in bicycle manufacturing and distribution.
- The European *NIKE head office* has been willing to test a new sustainable mobility concept for their employees in their Hilversum headquarters, which lacks of parking place.
- *Delft University of Technology (TUdelft)*, in particular the Design for Sustainability group, located in the faculty of Design, Engineering and Production, was asked to design a set of services around the Mitka and study the environmental impact of the concept.
- Governmental agencies (Novem) for subsidies program. In the case study have been submitted two kinds of subsidies programs: the EET and the MOVE. The requirements are slightly different; the first one is based on developing innovation technology and the MOVE program on stimulating chain mobility. In the MOVE program the technological innovation is not the primary goal.

## 2 Mitka history

### 2.1 The beginning (the vision)

The idea to have a new concept of transportation that could combine speed and comfort with a significant reduction of the environmental pressure has been created in a 3-year process that a sort of "vision building" phase. This phase contemplates all the ideas, research studies, failed network coalitions that have lead both to the present coalition and to the first concept design of the Mitka. Along the exploration phase, much information was scattered and not available. This phase is different from the phase of "policy formulation" and "ideas finding" in the product development or product innovation literature<sup>9,10</sup>. First, there is not a precise reference to one business organization's strategy but more to a combination of interests, expectations and opportunities of different organizations in different time frame. Second, the final concept of Mitka is the result of many ideas brought together by some key actors during the process.

In 1996, a manager from TNO, a governmental research institute together with two managers from Batavus (bicycle company) came up with an idea to have a new bicycle concept for longer distance than a normal bike uses to cover. A project plan for a "renovate" bicycle concept was the basis for a proposal submitted to the EET<sup>III</sup> asking for subsidies in order to develop a sustainable concept, but it was not accepted. As a research institute, TNO industry started to invest resources in studying the opportunity to develop such a concept. The team moved into two directions: on one hand, to find partners for a likely project and on the other hand to define the characteristics for a bike in order to be a "Bike Plus"<sup>IV</sup>. Stork Company (engineering



Fig.2. One of the bike concepts

<sup>III</sup> EET: Ecology, Economy and Technology program by the Dutch Government.

<sup>IV</sup> Definition given by Inge Oskam, TNO project leader in the beginning of the project.

development in automotive industry) decided to join the project, but unfortunately only the R&D agreed with the participation, the management of the company did not, so the stork company had to withdraw.

Simultaneously at Delft University of Technology several students' projects were focusing on sustainable solutions for substituting the car on short distance. One project (fig. 2) especially used the VIP (vision in product innovation) approach<sup>11</sup> in order to develop a new concept for the short distance in 2005 in relation to his study, which showed the commuters use for a distance between 2.5Km to 25 Km mostly the car (Up to 80%)<sup>12</sup>.

In 1997 a new cooperation program was established between TNO Industry and TUdelft: Kathalys. The mission of Kathalys is to create and develop sustainable concepts. Some workshops during this period helped to create the condition for a sustainable bicycle concept combining some characteristics of the car into it.

The TNO team started to characterize the future concept. It should have met the flexibility of the bike with the comfort of the car (rain protection, safety, seat position etc.). They made an inventory of individual transportation concepts on two and three wheels in order to understand their penetration in the market. They found out that any of them had a significant market share.

The first question was why alternative transportations to the bike and to the car are not successful. According the TNO team, the answers lay generally on:

- *Bad Image.* The electric vehicles as bikes and man-wide-cars are perceived by many people as transportation for elderly persons or for individuals having physical disabilities.
- *Conservative consumers.* Many bike users perceived new kind of bikes as three wheels bikes or horizontal seat position bikes as too innovative. They think these innovative bikes do not respond to their needs. These vehicles are also considered unreliable, uncomfortable and sometimes unsafe.
- *No marketing.* Many vehicles are made by "amateurs", developed in garages and known by few people<sup>13</sup>.

