

CROSS-NATIONAL BENCHMARK OF INNOVATIVE CONTRACTS IN ROAD INFRASTRUCTURE: THE USE OF GAMES FOR INVESTIGATING FUTURE SCENARIOS

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ABSTRACT

Many countries are experimenting with innovative contractual arrangements for the procurement of construction, maintenance and operation of roads. This paper aims to present a cross national comparison of the Finnish and the Dutch Model of Procurement and their respective developmental paths: from the traditional setting where many of the works were still done in-house, to the present mix of innovative practices.

From the field research in these two countries a role play/social simulation [1] has been developed. The simulation is an abstraction of the plans to change the traditional prescriptive contracts used in Periodic Maintenance, to more long term and performance oriented contracts that cover a whole road network.

A generic version of the game has been built and tested with two different groups. The goal is to play the simulation with civil servants and representatives from the different actors in both countries and discuss the results with national experts. This paper presents the results from the comparison as well as some preliminary results of the social simulation. The insights from these two research activities could be of significant influence as to how the management of road infrastructure assets is organized in the future.

1. INTRODUCTION

Many transportation agencies have discovered that traditional highway contract administration procedures and project delivery methods do not meet current demands. Some of the problems being faced by Road Administrations around the world are; insufficient funds to meet satisfactory levels of all roads [2-4], little innovation [5], little value-added services for the client and a general lack of integration between the phases of the road life cycle.

In response, they are experimenting with innovative contractual arrangements for the procurement of construction, maintenance and operation of roads. Four trends are perceived in road management [6, 7]. First, with respect to project delivery, more and more projects are contracted for the whole life cycle of the road. Second, contractors are given increasingly more freedom or design space [8], as the indicators used for monitoring their work become less operational and more performance based [9]. The third trend concerns project financing in which private investors are playing an increasingly important role and governments follow a dual track strategy [4]; managing a portfolio of directly and indirectly financed projects; dependent on the project characteristics. Fourth, contracts are granted for the longer term.

Benchmark studies have been realized that to some extent make an inventory of all these different “best practices” around the world. Nevertheless not much research has been done in mapping the evolutionary path or the history and context of these innovative practices and particular national procurement models. This paper aim to present a cross national comparison of the Finnish and the Dutch Models of Procurement and their respective developmental paths: from the traditional setting where many of the works were still done in-house, to the present mix of innovative practices in the three markets: capital projects, routine and periodic maintenance.

These innovative forms of contracting are expected to yield more flexibility in the road sector; more innovation, higher performance and consequently lower costs while keeping up service levels on public values such as mobility, safety and the environment. However, the limited application of these innovative contracts and the continuous reform in all the different dimensions of the procurement strategy (i.e. project financing, project delivery methods) do not allow reaching consensus about the effects of these practices in terms of performance and economic efficiency.

In order to do research into the possible effects of these practices, from the insights generated in field research in these two countries a social simulation has been designed that could allow us to research the impact of some of these changes –mainly for periodic maintenance- in the future condition of the road network. A generic version of the game called “road roles” has been built and after playing and refining it in two different groups, more country specific versions, that show different market structures, will be developed. The goal is to play the simulation with civil servants and representatives from the different actors in both countries and to discuss the results from these simulations with national experts.

The following section of the paper presents the results from the cross national comparison realized by realizing field research in Finland and the Netherlands and therefore the relative advance in the implementation of these innovative contracting practices. In section three the choice for a game simulation and the operationalization of it is presented. Section four presents the game and its main elements and characteristics. Section five discusses the preliminary results of the simulation after playing it with professionals in Finland and finally, section six shows the implications from these two research activities for the management of road infrastructure assets in the future.

2. CROSS-NATIONAL COMPARISON: THE DUTCH VERSUS THE FINNISH CASE

In this section we intend to present an overview of a comparison between the Dutch and the Finnish case focusing in three aspects; the reform process, the mix of practices in their national procurement strategy and the main effects or results achieved up to now.

2.1. Reform Process

The process of reform or reorganization of the administration of roads has followed different tracks in these two countries. Though in both countries the goal is to move towards what Public Choice theory considers a more efficient way of organizing procurement of public infrastructures; the specific drivers or triggers for starting the process as well as the specific practices that have been implemented in both countries,

are different. Table 1 shows the main differences and similarities of the process of reform in these two countries.

