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DESIGNING OUTCOME-BASED PERFORMANCE MANAGEMENT SYSTEMS THROUGH SYSTEM DYNAMICS MODELLING TO FRAME CORRUPTION BEHAVIOUR IN PUBLIC PROCUREMENT

A CASE BASED PERSPECTIVE ON SERBIAN PUBLIC SERVICE PROVIDER

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ABSTRACT

Corruption is one of the most significant problems facing Serbia. While there are some signs that corruption may have become less rampant in recent years, available evidence suggests that corruption levels are still high while trust in key institutions is low (European Commission, 2014). This phenomenon is ubiquitous and has serious consequences on a country's public welfare. Numerous conducted studies have mainly focused on specific characteristics such as economic issues, legal issues, social propositions, impact on national development, and about economic policy. The rationale of this research is to concentrate on a specific Anti-Hail Public Service provider in Serbia by not only exploring the outcome of the public provider's procurement practice, but also outputs of such actions on the territory level. Therefore, the aim is to build a model of corruption based on Dynamic Performance Management approach in order to extend our understanding of corruption and grounds behind, as well as to provide an input to future policy-making on corruption issues.

This is achieved by the use of computer simulation modelling to explore how the results of public procurement in a specific Public Service provider results both in short and long term. In other words, how to apply Dynamic Performance Management system to reduce the effects of corruption on Public Service organisation performance - on the one side, and Public Welfare - on the other side. Systems Dynamics model of corruption developed in this study would be of use to policy makers and non-governmental organisations in understanding the complex nature of corruption. This modelling methodology is used in perspective of Dynamic Performance Management approach, which gives an opportunity for decision makers to clearly distinguish how performance drivers can be used to reflect the effects on the End Results and Strategic Resources of this public service provider.

With this study, I expect to interpret better interrelated main forces that regulate corruption and to design sustainable policies on strategies to limit the negative effects of corruption in Public Service provider. Furthermore, this paper provides a case-study analysis that can be a basis for further examination of Public Service provider's performance using dynamic modelling. Future research should focus on the empirical examination of this study to redefine its applicability, and should give to the policymakers and managers a better position to understand the system and achieve the desired results.

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To the memory of my beloved mother, the
reason of what I became today

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ABBREVIATIONS

BS Balance Sheet

BSC Balanced Scorecard

CLD Causal Loop Diagram

CMI Chr. Michelsen Institute

CPI Corruption Perceptions Index

DPM Dynamic Performance Management

DPMS Dynamic Performance Management Systems

DRBV Dynamic Resource-based View

GCB Global Corruption Barometer

GDP Gross Domestic Product

EBIT Earnings before Interest and Taxes

IBP International Budget Partnership

ICJ International Court of Justice

IMF International Monetary Fond

KPI Key performance indicators

LGU Local Government Units

NGO Non-governmental Organisation

OBI International research Open budget index

P&C Planning and Control Systems

PETS Public Expenditure Tracking Survey

PMS Performance Management System

PPO Public Procurement Office

PPL Public Procurement Law

QSDS Quantitative Service Delivery Survey

RBV Resource-based View

RC Republic Commission for the Protection of Rights in Public Procurement Procedures

RHMSS Republic Hydrometeorological Service of Serbia

SAA Stabilisation and Association Agreement

SAI Supreme State Audit Institution

SD System Dynamics

SDM System Dynamics Modelling

SF Stock and Flow Diagram

SME Small and Medium Enterprise

TI Transparency International

UN United Nations

UNDP United Nations Development Programme

UNSCR United Nations Security Council Resolution

USAID United States Agency for International Development

WGI World Governance Index

I   CHAPTER INTRODUCTION

"Every dollar that a corrupt official or a corrupt business person puts in their pocket is a dollar stolen from a pregnant woman who needs health care; or from a girl or a boy who deserves an education; or from communities that need water, roads, and schools. Every dollar is critical if we are to reach our goals to end extreme poverty by 2030 and to boost shared prosperity."

World Bank Group President Jim Yong Kim, Washington, December 19, 2013

This thesis is the result of my doctoral research within my study of Corruption applied to Public Service Organization for Anti-hail protection, located in Belgrade, Serbia. The purpose of this work is to create a System Dynamics model that can help understanding of the influence of Public procurement on the efficiency of a Public Company and its performance. Therefore, the goal is to develop a useful tool for measuring and evaluating performance in a Public Service Organisation.

To reach this objective and accurately analyse the behaviour of the organisation's indicators, analysis of the two elements of the Dynamic Performance Management system approach was conducted. Namely, namely (1) output perspective, based on the direct results of the company's business and, and (2) outcome perspective, based on the indirect effect on the wider audience, all stakeholders. During the research, performance indicators and their causal relations were investigated. The objective is to provide better understanding of the causes and effects related to adopted policies, undertaken actions, and targeted results in the public sector, which includes the main performance drivers related to financial, organisational and social results.

This chapter sets up the study overall. The subject area of corruption is introduced and positioned in a historical background. This case study research used mixed methods, and the different knowledge areas within which the research has been placed are briefly described. The presentation is followed by an explanation of the research objectives guiding this study, and how these translate into focused research questions. Short summaries of the individual chapters of the thesis are communicated afterward.

1.1 Background

There are many scientific works available for the topic of the need for profounder corruption studying (Leff 1964, Friedrich 1972, Mauro 1995, Treisman 2000). These studies have primarily concentrating on legal issues, economic issues, and the influence on general growth. Academic analyses of corruption have given emphasis to game theory, econometric modelling, and similar mathematical methodologies. Nevertheless, presently a significant number of reports, books, and articles are published on a regular basis. This change partially can be explained as increased public concern for the issue. Additionally, it reveals changes in the methodical methods and techniques and together with first-hand data accessibility that has made corruption a researchable subject. As a result, it has also made it possible to perform an "elaboration on corruption studies" since various exciting hand-outs and insights are obtainable. Corruption is widespread and has serious effects in developing countries. Research on corruption is a crucial part of understanding the dynamics of corruption so that anti-corruption policies might be successfully implemented. In this study, I aim not to examine a global level of corruption in Serbia, but to achieve a more practical understanding of what corruption might mean in a long run, based on a case-study approach on specific Public Service provider using Dynamics Performance Management system.

Performance Management systems have become more significant in recent years since "managers, be they in the public or private sector, are under constant pressure to improve the performance of their organizations" (Holloway, Francis & Hinton, 1999: 351). There are many scientific works available for the topic of the need for performance management systems to the public organizations. On the other hand, growth in the use of performance management analysis in the public companies is also evident (Radnor & McGuire, 2004).

A widely used approach to Planning & Control (P&C) in Public organizations regards the usage of spreadsheet models and accounting packages. Although using excel sheets based on BS and PL can provide some simulation modelling to support decision makers in their business growth planning there are other approaches that are more reliable. Nowadays, the lack of P&C systems is an important internal complexity factor in firms, leading to a much-bounded set of relevant information for decision-making, processes which are often mainly based on accounting reports, balance sheets and "flair for business" (Bianchi, 2002). On the other side, using SD allows applying in details non-linearity, delays, feedback loops, and soft variables (for instance company image, perceived corruption level or skills of employees), therefore making it suitable combination with standard performance methods.

In order to give suggestions for improvement of company's performance, and foster strategic learning I will try to make evident how a DRBV supports an analysis of Public Procurement concern. I will provide an analysis of the procurement dynamics to show the differences in the insights with diverse policies. In so doing, the field of the potential use of tailored performance management systems in other environments, particularly in this case Public company will be extended by using SD modelling.

1.2 Motivation

Transparency International's 2013 Global Corruption Barometer (GCB)[1] provides information that Serbian citizens rated a number of key institutions around 4 out of 5 on a scale where 1 means 'not at all corrupt' and 5 'extremely corrupt'; the worst rated were political parties and healthcare, followed closely by parliament, the business sector, police and the judiciary. According to the available research and reports by international organisations, corruption remains a solemn problem in Serbia. In 2014, Serbia reached a score of 41 out of 100 in the Transparency International Corruption Perceptions Index (CPI)[2] yet, while in a different study carried out annually by Freedom House, it is similarly stressed out that "corruption has decreased overall from the excesses of the Milosevic era,"[3] and the CPI itself suggests some improvement. It should be mentioned that comparisons of the CPI among different years are challenging due to the index's changing methodology.

The model introduced in this work has been developed using the SD methodology "as it is well suited to dynamic environments in which human behaviour interacts with the physics of an operation, and in which there are multiple feedbacks connecting employees, managers, customers, and other actors" (Oliva & Sterman, 2009). To be more concrete, I used DRBV to create the SD model on the real case study. SD model focuses on investigating Anti-Hail Public Service organization internal procurement processes and their influence on the company's success (through key performance indicator).

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[1] See http://www.transparency.org/gcb2013/country/?country=serbia
[2] See Transparency International Corruption Perceptions Index (CPI), http://www.transparency.org/cpi2014/in_detail. The CPI - presumably the most known corruption index – is based on an average of a range of analysis and studies performed by other organisations; on TI's scale, country/territory's score indicates the perceived level of public sector corruption on a scale of 0-100, where 0 means that a country is perceived as highly corrupt and a 100 means that a country is perceived as very clean
[3] See https://freedomhouse.org/report/nations-transit/2014/serbia#.VWYGEc_tmko

The author thinks SD is a prominent instrument to display causal relationships underlying business results, could be exceedingly useful and valuable to Anti-Hail Public Service Company. The results of this work may be used as food for thought and as a way to learn from past decisions by testing different policy levers within the simulation model. Bianchi & Winch (2008) point out a lack of systemic view of the linkages between strategic resources and a flawed perception of the delays associated with their growth processes that constitute the major causes of losses for many organisations. The systemic view is intended to include a comprehensive set of relevant factors and dimensions, which together form an integrated managerial system of performance measurement.

The central idea of designing performance management systems using SD is to follow the use (transformation) of resources from the point of the very first (elementary) resource allocation to the point when the results of the allocation are realized (as company's outcome, and output in the society). In the causal chain, one factor at any point along the chain is regarded as a determinant of the factor that succeeds it. Moreover, the next resource allocation decision is dynamically affected by the results of the former decision, thus allowing for learning-by-doing.

During the review of the obtainable literature, no publications were found in the use and application of System Dynamics on corruption in Public Procurement within the Anti-hail Public Service field. As a result, this current research has a certain degree of novelty. Nevertheless, exploring new fields is always a challenge that comes together with the risk of failure.

1.3 Research Approach

A systems approach can be used in understanding corruption from a broader perspective. With a systems approach, one can create a model to recognise causes and consequences of corruption in any public organization in any country. Corruption affects both social and financial systems in either a damaging or positive way - that can be understood by using systems simulation, collecting data from the people employed in different public and private organisations.

One of the most important tools of systems analysis is systems thinking. Basically, system thinking is a way of seeing systems from a broad perspective that take account of overall system structures, rules and loops, along with complex connections and delays in systems, instead of viewing only particular connections in the system. This comprehensive interpretation can help us quickly categorise the existent causes of problems in organisations and know just where to work to address

them[4]. System thinking has created a diversity of codes and apparatuses for analysing and improving systems. It is a unique approach to problem solving, in that it views certain 'problems', e.g. corruption, as part of the whole system. Therefore, focusing on these outcomes will only further develop the undesired element or problem (Warren, 1999).

Several conceptual challenges need to be addressed in this research. The first challenge is coming from inconsistent definitions and effects of corruption, which seem to give a contradictory understanding of what is to be considered as corruption. Instead, this work uses the information provided by different official sources (e.g., UN, World Bank, IMF), and non-governmental organizations (NGO), containing abbreviations as used in this research. Also, all information are open for public use in different institutes like Transparency International (TI), CMI, and different Statistical Data. Therefore, by retrieving information from the same sources, it is possible to overcome this challenge. The primary hypothesis of this research is that the effects of corruption cases in public procurement on government budget are direct and negative - meaning that the higher the degree of corruption, the lower the relative public budget. Additional, the lower the budget, the lower is Public Satisfaction.

The second challenge is connected with using quantitative data that could lead to comparing divergent periods. Barro (1991) states that incomes converge over time and, therefore, should the problem be studied over the long time with the best available data (Barro & Sala-i-Martin, 1991). However, there is a risk of missing important data about the appearances and forms of corruption. This challenge is solved by using same quantitative data and methods, starting in 2004 and running the model for the following 50 years, isolating the corruption effect only.

The last one is connected with the modelling of corruption itself. For the aim of this study – limiting its scope to the problem that affects only public procurement, means restricting its usability to only policies that may be possible or interested in improving. However, there could be significant sources of corruption associated with unofficial influences and the revenue coming from different types of corruption actions, «which are measured by the Shadow Economy (Schneider et al., 2010, p. 1). In this work, the scope of corruption is narrowed to reflect the facts that are found in the Anti-corruption Council[5] report[6] and that are actually encountered in Public Service Company processes.

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[4] Read more on http://managementhelp.org/misc/defn-systemsthinking.pdf
[5] The Anti-Corruption Council (Savet za borbu protiv korupcije) was established by The Decision of The Government of the Republic of Serbia on 11th October 2001. The Council is an expert, advisory body of The Government, founded with a mission to see all the aspects of anti-corruption activities, to propose measures to be taken in order to fight corruption and to monitor them.
[6] See the report (in Serbian) http://www.antikorupcija-savet.gov.rs/analize-i-misljenja/cid1033-1104/preispitati-rad-rhmz-a-i-nezakonito-trosenje-budzetskih-sredstava-za-protivgradnu-zastitu.

1.3.1 Research Focus

This research mainly focuses on perceptions of corruption combined with available data on corruption practice, in order to gain an understanding of corruption connected with public procurement. This standpoint is associated with my curiosity in the study of practices that have a vast existence in people's daily lives.

In this study, we all will try to understand the issue of corruption in depth by using System Dynamics Modelling (SDM) with qualitative research methods to analyse the data and provide a foundation for the DPMS. Direction originated in qualitative data breakdown are operationalised in a SD model. The emerging computer simulation model is based on the description of the current situation in Anti-Hail Public Service provider. Strategic resources that were showed and elaborated as the most important ones, and what is the connection with the end results based on the performance drivers, are explained subsequently.

1.4 Objectives and Research Questions

The principal objective of this dissertation is to construct a computer-based model that can be used to understand better both performance dynamics and corruption practice, and their consequences. This research will explore and study this topic by using a systems approach to building a tailor-made structural model of corruption, gained through computational simulations on qualitative data collected from Belgrade (Serbia). This model aims to see corruption from a new perspective. An attempt has, thus, been made to understand the problem of corruption, financial problems, and social perspective through a system thinking methodology. Therefore, using the simulation modelling will allow to explore how the social system of corruption limits the behaviour itself. The standpoint of corruption utilised in this research is that it is a social phenomenon. That encompasses public dealing in general; demonstrated as a social system of corruption that affects many other structures in one or another manner. This thesis intent to explore the following issues in more depth:

General Research Question:
- How can our understanding of corruption be extended by using a DPM approach?
- What would an SD model of corruption in Serbian Anti-Hail Public Service provider look like?

Specific Research Questions:

- How can strategic resources and their relations be framed in a particular Public Service Organisation?
- What are the main strategic resources that affect the performance of public service institution?
- What are the key performance drivers related to critical success factors that impact on Public service organisation results?
- What are the end results affected by performance drivers that feed strategic resources over time?
- How are they presented in the SD model?
- Which policies can be recommended to manage the performance of Public service provider with regards to public procurement?

This dissertation has the objective to stimulate the broadening of a logical theoretical framework that can be used to investigate corruption dynamics. Despite the fact that it is challenging to ascertain the ultimate result study might have on concrete reforms of corrupt procurement practices, without providing an analytical framework for reform, meaningful change itself seems improbable.

In the table below in short are presented the main research methods used to answer the research questions.

Table 1-1 Research questions, sources and methods

Research Question	Sources	Research Methods
What are the main specifics of performance management system design and use in Public Service provider (RHMSS)?	Literature Public records	Literature review Analysis
How can strategic resources and their own relations be framed in a particular Public Service provider (RHMSS)?	Public records Literature	Analysis Deskwork
Which policies can be recommended to manage the performance of a public provider using SD methodology?	System Dynamics model	Mental model consideration SD simulations

1.5 Design of the Thesis

The thesis is organised into five chapters. This section provides short summaries of the contents of each chapter.

Chapter 2 begins by laying out the theoretical dimensions of the research and looks at economic and development theories on corruption. Here, I also present an overview of corruption, governance and economic issues in Serbia. Next part introduces the System Dynamics studies on corruption. The last part provides an overview of the Performance Management approach, and in particular different approaches elaboration.

Chapter 3 starts with describing the methodology used for the study. In this chapter, I also discuss the difficulties in studying corruption. Finally, it presents the findings from the qualitative data analysis phase. The chapter concludes by discussing how the themes contribute to a more nuanced understanding of corruption in Serbia by implementing SD to enhance traditional PM into Dynamic Performance Management Systems.

Chapter 4 focuses on a most important aspect of this research. It describes the set of data used by the System Dynamics methodology for development of the corruption model. This chapter has been organised according to the stages of model-building identified in Chapter 3: feedback process, causal loop diagrams, dynamic model building, dynamic behaviour and analysis. The last section of this chapter on simulation presents the analysis and a discussion of the simulation results in the context of the dynamics performance management, as well as suggested policies.

Chapter 5 rounds off the thesis as a whole by providing a brief summary of significant findings. Furthermore, the theoretical and practical contributions of this study are presented, as well as recommending possibilities for further studies that this study has opened up.

II CHAPTER LITERATURE REVIEW

"Corruption is widespread in many developing and transition economies, not because their people are different from people elsewhere, but because conditions are ripe for it. The motivation to earn income through corrupt practices is extremely strong, exacerbated by poverty and by low and declining civil service salaries".

The World Bank (2012)

In this chapter, the various approaches examined from the obtainable literature to understand the phenomenon of corruption are discussed, by using economic, organisational, and System Dynamics approaches. In the first section of this literature review, the focus will be on earlier theoretical and empirical studies of corruption to give a fair understanding of how the problem is formed and studied. Also, to develop a background, which will help the application of a System Dynamics approach. In the second section, an overview of corruption, governance and economic issues in Serbia is presented. Lastly, the focus is on the System Dynamics approach to giving an understanding about System Dynamics modelling and on theories of Performance Management.

2.1 Theories on Corruption

This section reviews important issues related to the theoretical and empirical work in the area of corruption, social and cultural issues, weak institutions, and economic development. Theories from economics and a development studies perspective on corruption are discussed.

Some scholars have defined corruption as behaviour by public officials that deviates from the public interest (Morris, 1991), others have conceptualised corruption based on deviation from moral standards (Brooks, 1970). Similarly, Morris defines corruption as behaviour that deviates from serving the common good, suggesting that it is an embodiment of a state's original norms and legitimising ideology (Morris, 2008). The most prominent definition of corruption[7], however, is the one used by the World Bank and this is worth exploring in a little more detail given how important it has been within the discussion of corruption within the „development" context. The World Bank defines corruption as the "abuse of public office for private gain" (World Bank, 1997)[8]. Transparency

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[7] The word corruption comes from Latin corruptus, past participle of corrumpere, from com- + rumpere, meaning to break, break down, and spoil.
[8] Likewise, Svensson (2005) perceive the corruption as the misuse of public office for private gain.

International (TI) also uses this definition. Although this definition may be useful, it is rather too narrow and simplistic.

Brown and Cloke (2004) point out some further limitations of the World Bank's definition of corruption. They argue that private individuals gains from corruption are not limited to purely personal and monetary interests and that the abuse of political position (political corruption) to pursue a particular socio-political program for personal interest, against the will of the majority of the people, is not adequately considered in the Bank's definition of corruption. According to Shleifer and Vishny (1992), corruption is the sale by government officials of government property for personal gain. For instance, public administration officers, every so often, get bribes for certifying authorizations and licenses, or for prohibiting the entry of competitors. In these cases, administrators charge for their selves for things that formally is a custody of the state.

When trying to discover the grounds and variations of corruption practice, it is typically rewarding to start with academic reviews of corruption but also to put it into perspective with country-specific knowledge, to understand it deeper and to propose policy actions. That makes it harder for handling from the purely theoretic methodology. Also, it is very problematic to investigate and collect relevant information, which often are hidden, untrustworthy, and "soft" or "mushy" data[9].

The GDP per capita grade bears most of the clarifying power of the different corruption indicators (Paldam, 2002). That implies that the poorest nations have the highest corruption practice, and the risk is high for e.g. foreign financiers.[10] There is also a specific variation regarding different democracy levels. For example, Cheung (1998) claims that the aforementioned promotes not only poor economic performance but corruption as well, "as politician's auction off government favours to factions in an electorate ill-prepared to appreciate the costs of such measures".

Practically, the issue of corruption occurs when public institutions and the business players have some kind of collaboration, and public institutions and decision makers have to be observed endogenous. The recognition that both corruption and government are endogenous is also detected by Ehrlich and Lui (1999). For example, if the authorised officer cannot differentiate a price between customers, at that point as a monopolist, he/she will just fix the marginal revenue the same as the marginal cost. When there is no misuse of the authority, the total price including the bribe at all times surpasses the government price. It pays the official to generate a shortage at the official price, and

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[9] Information about things that are difficult to measure such as people's opinions or feelings, company's image, etc.
[10] On the other side, Denmark had a score of 10.0 in the 1998 TI ratings, which is characterised as "perfectly corruption free." No country, on the contrary, has up till now received a score of zero.

then to get bribes as a method to clear the market for the government-supplied goods (Shleifer and Vishny, 1992).

Moreover, government activity beyond the protection of property rights will cause more corruption. If the incentives to corrupt further develop of the sort predicted by Krueger (1974), government size will increase corruption, and corruption too will increase government spending. Furthermore, the seller, in this case, has no incentive to report on the officials; therefore, the chances that corruption will be identified are significantly reduced. This in turn generates a further incentive for corruption with mugging to increase. For the reason that corruption practice supports the interests of both buyers and sellers, it will be more tenacious. This result suggests that the first step to reducing corruption should be to create an accounting system that prevents theft from the government. In the collection of payments duties, such accounting systems might well reduce corruption because without theft - bribes raise the buyer's cost and hence give him the incentive to expose the corrupt official.

From an ordinarily theoretical perspective, the most recent period has been a "time to rediscover bureaucracy" (Olsen, 2005) and some academics have claimed a strong defence for a recurrence of the Weberian bureaucratic organization (Pollit and Bouckaert, 2004). However, this supreme type of administration includes various structural features. For example, it is expected to be a formal, hierarchical, and skilled office together with a specialised governmental workforce with permanent engagement and structured careers improvements. These different elements possibly will not occur together in practice (Olsen, 2008), besides an absence of comparative data on these characteristics. Therefore, it is challenging to rely on one attribute to control and combat corruption.

Another approach to battle against corruption is with the help of the public influence. Collective choice regulates spending, which then defines lower corruption. Wittman (1989) argues that democracy progress the competitiveness of the administrative process and henceforth should improve efficiency, focused not on revenue but inclinations of the inhabitants. Such means may take account of freedom of thought (media), different laws, transparent and regularly publishing of information. The Wittman suggestions embrace the idea that democratic means for determining political power should encourage more efficient corruption control, possibly also with the usage of the modern technologies.

Advanced technologies could be the preferred choice, for instance for over-invoicing corruption practice. Besides, Shleifer and Vishny (1992) debate that the managers and bureaucrats in developing nations tend to import products on which bribes are the easiest to take (not the products that are most profitable for the state organisations). To achieve such a goal, they principally discourage or ban the import of suitable tools, and encourage the import of exclusive products on

which over-invoicing is harder to discover. Consequently, nations result in usage of instruments and goods that are notable below the required level of quality (and/or quantity). This illustration fits precisely into the framework of this thesis.

To get the most out of the situation for their private incomes, public servants ban procurement of products and services on which bribes cannot be gathered without exposure, and stimulate imports of goods and services on which they can have a private interest. As a result, available products and chattels in the country are defined by corruption prospects instead of preferences or high-tech updates. The above mentioned example may shed the light on causes why numerous developing countries instead of, for instance, on health and education (where remain restricted possibilities for corruption practice), would rather use limited funds on large infrastructure projects and defence (with plentiful opportunities for corruption).

2.1.1 Forms of Corruption

Based on a number of basic characteristics, Amundsen (1999) has categorised some key forms or manifestations of corruption that will be elaborated in this section.[11] Although it is hard to make a clear separation between them (in some cases they have similar or the same elements), they may label some basic variations of corruption practice[12].

Bribery could be understood as the offering or promising an advantage, or the payment itself (in gifts, money or kind) that is exchanged in a corrupt relationship (a relationship that is illegal or unethical). Lindgren (1993) defines bribery as a corrupt benefit given or received to influence official action so as to afford the giver profitable or better than fair treatment. This is undoubtedly a corruption form[13]. There are numerous comparable terms to bribery, like sweeteners, gratuities, "commercial arrangements", baksheesh, kickbacks, and payoffs. Despite different terms, they all have the same concept and purpose to get business pass smoother or more favourably through the public or administration system of government. Examples regarding private companies are getting easier

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[11] Since early 1990, The United States Agency for International Development (USAID) has become focused on corruption as the misuse of public administration for private gain. It encompasses abuse by a government official such as embezzlement and nepotism, as well as relating public and private subjects such as bribery, extortion, influence peddling and fraud. See more at http://www.usaid.gov/.

[12] The corruption forms arise in both political, or elite corruption and lower-level, administrative corruption. Political corruption usually includes a trade of goods, access to rents, or other benefits for governmental elite, privileged companies, and their networks of operatives and followers. The transaction volume is normally important. Administrative or bureaucratic corruption typically refers to smaller transactions and mid- and low-level government officials.

[13] Surveys in Taiwan, for instance, report 94% of interviewees as having been 'led to' bribe corrupt tax administrators and 80% of certified public accountants as admitting to bribing tax officials (Chu, 1990).

admission to government contracts and infrastructure projects, perform business activities despite environmental rules, forgery tax and so forth.

Embezzlement means to steal (theft of resources), or misappropriation of funds placed in one's trust or under one's control. Usually, it comes from an unfaithful employee who is hired to manage the money or goods. On one occasion it comes from the publicly authorised officer, it is then a form of misusing public resources – from that state institution, but in the wider picture of the whole nation. Despite the fact that it is not strictly understood as corruption per se (it does not include the "civilian" side directly), it is counted in the wider classifications.

From the legal point of view, corruption is a transaction between two persons, one state representative and one private citizen, where the state representative goes beyond the boundaries of the law and procedures with the intention of securing himself a private advantage. The public is disadvantaged when public funds are embezzled, but then again no individual property is stolen, and people do not have right to ask for remuneration. In many highly corrupt countries, it can develop separately of the public moral and with limited possibilities of public sanction. It is a crucial part of the sources of financing of the regime, possibly higher than resources coming from bribery.

Extortion is money and/or other resources pull out by the use of pressure, or extraction by coercion such as the intimidations to use force[14]. Blackmailing and extortion are corrupt transactions where money is violently extracted by those who have the power to do it, states Amundsen (1999) but where too little is returned to the "clients" (possibly simply some vague promises of exception from further harassment).

Straddling is one more form of the embezzlement. It occurs when some power-holders use their political workplace to enter into, secure and increase their private business interests. An example of this form could be found in a certain nation where the governmental decision-makers have made foreign companies and monopoly rights be, firstly, state-owned and, then reallocated these to the selected followers.

Protection" or "security" money, as a distinctive type of corruption, might be organised in some countries when, for example, the state and public organisations or some public representatives force money out from money from residents or companies. In this category belongs taking the money "below the table" and "gifts" from inhabitants when they intend to undertake some public service or

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[14] Extortion has been studied in the contexts of an organised crime (Konrad and Skaperdas (1997)) and public procurement (Auriol, 2006).

institution, as for instance hospital, university, municipality. These practices may perhaps be understood as "informal" forms taxation[15].

Fraud is defined as an economic crime that comprises some type of trickery, scam or cheating. It is the act of intentionally deceiving somebody so as to gain an unfair benefit and, in this case, includes a manipulation by bureaucratic agents between political figures and residents, with agenda of pulling a private profit[16]. In addition to this definition, fraud is seen as a wide-ranging and prevalent expression. For illustration, when forgery, smuggling and another organised economic lawbreaking is supported by "official" sanction and/or involvement fraud. Alternatively, when the governmental elite and public agents participate in closing their eye on different financial criminal activities, not to mention if they are as well participating in them.

Favouritism is an instrument of power misuse implying "privatisation" and a very biased distribution of state resources. It is the natural human inclination to give preference to relatives, friends, and anyone who is close and trusted. However, this is a form of corruption since it indicates a corrupted distribution of resources. Favouritism is the recognised weakness of administrative agents and governmental elite (they who are managing public funds and have the legitimacy to make a decision with regards to resources distribution) to favour certain people. A typical example of favouritism is, for illustration, to award a relative an office job to a relative or a close friend, not taking into account any merit.

Clientelism is, rather, the ordinary tendency of the majority to prefer his own kin (family member or ethnic, religious or regional group member). Clientelism itself can embrace a variability of types, from a one-time compensation of a person's vote, the allocations of jobs via patronage, to giving political allies right of entry to welfare programs, government subsidies, or other favours in return for electoral support from them (Piattoni, 2001).

Nepotism can be understood as a characteristic type of favouritism, based on both acquaintances and relationship whereby a person exploits his/her official administrative position to arrange for a job or position to a relative or close friend who is not qualified for or deserving the

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[15] The rise of the Sicilian mafia is explained in the book by Gambetta (1993). Faced with doubt that the other trader is cheating, a trader might ask for the paid (illegal) service of mafia to provide credible threats beforehand against cheating. Because of a low degree of mutual trust and insecure property rights, all traders end up paying members of quasi-public organisations to refrain from violence. This payment is not considered corruption but extortion, but most of the economic effects are likely to be similar.

[16] Therefore, for different academics this problem was suitable to apply the principal-agent theory or incentive theory (Eskeland &Thiele 1999; Fjeldstad 1999).

position. Many directors of institutions or majors in municipalities have attempt to secure their position by nominating e.g. wife, brothers, sisters, aunts to crucial job titles in the public apparatus.

Finally, as a form of corruption is worth mentioning Lobbying, as any activity carried out to influence an institution's policies and decisions in favour of a particular cause or outcome (Brooks et al., 2013). Even if allowed by law, these acts can become corrupt if disproportionate levels of influence are apparent from individuals or organisations.

2.1.2 How can Corruption be measured?

Various forms of manifestation and diverse approaches of defining corruption ultimately influence the way a corruption phenomenon can be analysed and measured. Berg (2001) analysed different ways and means on the measurement of corruption. Nowadays, corruption is measured using surveys and polls of a random sample from populations or businesspeople (known as subjective measuring method despite the fact that they are based on divergent approaches: on the perceptions and based on experience). Several quantitate measurements are worth mentioning such as Public Expenditure Tracking Survey (PETS)[17] method, Service provider surveys[18], at the bureaucratic level, and firm surveys, at the firm level.

PETS is a method for locating and quantifying political and bureaucratic capture, leakage of funds, and the organising issues of human and in-kind resources, for example staff, workbooks, and medicines (Reinikka & Svensson, 2003). Furthermore, the governmental honesty variable is an important corruption measure that shows an indication of the possibility that "high government officials are likely to demand special payments" (Damania et al., 2003).

Typical cross-national measures of corruption are collected through surveys. When trying to discover and analyse microdata, the cagey nature of corrupt acts has to be taken into account, since it is almost unmanageable to collect trustworthy quantitative data of corruption practice. For investigation on the firm level, information from Business International (BI) were analysed by Mauro (1995). In the early 80's, Mauro done a survey for more than 50 countries containing different elements, among them corruption. One of the questions apropos whether and if positive, to which level commercial relations contained elements of corruption or some suspicious transaction. The

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[17] Using sample survey basis, PETS tracks the flow of the public funds and resources through different layers to determine how much of the originally allocated resources reach each level.
[18] The quantitative service delivery survey (QSDS) for instance, is based on systematic quantitative data (input, output, quality, prices and so on).

survey was done with diverse professionals and experts from each country. Based on the perceived corruption level, BI ranked them consistently on a scale from 0 - 10.

The most comprehensive quantitative macro-level indicator of corruption, the Corruption Perception Index (CPI) is based on a cross-country survey with clearly defined country levels. Transparency International commissioned the Göttingen University, and a group of academics with supervision by Johann Lambsdorff produced the index. The CPI evaluates the degree to which public officials and politicians are assumed to agree to take bribes, do illegitimate transactions in public procurement, embezzle civic resources, and commit related cheats. Based on the corruption perceived level, CPI initially used a scale from ten to zero. When a country is ranked with a score of zero, that means that is perceived as completely corrupt while ten indicates a very honest country.

Transparency International (TI), based on an aggregation of multiple surveys of public and expert opinion, presently offers scores for 177 of the world's countries on an annual basis. In 2014, it was created on the basis of surveys conducted by 12 independent organisations and included 175 countries. These surveys, however, were not tackling corruption problem, but rather widespread development and business aspects. Therefore, this index is created as a weighted average of different indexes from ten diverse organisations. Also, as part of the update to the methodology used to calculate the CPI, the new scale of 0-100 was introduced in 2012 (see Figure 1 for the results of the new scaling). Because of the update in the methodology, however, CPI scores before 2012 are not comparable over time.

Another extensive indicator was developed in 2008 by the Forum for a new World Governance[19] for an accurate representation of the situation of world governance and its progress. The World Governance Index (WGI) is based on data from 179 countries, included in the survey, and combines five indicators. Each indicator is made of 13 sub-indicators, and each of those made up of 37 indexes – among them the Corruption Perception Index. The source for it is again TI index, calculated in the following way:

Equation 1 Corruption Perception Index

$$\text{Index} = \frac{\text{Country Score}}{10}$$

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[19] See http://www.world-governance.org/spip.php?page=accueil&lang=en
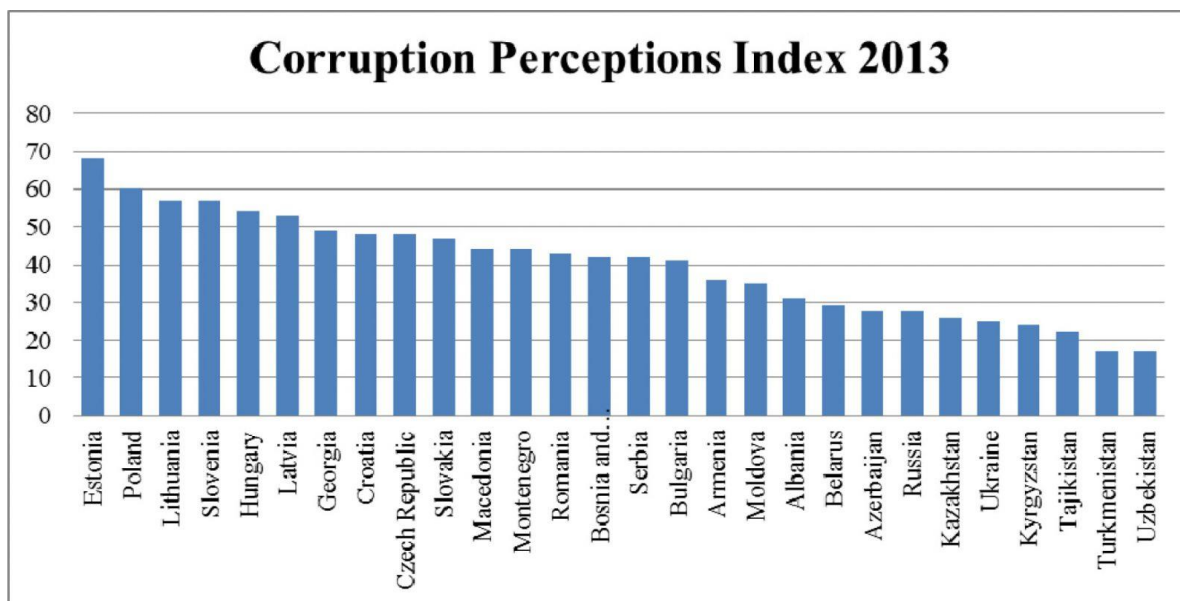
Figure 1 TI's CPI index, according to the new scaling

The majority of detailed indexes are based on justly ambiguous and overall questions regarding the occurrence of corruption actions perceived by either specialists or business leaders. Approximately half are made based on expert opinions within created checks to guarantee cross-country consistency. The other half is based on questionnaires from middle and high-level firm management. Hence, the CPI is mainly a "poll of polls", created by different ways of professionals and risk specialists assessment and, therefore, is replicating their impressions.

Survey-based measures of corruption have some fundamental weaknesses, such as the trustworthiness of data collected, or even that reliability of the CPI, for instance, might deteriorate over time since with rising media coverage. Therefore, there is a risk that survey participants, rather than stating how much ''real'' corruption happens, are reporting what they believe is happening[20].

Alternatively, a novel objective measure of corruption has been proposed by Golden & Picci (2005). They created a subnational proxy of corruption and, using Italian data, point the creation of an index of missing infrastructure, or 'corruption'. It is based on the difference between the amounts of the physical quantities of public infrastructure[21] (roads, hospitals, etc.), and the cumulative price government pays for these capital stocks. The larger the difference between these two is, the more money is being lost to misuse, fraud, bribes, and embezzlement, and the greater corruption level is.

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[20] For an overall discussion of the reliability of the TI index, see Lambsdorff (2001).
[21] This measure was made for Italy's 95 provinces and 20 regions as of the mid-1990s, controlling at the regional level for potential dissimilarities in the costs of public construction.

2.1.3 Manifestations of Corruption in Public Procurement

Procurement[22] of products and services by government bodies alone averages between 13% and 20% of Gross Domestic Product (GDP). In some states it is even more - worldwide is estimated the average of 9.5 trillion USD p.a.[23]. Hardly any other field is more attractive for misuse of public funds or gives additional prospects for corruption than government procurement. The loss in value of the contract, caused by various forms of public funds misuse, is estimated at in general between 10% and 25% and in some cases even higher, up to 50% (yearly damage in EU is calculated to be around 120 billion EUR or 163 billion USD [24]).

There are diverse aspects in which the effect of corrupt procurement can be recognised. Underneath, the key manifestations of corruption in Public Procurement are underlined and explained briefly.

- Financial impact or monetary loss can encompass the following categories:
  - Needlessly high expenses of purchases, capital investments, services, on the one side, or unnecessarily low income accrued from licences, permits, and concessions, on the other side;
  - Sub-specification quality of goods or works, not justifying the price actually paid;
  - Stocking a government budget with monetary obligations for acquisitions or investments that are not required, not economically reasonable or are overpriced; and
  - Increasing the government cost with early repair costs to restore and maintain goods, which are too recent to justify such maintenance expenditure.

- Economic Impact

Economic influence might contain loading a governmental budget with operational, maintenance and debt servicing obligation for public investments or procurements, without having any value for the country's wellbeing. Additional, indirect impact may take place if capital investment levels drop because of corruption costs and stipulations to businesspersons, hence affecting investment and monetary growth.

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[22] The term "Public procurement" concerns all agreements made by the public institutions and agencies and firms (public or private) or individuals.

[23] See more at http://www.oecd.org/gov/ethics/meetingofleadingpractitionersonpublicprocurement.htm

[24] Calculated by The European Commission, Report from the Commission to the Council and the European Parliament – EU Anti-Corruption Report (February 2014). Check http://ec.europa.eu/dgs/home-affairs/what-we-do/policies/organized-crime-and-human-trafficking/corruption/index_en.htm

- Environmental Effect

    Misuse of public funds could lead to a wrong decision, for instance, projects that have a controversial environmental impact. For illustration, if an investment venture is not aligned with the country environmental standards, then the harm might involve unnecessary environmental or health risks or else real loss, financial burdens, or durable indirect environmental influence.

- Health and Human Safety Influence

    Due to quality deficiencies, environmentally undesirable choices or even noncompliance with environmental or health standards might involve health harm and safety risk. A suitable example of this effect is a situation in which corruption stimulated sub-standard investing caused construction failure and had consequence in injuries (or even human losses).

- Effect on Innovation

    When there is an absence of competition due to strong corruption practice, that situation leads to the neglect of innovation. Firms that are counting on "corrupted" public procurement process will not use resources on innovation. Indirectly, even enterprises that are not involved in corruption practice might feel discouraged to invest in innovation if they cannot access the markets because of corruption.

