INNOVATION PROCESSES IN SURFACE TRANSPORT

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TABLE OF CONTENTS

1. Overall Approach

1.1. Overall focus

The focus of INNOSUTRA is distinguished by its primary objective of analysing the factors that drive or inhibit the spread of innovation through the surface transport sectors. This provides for a concentration on certain aspects of the innovation system/process, e.g. diffusion and the role of demand. We are hampered by the fact that we cannot conduct (as for instance did the MIRP[1]) lengthy, longtitudinal studies. Hence, in pursuing our survey approach we need to specify carefully the underlying bases of our approach.

A distinguishing feature of the INNOSUTRA approach is our concentration on economic factors rather than sociological factors, though not to their exclusion, particularly in relation to organisational factors, both intrinsic and extrinsic to the firm, and in relation to the activities of key players. This 'external to the individual firm approach also emphasizes the role of public policy, i.e. in relation to laws and regulations.

Clearly we also needed to start from the analytical position reached in our PIR (preliminary innovation report), as amended by the expert consultation. However, we may need to supplement the classification used, as indicated below.

1.2. Outline of INNOSUTRA approach

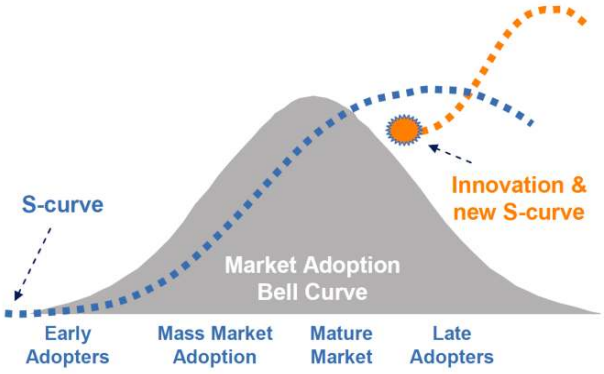
Taking account of the above points, our approach is along the following lines.

We encapsulate the point (on which we are all agreed) that the term 'failures' is misleading, except for a very few residual cases where either the amount of organisational change involved is insufficient to permit the example to be classified as an innovation at all, and where an innovation appears to have been declared a failure by the sector and has not progressed for say 5 years. In general all the innovations are considered as being at various points along a 'success spectrum'.

A success spectrum can be described as an innovation S-curve, Figure 1. If every specific innovative case is at a certain point on the S-curve we can easily compare the different innovative cases. For every innovative case we determine the potential market before the innovation was implemented and we determine the market that was reached. This is a clear indicator for a successful or not yet a successful innovation. Next to this we take into account the three P's; People, Planet and Profit. We explain the success of an innovation with these guidelines.

[1] Methods for studying innovation development in the Minnesota Innovation Research Program, see Van de Ven and Poole (1980)

Figure 1: S-curve



Source: Kaplan, 2007

Bearing in mind the point made above, our principal analytical focus (in relation to the private commercial innovations) is on those innovation system/process aspects that are extrinsic to the firm. These are:

- The institutional framework in which the firms operate. e.g. the sectoral dimension, industrial structure and competitive environment, pool of technical expertise, etc.;
- Linkages with other firms and sectoral or public research institutions, including in an EU context;
- The role played by customer demand;
- The role of technical standards' setting (there is an overlap with linkages with other firms here);
- The role of public policy, laws and regulations.

Clearly there is an interface with these external aspects of the system/process and those factors operating within firms. But our emphasis should perhaps be on how these external factors support or inhibit the innovation process within the firm, and assist or inhibit the spread of the innovations being considered within each sector.

One specific issue that is extremely important, but has not been well explored, is the role that uncertainty plays in inhibiting the adoption and spread of innovations. However, it is obvious that factors extrinsic to the firm will play a major role in reducing uncertainty.

The role of technical standards in encapsulating for whole industries is of considerable importance and has featured in our preliminary analysis of innovations. Perhaps a greater focus on this aspect is required.

The role of consumer demand and the interaction of the firms with customer firms (and indeed the whole industrial chain of supplying and consuming firms) is a critical area that again, because of methodological difficulties, has been insufficiently explored in its role in accelerating the spread of innovations.

We have already included the role of public policy in our early analysis of its potentially positive impact in reducing barriers to innovation. We therefore examine this in some depth, including the related subject of public research institutions and the positive role that these may play in providing an initial impetus for innovation.

Finally, as we have previously agreed, public policy initiatives are analysed separately as the factors influencing their adoption are different. In particular it appears from our preliminary

analysis that the calculation of costs and benefits is inadequate in a number of cases and inhibits the spread or adoption of the initiatives across the sector. This analysis also needs to examine the role of 'lobbying'.

1.3. Hypotheses

The overall aim of this phase and, more specifically, the next phase (Work Package 5 of the project) is to investigate and then to test a number of hypotheses/propositions relating to the innovation process. These may be summarized as set out below – though not exhaustively and not necessarily in order of importance or precedence. It may be, for instance, that further hypotheses will be suggested during the elicitation of data during this detailed examination of the individual innovation cases in WP3 and WP4. For this reason the initial hypotheses list below will not be formally tested until Work Package 5. For this deliverable D4 and for D5 they will form a *background* to the individual case analyses. There will be two sets of hypotheses: 1) those relating to commercial innovations and 2) those relating to public policy innovations/initiatives. It will be useful, at this stage, to list them even though no hypothesis testing will be reported on in this deliverable or in D5.

1) Commercial Innovations

- That the removal of barriers (of various types) to the spread of innovation is one mechanism to speed up and extend innovations through the sectors.

  Barrier Types
  1. Internal company financial barriers, e.g. high internal rates of return and short payback periods demanded of innovations
  2. Human resource non-availability, i.e. recruitment and training costs incurred
  3. Communication problems
  4. Lack of demonstrable economic benefits
  5. Objections by interest groups and the general public

- That the existence of adoption and implementation barriers, however, is not a *sufficient* explanation as to the speed or extent of the spread of innovations through the sectors.

- That the impact of support agencies external to the firms has a significant impact on the speed and extent of the spread of innovation through the sectors.

- That the impact of types of support processes internal and external to companies on the speed and extent of the spread of innovations through the sectors.

- That public financial support may be required to produce the optimum rate and extent of spread among the surface transport sectors examined.

- That industry research associations represent useful mechanisms to assist the adoption and spread of innovations within sectors.

- That linkages forged at EU level, e.g. the various EU research strategy groupings, lead to a more rapid pace of innovation.

- That the sharing of innovations with other firms in the transport chain is both a characteristic of a number of innovations and a factor in achieving the rapid spread of intermodal transport chain innovations.

- That the provision of independent information on the positive impacts of innovations on the volume and socio-economic, cost-effectiveness of freight transport across the EU may enhance the adoption and spread of innovations across the sector.

2) Public Policy Innovations/Initiatives

- The impact of lobbying by industrial/commercial representative organisations is an inhibiting factor in relation to public policy innovations/initiatives.

- Support of industrial/commercial representative organizations plays a role in the adoption process of public policy initiatives.

- That regulatory intervention by public agencies and governments may lead to the adoption of sector-wide innovations.

- That improved cost-benefit estimations of public policy initiatives will improve the chances of adoption.

- Implementation timing and transition periods play a role in successful adoption of policy innovations.

2. Objectives

2.1. General

The overall objective in this work package is to conduct a detailed analysis, based on the preliminary work done in WP2 and set out in D2.1, and as amended to take account of the expert consultation meeting. The aim will be to establish, via this analysis, the various factors and influences which determine the success of innovations selected for consideration.

Previous Work
In the past a number of innovations have been assessed (e.g. on their impact), but most assessments have not included the innovation process itself as applied to the spread and take-up of innovations within sectors.. As a consequence of this neglect, the factors which cause an innovation to be a success or, conversely, to be a failure, in relation to their adoption and fake up, are not clear. Therefore the key factors, crucial for an innovation process to achieve a rapid spread across a sector, remain to be determined. By determining the nature and relative importance of these factors then it should be possible to draw generic conclusions as to whether an innovation is likely to be successful or whether it will be a failure.. This creates the possibility of learning how an innovation process within a sector can be helped to be made more successful in the future, either by factors intrinsic to the industrial sector and company structures and operations or by external public policy intervention.

Specific Objectives:

- Assessment of key factors in the success of innovative concepts.
- Identification of key players involved.
- Analysis of the adoption process within sectors.
- Identification of current policy intervention initiatives.

2.2. Methodology Development

A generic methodology for the case studies has been developed for all partners participating in work packages three and four. This way, it was possible to compare and combine results from all the different case analyses. Such a uniformly applied methodology will also assure a consistent approach from all partners. The Technical University of Delft has, in consultation with partners, developed a suitable methodology, based on two existing and tested methodologies, and this is described in Chapter 3 below

2.3. Identification of Key Players

The key players involved in the innovation process are determined. Two types of key players can be identified, the generic key players (also operating out of the transport sector) and the specific key players (operating inside the transport sector). The generic key players are especially identified to supply the data for the analysis of the adoption process and the triggers for the innovation. The specific key players are identified to supply the data for analysis of the development process and the policy changes during the innovation processes.

2.4. Analysis of the Adoption Process

The key factors in the development and adoption process are identified after analyzing these two processes. These key factors will be valuable for decision makers in the industry.

The adoption process is analyzed. So it is clear if the market that was meant to be reached is reached. The time that it has taken for the innovation to spread widely in the market should be known, so it will be clear how willing the players in the industry were to adopt the innovation and whether the process was optimum in terms of the rate of spread.

2.5. Identification of Policy Intervention Initiatives

Analyzing the level and type of policy intervention gives insight in the impact policies have during the innovation process. Policy intervention can take place during all the stages of the innovation process. Changing a policy can change the path of an innovation process, and, as a result, it can change the overall outcome of the innovation into a failure or a success. We examine a number of interventions during the course of the case analyses. Of course, as far as the public policy innovations/intervention cases themselves are concerned we identify whether or not, and to what extent, these interventions have been successful.

2.6. Description of Tasks

Preliminary conclusions to be drawn on the key success factors and any policy contribution was the last objective of work package 3 and 4 and is reported on in Chapter 5 below .

Relationships present or absent in all the phases of the innovation process (task 2); the key factors reached or missed from the adoption and development process (task 3), and the policy conducted or not conducted (task 4) during the innovation process have to be combined to get an objective view of the entire innovation process.

Task 5 has to describe the case studies, indicating the activities that made the innovation process in each case to be more or less successful . From these activities and the associated processes the most important key factors that contribute to the success of an innovation can be identified. These factors will be be divided into categories such as technological factors, administrative and legal factors, political and process related factors, socio-cultural and psychological factors, and economic factors.

A typology will be constructed of the above characteristics relating to the different forms of innovation. This typology will be used as input in task 5.1 of WP5, the next work package. Comparing typologies for successes and failures (reported on in D5) should then enable us to identify which conditions/factors make a specific innovation a failure, a putative success or an actual success. It should also allow us, in WP5, to assist with the formal testing the hypotheses listed in paragraph 1.3 above.

3. Methodology

3.1. Introduction

The methodology has to support the study of innovation processes in a variety of situations across a number of sectors. Most methodologies developed in the past are not suitable because they are related to study a specific innovation and do not take the innovation process into account, while the main objective of INNOSUTRA is to study and assess the innovation process as it is implemented within sectors.

The methodology has to support an essentially qualitative study. INNOSUTRA requires case studies to achieve the formulated goals. Available data for the analysis of the case studies is one of the main restrictions in INNOSUTRA, this is a consequence of the time limit in INNOSUTRA (we are not able to follow an innovation process in real time). For this reason we decided that "qualitative research" is more suitable than "quantitative research". If there is the ability to use quantitative data to support the conclusions in a specific case we will utilize this opportunity. For comparison of all the specific innovative cases it is important that we are able to utilize a common methodology to compare the varying processes of the innovations under examination.

The chosen methodology has to be based on a proven methodologies and one which, adapted as required, will be usefulin achieving the goals which we are trying to achieve for INNOSUTRA.

After assessing different methodologies in relation to satisfying the above demands not many methodologies seemed to be appropriate. However, we are convinced that two methodologies could be useful in the development of the methodology to be used in INNOSUTRA;

- The Oslo manual; guidelines for collecting and interpreting innovation data, OECD .
- Methods for Studying Innovation Development in the Minnesota Innovation Research Program (MIRP).

These two methodologies are ones which study the innovation process and use extensive and solid, tested methods.

Both methodologies are, therefore, used in developing our methodology. The main difference between the MIRP study and INNOSUTRA is the limitation in available time in INNOSUTRA and the need for consideration of external economic and policy factors. In MIRP the researchers performed a lengthy, longtitudnial study, they observed the innovation process from the initial innovative idea until the termination of the innovation. As a consequence the methodology of this study is very extensive. This extensive methodology certainly contains suitable steps that can be used in INNOSUTRA. The Oslo manual is a manual for collecting and interpreting innovation data, in INNOSUTRA we will collect and interpreted innovation data, as a consequence this manual is also of assistance in developing a methodology.

There is also much literature on qualitative studies that is useful to us in assessing the survey results, including "basics of Qualitative research" (Stauss and Corbin, 1998) and "handling qualitative data" (Lyn Richards, 2005). We selected this literature because it is the

very complete and practical and applicable to qualitative studies of the sort which will be used in INNOSUTRA.

In paragraph 3.2 and 3.3 the objective and outcomes of MIRP is explained and the interlinking of the MIRP methodology with the rerquirements of the INNOSUTRA methodology isindicated. In paragraph 3.4 we go on tosummarise the developed INNOSUTRA methodology.

As we proceed through the detailed analytical phases, and discussed in this report, we will refer also to other relevant literature.

3.2. Minnesota Innovation Research Program (MIRP) and Oslo manual

In this section we describe the two methodologies used in development of methodology for INNOSUTRA. We describe Oslo manual in brief, but extensively focus on MIRP. The reason for describing the MIRP in such an extensive way is that we are going to use the outcomes of MIRP as a guideline in collecting the research data in INNOSUTRA. The outcome of the MIRP is a general innovation process. In the innovative cases in INNOSUTRA we are going to describe this innovation process. The data collection in INNOSUTRA is partly dependent on interviewing actors involved in the innovation process. When interviewing these actors we are going to use the outcome of MIRP as part of a topic list, and these topics will, as faqr as possible, be addressed in the interview.

3.2.1 Objectives and scope of Oslo manual

Oslo manual is a document that includes guidelines for collecting and interpreting innovation data. The Manual is based on a consensus of views on the demand for innovation indicators and the underlying policy needs and economic theory, on the definitions and coverage of innovation and on the lessons to be learned from previous surveys. Managed jointly by OECD and Eurostat, it has been written for and by experts from some 30 countries that collect and analyse innovation data. The complexity of the innovation process itself makes it difficult to establish absolutely precise guidelines. Nevertheless, the goal of the Manual is to provide a robust set of guidelines that can be used to produce meaningful indicators of innovation.
The scope of Oslo manual is limited to the following:

- The Manual covers innovation in the business enterprise sector only.
- It deals with innovation at the level of the firm.
- It covers four types of innovations: product, process, organisational and marketing.
- It covers diffusion up to “new to the firm”.

The guidelines provided in the manual have been useful in the initial stages of this research and for data collection, but for developing of the INNOSUTRA methodology we based mainly on outcomes of MIRP longitudinal study.

3.2.2 Objectives of MIRP

The objective of the Minnesota Innovation Research Program (MIRP) was to provide innovation managers with a roadmap that indicates what happens to an innovation between the input and the output. The roadmap should explain how and why the innovation journey unfolds. Controlling the innovation journey, with this knowledge, will be easier for the innovation managers.

The MIRP researchers called this roadmap a process theory. This process theory should explain the development of any innovation. It should explain the sequence of steps from the innovative idea until the implementation of the innovation.

3.2.3 Outcomes of MIRP

In MIRP, researchers observed specific innovative cases during their development period (1983 until 1990). They observed each innovation from the initial idea until the termination of the innovation. The innovations studied were qualified as technological innovation, administrative innovations, product innovations and process innovations in the public and in the private sector. The process theory is developed after completion of these case studies. This process theory is not complete because there are many innovations that have not been studied during the MIRP. Following the roadmap offered in this paragraph does not ensure a successful innovation but it could lead to a more controllable innovation process.

There was not one specific innovative case that did develop in a simple linear sequence, the development of innovations is much more complex than that. Feedback, setbacks and contingencies are frequently observed during the development of an innovation. So instead of a simple linear sequence common elements in the innovation development were identified. These common elements were divided between the initiation period, the development period and the implementation/termination period. Identified common elements were:

Initiation period
- Gestation period,
- Shocks that trigger the innovation,
- Resources and exposures,

Development period
- Proliferation,
- Setbacks,
- Shifting success and failure criteria,
- Innovation personnel,
- Technical difference of opinion,
- Top management involvement,
- Altering relationships,
- Team playing of entrepreneurs,

Implementation/termination period
- Linking the new with the old,
- When does innovation stops.

Next to these common elements the expectations of people on the potential of an innovation will be important. This expectation gives an indication about the future value of the innovation, it can be estimated in a structured way (cost benefit analysis). These expectations can be adjusted when the people involved obtain knowledge about the process theory.

3.2.4 Initiation period

3.2.4.1 Gestation

The gestation period is the period before the identification that a change is required. During this period many incidents occur that were not directly intended towards an innovation. Some of these incidents triggered the need for the “so called” change. This change could be an innovation.