Table 1- The Reorganization Process in the Finnish and Dutch Case

REFORM PROCESS	Finnish Case	Dutch Case
BEGIN		
ORIGIN	Year 1992, Economic Recession Roads: 1996 - proposed and accepted in 2001	Year 2001 Fraud Scandal in the construction industry 2002-2003 Parliamentary inquiry (green-left party) and measures from Central Government
ROAD REFORM	YES FINNRA (Agency) + Finnish Road Enterprise	NO RWS (Agency) <small>Also responsible for Water Management</small> No Public Enterprise
DRIVERS	- Cost cutting - Reduction of personnel	- Reduction of personnel - Breaking old "agreement" system of contractors
INSPIRATION	- Sweden (first) - New Zealand (relationship with industry)	- United Kingdom (International partnership project with Belgium)
ACTORS	- Minister of Finance: against PPP - Top management of Finnra: key leadership that made it independent development	- Minister of Finance: promoting PPP(PPP centre) -24 projects - Initiators spread through RWS
CONTRACTORS	- Small against (EU Lobbying) and Bigger:PRO	- Seem more PROactive <small>Reason: more experience internationally, i.e. PPPs in UK market</small> - Deductions/ sanctions too heavy
COMPLAINTS OBSTACLES/ Regulation	- Changing too quickly	- Right of Way Procedure - EU in general proactive, but problem of too easy impugnations of contractor selection
	EXPLICIT AND CLEAR-CUT PROCESS Small Agency	NOT SO EXPLICIT, SLOWER PROCESS Large Agency

The reorganization of the road sector in Finland had its origin already in 1992 when the economic recession created a window of opportunity for the New Public Management paradigm. Already since then the top management of Finnra was promoting a change. A reform proposal or suggestion was made internally in Finnra by a group of initiators and this was later in 1996 presented to Parliament. Parliament rejected it because of the strong opposition of the Labour Unions, the Communist Party and the Social Democrats, which were the dominant parties in the Finnish Parliament then. The decision of parliament did not stop the initiators of the change. The years between 1998 and 2001- when finally approved by Parliament- were a period of intensive preparation to achieve a smooth transition, if the three laws required were approved in Parliament. Meanwhile what created the window of opportunity or sense of urgency to change in the Netherlands seems to have been the 2001 fraud scandal in the construction industry. The new procurement strategy is a way to break with the old system of drawing up agreements between contractors.

However the main difference between these two cases is that Finland did experience a road reform, in other words, an institutional reform that separated client (Finnish Road Administration) from producer (Finnish Road Enterprise). Such a separation did not occur in the Netherlands.

All in all the reform process in Finland could be characterized as a more explicit and clear-cut process, while in the Netherlands changes have been realized at a lower speed and with more caution. De Jong and Aijo [10] characterize the road maintenance liberalization in the Netherlands as “the cautious way” where developments (not only in roads but also in other utility sectors) evolve incrementally and cost reductions have not been achieved.

Common lessons from these two cases are:

First, an important driver or general philosophy has been to implement practices that reduce the personnel of the agency needed, at least in Finland. This has proven to be more important in practice than other concerns like increasing innovation or even keeping total costs as low as possible. Maybe this is the case because this is an aspect easier to quantify and track down. Side effect of this philosophy has been an increase of the number of consultants working for the agency. They carry out all kinds of preparatory work or studies and quality monitoring tasks as well. In the future it is expected that only tasks that require authority –a resource unique to the government- will be left in-house.

Second, developments in neighboring countries as well as successful experiences elsewhere have also proved powerful in inspiring new practices, but foremost to bring the issue of the need of a reform in procurement practices, to the front of the political arena.

Third, actors and their positions have been shown to be decisive for the final choices made. While in Finland, the opposition of the minister of Finance to private financing has impeded to some extent the use of Public Private Partnerships, in the Netherlands the same authority has promoted its use and achieved a significant use of this scheme in large capital projects. Groenewegen and De Jong [11] in their study of the case of Road Management Liberalization in the Nordic Countries, claim that in not in all circumstances will the most efficient structures emerge as predicted by Transaction Cost Economics, but path dependency and power relations will largely determine the outcome of the process. In fact, multiple institutional equilibria exist, some of which are clearly economically suboptimal.

Finally, EU regulation is considered in both countries as promoting the use of these open tendering and new outsourcing procedures. Nevertheless, it also seem to facilitate to contractors the opening of legal disputation processes or claims to the tendering and selection decision of the road agency; and therefore slow down the implementation of practices that would allow more design freedom and innovation.

2.2. Procurement Strategy

An overview of the relative advance of the two countries in the use of innovative contracting and the particular nuances are presented in Table 2. As could be expected since Finland started the reorganization earlier; they are relatively ahead of the Netherlands in the use –at least in larger scale- of these practices. By the end of last year (2006) Finnra (Finnish Road Administration) presented to the sector their third procurement strategy while Rijkswaterstaat (Dutch Department of Public Works) is now in the implementation process of their first procurement strategy.

Moreover in what concerns the different aspects of the procurement strategy, the advance is characterized by:

Contractor selection: price is no longer the only criterion; quality aspects are also taken on board. Finland has standardized –at least for all routine maintenance contracts- that

25% of the points are due to quality. Nevertheless, it has a decisive effect of only 3%. In the Netherlands this percentage varies a lot per project.