The result of this phase of the project was the involvement of 3-4 actors as TNO, Batavus, Stork and Polynorm. The new concept should be faster than a normal bike (power assistance), flexible and reliable, safe and comfortable. It should get also a highly customized profile with high technological innovation and low environmental impact, although few calculations were made. A modular system has been evaluated in order to customise the concept according to the consumers' need for example, interchangeable modules for frame, steering mechanisms and brakes. The result should have been the development of different modules to build up several "Bike Plus"(flexible modular system vehicle).

After a second attempt rejected by the EET committee, a third attempt failed to get subsidies. This time the Batavus Company withdrew from the project because of the following interdependent reasons:

1. *The innovative factor.* The idea to build a bike that had added characteristics close to the car (speed, longer distance, privacy, status..) was evaluated too innovative and they could not foresee a serious market for it.
2. *The core business.* The project was considered too far the core business of the company: the bicycle production.
3. *New president in charge.* The company had financial problems and a new president took the lead of the company, deciding not to invest money in the project, in contrast to the former president who was quite enthusiastic about it.

At this point the TNO team was looking for other partners. The research already conducted and the Kathalys's support were the basis to develop a sustainable vehicle. The problem was to find partners to start again the process. These partners should have had resources and willingness to carry on the project.

The opportunity came along during a meeting with the environmental commissioner of the Nike Company on an official visit to the Nike European headquarters in Hilversum. The TNO team leader asked the commissioner for a joint partnership to create a new sustainable vehicle. The reaction was enthusiastic. Moreover, the environmental manager of European Nike took the chance to go further identifying the parking situation at the headquarters as a mobility problem for the coming years, as more buildings are going to be built and there is going to be less room for parking lots.

The decision to involve Nike Company in project was based on the need to find a client for a sustainable vehicle concept. In this way, the Nike employees are considered as the lead users, the final customers for such a vehicle. The new vehicle should be developed according to this clients needs<sup>14</sup>. The next step was to involve a company that had the resources and knowledge to develop the new sustainable vehicle, which is based on the current bicycle concept. The choice fell on the Gazelle Company, competitor of Batavus Company in the bicycle market. Also in this case the reaction was positive, the manager director of Gazelle looked to the opportunity to cooperate both with TNO engineers and with Nike Company, which is considered a successful and well-known company. In order to develop a

new sustainable bicycle concept, the manager director asked Peter van der Veer Design to work in the product design.

The basis for the 4<sup>th</sup> proposal to the EET-KIEM was established, submitted and further accepted. At this point, after three years of visions building and exploration, the process became consistent with a consolidated group of actors, who form a coalition in order to create a sustainable vehicle for short distance.

### 3 Analysis

#### 3.1 The actors' role and the human action.

In order to understand the role and the choices made by the actors, it is useful to identify and analyse the human actions and the role of actors in technological innovation processes in literature.

The rational actor perspective assumes that an actor with given preferences may choose from a set of possible actions. Each action yields an expected outcome that can be evaluated in term of actors' preferences: rational action consists in choosing that action whose expected outcome is most preferred<sup>15</sup>. This perspective is used by many economists, who treat the development as a rational means in order to achieve some goal (usually expressed by cost-benefit analysis): the certainty about costs, resources and technical feasibility is an important assumption. In our case study, the development can not be treated as rational process, but as an "emergent" one in which much information only becomes available over the time: the certainty in the development is in its own uncertainty. Many factors were discovered during the process due to scattered information sources. Thus the rational perspective is not useful in the case study.

Thus the development in the exploration phase is not the realization of one's actor intention pursued through the most efficient means, but the unpredictable final vision of a multi-group process as Pinch and Bijker assumed in the Socio Construction of Technology theory<sup>16</sup>. In their approach the uncertainty and limited knowledge along the process is taken into account.