- Erosion of Values

    Nowadays, corrupt practices have become a fair way of life in many countries and population is exposed in one or another way to the cases of flourishing corrupt practices. As time goes by, and these careless practices are not being sanctioned, while unscrupulous and corrupt officials are getting rich and becoming role models because they are perceived as successful - it is inevitable that morality of society undermined. Provided that greater wealth due to corruption activities causes increases in social status, without being punished then moral values of a society, in the long turn, will only grind down.

- Erosion of Trust in Government

    In a way connected with above explanation, erosion of trust in the government occurs, with time delay, when people witness that reckless deeds by public officials are not being sanctioned. Consequently, they conclude that public administration is not to be absolutely trusted. Moreover, it sends the message that cheating is morally tolerable and not against collective principles.

▪ Damage to Honest Competitors

The fraudulence of corrupt bidders, when fruitful and not sanctioned, damages and most likely destroys the honest competitor. Also, it might result in job losses on the side of a market subject who might be superior and more innovative. However, the corrupt bidder, not willing to rely on quality and price of his goods or services, but choices to corrupt to gain contracts, might be better off[25].

▪ Danger to Economic Development

If public administrators invest resources in capital investment projects not based on their contribution to economic development of the country but in their capability to produce bribe payments, a country might rapidly result in wasteful investment opportunities. That may limit external development assistance and therefore seriously hold back the country's economic development.

To end with, corrupt (bad) public procurement will contribute to the rising of poverty and inequality by taking the funds away from the social needs. It will stimulate wrong choosing, inspiring rivalry in bribery rather than in quality or price. Regarding firms, corrupt procurement will make available an imbalanced and risky competitive advantage for those companies who do not have aspiration, or cannot afford to bribe their way in the market.

2.2 Corruption in Serbia

Corruption is one of the most significant issues facing Serbia. While there are some signals that corruption may have become less rampant in recent years, accessible data advocates that corruption spread be still in elevation while trust in main government institutions is at a very low level. The effect on populations is substantial: everyday corruption routine can place a significant anxiety on the poorest and marginalized groups while numerous scandals including corruption linked with highest governmental representatives undermine nation's, especially young citizens', confidence in the future.

The TI's report summarized the results of the public opinion survey about a perception of corruption, compared with the other European countries, in Figure 2[26]. Notwithstanding this perception, the percentage of Serbian citizens who believe the country is moving in a good direction

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[25] Transparency International's Handbook for Curbing Corruption in Public Procurement provides more examples of corruption practice.
[26] Source: http://www.mdtfjss.org.rs/pub/serbia-judical-functional-review/, adapted from http://www.transparency.org/gcb2013/report

stands at 30 percent (CeSIDOpinion Polling Agency and UNDP Serbia, 2014). According to this survey, the low living standard critically affect perceptions of the issues Serbia is facing; most problems are related to financial matters. Unemployment (44%) and poverty (16 %) are two of the Serbia's leading issues. Ranked third is corruption, with 11% of all respondents seeing it as the key problem.

Also, Serbia has yet to consolidate its own statehood – is presently confronting the challenges of Kosovo's status[27]. A severely divided public is facing a political deadlock between reformist and anti-reformist that undermined the reform. This challenge resolution will determine the further progress toward EU accession. Serbia[28] is also a country in transition. It is essential to tackle corruption thoroughly to avoid it becoming institutionalised. Even so perceptions are thin on the ground, the country is on a progressive path in quite many areas. There are many indications of significant improvements, such as better public expenditure control, regulation of conflict of interest, availability of information as well as public agencies transparency. In addition, the capacity of enforcement agencies to investigate and take legal action towards organised crime cases is gradually growing. There has been a noteworthy enhancement of rules and procedures to make business easier for private professionals, at the same time reducing opportunities for bribery.

World Justice Project, Perception that Civil System is Free of Corruption (1 = no corruption), Serbia and EU and EU11, 2014
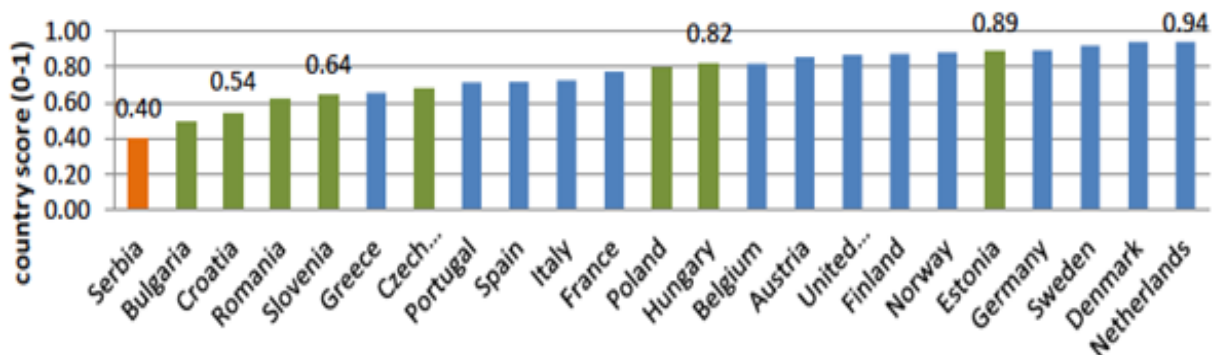
Figure 2 Perception of Corruption in Serbia compared with other European countries, 2014

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[27] Kosovo* is a disputed territory and partially recognised state in the central Balkan Peninsula that proclaimed its autonomy from Serbia in February 2008. Despite the fact that Serbia claims it as its own Autonomous Province of Kosovo and Metohija, Serbia recognises the Republic's control of the territory. However, Kosovo does not have diplomatic recognition from 85 United Nations member states. Kosovo is not itself a member of the UN, however it is a member of the International Monetary Fund (IMF) and World Bank. Within the EU, it is recognised by 23 of the 28 members.
*This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.
[28] See for details http://data.worldbank.org/country/serbia

Nevertheless, the political setting of the problem is persistent, and rooted elites frequently obstruct ambitious reforms. A continuous political determination at the highest levels of government is required to achieve a long-lasting impact on corruption.

A different explicit anti-corruption initiative – the effort to regulate the sponsoring of political parties and electoral campaigns, particularly the provision of civic resources – has been a major disappointment. The sponsoring is an especially ominous problem when the political parties are granted public funds, but there is no truthful control mechanism over how those funds are really expended. There are numerous irregularities, gaps, conflicts and inconsistencies in the newest legislation. Furthermore, the whole framework for its implementation is unfortunate. Despite that, the general public do not put enough pressure for changing existing practices and rules.

2.2.1 Types of Corruption in Serbia

The following sections emphasise certain vital occurrences of corruption in Serbia that need to be addressed.

- Political Corruption

The utmost demanding challenge Serbia needs to battle is certainly political corruption, coming in its various faces. The manifestation (particularly public perception) of such corruption activities, weakens the legitimacy and stability of voted political figures and the regimes, besides the capability and inclination of the regime to carry out meaningful anti-corruption policies.

Globally, misuse of the power by elected officials happens in the form of bribery of parliament members to vote in a preferable way (for particular interests as the natural resources, tobacco, telecommunication, and defence industries). Alternatively, in the form of misusing their official capacity to serve the interests of companies in which they hold stakes. In states facing transition (such as Serbia), this tendency might take on systemic proportions causing the phenomenon recognised as "state capture". Administrators are chosen in a transition environment where corruption is quite prevalent, public institutions are still under development, thus temptations are bigger as a result of larger opportunities (national assets privatisation, poor legislation and so forth).

Moreover, in an environment like this, even officials that strongly support the reforms are susceptible. For instance, when are faced with unethical negotiations that do not have to be connected with their personal gain, but in exchange for achieving political goals in favour of reforms). No

comprehensive researches of political corruption in Serbia exist, even though many scandals linked with government elite are seen in the media almost daily. Some cases have been to certain extent inspected and reported by the Anti-Corruption Council, but not any of these has been investigated with adequate methodological rigidity to make certain the facts are indisputable.

- Structural Factors

As the institutions in Serbia are still fragile, and noteworthy political instability is present, the common-sense consequence is that people are vulnerable to corruption. The example of such fragility could be illustrated with the vulnerability of political coalitions. The so-called "democratic block" consist of two key political parties with strongly different opinions about main problems fronting Serbia, such as Kosovo, joining the EU, and the speed of reforms. On the other side, there is a "radical block", with the diverse political program. A government cannot be constructed without one of the two major parties. That leads to a position of dependency of minor parties that are, for ensuring their support, compensated in many unethical ways, together with tolerating corruption.

The second example of structurally caused vulnerability comes because the absence of internal democracy inside the parties themselves, and a concentration of power within party elite. Because of the treatment within the party, in recent history several delegates firstly "defected" to be in parliament independently, or later to join an alternative party. The transfer between the political parties created a new ground for corruption activities. A fiery discussion about to who mandates belongs, resulted with the new Serbian constitution approved in October 2006, which explicitly specifies that mandates belong to parties rather than individual deputies.

- Corruption in the Public Administration

According to the international research[29], the Government of Serbia provides the public with limited budget information. Based on the Open Budget Index (OBI) for 2014, Serbia is placed to 47th position out of 102 counties (with the score of 47 out of 100) among countries that provide its citizens with „limited information on understanding and analysis of the budget". That result is slightly lower than the regional average (score of 53), while better than preceding scoring in 2012 (when the score was 39). It is worse than in 2010 (with a score of 54) and somewhat better than in 2008 (46)[30].

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[29] The International Budget Partnership (IBP) defines itself as an independent non-profit corporation performing a global research and advocating program to promote public access to budget information and the adoption of accountable budget systems. See more at http://internationalbudget.org/

[30] The OBI assigns a score to each country based on the publicly available information throughout the budget process. Comprehensive analysis and survey evaluate whether governments give the public access to budget information and opportunities to participate in the budget process at the national level. See http://internationalbudget.org/opening-budgets/open-budget-initiative/open-budget-survey/country-info/?country=rs

Many shapes of corruption occur in the public administration varying from "minor" (as for instance in the distribution of licenses), to "big" (the allocation of public agreements and infrastructure projects), however all containing the misuse of public resources by governmental bureaucrats in function to their private benefits. Generally is agreed that at least one, if not a combination of the following circumstances lead to this mismanagement of public funds:

- Regulations are imprecise or not widely available; public employees are underpaid and/or are not employed based on merit;
- Governmental representative are not answerable to strong regulations on conflict of interest;
- Public service elite omits internal control apparatuses; public funds usage rules and regulations are not clear enough;
- Insufficient of functionally dependent internal audit; and,
- Limited external audit to only accounting or is inadequate in some other way.

A vital prerequisite for cutting corruption in the public administration is the effective planning, ranking, distribution and controlling of public resources, along with the efficient audit of the actual use of such resources. Recording and accounting of usage of public resources need to be in compliance with international standards, and then inspected and eventually approved by Parliament. So as to accomplish the above mentioned, should exist an external Supreme State Audit Institution (SAI) with enough capacity and authorities, and it should report directly to Parliament.

In turn, targeting SAI to operate proficiently, an integrated system of internal financial control is required, including autonomous internal audit within public bodies, and an aligned accounting and audit principles through the public sector. Importantly, all of these components are requirements for EU accession (see Figure 3 for the overview of the key issues identified by European Commission in their report from 8th October 2014).

Since Serbia lean towards accession to EU, an obligatory condition of succession is to perform overall public administration reform. Characteristics of corruption in the public procurement are elaborated in more detail in next section, as public procurement is, in general, most vulnerable to corruption (together with privatisation, customs, social service delivery but they are not in the scope of this work).

Key issues for public administration reform:

1. **Strategic framework for public administration reform** — the political commitment to the reform process, including political leadership and technical coordination and monitoring of implementation.

2. **Policy development and coordination** — appropriate coordination at the centre of government, inter-ministerial coordination, policy development and financial analysis.

3. **Public service and human resources management** — this includes organisation and functioning of the public service, including depoliticisation, merit-based recruitment and promotion, training and professionalization.

4. **Accountability** — transparency of administration, including access to information and possibility of administrative and legal redress.

5. **Service delivery** — improving services for citizens and business, including better administrative procedures and e-government services.

6. **Public financial management (PFM)** — a commitment to a more comprehensive approach to improving management of public finances and the overall budgetary process through preparation and implementation of multi-annual PFM programmes and engaging in a PFM policy dialogue with the Commission and International Financial Institutions.

Figure 3 Public Administration Reform key issues

(Adapted from European Commission report, 2014)

- Corruption in Public Procurement

Public procurement – the acquisition of goods and services from governmental budget – is one of the main corruption grounds since it embodies a significant percentage of GDP in the majority of states. In the long term, corruption activities and wasteful public resources usage will, almost certainly, worse the quality of products and services, and might produce indirect negative feedbacks (for instance the sponsoring of binding parties via procurement kickbacks). In the process of compulsory application of EU Public Procurement Directives, candidate states, such as Serbia, have to carry out obligations on member countries regarding the management of procurement activities.

The first records of public procurement expenditure for Serbia occur subsequent to the introduction of public procurement rules in 2002. The Public Procurement Office reported a total of 124.75 billion Serbian Dinars (approximately 1.46 billion EUR) in all categories of public procurement for 2005[31].

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[31]The majority of the data available pre-dates 2006, and thus, is normally only aggregated data for Serbia and Montenegro: extrapolating specific figures for Serbia from these surveys is difficult.

Together with the implementation of the first public procurement guidelines, there were several attempts to regulate the field and battle corruption.

To begin with, an innovative Public Procurement Law (PPL)[32] – formed on the Slovenian law and mostly aligned with EU criteria – was approved in 2002 and together with amendments implemented in late 2003. The Law is an important effort to bring the Serbian framework closer to international procurement standards. But, more significantly is a step forward towards the alignment with the EU Procurement Directives (2004/18), as required by the Stabilisation and Association Agreement (SAA) between the EU and Serbia. In addition, the Law established the Public Procurement Office (PPO)[33] as an independent agency of the government. The PPO started in January 2003, and is accountable for monitoring and ensuring the effective implementation of the PPL. Therefore is responsible, among other things[34], for the preparation of appropriate regulations, the gathering of tender documents, training and advising bidders and clients. The PPO now fluctuates from 22 to 28 employees, which is a minimum knowing the scope of the Office's accountabilities, covering delivery of written opinions on all procedures prior carrying out the procurement.

Next, the first National Strategy for the Fight against Corruption was approved in 2005 and converted into an Action Plan in 2006. Nonetheless, the absence of willpower to steadily and permanently address the problem of corruption resulted in unexploding of the action plan, and basically leaving the "hot potato" to the responsibility of an Anti-Corruption Agency, established earlier in 2001[35]. The main worry was (actual nowadays as well) that without continuous political willpower, more systemic reforms are being stalled in the relevant line ministries. Regarding the remedies system, the Commission for Protection of Bidders' Rights was established in October 2010 as an independent body accountable directly to Parliament (European Commission, 2011). This Commission is set up as a second-instance body in the review procedure with authorities to cancel public procurement procedures completely or partially. Furthermore, the newest Public Procurement Development Strategy of the Republic of Serbia was adopted for the period 2014 – 2018. In the next years, focus will be on the publication of procurement plans and full texts of awarded public procurement contracts (rather than just details of those contracts); preparation of guidelines for right

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[32] The last edition of the Public Procurement Law (Zakon o javnim nabavkama) is dated 25 August 2015 and could be found (in Serbian) on www.ujn.gov.rs/download/files/cms/attach?id=595

[33] PPO (Uprava za javne nabavke) is defined as an independent governmental agency with the task to help the establishment of sound procurement procedures and practices ensuring that public funds are spent in an efficient and transparent way, thus complementing government's overall drive in containing corruption.

[34] For complete list of competencies, check http://www.ujn.gov.rs/en/about_us/nadleznosti

[35] See more at http://www.antikorupcija-savet.gov.rs/en-GB/page/home/

and timely planning and an objective evaluation of needs and market prices of procurement; preparation of models of internal act and procedures for contracting authorities; and training of managers on accountability and their role in the implementation of internal acts and procedures.
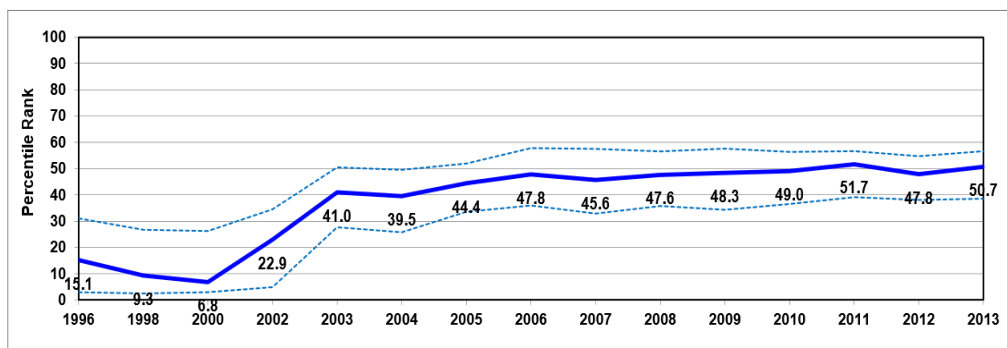
Figure 4 Aggregate Indicator: Control of Corruption in Serbia

Respectable progress has been made in the area of public procurement. According to Transparency Serbia (an official chapter of Transparency International), already in 2003 – the year of the PPL's entering into force – 200 million USD were saved due to the application of the law. This figure is gained by comparing the projected cost of the procurement by the contracting authorities (approximated based on prices in analogous contracts or the estimated market value of the goods/services) versus the actual cost of the procurement. In addition, the PPL from 2008 introduced numerous modifications, for example certification of professional public procurement officials, introduction of e-procurement and establishment of an electronic public procurement portal, the option of court review, introduction of anticorruption clauses and institutional independence of the public procurement bodies (especially the PPO and the Commission for the Protection of Rights in public procurement matters). See Figure 4 for the Country Data Report that summarizes the data from the Worldwide Governance Indicators (WGI) project on Control of Corruption in Serbia[36].

According to the PPL, with the newest adopted strategy all announcements of public procurements must be published on the Public Procurement Portal by all contracting authorities in all types of procedures, including small-value public procurement procedures. Furthermore, the PPL has also introduced the mandatory use of names and codes designations set out in from common procurement vocabulary, as well as a publication of other relevant information, such as information on contract amendments and execution, opinions of the PPO on the justifiability of the negotiated procedure, and negative references. The PPL envisages the option of submitting bids electronically

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[36] The WGI report six aggregate governance indicators for over 200 countries and territories over the period 1996-2014, covering: i) Voice and Accountability, ii) Political Stability and Absence of Violence/Terrorism, iii) Government Effectiveness, iv) Regulatory Quality, v) Rule of Law, and vi) Control of Corruption. For a full description of the WGI methodology, interactive data access, and downloads of the aggregate and individual indicators, please visit www.govindicators.org.

and provides for the introduction of distinctive e-procurement techniques, such as electronic auctions and the dynamic procurement system. Nevertheless, the PPL does not set a specific timeframe for the implementation of these systems.

There are still ongoing discussions about PPL. Even the latest Amendments and Supplements to PPL from 2015, has been criticised by Transparency Serbia emphasizing that Draft Law on Amendments and Supplements to PPL was submitted by the Government to the National Assembly without prior public debate, although the debate was obligatory in compliance with both the Law on State Administration and the Rules of Procedure of the Government. Or, that provisions on „mixed procurements", although possibly useful, are neither clearly defined nor elaborated. In the „anti-corruption area" amendments abandoned the concept that, contrary to provisions of the Law from 2012, were not being implemented. That way Governmental omission to adopt the anti-corruption plan in public procurements, to the proposition of the PPO and the Anticorruption Agency, is being cancelled by erasing this provision[37]. Also, the obligation for the larger purchasing entities to establish Service for Control of Public Procurements is cancelled.

Lastly, the strategy for improvement of the public procurement framework in Serbia needs to be finalised. The weaknesses in the governmental administration's internal and external audits are undermining the effectiveness of the system as a whole. Currently, two main institutions are focused on framework strengthening - the Public Procurement Office (PPO) and an independent entity responsible for review of complaints (the Republic Commission for the Protection of Rights in Public Procurement Procedures). Yet, when performing all the considerations elaborated and defining the optimum solutions, it is necessary to take into account all the particular characteristics of the national environment, especially the level of development of information and communication technologies and the level of sophistication of e-government services in Serbia.

In summary, Serbia is moderately progressing in the direction of establishing an efficient and entirely independent public procurement structure. Further work remains to be done on strengthening the institutional capacity for implementation of the SAA requirements. A coordination mechanism among the key stakeholders in the procurement system require further strengthening, particularly with the purpose of shrinking the grounds for corruption. Sustained political determination is required to ensure appropriate implementation of public procurement legislation.

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[37] See http://www.transparentnost.org.rs/images/dokumenti_uz_vesti/Javne_nabavke_najvazniji_nalazi_maj_2015.doc

2.3 Theories on System Dynamics

"System dynamics modelling offers distinctive capabilities to contribute to economics, social science, physical science, or political science modes of analysis. It identifies the complicated interactions among many feedback loops, rejects ideas of linear cause and effect, and requires the analyst to view a complete system of relationships whereby 'cause' may possibly be affected by the 'effect'"".
Choucri et al. (2006)

System Dynamics is a relatively young field, introduced in the early 1960's by Jay Forrester in his book, Industrial Dynamics (1961). Prior to the arrival of computers, solving analytically even the simplest of models was an enormous challenge. However, the field has been extended over the last 45-55 years to modelling new problems such as to model state stability, to analyse supply chain management, to explore dynamics of economic growth, to model software development, to analyse different policies for project management, etc. It is a "rigorous method for qualitative description, exploration of complex systems in relations of their processes, information, organisational boundaries and strategies; which facilitates quantitative simulation modelling and evaluation for the design of system structure and control" (Wolstenholme, 1990). The foundation of the modelling strategy is to design a system structure in terms of stock and flow, with the driving forces of feedback loops and including time delays (for detailed information about this methodology see Appendix B).

System Dynamics thinking and modelling helps analysts to discover 'hidden' dynamics. Moreover, System Dynamics (SD) provides the researcher enough space for being flexible in the research, having in mind that SD modelling encompasses both theoretical understanding of the subject and empirical data usage. Quality of SD models primarily is determined by three sources of information: a) numerical data, b) the written archive (reports, statistical data, etc.), and c) the expert knowledge of main actors in the organisation. The numerical archive is considerably minor as compared to the written catalogue that is large, and the expert knowledge of key participants is huge. "An important step in SD modelling is to obtain the wealth of information that persons keep in their heads. The mental database is a plentiful source of information on the system's elements, regarding the information obtainable at different points in a system, and the policies being followed in decision-making" (Forrester, 1991).

System Dynamics methodology has several important features. Firstly, the major benefit of SD simulation is that it smooth the progress of testing the business systems. While simulations are ordinary used in operational models, there were not as much used in strategic situations. As SD

models do not require detailed information or exact data about relations, a strategic system can easily be modelled and simulated[38]. That is primarily because SD focuses on the dynamic behaviour of the combination of feedback loops, and not on implementation of the exact numerical data. This means automatically that only structural, longer-term behaviour is of interest and therefore SD is a useful tool for performance management.

Secondly, System Dynamics is strongly related to systems thinking (Senge, 1990), which states that structure determines behaviour. Accordingly, changing the business system's structure means alter the behaviour of the system and thus changing the future of a company. SD allows that all formal goals and missions of public institutions are interconnected to a broad system of administration procedures, activities, and mutual influences, bearing in mind all criteria that are important in today's environment, such as budget, quality, service, distribution and modernisation. Furthermore, SD model ascertains a transparent correlation among these external criteria and internal performance measures. Next, taking into account internal insight about all the procedures, actions and processes are weighted to the criteria in a systems-oriented means. That finally generates a trustworthy, quantitative framework of the importance of system elements, which is used by management or interested parties to reduce a large number of variables (detail complexity). Dynamic complexity relates to the interaction effects and the delays that exist in a system.

Finally, learning takes place when people use the formal model and—by simulation experiments—gain insights into the relation between structure and behaviour of the system (Groessler, 1994). With the help of this understanding, they can design new structures of the real system. Through enriched policies and reduced structural complexity, this could lead to a decrease of adverse effects of bounded rationality.

Beginning with Urban Dynamics (Forrester, 1969), and ensued by World Dynamics (Forrester, 1971a) and The Limits to Growth (Meadows et al., 1972), there is a long tradition of applying SD to study public management problems. Hence, I conducted the extensive literature review of the present study and considered the existing formal models to obtain the insights about the overall corruption relations to apply them to a specific case of public procurement, and in a particular public service organisation. By definition, corruption includes compromising an efficiency in public funds usage. The empirical data, e.g. cases of granting the preferential treatment in procurement process, confirms that corruption favours those with close relation with authorities over efficiency.

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[38] Although for validation tests data are needed, in case of the transient, highly non-stationary behaviour (such as a truncated S-shaped growth), the best approach is to compare visual measures of the most typical behaviour characteristics and no general statistical tools can be offered in this case (Barlas, 1994).

The same negative direction of feedback relation between corruption and governmental expenditure can be found in the literature, e.g. by Treisman (2000), who is claiming an existence of a strong relationship between corruption reduction and good governance. That relation, of course, goes both ways, meaning that when bad governance is tolerated, in a long term, the corruption will blossom.

Additional relations could occur by dint of changing rules, introducing intentional delays or needless prerequisites, all with the purpose of generating extra payoffs for public administrators. The generally high levels of   corruption and low levels of quality of government   that are found in most contemporary countries turn out to have devastating effects on democracy, prosperity, social well-being, public satisfaction, and social trust (Rothstein, 2013). In most of the countries with extensive and long history of corruption, could be recognised either poor legislative regulations or unsuitable administrative reforms, or both. What is needed to turn the polarity of this relation (from bad to good governance) is to reduce both the opportunity and incentive for government officials to seek or accept bribes (Morgan, 1998). That is one of the key postulates of the SD model, presented in Chapter 4 – direct relation between corruption cases and incentive or inclination to corrupt further.

Another remarkable SD based study of relations linked with corruption was found in the literature. Ullah and Arthanari (2011) described the concept of corruption in Pakistan using a Causal Loop Diagram (CLD). Although they develop a macro-level framework that capture the dynamics of corruption in social, cultural, political, and legal systems, it can be used to study corruption dynamics by the means of SD. Figure 5 illustrates the high-level diagram of an overall model of corruption.

Almost all countries in the world have an informal economy (Cobb and Gonzalez, 2007), it can be defined as that part of the total economy in the country that neither registers with the government nor pays taxes on any business transaction. If the size of an informal economy is greater, the tax base for sales and for corporate and individual income taxes that are withheld by employers, will be smaller. Ultimately, it causes a reduction in government revenue.

To increase the tax base, the government will attempt to offset this loss of income by (a) increasing taxes in the formal economy, or (b) increasing import duties. Either response by the government is likely to force even more businesses out of the formal economy. As a result, the amount of public funds to pay salaries of government employees decreases. When a government is suffering a reduction in funds for salaries, it will either reduce the number of government sector jobs or reduce wages. As the actual wage rate falls below the acceptable levels, government employees have even less incentive to refrain from corrupt practices, and the competent workforce begins to leave government service.
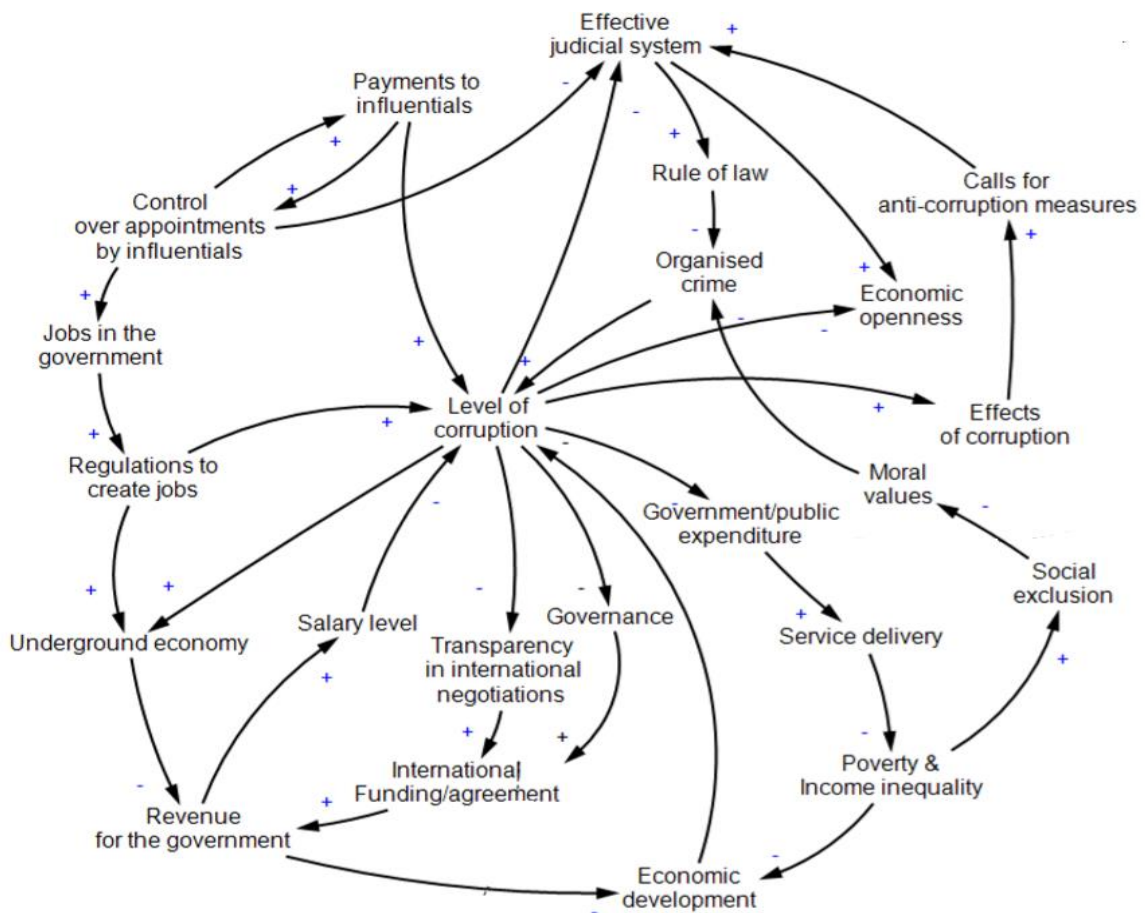
Figure 5 CLD macro-level of corruption

(Adapted from Ullah and Arthanari, 2011)

Based on the above mentioned feedback relations, the understanding of the compound corruption phenomenon is enhanced and it allows the author to design a new structure of the real system applied to an empirical case in Serbia in order to dynamically assess the organisational performance.

2.4 Performance Management

When you can measure what you are speaking about, and express it in numbers, you know something about it . . . [otherwise] your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in thought advanced to the stage of science.
(Lord Kelvin, 1824-1907)

Performance Management is an activity that executives carry out in order to accomplish the predefined targets, derived from the institution's strategic goals. Performance Management Systems turn out to be more significant in the latest years since "executives, coming from the public or private sector, are under permanent pressure to enhance the performance of their organisations" (Holloway, Francis & Hinton, 1999: 351).

However, external stakeholders have been inclined itself to consider only financial performance, and to use backgrounds and theories drawn mainly from the economics. Traditional financial measures are critiqued for many reasons. Firstly, they are missing strategic focus and are unable to provide data on quality, responsiveness and flexibility (Skinner, 1974). Secondly, they urge managers to diminish the discrepancies from standard rather than ask to improve continually (Turney and Andersen, 1989). To end with, they are criticised for being focused on history (Dixon et al., 1990). EBIT, for example, solely shows what has been achieved last month or last year, while utmost stakeholders would like to have projecting measures that point out what could happen in the future period, like next months, or next years.

Recently, there has been noticed a turn from the assessment of financial performance or performance measurement to a more structural development of the Performance Management. Performance measurement needs to fulfil the following assumptions (Bititcti et al., 2000):
– to ensure that gains achieved through improvement actions are maintained;
– to be sensitive to all the changes in the external and internal environment of an organization; revising and reprioritizing internal goals when the changes in the external and internal environment are noteworthy adequate; and
– to deploy the changes to internal objectives and priorities to critical parts of the organisation, therefore, to ensure alignments continually take place.

Up till now, a considerable number of the studies have been concentrated on specific models and frameworks for performance measurement, however that little has been done to describe and

investigate concerns with the application of these models and frameworks (Holloway, 2001). Bourne (2001) explicates a good performance measurement implementation as a Performance Measurement system, which is benefitted by the management team commonly to discuss and manage business performance associated matters. Atkinson et al. (1997) reasoned that performance related questions can be understood as primary objectives (and results) which are externally oriented and concerned with measurable deliverables, and internally oriented secondary objectives concerned with how services will be delivered (as cited in Kloot and Martin, 2000). Correspondingly, Kaplan and Norton's (1996) Balanced Scorecard debates for performance measurement over four dimensions of performance: financial, customer satisfaction, internal business processes, and innovation and learning dimension.

In order to observe, create, and sustain doable patterns of behaviour, the framework by Anthony (1965) at the Harvard Business School was established called 'management planning and control systems'. This traditional framework made a distinction 'management control' from 'strategic planning' and 'operational control'. The goal was to concentrate not only on financial indicators provided by accounting but to manage dynamics and patterns. Fitzgerald et al. (1991) clarify that Performance Management System encompasses the management of results (ends) and the determining factors of these results (means) lacking to specify precisely what these involve theoretically or practically.

2.4.1 Different approaches of Performance Management

Managing strategic resources to affect performance drivers and end-results related to a certain organisation is a dynamic and complex assignment. The resources and their results are dynamically changing over time. Also, the identification of the strategic resources may be difficult to structure since most of the analyses are grounded on financial indicators. Indeed, intangible resources are difficult to identify and measure (like employee attitudes, preference, and creativity). For illustration, liquidity (strategic resource) may change as an effect of cash flows (end-result); image and integrity of an organization to the customers (strategic resource) may change because of their (non) satisfaction (end-result). There are also interdependencies between different strategic resources. The image may affect the capability of an organisation to get funds from venture capitals or other stakeholders, for example.

While reading the related literature, several attempts to approach dynamically managing of performance were discerned. Conventional Performance Management approach explains company's

performance as a direct result of the unique combination of its resources (Grant, 1995). So-called resource-based view (RBV) explains differences in firms' performance and competitive position in terms of grants of fundamental productive assets or resources (Barney, 1991). However, this approach is seen as the static one. To evaluate the organisation's performance dynamics, important to assess behaviour over time (the organisation's performance can be observed both in the short and in the long-term).

Kloot and Martin (2000) research on local government using a qualitative methodology provides evidence that organisation's performance management systems put emphasis on managing the effectiveness of outcomes - in terms of customer satisfaction, and in specifying outcome measures during the planning process. Their research had implications for performance measurements on four dimensions of the balanced scorecard, already explained in the previous section. Moreover, they identified many strategic choices that affect the organisation's outcome and provided an overview of how these choices developed from the traditional approach to a performance oriented approach (see Table 2-1). The significance of a focus on both results and the means of achieving these results is particularly underlined.

Table 2-2 Public Performance Management Approaches comparison

Traditional Approach	Performance-Oriented Approach
Focus on financial measures only	Focus on financial and non-financial measures: a results and determinants approach
Top-down State Government, control-oriented performance measurement	Strategic, collaborative development of a PMS involving all stakeholders
Imposition of universal, industry-wide measures with less validity for specific councils	In-house development of valid, specific measures to be used for organisational improvement and benchmarking with similar organisations
Periodic reporting for the purpose of meeting control requirements of senior management, public agencies and State Government	Real-time, up-to-date performance information for all stakeholders to monitor progress, show accountability and manage outcome
Fragmentary, myopic approach with a focus on the measurement process	Integrated PMS across the organisation focussed on value-for-money service delivery and organisational improvement

(Adapted from Kloot and Martin, 2000)

Three elements can be distinguished as important ones in the analysis: goals, results and resources. According to the focus they give to one of these elements, two similar approaches can be distinguished in managing dynamically the organisation's performance (Bianchi, 2001). The frameworks have the perspective to be beneficial in any area where the ideas of the original static RBV have been already accepted. They are not alternative one to another but rather supportive frameworks.

To start with, Dynamic Resource-Systems View was constructed by Morecroft et al. (2000) on the basis of RVB framework. The main characteristic of this dynamic explanatory view is that it combines the System Dynamics with the context of the RBV of the company. The goal is to understand how competitive advantage arises in companies over time. The DRBV sees companies as the resource systems; therefore, the focus is on the resources. Resources can be categorised into tangible or intangible, and managed or unmanaged (Morecroft, 1998). DRBV emphases the process of PM system design, the means rather than the detail of concrete measures. Thus, has the strategic perspective, and basing on the resources the performance is set. In this case, means, drivers are not needed, and decisions are made upon coordination of resources. Goals are not made explicit; they are outside of DRBV and usually they are set on political, board level (in case of SMEs often only as a mental model of the owner).

A similar approach is Dynamic Performance Management (DPM), which also relies on the use of SD but has a different perspective. This framework focuses on the results (Bianchi, 2001). Based on desired results, the related drivers are recognised and only then, needed resources are identified. The approach, therefore, focuses on budgeting strategic planning, and decisions are made upon coordination of the resources. Policymakers (in case of public institutions, the general assembly) plan certain strategic aim based on the desired level of the financial result. In this case, drivers are imperative as the means of reaching desired results. Thus, based on the drivers the necessary resources are planned. Goals are seen as an instrument in the process and, therefore, the view is so-called "instrumental view". In Figure 6 is shown how, in a planning context, once defined the results, it is required to move backwards. For example, to outline the underlying processes and activities, and then to define goals and objectives, as well as products.
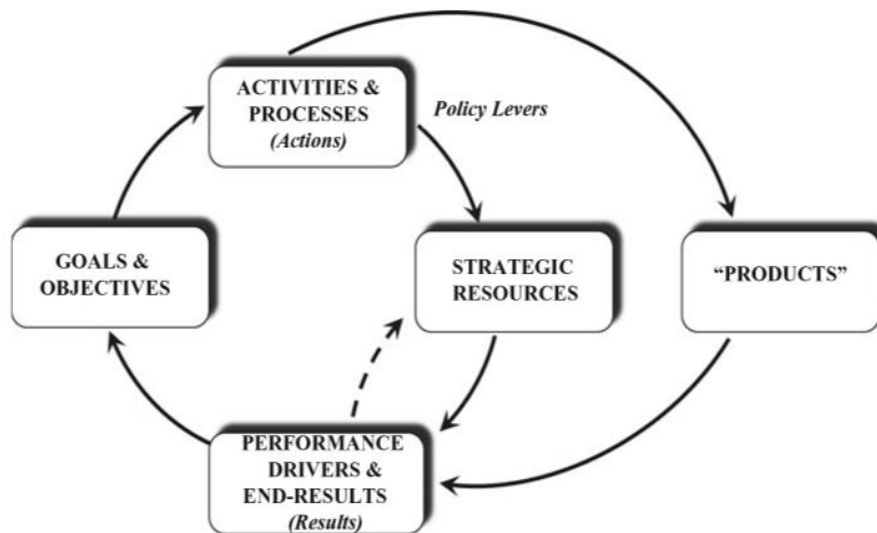
Figure 6 A synthetic picture of "objective", "instrumental", and "subjective" view

Source: Bianchi, 2012

To implement this view, important is to detect performance measures related to both end-results and respective drivers. The end-results are seen as efficiency or effectiveness measures of results, for the realisation of final products. Drivers are used to affecting end-results according to the expected direction and time horizon. Performance measures associated with the drivers are usually related to processes from which the realisation of intermediate products is possible. Therefore, each public organisation should recognise and arrange a proper patronage of strategic resources, systemically connected to each other.