Table 2- The use of Innovative Contracting in Finland and the Netherlands

	Finnish Case	Dutch Case
GENERAL ADVANCE	- Policy and Standard Contracts in Practice - 2nd or 3rd Procurement Strategy	- Still developing (i.e. size of maintenance service areas, contract term) - 1st procurement strategy (2008)
CONTRACTOR SELECTION	70 to 75 % Price	Varying a lot per project
INTEGRATION	- Capital: 60% DB - Maintenance: Service Area Contracts (all included) - Indicator: Average Value Tendered	- Capital: 100% DB goal for 2008 - Maintenance: 24% done by RWS. Unity changing towards the idea of corridors. - Indicator: % of projects tendered in period using innovative delivery methods (ambiguous)
PERFORMANCE INDICATORS AND QUALITY MONITORING	- Own responsibility concept + - Spot checking - Consultants are employed for testing, oversight and spot checking - Users' line	- Own responsibility concept (starting) - Spot checking (starting) - Consultants starting to be used "temporarily" I.e. Pilot project to gather historical data on assets condition versus maintenance investment
ALTERNATIVE FINANCING	- NO future projects - 1st project (shadow toll) 2nd (availability)	- Plans for more future projects (30 planned in gral) - Broad Support - All cases: "availability"
NEXT STEPS	- Integration PERIODIC + ROUTINE	- Accelerated/ combined maintenance of many bridges and roads

Periodic Maintenance still very traditional
 Periodic Maintenance 100% Price
 Not yet real OUTCOMES but side steps
 100% "Performance" Contracts (capital and routine maintenance)
 Meanwhile => Development of Functional Specification
 General Problem: Costly maintenance of Isolated Road Section
 More Design Freedom in Periodic Maintenance
 Toll Roads not accepted - unless Congestion/Pollution Scheme

Integrated contracts: the process differs per product. In capital projects Design-Build (DB) is widely used. While in Finland it already represents 60% of the projects, in the Netherlands the goal is to use it for all projects by 2008. For routine maintenance integration has meant the implementation of service contracts that include almost all routine and winter maintenance tasks in one. In Finland now 100% of the maintenance is contracted out in this way- making use area contracts-; while in the Netherlands the agency still perform around 24% of these activities in-house- and is developing the contracts and heading more towards the idea of corridors instead of districts or areas. The advance in the use of integrated and/or innovative contracts is measured throughout the agencies in different ways in the two countries, but is clearly a priority in both.

Use of performance indicators and quality monitoring: the research pointed out that there are still many issues to be solved before implementing fully outcome oriented indicators such as the lack of complete databases on the assets and their condition, historical information and reliable measuring techniques. Nevertheless the introduction is on its way and the use of functional specifications has begun. Meanwhile road agencies have found a way to grant more design freedom and responsibilities to the contractor by implementing the so called "own responsibility principle", complemented by (random) spot checking.

Alternative financing: here we find the main difference between both procurement strategies and a relative further advance in the Netherlands than in Finland.

In spite of the differences between both countries, it becomes clear from the comparison that the procurement of periodic maintenance remains very traditional. Price counts still for 100% of the selection decisions and contracts are prescriptive, more “work order” style and valid for a very short term. Consequently there are plans in both countries to make important reforms in this sector, either by combining periodic with routine maintenance in one contract or by developing long term rehabilitation contracts for a whole road network.