In order to explain the actors' interaction, three different approaches can be highlighted. The first one is related to the institutional perspective, stressing the importance of institution behind every individual action. It assumes that in any interaction actors engage in a search of self interests, which are given and do not require explanation and any actions constrained by the strategic context of the institution<sup>17</sup>. This approach is pertinent in the case study for the search of self-interest during interaction. But on the other side their interests are not always explicit, they becomes clearer only through negotiation.

The second approach is the actor-network perspective, which accentuates the individual actions.

Michael Callon used the concept of "Actor network" to stress the concept of the negotiation and interaction among the actors as the starting point for the development of technology (seen as contingent orientated<sup>18</sup>), which proceeds as a process of inter-group negotiation over an extended period of time<sup>19</sup>. This approach emphasises the free human action, which in the case study can explain the entrepreneurial attitude of some actors, but does not contemplate any external force or constriction in the development.

The third one is a compromise between the previous approaches. According to The theory of Structuration<sup>V</sup> (by Giddens) every human action is mediated by the structural properties consisting in rules and resources in their organization. Moreover when humans act in organizations, they recreate three fundamental elements of social interaction: *meaning*, *power* and *norms*<sup>20</sup>. According to the human action or to institutional properties perspective, these three elements assume a different connotation. The separation of the elements of organizations in the table 1 (based on Orlikowski<sup>21</sup>) are made only for analytical reason, they are interdependent and not separable in practice.

According to this scheme, every actor's action can be seen as a reaffirmation of the institutional structure *and* as an individual interest. This approach is useful in order to frame our case study, which a new conceptual framework is based on. The importance of actions and choices made by actors is here stressed.

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<sup>V</sup> In Giddens' framework, the regular action of knowledgeable and reflexive actors, patterns of interactions become established as standardized practices in organizations. Over the time habitual use of such practices eventually becomes institutionalised forming the structural properties of organizations. These structural properties are drawn on by humans in their ongoing interactions, reinforcing the institutionalised properties. This is known as the duality of structure.

	<b>Meaning</b>	<b>Power</b>	<b>Norms</b>
	Human interaction involves the constitution and communication of meaning via interpretative schemes <sup>VI</sup>	Capacity to provide resources in organizations to accomplish outcomes. Two kinds of resources: <ul style="list-style-type: none"> <li>• <i>Allocative</i> (extending over objects and material phenomena)</li> <li>• <i>Authoritative</i> (extending over persons)</li> </ul>	Informal elements of the organization, expressing the organizational culture
<b>Agency perspective</b>	Based on ongoing interaction with the world (knowledge and experience)	These resources are the means through which the power is exercised	Organizational conventions or rules governing legitimate or “appropriate” conduct
<b>Institutional properties perspective</b>	Interpretative schemes as organizational <i>structures of signification</i> , which represent the organizational rules that inform and define interaction	Resources constitute organizational <i>structure of domination</i> , which reflect the fact that all social system are marked by an asymmetry of authoritative and allocative resources	Organizational <i>structures of legitimation</i> , where by a moral order within an organization is articulated and sustained through rituals, socialization practices and tradition

### 3.1.1 Entrepreneurship of individuals vs. institution

With the term “entrepreneurship of individuals” the importance of the free human action in the process is stressed, the ability for actors to interact with each other for generating ideas and looking for directions in developing innovative concepts. In the exploration phase, where a structured strategy is not yet implemented by any of the actors, the “owner” of the idea is looking in different directions to build interactions with possible source of knowledge (other actors). He is also a “collector” of information, which is scattered and not easy to find. The team leader copes with the uncertainty and limited knowledge and he uses his *power* to provide for the process the *authoritative* (building a team) and *allocative* resources. His active role in looking for resources and information identifies a high degree of free human action.

In the case study, the process leader is the TNO team, which reflected more the entrepreneurial attitude of the TNO team manager than the research institute culture. The project leader, who is the owner of the idea, invested the resources of the organization (team formation) to find information and partners.