3.2.4.2 Shocks

In most of the observed specific innovative cases many innovative ideas were shaped before the development of an innovation started. Most of these innovative ideas needed some kind of shock to start developing. These shocks can be a change in management, a product failure, low resources, a decrease of the market share, and so on. These shocks can trigger people to recognize the need for change, an innovation.

A footnote with this observation of MIRP is that there is much literature on the shocks and triggers for the initiation of an innovation. Peter Drucker (1985) identified seven triggers for the initiation of an innovation.

3.2.4.3 Resources and exposures

Before starting developing an innovation, plans and budgets should be developed. In observing the specific innovative cases it seemed that plans and budgets were overoptimistic, most of the time. They were overoptimistic related to resources and development time. For this reason there was a gap in resources during the development period of the innovation, the resources were emptied earlier than expected while the development period extended.

3.2.5 Development period

3.2.5.1 Proliferation

During the observation period of specific innovative cases the initial idea about the innovation proliferated into many different ideas about the innovation, right after the start of the development period. As a consequence, managing the development period at the start is very complex. MIRP identified four factors that contributed to the proliferation of the initial idea:

1. Every innovative process is a highly uncertain process, as a consequence it is hard to find out which path will lead to a successful innovation. During the development of an innovation the innovation managers choose to follow a number of alternative paths to find out which one seems to be successful.
2. Most of the time one single product or process innovation leads to the change of related products or processes, it is frequently observed that one innovation leads to another.
3. Proliferation of the initial idea is used as a strategic choice to leverage the risk of the innovation between a few different paths.
4. The last factor which can lead to proliferation is the way the development of an innovation is controlled. Development activities can be controlled by institutional rules, controlled by goals and plans, or it can be uncontrolled. Institutional rules control the development of an innovation in a way that tends to the less proliferated innovation development. Goals and plans control the development of an innovation in a way that proliferation into multiple paths is possible. An uncontrolled innovation development will lead to more multiple paths, which will be followed during the innovation process.

3.2.5.2 Setbacks

There are two main reasons about the occurrence of setbacks during the development period of an innovation:

- Unexpected influences from outside the innovation development team often result in a change of the context of that innovation. When the context of that innovation changes uncertainty rises about the employability of that innovation. For this reason the development will be delayed and maybe the development plans will be changed.
- Initial plans related to the development of that innovation often change during the development period. The uncertainty in the development process about the employability

of that innovation often leads to changes in the plans. A change in the initial plan will probably result in a delay and a loss of resources.

3.2.5.3 Shifting performance criteria

An innovation entrepreneur and a resource controller in the same innovation process will have opposite thoughts about the performance of an innovation. At the start of the innovation the resource controller and the innovation entrepreneur believe that the innovation is an opportunity, their thought diverge. Problems in the development process will lead to a resource requirement and probably a delay. The resource controller believes a resource requirement is a negative development while the innovation entrepreneur will solve the problem with more resources and more time and believe that it is a positive development in the end, their thoughts will converge. When the problems are solved and the innovation will be implemented the thoughts of both (the resource controller thoughts and the innovation entrepreneur thoughts) will diverge.

3.2.5.4 Fluid participation of personnel

During the development period of an innovation many personnel is employed part-time for an innovation project. The innovation development is not the main task of their jobs, so the innovation team has a relative high turn-over rate. With every leaving team member the knowledge he/she has obtained gets partly lost. The leaving member will probably try to inform the new member about the knowledge he/she obtained, but this does not mean that the new team member obtained the same knowledge. Most team members involved in the innovation have a lack of experience in developing an innovation, resulting in a naïve planning of the development.

Emotions of the team members involved during the development period will change, with these changing emotions the motivation of personnel will change as well. During the start of the development period there will be excitement, the team members have a great expectation and confidence towards the innovation. During the middle period problems in the development can occur, resulting in uncertainty. At the end of the development period the innovation will be a success or it will not be a success with the corresponding emotions. The outcome of the innovation can have a great influence on the career of personnel involved.

3.2.5.5 Top management involvement and roles

The role and involvement of top managers in the development of the innovation can influence the development. The MIRP researchers observed three common patterns;

1. In the innovation development process many managers at different hierarchical levels are involved. As a consequence, an innovation entrepreneur has to report to a team of top managers.
2. The involved managers often perform different roles and shift between these roles. They perform roles like; sponsor, mentor, critic and institutional leaders.
3. The strategic planned course of the company does not influence the development of the innovation. The involved managers react on changes in the development process with pragmatic decisions and not with strategic decisions.

3.2.5.6 Relationships alter

During the development period of an innovation the MIRP researchers observed an increase in the amount of players involved. With the increase of players complex networks of relationships appear. The players are engaging in all kinds of transactions necessary to develop the innovation further. There are some unintended consequences caused by these relationships:

1. Low resources in the development process of an innovation often result in risky transactions. For example a customer contract is used to get a loan for hiring personnel to participate in the development of an innovation. This is a risky transaction because the development of the innovation is depending on the personnel, this personnel is hired with the help of a contract that requires a positive outcome of the innovation. When the innovation does not have a positive outcome for the customer, there will be no resources to pay off the loan for the development of the innovation.
2. The appearance of partnerships and joint ventures in the development of an innovation is often resulted in divided thoughts between participants. This is a result of the top management of the companies participating in the partnership or joint venture if they are not able to agree on terms of cooperation.
3. In cooperative relationships between companies there is a risk that the relationship can change from a cooperative one into a competitive one.
4. When cooperation between two firms turns out to be a successful cooperation there is the risk that this cooperation leads to groupthink. Groupthink means that a group of very skilled persons is influenced by the group processes, the participants in the group prefer a unanimous decision instead of a transparent consideration.
5. During the development of an innovation the company needs to invest in personnel to acquire certain competences. This is often observed to lead to defection of the personnel that acquired these competences by other personnel in the company.

3.2.5.7 Cooperation for suitable infrastructure

An innovation entrepreneur is most of the time not able to develop the innovation all by himself. Often one innovation entrepreneur does not have the required resources or competence to develop an innovation. The infrastructure required for the development of an innovation includes, according to the MIRP researchers (Van de Ven *et al.*, 1999);

1. Institutional arrangements to legitimize, regulate, and standardize a new technology.
2. Public resources donations of basic scientific knowledge, financing mechanism, and a pool of competent labour.
3. Development of markets, consumer education, and demand.
4. Research and development, manufacturing, production, and distribution functions to commercialize the innovation for profit.

The creation of this infrastructure demands (a large share of) working time of the innovation entrepreneur and the involved managers.

3.2.6 Implementation/termination period

During the development period the innovation teams introduced their innovation to the potential adopters in most of the observed innovative cases, this is part of the implementation process. The implementation period takes off with the adoption of the innovation by its early adopters. The end of the development period is characterized by the end of the (re-) invention period, the innovation should be suitable for implementation.

3.2.6.1 Linking the new with the old

There are two kinds of innovation related to this step in the innovation process MIRP identified homemade and non homemade innovation. There is a big difference between these two kinds of innovation processes. A homemade innovation is introduced and implemented during the development process, the new innovation will be integrated with the old process/product. A non homemade innovation will be implemented after the development period, the success of the implementation is highly dependent on the adoption process.

The researchers often observed that, if a company needs an innovation the personnel will be reluctant to this new innovation. Recommendations for a successful adoption are, according to the MIRP researchers;

1. An innovation sponsor is required who is able to continue the adoption process when problems occur.
2. The adoption process should be structured into small parts. When a setback occurs the delay will be smaller because the adoption process does not have to be started all over again. The more time the adoption process requires the less interested people will be to implement the innovation, as a consequence the adoption period should be forced to be a short as possible.
3. Take care of a flexible implementation process.

3.2.6.2 When does innovation stop

An innovation can stop in two different ways:

- It will stop when the innovation is implemented and institutionalized. In other words when the innovation is not an innovation anymore but considered as common practice.
- Or it is a failure/not yet a success when the innovation is not adopted and the company runs out of resources to successfully complete/redesign the innovation.

3.3. MIRP Methodology

In this paragraph the research methodology of the MIRP will be described and how a number of steps in this methodology can be utilised for INNOSUTRA.

3.3.1 MIRP methodology framework

The framework of the MIRP studies is based on the definition of an innovation. The definition of an innovation process according to the MIRP researchers is:

"the invention and implementation of new ideas, which are developed by people, who engage in transactions with others over time within institutional context, and who judge outcomes of their efforts and act accordingly" (Van de Ven, Polley and Ventakaraman, 1999)

The core concepts used to observe an innovation according to the MIRP researchers are:

- New ideas
- People
- Transactions
- Institutional context
- Outcomes

The study consisted of a so-called longitudinal study. A longitudinal study is a study in which the required data to analyze is obtained by real time process observations. The research team started observing in 1984, the core concepts were observed until the end of the innovation. Most innovations were terminated or implemented by 1990. The analysis of the data could, then, be initiated. The analysis should conclude on how and why an innovation developed over time.

3.3.2 Comparison of MIRP and InnoSuTra in methodological approaches

In this paragraph the research methodology of INNOSUTRA is described. We describe this methodology using the other mentioned methodologies; MIRP, OECD and general qualitative study methods. First we will describe steps in the other methodologies and after this we will explain whether, and how, it is suitable for INNOSUTRA.

The MIRP researchers developed guidelines to perform their study. These commonly used MIRP guidelines in fieldwork are:

1. Specific innovative case selection

2. Process observation, data collection
3. Variables to describe innovation process
4. Identify and compare alternative innovation processes theory
5. Measurement and sequence analysis, data analysis

These guidelines will be explained in the following paragraphs, some are suitable for INNOSUTRA. INNOSUTRA will use the following steps:

1. Specific innovative case selection
2. Data collection
3. Data analysis
4. Key factors which describe the innovation process

To use these guidelines in INNOSUTRA we had to simplify and reduce the amount of work that was conducted in MIRP. As a consequence; we collect the data and do not observe the innovation process, we are not going to identify and compare alternative innovation processes theories, and we simplified the data analysis into qualitative data analysis (only using transcribed texts).

In volume 2, 1.2 we will show an example on coding qualitative data. The example used is presented in Coffey and Atkinson, 1996, “making sense of qualitative data”.

3.3.2.1 Innovation processes selection

The researchers of MIRP intended to study many innovation processes in different industries. They were interested in technical and administrative innovation because their aim was to produce a general innovation process theory. A variety in innovations made it possible to compare the cases with each other and find general conclusions. The MIRP researchers selected 14 different innovative cases, these included; technological, product, process and administrative cases.

INNOSUTRA is interested in the surface transport industry. For this reason we only select cases in the road transport, rail transport, maritime transport, inland waterway transport and intermodal transport. Our interest is related to technological, organizational, logistical and cultural innovations and to policy innovations/initiatives. We have chosen to preliminary analyze 60 specific cases. After this analysis a consultation meeting with experts in the industries reduced the amount of cases to 20 cases. These 20 specific innovative cases are studied in more detail.

3.3.2.2 Data collection

In MIRP, the researchers decided to study the specific innovative cases in real-time. They observed the specific innovative case from the beginning (the idea) to the end (termination). During the observation the required data, to analyze the specific innovative cases, was collected. The real time observation and data collection took almost six years. The researchers decided to observe the unfolding of the specific innovative case process in real time because they are convinced that studying the case after it terminated, when the outcomes are known, creates biases with the researchers. When researchers have knowledge about the outcome of an innovation they will tend to judge the process in a way that will fit the outcome.

INNOSUTRA decided to study the innovation process after the innovation is terminated. Real time data of the innovation process will be richer than data which is collected after the innovation process is terminated, on the other hand real time observation will take much more time.

The biases mentioned above have to be prevented. We will try to prevent biases of researchers by validating the study. Every researcher is controlled by another researcher; both guarantee that the study has been performed without biases.

3.3.2.3 Variables to describe innovation process and collect innovation process data

In the MIRP five variables are indicated to describe the innovation process, these variables are mentioned in the definition of an innovation. With these variables (people, ideas, transactions, outcomes and contexts) the process of an innovation is described, as previously recorded.

"The process of innovation consists of motivating and coordinating people to develop and implement new ideas by engaging transactions (or relationships) with others and making the adaptations needed to achieve desired outcomes within changing institutional and organizational contexts." (van de Ven, Polley and Ventakaraman, 1999)

This may be compared with the INNOSUTRA description of innovation

"*A technological or organisational (including cultural, including marketing, as a separate sub-set) change to the product (or service) or production process that either lowers the cost of product (or service) or production process or increases the quality of the product (or service) to the consumer"*

The difference lies in the external economic focus of INNOSUTRA and the internal sociological focus of MIRP. The two foci are not in conflict. The analysis of INNOSUTRA requires examination of the internal sociological process of innovation in each of the cases, e.g. the role of key players. The key players will be intrinsic and also extrinsic to the actual innovation process, particularly as the focus of INNOSUTRA is discovering the linkages between the intrinsic sociological and extrinsic mainlys economic, and 'political' factors that are responsible for the transmission of innovations within sectors.

At the start of the MIRP study the innovation researchers made general assumptions, based on literature from the past, about the variables. During the observation and analysis of the study these general assumptions seem to be incorrect or incomplete. The general assumptions and the real observations are mentioned in Table 1.

Table 1: MIRP assumptions and observations

	Literature implicitly assumes	But we see this
Ideas	One invention, operationalised.	Reinvention, proliferation, reimplementation, discarding, and termination.
People	An entrepreneur with fixed set of full-time people over time.	Many entrepreneurs, distracted fluidly engaging & disengaging over time in a variety of roles.
Transaction	Fixed network of people/firms working out details of an idea.	Expanding, contracting network or partisan stakeholders who converge & diverge on ideas.

Context	Environment provides opportunities and constrains on innovation process.	Innovation process creates and constrained by multiple enacted environments.
Outcomes	Final result orientation; A stable new order comes into being.	Final result indeterminate; Many in-process assessments and spinoffs; Integration of new orders with old.
Process	Simple, cumulative sequence of stages or phrases.	From simple to many divergent, parallel & convergent paths; some related, others not.

Source: van de Ven, Polley and Ventakaraman, 1999 page 8

INNOSUTRA draws general conclusions about the innovation process at the end of our analysis. General conclusion drawn from many different specific innovative cases will require one consistent description of the specific innovative cases. The goal of MIRP was to describe the innovation journey in a general way, while our goal is;

"to assess the conditions, including policy support, under which innovative concepts have a high chance of getting adopted and being successful"

To achieve our goal we should describe the innovation process of every specific innovative case in a consistent way, for this reason we should adopt variables, which describe the innovation process. These variables are related to the outcome of the MIRP studies, the innovation process theory. However, there will be external economic and 'political' factors that wree not considered by MIRP.

The data collection in INNOSUTRA was performed in a different way than it was performed in MIRP. To collect the data we use the methodology of Oslo Manual, guidelines for collecting and interpreting innovation data, OECD publishing. In this manual different ways of collecting data are presented in chapter eight. We use a questionnaire described in this manual to collect our required data. Before we could use this questionnaire we found the key players involved in the specific innovative case (work package 3.2). These key players should supply the required data about the innovation process of that specific innovative case.

To find the key players we searched from the end of the innovation process back to the initiation. It is easier to find the players involved in the implementation period of the innovation, and work backwards to find the players involved in the early development of the innovative idea.

After the identification of the key players involved in the innovation process we collected the required data to achieve our goals. We needed data of the entire innovation process, including the policy intervention initiatives.

This data was collected in two different ways, we used the existing documents on the innovations and we questioned the key players. The amount of existing documents in the innovation process will probably be very limited, as a consequence we will focus on questionnaire. There were different ways to collect data by questioning involved people; an open or structured interview, individual or focus group interview, telephonic or personal

interview. There were some practical considerations that had to be taken into account when we traded-off between these possibilities. Practical considerations like; travel expenses, the amount of key players involved and the data collection period is very limited. The goal of the interview was to find as much reliable and relevant data as possible, to collect background information an open discussion would be the most suitable on the other hand a telephonic open interview would be very hard to conduct. As a consequence we developed some guidelines how to perform the interview.

All of the partners in INNOSUTRA tried to focus on collecting the same data of the innovation process. This was very hard to perform without a data collection template (volume2, 1.3), this data collection template was developed using the variables of the innovation process, including the variables in the outcome of MIRP. The data collection template can be used as a topic list during the interviews.

Guidelines for interviewing;
1 An open interview with a topic list (to receive as much background data as possible).
2 A personal interview is preferred over a telephonic interview.

If the amount of identified key players allows a focus group interview, this is preferred. In a focus group interview there will be more discussion about the innovation, arguments (which we need) will be mentioned.

3.3.2.4 Data analyses in MIRP

MIRP researchers collected raw data during the process of a specific innovative case. They collected qualitative and quantitative data by a questionnaire, by interviews, they observed during innovation team meetings and other observations. This large amount of data was be analyzed without losing relevant data. A huge challenge was the transformation of these raw data into structured data that can be used to develop and test innovation process theories.

According to the MIRP researchers an innovation process theory should include statements about the temporal sequence of events. The temporal sequence of events should explain the stream of incidents during the innovation journey. For this reason they should distinguish between an incident and an event to make the process theory operational. According to the MIRP researchers an incident is; an observation or an occurrence (we would call this an activity). According to the MIRP researchers an event is not observable, an event should explain the pattern of incidents. Any number of incidents can form an event (we would call this a process).

The problem of measurement deals with transforming raw data into incidents, relate them and form events. Measurement in MIRP consists of;
1. Define a datum, and enter raw data into incidents.
2. Evaluate the reliability and validity of incidents.
3. Code incidents into qualitative events.
4. Evaluate the reliability and validity of qualitative events.