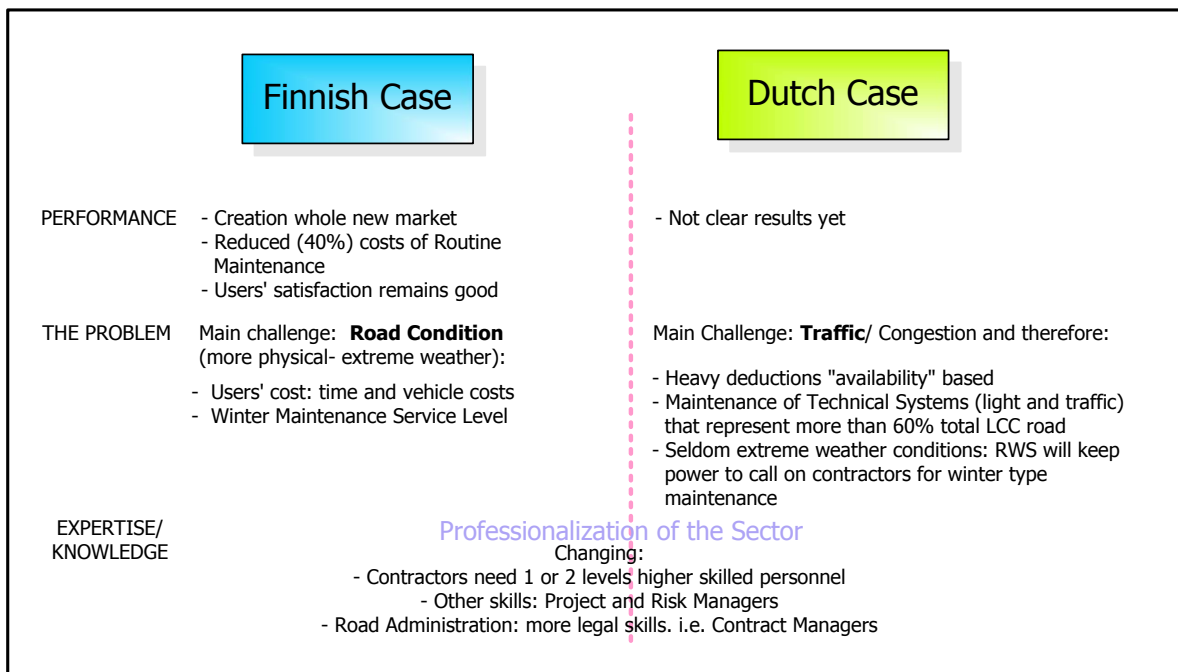
2.3. Overview of Effects

Table 3 demonstrates the most important results or consequences of the reform. It also shows –though both agencies are concerned with procurement of road infrastructure- the essence of the problem they face is different and therefore the outcomes of interest or key performance indicators that matter too.

For Finland the most important achievement could be considered the creation of a whole new market; which is competitive and has resulted in prices being cut by approximately 40%.

While in Finland the problem of (physical) road condition remains a top priority –partly due to the extreme weather conditions and the extension of the network- the problem in the Netherlands has taken in the last decades a different form and traffic management is the first priority.

Table 3- Results of Innovative Practices in Finland and the Netherlands



It is important to mention what effect these innovative practices have had on the expertise in both sides. While the expertise of road agencies has changed toward more project management and legal related skills; contractors have also experienced a process of increasing professionalization- that becomes evident in the need they have of skilled personnel in both technical and project and risk management aspects.

2.4. Challenges and Dilemmas

The analysis of the national procurement systems of the Netherlands and Finland, their evolving process and specific nuances that have resulted in a particular mix of contracting practices and plans for the future; have contributed to a better understanding of the problematic at play in each of them. It appears that important challenges remain for both.

2.4.1. Challenges Finnish Case

The most important challenges for the organization of the management and procurement of road assets in the Finnish context seem to be:

First, the profit levels of the sector –specially in routine maintenance- are low and could threaten the well being and sustainability of the industry or at least prevent significant investments in research and development, therefore affecting the competitiveness of the national contractors in a wider European market.

Second, the possible integration of routine and periodic maintenance activities in one contract may prove more difficult than expected since there are important technical barriers –different technologies and skills – and since it may result in a further process of market concentration, leaving too little competitors able to perform well in such contracts.

2.4.2. Challenges Dutch Case

Other issues seem more urgent in the Dutch context:

First, the issue of appropriate distribution of risks; contractors perceive the current sanctions as too heavy and claim that for certain kinds of systems a 100% reliability is almost impossible to achieve and the risks very difficult to quantify and control. In response they may charge fees that more than reflect the insurance costs. The question arises whether 100% reliability may be too costly for taxpayers. It may be wiser and cheaper, either for the agency to assume certain kind of risks or to place them in the right market, like the one of insurances.

Second, in the development of standard routine maintenance contracts close attention needs to be paid to establish the right size or scale, and combination of tasks to be included in the contract, if savings are to be achieved. Including all tasks may not be the best, since there are certain systems like lighting that prove more cost-efficient if outsourced as a single contract for the whole country, apart from all the other routine maintenance tasks.

2.4.3. Common challenges and dilemmas for the future

Common issues requiring attention in both countries are:

First, the issue of market concentration; all in all these innovative practices seem to concentrate the market in a few large players and the question remains whether soon the savings in transaction costs and economies of scope and scale, will turn around as contractors have more market power and are forced by low profit levels to start acting on their defense.

The second question, valid for these two countries where toll roads are not part of the scheme, is whether all these innovative practices and the new incentives indeed help to change the adversarial relationship between principals and agents, and the rent-seeking behavior of contractors. Or do they need to go further and place market risks also in the hands of private sector, so as to finally achieve real entrepreneurial behavior from contractors?

Finally, as mentioned before, the reform of the periodic maintenance sector remains a challenge for both. Which are the best ways to operationalize the change towards more performance and service like contracts? Will the public organization let go the control over bridges and their design? Will programming and planning be outsourced to the same contractor or to consultants? If contractors are given more freedom will they act opportunistically? Or conversely will these contracts result in more trust? The following section presents a gaming/simulation being proposed to explore some of these questions.