Each actor involved is one individual representing *in primis* the own personal interest: beyond the project leader (TNO), the facilitator manager for Nike and the Batavus manager there is not a corporate strategy; the development of such a concept is not part of the core business, their actions are not embedded in corporate strategy.

On the other extreme, the term “institution” stands for elements of the system, which mitigate and constrain the free human action. They are institutionalised properties (the rules and resources) as well as general external forces, whose power is stronger than the ability of single actors to act freely<sup>VII</sup>. In the case study the decision of Batavus management to drop out from the coalition can be seen as a lack of power of the manager in finding the right resources in the organization. Moreover, the organization reaffirmed over the manager’s action the structure of *domination* and *legitimation*, where norms and culture did not match with such an innovative concept.

A similar thing happened in the Stork Company: the management did not provide the resources to the R & D department.

Here the government played an important role in encouraging the process. Through the subsidy’s programs, the subsidies were the most significant financial support for start of the process, without them the project would probably never have started. Although the standard procedures and the institutional norms created the condition to

<sup>VI</sup> They are called also *socio-cognitive frames*: the basic idea is that actors do not interact randomly, but are guided by cognitive frames. Their knowledge, ideas and reservoirs of notions tell them how they can interact each other.

<sup>VII</sup> The structure is understood here as a generic concept expressed by Harro Lente based on the fact that any interaction and negotiation among actors are constrained by ‘something’ that is beyond the reach of mobilizing power of single actors.

have had the proposal forth times submitted (twice rejected by EET commission). The reasons could be that the previous proposals were inconsistent to the standardized requirements and the procedures were not flexible enough to allow these kinds of visioning concept proposal to be accepted<sup>VIII</sup>. However the contribution of the governmental agency was determinant for the ongoing of the project.

In this frame, the role-played by the university resulted determinant for the ongoing of the process. Many factors were identified and understood by students during their final thesis and used by the project team. The knowledge and the resources (students as low cost labour) available within the Delft University of Technology allows companies and research institutes to investigate in several directions of technological development. However these procedures were established by the faculty department director, who changed (free action) the organizational rules (structure) that inform and define the interaction itself. So if in the beginning his action was beyond his institutional role stimulating new research patterns (for example the Kathalys formation), later these approaches were institutionalised, becoming part of the standard procedure in the research.

Avoiding the extremes, any free interaction is enabled and constrained by the institution. Although the TNO team manager created the conditions to start the process, the procedures to find the key actors are the expression of the organizational culture. After the Batavus' withdrawal, the TNO team started to look for partners according to their resources needed for such a project: the Gazelle as business developer, with the likely resources to develop the "Bike plus", and Nike as a promising client, whose requirements could have been translated in a concept design. However for the rest of the concept development the resources would have been found inside the organization, as a reflection of a well-established organizational norm.

It is remarkable that no car producer or motorcycle company was contacted by the TNO Team along this phase. The reasons were:

- *Lack of contacts.* It was considered a difficult task to find a counterpart with commitment in a car company.
- *Bike, no car concept.* The concept was mainly focused on bikes and therefore it is not part of the core business for car companies.
- *Image.* Car companies and dealers are not keen of such a combination concept because it could mine the own image.

On the other side, the DfS director contacted representatives of car companies like Renault, General Motors and Audi, which were not interested. Large car companies have the resources and know how to deal with new technical developments, which in this case could have been applied to a new concept between a car and a bicycle. Moreover, nowadays the large car companies are constrained in their business by stronger environmental regulation. Dealing with sustainable concepts the car company image could improve in front of the public opinion.

In the following table the tension in actor's action is illustrated. The governmental subsidies programs are not mentioned in the table, they can be considered as a Meta-institution beyond the actors.