Sequence analysis deals with the problem to create a process theory of the innovation journey, this consist of;
5. Transform qualitative codes into quantitative categories.
6. Analyze temporal relationships in event sequence data.
7. Analyze temporal patterns or phases in event sequence data.

3.3.2.4.1 Define a datum, and enter raw data into incidents.

The raw data should be structured into a clear data file. Before structuring this data the MIRP researchers had to define a datum; the basic elements of information that should be presented when describing an incident. The incident that was described should be related to one of the five core concepts defined in the definition of an innovation; innovative ideas, people, transaction, context and outcomes.

MIRP researchers defined a qualitative datum as (1) a bracketed string of words capturing the basic elements of information (2) about a discrete incident or occurrence (the unit of analysis) (3) that happened on a specific date, which is (4) entered as a unique record (or case) in a qualitative data file, and (5) is subsequently coded and classified as an indicator of a theoretical event. (Van de Ven and Poole, 1990)

In other words each description of an incident should contain; the data of occurrence, actors involved in the incident, action that was performed (incident), the consequence of this action (incident), and the source of information. After describing all the incidents, the incidents were listed in a chronological sequence.

3.3.2.4.2 Evaluate the reliability and validity of incidents.

Transforming the raw data into an incident as performed in step one should be controlled. If this first step is not reliable, the outcomes of the study are not reliable. The MIRP researchers guaranteed the reliability and validity of the incidents by using two methods of testing. The first method contained two researchers, independent from each other, entering the same raw data into incidents. These two incidents were checked for differences, if there were any differences the researchers should change the incident until they both agreed on the incident. After this first test the chronological list of incidents was sent to key managers involved in that innovation process and they checked the list, the key managers supplied feedback about; missing information, misinterpreted incidents and so on. The researchers should change the incidents until everyone agreed on the incidents in that specific innovation process.

3.3.2.4.3 Code incidents into qualitative events.

At this moment the chronological list of incidents is not ready to analyze, the incidents are just qualitative descriptions. The MIRP researchers had to compare and analyze these incidents, for this reason a coding system was required, the researchers decided to code the incidents into meaningful events. To guarantee that no rich longitudinal data was lost the researchers developed a coding system.

Incidents were coded into multiple dimensions, if they coded an incident in one dimension, rich data would have been lost, e.g. if an action has influence on the outcome of an innovation project, it can at the same time have influence on the people involved and it can also influence the transactions in the innovation process. For this reason incidents should not be coded into a single dimension but into multiple dimensions. And again the coding system is based on the definition of an innovation according to the MIRP researchers, so the key dimensions were; ideas, people, transactions, context and outcomes.

3.3.2.4.4 Evaluate the reliability and validity of qualitative events.

The reliability and validity of incidents is important for a meaningful outcome of the MIRP study, so is the reliability and validity of the qualitative events. To guarantee this reliability and validity the researchers took some steps.

The first step was to create definitions for the events, these definitions were mentioned in meetings with all the participants in the research team, everyone should understand and think of the definition as logical definition. The second step was again to form a number of incidents into an event by two independent researchers. These two researchers should discuss their differences and find an event they both agreed on.

The third step was to ask the innovation managers to check the events for missing information, misinterpreted information and so on. These three steps should assure reliable and valid events.

3.3.2.4.5 Transform qualitative codes into quantitative categories.

The transformation of qualitative codes into quantitative dichotomous variables permits analyzing the time-dependent process with different statistical methods. The dichotomous indicators can be 1 or 0. When the indicator is indicated with 1 there is presence of this certain code of the qualitative incident. When the indicator is indicated with 0, the certain code of the qualitative incident is absence. The indicators mentioned in the bit map are of course related to the definition of the innovation process according to the MIRP researchers.

3.3.2.4.6 Analyze temporal relationships in event sequence data.

After creating the bit map it is possible to examine temporal relationships and patterns among all the different dimensions in the development of an innovation process. One way to examine these relationships and patterns among these events is sequence analysis. With these statistical methods the bit map can be analyzed, the outcomes are time dependent patterns of relationships among the innovation dimensions.

3.3.2.4.7 Analyze temporal patterns or phases in event sequence data.

The coding of incidents into qualitative events makes it possible to examine multivariate patterns in temporal sequence data. This can be done by a technique called; phase analysis. And is used by MIRP researchers to identify and compare development phases in temporal sequence data.

With this technique it is possible to develop and test models that produce hypotheses about the development of an innovation process. The phase analysis requires defining discrete phases before they can be analyzed in their sequence. A phase is defined as a coherent pattern from any number of events.

An example of this phase analysis is given below.

"So one phase for the five MIRP tracks might be "concept refinement," indicated by a change in some innovation idea, occurring at a meeting of three experts (people) engaged in discussion and conflict (transactions) during a period of low resources (context) and resulting in high tension and morale (outcomes). The phase would be indicated by the co-occurrence of this pattern (change in idea; experts; discussion and conflict; low resources; high tension and high morale) in a consecutive series of events." (van de Ven and Poole, 1990)

A phase does not necessarily define one coded pattern, but can define more coded patterns at the same time.

For example, "concept refinement" might be indicated by two patterns: (change in idea; experts; discussion and conflict; low resources; high tension and higher morale) and (change in idea; experts; discussion and conflict; influx of resources; high tension and higher morale). Either of these patterns would be recoded into the phase designation "concept refinement." (van de Ven and Poole, 1990)

3.3.2.5 Data analysis in INNOSUTRA

Qualitative analysis can be divided in two main steps; structuring the received innovation process data and interpreted the structured data. Structuring the received data can be described in eight steps while the interpretation requires one step. The method of analyzing qualitative data is extensively described in much literature. The reason to structure the data is to create a clear view on the subjects addressed in all the innovation processes. The comparison of different interviews and different innovation processes is easier. The structured data includes codes on all the received data; these codes mention the subject of that data. For comparison we can select one code (subject) and compare and conclude on the data with that subject. Structuring the data means that we prepare the received data and make it ready for analysis.

Two templates have been developed to assist in collecting and analyzing all the received data (volume 2, 1.3 and 1.4). The core labels mentioned in the following steps were already developed. They are called key aspects in the process description template. The labels mentioned in the following steps were already developed. They are called aspects to be considered in the process description template.

We decided to use a general methodology of how to handle the qualitative data and used "*basics of Qualitative research"* (Stauss and Corbin, 1998) and *"handling qualitative data"* (Lyn Richards, 2005). Every literature describing an introduction into qualitative research describes the following steps.

3.3.2.5.1 Transcribe the received information

The first step after interviewing is to transcribe all the received information. It is preferred to record all the interviews with audio equipment, this way no information will get lost. Transcribe the audio records into text records without modifying the information.

3.3.2.5.2 Sort received information on relevance

The second step is to delete all the information that seems not relevant to answer the research questions. In this step the amount of data will be reduced related to the relevance of the received data. The reduction of data can decrease the quality of the study or it can increase the quality of the study. Depending on the deleted data, for this reason it is important that data which seems not relevant should be kept in separated documents, as a consequence no data will ever get lost.

3.3.2.5.3 Split relevant information into fragments

During the third step we will follow some guidelines to split the information into fragments;

- In every fragment only one subject is treated.
- Each fragment should be readable and understandable without knowledge about the context of the interview.
- Fragments can overlap each other.
- When there are any doubts about a fragment it is better to put together two fragments than treating the fragments individually.

In the data collection and process description template the boxes that are filled out refer to these fragments.

3.3.2.5.4 Labelling

The goal of labelling is to reduce the study material in a useful way. We are going to grant names to the fragments. This step will be performed using the following guideline;

- Search for a name (label) that characterizes the text fragment. This label has to be relevant to answer the research questions.

- Each fragment can be granted more than one label, as a consequence little pieces of the fragment can be labelled as well.
- Don't use too many labels; the labelling should reduce the study material.
- The labelling has to tell something about the innovation process.
- Variation of the label is a requirement.
- In the label of a fragment all the relevant aspects of that fragment have to be recorded.
- Every participant should continue labelling the text fragments until no new labels occur.

These labels are mentioned in the process description template, they are called aspects to be considered.

3.3.2.5.5 Ordering and reduction of labels

In this step we organize the text fragments using some guidelines;

- Indicate the most characterizing label (the core label) of each fragment.
- Put together all the labels with the same characteristics.
- Try to find the dimensions (e.g. a dimension of inland transportation is a vessel) of each characteristic and if possible identify the different loads (e.g. a load of a vessel are different kind of vessels, like tankers, container vessels and so on) mentioned in characteristics.
- Put together all the characteristics with their dimensions and check if there are no characteristics that overlap each other.
- Overlapping characteristics have to be put together in one label.
- Check whether the labels with their dimensions are relevant for answering the research questions and delete the ones that are not relevant.

3.3.2.5.6 Validate the labels

A very important step in this process is checking whether the labelling system is also suitable for new information in an equivalent innovative process. We developed the labelling system in the first innovative case and validated the labelling system in the second innovative case. It is important to identify if the labelling system covers the second innovative case as well. If the labelling system does not cover the second innovative case, we have to adapt the labelling system. When the adaption contains a fundamental adaption we should check this adaption at a next innovative case. In validating the labelling system we checked whether the labelling system is suitable for any innovative case in the surface transport industry.

3.3.2.5.7 Define the core labels

After we identified the most characterizing label, the core label, we defined them. The definition of the core label should clearly mention what the core label means. The core labels are already mentioned in the process description template, they are called key aspects.

3.3.2.5.8 Validate the structured data

In this step we validate our structured data, we perform this step with help of independent researchers. The main question that had to be answered is: "do the analysis of the data, when it will be performed by another researcher, result in other outcomes?". Another researcher was asked to divide parts of the transcribed text into fragments and label these parts of the text. If there were differences between the two researchers they had to discuss their differences and find a solution for the differences.

3.3.2.5.9 Answering the research problems

This step is divided into two steps, first we described the innovative case and second we explained why an innovative case unfolded in the way it did. The description of the

innovative process in an innovative case will be performed in a chronological manner. To explain the unfolding of the innovative process we have to study links between the labels.

This approach secures the consistent methodology despite the different team members.

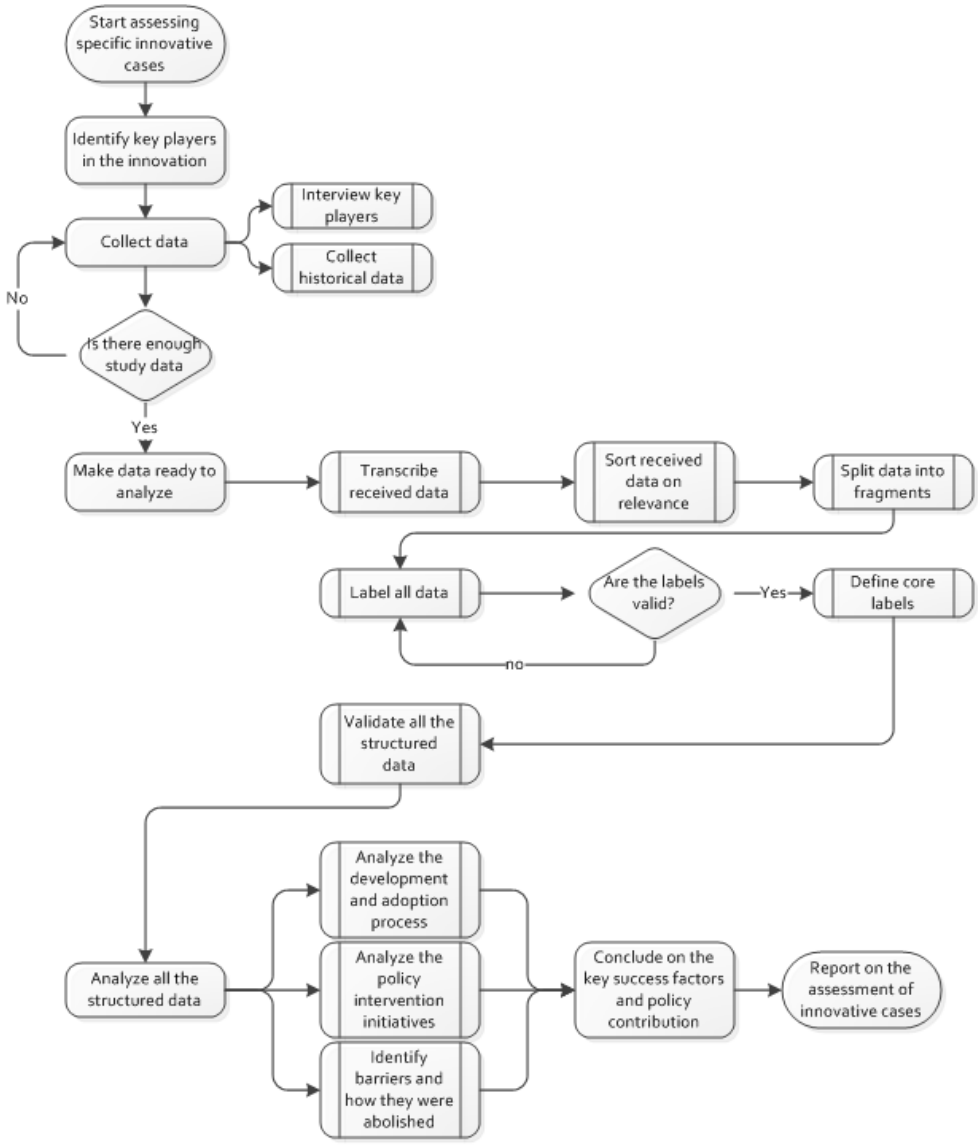
3.3.2.6 Example of coding qualitative data

Presented in volume 2, 1.2 is an example of coding qualitative data. This is a copy of literature from A.Coffey and P. Atkinson; "Making sense of qualitative data". In this example we will show which steps in coding the data will be performed in INNOSUTRA.

3.4. Brief description of INNOSUTRA methodology

Using a flowchart, Figure 2, we will briefly describe the methodology developed for work package 3 and 4. The reason for summarizing the methodology in a flowchart and briefly describe it, is that the methodology will be clearer when you will read the following paragraphs with reference to the more extensive methodology description set out above.

Figure 2: Flowchart Methodology



Step 1: Start assessing the innovative cases.
During the assessment of the innovation processes we need to bear in mind that there is a difference between the initial adoption of an innovation case and the (possible) application of that innovation case in other firms in the sector. it will be important to study the various applications/adaptations of the innovation and compare the adoption and implementation process withinin the industry.

Step 2: Identify the key players in every innovation process.
Key players should supply the required data about the innovation process of that specific innovative case. To find the key players we should search from implementation to initiation.

Step 3: Collect research data
The research data is going to be collected in two different ways; interviewing and historical data. The required data for INNOSUTRA is data about the entire innovation process and policy intervention initiatives. As a consequence there is a lot of research data required to perform our study, for this reason we produced two templates, one data collection template (volume 2, 1.3) and one process description data template (volume 2, 1.4), which will assist in analyzing the data. In these templates a list of aspects related to the innovation process is mentioned. These aspects will be the important elements on which we have to focus during the data collection. These elements are addressed during the interviews with all the different actors, as a consequence this template can be used as a topic list during the interviews.

Step 4: Make data ready for analyses
When all the research data on the innovation process is collected we need to structure the data to identify linkages and causes in the process. Coding all the received data is a suitable method for structuring the data. First we need to transcribe all the raw material from the interviews. After that the data will be checked for relevance, irrelevant data can be deleted. The sorted data need to be split up into fragments, fragments are parts of text with the same subject. Labelling the data will be the next step, the label is the subject dealt with in that fragment. One fragment can deal with more than just one subject if there is no ability to split the fragment up, as a consequence the fragment owns more than one label. The core label of that specific fragment has to be identified. The structured data is now ready to be analyzed.

The process description template in volume 2, 1.4 can help us coding all the data. The template already mentioned all the aspects that have to be addressed during interviews or other data collecting. The key aspects will be the core labels, and the aspects to be considered will be the labels. There will be many more unexpected relevant data with an aspect not mentioned in the template while interviewing, the templates are guidance for interviewing.

Step 5: Analyses of all the structured data
The analyses of the structured data is split up into; analyses of the development and adoption process, analyses of the policy intervention initiatives, and the identification of barriers. The required data for these analyses can be put together with help of the structured data, the subjects related for analyses can be selected and the data will be sorted on subject in the process description template (volume 2, 1.4). We have to find linkages in the data to be able to describe the innovation process. We have to describe how and why the innovation process did unfold in the way it did. With this description we will present the key success factors and the contribution of policy in the innovation process.

Step 6: Conclude on the key success factors and policy contribution

When the key success factors and contribution of policy is known we have to describe this. From our description it is clear how these factors and policies influence the innovation process.

Step 7: Report on the assessment of innovative cases
The outcomes of the previous six steps are put together in one document for future analyses.

4. Development of Analytical Approach per Task

A consistent approach between all the partners in INNOSUTRA was developed. Only with a consistent approach different specific innovative cases can be compared. For this reason, every sub work package or task has a partner responsible.

4.1. Identification of Key Players/Actors Involved

4.1.1 Principal Objective

The main aim of this Task is to identify the key players/actors in the innovation process. It will entail establishing a generic approach to their identification to ensure a comprehensive and consistent approach by all partners when analysing the specific innovation case processes. However, the actual key players are determined by the nature of the specific innovation process. Hence it was important to define the roles (which may be attributed to one or more particular actors) fairly widely so as not to exclude actors that may have a key role in relation to the specific innovation involved.