3. GAMING SIMULATION OR THE POLICY EXERCISE ALTERNATIVE

In the previous decades many decision techniques to aid planning and management in large organizations have been developed. As Duke and Geurts [1] explain, within these techniques there are two major styles. One set of these techniques has its history in applied mathematics, econometrics, operation research, and systems analysis. This set focuses on the use of formal models and algorithms for policy development and is most effective when dealing with problems that are more rational and calibrated, where few variables are key and there is a single decision maker. The second set refers to the so called “judgmental” techniques. They originate from disciplines like cognitive and social psychology and focus therefore on intuition, creativity, discussion and communication as stepping stones to strategic policy formulation.

Both sets have their limitations and advantages depending on the kind of problems under study. Gaming/simulation could be considered a hybrid form of these two sets. Geurts and Duke [1] state that an optimal approach to strategic planning formulation “should try to combine the best of these two approaches”. In gaming/simulation reality is simulated through the interaction of role players using non-formal symbols with formal, computerized sub-models (where necessary).

Innovative contracts are expected to yield more flexibility, innovation, higher performance and more efficiency. However, the limited application of these innovative contracts and the continuous reform do not allow for consensus about the effects of these practices in terms of performance and economic efficiency. For this reason it seems important to find new ways, like simulation/gaming, that allow us to investigate future scenarios and discuss in a more structured way the possible implications of these new contracts for the condition of the road network, the economic performance of the system and the protection of public values. In order to design this simulation a system analysis of the sector was carried out. The following subsections present the main results.

A choice has been made to focus the policy exercise on the area of periodic maintenance. The previous section illustrated that the relative advance in the use of these innovative practices in the market of capital projects is large in countries like UK and the Netherlands and also significant in the area of routine maintenance in countries like Finland. On the other hand, the market and the contracts used in periodic maintenance remain rather traditional. If one also considers the quantitative magnitude of periodic maintenance contracts versus the few new capital projects and the relatively large influence they have on the condition of the network versus more surface related activities like the ones included in routine maintenance; the choice for researching the impact of innovative contracts -that give more design freedom to contractors- precisely in this area of periodic

maintenance, seems by far the most significant. It is precisely in this area that revolutionary changes are expected in the future.

3.1. The Periodic Maintenance Sector

Once the choice was made for researching future scenarios for contracts in road infrastructure for the specific case of periodic maintenance, it became imperative to study this sector in more detail. Here we give a short overview of the issues at stake in this sector. Understanding the system is also needed for a proper design of the simulation. Generating knowledge and making a model can be seen as System Analysis¹.

Until now the design freedom given to contractors is quite small. Periodic maintenance (understood as the resurfacing and reconstruction of roads) is outsourced but payments and quality checks are done immediately after the project is realized with no functional specifications but rather by supervising them in the process and the final thickness of the pavement, its roughness, and other physical characteristics. Projects are until now also tendered for small sections and one-time works.

Nevertheless plans for the future are either combining periodic maintenance with winter maintenance activities (snowplowing, deicing, and so forth.) or assigning different areas or tasks to the actors already active in the area, mainly contractors, consultants (design and geotechnical issues) and of course to the Road Administration itself.

3.1.1. Maintenance Management Cycle

The Maintenance Management Cycle consists mainly of tasks such as Policy, Management, Planning, Programming, and so forth, progressively translating very general guidelines into a concrete list of "works" to be realized by each district or region and further into a set of contracts to be tendered.

Until now the regional offices have done the Planning, Programming and Procurement themselves, with some consultant support. However, there are plans to organize contracts and activities in such a way that they include the whole process even from planning and use consultants as subcontractors. Or, alternatively, a scenario is considered where consultants may do all the activities from programming on and themselves look for construction contractors. In total there are 4 possible arrangements.

3.1.2. Future Scenarios in Periodic Maintenance

Possible future Scenarios for the maintenance of roads are the following:

- 1) Traditional situation: where Road Administration tenders out a specific section of the road and with a specific action and mix of bitumen prescribed.
- 2) Contractors are hired to repair a specific section of the road, not told exactly what to do, but expected to give a guarantee of 5 years.
- 3) Contractors take care of a whole area, programming and planning, are paid a fixed service fee per year (lump sum) and in coordination with Design Consultants

¹ As described by 12. Wenzler, I. *Take five- gaming/simulation design process*. in ISAGA. 1996. Riga: ISAGA. System analysis is an interactive process during which the design team, together with their client, analyses the problem environment and develops the conceptual model of that environment. This model is the basis for the design process.

perform the proper works to ensure a certain Service Level of Annual Objective, i.e. 80% of roads are in Sufficient Condition.