<i>Entrepreneurship of individuals</i> ←	→ <i>Institution</i>
Batavus manager: Project Promoter	New Batavus management: They refused to continue the project
Nike manager: Willing to participate for his own interest	Sustainability as a possible strategic asset
Stork R&D: Willing to participate	Stork management Contrary to the project
TNO team manager: Project promoter and leader	TNO organization: Norms and procedures to be followed
Gazelle director: Willing to cooperate according to organizational norms	Gazelle company: Structure of legitimation reaffirmed
DfS Director: Entrepreneurial attitude in order to create new procedures	TUdelft organization The new procedures are been embedded in the organizational structure

Table 1. Actors' dilemma.

<sup>VIII</sup> For projects aiming to system innovation the uncertainty in the final result can be high. The outcome can be at technological level as well as organizational or social level. In the EET program the requirements for any projects take strictly into account only the technological innovation.

### 3.1.2 Conclusion

In the exploration phase many elements contribute to the visioning process. Uncertainty, lack of knowledge, scattered information and no organizational strategy, create space for free actions guided by individual interests in developing sustainable concepts. These actions are mitigated by the structure beyond them. In a scattered information context, the free action of one actor is essential for the starting process. This actor is likely to be found in intellectual entrepreneur group, as research group or university, capable to collect the information needed. On the other hand, the process can take time before acquiring momentum, without a strategy or motivated business actors. The government in this context provides the financial support for the project, which should be overtaken by the same business actors. If it does not happen, the project is likely to fail.

The framework can partially explain why these actors are part of the coalition and why not other actors were involved. In the next section we look closer to the interests and expectations of the actor involved in the network, using different theoretical approaches.

## 3.2 Network formation

A network is a form of co-ordinating social activities, which falls beyond traditional formal market, and organization, defined as a third form of co-operation beyond market and organization<sup>22</sup>. Individual and collective actors become involved in a network as the potential profit of cooperation exceeds individual strategies to maximise benefit.<sup>23</sup> A network is defined as a loosely coupled system of organizations and individuals coming together in order to reach certain goals unattainable by partners, individually<sup>24</sup>.

In order to explain the dynamics in the coalition, some works in socio-technical systems and innovation networks field are used. They deal with problem perceptions in the complex systems.

According to Trist, problems sets are made up of interconnected issues<sup>25</sup>. The interconnections and complexities that arise in the systems (that contribute to the problem sets) are defining the characteristics of the problem sets. These characteristics mean that any response to one problem in the overall set is likely to influence other problems in the set. Moreover all human interactions with problem sets wherever those interactions are categorized as problems, solution and outcomes, are extremely difficult to conceptualise, visualize and analyse. And problems organized in sets are partially seen by individual and organizational actors, which perceive these systems through their own lenses and mental frame. Moreover actors invariably define their goals in relation to partial interests in the resources that form that system, which circumscribe problem sets. And any unilateral solutions are perceived as desirable and or undesirable according to the perspectives and interest of different individual and organizational actors<sup>26</sup>.

According to Roome, any robust responses (innovations) to problems need to originate through the interaction between organizations, which share the interests in the systems or resources within the problem set.

The self-organization theory considers that new social organizations are the effect of social dynamics, which is based on the "uncertainty principle"<sup>27</sup>: the expectation of what can be obtained in a specific situation but it is not certain to achieve it.

This uncertainty makes social process floating with respect to their development in time and forces activities to its reduction. Therefore new ways of co-operations and confrontation can reduce the uncertainty. Even if there is the risk of building co-operations only for the specific problem for which they were developed. Therefore the reduction of uncertainty is equivalent to the emergence of rules, which integrate individual interests and competence and form a social system with a given boundary beyond the "rationality" of negotiations and contracts<sup>28</sup>.

In the case study we can observe something similar explained above by the mentioned theories. Each actors involved in the Mitka project had the own perception of problems in the mobility realm linked to their own benefit and business. The categorization of the different problems for each actor was difficult to conceptualise and only through the confrontation it was possible to visualize them. The cooperation based on the confrontation foster the different problems of each one in an integrated set of problems, which have been translated in an opportunity to cooperate.