Previous research, e.g. the MIRP, has established the key roles that certain players have in the total innovation process/system. We attempted to identify these key players, i.e. those relevant to the innovation process in the industrial sectors examined, both within firms and external to firms, and also those players with the ability to remove barriers, such as governments. This latter group is important because they are responsible for ensuring that socio-economic considerations play a part in the spread of innovation.

However, before attempting to identify the key players, it was first necessary to establish – in relation to the INNOSUTRA focus and objectives – the roles of the key players whose activities are principally extrinsic to the firms involved in the innovation process, as well as the actors within firms, who acted as initiators of innovations and, potential acceptors of innovations. Indeed, in assessing in INNOSUTRA the rate of spread of innovations the role of acceptors of the innovation is a critical element in the innovation process.

4.1.2 Influence of INNOSUTRA Approach on the selection of Key Actors' Roles (Private commercial innovations).

Clearly the overall approach had an influence on the selection of the key actors. It is these actors who could be elicited the further detailed information that is required to expand our preliminary analysis and take forward the tentative conclusions reached in the first phase of the project, supplemented by the views of the outside experts at the Consultation Meeting in April 2010.

As we were approaching the detailed analysis, at least initially, from the viewpoint external to the sectoral firms involved then the key actors will be similarly approached and designated. However, it was necessary to structure the collection of key actors along a line that starts from the initiation process, as this is the first stage of the total innovation process (the 'innovation journey'). It is here that is established the set of ideas that form the initial conception of the innovation involved. These ideas could take various forms and involve invention, modification, discarding, or any other suggested change in process, product, or behaviour. The line or spectrum of the innovation process then mapped the spread of the innovation as it moves across the sector and is adopted by more firms.

There were key actors at all stages of the innovation process. To facilitate contact it was necessary to divide the innovation process/system into a number of discrete steps. This does

not mean that the process is a linear one as there are likely to be overlapping steps in the process and a number of feedback loops. Moreover, some steps will 'elide' into each other. However, it was possible to identify, without fatal ambiguity, the individual steps, and hence the groups of actors, involved.

4.1.3 Identification of Key Actors and their Roles

4.1.3.1 Initiation

We started with the initiation stage of the innovation journey (defined as above). Then we were able to identify the individual or team (formal or informal) and within the firm, or across the trans-firm boundary with external actors) responsible for starting the specific innovation process. In INNOSUTRA, we are not principally concerned with examining the initiation stage, except insofar as it may influence the rate of transmission of the innovation across the sector. As far as INNOSUTRA is concerned some examination is required, however, of the proposition that external (to the firm) private public research organisations may be involved in initiating the innovation.

From the viewpoint of INNOSUTRA, the key actors that are likely to be involved in the initiation stage are those concerned with maintaining or improving the competitiveness of the firm. These may be concentrated in an R&D Unit in a particular firm. Alternatively they may be in a research association of firms in the sector, e.g. rail. They may also be in a private organisation such as a university involved in sponsored or independent research for the sector concerned.

4.1.3.2 Dissemination and Prototyping

The next, dissemination stage is likely to involve some financial and resource commitment to take forward the ideas generated in the initiation stage. It is likely to involve some prototyping. This may be conducted in a special group or less formally. It may also be the case, for instance when the innovation is initiated outside a firm, that the prototyping may be viewed by a number of firms together.

From the viewpoint of INNOSUTRA, this process, wherever conducted, is a crucial one. For instance it is a factor reducing uncertainty in relation to the impacts of the innovation. Demonstration of the technological or organisational benefits of an innovation, in the context of the firm or firms involved, is likely to be a key element in judging whether to go further with the appraisal of the innovation. The person or persons responsible for this stage of appraisal/evaluation will be key actors/players the decision to adopt or not to adopt the innovation. Their role and level in the organisation will be critical in determining the level of acceptance of any recommendations made to higher management and in any subsequent financial appraisal.

4.1.3.3 Investment Appraisal

Assuming that the prototyping stage is successful, and the innovation is regarded as technologically or organisationally sound and appropriate, then the costs and anticipated financial benefits of any further development or implementation of the innovation will need to be estimated. At this point the 'host' organisations financial framework for investment will enter the process. This stage – financial or investment appraisal – will probably be the final crucial decision as to whether or not to implement the innovation

From the viewpoint of INNOSUTRA, this stage needs to be examined carefully as not only is it likely to be the definitive internal firm decision process, but any external intervention from public policy will be at this stage, to reduce the costs of implementation as barriers to adoption and implementation.

Normally, this financial appraisal will be carried out by the finance department of the firm against a set of predetermined rules. In effect these rules will set the length of the payback period and the internal rate of return on the project (whether or not to adopt the innovation). Often these rules are set without any flexibility to adjust them, but nonetheless some adjustment may be possible. There are three ways in which adjustments might be introduced. First, it may be argued that innovative projects per se should not be set as strict a financial regime, in terms of the level of the internal rate of return and the length of the payback period as those of conventional company investments. Alternatively though the class of innovative investments is not seen as meriting the application of different financial criteria the particular innovative investment may be regarded as being of such potential benefit as to be permitted some relaxation of the financial rules. Finally, it may be that the innovation may qualify for public support under some existing grant or bonnified loan scheme (e.g. from the European Investment Bank).

4.1.3.4 Adoption and Implementation

This stage of the innovation process is important from an INNOSUTRA perspective for two reasons. First, it is likely that any innovation may have characteristics in relation to its adoption and implementation that are peculiar to the operations of the host organisation. It may be the process of implementation of the particular innovation in one organisation make possible a lower rate of return than in another, albeit similar, organisation. This could include extra resources having to be devoted to training or to the recruitment of costly specialist labour. (From an INNOSUTRA perspective this phenomenon may reduce the likelihood of the spread of the organisation across the sector). However, this may well be a role which generic key players may be able to perform.

Second, the implementation of the innovation may take considerable time and of itself this may slow down the innovation, even to an extent that the adoption across the whole sector is made redundant by other factors, e.g. some economic constraint or a different innovative process being introduced in other parts of the sector. Also innovations that are led from a top-down approach may encounter significant problems at ‘shop-floor’ level.

Those players involved in the implementation are likely to cover a range of specialism’s, e.g. engineers/technicians, production managers, and human resource managers. In the case of the implementation of marketing innovations the sales and marketing departments will be involved. Indeed it is likely that whatever innovation is introduced its impact of the products of the organisation will have marketing and sales implications. Given that the intention of the introduction of any innovation is either to reduce costs or improve the product the impact on the goods and services provided by the organisation will need to be brought to the attention of the customers.

4.1.4 Public Policy Innovations/Initiatives

This category of ‘innovations’ has to be treated in a different manner than the private commercial innovations. These initiatives are generally introduced to adjust the accounting costs and benefits presented in the market situation to firms. The aim is, by taxes, subsidies, laws, regulations, codes of practice (including standardisation), or marketing initiatives, to

modify the behaviour of the firms in the market in line with the calculated net socio-economic benefit (essentially based on a socio-economic cost/benefit analysis).

In our initial research it seemed that the calculation of the net benefits was inadequate in a number of cases. (See PIR Report D2.1). The key actors here will include policy makers, e.g. in national governments and in the European Commission or, in some cases other EU bodies (e.g. the EIB). The group will also include a variety of lobbying organisations representing the industries involved and other interested parties, e.g. environmental groups.As it is the response to the introduction or proposed introduction that is a determining factor in the success or failure of the initiative then key players here are likely to be the various industrial representative organisations.

4.1.5 Identification of key players involved

Having identified the key actors, or at least their roles, in principle, there may be problems in contacting them in practice. For instance, in the initiation stage it may be very difficult to contact the persons involved. It may be necessary to work backwards and discuss with those involved in the step next to the initiation stage. It may be that such indirect contact may be sufficient to identify the key actions of those who initiated the innovation.

It may further be the case that some actors will have played more than one key role in the process. This is certainly likely to be true of middle management personnel. Hence, the interviews should bear in mind the different roles being played by, sometimes the same persons.

4.1.6 A Common Aide-Memoire for Interviewing the Key Actors

The interviews should allow for open-ended discussion to elicit as much background information as possible. However, to facilitate the statistical analysis of the results, it will be useful to have as the core of the interviews a structured template.

The Annex to this report provides this aide memoire template. The ‘template’ has deliberately limited to 10 questions only to be answered. The aim of the questions is to obtain the following relevant data across the various sectoral innovations to be examined. This is indicated below.

- The organisation and position of the person being interviewed
- How is the innovation classified, e.g. technological, organisational, etc. And how much re-organisation was involved (ask to score out of 10)
- When was the innovation started and where and what are the positive and negative impacts of the innovation (ask for scores out of 10)
- The precise role, or roles, of the person in relation to the innovation
- The impact on the spread of the innovation claimed by the person
- The formal reporting links of the person within the organisation they are working for
- The informal relationships of the person with other key actors in the innovation process
- The positive experiences of the person interviewed in relation to moving forward the innovation process, e.g. support from senior management
- The difficulties experienced by the person in performing the role ascribed by the person in relation to the innovation process, e.g. barriers (ask to score the difficulty of the barriers out of 10)

- How the role may be redefined and/or supported to enhance the innovation process

4.2. Approach to Analysing the Development and Adoption Process

4.2.1 Principal Objectives

The objective of task 3.3 is to analyze the development and adoption process. The main aim is to develop a consistent approach to be adopted by all partners in INNOSUTRA when analyzing the development and adoption processes in all the individual cases.

Previous research (the MIRP) has described a generic innovation process (e.g. innovation process). In this process many activities did occur, these activities do not follow a linear path, but they do occur in feedback and feed forward loops. We will describe as many individual activities in every innovation process and analyze the outcome of that activity. With help of the identified key players (work package 3.2) and the present historical data we should first identify every activity in the specific innovation case.

Before we are able to identify every activity in the innovation process we should first identify which kind of activities frequently occur.

4.2.2 Activities in the innovation process

The unfolding of the innovation process will occur in many steps. For our analysis we identify these steps. This does not mean that these steps should follow a linear process, in reality these steps will occur in feedback loops, feed forward loops and they will overlap each other. For this process we shall again use the MIRP approach, the steps mentioned in this process are general steps. These steps are observed in most of the innovation processes, but they are not complete, every innovative process is unique. In real life there are many steps more in the innovation process, for this reason the innovation journey in MIRP should be seen as a guideline in identifying all the different steps. When studying the INNOSUTRA cases there are more or less steps in every specific innovative case;

The common elements in the innovation process according to the MIRP are:

4.2.2.1 Initiation period

- An extended gestation period lasting for several years in which seemingly coincidental events occurred that preceded and set the stage for the initiation of innovation.
- Concentrated efforts to initiate innovations are triggered by “shocks” from sources internal or external to the organization.
- Plans are developed and submitted to resource controllers to obtain the resources needed to launch innovation development.

4.2.2.2 Development period

- Initial innovative ideas proliferate into numerous ideas and activities.
- Setbacks and mistakes are frequently encountered.
- Criteria of success and failure often change, differ between resource controllers and innovation managers and diverge over time, often triggering power struggles between in- and outsiders.
- Innovation personnel participate in highly fluid ways. Personnel participate in part time jobs, high turnover rates. High turn-over rates frequently occur due to emotions during the

innovation process (euphoria in the beginning, frustration in the middle and closure in the end).

- Investors and top-managers are frequently involved in the development process.
- Innovation development entails developing relationships with other organizations.
- Innovation participants are involved with competitors, trade associations, and government agencies to create an industry or community infrastructure to support the development and implementation of their innovations.

4.2.2.3 Implementation/termination period

- Adoption and implementation occurs throughout the development period by linking and integrating the "new" with the "old" or by reinventing the innovation to fit the local situation.
- Innovation stops when it is implemented and institutionalized. In other words when the innovation in not an innovation anymore but considered as common practice. Or it stops when resources run out before the innovation is completed or redesigned. Investors/top managers make judgements about success/failure. These may be misapplied, but will influence the fate of innovation and sometimes the careers of the participants in the innovation process.

4.2.3 Data Collection and Analysis

In the work plan for WP3 and WP4 the data collection process and data analysis process is described. To ensure a consistent approach by all partners and to simplify the work that has to be carried out during these processes two templates have been produced. One template is used to collect all the required innovation process data and the other is used to analyze all the innovation process data.

The main goal of the data collection template (volume 2, 1.3) is to streamline all the collected data in the time. The collected data exists of published articles, books, interviews etc. This template assists each partner in structuring the data during the data collection process, the data is related to management, organization, financial matters, market, government and culture. Managerial data is data related to the decision making process in the direct leading of the innovation process. Organizational data is data about the impact of the functioning of the innovation process, related to how the innovation process is organized and how well this organization is functioning direct related to the leading of the innovation process. This could be data like human resources, relationships between innovation entrepreneurs and joint ventures or partnerships. Financial data is data related to cost benefit analysis, investments etc. The cost benefit analysis is not only a financial matter, benefits can be related to; people, planet and profit. The data related to the market is data that describes the potential market, the reached market, the rate of adoption, marketing, etc. Governmental data is data related to the support of the government, subsidies, policies, regulations, etc. Cultural data is data related to communication, religion, sustainability, the environment, etc. In every aspect of the innovation process some examples of required data are mentioned here, this list is far from complete and arbitrarily chosen. In the data analysis template the aspects that should be considered are mentioned.

The chronological sequence in the data collection template is a sequence in which the aspects occurred during the real innovation process. In the boxes every partner had to fill out the publication data, publication title and author of the publication or the source of the collected data. One publication can overlap more aspects of the innovation process, in that case the publication should be filled out in all the overlapping aspects. Filling the data out

into a template in a chronological sequence gives us the opportunity to observe the speed and rate of the spread on the innovation.

The process description template (volume 2, 1.4) is a template that will assist in analyzing the collected data on the innovation process. In the MIRP studies the research team noticed the following three main processes: the initiation process, the development process and the implementation process, these processes can be divided in sub processes according to the generic innovation process theory like idea evaluation, adoption etc. These main processes and sub processes are mentioned in the process description template. Areas of attention related to the main processes based on previous research like MIRP are mentioned in text blocks above the main processes. Every publication or interview probably addresses more aspects than just one, as a consequence it will be difficult to find all the data that addresses one aspect of interest. For this reason we follow, in a simplified way, the method of ordering and structuring the collected data mentioned in the work plan;

1. Split relevant data into fragments.
2. Labelling of fragments.
3. Define the core labels.
4. Describe the actual innovation process.
5. Analyze all the different aspects in the innovation process.

In the first step we split interviews and publication into fragments, these fragments should address one aspect mentioned in the process description template. The labelling of the fragments is mentioned in the template, these are the aspects to be considered. The core labels are the main aspects mentioned in the process description template. If these fragments are filled out in the right process (right box in the template) than the description of the innovation process will be an extract of all the presented fragments. The analysis of the innovation process is now simplified to the comparison of fragments related to one aspect, as a consequence we will be able to conclude on: the success factors, barriers and the policy support during the innovation process.

4.3. Policy Intervention Analysis

Innovation is a key factor for the competitiveness of all European member states in a complex and interdependent world with new emerging economies in China and India. In the field of transport, this question is crucial as Europe is largely dependent on exports and imports – and hence indirectly on transport infrastructure and operations. But also the European Union is a very dense country based on a historical and spatial mix of cities, industrial activities and plants, rural areas and hence extensive transportnetworks. As shown in the OECD Transport Forum (Leipzig, April 2010), in the transport sector, today, innovation relies less on speed increase or technical change, but rather on issues of seamless transport interconnections and the key role of information.

As it has been often shown in the economic literature, innovation rarely occurs alone but needs policy intervention and often in an extensive public context. The emergence of the Internet is one of the main examples of large public support to a new information infrastructure, used among others by transport operators and infrastructure managers..

Based on and linked with our cases studies, this task assesses the emergence, implementation and impacts of different public policies that have been implemented with respect to innovation, and what impacts they can have in a middle and long term perspective. The analysis is mainly focused on success and failures presented in the the other WPs, especially starting from the templates that have been developed.. Starting from a static perspective (definition of the state of the art), we suggest a prospective and auto-reinforcing perspective (ex post evaluations linked to ex ante recommendations).

4.3.1 Definition and state of the art policy intervention to support innovation

We have first to distinguish between normative recommendations and the positive organisation of policy actions. If the European Union is playing with the PCRD a key role for initiating and financing large research program (and INNOSUTRA Project is for example part of this), framework of research and active participation of research team is mainly occurring at national level. Some local or regional intervention could exist but are less important than the national framework: for example evaluation of research is often managed at national level in the main European countries! Even if this "national" framework is the key player, it could be interesting to investigate the level of government – European Commission, central, regional, local - involved in policy actions. Sometime, public-private partnerships are also involved and it would be interesting to evaluate this action. According to the role that the competent authority may assume, the impact may be different: positive, neutral or negative. One of the aims of INNOSUTRA Project is then, in applied innovative cases, to find positive effects but also negative effects of synergies between actors and level of government involved.

Starting from this point, we consider actor roles and then analyze policy intervention and its impact for the selected cases.

1) *First*, we consider the emergence of innovation: we suggest identifying, in different templates and case studies from our partners, the typical breakthrough and triggers during the different innovation phases:

Within this perspective, we develop the methodology based on the stages of (transport) innovation: initiation period, development period or implementation/termination period. We may then discover which factors during which stages contribute the most to the innovation process in the various transport sectors. These factors are described in section 4.4.2.The methodology is presented in volume 2, 1.9.