- 4) Design consultants take care of a whole area, they are paid a fixed service fee and they are the ones who hire construction subcontractors and look after the quality of their job, in order to ensure a certain Service Level.

In the game, scenario 3 will be simulated. This is the scenario considered to be the more innovative one and at the same time the one more interesting to be explored given the ample freedom that would be granted to contractors in this case. Scenario 4, though also very innovative is not an option being seriously considered, since the practical implementation of such a scheme remains very difficult; specially since consultants up to know have not developed the same capacity as contractors to bear risks.

3.1.3. Actors

“The process of identifying and creating the knowledge which is relevant to the problem environment starts with identification of main (real-life) actors within that environment [12]. The most important actors in the sector of periodic maintenance are:

- Road Administration (Headquarters). Goal: keeping the national road network in a condition that ensures certain public values (mobility, accessibility, and so forth)
- Road Administration (Regional Offices). Goal: keeping the local road network in the condition required by higher government levels
- Contractors. Goal: To earn money by maintaining roads
- Design consultant. Goal: To earn money by delivering information to consultants or the Road Administration
- Users and residents. Goal: to reach place A or B, comfortable and safe trip

3.1.4. The problem

Advanced computer models have been developed in both countries that can help calculate what would be the resulting road condition for given investment decisions (prioritizing high or low volume networks) and actions (from very light actions such as filling potholes to very heavy actions such as reconstruction of structural or unbound layers). Nevertheless it remains uncertain what happens if contractors are given this freedom: What trade-offs will they make? Will Quality of Road decrease/increase? Will efficiency in the sector decrease/increase? Will Regional Offices be able to monitor/control contractors? How would the private road maintenance sector develop?

3.1.5. Transformation of the conceptual model into a gaming model

Model transformation is an interactive process during which the conceptual model is transformed (in all of its qualitative and quantitative aspects) into a dynamic gaming/simulation model [12]. In order to arrive to a manageable game the real situation was simplified in the following ways:

- The relationship consultants-contractor was simplified such that the road administration deals only with contractors, where is assumed that contractors and consultants will act as one in a cooperative way
- Only one organisational level of the Road Administration will be played, the regional level is abstracted from
- Other government bodies and layers or activities are played by the facilitator

- It was decided to simulate the future (expected or desired) reality – choosing the most ambitious scenario out of the four possible scenarios for periodic maintenance. Other options were to focus on the existing reality or in the transition from existing to future reality

3.1.6. *Testing and improvement of the game prototype*

An overview of the two times the game was tested is presented in Appendix 1. The second time it was fully played. Though it was still part of the refining process, the verisimilitude of the results and the relatively small changes that were found necessary make the results still very interesting to be discussed and analyzed. These are considered preliminary results and are consequently presented and discussed in section 5.

4. ROAD ROLES: RESULTING PROTOTYPE

4.1. Subject Matter

The game is to simulate at an abstract level the new situation where instead of traditional prescriptive contracts more long term and performance oriented contracts are used which cover a whole road network in Periodic Maintenance. In other words, the change from traditional contracts that prescribe the kind of work that needs to be done in a specific section of the network, to more flexible contracts, increasing the contractors' freedom to a maximum level, where the contractor decides which section, when and what kind of work he will perform, with the only condition of keeping a certain level of performance for a whole road network within a specific area or district for a certain number of years.

4.2. Purpose

The game aims to help us investigate the complementarities and tensions between giving more design freedom to contractors, (the technical aspects of flexibility) and ensuring public values. It will help us answer the previous question for the specific case of periodic maintenance by allowing the involved actors to see the problem in a different way; it will open possibilities for creative thinking and the finding of solutions to solve this dilemma.

4.3. Intended Players

There are two major potential groups of players. First, there are professionals from the contractors' side and decision makers in the area of procurement of roads and/or public infrastructures. Second, we have students in the fields of civil engineering, public policy, economics and systems engineering.

4.4. Roles

In 'road roles' there are two parties participating actively in the game; contractors and the Road Administration. The Road Administration sends out an invitation to tender for the maintenance of a complete network consisting of 5 road sections; contractors have to present an offer and compete for the contract and the one winning it is entitled to maintain the road network in order to make money.

Other roles, like the bank, the central government, consultants and all other external factors and actors are played by the facilitator.

4.5. Impact analysis

An excel model that simulates road condition has been developed to realize the impact analysis. Once all players have registered action decisions – road administration has selected a winner and this contractor has developed a work plan for the next 4 years- with the game director, impact analysis for that game step – in this case a tendering round- is initiated. Briefly, the model takes as input the work plan of the winning contractor- and computes the results for that game step.

4.6. Scenarios

In this game, the kind of contracts will be kept fixed (long term rehabilitation contracts) but three different scenarios will be played that reflect the different market structures in different countries.