However, a significant difference can be noticed between the theories and what happened in the case study. In the previous theoretical framework the problem perception and the uncertainty are the main drive to cooperate. This creates a sense of urgency in finding new ways of aggregation and conditions to collaborate. On the contrary, in the

case study no real sense of urgency is perceived by the most of the actors, only the project leader tried to “trade” the sustainable concept as an opportunity for the actors involved in order to address a likely set of problems. Without a sense of urgency, the problem perception and the uncertainty are weak drivers. Thus the main driver here is the opportunity to realize something new balanced by a waiting attitude of “to see what happens”. The core of a network is the expression of a *set of different opportunities* more than based on a common problem definition. Moreover, the risk of a limited commitment exists because of the absence of urgency.

In this condition, without a sense of urgency the coalition is based on a set of opportunities surrounded by uncertainty and lack of knowledge, which make unclear the purposes the actors are intended to achieve. A coalition with several actors with different backgrounds and different interests and goals can create instability and problems to the endurance of the coalition itself. This phenomenon can be explained as a dilemma between the “broad supports vs. congruency of goals”.

### 3.2.1 *Broad support vs. congruency of goals*

The dilemma term “broad support vs. congruency of goals” refers to the tension between a large numbers of actors and their different interests. The presence in the coalition of many influential actors in order to give the coalition strong support, is compensated by the difficulty to manage by the project leader different interests and goals: the greater number of participants the greater the probability that their goals will not be congruent with each other. During the process, the project leader was looking for partners, according to power and resources required. The initial coalition is the result of the partner’s research expression of influential actors as Nike Company and Gazelle Company in the business arena.

The definition of interests and expectations of each actor illustrates this dilemma.

The TNO team leader was eager to develop a new concept applying the Ecodesign principle for a more sustainable vehicle. TNO is not a business organization, its final goal is not to sell the vehicle, but develop technical concepts design and get the rights on it.

The Nike Company was willing to participate because the Sustainability issue is part of the mission statement. The participation in such a project improves the image of the company showing to the public their interest in sustainable projects. Moreover, the scarcity of parking lots in the coming years gave a reason more to act as client of the new concept. The enthusiastic manager approached the project offering the employees to market research but without having a strong commitment for the project. According to the Nike company “client”, the concept should reflect the company image: fast, sportive and attractive.

The choice of Gazelle Company to participate in the process is the expression of direction manager’s personal interest and linked to the possibility to work together with Nike Company. However, if for TNO the project was addressed to the development and implementation of a new sustainable concept, for Gazelle was important to create innovative prototypes to promote the “normal” bicycle sale. From a technical point of view, any innovative solutions during the development could be utilised for further applications in the bicycle construction. The Gazelle expectations are strongly linked with the usual bicycle development.

The mission of the Design for Sustainability group at Delft University of Technology is to design, create and study opportunities for any sustainable concepts or systems. As a research group, they are looking for learning experiences to foster sustainable solutions in the society.

In the table 2, a summary of the interests, expectations, problem definitions and the attitude to the coalition are illustrated (findings based on interviews).

<b>Actors and their role</b>	<b>Interest</b>	<b>Expectation</b>	<b>Problem definition</b>	<b>Attitude</b>
<b>TNO</b> Business developer	Technological solution design	New vehicle for short distance combining the car and bike	Car use up to 80% in short distance for home-work travel, new technical solution are needed	Leading Project leader, very active in finding financial support and partners for the project
<b>Nike Company</b> Client	Good image for the company, Personal interest of the manager about environment	Vehicle expression of the company image: fast, attractive and sportive	Parking lots scarcity	Waiting As a client, the employees offered for user research.
<b>Gazelle Company</b> Business developer	Promoting the bicycle sell through innovative concepts	New concept with a strong bicycle character	Bicycle market sutured	No committed as a company. The v/d Veer designer brought by them in the coalition
<b>DfS</b> Knowledge keeper	Looking for learning experiences to foster sustainable solutions	New product service system combination for system innovation	Lack of sustainability in current mobility system because of emissions, congestion, etc.	Cooperative. Students involved as well as researchers. Lobbying/business networking development
<b>Governmental subsidy's programs</b> Financial support	Promoting and stimulating sustainable projects	Implementation of sustainable concepts	Lack of sustainable solutions	Promoting and regulatory