Additionally, Bianchi (2010) differentiate two different and related levels for measuring and managing organisational performance under the perspective of sustainability, i.e.: an institutional and an inter-institutional level. According to the institutional level, performance is analysed as an output or an outcome of the implemented policy(ies) and the activities that are carried on by decision-makers in a particular institution. That means that evaluation of organisational results is done mainly by comparing the results made by decision-makers on their organisations. On the other side, the interinstitutional level assesses performance as an outcome of the implemented strategies and the activities by a public governor in diverse, but interrelated institutions or organisational parts. Strictly speaking, performance is evaluated by comparing the results of the organisation with the impacts generated by decision-makers in the broader system, e.g. either a bounded territorial area or the industry to which they belong (Bianchi and Tomaselli, 2013).

Performance evaluation on an institutional level – a company or public organisation level, still conserves a traditional perspective when assessing success and/or sustainability of growth. Regarding

a public organisation, performance is mainly evaluated with respective financial results, for example, sales orders, expenses, income, and cash flows. Thanks to developing dynamic complexity both in the market-oriented and public structures for offering goods and services, institutions and firms more and more recognise an increasing necessity to evaluate organisational performance at an inter-institutional level too.

In actual fact, by looking at only financial results, they may neglect to consider some important elements that might leave an impact on its performance. Such factors can be connected to delays, nonlinearity, intangibles, and to not deliberate consequences on human perceptions and behaviour triggered by a superficial "or mechanistic approach in setting performance targets, especially if such targets are used as a basis for organisational incentive and career systems" (Bianchi et al., 2015).

Evaluating performance at an institutional level, although not sufficient for a comprehensive analysis of the performance, is the first step to evaluating performance at an inter-institutional level. Indeed, an organisation that is capable of balancing the production of profits with the opening of additional workplaces, or of contributing to the industrial know-how while improving functional characteristics of goods at a realistic cost, is expected to have an appreciated feedback from numerous stakeholders. The positive feedback might be expected in a form of higher tax payments, rising employment, joint know-how, and environmental contributions. These broader benefits will, in turn, offer superior conditions for the establishment of better standards for each organisation, and, therefore, will create the further progression of the institutional level.

Having in mind that the analysed Anti-hail Public Service provider produces several different, but highly interrelated results (outputs and outcomes), to dynamically assess its performance the inter-institutional level has been followed in this works. For that reason, the focus is put on the identification of the performance indicators, concerning both the drivers and end-results (so-called instrumental view), and the goal is to correlate and model their inter-connections (so-called institutional level).

Therefore, SD modelling has a significant role in adopting a process—rather than functions—oriented view of performance. With a process-oriented view, the influence of organisation on results are considered, besides the effects generated by material and information delays. From a strategic standpoint, the formulation and implementation of a DPM system may assist decision makers to overcome the shortcomings mentioned above of traditional PM frameworks and support them in improving decision-making processes. For all above reasons the SD methodology (Forrester, 1961) is proposed (and the simulation package iThink^{TM} in particular).

III CHAPTER METHODOLOGY

"The case study emphasizes the proximal causes of the behaviour and circumstances, whereas life history emphasizes the remote origins, and the continuities and discontinuities in the organization of behaviour over a relatively long period of time"
Bromley (1991, p. 86)

This chapter summarises the two-phase methodology (a Case Study and System Dynamics model) applied to this research to answer the research questions: a) How can our understanding of corruption be extended by using a DPM approach?; b) What would a SD model of corruption in public procurement in Serbian Anti-Hail Public Service provider look like?; and c) What are the contributions of such a model? The function of this section is to: (a) appraise the research methodology chosen and why it was adopted for the research question, and (b) describe how the model is analysed in. This chapter also covers the research methodology of the study, data collection instruments, and data analysis methods used in this study. A justification for the reasons these were selected is outlined. Figure 7 demonstrates the phases of this work.
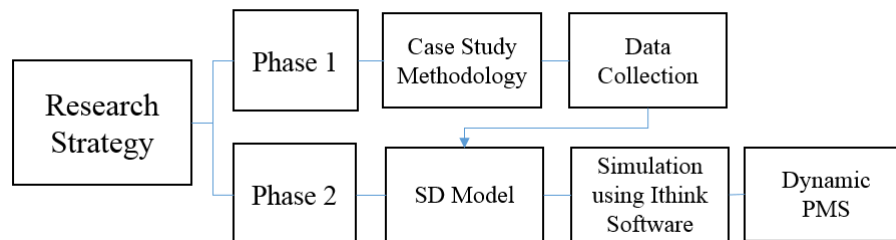
Figure 7 Phases of the Research

3.1 Research Strategy

The research strategy takes into consideration the accomplishment of several relevant academic researchers and thematic syntheses and they are valorising some sociological research methods. Polit and Hungler (1999) describe a research strategy as a blueprint, rough draught, used to conduct research in a supreme controlled manner, by focusing on any aspects that might obstruct the validity of the study results. Generally speaking, the research strategy is the academic's widespread scheme aimed at finding answers to the questions that steer the exploration process. Indeed, planning

the process timely aids academics to conduct the research in a structured manner, and to achieve the anticipated results, therefore improving likelihoods that the results they gained are aligned with the actual conditions (Burns and Grove, 2003). In fact, the proper strategy of whichever study remains to be the common-sense order that links the empirical data to a research's primary research questions and, finally, to its conclusion (Yin, 1989).

Various research methods contribute to the wider understanding of different conditions under consideration and are used for diverse reasons (Deetz, 1996). As a consequence, the choice of research strategy applied have to be suitable to the particular phenomenon of concern. By focussing on the nature of the research topic and research question, instead on the research method, more suitable methodologies can be carefully chosen (Falconer & Mackay, 1999). The ordinarily applied methods in qualitative studies are the case study, ethnography, grounded theory, and action research (Collis and Hussey, 2003). A case study is defined as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context; also is the best suitable strategy, when "how" and "why" questions are there, resolving mainly exploratory research problem" (Yin, 1989). The raison d'être of such a widespread application of this methodology in countless studies is because it allows capturing of all and complete real-life manifestations, and its activities, in natural setting, therefore, donating a comprehensive interpretation of a particular situation (Eisenhardt and Graebner, 2007).

In this research, a mixture of methodological methods was used for answering the research questions and investigating this sensitive subject. Having in mind the statements mentioned above, the focal strategy of this work is a case study, which is expected to provide basic framework and information for a structural model. It was decided to employ the case study methodology because of the qualitative and exploratory nature of the research as "the flexibility of the case study strategy lends itself particularly well to exploration" (Robson, 1993). This methodology is expected to be very beneficial to get information via qualitative research ways and means to detect different relations, aspects, connections and variables (and, in the bottom line, to ameliorate understanding of corruption by using a SD model).

Therefore, the implementation of the research strategy started by applying, in the first phase, a case study approach so as to gather qualitative information for the second phase that applies a SD model. A research normally involves reviewing the main stakeholders such as public institutions and bodies, agencies, judiciary, NGO and the community in general. A mixture of two approaches was utilised to gather the information, namely interviews and document analysis. Considering that many previous case studies were conducted vis-à-vis human behaviour and interactive actions, comes as no surprise that interviews are an important source of case study evidence. Conversant participants

normally endow with shortcuts to the previous background of the investigated subject, give unofficial information, and shed the light on the hidden relations aiding scholars to detect additional sources of information. For an exploratory study, interviews could be a very useful technique to discover what is happening and to seek new insights (Robson, 1993), even though it is vastly time-consuming to gather all data, and material collected is problematic to compile for an analysis (Patton, 1990).

According to Myers (2009) this methodology can be accomplished entirely on the basis of a one or a small number of interviews with key people. Henceforward, it is possible to have adequate available substance for further study (Miles and Huberman, 1994). In this work, taking into consideration the sensitivity of the subject matter as corruption certainly is, other sources of evidence besides an interview were used. Myers (2009) further illustrates that written documents can be valuable as they constantly make available confirmation of information and data, which persons on occasion have trouble recalling. Documentary evidence takes account of things such as research reports, annual reports, newspaper selections, and memorandums

Document analysis is a method used in qualitative case investigations to examine documents or describe the content of connections. The qualitative study is closely connected with the analysis and depiction of the practices which generate patterns of behaviour, and "measures information based on opinions and values, not on statistical data" (Yin, 2009). The data obtained by the means of the statistical and public administrative scale will be analysed in connection with the performance indicator of public procurement of the Anti-hail Public service provider in Serbia.

To develop a System Dynamics model, the material from the official public report submitted by The Anti-Corruption Council (an expert, advisory body of the Government) to the Prime Minister of the Republic of Serbian, in 2010 was used. The report describes the structure and the behaviour dynamics that result from that structure regarding corruption in the public procurement of anti-hail rockets. Also, several informal interviews were conducted, where all the participants insisted on remaining anonymous. While the interview did not provide any empirical data, they did provide detailed qualitative descriptions that can be represented formally in a System Dynamics model. Moreover, the literature review carried out for this study helps in defining many of the relationships between variables.

It is worthy to mention here that some interesting relationships have been developed in the model from the qualitative data analysis already explained in Chapter 2, Section 3. Empirical data were collected from various statistical sources, governmental reports, publicly available data and newspapers articles.

3.1.1 Difficulties in Studying Corruption

In any research project, researchers are expected to adopt high standards of academic rigour, and to act with honesty and integrity. Ethical issues, such as those related to informed consent and confidentiality are more probable to arise in qualitative research. Some difficulties emerge specifically because a high level of rapport, so important for many characteristics of qualitative research, has been established between researcher and participant. Informed consent is seen to be one of the most significant issues in qualitative research. In fact, it is regarded as the 'key issue' in research with human beings (Bogdan and Taylor, 1992).

To carry out an interview on the topic of corruption the researcher has to rely on his contacts, as participants were a bit scared to give an interview to someone to whom they do not have any connection. In a few cases, a snowball technique has been used to select participants but in most cases personal contacts were the easiest way to approach participants. According to Konza (1998), covert research is claimed to have some validity if it is used to expose malpractice or corruption. Alternatively, if there is no risk to the participants, it is widely rejected and is seen by many as being intrinsically wrong. Some researchers argue that "the foremost consideration in research should be given to the dignity of the research participants, and that on these grounds alone, deception in research can never be condoned" (Kiegelmann, 1996).

Corruption is a challenging and exceptionally sensitive problem that requires lots of protections for whistle-blowers. In order to accomplish a "somewhat coherent understanding of statements, actions and perceptions, which may prove to be varied and may be ambiguous, it is important to engage in participant observation in various social situations, as well as conduct different sorts of interviews and conversations with various stakeholders - ranging from 'informal conversations' to 'structured interviews'" (Bernard, 1994).

According to Stulhofer et al. (2008), corruption studies are a significant component of an effective anti-corruption policy. It is further argued that since "corrupt practices occur in the 'grey area' of social behaviour — which makes measuring the level of corruption very difficult — the research on corruption is often descriptive and suggestive at best". The implicit method to studying corruption (by the use of surveys) dominates, and, despite the fact it continuously welcomes criticism, it is commonly presumed that perception of corruption is a fairly accurate index of the actual level of corruption (Lambsdorff, 1999).

According to some researchers, "studies on corruption were limited due to ethical concerns, cultural sensibilities, and methodological difficulties in the past. The reason for facing such problems

were mainly related to the ethical concerns that stemmed from the researchers having to resort to 'gift giving and bribery themselves, and researchers exposing informants and putting themselves in danger as they explored the nefarious realms of organised crime and corrupt politics" (Haller and Shore, 2005). Andvig et al. (2000) suggest that corruption is hard to approach methodologically because of its complex nature and because individuals are hesitant to admit their interaction with it even when it is pervasive.

The suitable method that could reveal the collective behaviour rules and local moral codes regarding corrupt activities can be found in informal interviews. Focus group debates and case studies can also be fruitful in some situations. According to Blundo and Sardan (2000), the significance of methodological triangulation approaches and methods can be mixed and used simultaneously - e.g. informal interviews interacted with observations and newspaper articles, or official reports, to validate and confirm the findings.

According to Yin (2009), case studies present a more difficult situation than when using other research methods because these interactions are not essentially as structured as with other methods. It is also important to protect those who participate in the study from any harm, including avoiding any deception in the study. However, Miller (2006) argues that if there is any contentious issue then covert participant observation can be used. Myers (2009) suggests that covert observation can be used if it is the only way to obtain data. Myers further stated that the covert participant observation might be the only way to study, for example, crime or corruption. Qualitative research progresses as the researchers proceed with data collection and analysis. Plans that have been made in the office or on the computer in the quiet of their space by researchers may need to change as they proceed in the real world.

3.2 Research Process of System Dynamics Modelling

Measurement is not an end in itself. To be effective it must be part of a feedback control system where corrective action is taken within the process – and results are fed back into consideration of future strategy.
Fitzgerald (2007)

This chapter describes the modus operandi of systems thinking that can ratify the relationships shaped by the SD model of corruption. It has the lone purpose of interpreting the natures of complex relations between variables and their potential behaviours. To illustrate that relations, firstly are used

diagramming tools to symbolise dynamic hypothesis and behaviour, to support their understanding and the capture of the mental models.

The modelling process itself is a feedback process, not a linear sequence of steps. Models go through constant iteration, continual questioning, testing, and refinement and the products of any iteration can yield insights that result in revisions in any previous step' (indicated by the links in the centre of the diagram, Sterman (2000)).
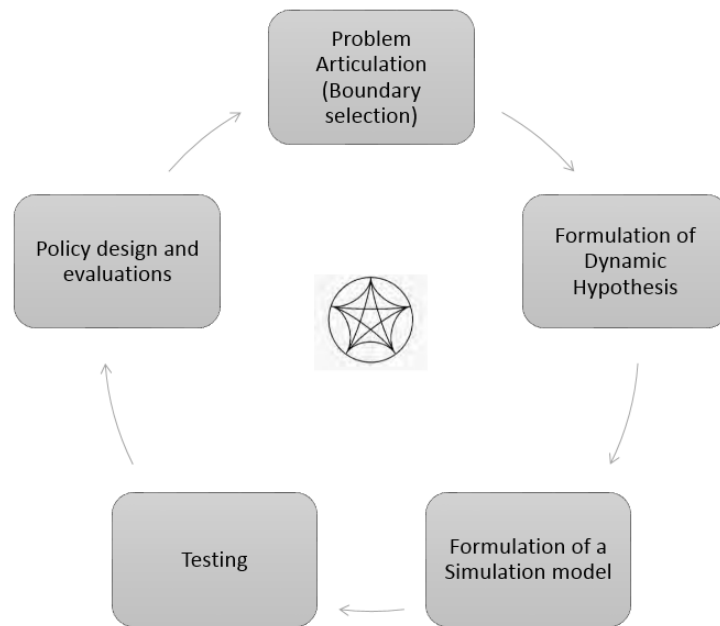
Figure 8 Modelling Iterative Process

(Adapted from Sterman 2000)

Normally, the problem articulation is the definition of the issue the researcher wants to investigate. It includes the description of the current problem behaviour and its background. The next task in applying the systems methodology to modelling, in this case corruption, is to define the key system features. Subsequent, to construct a diagram that captures the key dynamic hypotheses of the observed system, containing the major feedback loops. Qualitative System Dynamics tools are also called causal loop diagrams (CLD) or influence diagrams. They are used to represent feedback processes around the central topic of interest. They are not followed by the real values and are not numerically expressed. Therefore, they are not used for simulations and policy testing. On the other hand, quantitative SD models, are fully numerically supported. They support the formulation of the model based on the CLD in the previous stages and aim to run the simulation and test different

policies, consequently. The details on fundamentals of System Dynamics methodology are described in Appendix B.

For a more accurate quantitative analysis, an influence diagram of the corruption model will be transformed into a stock and flow diagram. Moreover, it is essential to perform a kind of validation regarding past data; variables' past conditions should end up with the depiction of a known state of the system in the respective period (Sterman, 2000).

In this dissertation, the attention is on one particular issue - the corruption in public procurement that has, more or less directly, the influence on economic and social distribution, in the country. According to Sterman (2000), in System Dynamics models variables are classified as either exogenous or endogenous variables. Table 3-1 shows the variables of the empirical model that are labelled as endogenous, exogenous, and variables that are excluded. Exogenous variables are variables that are not part of a feedback loop (in this study market price of the rockets is exogenous) while endogenous variables are members of at least one feedback loop. A few variables are excluded from the model due to the unavailability of reliable data and for the sake of simplicity; these variables could be considered for inclusion in a future work.

Table 3-3 Key Variables of the Corruption Model

Endogenous	Exogenous	Excluded
Corruption	Market price of the rockets	Moral Values
People attitude against corruption (Inclination to corrupt)	Desired protected arable land	Payments to influential
Arable land protected	Budget level	Service Quality
Anti-hail rockets		
Public Satisfaction		
Money Dispersion		

In the literature review chapter, we saw a whole range of potentially significant joint dependencies (and feedback dynamics) that capture overall system behaviour and performance over time rather than one 'dependent variable'. A causal loop diagram of the model's structure is constructed from these key variables, illustrating the major feedback processes of the corruption procurement model. Therefore, a feedback loop is a closed loop of cause-effect, and an interdependent set of feedback loops is a feedback system, Richardson & Pugh (1981).

Both reinforcing and balancing feedback loops[39] were identified. The arrow between variables indicates that a causal relationship exists between variables A and B. The sign at the head of the arrow signifies the nature of the relationships as follows:

$$A \xrightarrow{+} B \gg \frac{\partial y}{\partial x} > 0 \qquad \text{and} \quad A \xrightarrow{-} B \gg \frac{\partial y}{\partial x} < 0$$

An arrow from A to B with a positive sigh means a positive value for the partial derivate of A with respect to B; an arrow with a negative sign means a negative value for the partial derivate. Behaviour of the corruption model is constrained by balancing feedback and driven by reinforcing loops, where all variables have + or positive influence one on another. The structure of the model contains variables identified during literature review analysis in Chapter 2, e.g. government expenditure, the inclination to corruption, effects of corruption, and cumulative corruption. Similarly, socioeconomic variables, as discussed in the previous chapter, include perceived corruption, public satisfaction, people's attitude against corruption, tax evasion, etc. They will be argued in further detail in balancing feedback loops in the next section.

According to Qureshi (2009), the System Dynamics models are causal models and these models should generate the right behaviour for right reasons. The general direction of these functions is based on corruption literature and interviews for this study. Time constants for the flows are constant per year for the simulation.

3.3 Implementing SD to enhance traditional PMS into DPMS

Traditional PMS may deliver a static analysis of value creation processes and, therefore, may not consider the time delays existing between the adoption of a policy and the achievement of the related results, Cosenz (2013). In addition, not tangible variables and nonlinearities often considerably influence strategic resources, and the associated performance drivers and end-results. To overcome such undesired effects, by incorporating SD models to PMS is possible to ease decision-makers' understanding.

In addition, "identifying administrative products, mapping the underlying processes and matching them to key-responsibility areas is a major component of developing a System Dynamics

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[39] When the main loop behaviour is one of reinforcing the original state of the system, the loop is positive. When the main loop behaviour is one of opposing the initial situation of the system, the loop is negative, balancing or goal seeking.

(SD) model-based performance management approach" (Cosenz and Bianchi, 2013). SD models may support decision-makers in identifying those policy levers on which to act to undertake sustainable performance improvement programmes in universities (details of the SD model are shown in Chapter 4). SD modelling is used to depict the dynamics of the strategic resources and the factors determining performance – drivers (since some of the strategic resources are hard to express and quantitatively measure).

To evaluate the outcomes of public policies, a civic decision-maker, e.g. a regional planner, needs to move the focus of analysis from an institutional to an inter-institutional perspective (Bianchi 2010: 378–381). The relevant system's boundaries for such analysis are much broader than those associated with an institutional perspective. In fact, other public and private institutions will be involved in such a system.

An inter-institutional system's perspective, apart from evaluating the sustainability of the performance based on the single organisation's results, should take into account how such results participate in the wider system's performance (that will influence the organisation in the long run). Inside such a broader system, strategic resources such as infrastructures, human capital, capacity, image, and the environment are shared among the organisations and built for mutual benefit. Both the aggregate performance of a territory or industry and the specific performance of each organization inside it are significantly affected by the accumulation and depletion processes of social capital and other strategic resources, e.g., infrastructures and image.

IV   CHAPTER AN EMPIRICAL APPLICATION

The more corrupt the republic, the more numerous the laws.
Tacitus, Annals

The interpretation so far communicated a not very imposing picture about Serbia's development performance. The intention of this thesis, however, is not to portray Serbia in a negative light. Therefore, this chapter seeks to explicate the intricacies of corrupt public procurement practices influencing, among other factors, its development performance.

Constructed from the previous description of the problems facing Serbia, this chapter moves on to investigate the occurrences of corruption more directly. Firstly, investigation via publicly available arguments of the range of the phenomenon in a particular public service provider. Secondly, research via discussion of some of the key relations, feedback factors, and simulation results of embedding of corruption; before finally moving on to consider some of the outcome-based performance related attempts made to tackle corruption through implementation of possible policies.

4.1 Problem Articulation

Thieves for their robbery have authority
When judges steal themselves.
William Shakespeare, 1623

The key problem addressed by this work is the debatable public procurement practice by Republic Hydrometeorological Service of Serbia (RHMSS), and more specifically procurement of the anti-hail rockets (missiles) that are used for the protection of the agricultural land in Serbia from hail. The official report number 72 submitted to the Prime Minister on October 16 by Anti-Corruption Council - the foundation of this work, publicly revealed several instances of bad governance of the public funds.

According to the claims of the assistant director of RHMSS who addressed the Council, the rockets were procured via direct negotiations with the supplier Poliester" from Priboj, at a higher price than could be reached by the public tender. Moreover, priority purchase of rockets always had

company "Poliester"[40], without sufficient argumentation (except that they have well past collaboration). It is further stated that, other than missiles procured via official purchases, in the main warehouse of the RHMSS in Rekovac were stocked the additional rockets, which have not officially been ordered or purchased, supposedly because company "Poliester" had nowhere to store them. Eventually, these rockets, which were there for storing purposes, were bought with funds from the budget.

The purchased quantity of the rockets is disputable as well. Namely, besides the accounting records of the number of bought and used rockets, other analytical databases would, in theory, have to match up with accounting records. These databases originate from RHMSS sector that deals with keeping the records of a number of launched rockets, based on the radars data about affected clouds by the rockets. According to the allegations that were submitted to the Council, the unregistered rockets (mis)usage reached the amount of approximately 28.000 rockets - actually the Anti-Corruption Council report (2010) states that the mismatch in the number of rockets is 28.501. In other words, for the total of 28.501 rockets no evidence exists as a proof that they were actually used. According to the statements of the assistant director, it can be interpreted in two ways. Firstly, the rockets were launched into the clear sky only to be consumed. Another explanation is that the rockets did not exist at the first place, since there is a general arrangement (and practice) to distribute directly the rockets from the "Poliester" factory to the end users - radar centres, without any mechanism of control from the central warehouse in Rekovac. However, at the end of the financial year, a set of the accounts showing the income, expenses, and the net results for tax purposes needs to be summaries and finalised, and that includes the accounting records, as well. As per the Anti-Corruption Council report, only at that point the records concerning the rockets were made. Also, a document confirming the entrance to the main warehouse (receipt of the missiles) was retroactive signed by a person that never had seen that rockets before.

These statements support the suspicious that there is a strong and close coalition between supplier and buyer (in this case manufacturer Poliester from Priboj and RHMSS)[41]. It is deducted in this report that either the rockets were used randomly during the year in the days with no hail, or –

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[40] There are certain amounts of the rockets bought from the other suppliers, but they are very modest if not trivial. For example, in 2010 from the "Krusik", Valjevo only 270 anti-hail rockets were procured. In the "Krusik" they claim that they can quickly and efficiently produce missiles, however, they are receiving only minor orders per year (the orders amount never had exceeded 500 pieces). http://www.novosti.rs/vesti/naslovna/aktuelno.69.html:332443-Njive-od-grada-nema-ko-da-cuva

[41] For more testimonials, read – in Serbian,
http://www.transparentnost.org.rs/stari/index.php?view=details&id=357%3Amediji-o-korupciji&pop=1&tmpl=component&option=com_eventlist&lang=sr or
http://www.vreme.com/cms/view.php?id=946179

more probably, however without a verdict so far[42], that these rockets were displaced to be purchased/paid again (there is a certain recurrence rate). Both alternatives are undoubtedly not driven by a good governmental practice and efficient usage of a public fund but on the pure lucrative motives of gaining private interests.

Whether it has one or the other explanation, the damage is immense. If we bear in mind that those disputed quantities were paid with the price per rocket around 300 EUR, then the estimated damage and misuse of the public funds is over 8.5 million EUR[43]. The problem itself is a dynamic one, since the act of official buying, and misusing is repeatedly happening during the whole year, and every single year with delayed different non-linear and accumulative effects. This dynamic behaviour will be analysed in terms of the effects of such practice on several strategic resources, and possible actions that could be undertaken to mitigate not only the unbefitting end results but also the roots of this complex problem.

4.2 Formulation of the Dynamic Hypothesis

The report indicates that there exist several irregularities, and at the same time a close connection between supplier and buyer, and even co-location. Since the RHMSS and Poliester (supplier in the rest of the text) share the same storage place, there is no clear evidence of entry/exit of the rockets from this storage place, and the grounds for corruption are fruitful. However, it cannot be reasonably assumed that more than 20.000 high-priced rockets were launched into a clear sky "just for fun". Most likely, and also as described in the official report, we are facing planned and organise abuse of rules.

Therefore, it is realistic to adopt the hypothesis that because of the clear corruption practice, occurs a different depletion of the rockets, other that the official purpose of the rocket – to hit the hail clouds in order to protect better the agricultural land. That certain amount of anti-hail rockets is again purchased from the same supplier. However, it is not reasonable to assume that every year enormous amount of the rockets is being smuggled or repurchased. For the purpose of this research, I will start with the hypothesis that every year only 10% or procured rockets are disputed during the year, and

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[42] A criminal charge was sent to the prosecutor's office mid-August 2010 uttering that for years, anti-hail rockets procurement was performed by direct agreement with the favoured producer "Poliester" from Priboj, and that due to the uncontrolled spending of public funds in the last six years, there was been a damage of over 8.5 million EUR.
[43] The official investigation of this subject was initiated but not any results were concluded from it. Source: http://www.politika.rs/rubrike/Drustvo/Pocela-istraga-u-RHMZ-u.lt.html.
The damage was that high because, instead of optimal number of usage of 30.000 rockets that year were available only 13.250 rockets for shooting, http://www.slobodnaevropa.mobi/a/grad_srbija_rakete/2124577.html

since the real need is constant - that amount of rockets is required and thus is being procured again. That is a simple and fair assumption, used to show the dynamics of such a practice.

Consequently, the bigger quantity of rockets procured directly leads to the greater smuggled amount of rockets, which in turn leads to the higher public procurement expenditures. With every amount of misused public funds, history of corruption cases becomes bigger or so to say corruption cases accumulates. The rockets purchase rate (and consequently smuggling rate and public procurement expenditures) is triggered by the actual need for rockets coming from desired agriculture land that needs protection. How much of the agricultural land needs to be protected by using anti-hail missiles, is a constant of the territory area that is decided by the Ministry of Agriculture and that defines the required number of anti-hail rockets.[44] Since there is a certain amount of rockets that are actually not being used for the seeding of the clouds, subsequently more and more land is remaining unprotected and, in turn, occurs a higher or additional need for buying new rockets. For that reason, as the number or rockets bought increases so does the smuggling rate (as a percentage of the rockets procured).

As stated by the Anti-Corruption Council report, public procurement is continuously realised without official and public tender, although the public tender is usually initiated[45]. That is not in compliance with the law of the Republic of Serbia, however, it is a common practice.[46] A brief look at the figures from the report of the Public Procurement submitted to the Serbian Government tells us that it is a non-transparent implementation of public procurement through the legally prescribed negotiated procedure without publication of the call is still frequently applied.

The authorities from this Public service organization are justifying that by stating that they have the best practice and excellent historical relation with the provider company. Based on their statements, the provider company is available on the very short notice, they have good experience with them in a long term, and they are even sharing the same storage place. On the ground of that collaboration, Anti-hail rockets price paid is 300 EUR per rocket. If there would be a public tender, and the other providers would be considered than the price that could be reached is 200 EUR. There

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[44] Experts in the area worth mentioning are Tihomir Dejanovic (2012) and Dragan Nikolic, read in Serbian http://www.znanjenapoklon.rs/clanci/agroekonomija/otvoreno-pismo-ministru-velimiru-ilicu.html

[45] Recently, there has been a purchase of 20 vehicles from the public funds dedicated, among other thing, for the rockets procurement. Anti-Corruption Council has reacted on that as well (read, in Serbian, http://grockainfo.com/kupili-20-dzipova-a-nemaju-za-protivgradne-rakete/) however, even the Council has severe problems when trying to obtain relevant information http://www.b92.net/video/vesti.php?yyyy=2015&mm=09&dd=17&nav_id=1040735

[46] Because the shreds of evidence of this corrupt practice were brought to light, there were certain attempts to change the situation. The example of that is changing the authority from RHMSS to Ministry of Inferior in 2010. However, this decision did not result in improving the service. Quite on the contrary – with the transfer of mandate to Ministry of Inferior more land remained unprotected (possibly because the lack of experience and organisational defects for anti-hail procedures). That led to the newest decision in 2015 when the mandate is returned to RHMSS.

is an enormous discrepancy between these two prices, and that is another obvious example of corruption.

Based on the elaborated hypothesis, several reinforcing loops that triggers corruption in this service organization are identified. The main reinforcing loop is R1, which shows that with bigger accumulated corruption (History of corruption cases) from previous years, then decision makers face, with certain time delay, the higher inclination to corrupt further. So to say, when their behaviour is not properly controlled and sanctioned, they continue this practice in the years to follow. The "profit appetite" grows, therefore influencing the fraction of quantity (meaning that in the years to come the number of ordered rockets might increase since every single rocket is the source of private, corrupt profit of the people involved in this corrupt practice).

Grounded in the literature review and the above qualitative dissection, Figure 9 illustrates three reinforcing loops "R1", "R2", and "R3" that are detected and that will be used in the empirical application in the next section. The role of government can be observed in the feedback loop R1, which deals with the constructs of government expenses and public bureaucrats' attitude towards corruption. The higher the levels of bribery are, result and consequently increases the inclination to corrupt further and, in a long term, will increase governmental expenditures.
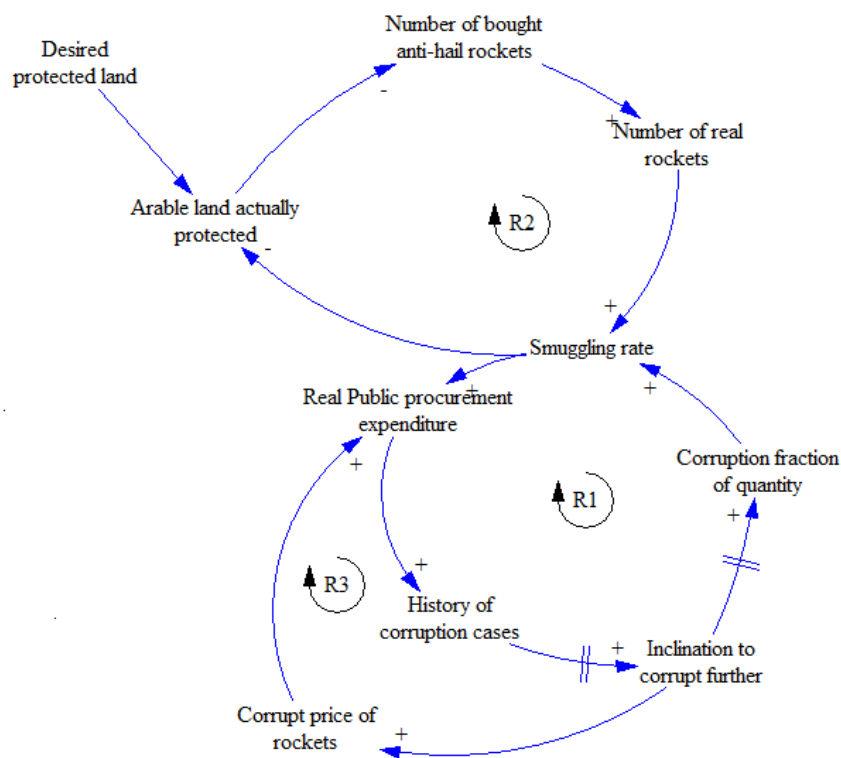

Figure 9 Reinforcing feedback loops

Generally, bureaucratic malpractice manifest in the diversion of public funds to the areas where payoffs are easiest to collect, therefore, abuse of public office may not only reduce the volume of public funds available to the government but may also lead to misallocation of those funds. In this particular case, public money were not only spent on disputable quantities of the rockets, but the misuse occurs also connected with the price that is paid for rockets (see R3). Feedback loop R2 explains the purpose or so to say the actual need for the anti-hail rockets procurement. To protect the arable land from possible devastating effects from the hail a number of rockets available per year for such a purpose has to surpass its minimum required number.. More about this methodology, historical background, its practical application, and the required settings for a good governance the reader can find in Appendix A.

On the other side, the inclination to corrupt further is limited by the several balancing loops, presented in Figure 10. The first of them, loop B1 comes from the amount or level of land that is actually protected. With all the inefficiencies originating from the poor procurement process and resulting in not having enough anti-hail rockets to actually and timely protect the arable land, the public become furious. This behaviour directly leads to the diminishing level of public satisfaction, which - with certain time lag - makes pressure on the public bureaucrats and stops, or better to say, limits their inclination to corrupt further and more each year.
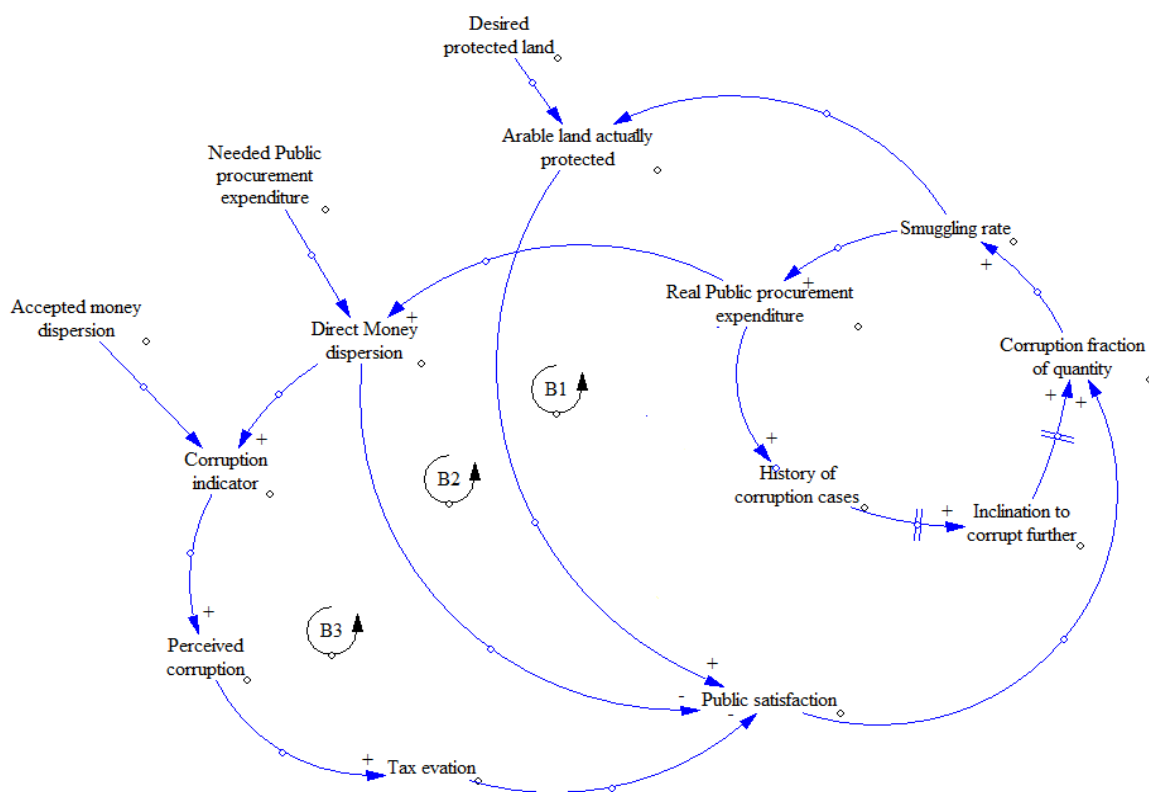

Figure 10 Balancing feedback loops

The second balancing loop is originating from decreasing public satisfaction caused by obvious money dispersion of the public funds. Compared with indispensable public procurement expenditures, which the population of Serbia is more than willing to pay to protect their crops efficiently, there is a significant gap of money that is misused. That has a straightforward influence on public bureaucrats when they are deciding upon public funds usage. In addition to this limiting factor, inhabitants in Serbia make a similar effect with tax evasions that in turn make additional pressure not to corrupt further.

It seems realistic to assume that if corruption increases and arable land protected deteriorates, the public satisfaction will decrease as shown in the balancing loop B1. The same as discussed in Chapter 2, as corruption increases public funds dispersion, it causes a diminution in economic growth too, leading to decrease further the general satisfaction, loop B2. The model also assumes that as perceived level of corruption increases the population will be further unhappy with the governmental actions. Moreover, will face tax avoidance, which is a similar relation as the loop B2 (see Figure 11). Since attitudes towards corruption play a critical role in the persistence of corruption — if people's attitude against corruption went high then the corruption would be decreased over time.
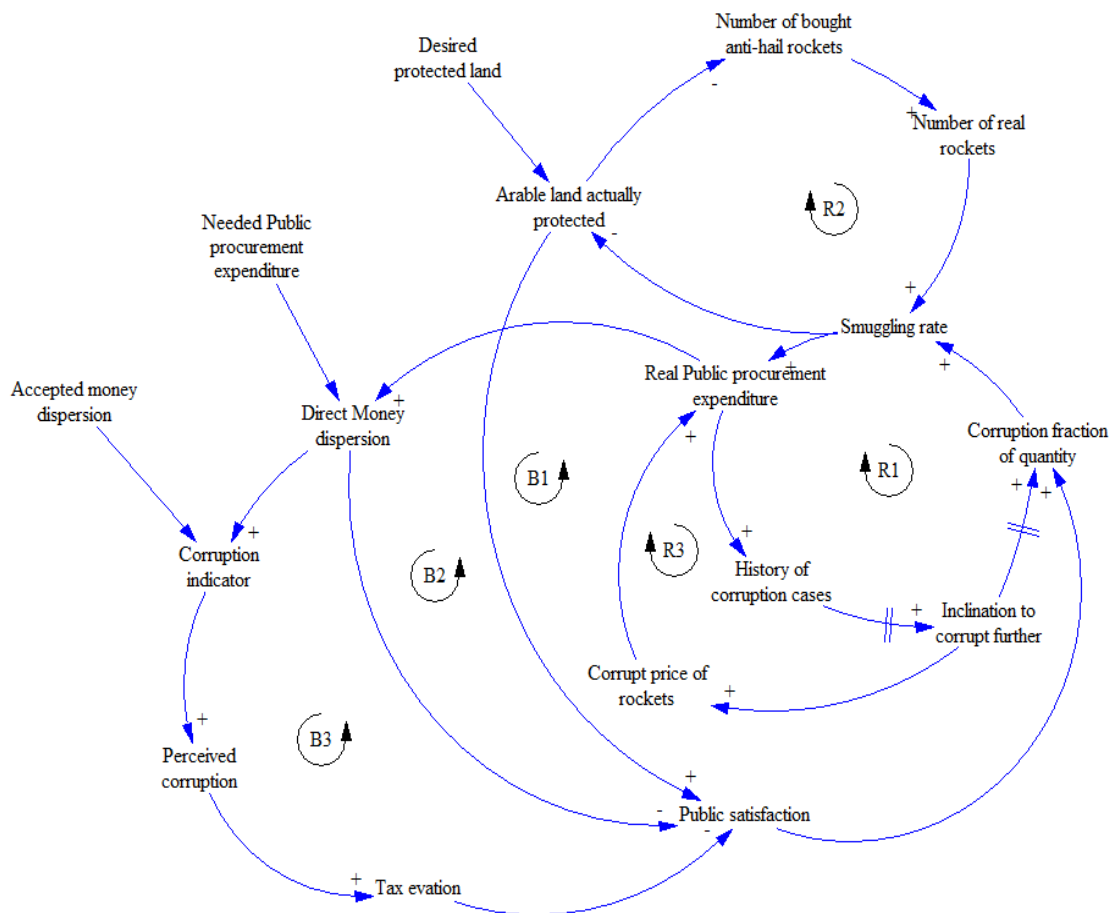

Figure 11 Causal Loop Diagram

The nature of this research calls for a different approach when referring to hypotheses. The purpose of the model is to incorporate postulates of various reports. The endogenous estimations on the elements of the corruption practice are integrated into the model. The connection of different hypotheses results in a well-structured model, demonstrating multiple areas of the workflow and similar explanations of effects, usually separated by time delays. Therefore, the research project has objectives instead of only hypotheses, which will be elaborated in details in the next section.