5. PRELIMINARY RESULTS

This section will present the results from playing the game with a group of road and pavement experts from a large Nordic design consultancy company (Ramboll) in Espoo, Helsinki. The game was played for four rounds which account for a real time period of 16 years.

In general lines the game advanced as follows. The road administration received a network of 5 road sections in an acceptable condition, no roads under 2 stars. Then they tendered their first 4 year contract and used price as the only selection criterion. The cheapest contractor was chosen and since he had prepared a very poor work plan the condition of the road decreased significantly in the following years, and delivering at the end a network of very poor condition, with no road above 3 stars (reasonable) and two with practically no functional life. The road agency learned from this experience and added new selection criteria and requirements to his wish-list. In this way contractors learned to play with the selection criteria and the payment mechanisms –bonuses and penalties- in order to maximize their profits and specialize through investments in Research and Development; and as the road agency learned from the response of the contractors and refined the rules and selection criteria. The way the game evolved will be described and analyzed in further detail in the following subsections.

5.1. Road Condition

The following table shows how the condition of the road network changed throughout the years as contractors realize different work plans. The condition of roads can vary from 0 to 5 stars. This grouping of roads in 5 categories– very good, good, reasonable, mediocre and bad- is used in Belgium, the Netherlands and the UK. However in the game simulation the scale runs inversely, being the best road the one with more stars. Meanwhile in the system used by these countries a condition of 1 means perfect or very good with no signs or damage or just signs of initiation and a condition of 5 is bad with a degree of damage that represents a threat to safety and functionality.

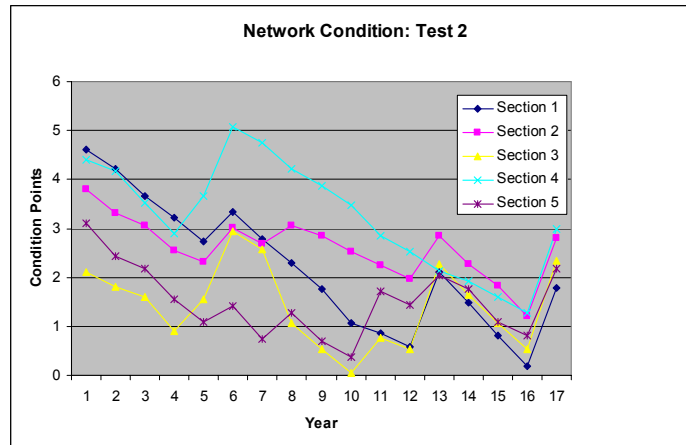


Figure 1- Progress of road condition

As it can be seen in Figure 1 the general tendency is a decrease in the condition – at least until around year 10 for all sections and even year 12 for some others. From year 12 on it starts to rise. Thus a decrease in condition – at least temporarily- is seen. This could be partly due to the lack of experience of the road administration in organizing the tendering process for this new kind of contracts. Though we don't have conclusive evidence – it has been found out in a study of procurement in the public transport sector that this learning causes a problem in the beginning and has a cost in terms of quality [13]. The mechanisms at play behind these results will be reviewed in the following sections.

5.2. Road Administration Evolution of Rules

Reviewing the selection criteria and requirements in Table 4 it can be noticed that rules keep changing and are adapted to the performance delivered by the previous contractor to either become more strict -from round 1 to 2 where sanctions are introduced- or to lower standards demanding relatively low service levels. In round 1 a minimum condition of 3 stars is asked and after some terms of really poor performance the road administrator is satisfied and demands a minimum condition of only 1 star in round 3.

Table 4- Selection criteria and requirements

Round	Selection Criteria	Requirements	Road Quality	Budget (Spent)	Offers	Winner	Profit
0			4 3 2 4 3				
1	Price	Condition of all sections at least 3	2 2 1 3 1	1000 (800)	2	Contractor 1	75,00%
2	Price Quality	Condition level must improve on 3 sections. In other 2 sections at least the same. Sanction per section with lower quality: 200	1 2 0 3 0	1400 (400)	3	Contractor 3	15%
3	Price Quality Work Plan	Condition of section 3 and 5 must be at least 1. All sections: must be at least 1. Sanction per section if condition is lower than requirement: 200.	2 2 2 2 2	1000 (all)	2	Contractor 1	23,50%
4	Price Workplan Environmental Effects	Condition must remain at least the same level (2 Condition points). Key aspect: environmental issues must be taken into consideration. Pollution rate must be lower than year 2014. Sanctions/bonuses: like previous.	1 2 2 2 2	1400 (all)	2	Contractor 2&3 merged	10,00%

The list of selection criteria and requirements grows and prices are not the overruling criterion any more. De Bruijn [14] in his book *Managing Performance in the Public Sector* describes a similar process of “mushrooming”. The situation seems to stabilize at a certain point when sanctions achieve a fixed value but if the environment changes and new policies are introduced; the search for a new balance and a new learning curve starts. This happened when an official communication card (an element of the game that simulates changes in policies in central government policy) -that required the introduction of environmental aspects in tendering- was received by the road agency.