Innovation often faces opposition through barriers or defensive behaviours. Barriers against innovation are also playing a key role:

1. Lack of awareness of available information.
2. Regulatory and legal barriers: legal and institutional barriers, liability issues, administrative and organisational structures, protection of intellectual property rights.
3. Technical barriers: lack of interoperability and interconnectivity between modes, lack of standardisation and certification.
4. Financial and commercial barriers: insufficiency of innovative financial mechanisms, lack of incentives to encourage innovative concepts, market imperfections, lack of competition in a mode or in a given market.
5. Societal barriers: lack of qualified manpower in certain fields of transport, insufficient acceptance of certain innovations.
6. Decision making barriers: the lack of comprehensive and co-ordinated action towards the resolution of the mobility problem, fragmentation of levels of decisions.

These barriers for innovation are described in section 4.4.3.

2) *Second*, we consider the policy analysis side for supporting innovation It is possible to observe in the selected cases the policy interventions (see WP 3.4) and then to fill out the relevant template (see table 1.5 in volume 2).

The tables 1.5 and 1.6 in volume 2 aim to identify key points on each case. Each cell has not to be filled out, but the main collected cells could be inputs for further research.

Failures, very often, occur when only one dimension, mainly technical, has been taken into account. Sociological approaches of technical change (B. Latour, M. Calon – Ecole des Mines de Paris) will be useful here to understand how engineer's rationale is at once necessary, but not sufficient. It is also important to determine what the key agents are because they are the key to success. Once again, our tables aim to identify key points on each case. Each cell has not to be filled out but the main collected cells could be inputs for further research.

The template in volume2, 1.8 integrates this methodology in a template perspective for our partners linked with their case studies.

But this perspective seems to be too narrow: if the link between technical research on one hand and, on the other hand, economic, social and political implementation is a key factor for explaining success or failures, it gives us few elements for policy recommendation, especially if we consider the large amount of public money invested in large projects. We need then ex post evaluation for an ex ante positive "recommendation". Facing the "charm of pure technological change". Appropriation of these innovations by politicians, key decision people, industrialists, lobby groups but also the population (see NIMBY or Not In My Back Yard behaviours) is often explaining the orientation towards success or failure.

It is why we suggest a wider, more integrated perspective.

4.3.2 Integration: ex post evaluations and ex ante recommendations

This part is also integrated in the template we suggest in volume 2, 1.8. With this part, we asked to stand back in order to assess the different policy interventions observed and listed in part 1:

- What are exactly the objectives of these innovations?
- At the end, who are the winners and who are
- the losers?
- Can we see underlying strategies of some actors after a long process of innovation?

First, we should try to redefine the definition of a large project (see the literature on mega projects). The work of N. Curien (in N. Curien, "L'économie des réseaux", 2005) and the economics of networks (see paper from Nicholas Economides. 1996 ; Shapiro C., Varian H., Information Rules: A Strategic Guide to the Network Economy", 1998) opens the black box of infrastructure: for instance, by defining transport infrastructure in a three ways: infrastructure in a narrow sense (the physical network), info structure (communication/control of the infrastructure's system) and associated service (call or data for telecommunication).

These results of network economics help us to investigate the reasons for success/failure. The preliminary strategic context requires definition of the problem area. Is the problem at the level of the infrastructure or at the level of info structure or at the level the associated service?

The "Public Goods School" (J.M. Buchanan, G. Tullock and others) often analyse public decisions in this way..

In a second approach, we could refer to the 'toolbox of the sociology of innovation' (M. Callon, B. Latour) to show the "actors of the game" (lobbyists, politicians, industrialists ,…) and the "reinforcement" process of failure or success (See the concept of "Negative Feedback" (Failure) and "positive feedback" (Success) in C. Shapiro and H. Varian, Information Rules: A Strategic Guide to the Network Economy", 1998). There are many

elements that are sometimes neglected in large projects: e.g. estimated level of demand, building costs, level of return on investment,…), and a clarification of the definition between public goods and private goods,... In this framework, managing information is a key element in today's transport economics.

Finally, we then need a tool box for recommendation of further projects in a prospective way. Public money is becoming scarce and history of transport economics is showing questionable large public spending in mega projects or large transport infrastructure.

We need an ex-ante evaluation framework for the innovation projects to be developed. In this we should move from pure technical questions and look more widely and in an integrated fashion at all elements and the private and public risks of any innovation involved.

We suggest then an ex-ante tool box for an optimal policy recommendation based on stress tests for transport innovation in the same way as banks have developed stress test to analyse the risk in their assets and liabilities.

Stress tests (see volume 2 1.7) is a form of testing the aggregate coherence of a transport innovation – mainly for a large infrastructure or for a real and impacting innovation – to determine the stability of the transport system, mainly in a socio-economic perspective: i.e. breaki-even financial points, following change in demand and supply, impact on congestion, stability and continuity of transport services, external factor shock, extreme events, etc,…

To sum up, it would be an interesting idea, at the end of the policy innovation template, to try to take all elements into account and simulate the associated risk with a stress test approach. This work involves adegree of complexity and its full exploration should be reserved for consideration in WP5. However, some elements may be possible to explore in WP3/4. It would include:.

- What needs are to be satisfied? Level of demand before and after transport innovation. Why demand should increase after transport innovation and why demand might have not increased after such an innovation (stress test on demand).
- Balance sheet of losers and winners facing public decision both on demand and supply side.
- What type of actor game behind? Who needs this project, who has interest in it? See the concept of "green washing", it means promoting a misleading perception that a company's policies or products (such as goods or services) are environmentally friendly. The question relates to non-transport issues too.
- Who will cover the costs of building, managing and promoting the project? Stress test for example to be developed here: who will pay (taxpayer, financial markets, private operators…) if a large transport innovation is not working properly or was overestimated in terms of demand?

The table 1.7 in Volume 2 tries to sum up the question in a prospective analysis. The first part of the table lists the selected indicators: before (existing infrastructure); estimated results (forecast, planning, projected data) from experts / advisors/ planning agencies ; real operation, up to date data.

In the right part of the table, we try to develop a stress test facing transport innovation based on a change of traffic for example… This can be may be analysed in a more qualitative way.

This methodology is not to be applied to all transport innovations (project infrastructure can be particularly interesting from this perspective

4.3.3 Policy analysis template

In order to build an accurate analysis of the impact of European public policies on innovation processes, it was proposed to each partner to select an appropriate case of innovation and analyze it regarding the issue of public intervention.

The template in volume 2, 1.8 is made of two parts. The first one deals with the general process of public intervention on innovation, depending on country or mode. Consequently, it was asked to briefly present the general national framework of intervention according to the origin of innovation and country.

In the second part, participants were asked to define the selected innovation and the specific public intervention that it benefited from.

4.4. Key Success Factors

4.4.1 Principal Objective

The main aim here is to see if there are patterns and paths in all the innovative cases considered. In general, innovation often takes place in a complex dynamic system and small events may have enormous consequences (Arthur, 1994). Furthermore, innovation is characterized by path dependence among events. The consequences and problems of the introduction and implementation of an innovation grow larger as the number of different actors, activities and technologies grows larger, in other words, if the system repercussions are greater (Van der Geest and Heuts, 2008).

As a consequence we combine all the aspects analysed in this WP3 – namely actor actions and relationships in all the phases of innovation process (WP3.2); the Key Performance Indicators (KPI) from the adoption and development process (WP3.3), and the policy framework encompassing the innovation process (WP3.4) – in order to provide an objective view of the entire innovation process, and to formulate some conclusions..

Previous research, e.g. the studies in the area of sustainable transport realised by Van den Bergh et al. in 2007, have established different categories of factors governing success and failure in innovative processes/systems. We shall attempt to identify these categories of factors and evaluate which ones determine whether a project is a success (or a failure).

Thus, before formulating final conclusions for all the case studies, it will first be necessary to establish – in relation to the INNOSUTRA focus and objectives – the factors that contribute to the success of an innovation, as well as the existing and potential barriers to innovation process. Moreover, an analysis of policy interventions and impacts will also be conducted to ascertain if and how such interventions have been introduced and their impact, as reported by the key players and/or by retrospective analysis of the cases...

4.4.2 Identification of Key Factors for Success

A lot of factors can contribute to the success of an innovation. First it is important to define the categories of factors which determine the success or failure of an innovation.

We adopt the approach used by Banister (2004) and Van den Bergh et al. (2007) considering the following five categories of key factors:

- Technological factors: e.g., availability and complexity of the required knowledge and expertise, availability of complementary technologies, compliance with technical standards.

- Administrative and legal factors: e.g., compatibility with current regulation, fitting in with existing procedures, consistency with legislation, and (lack of) clarity about division of responsibilities and competencies.

- Political and process-related factors: e.g., existence/lack of necessary institutions to implement the innovation effectively or efficiently, the role of interest groups, the distribution of political power, and the time horizon (short- versus long-term) of politicians.

- Socio-cultural and psychological factors: e.g., involvement in and affinity with the project on the part of the stakeholders, perceived risks and interests of firms, consumers and civil servants, and degree to which drivers and passengers are asked to change their behaviour.

- Economic and financial factors: e.g., net benefits for actors (both specific key players and generic key players as indicated in WP3.3), availability of funding and subsidies, possible lock-in due to increasing returns to scale, expected influence on (international) competitive position, possibility of 'free rider' behaviour, and expected influence of the project on the regional and local economy (jobs).

Key success factors may be transport-specific or generic. General competition policy for instance may favour the development of innovative concepts.

We have reported the sub-categories of factors in the table 1.9 in volume 2. There are 3 sub-category to be ranked for each category of factor (1=min importance; 5=max importance), to take into account for the analysis of each case, during the three main phases of life-cycle.

According to the INNOSUTRA approach, the cases analysis is focused more on economic factors rather than the other categories of factors. However, these latter factors will be also included in the evaluation of the innovative cases. The final aim will be to provide a sound analytical basis for innovation policy development in the European Union, both for private and public actors..

In the following table the factors influencing each of the 25 cases (C1 to C25) analysed can be counted and evaluated a success or not yet a success (intermediate) (S or F or I). From the total number of the positive factors for S, F and I may be derived a final initial enumeration of the key factors for each case (see case 1; reported as an example of Success). However, this enumeration will require to be supplemented by an evaluation which scores the weighted factors and taqkes account of the fact that one or more of the factors identified may be critical in preventing the adoption of the innovation. .

Table 2

	Category of factor	S or F or I	C 1	C2	C 3	C4	C5	C 6	C7	C8	C9	C1 0	C1 1	C 12	C 13	C 14	C 15	C1 6	C1 7	C 18	C 19	C 20	C 21	C 22	C2 3	C2 4	C 25
number 0-10	Technological	S	2																								
		F	1																								
		A	0																								
	Administrative and legal	S	2																								
		F	1																								
		A	0																								
	Political and process-related	S	1																								
		F	2																								
		A	0																								
	Socio-cultural and psychological	S	2																								
		F	0																								
		A	1																								
	Economic and financial	S	3																								
		F	0																								
		A	0																								
	Total	S	10																								
		F	4																								
		A	1																								
	Overall S or F or I		S																								

4.4.3 Identification of the barriers hampering innovations

Innovations may be hampered by a number of barriers. There can be reasons that slow innovation activities or have a negative effect on expected results (OECD, 2005). Barriers can represent the cause of the failure of an innovation process and they can occur in different phases of the life cycle of the innovation (initiation, development, implementation/termination period).

In case of innovative successes, it is important to investigate how the barriers have been overcome and how this occurred. .

Barriers are often present in the innovation process in transport. However, the key players, especially, national governments overnment and the European Commission, can address these barriers and try to remove them. The High Level Group of the European Commission in 1999 did an investigation into the existence of barriers to innovation, as well as OECD in 2005. The following list of barriers to innovation reflects their approaches, and it will be used as a checklist (volume 2, 1.10) for the analysis in this WP3 and in the WP4, especially to check if they are or were present in the cases considered.

- Knowledge factors: e.g., lack of information on technology or on market, lack of qualified personnel (within the enterprise or in the labour market).

- Regulatory and legal barriers: e.g., legal, institutional and administrative barriers, protection of intellectual property rights.

- Technical barriers: e.g., lack of interoperability and interconnectivity among modes, lack of standardisation and certification, difficulties in adaptation to a new technology (van der Geest and Heuts, 2008).

- Financial and commercial barriers: e.g., insufficiency of innovative financial mechanisms, lack of incentives to encourage innovative concepts, market imperfections, lack of competition in a mode or in a given market.

- Cultural and societal barriers: e.g., insufficient acceptance of certain innovations, organisational rigidities within the enterprise (scarce attitude of personnel towards change and Inability to devote staff to innovation activity).

- Decision making barriers: e.g., the lack of comprehensive and co-ordinated action towards the resolution of problems, fragmentation of levels of decisions, coordination of problems among different actors

It is necessary to point out that the categories identified in the table 1.10 in Volume 2 are actual and existent barriers, instead of perceived barriers to innovation. Since the strategy used to overcome a perceived barrier to innovation may be different from that used against an actual barrier, it is important to know whether a particular barrier to innovation is real.

These barriers can be related to a specific type of innovation (technological, cultural, etc.) or to all types considered in this project.

4.4.4 Policy Intervention Analysis

Establishing whether policy intervention was involved and if necessary or not to the success of the innovation in terms of its adoption across the sector involved will be made via two approaches. First,

from the interviews, to ascertain the views and position of the key players. This will entail enquiring if the intervention was requested and if so by whom and for what reason. If the intervention was not requested what was the attitude to it of the key players. Second, by analysing the documentation concerning the case and indicating the nature of the intervention.. N.B. The conclusions related to all the innovation cases, analysed as above, are set out below in Chapter 5.

5. Conclusions on Successful Innovation Cases

When considering the innovative cases classified and analysed as successes in the previous paragraphs, they are equal to 9 out of the total of 23 cases (8 are "not-yet successful cases" and 6 are "intermediate cases").

A first observation is to note the differences per mode and type of innovation, shown in the following table of the innovative cases examined as "successes".

Table 3: Success cases analysed

	Road	Rail	Maritime	IWW	Intermodal
Technological	ITS: Variable Speed Limits (VSL)		Reefer containerisation	Information Technology in the inland navigation industry	Port Community System (PCS)
					Superfast Ferries (SFF)
Organizational		Eurotunnel			Freight Villages (FV)
Policy	EU Cabotage		Port State Control (PSC)		

As it is evident from the table, the majority of the successes is technological (5 cases out of 9), while the remaining cases are equally divided between organizational and policy initiatives. This means that private commercial or industrial innovations pre-dominate in terms of successful cases in comparison to policy initiatives, mainly public and involving a high number of stakeholders.

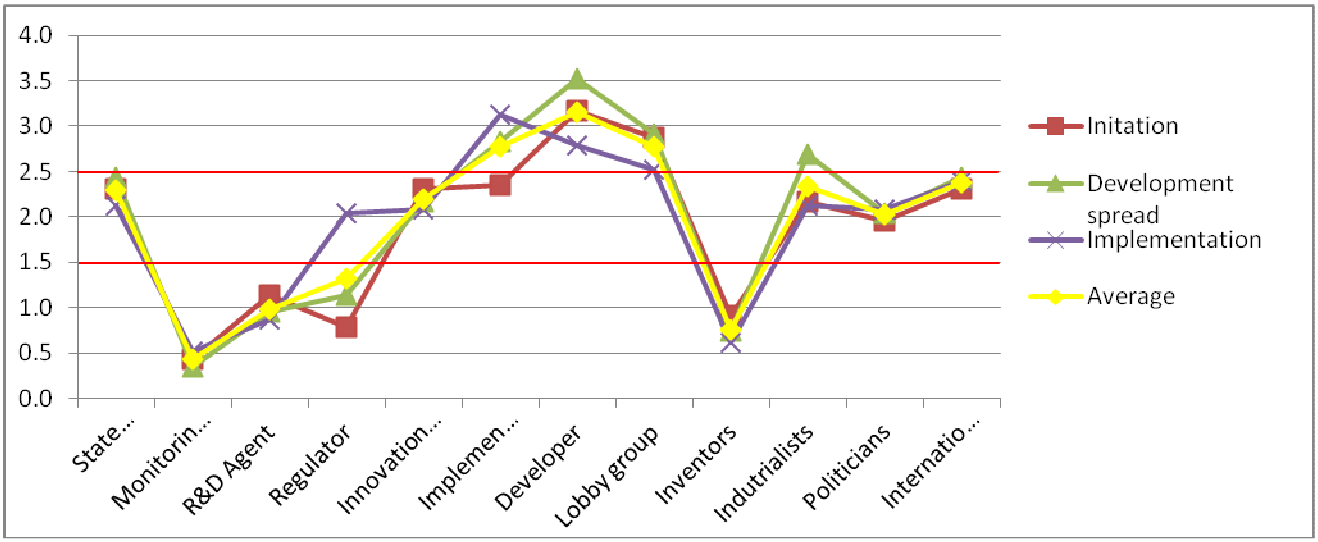
The majority of technological cases under consideration in this phase of INNOSUTRA derives from the weight given to such innovations in the experts' opinions provided at the Consultation Meeting held in Antwerp in April 2010.

5.1. General observations on the case studies

The purpose of this first analysis is to characterize the general field of the policy intervention by the identification of the actors most involved, and the types of policy most applied according to our 23 cases.

Concerning the actors involved in the innovation process, after analysis of the general tables, a first typology can be suggested.