4.3 Simulation Model

One of the research questions concerned structure of the model: How can strategic resources and their relations be framed in a specific Public Service provider? The RHMSS qualitative model combining different relations through feedback mechanisms to capture the behavioural complexity of corruption practices has been already explained in Figure 11.

The primary objective is to create a model that conceptualizes the dynamics of a RHMSS performance drivers and strategic resources (and the end results, respectively). The purpose of such a model is to provide an understanding of the existing state of affairs of the public service provider being modelled and to indicate the path of reducing the corruption, as one of the main strategic resources. Besides, the model has to demonstrate each of the following characteristics. The model is:

- simple enough to be easily explained and understood at the administrative level of any public service provider
- sufficiently comprehensive to include different dynamic structures, and policies affecting the overall efficiency of the organisation

The secondary objective is to validate the model using estimated data characteristic of a public service provider. Once the data is loaded into the computer simulation model, will be run once to obtain the current state, and then run several times with different strategies and policies to identify opportunities for improvement.

The data for this case study was collected using different sources and techniques. The research was carried out through a process of document analysis, unstructured interviews, and observations. The data has been collected from various sources; for instance, Anti-Corruption Council reports, Statistical office, and diverse Serbian Laws, as well as newspapers reports. As said previously, before creating the quantitative model, the key relations as well as exogenous and endogenous variables were also identified (presented in a table form for easier understanding, recall the Table 3).

4.3.1 Framing a DPM Model

Traditional PMS may deliver a static analysis of value creation processes and, therefore, may not consider the time delays existing between the adoption of a policy and the achievement of the related results. In addition, not tangible variables and non-linearity often considerably influence strategic resources, and the associated performance drivers and end-results. For example, some of the strategic resources are hard to express and measure in a quantitative way but rather as a level 0-1, or 0 to 100%. For overcoming such undesired effects, it is possible to facilitate decision-makers' understanding and to achieve that, DPM based on the SD model has been chosen as a framework to foster accountability and performance improvement.

Firstly, strategic resources can be presented as stocks (or levels) of available tangible or intangible resources in a given time. Consequently, the stock levels are influenced by the value of corresponding inputs and outputs over time (inflows and outflows). Exactly this influence is used to test different policies in the modelling process. Identification of the strategic resources and the most important factors that are influencing their change (drivers) is essential to shed light on the business areas important for the performance improvement. They can be measured in relative terms (i.e. as a ratio between the business performance perceived by clients and a benchmark, or target). Finally, end-results are a measure of the efficiency and effectiveness expressed in terms of volumes or impact. They are flows affecting the accumulation of corresponding strategic resources

Using an instrumental dynamic performance management (DPM) model, I divided the performance into three linked levels: strategic resources→ performance drivers→ end-results (see Figure 12), which are separated into three sections by dotted-line boxes. The following main strategic resources linked with the direct outputs of the corrupted RHMSS practice are identified: Number of Anti-hail Rockets, Number of Unregistered Anti-hail Rockets, and Cumulative Corruption (History of Corrupt cases). They can be altered by using different policies to change or improve the end-results. Namely, the direct end-results of the public service provider are Rockets purchase rate, Repurchase rate, and Additions to Cumulative corruption.

In addition, there are several interesting drivers identified in this case study. First, Relative area remaining unprotected. This performance driver is a ratio between the Desired protected land and the Effective area protected. It shows the success of the anti-hail methodology provided by RHMSS, however, the outputs of the method are heavily damaged by the corruption practice. This performance driver has an impact, through pressure to buy more rockets indicated by agricultural

needs, on the Rockets repurchase rate, and stock of Anti-hail rockets, respectively[47]. Next is presented ratio or fraction of unregistered rockets usage that shows how much of the Anti-hail rockets will end up being smuggled.

Focusing on a single static performance measure (for example, the number of rocket consumed based on the account records) might lead the public provider's decision-makers (or public revisers and controllers) to think that sole problem is in a shortage of the rockets. Therefore, to stipulate them to believe continuously that the problem is in the stock supply side, and to try to solve the issue by procuring additional missiles (what is exactly happening in the practice, when local municipalities or even inhabitants are collecting money to buy additional rockets independently). Solving the problem and increasing the number of rockets actually used to protect arable land, might produce a certain effect on the Effective arable land protected, and that is accurately what the public provider counts as the after-effect of its service.

Nevertheless, there are "indirect" effects of the public provider practice (in particular, corruption practice), and they can be demonstrated to a lower or higher level of public satisfaction. With deductive thinking, public satisfaction is identified as an additional strategic resource that organisations are not primarily, if at all, taking into account. This strategic resource is not, however, a direct result of the company practice (perceived as an output), but rather indirect or outcome. Therefore, it is illustrated in Figure 12 as a separate section.

Related to this strategic resource a number of performance drivers can be identified. Firstly, Relative rockets usage effectiveness as a ratio between Rocket usage effectiveness and Minimum acceptable rocket usage effectiveness. It shows the influence of the actual usage of the rockets to protect arable land taking into account Unregistered rockets usage rate. When the service that supposed to be provided by the public organisation is above minimum acceptable level, public satisfaction rate will decline, and with a time lag will influence defined strategic recourse. Another important performance driver is identified; namely it is a ratio of money dispersion over a specific acceptable threshold value. The rationale behind it is that public will tolerate some level or misused money, over a number of time units, let say years. The reaction of the public is never instantaneous, and "negligible" amounts of mishandled public funds are overlooked. However, with constant and significant abuse of public power, there will be a change in public satisfaction, meaning that there is a direct linkage between end-result (change in public satisfaction) and the performance driver that compares the threshold amount of public funds dispersed and an actual amount of dispersion.

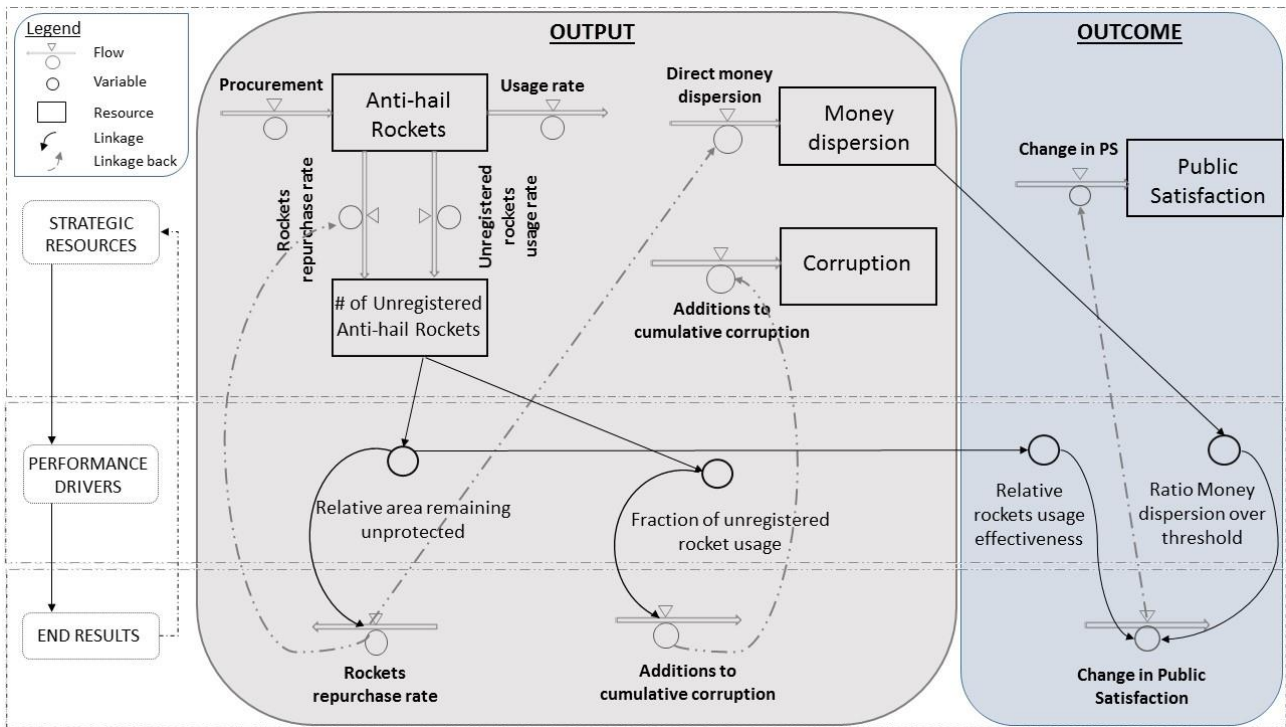[47] The ratio goes from 0.1 to 0.95 in the simulation model.

Figure 12 DPM framework

The RHMSS model combines different element through feedback mechanisms to capture the behavioural complexity. The representation of all these elements follows a structured approach. The model reproduces the important elements or processes of the system in question rather than simulating its behaviour through mathematical, pattern-matching type behaviour.

4.3.2 Composing the model structure

The second general research question is: What would a SD model of corruption in Serbian Anti-Hail public service provider look like? The final aim of this research is to make recommendations for improving the performance, and these recommendations are based on simulations; hence a quantitative model is needed.

For System Dynamics modelling of RHMSS case study, I used iThink™ software (Richmond and Peterson, 1997) which supported model design in stock and flow diagram, following the same relation of the causal loop model seen in Figure 11. The simulation starts from 2004 where the first corruption consequences of the company have been revealed and published later in 2010, and it runs for the following 50 years. The previous history has been abstracted from the model, leading to the settings of the initial values of the stocks to be 0.

To exemplify, corruption is modelled as a stock. This stock is represented by Equation 2 specified below. The equations of the entire model can be found in Appendix F, together with the values corresponding to the base case and documentation. A selection of important iThink^{TM} equations for the simulation model, developed from the S&F diagram, are presented in Table 4-1.

Equation 2

Corruption (t) = Corruption (t - dt) + (change_in_C) * dt

INIT Corruption = 0

The first equation communicates that corruption at the present time (i.e. 't') is equal to the corruption at the previous time (i.e. t − dt), plus the change in corruption that occurred during the period (i.e. dt) since the corruption level was previously calculated. The second equation indicates that the initial value of corruption was 0 at the beginning of the simulation. Dimensions (units of measurement) are provided here for each variable in the brackets at the end of each equation.

Table 4-4 Equations of the Simulation Model

Equations of the RHMSS corruption model
Accumulated_Dispersion(t) = Accumulated_Dispersion(t - dt) + (Direct_money_dispersion) * dt
INIT Accumulated_Dispersion = 0
INFLOWS:
Direct_money_dispersion = Procurement_value-Real_rocket_price*rockets_purchase_rate
Accumulated_Procurement(t) = Accumulated_Procurement(t - dt) + (Procurement_value) * dt
INIT Accumulated_Procurement = 0
Rockets_purchase_budget = 6000000
Rockets_purchase_rate_indicated_by_agriculture = (Desired_protected_land)/
Area_coverage_by_a_rocket *effective_pressure
Rockets_purchase_rate_indicated_by_budget = MAX((rockets_purchase_budget -
unregistered_rockets_repurchase_rate * unregistered_rocket_price) / Real_rocket_price , 0)
Rockets_usage_effectiveness = Effective_area_protected / Desired_protected_land

The quantitative corruption model has been made of 6 stocks: Cumulative Corruption (Dmnl), People's Satisfaction (Dmnl), Rockets (Rockets), Rockets being smuggled (Rockets), Accumulative Money Dispersion (EUR), and Accumulated Procurement (EUR). Stocks of Accumulative Money Dispersion and Procurement, for example, have the initial value 0. With that, it is said that the

previous history is not relevant for the model. Strategic resources identified are Stock of Rockets, Arable land to be protected, Stock of Money Dispersion and Stock of Public Satisfaction.
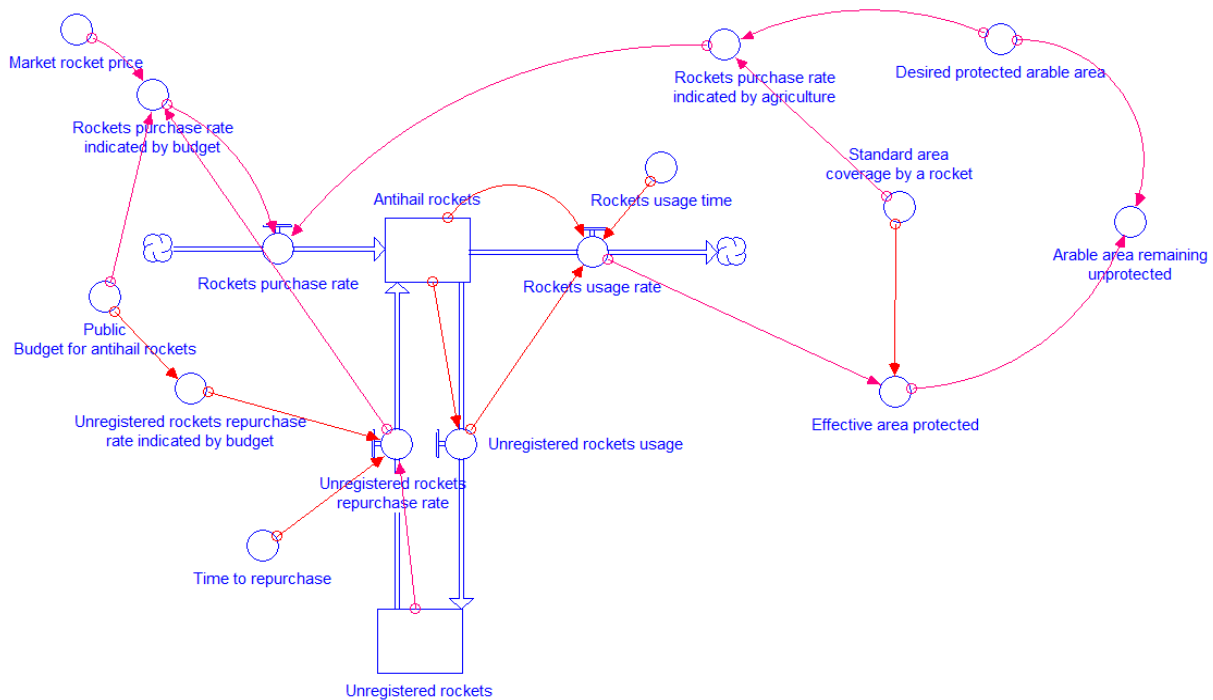

Figure 13 Snapshot - The main model dynamics

Furthermore, flow equations are normally the policy statements in the system. They manifest the rate at which the system will improve during the upcoming simulation interval of time – in other words, they represent the end result according to DPM (an example of a flow equation from the corruption model is given in Table 3).

The size of arable land to be protected is defined by Ministry of Agriculture, Forestry and Water Management area, therefore, Desired protected land is 4.800.000 ha (hectares). Based on that information, the number of the rockets needed per year to fulfil the requirement of protecting land, is defined to be 30.000 rockets[48], so the Rockets purchase rate accumulates in the stock of Rockets to be used. The usage of the Rocket is defined by Rockets usage rate; however, this is not the only outflow from this stock.

In the simulation model, the main dynamics is exactly related to the stocks of Rockets and Rockets being smuggled, and re-bought inflow to the stock of Rockets (see Figure 13). This dynamic behaviour is addressed with reinforcing loop R2, showing the relation between Rockets purchase rate,

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[48] Therefore, coverage by a rocket is a hard number (equivalent to 160). The number of the rockets needed per year is connected with optimal public satisfaction, as well.

Unregistered rockets usage rate and the Effective or actual area protected. Because of the smuggling rate, there will be a gap between the real area protected and the desired protected land (caused by the shortage of the rockets), then this gap induces the company to purchase more rockets – since there is an additional need for rockets to protect the land.
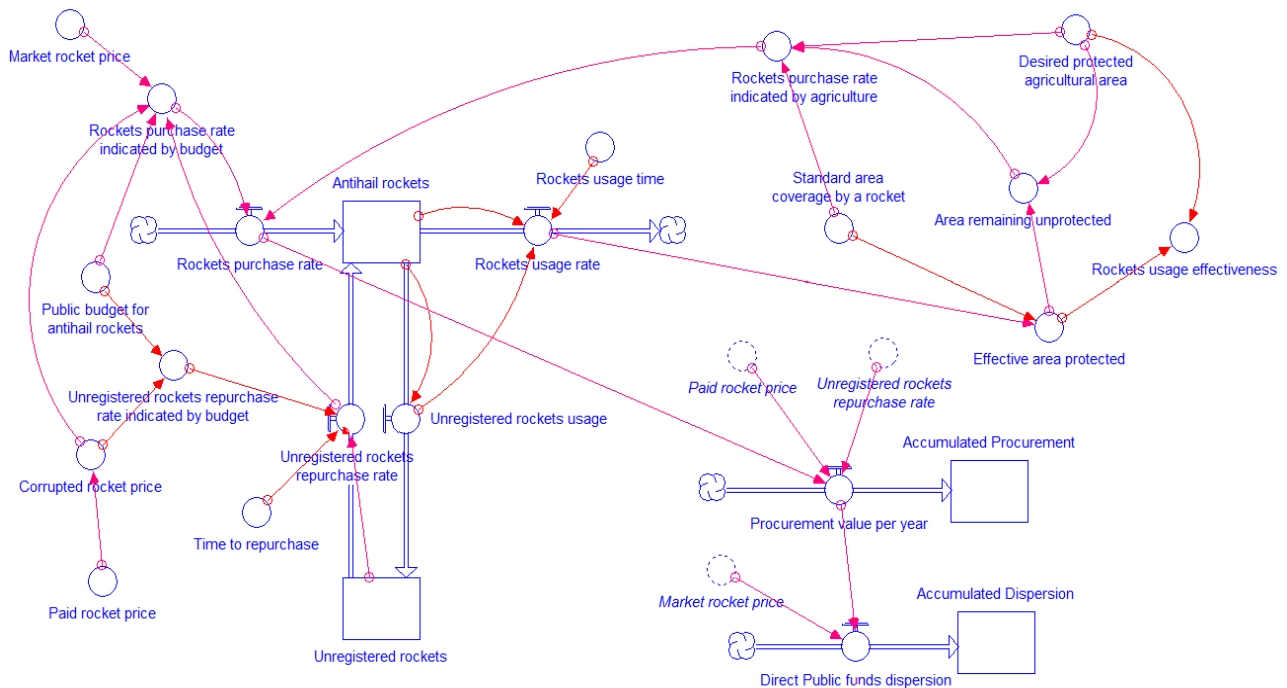

Figure 14 Snapshot - Enhanced S&F model

As for converting a reinforcing loop R3 into the S&F model, three prices were put in the model (see Figure 14). The first one is the price as per perfect market conditions – "Market rocket price", following laissez-faire economic philosophy or "an invisible hand" of the market, Smith (1776)[49]. The second is the price that company pays in order for public bureaucrats to gain some private interests –"Paid rocket price". That price is a trigger for an inclination to corrupt further, so the price could even be higher over time (if there would be no mechanisms of control) - creating the third modelled price "Corrupted rocket price".

The values are 200 EUR and 300 EUR for the Market rocket price and the Paid rocket price, respectively, while once the model is launched Paid rocket price can trigger the further corruption

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[49] Laissez-faire is an economic system in which transactions between parties are free from government interference such as regulations, privileges, tariffs, and subsidies. Likewise, Adam Smith viewed the economy as a natural system and the market as an organic part of that system. Adam Smith first adopted the metaphor of an "invisible hand" in his book The Theory of Moral Sentiments to explain the unintentional effects of economic self-organization from economic self-interest. Later, many academics have considered the invisible hand metaphor as one for laissez-faire, though Smith never actually used the term himself.

and the value of that growth will be presented with Corrupted rocket price. There is a limit to the growth of that price, and that is established inside of the graphical function. A reasonable assumption is that growth of the price will go up to 400 EUR at maximum, see Table 4-2.

The simulation model is then set to compare Market rocket price with Paid rocket price[50]. By multiplying the prices with the quantities officially procured, will show the difference using flows - Procurement value per year and Direct Public funds dispersion rate, respectively. These flows or the end-results of the procurement process will eventually build up into the stocks of Accumulated Procurement and Accumulated Dispersion. Feedback loop R1 is then closed by showing the relations between Rockets purchase rate, Cumulative corruption – history of corrupt cases, an Effect from cumulative corruption on the inclination to corrupt, and Accumulated Procurement.

Table 4-5 Relative cumulative corruption and the Effect on the corrupted price

Relative cumulative corruption	Effect on the corrupted price
0	1
1	1
2	1.01
3	1.03
4	1.07
5	1.12
6	1.17
7	1.23
8	1.28
9	1.29
10	1.30

Additional counteractive loops connected with the limiting factors of the corruption practice i.e. public satisfaction or the budget of limited public funds, are also converted into SD quantitative model. For the complete process of the transformation of the feedback loops into S&F model, read Appendix C. Here the whole quantitative model will be presented (see Figure 15) and explained the counteractive loops.

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[50] A ghost function has been used in Figure 14. As cited in Ullah (2006) a ghost of an entity has no independent identity - it is simply an image of the building block from which it was ghosted. The ghosted replica has no equation of its own. In particular, ghosted stocks can have no inflows or outflows; ghosted flows. Ghosts serve the primary role of keeping a diagram tidy. When connectors might otherwise run all over the screen, leading to diagram "spaghetti," ghosted images can help to keep the connections neat and clean (Richmond and Peterson, 1997).
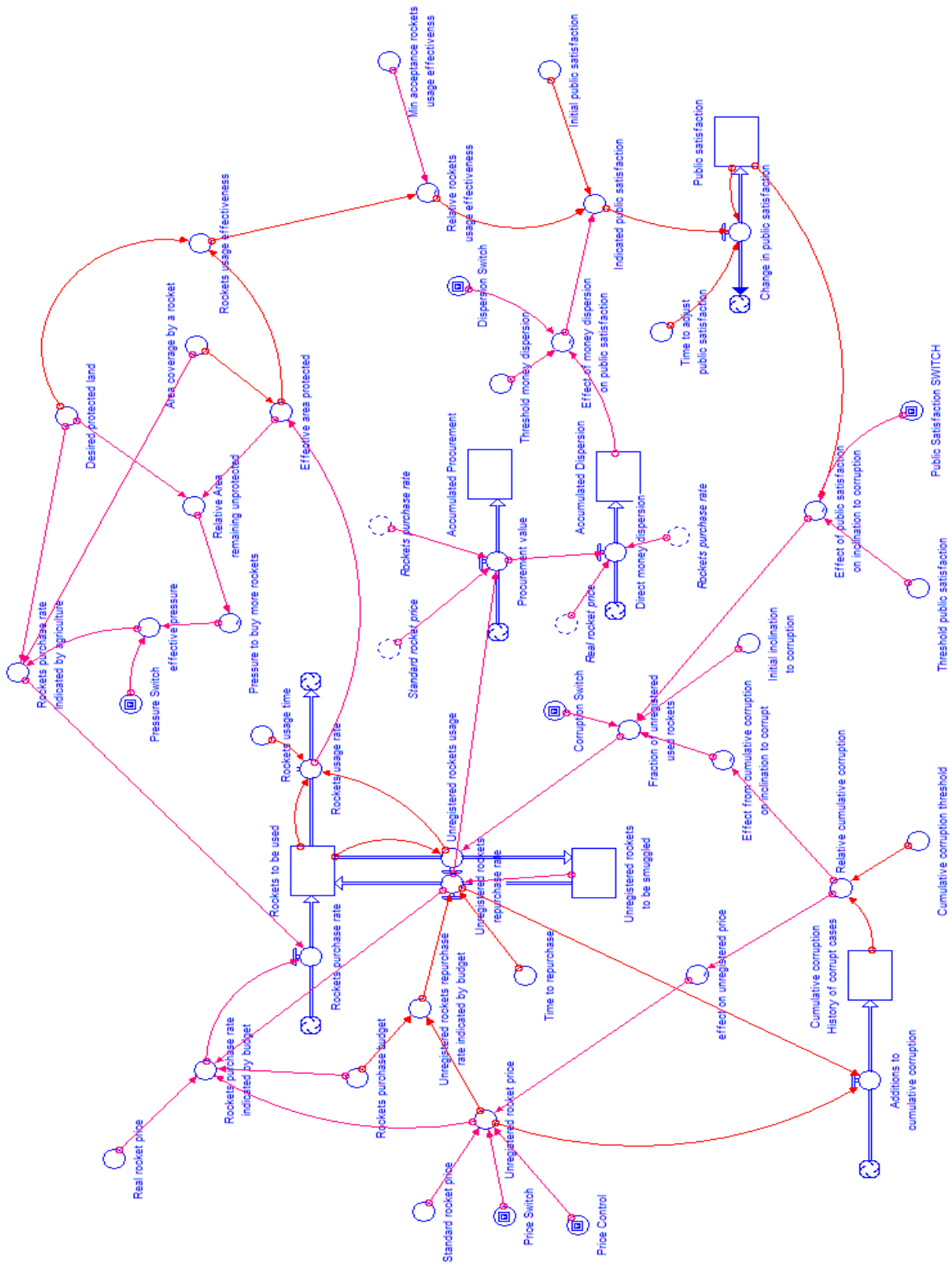
Figure 15 Snapshot - Full S&F model

The model takes into the account Effect of Money Dispersion on Public Satisfaction[51] (calculating it with a threshold value of money dispersion of 7.000.000 EUR), as a counteractive force limiting the corruption. This effect is build up both from the impact of rising price and from the consequence of misused quantities of rockets since there is a dual source of money dispersion of public funds. Then in turn, an important effect of Public Satisfaction to subsequently reduce and slow down Inclination to corrupt is modelled, which SD model compare to a certain threshold public satisfaction (initially the value is one). Having in mind that people's attitudes towards corruption have a crucial role in the perseverance of corruption — if people's attitude against corruption goes high, then the corruption will diminish in a long run. As stated by Cameron et al. (2005), peoples' attitudes towards corruption are formed by the systems of the nation state they live in as well as their everyday experiences of corruption. In the SD model, this is represented by the stock of Public satisfaction. These effects are constraining the growing appetite of the public bureaucrats to (endlessly) corrupt.

The budget is publicly available data, and for the protection of the agricultural land per year an amount of 10.000.000 EUR is dedicated from the public funds. The actual budget of the Republic of Serbia for this purpose is somewhat higher that I put in the model. However, in reality, it also includes salaries and other administrative costs (that are outside of the model boundaries) while this model is taking into account only the budget for the rockets required (30.000 rockets). Therefore, the model operates under strict budget of 6.000.000 EUR per year calculated with market price.

One of the performance drivers showing how successful/unsuccessful the service provider operates, is the relative rocket usage effectiveness (showing the area protected not in terms of area, but in terms of ratio). The model is set to compare this relative indicator with the Minimum Acceptable Rocket Usage Effectiveness – public expect that everything is 100% working, so I put in this indicator value one as the initial value. In addition, some level of corruption the public will tolerate because of different factors such as lack of information, perception delays, etc. Indeed, the public can and does tolerate certain public funds misusing; meaning that there is not a straightforward reaction of the public to the corruption cases - there is a non-linearity in this behaviour, similar as for the price explained in Table 5. The model assumes that public can tolerate certain public funds misuse with an informational delay of 4 years (after four years of the corruption indulgence they will start expressing dissatisfaction and/or protest). Therefore, the Threshold Money Dispersion is 3.600.000 EUR[52].

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[51] The Initial Public satisfaction is one while the time to adjust public satisfaction is set to be three years.

[52] The logic behind this number is that corruption process starts with 3.000 rockets being smuggled and with the price paid of 300 EUR. Therefore, it is 900.000 EUR per year, and after four years of this continuous corruption, tote up to 3.600.000 EUR and then the general public will show confrontation and put the pressure on the company.

4.3.3 Simulation results

This section is dedicated to the simulations of the RHMSS procurement SD model. All the simulations have been conducted in iThink™ software. The section starts with the design of the simulations and the execution of this plan. Then, the results of the simulations are shown.

The dynamic behaviour of the corruption model can be studied through simulations by varying the parameters of the model. Firstly, the model needs to be placed in equilibrium (see Appendix D). At the equilibrium, the model does not generate any dynamic behaviour, i.e. nothing changes over time, and it lies at equilibrium unless otherwise disturbed. The focal point of these simulations is to evaluate the impact of different policies on different indicators of interest.

The simulation procedure consists of three steps.

To start with, the parameters of the model are set ideally. Meaning that the key performance indicators (which are present in the model) are at desired values. For example, an unregistered rockets usage per year is set to be at 10% during all simulations.

After these settings, the simulations were done. There are two different kinds of simulations:

(a) Firstly, the exogenous variables can be changed (one by one) to see whether the KPI's are as expected. These variables are for instance the Minimum acceptable rocket usage effectiveness, Desired protected agricultural land, Thresholds levels, Time needed, etc.

(b) Secondly, changes in decision rules can take place (for instance, to which level to set the Unregistered rocket usage rate). Once more, that is only in order to find out how the KPI's levels are changing.

Finally, the effects of the simulations are compared to determine which parameters have the highest influences and which structure or decision changes could cause improvements. Furthermore, based on these results certain recommendations are made.

During all simulations, the model ran for 50 (years) and the time step was one year. In every simulation, the following indicators were measured:

- Effective are protected, as one of the most important indicators.
- Direct Public Funds dispersion.
- Ratio Indicated Public Satisfaction.

Ideal parameter setting

As pointed out before the first step is to fine-tune the model; all the parameters are set ideally. There are three sorts of parameters in the model:

1. Exogenous parameters: These parameters provide the input for the model. They do not depend on other variables. These parameters can be changed to simulate with the model. For example, the desired levels (e.g. of a territory of land to be protected) can be adjusted manually such that the forecast deviates from the actual need. After running the model the influence of these changes on the main strategic drivers, and consequently on the end results can be determined. Despite the fact that the value of the parameters can be set arbitrary, there are some logic bounds. The Number of unregistered rockets can never be higher than Number of Anti-hail Rockets, Accumulated Procurement will never be negative and Corrupted rocket price will not rise to infinity.

2. Levels: these parameters cannot be changed by ourselves, except for the initial value. The levels are governed by on they own inflows and outflows.

3. The rest of the parameters: these parameters are determined by on the system and are the result of decision rules (equations). The internal decision rules can be changed in simulations. For instance, rockets purchase rate - based on the Desired protected agriculture area (this rate depends on the critical ratio, Gap Area remaining unprotected over Effective area protected) the decision rule of Rockets purchase rate indicated by agriculture determines the best possible stock size. Generally, all the decision rules can be transformed; nonetheless, some rules are not logic to change. An example: the Number of Unregistered Rockets is designed as the percentage in relation to the Number of Rockets. It would be strange to change this rule.

The exogenous parameters were set such that the outcome of the model is ideal, meaning the maximum quality level is 100%, or 1, the maximum image is 100% or 1. The basic run of the model is the simulation run with the ideal parameter setting.

With the intention of understanding truly the different influences of the internal variables on the strategic resources, it was chosen to use a constant Budget. Naturally, this is far from real, but it does provide a better inside understanding the relations between observed strategic drivers and end results without any noise from other factors.

Parameter alterations

Before any parameters were changed a base run was conducted. This run was done to verify the structure of the model and matching with the behaviour that is expected. The simulations start with the parameter alterations. The model can be studied through simulations by varying the parameters of the model. First the model needs to be placed in equilibrium (see Figures 16 and 17). At the equilibrium, the model does not generate any dynamic behaviour, i.e. nothing changes over time, and it lies at equilibrium unless otherwise disturbed. The focus of these simulations is to analyse the impact of different policies on different indicators of interest.
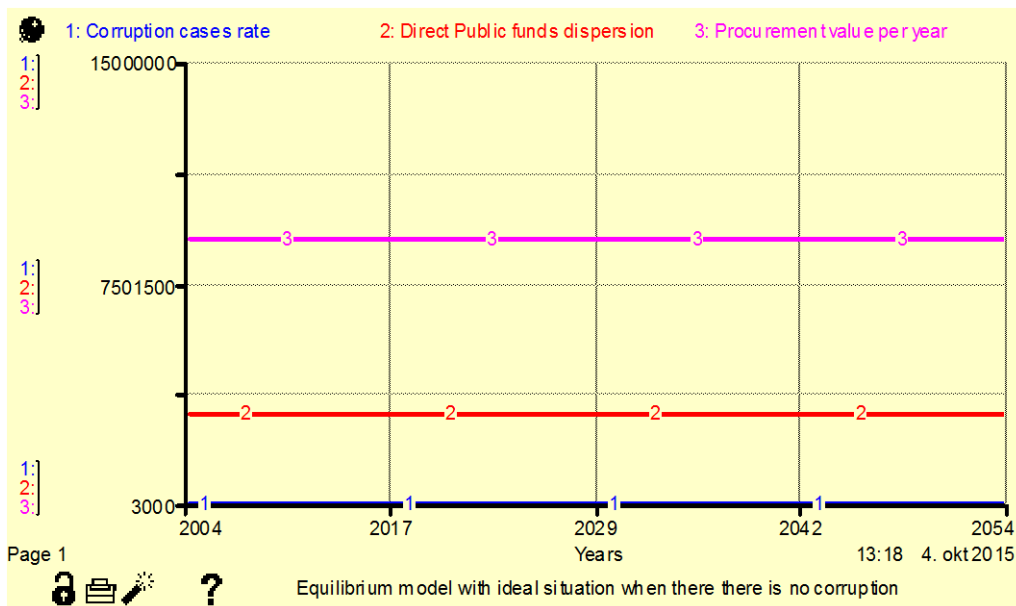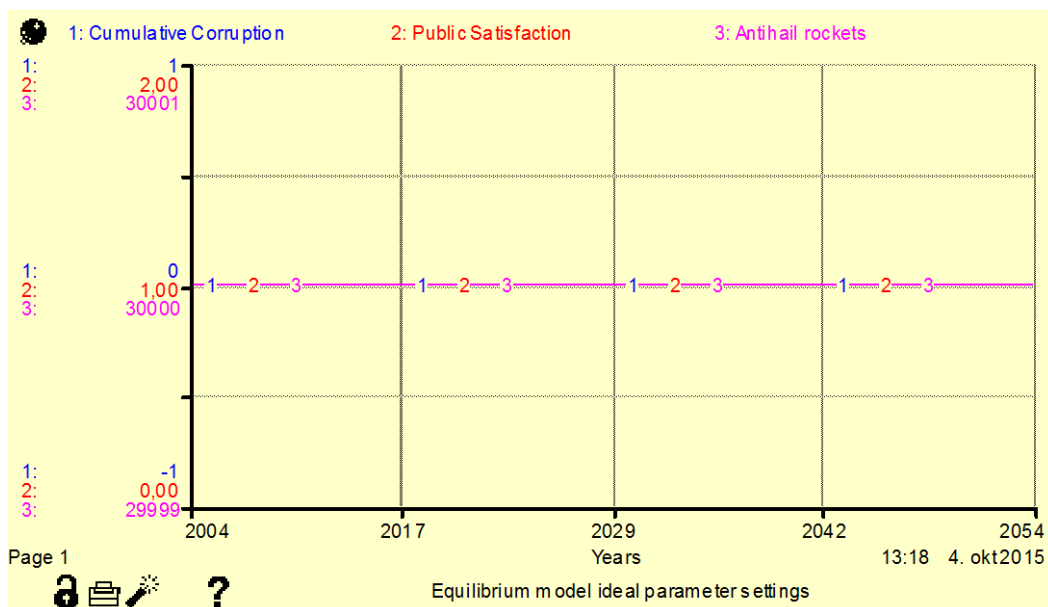

Figure 16 Equilibrium case 1

Figure 17 Equilibrium case 2

In the equilibrium, the effective area protected is equal to the desired area, therefore, the gap is zero. I modelled hypothetical situation of what could be happening without any corruption. Since the budget is limited, public bureaucrats procure exact quantity that needs to be bought for the protection of soil, so the need is exactly satisfied (as we can see in Figure 17, Anti-hail rockets are exactly 30.000 pieces as optimal, and Public Satisfaction is 1 or 100%). This run is the benchmark for comparison, showing how everything would be functioning without corruption practice. In principle, the money dispersed can be calculated by comparing the simulation with and without corruption behaviour, they subtracting the values from two simulations.

As the model is initialised, I simulate the model with the behaviour that reflects the status quo before Anti-Corruption Council report was published (see Figure 18 for Behaviour over Time diagram - BoT). At this point, scenario planning is done and the results are drawn from the model. This provides extraordinary guidance to anti-corruption policy for the government since the outcome can influence their decision-making process towards focussing on important factors to target corrupt activities.
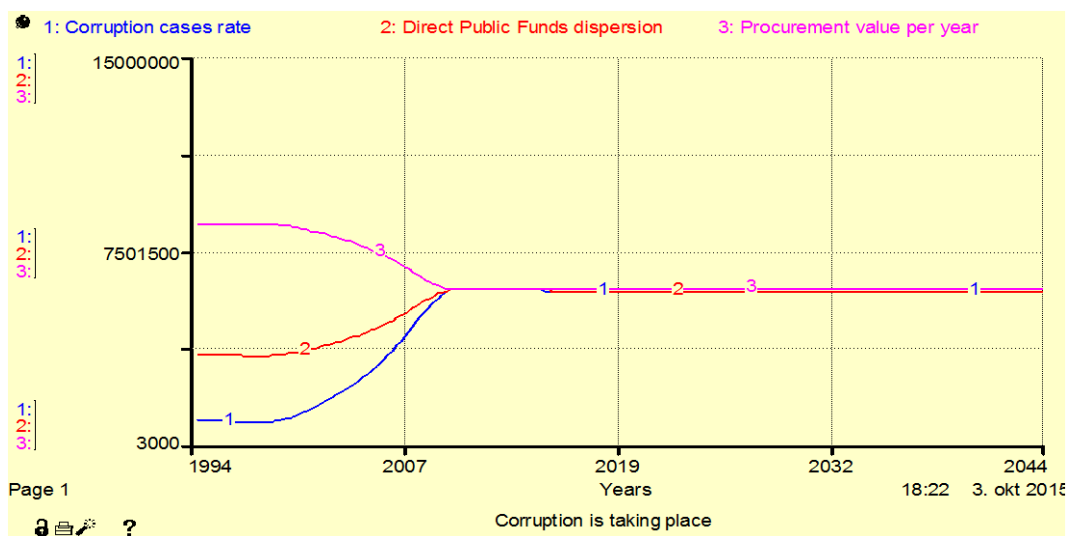

Figure 18 BoT Historical corruption practice

The SD model enables the projection of several different scenarios (see Appendix E for extensive simulation results from different scenarios). Stocks will approach their highest or lowest value if one or more of the stock parameter is pushed up or down (see Appendix D for Extreme-policy test), although the rapidity of that change is dependent on the extent of the push. In other words, when changing the value of stock parameters the model approaches either a very corrupt system or a very clean system. This is the most important stage of the modelling process (Maani and Cavana, 2007).

Using this dynamic simulation, helps in several ways. Firstly, we can clearly distinguish the amount of money that needs to be used compared with the actual procurement expenditure. Not only that we see the results of a mathematical operation, but the long-term, dynamic effect on the public satisfaction and the real land protected. Secondly, we are able to produce different policy scenarios but cutting some reinforcing loops and seeing the results of such policies. Thirdly, the simulation itself ensures that we can identify main Strategic resources we want to address in the implementation of different policies, main Performance drivers we want to use in order to achieve better end-results.

The BoT diagrams below show the results of corruption practice over time with different levels, however the interaction of corruption and government spending share is always negative and significant – meaning that we are far from ideal conditions whenever corruption takes place. Most of the flows are showing goal-seeking behaviour, or have so-called "S-shape".