Another interesting event recorded is that the contractor aiming to become a quality oriented one and was good intentioned, did not succeed. The selection procedure was apparently not able to select him as the winner. So finally this contractor went bankrupt.

5.3. Market and Sector Development

Two tendencies are shown in Table 5. The first one relates to market concentration. The number of players decreases –either because they go bankrupt or the fierce competition of one successful player force them to merge; it is difficult however to make a final statement in this respect since the game design does not allow new players to enter the market, as might happen in reality.

Table 5- Development of the market and the sector

Round	Players	Average Profit (sector)	R&D (investment)	Cost Structure	Impact Maintenance Actions
1	3	40%	Contractor 1 ==> 2 Contractor 2 ==> 1 Contractor 3 ==> 0	All contractors: LA: 100 HA: 175	All contractors: LA: +1 HA: +2
2	3	21%	Contractor 1 ==> 0 Contractor 2 ==> 1 Contractor 3 ==> 1	Remains the same, except for contractor 2: LA: 85 HA: 160	All contractors except for Contractor 1: LA: +1,2 HA: +2
3	2	14%	Contractor 1 ==> 2 Contractor 2 ==> 0 Contractor 3 ==> 0	Remains the same, except for Contractor 1: LA: 95 / HA:160 Contractor 2: LA: 85 HA:160	Same that previously
4	2	19%	Contractor 1 ==> 2 Contractor 2 ==> 0 Contractor 3 ==> 0	Contractor1: LA: 95 HA: 155 Merged 2&3: LA: 85 HA: 160	Same that previously

The second tendency is a significant fluctuation in the average profit levels of the sector, partly due to the introduction of new technologies but mostly due to changes in the rules. While the first contractor profited significantly (75% profit) from the recently granted freedom and few rules (no sanctions) then the increasingly strict rules of the road administration reduced profit levels to a minimum of 14%. In the last round the profit level increased to 19%.

5.4. General remarks

During this game as well as during previous occasions the game was played it seemed that as the game advanced the road administration lost touch with reality as to how much a certain level of effort or maintenance activity cost. This may happen either due to the introduction of new technologies that break with previous cost reference frameworks or due to the false perception the agency creates in case quite poor performance is delivered right at the beginning of the game.

6. CONCLUSIONS AND RECOMMENDATIONS

The previous sections lead us to conclude that:

First, many evolutionary paths exist (Finland, the Netherlands and many others) exist, which may or may not lead to efficient institutional systems. Transition towards optimality is at least certainly not automatic. Progress has been made in reforming road management in some countries, but in both Finland and the Netherlands important challenges remain.

Second, special attention needs to be paid to the issue of market concentration as a result of all these innovative practices. The question here is whether soon the savings in transaction costs and economies of scope and scale will be reversed as contractors have more market power and are forced by low profit levels to start acting on their defense. An important fluctuation in profit levels were also observed in the game results.

Third, the reform ahead in periodic maintenance remains a challenge. The game results raises concern about the reaction of contractors to greater freedom and the consequences of their choices in the physical condition of the network. A decrease in condition – at least temporarily- was recorded. This may have been partly due to the lack of experience of the road administration in organizing the tendering process for this new kind of contracts. Though we don't have solid proof – it has been found out in procurement studies in the world of public transport that this learning does cause a problem in the beginning and has a cost in terms of quality.

Fourth, it was also noteworthy that as the game advanced the road administration lost touch with the issue how much a certain level of service costs, showing that information asymmetry between principals and agents only increased, raising concerns about the ability of road agencies to control contractors in this new system, at least in the first decade after the reform has become effective. The subject of allowing greater freedom to contractors needs to be investigated further, especially when it comes to periodic maintenance where consequences of poor contractor performance could certainly threaten the functionality of the road network.

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Appendix 1

Aspect	The Netherlands- test 1	Finland- general repetition 1
Objective	Test mainly playability of the game and learning potential	Test mainly validity and verisimilitude of the game setting and results
Location	Delft, The Netherlands	Helsinki, Finland
Group	10 Master students of Technology, Policy and Management	8 Experts in roads and pavements
Knowledge of the content or sector	Limited but with knowledge about gaming techniques	Extensive
Context of use	Session of the Design a Game course	Continuation of a meeting of periodic maintenance experts of Ramboll from different country offices: Tampere, Oulu and Espoo
Homogeneity	High	High
Rounds played	5 tendering processes, 4 maintenance terms	4 tendering processes, 4 maintenance terms
Contractors	4 companies	3 companies