Figure 3: Role of the actors in the general innovation process



For the highest scores, we have three actors above the 2,5 points line: the implementers, the developers and the lobbyists. The intervention rank of these different agents in the innovation process is reserved for the developers and the implementers, while we observe in the lobbyists' case a higher involvement in the two first innovation stages. This special position can result from the nature of the analyzed cases which are, for many, at the initiative of the EC. This situation provides a strong position for the lobbies, especially during the two first innovation stages where the different actors involved in the project are able to group themselves in wider interest groupings to gain in visibility and authority. We could mention for example in each case where the EC has played a key role (ERTMS, EILU, ECMT, Eurovignette, etc.) these lobbying groups, e.g. the Maritime Industries Forum (MIF) have been vociferous.

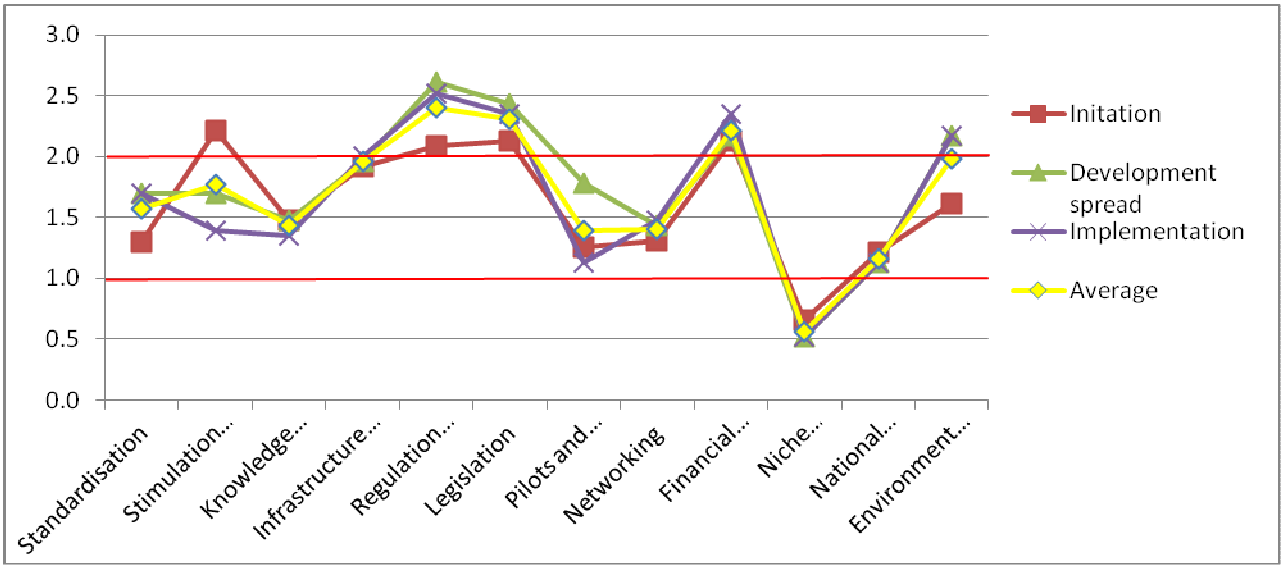
Grouped around the 2,5 points line, we have the majority of the other actors involved in the innovation process, in diverse degrees depending on the cases. There are the industrialists, the State experts, the innovation agents, and the international organizations which play a role more and more importantly in the transport sector on two aspects: legislation and standardisation. Several cases included these different actors and few cases can to be identified only as being public or private. On 23 cases, only three cases have been declared realized without policy intervention: Reefer containerization, Mega containership, and Eurotunnel.

Finally, some actors have been recognized as undervalued by the partners' analysis: the monitoring agents, the R&D agents, the regulators, and the inventors. However it is important to place a focus on the regulator role because, if the other cases have weak scores in all their innovation process, the regulator has a score of 2 in the implementation stage. We can make the hypothesis that its role is important when the innovation is set up in the market. It ensures the innovation is fully implemented. The other actors have been under evaluated with a little advantage for the R&D agents and the inventors in the initiation stage. We can explain this situation by two ways: on the one hand, the main analysis in the INNOSUTRA project has been about the development and initiation stages and on the other hand, it is difficult to identify the initiator especially when it is an institutional organization.

Therefore, we can observe, in this general approach to the actor involvement in the innovation process, a net advantage for the development and implementation agents compared with the initiators which corresponds to the research problematic of the INNOSUTRA project. Finally, these are the traditional actors which have the best scores (industrialists, lobbies, State experts, etc.) with an important role for the international organizations.

Now, we can analyze the different kinds of policy intervention put in place to support the innovation in the transport sector.

Figure 4: Type of policy intervention in the general innovation process



In accordance with the first observations, 5 kinds of policy intervention have been scored at 2 in average or more: infrastructure management, regulation and planning, legislation, financial resources, and environmental issues. For each of these policies, the intervention moment in the innovation process concerns mainly the development and implementation stages, except the financial intervention and the infrastructure development. We observe that the financial intervention varies depending on the cases. It can to be important in the initiation stage to support the project (as the intensification of small waterways case, reefer containerization, etc.) or to be weak during the first stage and to be stronger in the implementation stage to allow the market introduction of the innovation (Modalohr, AIS, etc.).

However, these are the 5 kinds of classical interventions ordinarily used to reduce the market failures by regulation and legislation, financial support, or environmental policy. The weight of these interventions is strengthened by the fact that several case have, for the initiator, the EC (about 7 of 23, or 30%) while 6 cases come from a private initiative (26%).

Concerning the other kinds of policy intervention identified, only the Niche management and national security have been evaluated to 1 point or less. However, some cases differentiate themselves by the weight of this last policy like the AIS, the small waterways intensification, and the ECMT. In the AIS case, its role has been important in the innovation success. The Dutch government involvement has been strong in developing innovation on the national waterway network and in spreading the system to the neighbouring States, with the support of the EC. Finally, in the ECMT case, it is the national withdrawal strategy which has prevailed. The different States have preferred to protect the interests of their road hauliers.

There is a consistency between the scores obtained and the classical innovation process. The policy of R&D stimulations has been well observed in the initiation period, while the test and simulation policy has been well observed in the development period.

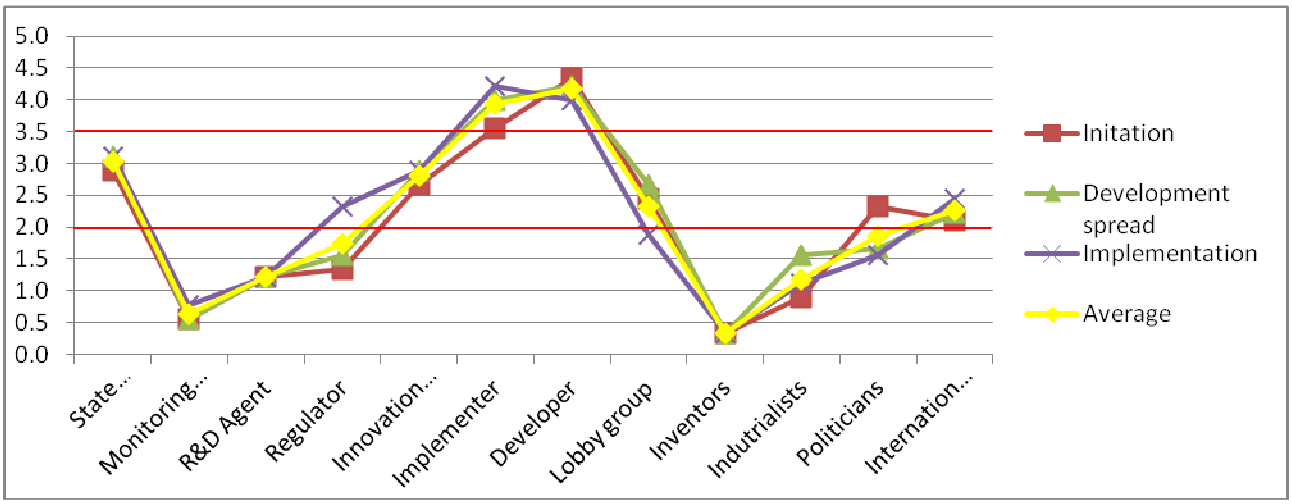
Consequently, according to the INNOSUTRA project, we have two kinds of intervention policy which are strongly linked: the legislative intervention for the application of new rules and norms and the financial intervention to support the innovation initiative. Several level of public governance can interact between them.

Therefore, we have identified in this first analysis of the "policy intervention" templates two facts: first, the special weight of the development and implementation agents which can be connectors between the other agents like the industrialists, the States experts, the international organizations, etc. Second, concerning the kinds of policy intervention, these are the classical policies which have the best score such as legislation or financial intervention.

5.2. Observations on "successful" innovation cases

Concerning the actors, the graph shows that the development and implementation agents play an important role in the innovation process while the inventors and the monitoring agents have a weak impact.

Figure 5: Role of the actors in the "successful" innovative cases

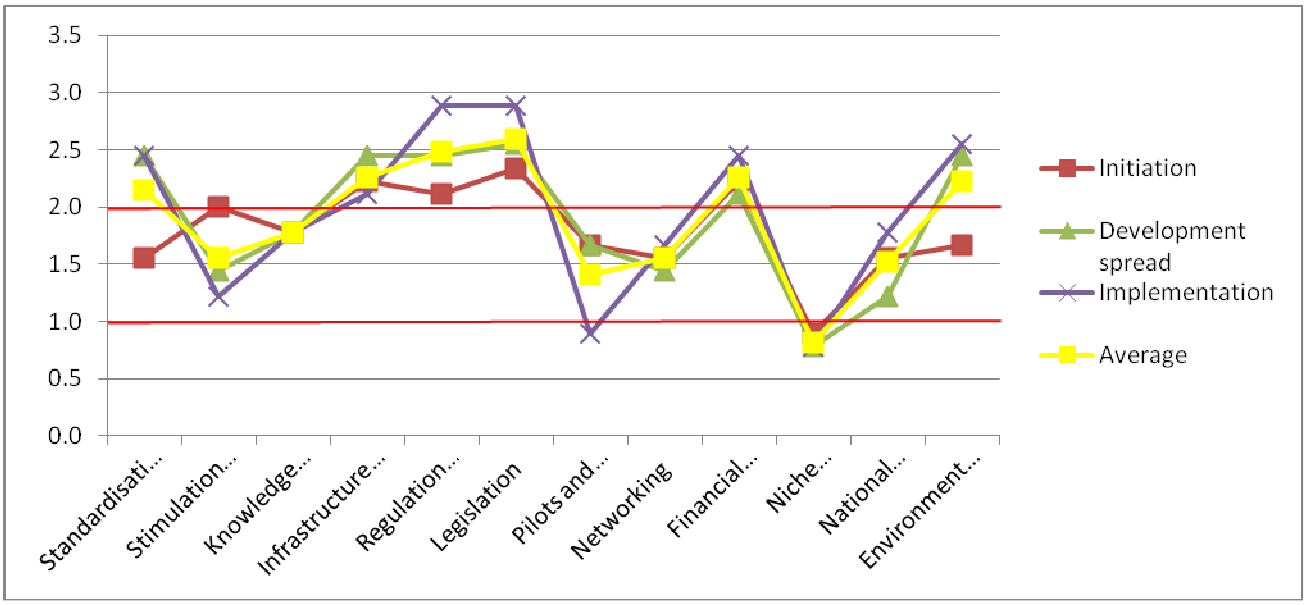


However, if the lobbying groups keep a key position in the innovation process, we can observe a strong reduction of the industrialist role (insofar as they are not represented in lobbying groups) in the process. International organizations meanwhile keep their position. This result can be interpreted in two ways.

First, it could be linked to the nature of the cases which are successes. Indeed, several cases do not have an industrial base which reduces the final score (ITS, EU cabotage, etc.)
Secondly, the innovation success is not necessarily correlated to the intensity of the industry involvement in a project. ERTMS is a good example for this case. While the European rail industries are strongly involved in the process, the equipment demand from the railway actors (operators and managers) stays weak in Europe for political (national strategies) and economic reasons.

Therefore, it is important to make the distinction between the innovation success and the industry involvement.

Figure 6: Type of policy intervention in the "successful" innovative cases



Concerning the kinds of policy intervention, the highest scores among the success cases stays the same as in the previous observations. The areas of development of infrastructure, regulation, legislation, finance, and environmental issues have the best scores.

However, as indicated in the general observations, the impact of the standardisation policy in the innovation process is emphasized by this graph. It is very strong in the development and implementation periods; the score given at this policy comes mainly from the cases defined as successes considered in D4. AIS developed initially for the Dutch inland navigation has been adopted at the European scale during the 90's, resulting in a standardization policy during its implementation stage. Another example of policy standardization, PSC, which by the EC action and three directives (Directive 2005/95/21/EC, Directive 2001/106/EC and Directive 2002/84/EC) has been standardized to be implemented in the same way everywhere in Europe. Finally, to give another example in the private field, we can cite the reefer containerization.This innovation came from a world standardization of the transport operation and design.

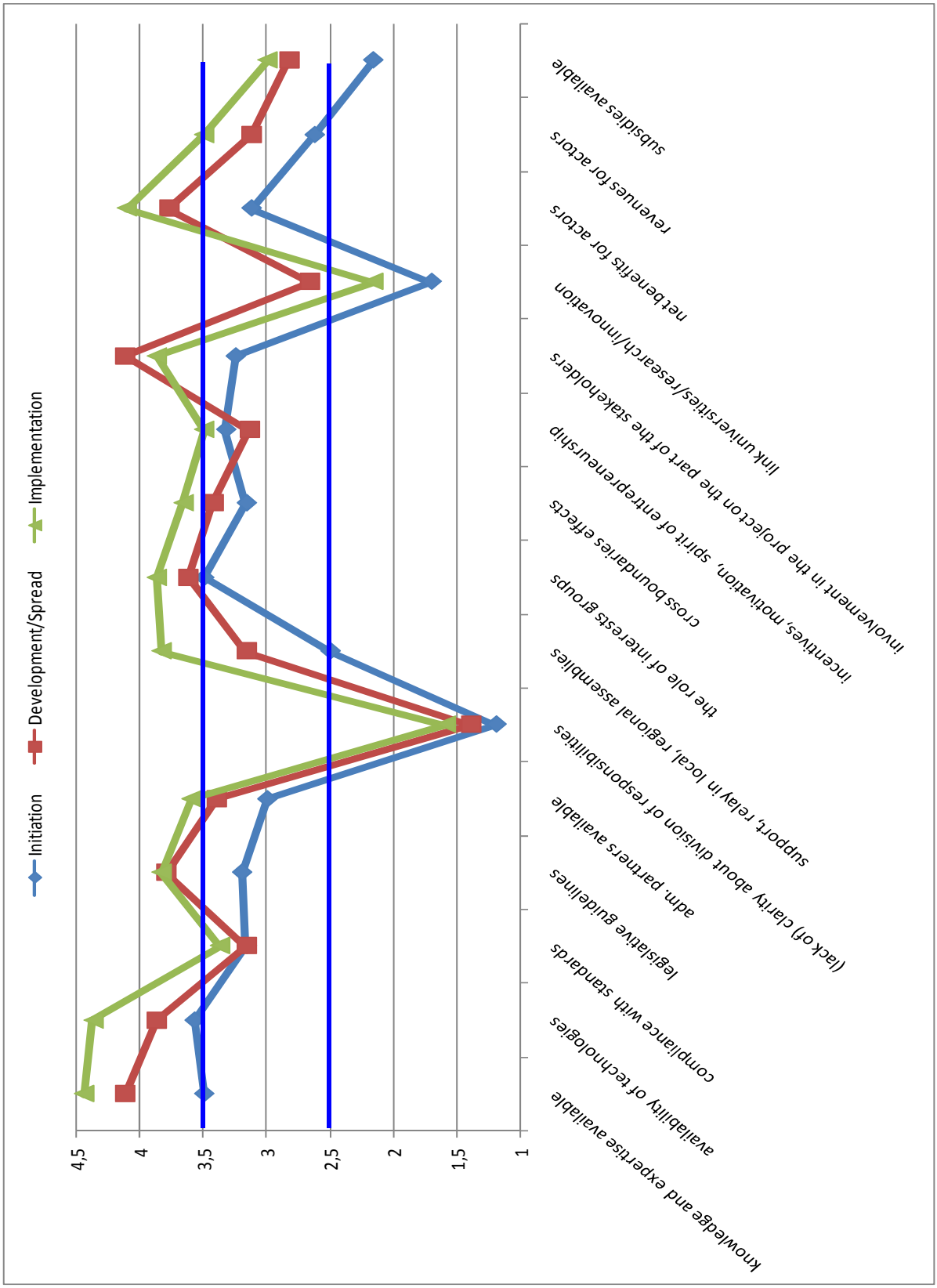
To conclude about these "successful" cases, we can remember firstthe lack of correlation between the industrialist involvement and the innovation success, and secondly the special weight of the standardization policy among the other kinds of policy intervention.

5.3. Key factors in successful cases

The success of the analysed cases is linked to several key factors among which the technological ones are the most relevant (as they have been highly ranked).

This is primarily the position in the majority of the technological cases. However, in order to evaluate if other categories of factors (administrative and legal, political and process-related, socio-cultural and psychological, economic and financial) may influence the successful cases besides the technological ones, a comparison among the ranked key factors has been made.