Firstly, we can see that due to informational and actions delays, and shifting dominance of the loops in the model, the behaviour of the Effective area protected shows some oscillations (what's more due to the fact of stabilisation in number of used rockets). Presented in Figure 19, it sharply drops as the simulation starts, before it begins to stabilise steadily over time as a direct consequence of the change in the fraction of unregistered rockets usage. Logically, when the fraction or the amount of smuggled anti-hail rockets is the highest, the effective area protected is in its minimum level in the observed period.
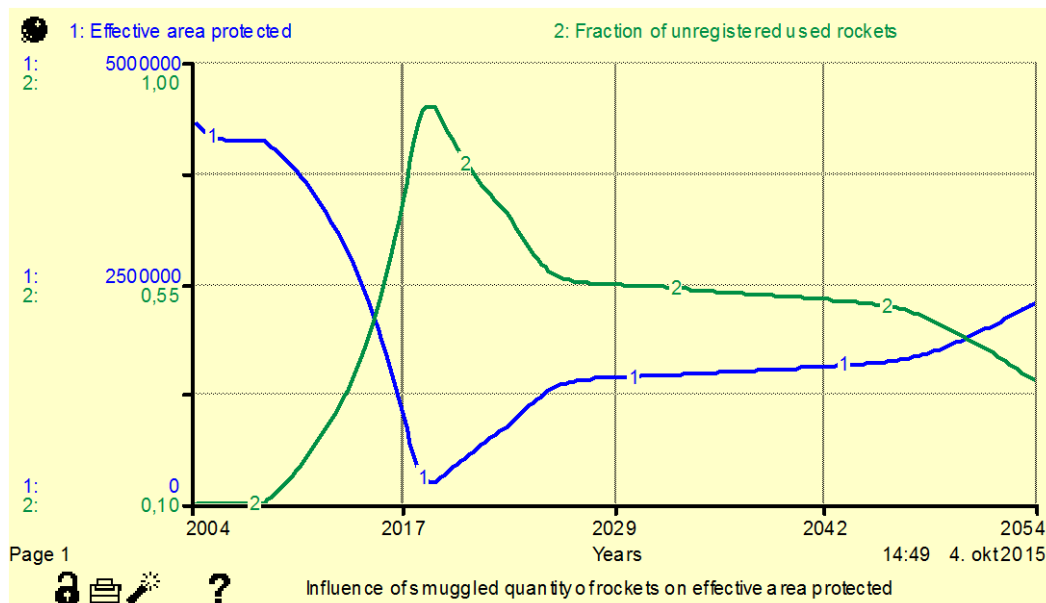

Figure 19 BoT The Effective area protected and the fraction of rockets misused

As the arable land is getting insufficiently protected, the need for better protection grows. Therefore, the effective pressure to buy more rockets takes place (coming from the Agriculture with a certain time delay, of course), indicating the needed rockets purchase rate (see Figure 20). We can see that the needed number of rockets goes up to 39.000 pieces in the simulation model (which is 9.000 more than an optimally defined level by the experts). During the time, the number stabilises to a reasonable level, but as long as the corruption exists the number will always be above optional of 30.000 rockets.
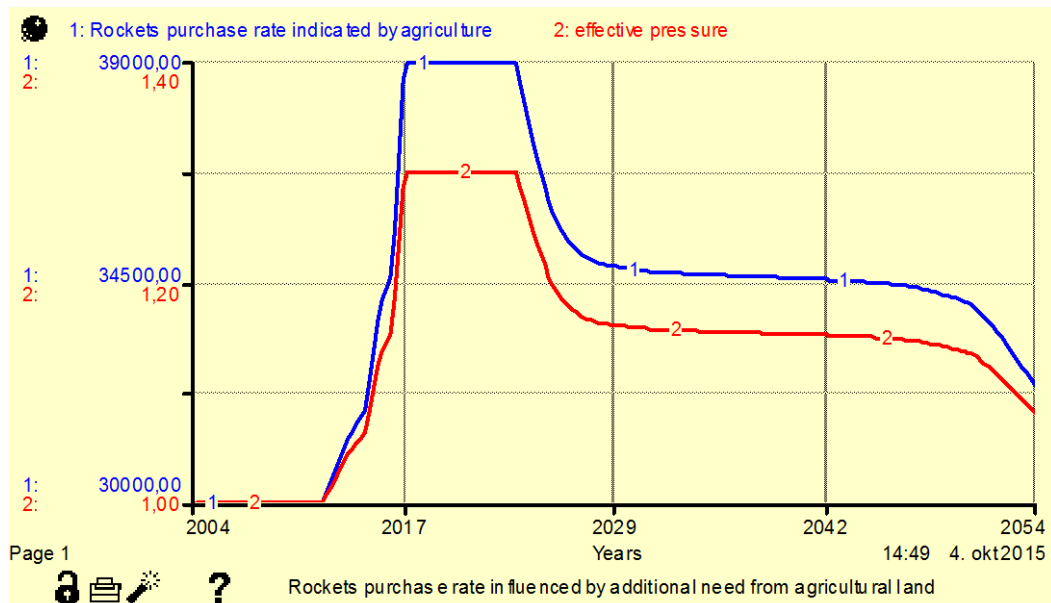

Figure 20 BoT Rockets needed and the pressure from the Agriculture

In addition, as long as there is unrestrained and/or unsanctioned corruption practice, due to rising inclination to corrupt further, there will be incentives to pay an even higher price per rocket in order to achieve private interest from such transactions. As we can notice in Figure 21, the price per rocket is rising until it almost reaches the defined maximum level[53], however it stabilises at the level of 390 EUR per rocket, which is an increase of around 30% compared with presented standard paid price, see line 2. Let us not forget that the standard paid price of 300 EUR is still higher that the Market price, so the effects of corrupt actions are even severer.

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[53] In the System Dynamics methodology, this is called "Goal seeking behaviour", meaning that the variable will raise or decline up to the modelled value, but will never actually reach the exact defined value.
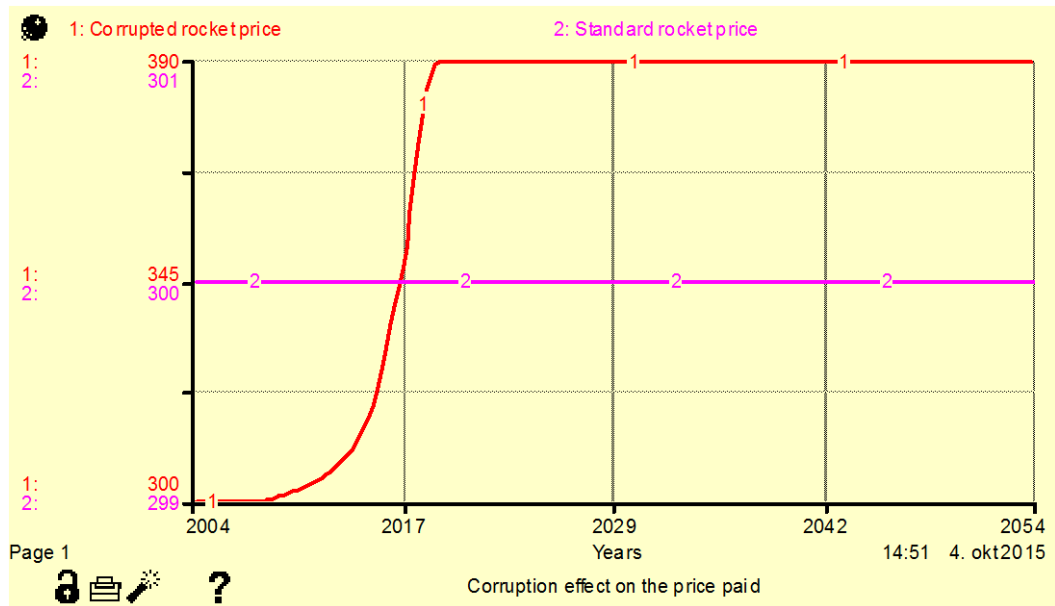
Figure 21 BoT Corrupted price vs Paid rocket price

With growing inclination to corrupt, the unregistered rockets usage increases from the initial assumption of 10% or 3.000 rockets to mishandle for a private interest to 10.000 rockets in 2015, presented in Figure 22. Having in mind that the model operates under strict public budget, which manifests in the lessening of the usage rate of the rockets to protect agricultural land. However, this behaviour is contracted with explained balancing loops. Therefore, unregistered rockets usage declined over time and in the long run model aims to stabilise around mid-values.
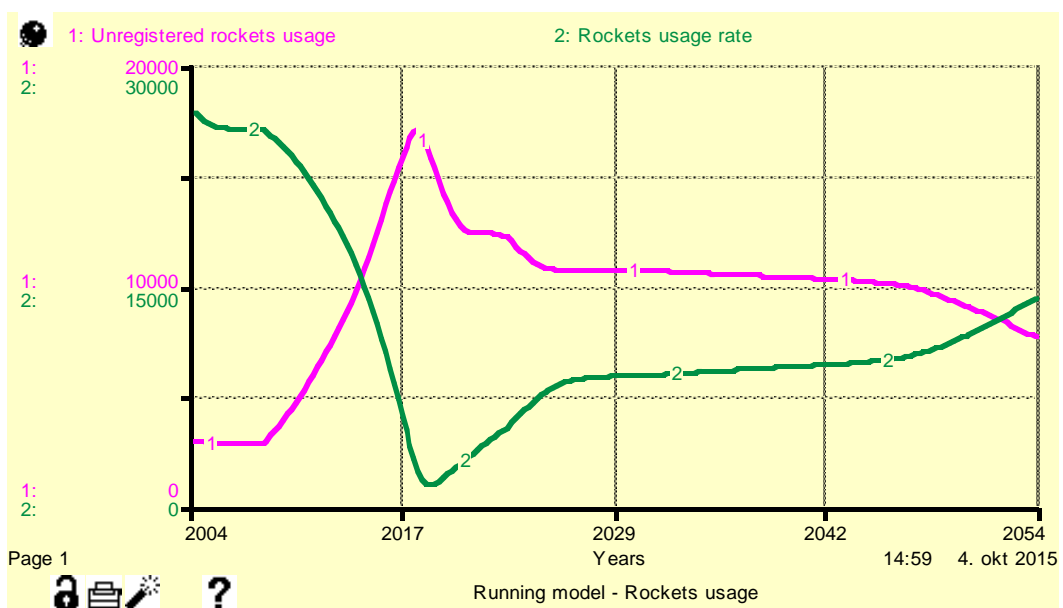

Figure 22 BoT Rockets usage rates

As per overall Public Satisfaction, the behaviour showed in Figure 23 is absolutely expected. As corruption practice blossom, with a time lag, people began to realise misusing of the public funds. Indeed, this happens with new cases being discovered and prosecuted, new information from whistle-blowers, and media coverage of suspicious actions. After informational and perception delay, the level of Public satisfaction begins to decline. When it almost reaches its bottom lever, it tends to stabilise it, known as "indifferent behaviour", after population being disappointed for a long time. However, public satisfaction itself does limit the behaviour of public bureaucrats, and in the model that is framed with the effect of public satisfaction on the inclination to corrupt (meaning the proclivity to misuse public funds will have to decay, as well).
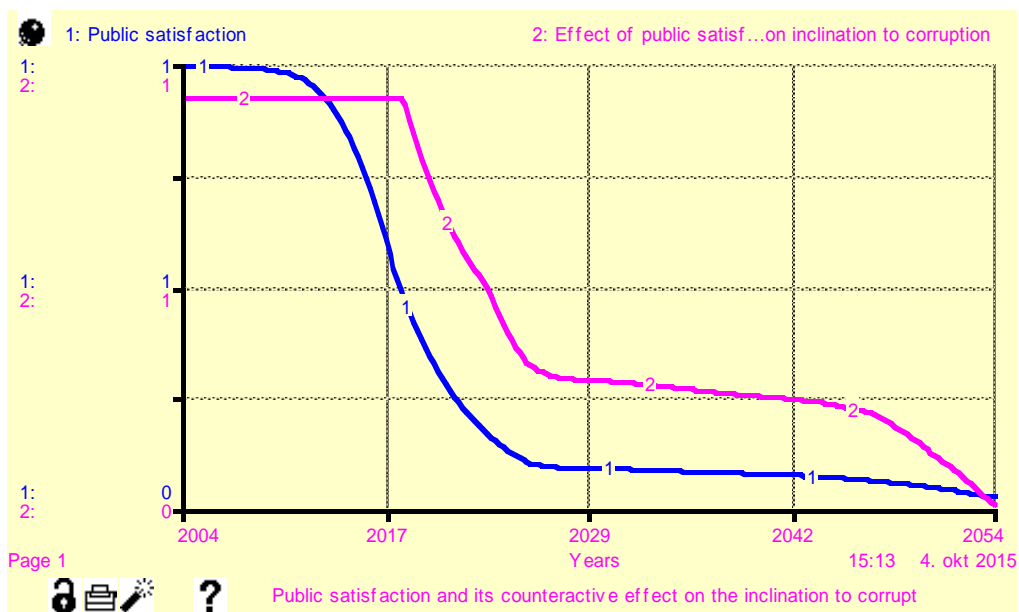

Figure 23 BoT Public Satisfaction

4.4 Model testing

Testing of the simulation model consists of a number of defined test to assess the model's robustness. Normally, wide-ranging assessment uncovers errors that ask the author to return to preceding phases in the iterative modelling development. The sensitivity of the S&F behaviour and proposed policies need to be evaluated here to assess structure and model variables above all those with high ambiguity (like soft variables or graphical functions). Arithmetical, behavioural and policy sensitivities to changes in parameters and structure are evaluated in connection to the model's purpose. The validation tests that are analysed were chosen according to Forrester and Senge (1980), and examine the structure and behaviour of the model. For each test, a short description of the test and a brief analysis is given in Appendix D.

1. Tests of Model Structure:

    - Structure-verification test

    - Parameter-verification test

    - Extreme-conditions test

    - Boundary-adequacy (structure) test

    - Dimensional-consistency test

2. Tests of Model Behaviour:

    - Behaviour-reproduction tests

3. Extreme-policy tests

The public procurement corruption model has been covered to a number of tests that are in a few words recapitulated below:

a) The CLD diagram needs to be consistent with the demonstration of the problem. The complete diagram presented in Figure 11 does match up to the problem articulation rounded up in Section 4.1 in Chapter 4. Ratification that the CLD does resemble the problem statement is as well emphasised by the qualitative breakdown of the feedback loops in Section 4.2.

b) The equations must match up with the CLD; in specific the positive or negative signs in the loop have to correspond the sight in the equations. A careful definition and control of the model equations (see Appendix F) confirmed that the direction of the relations in the CLD, presented in the Figures 9 and 10, corresponds to the course of the relationships in the S&F model simulated with iThinkTM. However, it has to be indicated that the S&F model contains more variables than the CLD, since running model requires higher mathematical induction. It is relevant to mention here that the literature review helps in providing interrelationships between the variables in the model. Wherever possible the qualitative descriptions have been supplemented with quantitative data to provide parameter values for the constants and initial conditions for the state variables. The relevant theoretical and empirical literature described in Chapter 2 provides the structural validity of the model, as well.

c) Does and to which extent the model-generated behaviour fit activities from the real system? An exact matching between the real data and model data points is not required for model validity, because SD model is not designed to include the internal, external or random factors that are needed in the short-time forecasting (Maani and Cavana, 2007, cited by Ullah, 2012).

The approximated hypothesised behaviour was reproduced given the normal conditions and the presented S&F structure.

4.5 Policy Design and Evaluation

Generally, whether the model fits the identified purpose is ascertained with the policy design and evaluation. In this section, I will present policy analysis, advocate interventions, or activities to expand understanding about possible short-term and long-term effects, and to end with the final recommendations are made. The section starts by given the answer to the research question regarding the possible policies to be adopted in 4.5.1. In the second part, section 4.5.2, recommendations for improvement are given (in section 4.5.3 these recommendations are summarised).

4.5.1 Possible policies to be adopted

Let us recall the research question concerning policy recommendations: Which policies can be recommended to manage the performance of public service provider with regards to public procurement? To answer this question, the exogenous parameters that have the most influence on the key performance indicators, were identified:

- Budget level
- Desired Land to protect
- Minimum acceptable rocket usage effectiveness
- Threshold values (values of public funds dispersion, public satisfaction, or cumulative corruption)

Therefore, other than understanding the suggested policies, it is possible to combine the possible scenarios by setting these variables (in iThink^{TM} software this is made possible by creating slide bars with defined min and max amount. The user can easily play with the potential values of the exogenous parameters to see how they have an influence on related variables).

 Each of the policies is compared with the equilibrium case, the case without any corruption in the public procurement - we can even call it the ideal system. That ideal behaviour is marked with the number 1 in the BoT diagrams within 4.5.2 section. The line number 2 represents the model reproduced behaviour with corruption practice and without any intervention. We can call it a replication of the real practice – a very corrupt society (for example with this behaviour the price paid

per rocket will raise up to 400 EUR). Next, I will introduce several policies, marked with different line numbers. To implement separate policies, I put the switches[54] into the simulation model and tested them separately (for each loop in the model has I created a separate switch or activator for a policy). Finally, I will perform analytical initialization for the following policies:

— The first policy is a Strict Price Control Policy. This very aggressive price policy is almost a naïve one, meaning it is possible to control the procurement process and to force the public decision makers to pay the lowest market value, in this case, 200 EUR. This policy may be achieved by defining strict procurement procedures, and more importantly organising and controlling practice. Without rigorous and efficient punishment mechanisms, this policy is challenging to implement and remains as "a wishful behaviour".

— The second policy is a Realistic Price policy and, therefore, the results are expected to be somewhat in between. In terms of effectiveness, if we cannot coerce public decision makers to operate under market price of 200 EUR, then the overall effect is not the best possible (at least it would take very long time, beyond the time limit of the model). Nevertheless, it is more realistic one since some of the improved mechanism to control the price paid could be, without major problems, implemented in the procurement practice.

— The third policy is presented with the line 5, and here we do not implement any price control but rather we challenge the direct public funds dispersion effect. This policy implies that population do not have available information and complete data about corrupt practice (by the explanation of corruption it is normally hidden activity, and people are generally unaware of public funds dispersion). However, by insisting on the transparency of the business practice or the openness of public bureaucrats' actions, people can and should become aware, and the access to information may lead to disclosing some new information. Then, the effect from Public Satisfaction will take place in the simulation model. The line number 5 shows how that will influence the flow of the main strategic elements studied.

4.5.2 Results of the policies

The behavioural manifestation of the modelled policies will be presented next with different BoT diagrams. All the results of mentioned policies will be illustrated on both the important performance drivers (the effective area protected) and, more importantly, on the end-results of such

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[54] A switch is basically just another variable, with the function of putting "On" or "Off" certain policy. A switch has either value of 0, meaning that the policy is not active, or the value of 1, meaning that policy takes place in the running model.

a policies (additions to cumulative corruption, direct public funds dispersions). We will see as well the outcome - the Public Satisfaction, as one of the main strategic resources.

By examining the Figures 24 - 27, we can comprehend the simulation results distinctly. The first run or the line number 1 is the ideal state with no additions to cumulative corruption (no new corruption cases). The second run or the line number 2 is modelled real situation where extreme corruption takes place. It reaches the defined limit of an available budget (meaning that the whole budget is likely to be spent if there is no control over public procurement practice). The third line represents a Strict Price Policy, and the results are expected to be significantly improved. The Realistic Price policy and the behaviour produced are supposed to be somewhat in between the lines 2 and 3, between the ideal and the real situation and is represented by the green line labelled with number 4. Finally, the behaviour with the effect from public funds dispersion is shown by the line 5, with the tendency that the system stabilises over time. Below, several graphs are presented to see comparative results, namely BoT diagrams for Additions to Cumulative Corruption, Public Satisfaction, Effective Area Protected, and Direct Money Dispersion.

Observing the end-result of the public procurement practice - Additions to Cumulative Corruption, presented in Figure 24, we can see that ideally there is not any new case of corruption while in practice it reached the maximum possible per year, or 6.000.000 EUR limit. With the implementation of the strict price policy, the additions started later than any other simulated flow, and, in the long run, tends to stabilise at the lowest level compared with the other options. There are oscillations in the cumulative corruption, but let us not forget that additions are connected in the model both with the prices and quantities smuggled. The realistic price policy behaviour is indeed somewhat in between lines number two and three.
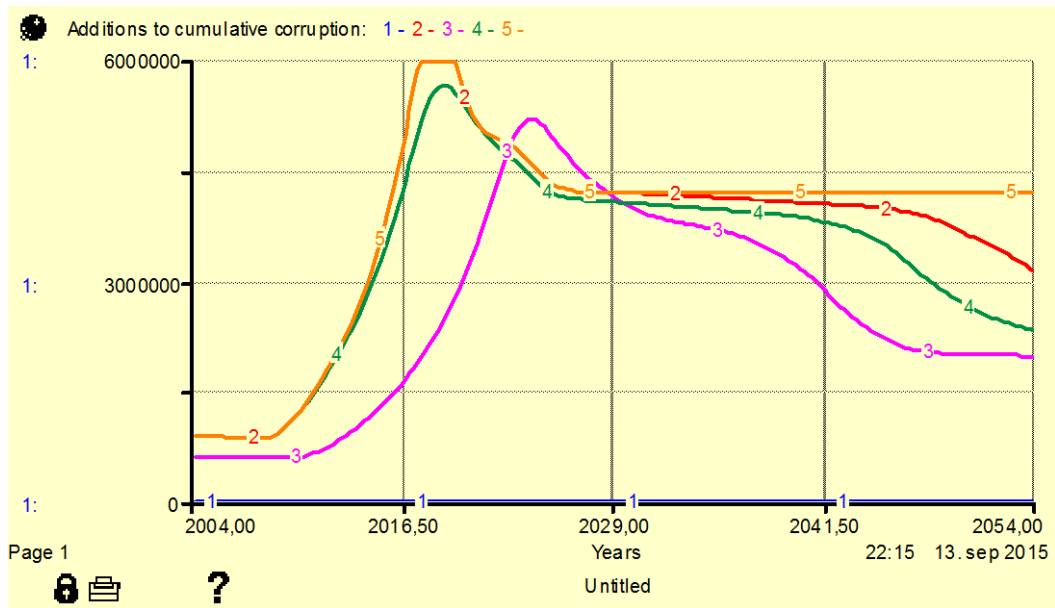
Figure 24 Policy evaluation to Cumulative Corruption

As per outcome on the strategic resources, in Figure 25 is presented the result of the policies on the Public Satisfaction. Ideally, it has the value 1 (or 100%), however in the reality is drastically lower, especially if the corrupt practices continue in the long run. Population tends to be most satisfied when they see the implementation of a very strict and fully controlled price policy – line 3, but as that one is almost not reachable, line 4 or 5 are showing where the level will end up in the observed period of time. Line 5 includes the effects of public funds dispersion and underscores the overall effects on public satisfaction making it almost a flat line towards the end of the simulation.
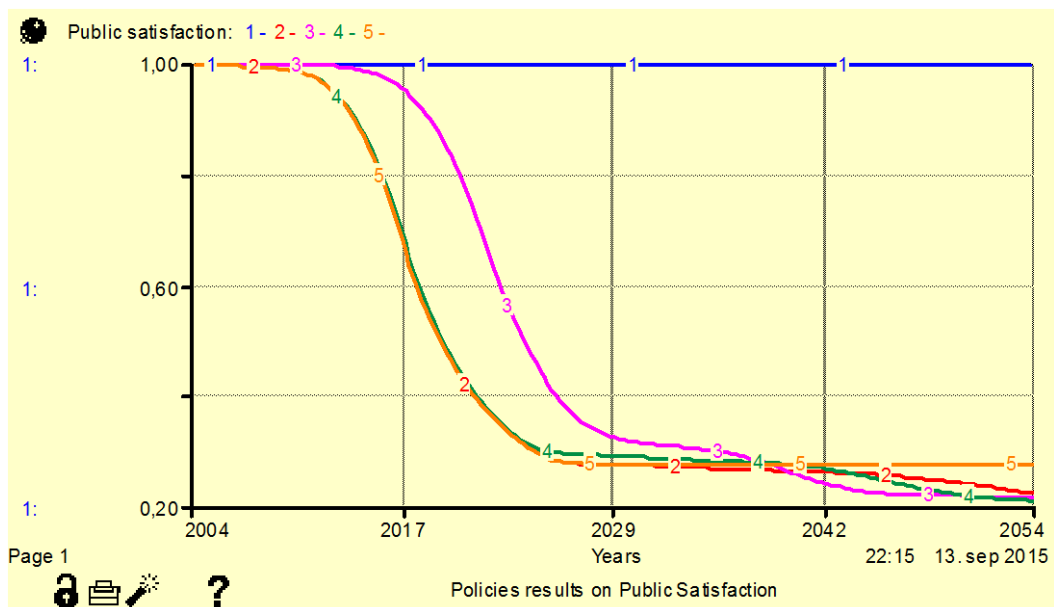

Figure 25 Policy evaluation to Public Satisfaction

Accumulated Money Dispersion is another significant strategic resource that is influenced by the outputs of the public procurement malpractice, and therefore inflow or the end-result is chosen to be presented on BoT, see Figure 26. In an ideal world, the public service provider procures exact quantity to cover the need and for it pays the lowest possible price, see line 1. However, in reality there are different levels of public funds dispersion, depending on the simulated options. Strict price policy, predictably, reaches and stabilises at the lowest level, around 4.000.000 EUR. Other policies show the oscillations, because of the time lag in the balancing loops, as well as the different behaviour of the quantities of rockets. The behaviour of money dispersion is of particular importance, having in mind that the performance driver Ratio Money dispersion over the threshold (value of 7.000.000 EUR) directly influences Public Satisfaction.
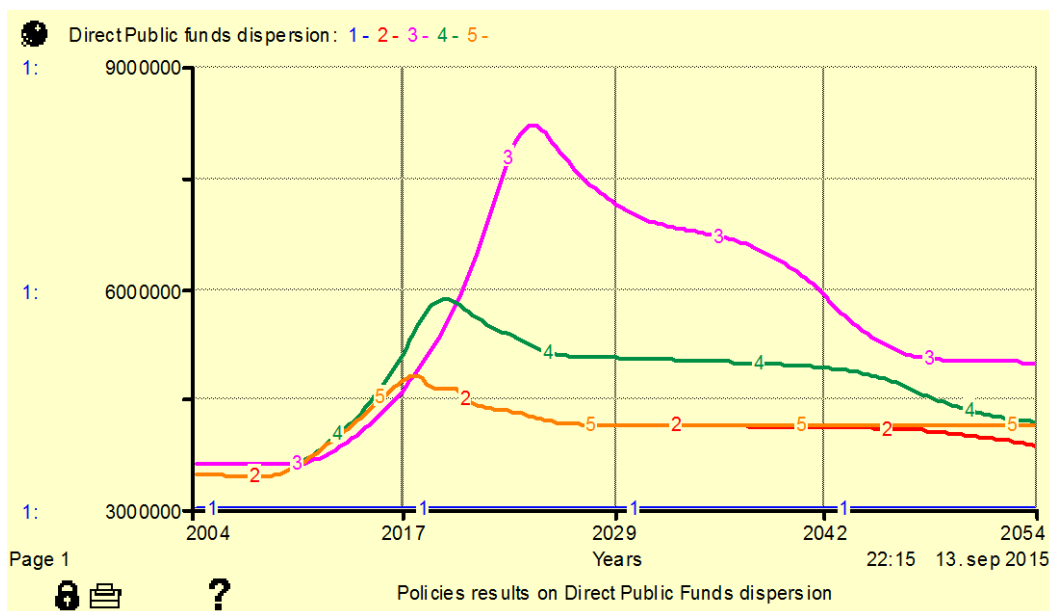

Figure 26 Policy evaluation to Direct Public Funds dispersion

Last but not least, the effective area protected is observed in order to see the results of diverse policy options. Figure 27 illustrates that, if possible at all, the whole territory of arable land is completely protected from the hail with the extinction of corruption in the public procurement.[55] As for the current practice, it drops and remains below the 50% of the area that is supposed to be protected. The flows indicate that the preferred policy is Realistic price control policy that, ceteris paribus, generates optimal possible protection of the arable land in Serbia.

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[55] This policy implies that the rockets have maximum efficiency and that every rocket works without any fail. Obviously, this is a hypothetical situation.
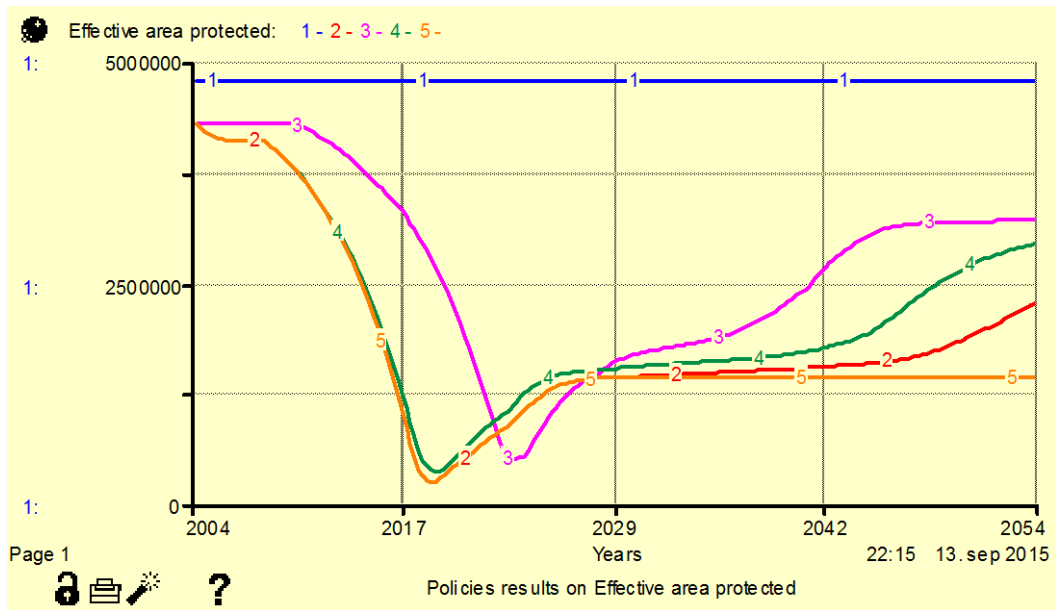
Figure 27 Policy evaluation to Effective area protected

4.5.3 Summary of recommendations

The first part of this subsection was devoted to testing the possible policies for the public service provider. The public procurement structure modelled is showing far-reaching issues in all areas of concern. These policies do not offer a distinctive cure for a current situation with corruption practices. They rather show variations of the possible outcomes (depending on a change in a mental model of public bureaucrats and control points in the procurement process) and their implication in the long term. SD allows a public decision-maker to test different policies (dynamic capabilities) and their influence to change in company's routines (functions) and to discover how these changes influence public provider's future performance indicators. Besides, the present model has substantial boundaries defined according to the current structure of the resources and macro goals. According to the boundaries set, three main recommendations are presented (absolute control of the overall public decision process, push for price control and encouraging general public pressure). The first option includes limits control of both quantities and prices in the procurement process.

In the case that decision-makers decide to implement absolute control of the process, the initial boundaries should be considered, seeing the long-term impact. This statement complies with the implemented framework (so-called "instrumental" view of DPM). Also, the organisation's impacts should be reconsidered in case decision makers choose to keep the existing boundaries. Since DPM focuses on strategic planning, particularly concerns budget planning, it is possible to make the decision about the structure of the company upon coordination of assets. Thus, the option is to

decrease the number of the rockets misused (this could be done by thought additional financial internal and external control, or else observance – physical or video of the warehouses). Sustainability of the protection of arable land, in the long term, can undoubtedly and impeccably be analysed and evaluated using SD model in the context of DPM.

An interesting relation of public satisfaction and regulating corruption has been proven to be the second best policy in the simulation model (after the absolute control of the process and expenses). For the reason that public satisfaction impact becomes evident only after a delay (it takes time for population to realise the public provider's overall deeds has been degraded and takes even more time for citizens to reach the critical point of when it is enough), is important to work on the transparency of the public procurement process, regularly and ad-hoc performing internal and external revisions and publishing the result of the investigation in media. Also, citizens should be encouraged to use their individual power and responsibility to improve the government (that implies that firstly they would have to be protected as whistle-blowers). In general, the extent of financial crime is a political challenge (Joly, 2006) and it is up to us citizens to rise to the challenge set by the modern financial criminal[56].

Modernisation reconsidering

One of the initial limitations of the model was setting the Area coverage per rocket on 160 hectares/widget. This restriction is a serious limit to the land protection effectiveness (and public satisfaction, as a consequence). If, just for the testing purposes, the model is set with a huge amount of Area coverage per rocket, for instance, 1000 hectares/widget, see the line number three in Figure 28, then the company could reach 30% more of the Effective are protected and Public Satisfaction (other conditions being equal). Consequently, with inventions of the new instruments for protection, or placing the anti-hail nets, the arable land would be better protected (although that would not diminish the corruption per se).

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[56] Eva Joly is a Norwegian-born French magistrate, and she symbolises France's struggle to do away with long-tolerated corruption in government and business. She is very famous examining magistrate, and the number one investigator in cases of financial corruption.
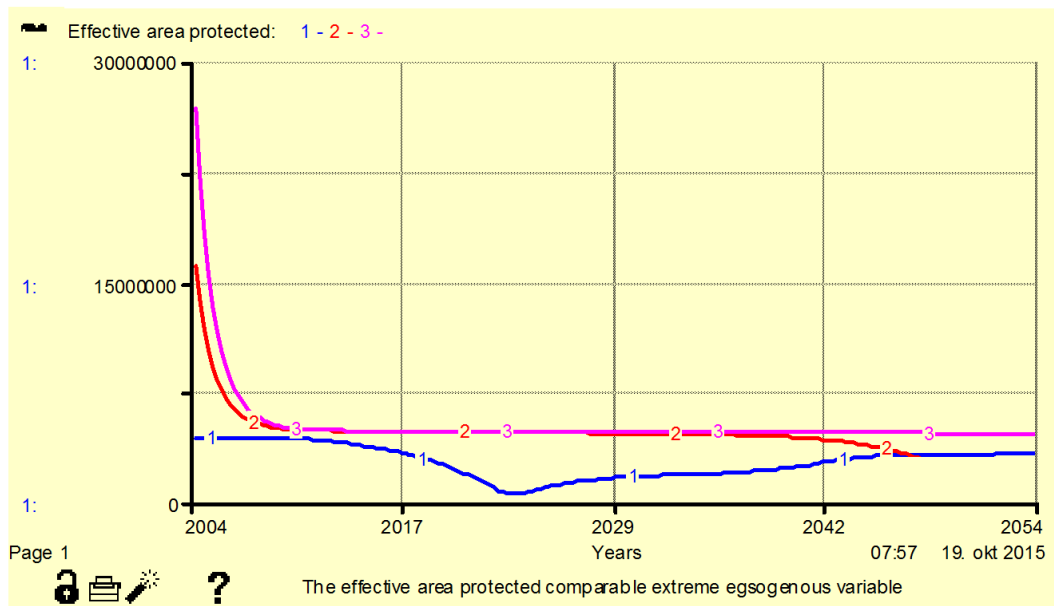
Figure 28 Modernisation reconsidering policy

4.6 Conclusion

The significance of combining DPM approach with SD modelling is underlined. It also implies that, for the entire public procurement process, the impact of the social and financial aspects, and the effects generated by material and information delays are taken into account.

Fluctuations in the main company's assets were modelled by means of in or out-flows of the stocks that change over a given time of 50 years, as a result of potential activities implemented by decision makers. For example, it is revealed that Public Funds dispersion (strategic resource) changes as an effect of rockets repurchase rate (end-result). Public satisfaction (strategic resource) may change as a consequence of relative rockets usage effectiveness and ratio money dispersion over threshold influence the change in public satisfaction (end-results). There are also causal relations between different strategic resources: number of unregistered anti-hail rockets may affect both the accumulated money dispersion and corruption. Furthermore, relative area remaining unprotected may affect rockets repurchase rate (end result) and relative rockets usage effectiveness (another performance drivers). On that way, following so-called "instrumental view" was confirmed, once more, very useful in model building.

Since the public service recognition becomes evident only after a delay (it takes time for individuals involved with agriculture to recognise the public provider's overall quality has been changed), it is crucial to monitor constantly and strive for a sustainable quality level at all times. Creating quality pressure requires bureaucrats to become aware of the implications of their service

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and then, through training, incentives and measurement, persuade public servants that avoiding these costs is a priority and that they will not be punished for slowing their work to correct any quality problems they detect (Sterman, 2000). In addition, have to be put into a place full and unconditional support for whistle-blowers in connection with any quality issues, or related to intentional misuse of public funds.

The simulation model developed demonstrates major problems experienced by the public administration (e.g. sensitivity to public satisfaction) and can be explained by the provider's ignorance to public funds dispersion and non-protected area. The model represented the public procurement structure and resulted in high correspondence with the real situation. In addition, the simulation model has predictive abilities and, therefore, is worthwhile for public decision makers to test resources they believe to be valid will lead to better performance in the future. Public bureaucrats are encouraged to use the model for the future decision (if no significant changes happen in the structure of the company).

V   CHAPTER CONCLUSION

Things may come to those who wait, but only the things left by those who hustle.

Abraham Lincoln

This last chapter serves a number of purposes. Firstly, the evidence in support of the initial position adopted in arguing that the complexities of corruption in public procurements require the use of a more complex systemic and dynamic framework will be summarised. Following that, the author provides a summary of the insights gained from the investigation. A critique of this research effort is then given based on the perceived shortcomings and gaps that exist. Next, the contributions of this work are identified. Finally, the methodology is placed into perspective related to other approaches and improvements and future directions in terms of this research are discussed.

5.1 In support of the central Thesis

The central thesis of this research is that the dynamic behaviour of the RHMSS procurement practices arises as much from the exogenous inputs (i.e. budget level or the modernisation level, expressed through Area coverage per rocket, or public satisfaction) as from the interactions of the decision makers, and strategic resources flow within the RHMSS. Therefore, the dynamic behaviour is highly dependent on an internal, systemic structure. The author offers the following evidence obtained from the research in support of this thesis.

The systemic feedback structure with resources accumulation and policies of the decision agents replicated the performance experienced by the RHMSS given the same exogenous environmental factors. This replication provides one point of bond with the behaviour of the actual system, developing a measure of confidence in the validity of the model as the means of explaining the performance.

Within the system as bounded for this research, there is a systemic feedback structure consisting of several feedback loops that attempt to keep the strategic resources accumulation in balance to ensure a sustainable increase in the area protected from hail. The major loops are R1, B1 and B2, who are in control and dominate the behaviour. Other derivatives of these loops also exist, for example, the loop B3. Different policies produce a different performance on Public Funds dispersion and consequently on the stocks of Corruption and Public Satisfaction.

5.1.1 Thematic Analysis

In March 2012, Serbia was granted EU candidate status[57]. EU accession implies the efficient implementation of the entire body of EU laws, as it stands at the time of accession. According to Accession Document (2014) "on the path towards accession, Serbia will need to continue its efforts to align its legislation with the acquis and to ensure full implementation of key reforms and legislation, in particularly in the areas of the rule of law, including reform of the judiciary and the fight against corruption, the independence of key institutions[58], and further improving the business environment".

According to European Commission (2014) Serbia[59] is moving ahead in ameliorating its public administration. An extensive reform, supported by proper analysis and performance management tools, is however still needed. There are several problems that need to be addressed right away. Firstly, corruption remains a prevalent problem. Corrupt practices within public procurement continue to deflect limited national funds, affecting citizens directly throughout education and health services, while tools to efficiently prevent corruption stay under-used. In addition, the ratio of convictions over prosecutions is low. Public administration reform targets at greater transparency, liability and effectiveness and a better focus on the needs of inhabitants and industry.

An efficient public administration is compulsory for democratic governance. It also directly influences governments' ability to provide public services and to foster competitiveness and progress. Serbia has to develop a track record of concrete results in the fight against corruption, to establish whistle-blowers protection, and to implement repression mechanisms. In order to do needed public administration reforms, the following has to be (better) implemented: the management of conflicts of interest, transparency in the use of public funds, access to information and the appropriation and confiscation of assets. Improvements in data collection and accessibility are required to improve transparency and help monitor the implementation of anti-corruption policies.