Table 2. Actors' opportunities<sup>IX</sup>.

### 3.2.2 Conclusion

The network can be formed if there are enough motivations for each actor to collaborate. In the case study, the motivations are linked to different opportunities for each actor rather than to sets of problems. Moreover, they are not based on a sense of urgency as the waiting attitude by business companies as Nike and Gazelle demonstrated. The heterogeneity of goals of influential actors can create problems to the coalition. Without a sense of urgency, the commitment of each actor is also weak.

Cooperation could be risky for all the partners involved because of the possibility of opportunistic behaviour. For this reason the concept of trust is very important for setting up networks and who manage such cooperation becomes crucial.

In the case study TNO as a governmental enterprise initiated the cooperation and tried to meet trust by the others actors involved. In this situation, where the idea generated the network, and not vice versa, where the organization is the place for ideas, how the cooperation is working is essential for the existence of the coalition itself. Moreover knowing how to make a product and how to make it work is absolutely critical to success<sup>29</sup>.

<sup>IX</sup> The table is based on interviews.

## 4 Final Synthesis

In this paper many issues have been explored. The innovative process regarding the Mitka was driven by the sustainability. The Mitka project can be encountered as an experiment in integrated mobility towards system innovation, because its development can involve changes in technology (the new artefact), in organization (services combined) and in infrastructure (new facilities for recharging batteries and for storing). In order to create such a concept, a coalition has been established. The exploration phase in three years time produced the visioning for the Mitka concept as well as the network. The paper tried to understand the dynamics of the process along the exploration phase, studying the role of the actors involved and their interactions. Several theories have been used to explain the dynamics along the process. As result, a new conceptual framework has been developed in order to understand the dynamics in the actors' interaction. The following findings have been found:

- In a coalition formed by different actors, two levels of interaction can be identified.
  - The first one contemplates the interaction between the free action of individuals, who participate in the network and the own institution beyond them. The actor's power to transform the organizational resources in meaning for the network's goal is enabled and constrained by the institution. The tension between the individual and the own institution has been explained with the dilemma between the entrepreneurial of individuals vs. the institution.
  - The second interaction is among the actors in the network. The role of the actors in the coalition has revealed their interests and expectations and attitude towards the concept. The motivations to create a network in this case are based on opportunities and not on a set of problems discussed in problem definition theories. This reflects the absence of urgency in creating momentum in the process. The poor commitments and a range of goals of different influential actors can create problems to the coalition. In this context, the willing to have many influential actors compete with their differentiate goals, which could be incongruent among each other. The dilemma broad support vs. congruency of goals tried to explain the tension.
- In coalition expressed by "a set of opportunities" where the sustainability is one of the main drivers, the role of the research institutes and universities plays a crucial role for the start of the exploration phase. Moreover without a sense of urgency the project is unlikely to begin if the governmental financial support is lacking. The business developers in the exploration phase have a waiting attitude: they want to be in the coalition in order to pursue new strategies of innovation, but with few commitments keeping a low business risk. However, this new heterogeneous institutional arrangement seems to be necessary in order to deliver the required Mitka product-service combination.

The next step is to investigate the process from the building coalition to the state of art, where the design of the product system has been developed. The form of the coalition and the important choices along the Mitka development process are going to be identified and analysed as part of the research program in the "Design for Sustainability program" section of the sub-department of Industrial Design Engineering.

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