Figure 7: The trend of the key factors for 9 successful innovative cases



The mean of the ranking has been calculated (1 indicating lowest relevance, to 5 indicating highest relevance) from 15 key factors given by each research team (*knowledge and expertise available, availability of technologies, compliance with standards, legislative guidelines, administrative partners available, lack of clarity about division of responsibilities support, relay in local, regional*

assemblies, the role of interests groups, cross boundaries effects, incentives, motivation, spirit of entrepreneurship, involvement in the project on the part of the stakeholders, link universities/research/innovation, net benefits for actors, revenues for actors, subsidies available) for each of the 9 successful innovative cases analysed, covering the three phases of their innovation's life: initiation, development and implementation. This calculation has not included the key factors evaluated as "n.a." (not applicable), and it does not have a statistical value due to the limited data collection.

As shown in Figure 7, the difference among the three phases considered, namely initiation, development/spread and implementation, is minimal. Only the technological factors, especially "knowledge and expertise available" and "availability of technologies", are more important in the phases of development and implementation rather than during initiation. For example, this is valid for the case of reefer containerisation, whose current success is linked with the support of reefer experts coming from global shipping lines like Maersk Line, MSC and CMA CGM. These companies, originally external to the reefer business segment, in the recent years have highly invested in research for new reefer technologies and consequently in human resources specialized in this field (i.e. the role of reefer manager).

The most relevant factors, with ranking superior to 3.5, are not only technological, as already said above, but also belong to other categories.

Among the administrative and legal factors, the presence of legislative guidelines emerges as the most important factor. This is the case of EU Cabotage, where gradual and well-timed implementation of its regulation has been the factor that ensured the success of this case. And it is also the case of Port State Control (PSC), another policy innovation. The success of this policy instrument is strictly linked with its legal compulsion. Since 1995, when the EU States have been obliged to adopt PSC regime (Directive n. 95/21/EC), the number of ships inspected has increased, and the number of maritime accidents has diminished as well as the number of ships' recorded as having deficiencies needing rectification.

Among the political and process-related factors, the most relevant is the role of interest groups. An example is provided by the case of the Port Community System (PCS). The PCS has involved a 'bottom-up process' which has been supported by several stakeholders in Greece, in particular a Port Authority. It made efforts to integrate all the parts of PCS system via funding from various European programs available during its implementation. Among the social-cultural factors, the importance of the positive involvement in the project on the part of the stakeholders emerges. This influences mostly policy cases.

Also incentives and spirit of entrepreneurship are relevant factors, especially in the phase of initiation. This is the case of Eurotunnel, whose size has been ranked as number one among the top ten of the biggest infrastructures in the world which have been built in the 20thcentury. The financial constraints and the necessity for Eurotunnel to gain quickly in experience in the management of its traffic flows have encouraged the concessionaire company to develop a permanent spirit of innovation and development.

Among the financial and economic factors, the most significant seems to be "net benefits for actors", followed by "revenues". The presence of net benefits concerns above all the intermodal cases of Superfast Ferries on the Greece-Italy route, and the Freight Villages, these innovations appear to be able to generate "internal" and "external" benefits. For Freight Viallages, the internal ones refer to the advantages accruing for users from sharing the total acquisition and operating costs of common facilities, equipment and services offered; that is without having to proceed to heavy

and risky investments for building their own, fully private, logistics centre. In addition, Freight Villages also generate larger-scale or external (network) effects, such as traffic diversion and modal shift, land use reorganization, changes in local economy, employment, reduced energy consumption, and environmental benefits.

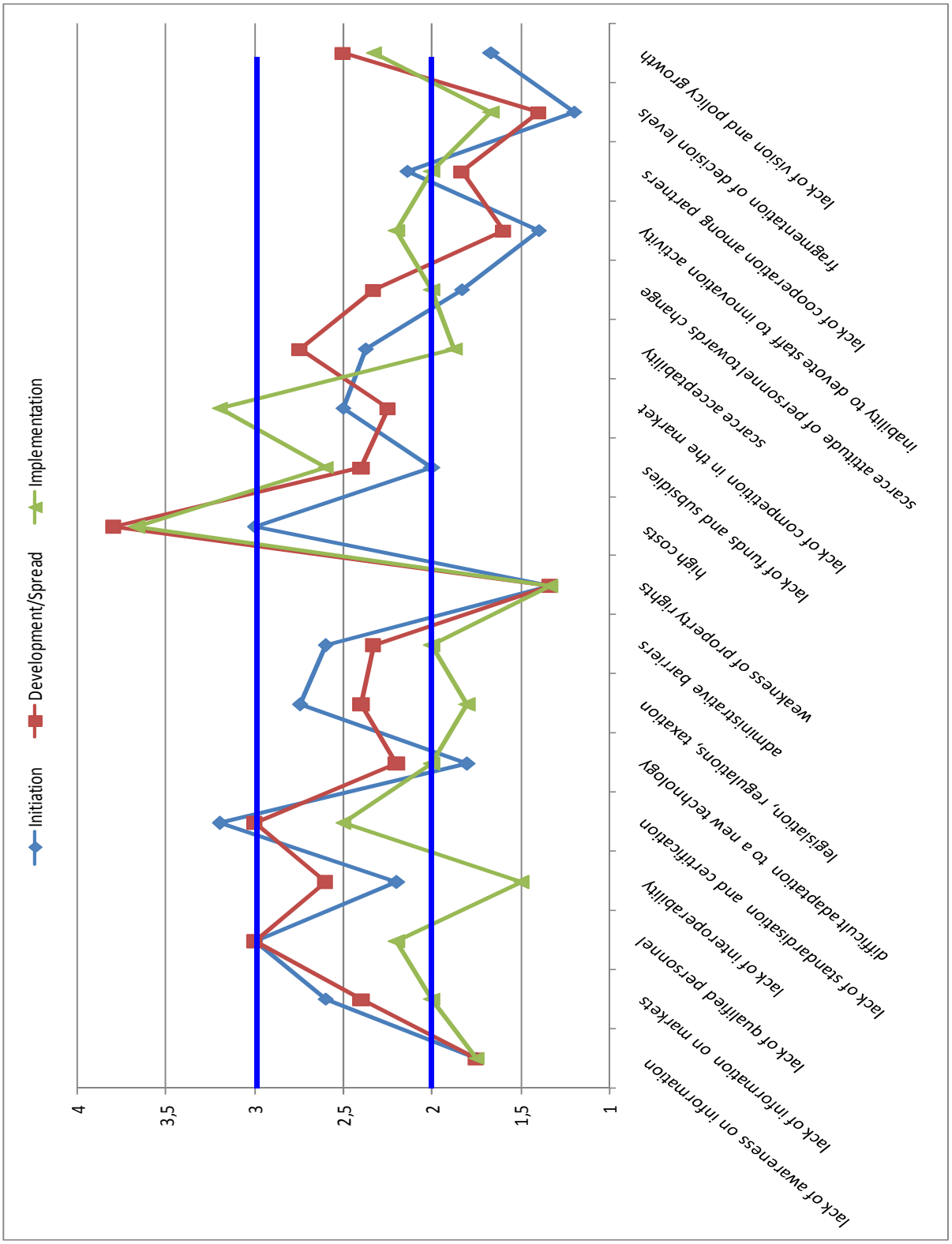
Considering the intermediate ranking in the figure above (between 2.5 and 3.5), many factors are included, mainly administrative and legal, and socio-cultural. They can be evaluated as factors influencing some phases of the innovation development without being relevant for the overall success of innovative cases.

Finally, when considering the lowest ranked factors, they are "lack of clarity about division of responsibilities", and "link universities/research/innovation". The low relevance of these last factors might be due to the type of innovations examined in this project; these are mainly incremental (see 2.3.1, D 2.1 – Preliminary Innovation Report). Therefore, the examined cases are more readily applied than radical innovations, and they often represent just the last part of a long process of accumulation of knowledge originally started from Universities and Research Centres. Another possible reason to explain the lowest ranking of the link with universities/research/innovation could be that some transport sectors, such as the maritime one, are composed of many multinational companies. These companies have developed internally, within their own departments, the research on, and application of, 'in-house' innovations.

5.4. Barriers to success

Although the 9 innovative cases described above have been evaluated as successful, there is still the presence of some barriers in the phases of their lifecycle.

Figure 8: The trend of the barriers for 9 successful innovative cases



First of all, it emerges that the barriers have been evaluated by all research partners with a lower ranking in comparison to the previous analysis of key factors. This means that the barriers found are of only medium importance in relation to the adoption and development of innovative cases. These successful cases have not faced all the barriers, but just some or very few. Alternatively the barriers faced may have been overcome.

As shown in Figure 8 the barriers evaluated as more relevant (with ranking higher than 3) are only 3 (out of 18 barriers analysed): lack of standardisation and certification, high costs, and lack of competition in the market.

Lack of standardisation and certification is a technical barrier which strongly influences technological cases, such as Information Technology in the inland navigation industry. In this case, the amount of instruments used in River Information System (RIS) cannot be implemented at once without some kind of integration. But a complete interoperability between Inland Automatic Information System and other systems in Europe has not been achieved, despite the need for a European standardized information exchange system. Also adaption to a new technology seems a huge barrier in every innovation process related to the inland navigation.

Another strong barrier is represented by high costs. In the case of Reefer Containerisation, there are high costs for building a reefer container: the cost of its construction is about 20.000 US$, 10 times higher than the cost of a dry container (according to a Reefer Manager of Mediterranean Shipping Company).

An apparent lack of competitors in the market affects several cases, in particular the case of Eurotunnel. They have three shipping companies as potential competitors in its market. There is the ferry operator 'Seafrance', financially supported by the SNCF group. Eurotunnel accuses the operation as being uneconomic and engaging in unfair price competition, assisted by the payment of public subsidies and hence causing a strong competititive distortion in the market.

A further high barrier (ranked more than 2.5) is low acceptability, mostly referred to policy cases such as European Cabotage. The low acceptability in some Member States, wishing to keep the cabotage markets closed in the initial stages, has been the highest barrier for this innovation case. Even when the cabotage regulation was in force, some Member States that did not agree with the regulation were enforcing their own restrictions on cabotage to protect their local market.

Finally, it is interesting to see how the barriers to innovation may change over time through different stages of the life-cycle. This is the case of Freight Villages, whose main barriers to adoption were initially related to decision making, such as complexity of the coordination between stakeholders, and strong competition and lobbying from other market actors (e.g. large forwarders or road hauliers). Subsequently, in the phases of development and implementation, other barriers came into force, such as lack of land availability, lack of financial resources and policy restrictions.

5.5. Lessons from successful cases

From the analysis of key factors and barriers related to successful cases some general conclusions can be drawn in terms of lessons across all modes of transport.

- The success of an innovation may derive from the combination of several categories of key factors, mainly technological and economic/financial, usually present in all the stages of development with a similar level of relevance;

- The main key factors for successful innovative cases are technological, together with facilitating finance. These factors have emerged particularly in the phase of implementation to determine the success of an innovation. It is a consequence of the fact that the transport industry has a network structure and consequently requires technical conformity across the sector, implemented via either CEN or ISO technical standards, or by informal market-led approaches (which may, eventually become formal standards);

- The importance of net benefits for the transport chain or even for the whole community in comparison to revenues for a single player; this means that net benefits related to all stakeholders are more important in determining the success of an innovation than revenues for individual and private players;

- The support from stakeholders is essential in policy innovation/initiative cases. Even where the interventions may produce overall, identifiable, net societal benefits, there may, at least initially, be objections from stakeholders who will concentrate on perceived cost implications for some sectors or sub-sectors of the transport industry;

- The presence of various kinds of barriers may limit the spread of innovative cases. In particular, in many innovation cases the main barriers are represented by high investment costs in the phase of initiation and development. However, barriers are not an irreducible obstacle for the development of an innovation. They may be overcome (e.g. by policy interventions) and allow the innovation to be successful..

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6. Conclusions on Not yet Successful Innovation Cases

If considering the innovative cases classified and analysed as "not-yet successes" in the previous paragraphs, i.e. 8 out of the total of 23 cases (9 are "successful cases" and 6 are "intermediate cases"). These cases have been considered as 'work-in-progress' in line with the INNOSUTRA consortium general view on the nomenclature.

The barriers to the spread of public policy initiatives are obviously different from those facing private industrial or commercial innovations. A first observation suggests the presence of differences per mode and by type of innovation, as shown in the following table of the innovative cases classified as not-yet successful.

Table 4: Not-yet-success cases selected

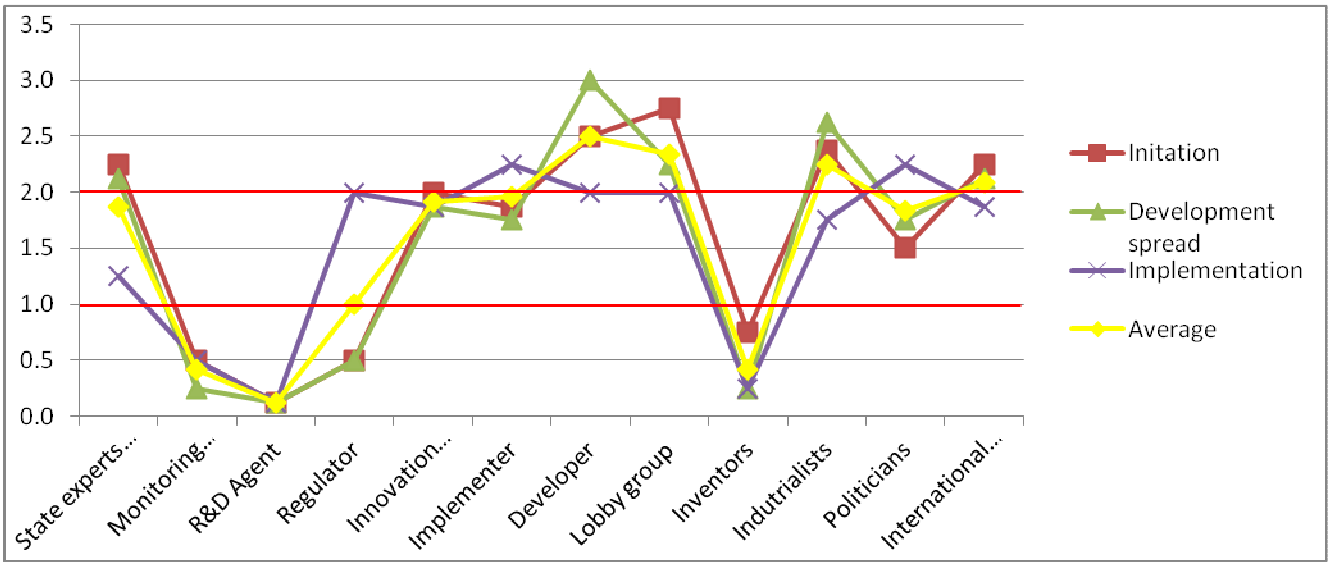
	Road	Rail	Maritime	IWW	Intermodal
Technological			Cold ironing	Air lubrication of ships	
Organizational			Indented berth	Available capacity on small IWW	
Policy	Eurovignette Directive				Internalization of external costs
	ECMT				European Intermodal Loading Unit

As it emerges from the table above, the majority of the above cases are policy (4 cases out of 8 cases), followed by 2 organisational cases and 2 technological cases. This is the opposite condition found for successful innovative cases. In this grouping policy cases, mainly characterised by the presence of public interests and stakeholders, prevail in comparison to the private commercial or industrial innovations.

6.1. Observations on not yet successful innovation cases

It may be observed that there are not any cases deriving wholly from a private process. All cases ranked in the "private-public initiative" section received policy support more or less important at a moment in their innovation process (financial, technical, etc.).

Figure 9: Role of the actors in the not yet successful innovative cases



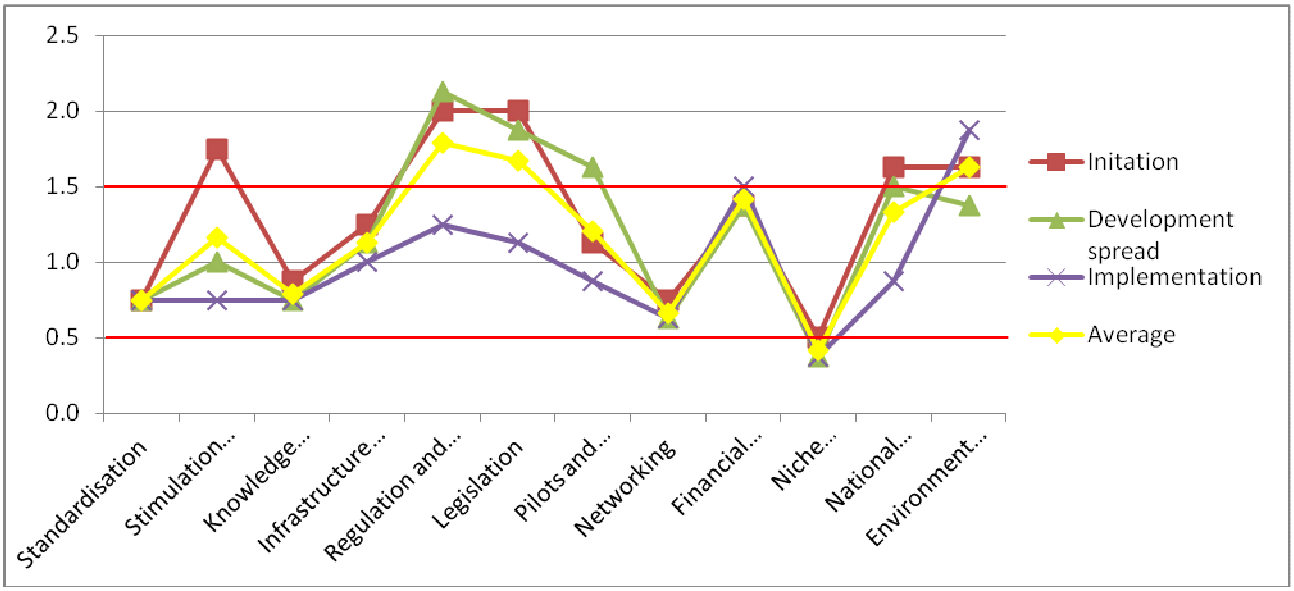
There are two noticeable facts in this graph: the lobby groups and especially the industrialists have significantly higher weightings when compared with the previous observations in the successful cases.