Appropriate human resources management, enhanced policy planning, coordination and development, rigorous administrative procedures and enriched public financial management, are of crucial significance for the functioning of the state and for implementing the reforms needed for EU

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[57] See more http://ec.europa.eu/enlargement/countries/detailed-country-information/serbia/index_en.htm. Besides, in September 2013, a Stabilisation and Association Agreement between the EU and Serbia entered into force (European Commission, 2014).

[58] Other independent regulatory institutions – the State Audit Institution, the Committee for the Suppression of Conflicts of Interest, the Anti-Corruption Council, the Competition Protection Commission, the PPO and the Commission for the Protection of Bidders' Rights – all continued to face difficulties in carrying out their mandates. These are connected predominantly to the lack of resources and inadequate official follow-up to their decisions and recommendations.

[59] The entire report can be retrieved at http://europa.rs/upload/2014-strategy-paper_en.pdf

integration. Greater coordination in the implementation of public administration reform is needed, including monitoring and evaluation, and better management practices need to be developed. The adoption of new methodologies is encouraged, and this work particularly advocates the adoption of the method that combines systems thinking, an investigation into dynamic causality analysis, multiple criteria decision analysis and SD modelling, as an integrated approach.

5.1.2 General Insight Obtained about the Resource System – SD and DPM

There is a path-dependent evolution of performance based on the state of the key resources. Thus, numerous drivers of the procurement structure in turn are dependent on the state of the key resources that themselves are dependent on the complementarity between the key resource accumulations. Therefore, following dynamic performance management, decisions about the structure of the organisation upon coordination of resources can be tested in the SD model. The combination of these two approaches is verified as very beneficial one in this work. Thus, the performance management is not seen as an extravagance for the public institution. It allows decision makers to firstly, test the possible actions of their policies and mental models over time, and secondly, change the goal according to the resources coordination. DPM focuses on both processes and outputs, as elaborated in this dissertation.

The key strategic resources accumulation, by which the arable area is protected, embraces the Number of Rockets, Number of Unregistered rockets, and Public Satisfaction. The resource flows are governed by the competencies and level of honesty of public bureaucrats. The implemented DPM approach shifted the focus from static comparison or resource contributions to the dynamic analysis of resources accumulation, feedback processes and delays.

Different performance drivers are included in a clear and simplified way. Hence, the initial research question (what are the end results affected by performance drivers that feed strategic resources over time?) got its answer in System Dynamics approach. By uniting, performance management system and SD performances that can be applied in a simple and user-friendly way. Moreover, several policy recommendations were elaborated, tested, and suggested as possible improvements in the public procurement process that would have, in higher or lower dimensions, the positive consequences on the main strategic resources – the effective area protected, public funds dispersion and public satisfaction.

5.2. Gaps in the research, knowledge and methods

5.2.1 Gaps in data

Much of the financial data required for this research was documented and available. However, as soon as one moves outside the realm of financial information, data sources become far harder to source and the data itself is flimsy and often held in disparate sources making it difficult to trace. Thus, the utmost of the intangible variables were hard to identify and quantify the proper influence on the public service organisation' structure. System Dynamics methodology ascertained to be very useful in the description of the corrupted procurement problem together with soft variables such as Public Satisfaction or governmental bureaucrat's Inclination to corrupt further. Despite the fact that numerical data were unavailable or non-existent, these intangible variables are critical to decision making and, therefore, were integrated into the System Dynamics model. Nonetheless, the challenge was to incorporate them into the simulation model in forms that are both scientifically sound and logically defendable[60].

Similarly, hard information such as the graphical functions is not recorded automatically. Before-mentioned variables were easier to estimate but also represent gaps in the data. Much further research would be required before one is certain about the parameters, values and relationships assumed in the model.

5.2.2 Gaps in structural knowledge

Conceptualising the resource structure and feedback loops of a business required one to translate perceived causal relationships into a structural framework. The lack of data of the makes it impossible to verify the hypothesised relationship. Various individuals may also have diverse views on the nature of the causality as well as the direction of causality. The corruption cases and evidence of the manifestation of public satisfaction pose the greatest challenge in terms of structure and data. This is a definite area in which behavioural and structural knowledge is lacking. Hence, Sterman (2002) stated that "all decisions are based on models… and all models are wrong", a phrase quoted almost every time in empirical application of System Dynamics methodology.

For the reason that no model is one hundred percent right, denying to use a model merely because it is false is equal to denying to use any models at all. The aspiration in exercising the

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[60] However, "to omit such [soft] variables is equivalent to saying that they have zero effect – probably the only value that is known to be wrong!" (Forrester, 1961: 57)

scientific method is to differentiate useful models from useless ones as noted by Box (1979) when saying that "all models are wrong, but some are useful".

5.3 The Contribution of this Research

5.3.1 Theoretical Contribution

This research has demonstrated the dynamic results of assessments and contributed to the body of knowledge concerning the interrelated aspects of public procurement efficiency. The simulation model made evident the structure and the emerging behaviour with the policy-based course of actions and is able to foresee the relative variation in resources, time and organisation when using different approaches. In addition, the model could support additional studies as innovative model variables can be integrated without difficulty. The study presented has also confirmed that SD is a suitable modelling framework for public procurement structure in general and demonstrated the modelling can be improved with additional expertise to support public administration reforms. The combined dynamic model and performance management approach also supports risk assessment in numerous concerns.

This study has also inspected complementary attributes of dynamic and static models of the public procurement procedure. It was presented how a static model is utilised to calibrate a basis of the dynamic model (using the accounting data from balance sheet reports), and the dynamic model then integrating more reasonable assumptions of problem-related behavioural manifestations. SD model could corroborate behavioural comprehension, likelihood and assessment of public procurement enhancement, control of the procurement activities and retreating the corruption cases occurrences, and the effects on the wider national issues (level of GDP, employment or inflation). Different segments of the SD model could be used for other procurement models elements, such as a different cost-driven practise (since assessments are analogous to introducing diverse price paid and cost-benefit models).

5.3.2 Practical Contribution

The primary contribution of this research is in the systematic and systemic abstraction of the corruption in procurement, generating structure of a particular public service provider, and thus the development of a quantitative model of limited scope and the insights obtained from it. The model developed may be considered to be a distinct model but possibly applicable to another Anti-hail

protection organisation (in case of usage of anti-hail rockets as an instrument of the protection), with a similar structure but with diverse objectives, parameter values, strategic resources, policy parameters and exogenous inputs and offers various performance time paths with the same structure.

The model captures the major causal relationships and feedback loops of the procurement generating system and provides a basis for understanding the path-dependent evolution of the performance management. This evolution is in contrast to the linear and financial planning tools that are prevalent in the public institutions. Tools such as spreadsheets allow any value to be injected in the SD model (standard features of the SD simulation software).

From a strategic planning viewpoint, this kind of model provides a means of establishing the medium to the long-term impact of alternative actions without the use of data-intensive models. Especially, it proves a good combination of the two approaches, SD and resource-based view in PMS.

5.4 Improvements and Future Directions

Be not afraid of going slowly; be afraid only of standing still.

Chinese Proverb

In this section, I will try to extend the knowledge to make a connection beyond the boundaries of this particular research project. The intention is to provide some perspectives that could guide further research direction.

There are lots of thought-provoking questions and challenging prospects for extensions of this study. An explanation of recommendations for future explorations is provided in the paragraphs below. Different public reforms can be incorporated into the model. Additionally, various anti-corruption policies could be implemented. There is a diversity of different formulations to an interpretation of rockets effectiveness. For example, taking into account efficiency of different types of rockets would enhance the model and further support the arable area protection and causal analysis benefits. The present SD model does not account for other anti-hail procedures such as usage of the anti-hail nets, shooting the clouds from the plane, etc. Though many organisations in this region of Europe elect for only anti-hail rockets usage, there are various other ways and new methods of arable area protection that can be integrated into a dynamic model.

As beforehand acknowledged, this model studies public procurement in a public service organisation, corruption and performance independent of other factors incorporated in the model. Numerous additional opportunities exist besides those explored here, such as including the workforce and their productivity into the simulation model. The SD model can be refined for finer performance drivers and indicators. To begin with, high-level procurement process and LGU rockets procurement can be separated out and control points can eventually be incorporated. The rockets usage effectiveness can be further disaggregated according to the municipalities in Serbia. The model may possibly be enriched to "drill down" further into the corruption control process, and look into the dynamics of control effectiveness, rates, etc.

The simulation model can be enhanced for additional RHMSS cost drivers, and exploration of their dynamic effects on the end results could be performed. Further validation against recent data is also sought after. The simulation should be re-tested when a whole problem figures are available. A diversity of enrichments and further studies can be undertaken for the knowledge-based aspect. Additional data from the newest public procurement activities could be collected and evaluated. Other features can be added as different suppliers, workforce, control points against the corruption practice in the system, enhanced cost model and consequently Direct Public fund dispersions Also, other rules can be pinpointed and incorporated to handle more performance drivers, to define different non-linear effects, and to enhance the relations within the simulation model.

The aim of this thesis has been to develop a resource-based systemic and dynamic view of the corruption generation structure of a Serbian public service provider (as a case study of the analysis of public procurement) that will allow testing the dynamic hypothesis about the causes of observed behaviour and explain the dynamic behaviour from a complex feedback perspective. Whilst the model does support the objective, one can argue that there are many more pertinent factors that are taken as given, but that may shed additional light on the performance of the procurement generating system of an organisation. Thus, several extensions can be proposed.

The main argument is that performance arises as a result of the accumulation of key resources of rockets, etc. Even as this holds true the model, the boundary of the model does not draw broad enough to explain fully how competitive advance arises for generation system of the company. It is a principle of system dynamics that one cannot model the entire system, but only model those aspects that are relevant to answering a particular research question. With this in mind, opening the boundary of the model would necessitate a revisit of the objective of the model to, perhaps, encompass the understanding of competitive advantage rather than performance.

The second consideration - drawing the boundary wider to include the competitors from rockets supply side - would be to acknowledge the fact that the companies operate in a competitive environment where public tenders would possibly severely change the structure and dynamics of the model. Therefore, to attain a better understanding of how competitive advantage arises, a rivalry will have to be taken into account for all strategic resources that companies provide. This may include population (stock of public satisfaction), agricultural lands protected, etc.

Finally, Investigation of alternative policy design is an area that has not been explored in this research. The use of alternative sources of information in the policies is a potential area of research.

5.4.1 An enhanced DPM Model

Public administration constantly experiences difficulties in dealing with dynamic problems, particularly when having in mind its capacity to properly measure the results, evaluation of policy outcomes, and trying to create a system where decision makers would be responsible for the targets (based on clear evaluation criteria). In particular, the results of this public provider might reduce not only the general satisfaction already presented in the model but as well community's quality of life and different outcomes to the society. For example, with longwinded experience of their soil being not protected, the population might change their activities from agriculture to other business avenues. That would be severe knowing that agriculture is the third sector of the economy that participates in the composition of the GDP of Serbia. Moreover, agriculture made Serbia well-known for exporting agricultural products e.g. all sorts of berries. In other words, an excess of focus and intensive efforts on a single policy might generate specific dysfunctional effects over time. That would further reduce GDP of Serbia, and in turn lessen the budget for the procurement of the anti-hail rockets (and not only), creating a new vicious reinforcing loop.

This analysis suggests a possible way to counteract the behaviour distortions arising from the performance paradox by extending the boundaries of the observed system to adopt policies that might reduce the risk of gaming and unintended behaviours effects. Figure 29 illustrates how instrumental DPM modelling might extend the system boundaries. It demonstrates that when considering additional end-results related to the stock of anti-hail rockets, two more flows are taken into account: the effect of the desired protected arable land and the impact on the GDP. Correspondingly, the new stock of GDP would have to be added as a relevant strategic resource to include when formulating policies that may contribute to the sustainable production of the majority of people in Serbia.
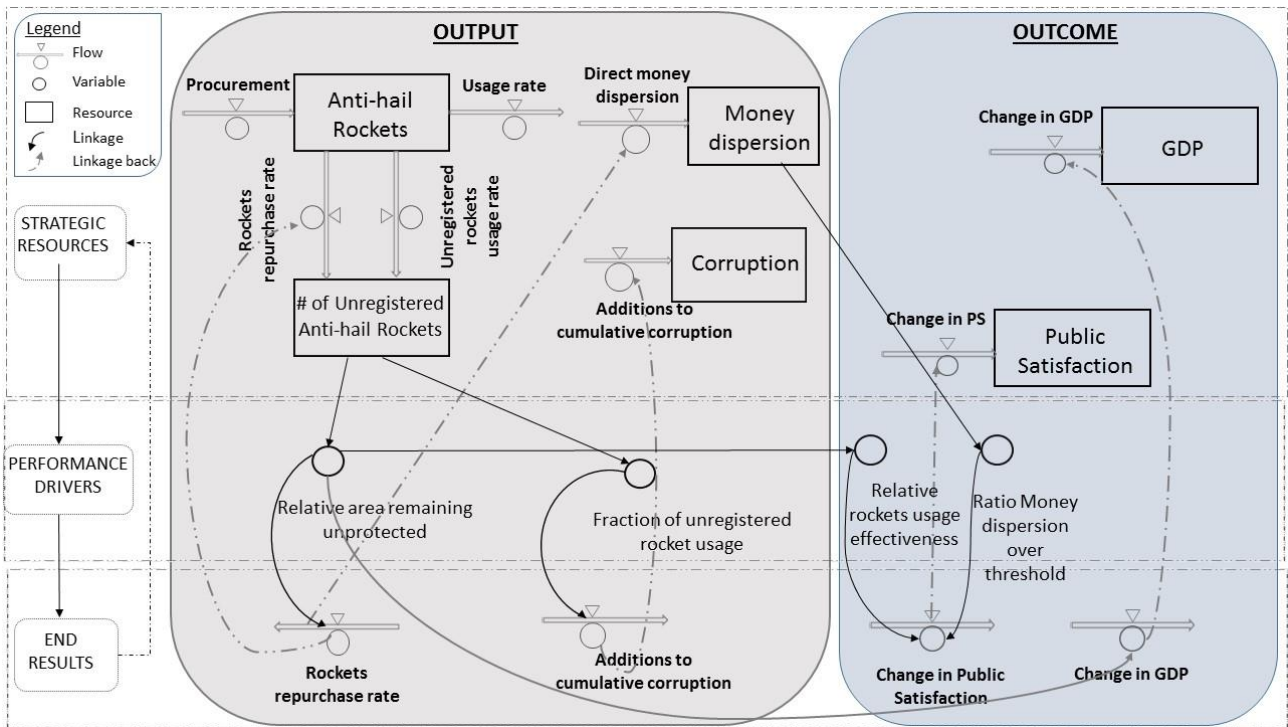
Figure 29 DPM framework future direction for research

5.5 Reflection

Looking back at a research you performed there are always things you would do differently if you have to do them again. In my case, this is also true. I have learned many things: how to tackle such a sensitive subject as the corruption is, how does a public service organisation like RHMSS operate, and what dynamic performance management is. These things were essential for my research.

I think SD is a useful tool for modelling the soft variables in public procurement, it provides dynamics and a rich picture of the whole process. Moreover, in this research, I noticed the significant development of my modelling skills, and it can be seen by the progress of the models.

During this research, I investigated, collected and analysed data, and made suggestions within a research experience. In turn, I felt the impact of learning how to conduct science for a corrupted public procurement procedure. The content, scientific process, experience in studying in Sicily and Norway, and reasoned findings of my doctor's thesis nudged me into a new life stage as a researcher.

"What you need to know about the past is that no matter what has happened, it has all worked together to bring you to this very moment. And this is the moment you can choose to make everything new. Right now." – Author Unknown

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APPENDIX A: HAIL SUPPRESSION IN SERBIA

General overview of Hail Suppression System

Hail suppression attempts to modify hail-bearing clouds (Cumulonimbus) by seeding them with silver iodide or other agents (Gavrilov et al., 2013). The focal objective of hail suppression is to reduce the production of hail to mitigate damage caused by it, principally in agriculture (World Meteorological Organization, 2007).

Namely, by seeding a hail-bearing cloud with silver iodide crystallization nuclei, many of potential deposition cores rises, since silver iodide also crystallizes in hexagonal grids like ice. Hence, its small ice crystals grow on additional cores as on natural cores so that each hail grain will become less and melt as it falls. Therefore, less sized hail and/or rain will fall rather than larger sized hail. This premise was first used by rainmakers in the United States when they tried to stimulate rain in dry areas of America. In the 1950s, this hypothesis was also applied in Georgia (former Soviet Republic), intended for defending vineyard plantations from hail. However, even before the development of rockets in hail suppression, people defended themselves using traditional methods. The figure below shows the shooting towards storm clouds with bows and arrows that originated in ancient times. This method was practiced in Scandinavia during the 16th century (Magnus, 1976).

Figure 30 Out-dated protection approach

A number of countries adopted hail suppression with due caution concerning its effectiveness. To evaluate the efficiency of cloud seeding with silver iodide, two notable experiments were conducted almost in the same. One was in Western Europe called the "Great experiment" and another in the USA called the "National Hail Research Experiment" (Gavrilov et al., 2013). The results of the

experiments showed that there were no statistically significant differences in the occurrence of hail between seeded and non-seeded hail-bearing clouds. Numerous European countries reasoned that cloud seeding cannot modify weather. Later no such overall experiment was performed but individual countries implemented their evaluations with similar results – in Serbia (Aleksic, 1989).

During the 1960s, hail suppression was attained from the ex-USSR to the ex-Yugoslavia and remained operational till the present-day. In Serbia, hail suppression via silver iodide seeding has been conducted according to the so-called Soviet method since 1967 (Aleksic, 1989), with later smaller adjustments but still based on the beforehand cited seeding hypothesis. Radars are used for the identification of the hail clouds, while for the injection and seeding of silver iodide from the terrain into the cloud, are used rockets. Rockets reach heights of 6 to 8km, and each rocket bears 400g of silver iodide (Vujovic et al. 2007).

Nowadays, only Serbia, Macedonia, Bosnia and Herzegovina, and Croatia actively support weather defense against hail (Pocakal and Stalec, 2003), although it is starting being abolished in Croatia. In different countries, hail suppression is basically left to private initiative, gets very limited government support, and/or is constrained to small areas. The occurrence of hail suppression in Europe in 2007 is presented in Table A-1.

Table A-1 Distribution of hail suppression and mode of financing

SN	State	HP	Fin.	SN	State	HP	Fin.
1.	Austria	Yes	No	21.	Montenegro	No	–
2.	Bulgaria	Yes	Yes	22.	Croatia	Yes	Yes
3.	Lithuania	No	–	23.	Spain	No	–
4.	Israel	No	–	24.	Island	No	–
5.	Sweden	No	–	25.	Ireland	No	–
6.	Greece	Yes	No	26.	Albania	No	–
7.	Bosnia&Herzegovina*	No	–	27.	Romania	Yes	Yes
8.	Slovakia	No	–	28.	Finland	No	–
9.	Netherlands	No	–	29.	Portugal	No	–
10.	Hungary	Yes	Yes (40%)	30.	Azerbaijan	No	–
11.	Germany	No	–	31.	Latvia	No	–
12.	United Kingdom	No	–	32.	Russia	Yes	Yes
13.	Italy	No	–	33.	Turkey	No	–
14.	France	No	–	34.	Macedonia	Yes	Yes
15.	Poland	No	–	35.	Bohemia	No	–
16.	Switzerland	No	–	36.	Estonia	No	–
17.	Belarus	No	–	37.	Slovenia	Yes	Yes
18.	Armenia	No	–	38.	Norway	No	–
19.	Moldova	Yes	Yes	39.	Belgium	No	–
20.	Serbia	Yes	Yes	40.	Denmark	No	–

Source: http://www.wmo.int/

Meteorological activity on the territory of the Republic of Serbia has a long and rich tradition. First systematic meteorological observations started in Belgrade, on 1 January 1848. Already in 1856, a network was established in Serbia with 20 meteorological stations and, in 1887, Belgrade Meteorological Observatory was founded at the University of Belgrade. For more than a half of the century, Belgrade Observatory was the centre of National Meteorological Service. Republic Hydrometeorological Service of Serbia was established right after the II World War, in 1947. From 2003, hail suppression has been carried out from 13 radar centres using approximately 1650 rocket-launching stations that are evenly distributed over the territory of Serbia (Figure 31). Each radar centre is authorised for a certain number of rocket-launching stations and issues commands by radio communication on when, where and how rockets should be used for firing into hail-bearing clouds.

Figure 31 A rocket-launching station type in use at the Radar centres in Serbia

Hail suppression is operatively carried out six months a year, from April 15 to October 15, and has been operatively conducted by the RHMSS[61]. Because of many complaints and report of the corruption, after 2010, all activities related to hail suppression came under the Ministry of the Interior's jurisdiction, Sector for Emergency Management.

Opposite to all other countries that abolished or decreased hail suppression, Serbia significantly expanded it to the territory of Vojvodina from 2003. Nowadays, Serbian hail suppression covers the whole territory of the Republic of Serbia without the region of Kosovo and Metohija. For instance, the budget of the Republic of Serbia for 2008 approved the purchase of 13.000 rockets. It

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[61] Additional information, in Serbian, www.hidmet.gov.rs/podaci/novosti/priprema_PGZ-lat.doc

was further expected that the Ministry of Agriculture would provide additional funds for the procurement of an additional 6.000 – 7.000 rockets. The cost per rocket approved is 270 – 300 EUR (Law on the budget of the Republic of Serbia). Equivalent data can be found for other years. Hail suppression in Serbia includes approximately 250 full-time personnel, 3.500 part-time personnel, 1.650 rocket stations, 13 radar centres, lots of cars, around 12.000 rockets fired annually. It is estimated that the annual cost of hail suppression is around 10.000.000 EUR, funded by the budget of the Republic of Serbia.

In 2014, according to available data, for the hail protection was spent about 460 million Serbian Dinars, which was insufficient for the full effectiveness of the system. From the whole amount, approximately 300 million Serbian Dinars was funded from the state budget and 160 million Serbian Dinars from the budget of local government units. Namely, for the hail protection, in 2014 was spent[62]:

- From the Republican budget 438 million Serbian Dinars, from Ministry of Interior 303 million Serbian Dinars (funds planned for 2015 are even lower because the wages are reduced by law by 10%) and RHMSS 135 million Serbian Dinars (covering wages and medical examinations for 3.300 shooters). It is claimed that this was insufficient, primarily due to an insufficient amount of anti-hail rockets. The system during one season has operationally to order around 25.000 missiles. Also, there was no allocations of the funds for the maintenance of the radar system of radio communication, or the procurement of computers and so like. Therefore, lacking is about 400 million Serbian Dinars for the full operational function.

- From the budget of local government units (LGU) about 160 million Serbian Dinars for the purchase of 3.000 anti-hail rockets, about 100 million Serbian Dinars, and for shooters around 60 million Serbian Dinars.

According to Bergant (2011, 246): »People need protection against hail, so they are sometimes like to accept the ways of defence for which there is no clear evidence that they work. Local and state politicians want to help people and are willing to support ways of defence for which there is no proof they work to gain their affection. Operators of hail suppression wish to obtain funding for their activities and are willing to offer a means of defence for which there is no evidence that they work.« However, in Serbia the hypothesis obtained the status of a confirmed and accepted scientific theory. Based on that, for almost half a century hail suppression has been operative covering the whole area of the Republic of Serbia except the region of Kosovo and Metohija.

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[62] Source, in Serbian, http://www.otvoreniparlament.rs/

There are a couple of reasons why hail suppression is still adopted in Serbia. One of the reasons is because of the trust and misconception by the population. The authorities believe that by impressive actions of »shooting clouds« they look after the interests of the population. At the same time, because of intuitive fears of catastrophes, the nation perceive this as a genuine attempt at extending help. Also, there are also meteorologists in favour of these actions, particularly having in mind the statistical data on hail days per year. Figure 32 is showing the mean number of days with hail per year, and a linear trend line covering the period from 2003 to 2010.

By this time, they have grown so strong that they made together with other stakeholders very powerful lobbies for the support of »shooting the clouds«. The lobby consists of rocket producers, budgetary controllers, operative workers, analysts, propagandists, and scientists, opening a ground for corruption activities widely. We are witnessing, almost every year, a damage caused by natural disasters in Serbia – only in 2012 the damage summed up to about one billion and 700 million EUR. However, agricultural land and buildings suffered damage, not only from hail but also from the flood. Cause by the hail only, the damage in 2010 was estimated to 100 million EUR[63]. A long-standing problem in Serbia is the lack of anti-hail rockets and archers.

Source (Gavrilov et al. 2011)
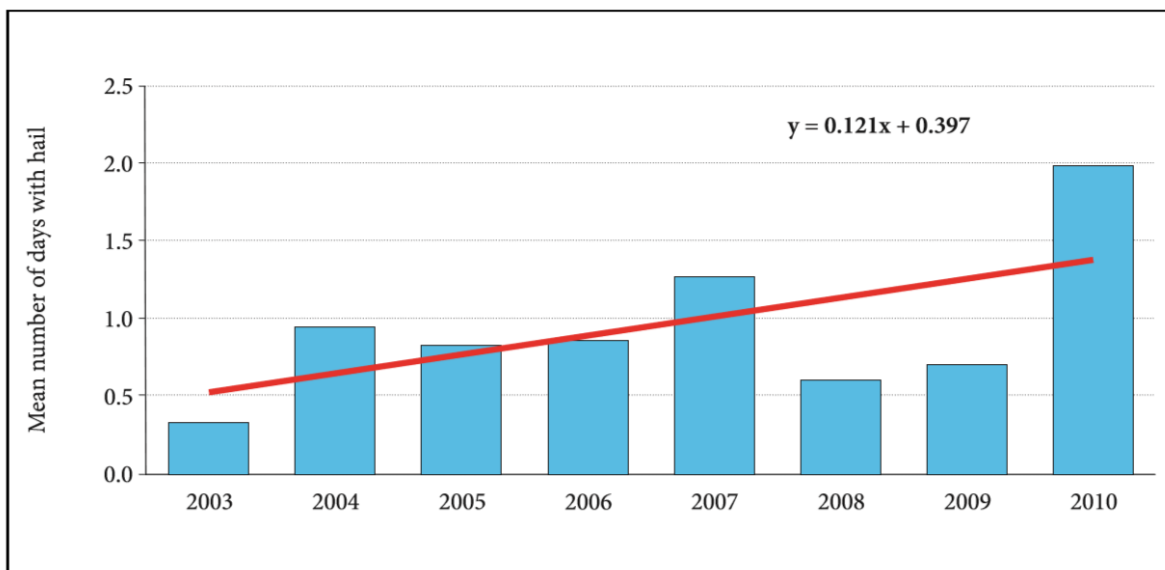
Figure 32 A linear trend line of days with hail

Hail suppression is not distinctly covered by the legislation. In the system of anti-hail protection there is a legal mismatch and undefined jurisdiction of the Republic and local self-government, it is not known who buys rockets and who pays shooters[64].

By 2008, the single place in the legislation that regulates the hail suppression activities were element of the Article 34 of the Law on Ministries of the Republic of Serbia (2008) that says: »…Republic Hydrometeorological Service of Serbia performs expert activities related to…defining hail risk degree and acting on hail-bearing clouds…«. Based on that, it is problematic to figure out to which action hail-bearing clouds should be »exposed« to, why, and on how? After placing all the hail suppression activities under the jurisdiction of the Ministry of Interior, this activity is solely regulated by the Article 8 of the Law on Emergencies (2009), in the »preventive measures of rescue and protection in extraordinary situations« paragraph.

In order to overcome the constant problem, a new Law for a regulation of this complicated matter came into for force 30th June 2015[65]. The funds for implementation of the Law on Protection from Hail are provided in the Law of the Republic of Serbia Budget for 2015 ("RS Official Gazette", No. 142/14), of Section 15 Ministry of Interior, Chapter 15.0, Function 310, Point 1401 - Safe Society in the amount of 287.350.000 Serbian Dinars or approximately 2.394.000 EUR per year.

It is proposed that the implementation of anti-hail defence activities will be the responsibility of local administration (operation and maintenance of the network launch stations and work shooters), who will provide the funds from the budgets of local managements, which will relieve the budget of the Republic of Serbia and is supposed to reduce costs compared the current allocation. However, the full jurisdiction of the hail protection will be under the Republic Hydrometeorological Service.

The proposed legal solution would improve the funding of the hail protection, and we would relieve the budget of the Republic of Serbia. During 2015 and 2016, responsibility for anti-hail stations functioning and of shooters are to be transferred to the local governmental units (LGU). That would finally resolve their status, which was during the last four years inadequate since they were still under the jurisdiction of the Republic Hydrometeorological Service. In comparison to 2014, it is expected a reduction of 135 million Serbian Dinars in the Republic budget. According to the draft

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[64] In Serbian, see http://www.slobodnaevropa.org/content/protivgradna-zastita-u-srbiji-i-dalje-bez-sigurnih-resenja/26966083.html
[65] For the Draft Law on Protection from Hail, in Serbian, check
http://www.parlament.gov.rs/upload/archive/files/lat/pdf/predlozi_zakona/1045-15%20-%20lat.pdf

law, 70% would be paid into the state budget for the purchase of the procurement of the rockets, and 30% in the budgets of LGUs for the financing of anti-hail stations and shooters on their territory.

APPENDIX B: FUNDAMENTALS OF SYSTEM DYNAMICS MODELLING

According to the System Dynamics Society[66], "System dynamics is very similar to systems thinking and constructs the same causal loop diagrams of systems with feedback. However, system dynamics typically goes further and utilises simulation to study the behaviour of systems and the impact of alternative policies", which are described in Chapter 4, Section 4.5. Here below are explained the fundamentals of the SD Modelling.

▪ Feedback

In any system, there is a reciprocal stimulus among the components, direct or indirect one. In a dynamic system, interchange describes any relation as either a cause or an effect, concurrently, with interactions both ways in the so-called feedback loop. Sterman sharply separates the feedback loop as positive or negative. The positive reaction or loop enlarge whatever is happening in the structure, as a stimulus for a change. Therefore, it is also known as a reinforcing loop. Contrariwise, the negative feedback loop acts as a counteract change and, accordingly, is called self-correcting or balancing loop. Ordinarily, systems are combinations or networks of feedback loops, both positive and negative, from where all the complexity of the dynamics arises (Sterman, 2000).

▪ Causal Loop Diagram

This simple diagram represents the behaviour of any system by mapping its elements and the relationship among them. It is an important tool for evidencing the hypothesis assumed in the model, drawing mental patterns and relevant feedback to problem explanation (Maani and Cavana, 2007). Causal loop diagrams contain:

a) System elements or variables relevant to the system;
b) Delays: effects that are only perceived after a waiting time;
c) Relationships: arrows are indicating the influence of one element on the other. To each causal relation is designated a polarity, being either positive (+) or negative (-), depending on how the dependable variable changes with changes in the independent. Methodology variable (either with
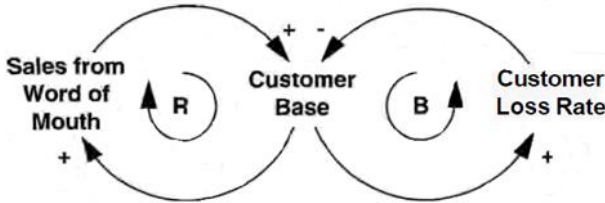
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[66] See more http://www.systemdynamics.org/
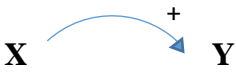
the same or with the contrary effect, respectively). It is relevant to note that individual links take into consideration that all other variables are kept constant (ceteris paribus), assuming that different interactions have different impacts on the system as a whole;

d) Feedback loops: as previously explained, either positive or negative. Positive feedback loops are also known as reinforcing loops (denoted by the letter "R" in the diagram), and negative loops are known as balancing loops (denoted by "B"). In real life, the first usually represents growth mechanisms and the second equilibrium mechanisms. The example below is a core representation of a causal loop diagram;

Table B-1 Link polarity interpretation

Link polarity symbol	Interpretation	Example
X + Y	Ceteris paribus, in case X increases, then Y increases above what it would have been.[67]	Birth + Population
X - Y	Ceteris paribus, in case X increases, then Y decreases below what it would have been.	Death - Population
When the number of negative links is even, the loops are reinforcing, symbolised with an "R" or "+" sign. If the number of negative links is odd, the loops are negative or balancing, denoted by a "-"or "B" sign.	Sales from Word of Mouth — R — Customer Base — B — Customer Loss Rate	

The most important limitation of causal loop diagrams is the inability to represent stocks and flows (Sterman, 2000), which will be discussed in the next section. To several systems, this means losing important information about the flow of materials and data from one loop to the other and about the accumulation of stocks in specific points of the system.

- Stock and Flow Diagram

Stock and flow diagrams are further particularised than causal loop diagrams since they specify entirely the balance of physical flows of material and information of the system. This diagram is particularly important in understanding dynamic behaviour since the stocks generate unevenness in the flow rates by the accumulation. A stock value can be accumulated by diminishing its outflow

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[67] Kim, 1992 offers an alternative convention for causal loop diagrams notation. He denotes a link polarity with "s" and "o", instead of + or –, respectively. "S" denotes that x and y move in the same direction, while "o" means that x and y are moving in the opposite direction.

rate as well as by increasing its inflow. Clearly, this unevenness has effect in the delays in the response of material and information flows and, as a consequence, in policies implementation.

Conceptualisation of the symbols used for stock and flow diagramming are described as given in Sterman (2000), in Table B-2.

Table B-2 Stock and Flow symbols explanation

Symbol	Key
▢	Module
▭	Stock
⟶	Flow
X	Valve (flow regulator)
⬯	Source or Sink

Stocks are the focal point of every dynamic system. They represent the fundamentals of the system that at whatever time you can see, sum total, or quantify. In other words, a stock is an entity that steadily accumulates or diminishes over time. A flow signifies the rate of alteration of a stock. Mathematically, the connection between stocks and flows parallels to differential equations. Except for stocks and flows, in any system there are auxiliary variables as well demonstrating the stock-to-flow relations explicitly.

According to Forrester (1961), the stock and flow diagram has an exact mathematical connotation. Stocks accumulate their inflows minus their outflows and, therefore, is the memory of the history of changing flows. As a consequence, a stock and flow diagram is superior to causal loop diagram, imposing constructing codes in the construction of the system elements:

a. Module - A module of the subsystem diagram is an independent subsystem included in the model, and normally classify model structure following the mental models, functional areas or organisational divisions. Module outlines the inputs it has to simulate and the output it will generate when the module is simulated.

b. Level - (also named Stock, Accumulation, or State). Stocks accumulates gradually and can only be changed by values of inflows and outflows. Levels are additions of flows, whether material, monetary or data flows. Stocks normally alter slowly, even when the flows into or out of them alter rapidly. For that reason, stocks act as delays or buffers or shock absorbers in systems. On condition that the sum of all outflows surpasses the sum of all inflows, the level of the stock will fall, and vice versa.

c. Rate equations (also called inflows and outflows) regulate the flows that modify the stocks. The flows are denoted by double arrows, habitually with a cloud on one end. The cloud represents a system boundary (we assume that the cause of the flow does not restrain our problem). Stocks permit inflows and outflows to de-couple - to be self-governing and to be out of balance with each other (except in a perfect dynamic equilibrium, when they are equal).

d. Auxiliary variables are converters or so-called functions. Auxiliary variables receive info from other variables as an input and convert them to an information output. Auxiliary = f (input1, input2... inputn).

Chapter 4 defines all variables used in the model and determine their characteristics in terms of behaviour and state. Chapter 4 also presents the model of corruption in the form of causal loop diagram. This form is simpler for the first understanding of the system dynamics but is later detailed in a stock and flow diagram, from where the model derives.

▪ Dynamic Behaviour

The forms of interaction among the several elements that compose a dynamic system define the behaviour of the whole structure. The combination of feedback and causal loops determine the forms of interaction, elucidating the characteristics of real-life phenomena seen in the compound world. This section briefly describes the types of behaviour of these dynamic (sub) systems. Figure 33 shows a graphic representation of the different behavioural types (Sterman 2000).
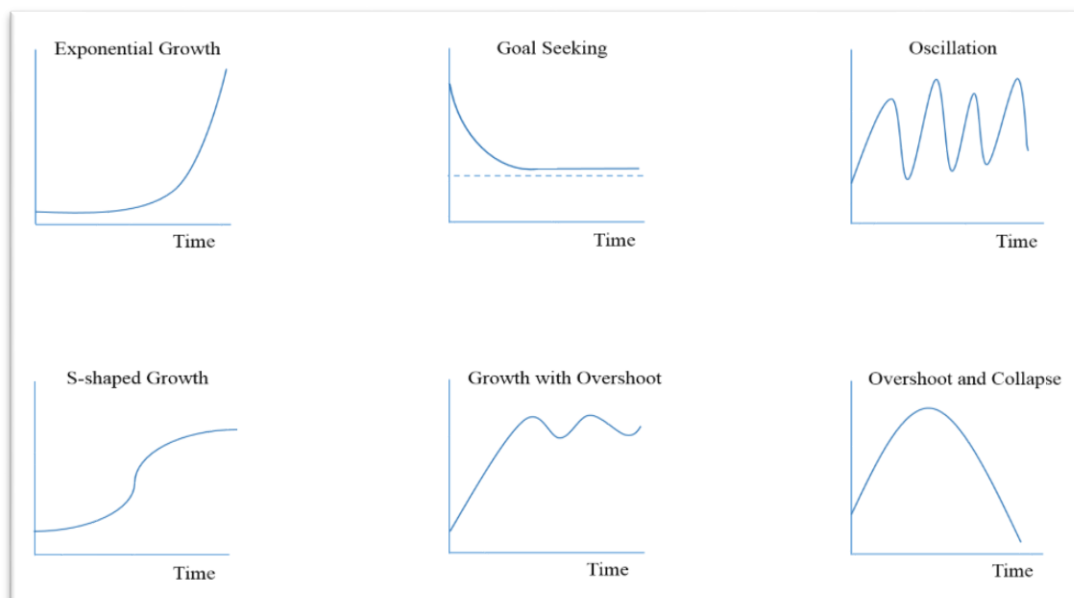
(Adapted from Sterman, 2000)

Figure 33 Fundamental Modes of Dynamic Behaviour

The model for corruption forecasting comprises one or more forms of behaviour presented above, according to the interactions found in the system. The starting point in determining the behaviour of such interactions is the analysis of the graphic forms of the variables in time. This analysis compares the shape of such graphs to the fundamental forms of behaviour and enables the drawing of the causal loop diagrams. The thesis uses this procedure to build the System Dynamics model of corruption in Chapter 4, Section 4.3.2.

Simulation models offer learning environments where academics, modellers, decision-makers can create and test policies. Simulation modelling also gives a convenient context where modellers can experiment with and learn about the impacts of various policies without any remarkable political or financial expenditure. Moreover, simulations can help to build consensus on challenging social and financial problems. SD model can support discussion and lead to the development of shared interpretations regarding the cause of the respected behaviour. Even for problems where the model encompasses diverse objectives and conditions, simulation running might assist in putting the attention on the analysis of particular variables and results that are the cause of disagreement.

APPENDIX C: TRANSFORMATION OF CLD INTO THE STOCK AND FLOW

Table C-1 Transformation of CLD into S&F
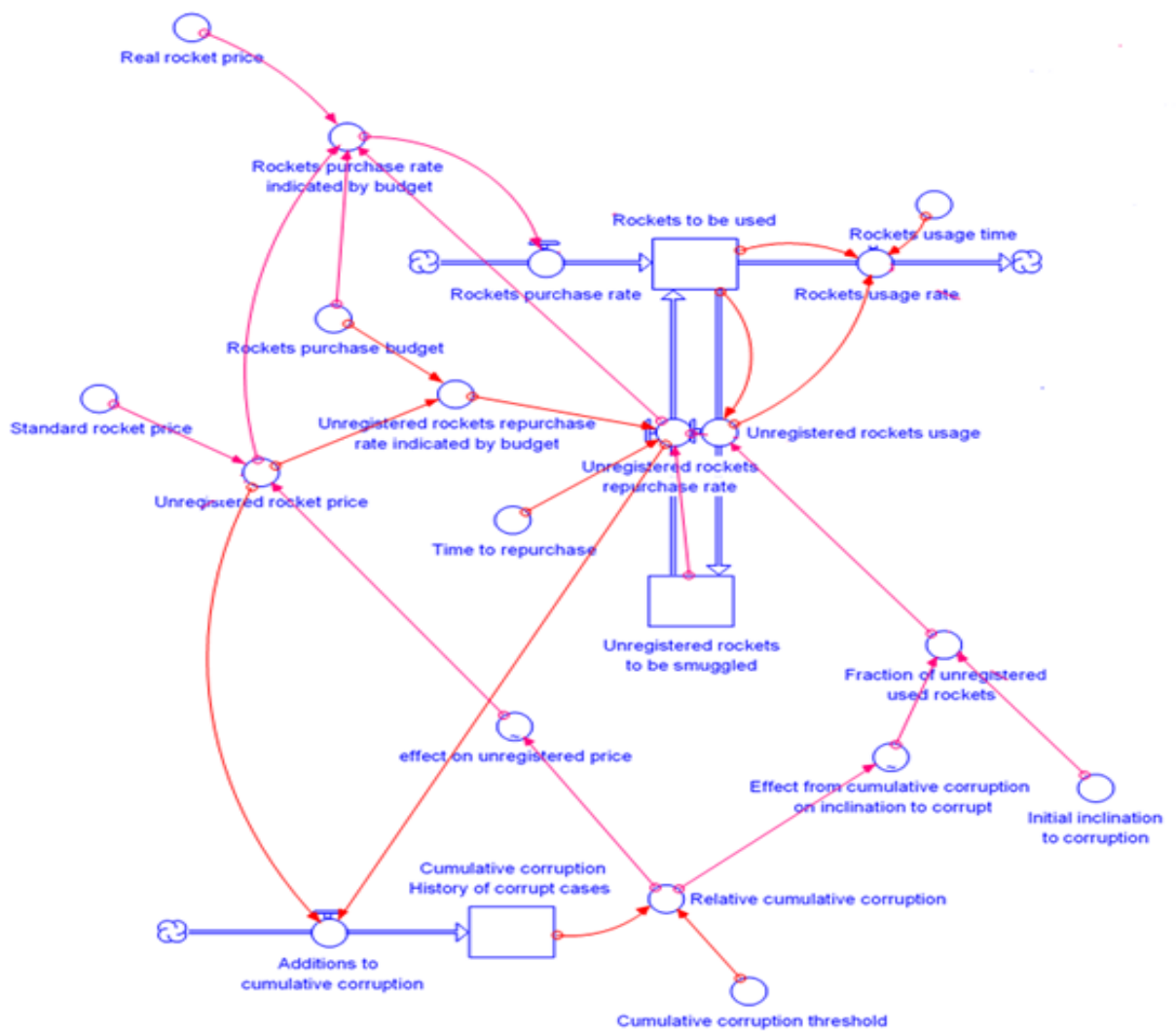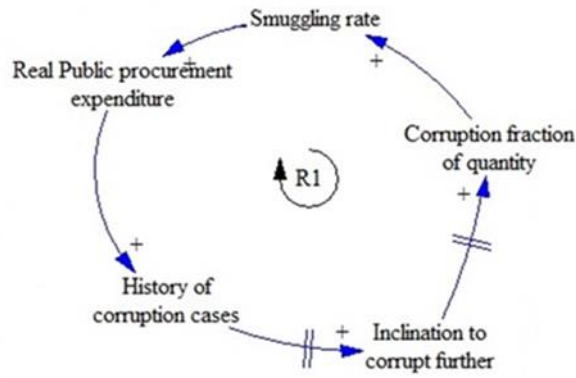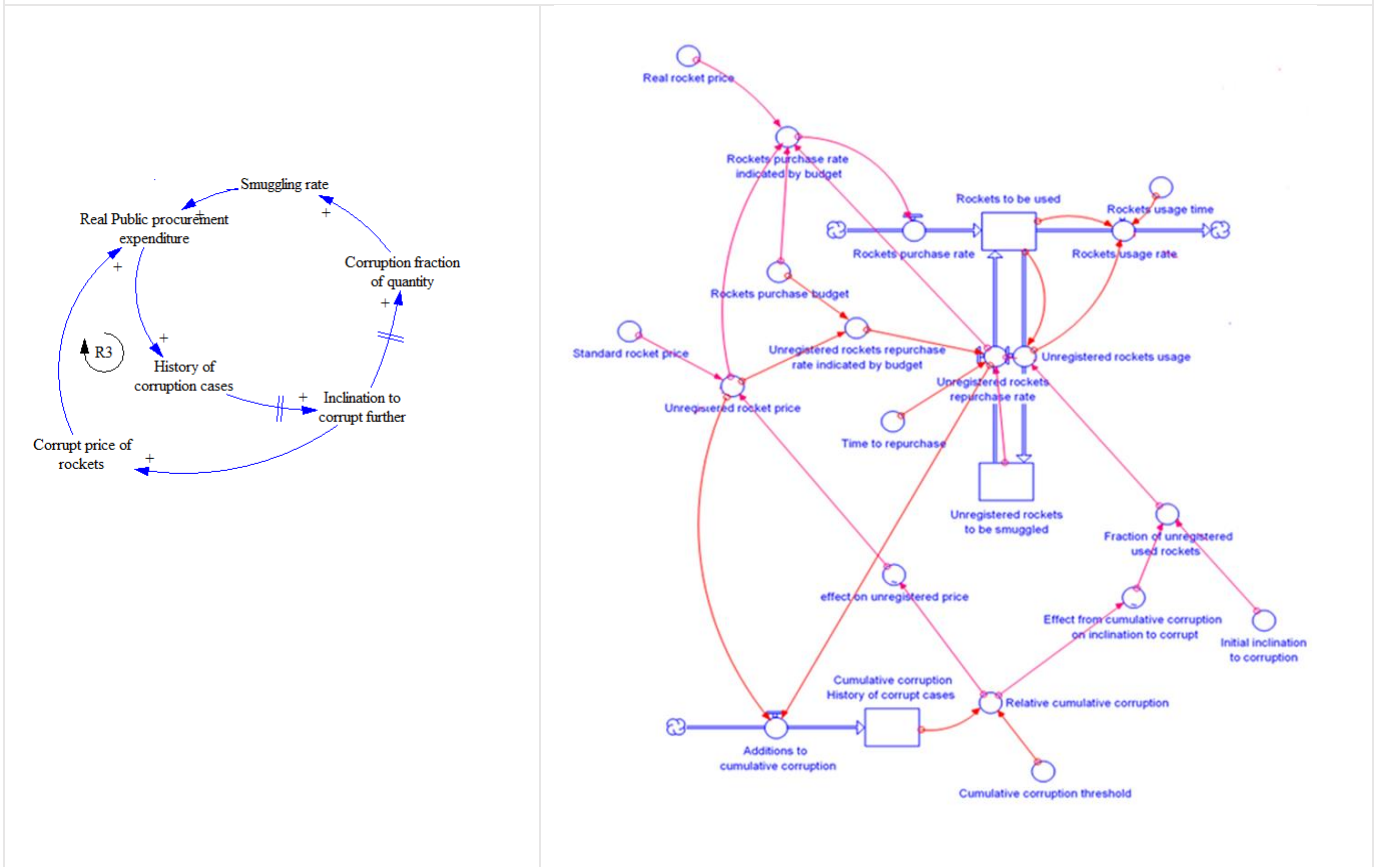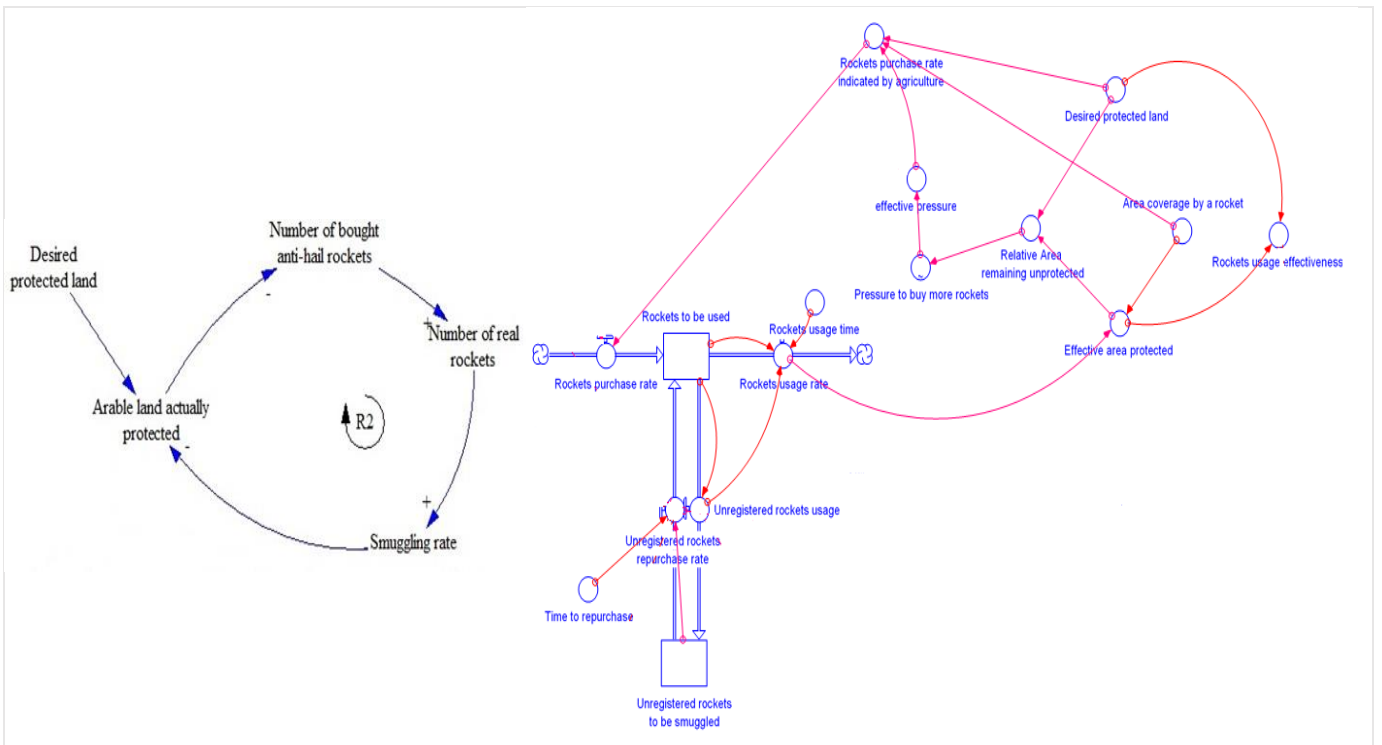
APPENDIX D: VALIDATIONS OF THE MODEL

In this section, some validation tests will be conducted and analysed. According to Barlas and Carpenter (1990), System Dynamics models should be validated concerning their intended purpose. Therefore, these validation tests will be performed based on the objective of the model, which was translating a case of corruption in the public procurement of the anti-hail rockets into a System Dynamics model. For all validation tests, the base model behaviour is based on figures retrieved from the available sources.

Tests of Model Structure

The testing of the model structure instantly starts when creating the model. All through the model building, the model is attuned and improved to represent the real situation in the public procurement. Five structure tests were conducted on the model.

1. Structure-verification test

"Verifying structure means comparing the structure of a model directly with the structure of the real system that the model represents. To pass the structure verification test, the model must not contradict knowledge about the structure of the real system. . . .The structure-verification test is first conducted on the basis of the model builders' personal knowledge and is then extended to include criticism by others with direct experience from the real system." Forrester and Senge (1980)

The author firmly believes that the structure of the model does not contradict the real system. The model structure corresponds to the hypothesis and the mental model depicted in the official report number 72 by Anti-Corruption Council; therefore, it represents the real system.

2. Parameter – verification test

"Model parameters (constants) can be verified against observations of real life, just as a structure of a model can be compared to available knowledge. Parameter verification means comparing model parameters to the knowledge of the real system to determine if parameters correspond conceptually and numerically to real life."[Forrester and Senge (1980), p. 212-213]

Parameter values were collected from the report and relevant literature and match the actual data of the projects. Therefore, they correspond numerically to real life. All values of the graph function conceptually correspond to real life.

The parameters in the simulation model were set ideally, for instance, the rockets usage time is always 1 year, public funds for anti-hail rockets does not vary from the value of 600.000 EUR/year, the coverage by the rocket is constant, and the initial public satisfaction is 1 or 100%. Although these parameters are not that fixed in real life, the reason for regulating the model this way was to determine the impact the several parameters have on the key performance indicators.

3. Extreme conditions test

An extreme conditions test includes setting the model state variables (stocks) to conditions that are outside the normal values in order to see how the model reacts. For example, if the number of Anti-hail rockets on the stocks suddenly drops to zero, an effective arable area protected will also have to drop to zero. Moreover, opposite if there is a sudden increase in relative rockets usage effectiveness then level of Public Satisfaction, other conditions being equal, should also increase. "A model should be questioned if the extreme conditions test is not met."[Forrester and Senge (1980), p. 213]

One of the assumptions in the model is an initial value of Public Funds available for rockets procurement. To test the plausibility of model structure, I conducted an extreme condition test on this particular value. Firstly, I wanted to see what behaviour the model would generate in an initial absence of the budget for this purpose. Secondly, I run the model with an initial excessively a high number of Public Budget. The rationality behind public procurement corruption model suggests that if there exist no procurement (or the figure of the rockets is infinitesimal) there will not be anything to use for shooting the clouds, so there would be no protection of the agricultural land whatsoever. The test of this hypothesis showed that when a number of rockets are set to extremely low (approximately 0.0000000001 rockets purchase rate indicated by budget) there is no relative rockets usage effectiveness generated by the system. Consequently, the Effective area protected goes below 1 hectare, and Public Satisfaction drops to the bottom limit of 0.2.

These values are because the system does not intend to close the gap between Desired protected land and the Effective area protected. The results of this extreme behaviour could be clearly understood by looking at the behaviour over time diagram, Figure 34. The stock of Anti-Hail Rockets is depleted before 2014, as well as the Effective Area Protected, as a consequence. The drop is equally sharp in the Public Satisfaction, though with a defined time postponement in the mental model of the population perception. In addition, a delay occurs because of the initial value of the stock (let us not forget that the stock of the Anti-hail rockets had 30.000 widgets at the beginning of the simulation), leading to the fact that some area was protected in the first simulation years due to this backlog.
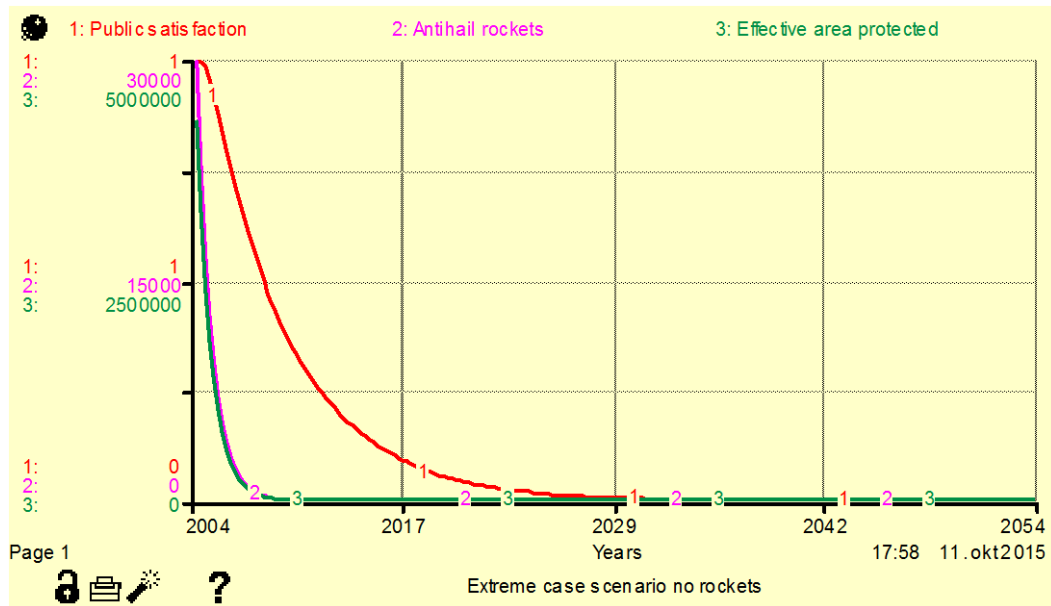
Figure 34 BoT Extreme case scenario no rockets

Considering that the ratio Relative Rockets usage effectiveness compares the Rocket usage effectiveness (coming as a function of the exceptionally low amount of effective area protected) and a defined minimum acceptance rockets usage effectiveness, the result of this ratio is dropping to zero within only four years, see Table D-1.

Table D-1 Extreme case 1 scenario results

Years	Public satisfaction	Rockets to be used	Effective area protected	Relative rockets usage eff
Initial	1,00	30†000,00		1,00
2004	0,94	9†492,19	1†822†500,28	0,26
2005	0,80	3†003,39	576†650,81	0,05
2006	0,69	950,29	182†456,25	0,02
2007	0,60	300,68	57†730,63	0,01
2008	0,53	95,14	18†363,04	0,00
2009	0,47	30,11	5†859,65	0,00
2010	0,42	9,53	1†867,03	0,00
2011	0,38	3,02	594,34	0,00
2012	0,34	0,96	189,23	0,00
2013	0,32	0,31	60,51	0,00
2014	0,30	0,10	19,60	0,00
2015	0,28	0,03	6,57	0,00
2016	0,26	0,01	2,43	0,00
2017	0,25	0,01	1,12	0,00
2018	0,24	0,00	0,70	0,00
2019	0,23	0,00	0,57	0,00
2020	0,23	0,00	0,53	0,00
2021	0,22	0,00	0,52	0,00
2022	0,22	0,00	0,52	0,00
2023	0,22	0,00	0,52	0,00
2024	0,21	0,00	0,52	0,00

Another and opposite extreme case would be if there were infinite inflow to stocks of Anti-Hail Rockets, meaning that there are no limitation in the Public Budgets for this purpose. This extreme case is, of course, unrealistic scenario but is found to be very useful in testing the model structure validity. To perform this test, variable Rockets purchase budget were assigned a value of the sufficiently large amount of 1.000.000.000.000.000 EUR/year (in the previous extreme test case, this value was only 1 EUR/year, since it was needed to restrict the inflow of the rockets). Ceteris paribus, it is expected that this test shows the increase in the stock of the Anti-hail rockets, an increase in Public Satisfaction, and growth in terms of the Effective area protested, as there are no almost no limits in funding this service. The results are quite interesting and are shown in the figure below.
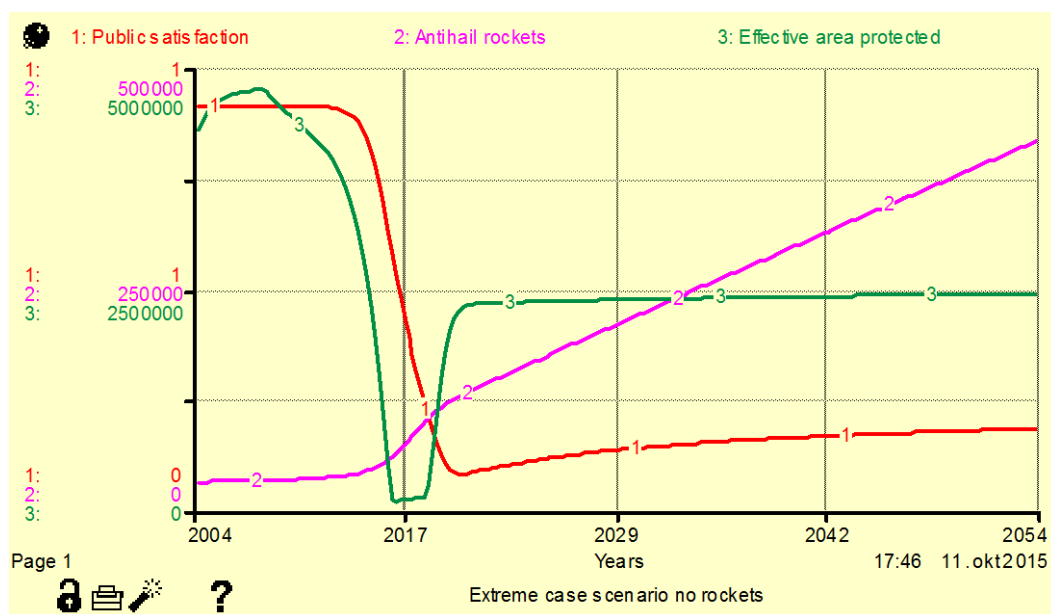
Figure 35 BoT Extreme case scenario no funding limits

With virtually no limits in the Public Budget, the stocks of Anti-Hail Rockets indeed is skyrocketing, or in the jargon of System Dynamics there is an exponential growth of the stock of the Anti-hail rockets. With no restriction in procurement, we might guess that there should be the same logic for the stock of Public Satisfaction and the area protected. Nonetheless, there is also the effect originating from the corrupted price paid to both of them. Hence, around the year 2017 the model is shifting the dominance between balancing and reinforcing loops. After that the system tends to stabilise itself at the level of 0.52 or 52% of Public Satisfaction, coming from the level of around 2.300.000 hectares protected per year (see Table D-2). The model takes, correctly, into account other loops as well, that is why there is no linear behaviour of Public Satisfaction or the Area protected.

Table D-2 Extreme case 2 scenario results

Years	Public satisfaction	Antihail rockets	Effective area protected	Relative rockets usage eff
2004	1,00	32†066,02	4†570†425,00	1,00
2005	1,00	32†796,92	4†704†913,77	1,00
2006	1,00	33†092,54	4†757†788,20	1,00
2007	1,00	33†222,13	4†780†607,01	1,00
2008	1,00	33†412,28	4†607†987,48	1,00
2009	1,00	34†082,20	4†435†574,34	1,00
2010	1,00	35†297,85	4†245†352,55	1,00
2011	1,00	37†098,86	4†041†797,42	0,97
2012	0,99	39†623,77	3†856†171,37	0,90
2013	0,96	43†940,32	2†908†730,62	0,62
2014	0,86	52†774,38	1†507†357,15	0,17
2015	0,74	69†647,62	93†750,97	0,01
2016	0,64	88†591,77	120†696,87	0,01
2017	0,56	107†687,95	275†663,82	0,09
2018	0,50	122†998,39	1†811†944,87	0,43
2019	0,50	133†083,97	2†287†963,68	0,52
2020	0,50	141†974,10	2†341†004,69	0,53
2021	0,51	150†706,83	2†350†697,42	0,53
2022	0,51	159†395,88	2†356†967,49	0,53
2023	0,52	168†052,20	2†362†835,39	0,53
2024	0,52	176†677,79	2†368†446,58	0,54
2025	0,52	185†274,08	2†373†796,48	0,54

We can conclude that the model pass the extreme tests, since the behaviours after altering the extreme values follows the structure of the model. In addition, equilibrium case is another special kind of the extreme test where all the loops are cut. The structure developed passed this test successfully, as well. In testing these two extreme cases, all the loops were taken into account, and the simulation results are the consequence of the modelled structure. In the second extreme scenario, despite the fact that we are not financially restricted, there will be no complete coverage of the agricultural land in Serbia. Consequently, the level of the Public Satisfaction will be half of the desired one. This incomplete protection is because the corruption is not obstructed, and while the funding is limitless so is the corruption practice (both in terms of quantity procured and the price per widget paid).

We can even go further and speculate that complains about insufficient funding for the rockets, are simply not valid. The problem is not on the Budget side, quite the opposite – the available funding should be used optimally to fulfil its purpose and protect the arable land from possible severe damage from the hail.

4. Boundary-adequacy (structure) test: the model includes all relevant structures

"The boundary-adequacy (structure) test considers structural relationships necessary to satisfy a model's purpose. The boundary-adequacy test asks whether or not model aggregation is appropriate and if a model includes all relevant structure."[Forrester and Senge (1980), p. 214-215]

Strictly speaking, the model does not pass this test because the structure and influence of the competitors from the supply side are not included, and the usage of the rockets does not cover all possible scenario.

Comparing the boundary of the quantitative model to the boundary that was set in the beginning, we see that the model is somewhat restricted. At the start of the model building, it was determined that the boundary of the model would reflect the boundaries of public procurement and (mis) usage of anti-hail rockets. However, the model focuses mainly on the Rockets usage process based on the hypothesis that the rockets are bought, were not use and were rebought, due to lacking of controls mechanism. However, the actual boundaries are beyond this process. The shooters of the rockets and their efficiency are for the most part absent from the model (technically, I assumed their 100% efficiency). The part of the actual working force is important for determining the forecast because this indicated the real need for both budget and distribution of the rockets; however, this is not included in the quantitative model.

In addition, the buying scheme of the rockets is critical for the corruption procurement process. In theory, the Price of the Rockets could go even more down via modernisation, technical development or if the market is completely open, leading to the effective protection of land would rise. As a matter of fact, I have found certain records recently that small amounts of rockets are purchased from another supplier. Although these factors are important and perhaps the boundary should be extended to include them, I have decided not to do this.

First of all, the data regarding these issues was not really available; market intelligence depends on the market, and the price change is not easy (perhaps not possible) to be predicted by decision rules. Concerning the additional suppliers, the official report from Anti-Corruption Council did not mention such information, and thus they are not included. Moreover, it is pointed out that the Department of Public Procurement in the memo no. 404-02-594/10 dated 29.07.2010, claims a violation of the Public Procurement Law Art. 24, paragraph 1, item 4, because there were not a public invitation to tenders or call for bid, but only direct negotiation between supplier and this public service provider. Finally, the official report states several different alternatives for the rockets usage: e.g. rockets were hit into the clear sky only to be consumed, the rockets did not even exist, but they were

paid anyhow. The extension of the model with these activities would, therefore, be done with many assumptions and even fewer empirical data. This also has to do with the second reason: lack of time. The last reason is the fact that the planned simulations only focus on the corrupted procurement process to see clearly the influences. When examining the model one can conclude that the model boundary is adequate for the model purposes[68].

5. Dimensional-consistency test

The dimensional consistency test was passed without the need for adjustments (see Figure 36).
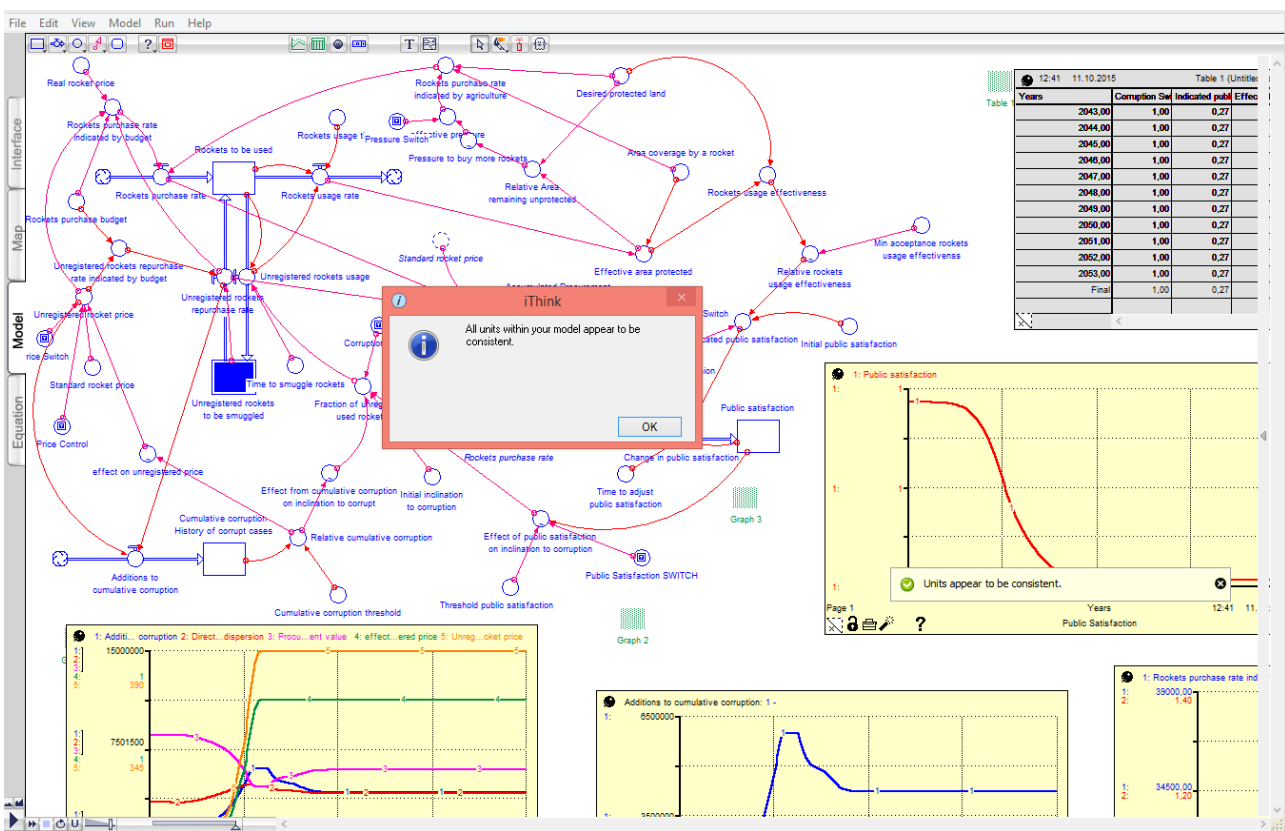
Figure 36 Unit consistency test results

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[68] The model purposes are to determine the impact the parameters and the decision rules have on the key performance indicators.

6. Behaviour-reproduction test - Symptom generation test: the model behaviour matches the imaginary reference mode.

Replication of reference modes of behaviour was tested through the model's ability to match the historical reference modes of behaviour. All stocks were initialized to match the historical situation for the company as of 2004. The curves show a reasonable trend-line over the period under review. For the purposes of the research, it is more interesting to see the broad trends and the response of the system to such trends.
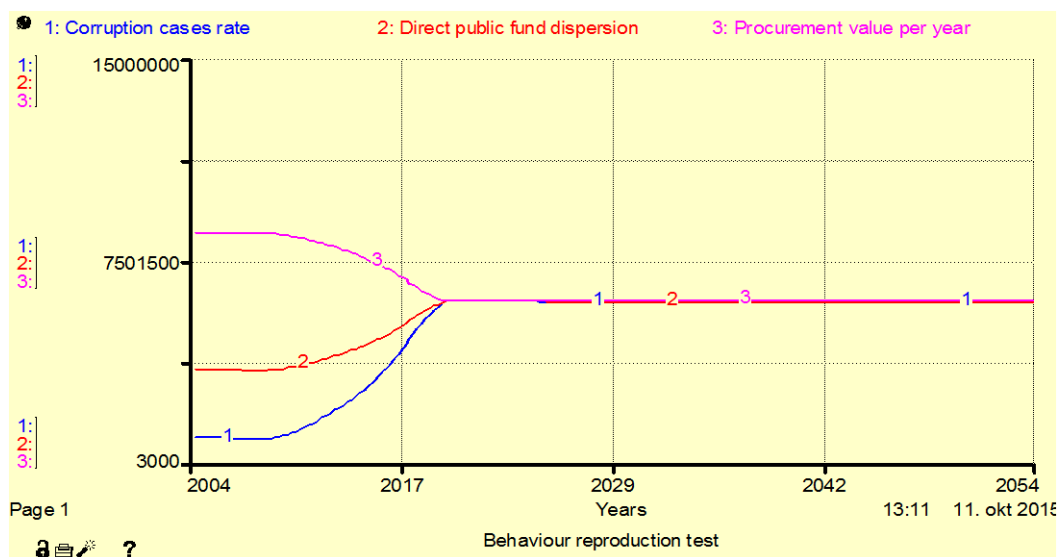
Figure 37 Behaviour reproduction test

The model generated resource accumulation corresponds closely with that observed for the company over the period of study (see Figure 37). At the report date, the mid-2010 number of the as well as seen in reference mode. When merely corruption is introduced in the model[69], both regarding quantities smuggled and concerning a price paid per widget, we expect to see rather excessive behaviour. In this case, there is no information to the public, or they are careless to corruption practice. On the whole, no limits to this behaviour are operating, since the other loops are cut (see different consequences in Figures 38 to 41). The general public, in theory, expect that everything is 100% working properly, so this variable has value one as the start value (see the blue line, numbered 1 in Figure 41). The model will produce non-linearity, meaning that not immediately all the effects are working and with the same lane.

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[69] The conventional and regularly used kind of sensitivity analysis has been to alter model parameters and to watch how behaviour transforms. This form is a very useful procedure for model testing, learning, and validation.
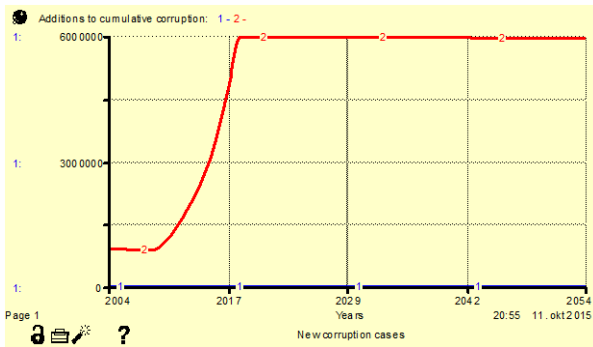
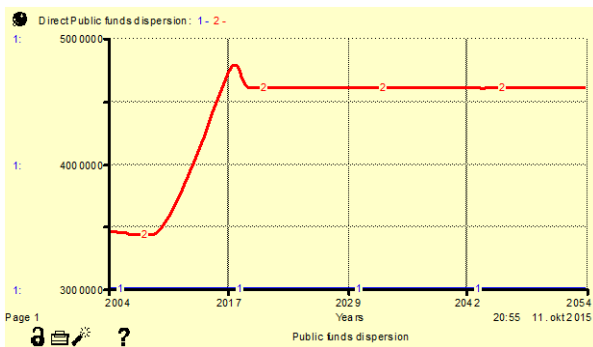Figure 38 BoT R1& R2 are active, new corruption cases

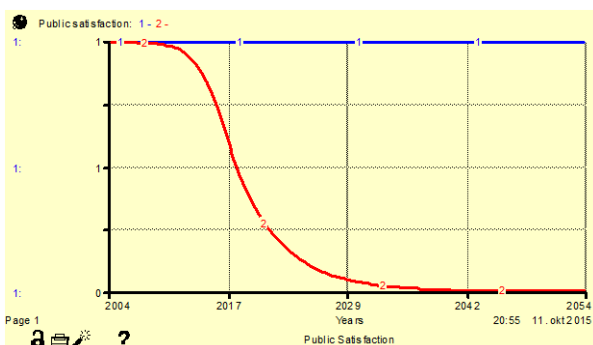Therefore, when corruption starts, both corrupted quantity and corruption regarding price paid per rockets takes Place. Since there exist no limitations in the model, corruption will reach its maximum of 6.000.000 EUR/year very sharply, within 15 years.

Figure 39 BoT R1&R2 are active, effects on fund dispersion

Although the detected amount of public funds dispersion for the rockets is 3.000.000 with limitless corruption the amount grows sharply before it stabilises at the level of approximately 4.600.000 EUR/year (see Figure 39).
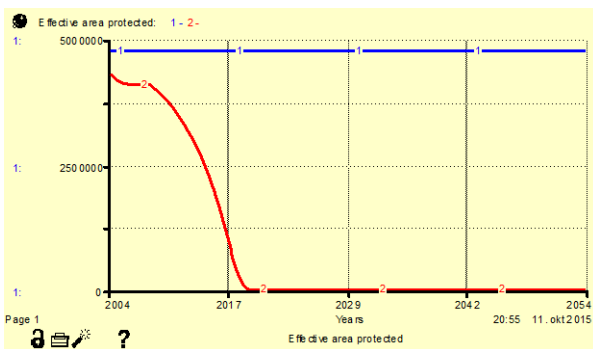
Figure 40 BoT R1&R2 active, effect on the area protected

With boundless corruption, Rockets usage effectiveness will start lowering so relative usage effectiveness will also go down. Hence, the Effective Area protected will practically be zero from around 2020 (there will be not enough rockets to protect the land, Figure 40).

Figure 41 BoT R1&R2 active, effect on Public Satisfaction

In addition, the Public Satisfaction will be going below one (Figure 41), with a typical "S-shape" behaviour.