We can also observe a net differentiation of the role of several actors between the different periods of the innovation process. The regulators have an important role in the implementation stage, idem for the politicians, while the role of the implementation agents is undervalued compared with the previous observations.

The weight of the public policy in these cases is a first way to understand these observations. This situation emphasizes the lobby groups' and politicians' activities in the innovation process. It is a characteristic of the European projects which, by their spread, favor the involvement of many lobby groups, relating to the diverse interests of the actors.

The Eurovignette case is a very good example. First, during the legislative process, several organizations and lobby groups have tried to influence the process, in line with their interests. Secondly, the EC, at the project inception, has to make compromises with the major EU institutions (European Parliament and Council of Ministers) to find a consensus about the new legislation, prior to any successful outcome of the project. Finally, the development period is often marked by a strong opposition between the Member States and the European Parliament and the Commission which reduces the likelihood of successful prosecution of the project. The same analysis could be applied to the Internalization of the External Costs, the EILU, etc.

Figure 10: Type of policy intervention in the not yet successful innovative cases



If we consider now the policy intervention graph, we observe that, on the hand the policy intervention elements are noted to be lower than in the previous graphs and, on the other hand, the differences between the different periods of the innovation process are more important than in the previous graphs with a strong uncoupling of the implementation stage compared with the other stages. However, as might be expected, the initiation period is well represented in relation to policy initiatives and interventions.

These are the same types of policy intervention which have the best scores: regulation, legislation, financial support, and environmental issues. However, in opposition to the success graph, the standardization policy is low-valued and the national strategy policy is high-valued. This high-valuation is explained by the EC and national government involvement in most of the cases (ECMT, EILU, Eurovignette, etc.).

Therefore, we have, with these two graphs, an illustration of the European problem: how to conciliate the different interests and find a consensus between an authoritarian choice and a choice creating unanimity between the different actors?

To conclude these observations, it seems that it is unanimity which is most often chosen. It could explain on the one hand the strong involvement of the lobby groups, industrialists and politicians observed in the “not yet success” category. On the other hand, it may explain the over-valuation of the standardization policy in the “success” category. Standardisation is a technical issue which politicians are less ‘comfortable’ with.

6.2. Key factors for not-yet successful cases

There are various categories of key factors characterising the processes of “not-yet successful cases”. Political and process-related and socio-cultural factors have ranked the highest. This is mainly due to the strong presence of policy initiative cases. However, in order to evaluate if other categories of factors (technological, administrative and legal, economic and financial) may influence the not-yet successful cases, a comparison among the ranked key factors has been made (even in this case the ranking is from 1=less relevant, to 5=most relevant).

The mean of the ranking given by each research team to 15 key factors (*knowledge and expertise available, availability of technologies, compliance with standards, legislative guidelines,*

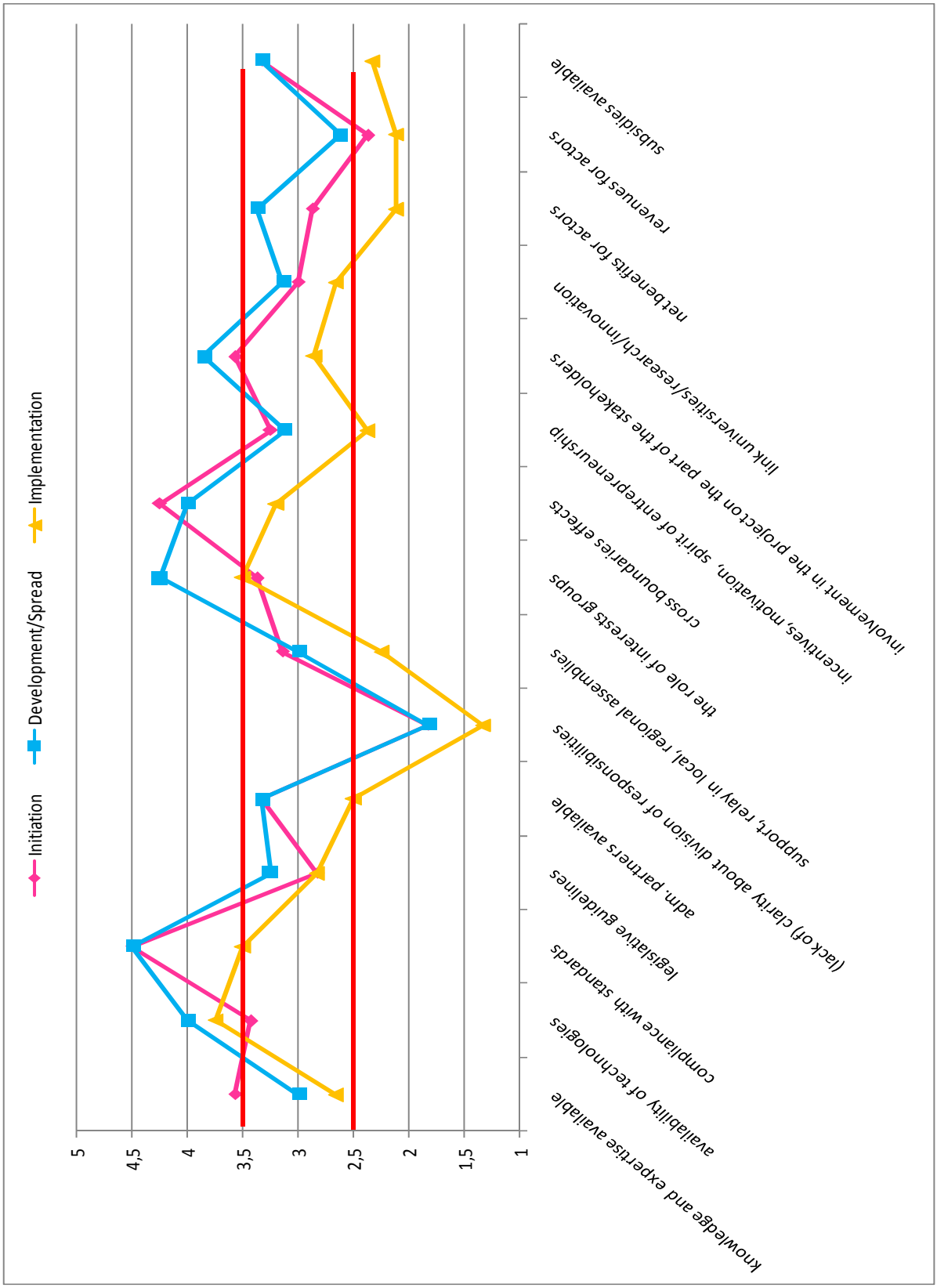
administrative partners available, lack of clarity about division of responsibilities support, relay in local, regional assemblies, the role of interests groups, cross boundaries effects, incentives, motivation, spirit of entrepreneurship, involvement in the project on the part of the stakeholders, link universities / research / innovation, net benefits for actors, revenues for actors, subsidies available) has been calculated (from 1 equal to lowest relevance to 5 equivalent to highest relevance) for each of the 8 not-yet successful innovative cases analysed – in the three phases of their innovation's life: initiation, development and implementation. This calculation has not included the key factors evaluated as "n.a." (not applicable), and it does not have a statistical value due to the limited data collection.

As emerged in Figure 11, the difference among the three innovation phases considered is quite relevant. A possible explanation is that some key factors may be so important in the phases of initiation and development as to determine the failure of one innovation in the next phase. It is the case of Cold Ironing where the factor "availability of technology" was relevant in the phase of launch, but lost importance once that other factors have emerged, namely economic barriers related to the technology already available and costly to be implemented at European ports. Many key factors have been evaluated with a score between 2.5 and 3.5. This ranking means that these factors influence innovations without necessarily determining their failure.

As shown in Figure 11 the main key factors (with ranking higher than 3.5) are: availability of technologies, compliance with standards, the role of interests groups, cross boundaries effects, and involvement in the project on the part of the stakeholders. One innovative case influenced by all these principal factors is the case of European Intermodal Loading Unit (EILU). Its introduction was intended to provide a stimulus to expand intermodal freight transport across the EU. The problems that arose in this case concerned an opposition between a market driven approach supported by transport operator lobbying groups and the formal standardisation approach. However, there were also economic, legal and technological factors influencing the willingness and ability of both industry to accept and the EU Institutions to implement the innovation. Moreover, there are other barriers such as processes of path dependence related to the size and type of loading units adopted in intermodal transport, which has both an EU and an international trade context.

The role of interests groups may become a barrier, such as for the case Internalization of External Costs, where an important barrier is the opposition of significant road transport-related lobbying groups, backed for reasons of protecting subsidiarity by a number of Member States. A key issue here is how the European Commission responds to such opposition. It has tended to follow consistently, but not successfully, a short-run marginal social costs approach. There is also involved the opposition from the EU maritime sector to the tackling of CO2 emissions by bringing the maritime sector into the EU Emissions Trading Scheme.

Figure 11: The trend of the key factors for 8 not-yet successful innovative cases



6.3. Barriers to not-yet successful cases

Several categories of barriers have been found in relation to the 8 not-yet successful innovative cases above examined. The main barriers to the not-yet successful cases result as follows (ranked

higher than 2,5 in Figure 12): lack of interoperability, lack of standardisation, legislation, regulation, taxation, high costs, lack of competition in the market, and lack of vision and policy growth.

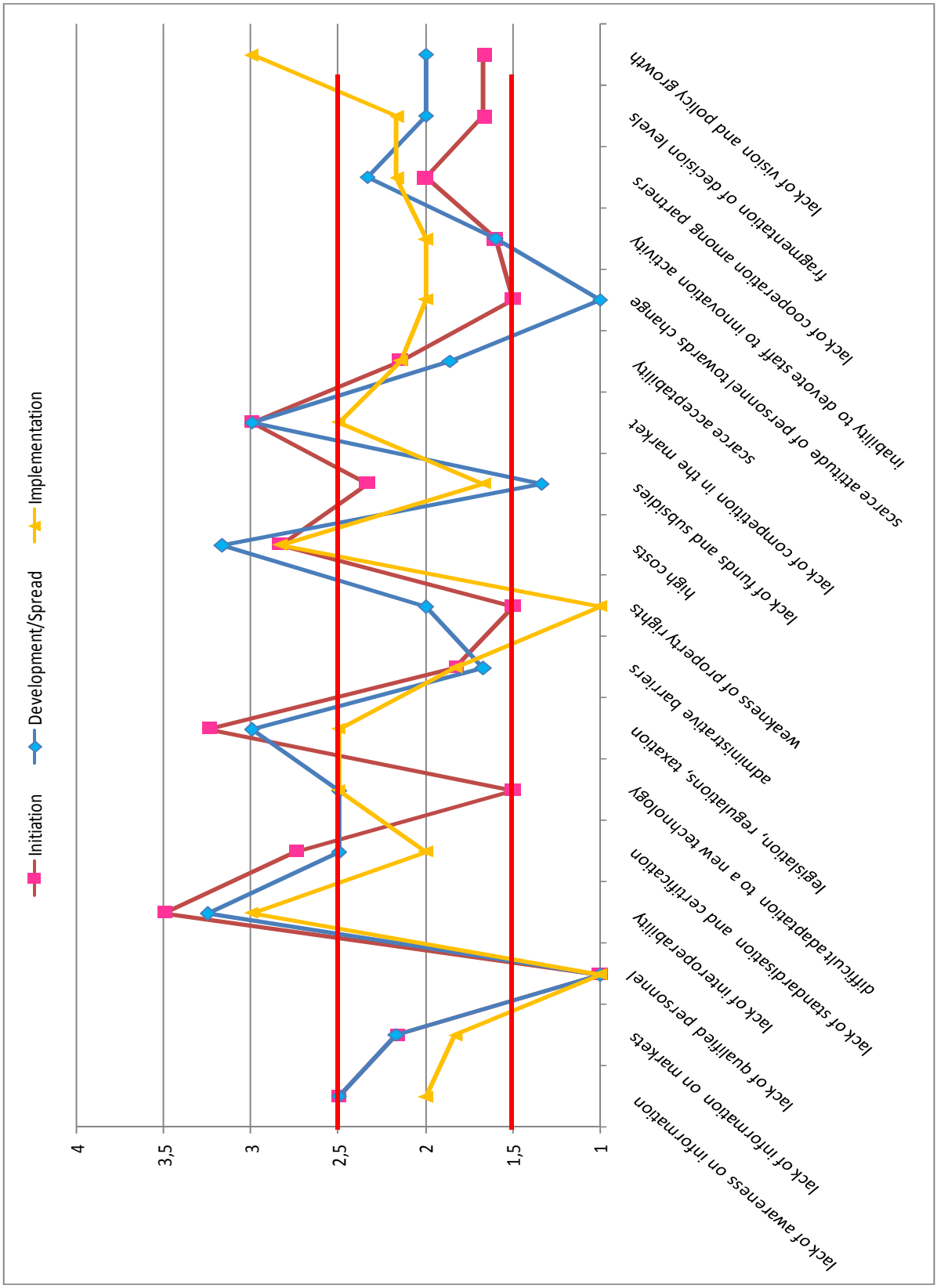
Technical barriers such as lack of interoperability and standardisation are typical in the initiation phase of technological innovation. In the case of Cold Ironing, these barriers concern compatibility of electricity parameters: ships, built in different international yards, have no uniform voltage and frequency requirement. Some ships use 220 volts at 50 Hz, others use 110 volts at 60 Hz. Primary distribution voltage may vary from 440 volts to 11 kilovolts. Load requirements vary from ship to ship – ranges from a few hundred kW in case of car carriers to a dozen or more MW in case of passenger ships or reefer ships. Also connectors and cables are not internationally standardised, though work has progressed in this direction.

Problems in legislation and regulations concern mainly policy innovative cases, such as the Eurovignette whose adoption process of the three Directives has faced low acceptability due to serious lobbying from different sides. This included that of different member states of the EU and industry associations representing both, road and competing modes of transport. Furthermore, also countries from outside of the EU, like Norway, have tried to influence the process. This shows the influence and importance of this policy innovation in the EU, but also outside.

Another case characterised by acceptability barrier is ECMT. Germany was lobbying strongly in the initial stages of this policy case. Initially a statistically unreliable survey was used for this purpose. It also obtained support from other ECMT member countries with similar views for political support. The member countries strongly reacted to the proposals of Germany. Most (33 of 41) expressed their views on the proposal, with a certain degree of uncertainty amongst the ECMT member countries about the effects of the initial 6 weeks restriction. They were unsure about the effects of the policy. Therefore, the initial restriction was introduced for a probationary period.

A further significant barrier is represented by high costs affecting all the cases examined. For example the cost of electric energy represents a first barrier to the spread of Cold Ironing in Europe, together with the costs for port electrical infrastructure equipped for cold ironing. This represented an investment that not all ports are able, or willing, to make.

Figure 12: The trend of the barriers for 8 not-yet successful innovative cases



There are also innovative cases whose "not-yet success" or "failure" is due to many factors and barriers "external" to the innovation itself, but more related to barriers concerning decision making, such as "lack of vision". This is the case of the Indented Berth at Ceres Paragon terminal in Amsterdam, evaluated as a revolutionary concept at a highly productive terminal. The project

presented advanced equipment; fast vessel turnaround time; working at the 2 bays next to each other; higher berth utilisation at terminals with limited quay length, and low handling costs. These represented a number of important technological and operational (success) factors for the Ceres Paragon Terminal. Hence, it could have been a success from an organisational perspective.

However, the detailed analysis reveals the presence of several barriers associated to the failure of the indented berth in the port of Amsterdam. The major challenge was from 'stakeholders who were also linked with the port of Rotterdam, a major competitor. Therefore, in this case, barriers have been mainly related to the decision-making and political power of the leading parties in the container port of Rotterdam. Lobbying attempts by NYK, manager of Ceres Terminal, to draw attention to the Amsterdam based terminal, were hampered by P&O Nedlloyd veto rights, in order to protect its interests in the port of Rotterdam. This phenomenon may be considered as contributing, directly or indirectly, in the failure of the Ceres Paragon Terminal.

6.4. Lessons from not-yet successful cases

From the analysis, some general conclusions might be drawn in terms of lessons across all modes of transport concerning "not-yet successful" innovative cases.

- There is no particular type of innovation more "unsuccessful" than others, although the majority of the cases analysed covers policy initiative and organisational innovation, which are influenced by a wide range of key factors and barriers;
- The temporary failure or not-yet success may derive from the combination of various categories of key factors, mainly political and socio-cultural, influencing all the stages of development with a different level of relevance;
- The presence of barriers of various types may limit the spread of innovative cases and determine the failure of one innovation in one or more phases of its cycle. In particular, in many innovative cases the main barriers are represented by high costs and lack of vision and policy growth;
- Low acceptability represents a strong barrier especially for policy cases characterised by social benefits, but also offering very few incentives to compensate the players whose interests are in conflict with the innovation;
- Some innovative cases have been examined as "not-yet successful" because of the short period of their promotion. With development still in progress, this means that there are still potential opportunities to become a success after overcoming any barriers in the initiation and development phases, or in the final phase of implementation.

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