7. Extreme-policy test: when applying an extreme policy, does the model behave as it would in the real system?

a) Playing with Contractions from Public Satisfaction

One of the assumptions in the model is an initial value of Public Satisfaction, set to one. Also, a bottom limit of public satisfaction is placed; it cannot drop down to zero. The lower limit is 0.2 (level of an indicated public satisfaction). To test the plausibility of model structure, I conducted an extreme condition test on this particular value. Firstly, I wanted to see what behaviour the model would generate in an initial absence of corruption, which has been already presented ad Equilibrium Case (Figures 16 and 17). Secondly, I run the model with previously explained simulation, where Public Satisfaction is absolutely ignored and not taken into account, so-called limitless corruption (Figure 42). Therefore, corruption is growing up because of the all three reinforcing loops. Finally, the model is simulated with the same assumptions but I put active the contraction coming from Public Satisfaction – a balancing loop.
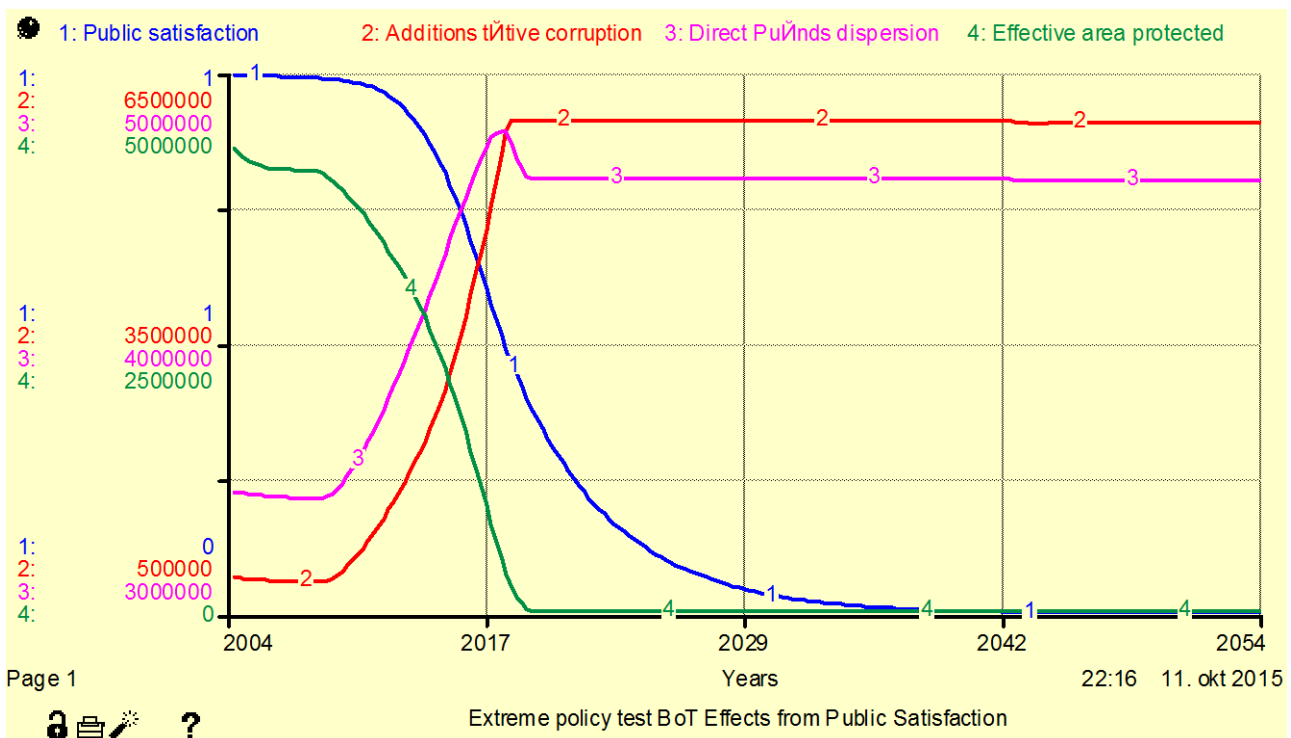
Figure 42 Extreme policy test, a base line for policy test 1

As elaborated in the dissertation, this situation happened when new information are available and the general public all of the sudden reacts on what is happening. Alternatively, population was aware all the time, but their patience reached the maximum, and they strongly protest and limit the corrupt behaviour of public bureaucrats. Just to recall the reader, in this test corruption is on (both the quantity and the price effect) and the limiting factor coming from Public Satisfaction is operating. Therefore, with the certain time delay forces the corrupt behaviour to descend (Figure 43).
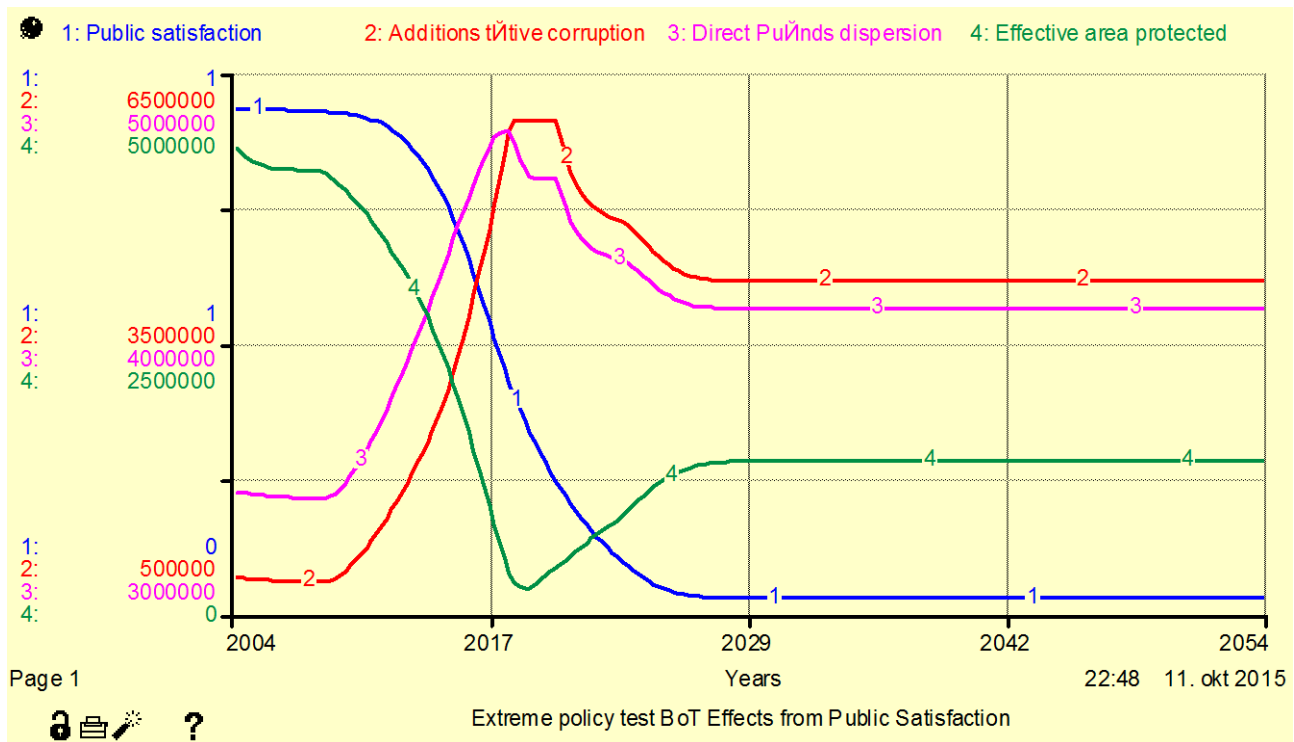
Figure 43 Extreme policy test, effects of the policy test 1

The effect is that the level of Public Satisfaction will be dropping but not as much as without the policy in place. Population see the results of their action (the fraction of the unregistered rockets will be less), plus there is significant incremental in the effective area protected; therefore, the level does not drop to the bottom line. The clearer illustration of the extreme policy test can be seen in Figures 44 and 45, where comparative simulations were performed, as explained in the begin of this section. In recap, the blue line is representing the equilibrium case, the red line is the limitless corruption practice and the pink line is the behaviour over time with contractions coming from Public Satisfaction. Figure 44 show that equilibrium is at the bottom level of the diagram, the red line is significantly higher than the line number 3 – where policy takes place. Therefore, direct public funds dispersion stabilise at the level of around 4.000.000 EUR/year which in not ideal, but still much better that uncontrolled corruption.
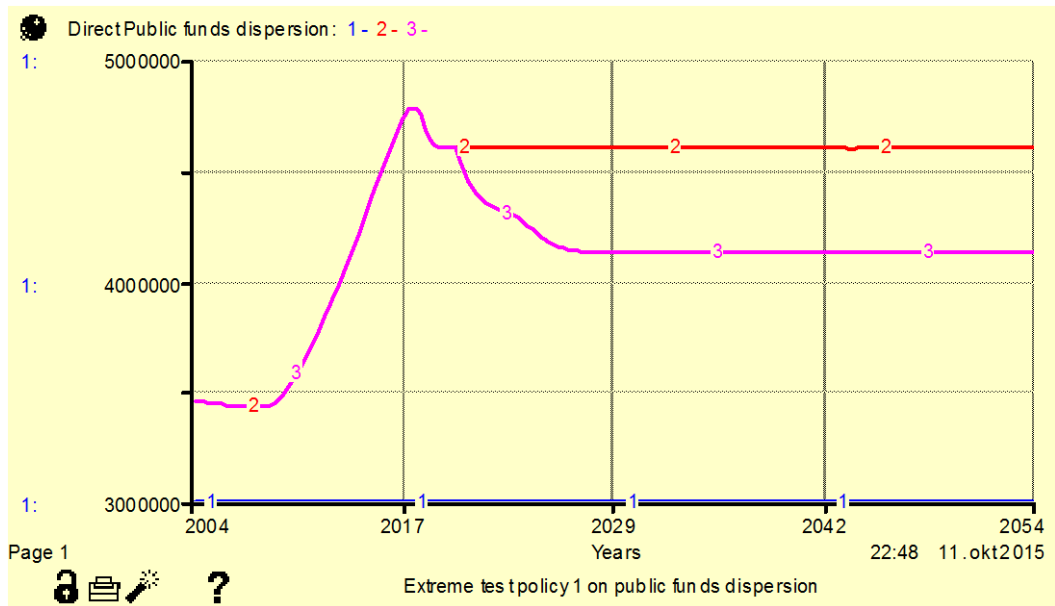
Figure 44 Extreme test policy 1 - public funds dispersion

The significant impact of the policy, as would be expected in the real life, we can comprehend in Figure 45. The Effective area protected, from 0 hectares per year, when extreme corruption is in place could go to the maximum level of around 5.000.000 hectares per year, when there is no corruption. However, with motivating the people to be more aware and active in participating the political life, or to protest even, the Effective area protected would become constant on the level of 1.300.000 hectares per year. The system tends to stabilise itself in the long run.
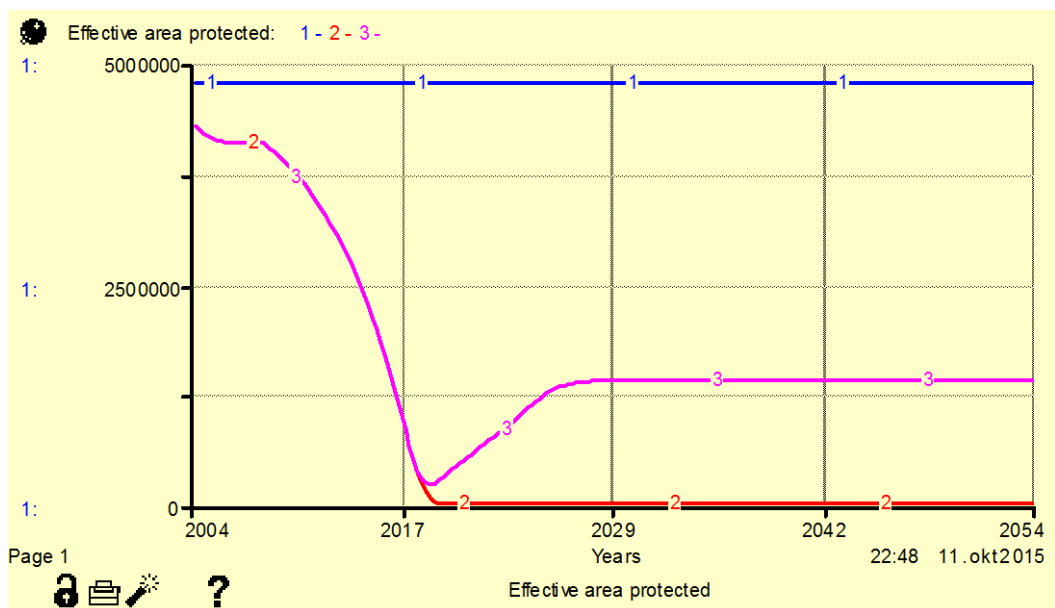
Figure 45 Extreme test policy 1 - Effective area protected

b) Playing with Contractions from Public Satisfaction plus Effects of Public Funds Dispersion

As expected, there were positive effects originated by including pressure from the general public, with regards to dissatisfaction with corruption practice about quantities bough and the price paid per rocket. Next, I will test the policy including the effect of Public Funds Dispersion. Namely, the population might be not happy or even furious when their crops are continuously damaged or destroyed by hail that could have been prevented. As in life, one thing leads to another, people are eager to know more and soon after the Effect of Public Satisfaction, so-called the Effect of Money Dispersion takes place. It manifests the disappointment of people connected with public funds dispersion in general. At that point, it is not only important if crops could have been better protected, but also if the public funds could have been used elsewhere (e.g., hospitals, schools, or safety).

After the year 2020, we start seeing the effect of Public Satisfaction, triggered by direct public funds dispersion. The value of the Money Dispersion is 7.1231 million at that point, and only after it surpasses the Threshold value of 70 million (that is indeed higher than initially estimated because the price was increasing as well). After that value of Money Dispersion, the Effect of Money Dispersion starts happening. The effect is represented by a graphical function from zero to one; it is one until this point and then it begins to decline. In conclusion, in this test corruption is on (both the quantity and the price effect), the limiting factor coming from Public Satisfaction, and the factor from Public funds dispersion all together are operating (see Figure 46).
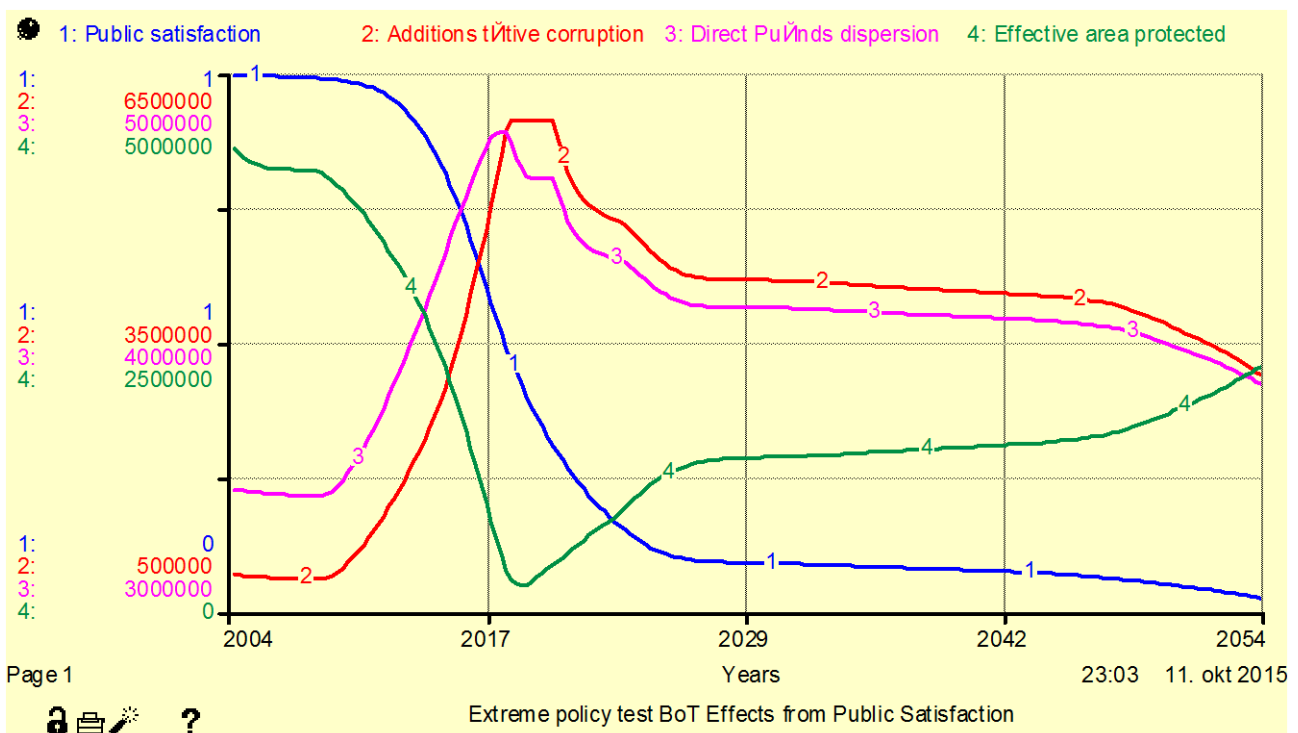

Figure 46 Extreme policy test, effects of the policy test 2

Because of this effect, overall Public Satisfaction is going down even more, as an additional force influence. Comparing with Figure 43, the Effective area protected start to increase considerably, because of the intensive public pressure on funds dispersion, and sounder control of the procurement process. The more positive effect we can also be seen in a decrease of new corruption cases, and consequently in a reduction of public funds dispersion.

The comparative simulations of the extreme policy test were performed, and illustration of them is offered in Figures 47 and 48. As stated before, a comparison will be presented regards all the previous runs, plus the new green line, labelled with number 4 shows the results of the new policy.
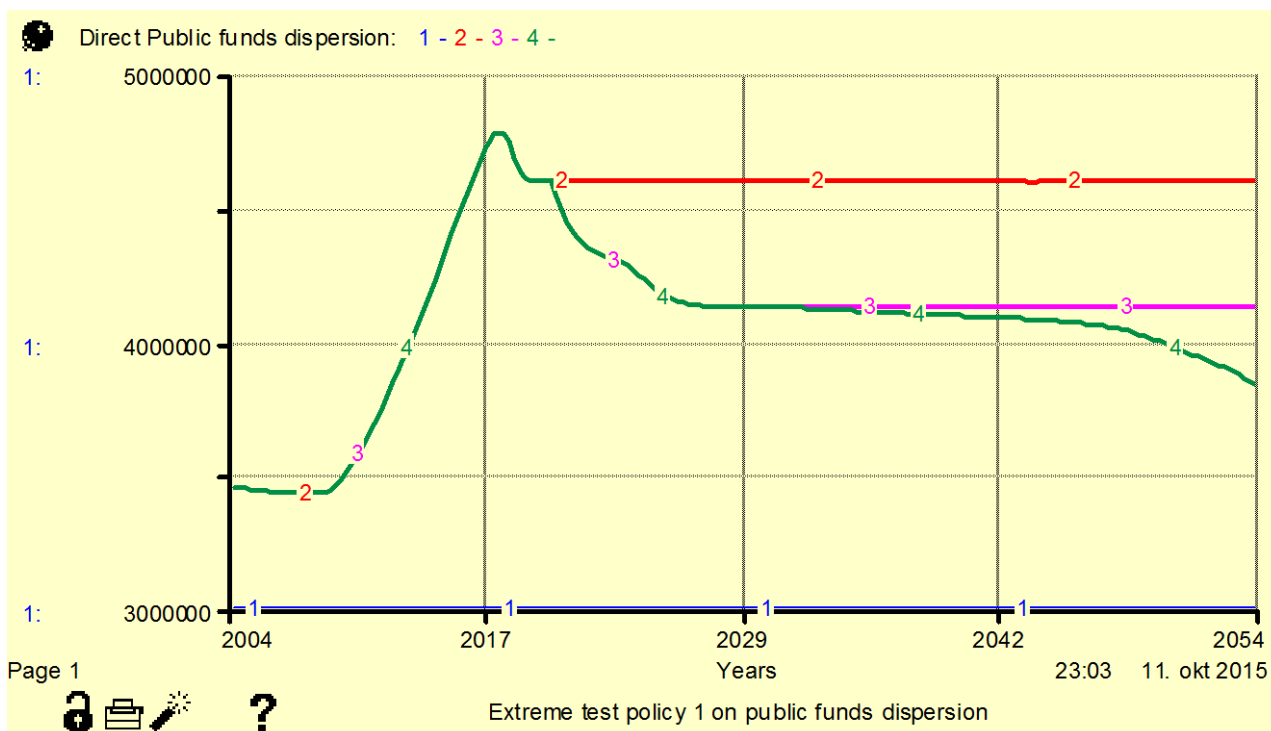
Figure 47 Extreme test policy 2 - Public Funds dispersion

Public funds dispersion now decreases, in the long run, below the level of 4.000.000 EUR/year. If the simulation period would be extended, there is a high probability that the level of misused public funds would approach the optimal level of 3.000.000 EUR/year (see Figure 47). However, it was not expected here that all the simulation results reach the ideal values; we rather expect to see that policies have reasonable performance and that they could approximately match the reality.
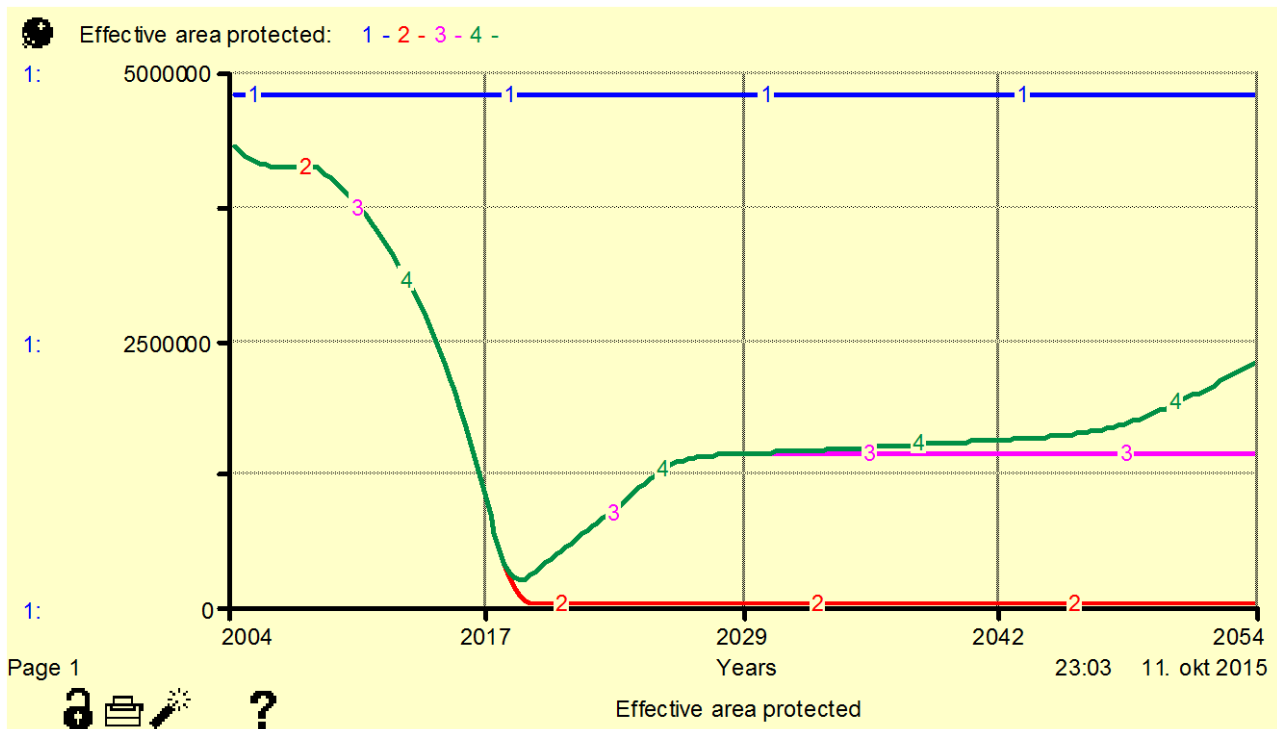
Figure 48 Extreme test policy 2 - Effective area protected

The simulation generates behaviour according to our expectations, displayed in Figure 48 regarding the Effective area protected. Arable land is increasingly covered and in 2054 in reaches the level of 2.500.000 hectares.

Even though it has not been feasible to test all possible scenarios, no surprise behaviour in the direction of trends have been observed. The scales of movements in trends are not always correct, but the direction of the observed is explainable and appears to be correct. The relationship thus seems to be correct in direction, but further work needs to be done on refining the values attached to the relationships.

c) Playing with Price Control

To check the behaviour of the price effect, as the first extreme condition I put value 0 for price effect. On that way, it is confirmed that no input of the corruption is included in the price structure, and in the stock of Public Funds Dispersion, as a final point. Therefore, the only quantity of the rockets procured contributed to the inflow of Public Funds Dispersion and the behaviour in comparison to the reference behaviour is also confirmed. Thus, the model once more confirmed to represent the real life business. The unregistered rocket price in the simulation model does not develop (see Figure 49), and explicitly it stays on the actual rocket price level of 200 EUR per piece.
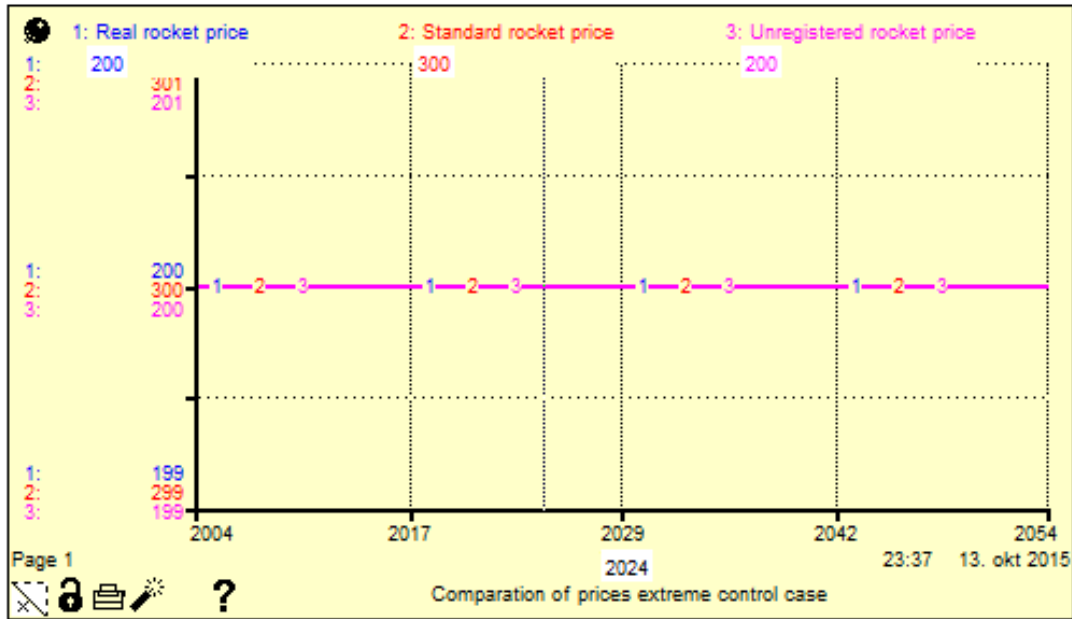
Figure 49 Extreme test - Price Control Policy

Compared with the previously presented extreme test policies, the Price control policy effect is the most significant one. In Figure 50 it is shown with the yellow line labelled with number 5 how substantial impacts on the occurrence of the new corruption cases restricted price policy has. First of all, it occurs several years later. Then, additions to cumulative corruption cases overshot at the level of around 5.000.000 EUR before it collapse, and finally stabilises around the level of 2.000.000 EUR.
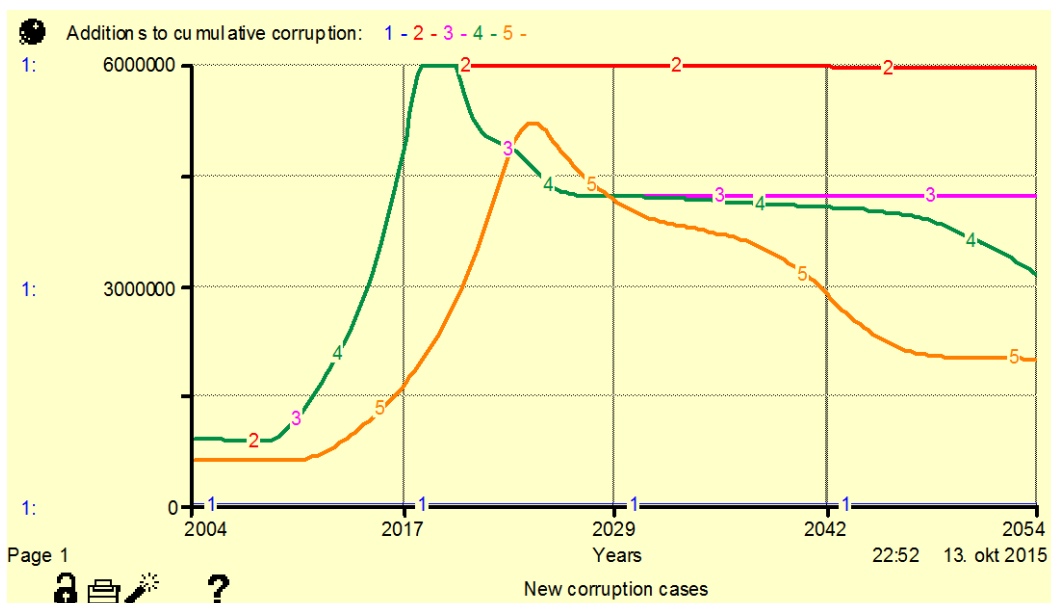

Figure 50 Extreme test restricted price effects on new corruption cases

Finally, in the figure below is shown the effect of the constricting price control policy on the effective area protected. The extreme policy test labelled with number 5 in Figure 51 shows clearly its superiority. Again, the effective area stayed protected maximum possible in the model, around 4.000.000 hectares. In addition, it stays protected several years more than any previous simulation result. Also, it never drops below the level of 1.000.000 and that drop is only for a short period before the system does not finally take into consideration full effect of the balancing loops. Finally, it tends to stabilises on the highest level compared to all other runs. Namely, the effective area protected, in the long run, would stayed protected with approximately 3.500.000 hectares per year, if the strict policy control is in place (if the government bureaucrats are forced to pay 200 EUR per widget)
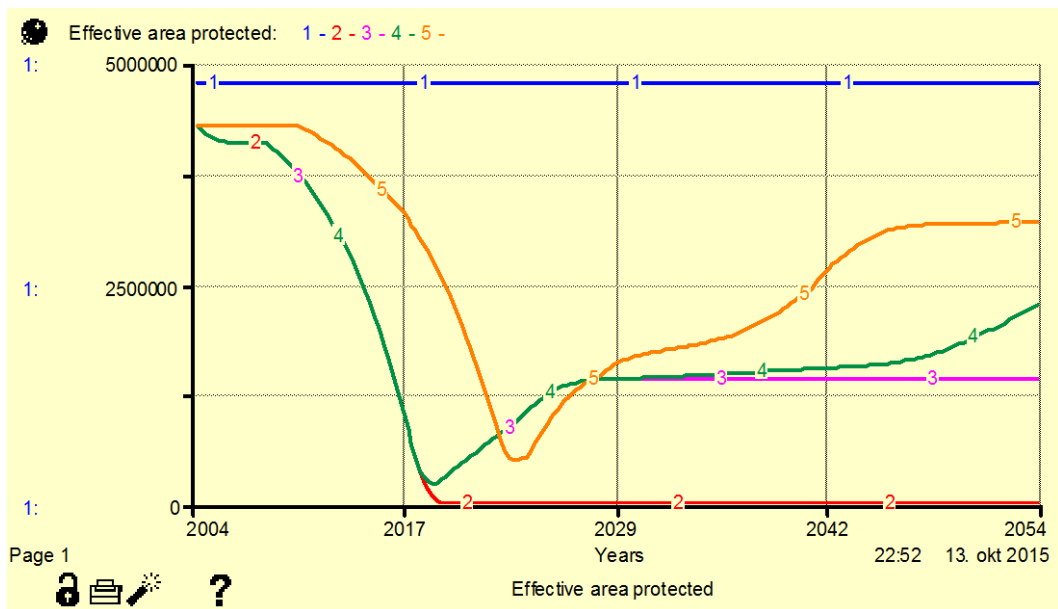

Figure 51 Extreme test restricted price effects on the effective area protected

APPENDIX E: SIMULATION RESULTS

As mentioned earlier, the time horizon selected is equal to 50 years (2004-2054) which is a period sufficiently long for showing how corruption is affected by a change in some important variables. Here below will be illustrated the simulation results of the full corruption model of this Public Service provider, where all the processes were taken into account simultaneously.

The complete model comprises all the loops, including loop R2, which was not separately explained in the main body of the thesis. It is the reinforcing loop that shows when more and more area is being unprotected; we are going to do more and more ordering for the rockets[70]. This additional procurement is, in fact, happening in practice, when in the middle of hail season, the local governmental units are dedicating additional funds for the hail protection or even self-financing the rockets expenditures.
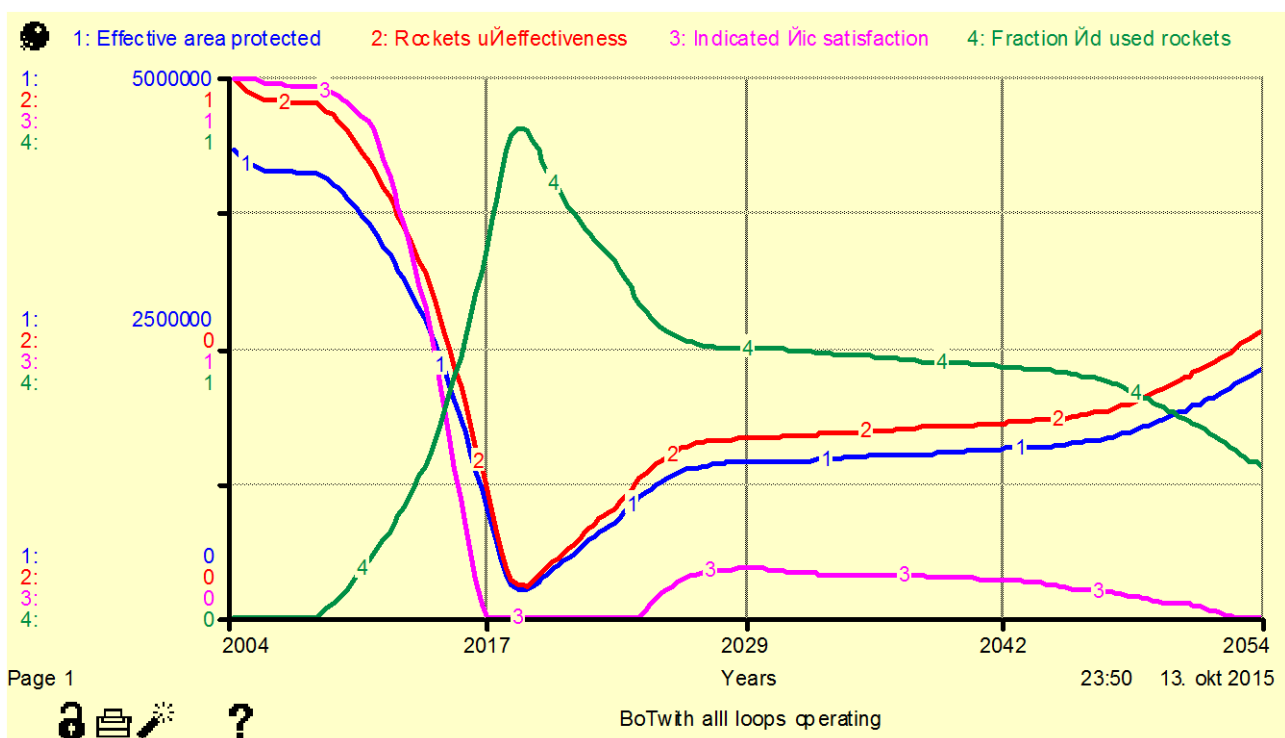

Figure 52 BoT results with all the loops operating

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[70] The loop is running taking into account information from a graphical function. The area remaining unprotected is exact area originating from the simulation but variable of the relative area is expressed as a fraction of desired protected area. This relative area is another performance driver. With corruption practice, the relative area unprotected will be increasing. This relative area is between zero and one in graphical function, and the pressure will be from one to 1.3 since that it does not produce strong effect.

We clearly see in the figure above that as corruption practice increase (which has direct implication to the fraction of unregistered rockets, presented with the green line), the Rockets usage effectiveness decrease and reaches its lowest level around the year 2020. Consequently, the Effective area protected sharply drops in the respective period. However, it stabilises around 2.500.000 hectares/year being protected in the long run.

Logically, when the additions to the accumulative corruption reach its peak, approximately the year 2020, the Relative area remaining unprotected is on its highest level (see Figure 53). Labelled with the blue line, we see the most important indicator - Addition to Accumulative corruption. Here the dynamics of the model is clearly shown, the corruption is growing because of the reinforcing loops. For recalling, the main loop is R1 but also the others loops coming from the needed protected area, and the price are operating. Then, the additional forces such as Public Satisfaction, the loops deriving from public procurement, or ineffectiveness to protect shift the dominance. Addition to Accumulative corruption drops, but it drops and also stabilises because we do not completely expurgate the corruption.
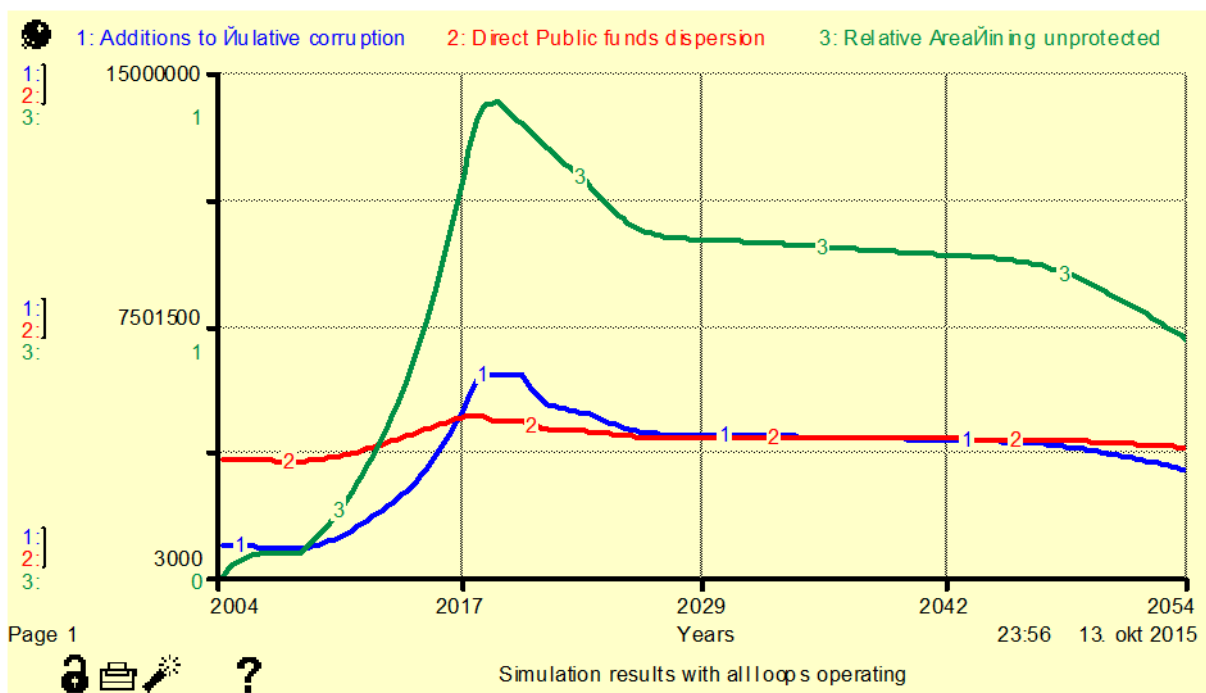

Figure 53 BoT other simulation results with all the loops operating

Next, the behaviour over time of the several major stock is presented in Figure 54. One of the main characteristics of the stocks is that they accumulate, therefore, illustrated with lines numbered with one, two and three we see almost linear behaviour of cumulative corrupting cases and accumulated procurement, while the stock of the Rockets to be used have certain dynamic behaviour.

Until the year 2020, the pressure originating from the agriculture grows and reaches the level of 1.3, creating the feedback effect on the rockets needed. Plus, the effect influences directly the rockets purchase rate, and with the new procurements the pressure is dropping. This pressure decrease is also because the modelled corruption is reducing due to other balancing loops.
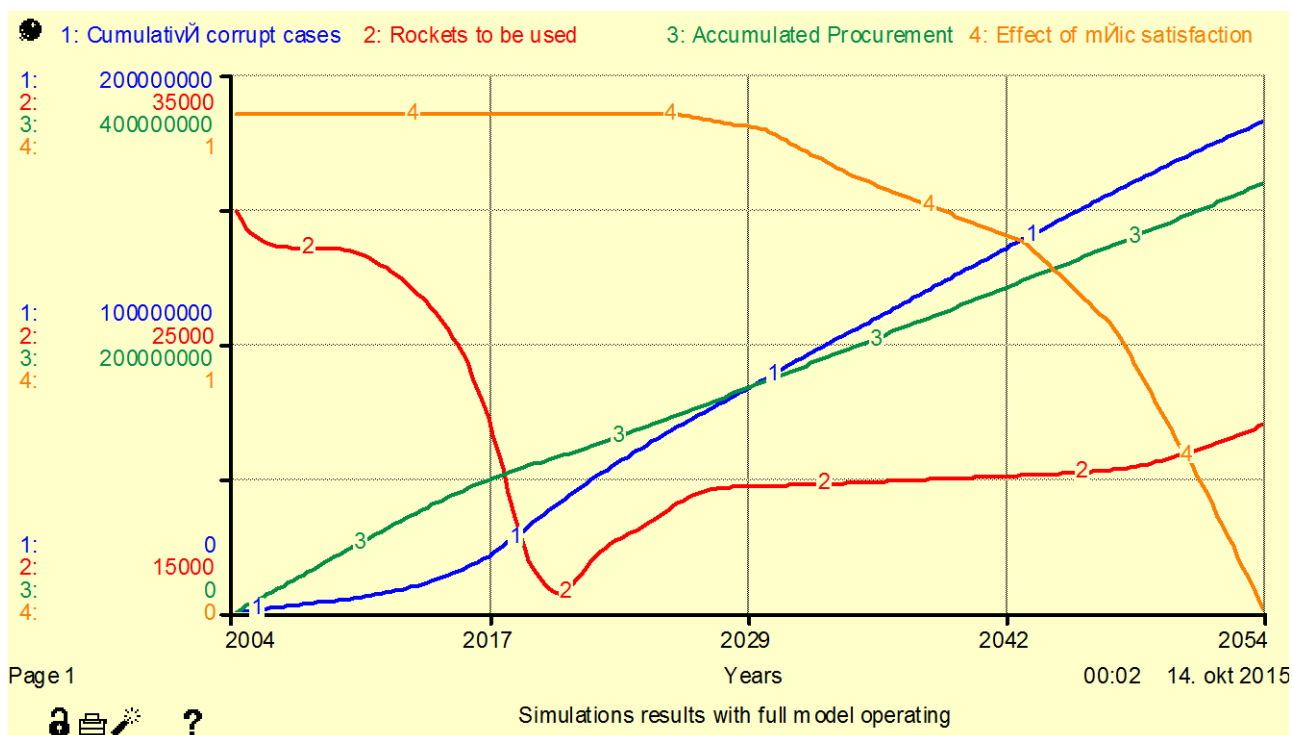

Figure 54 BoT Simulation result of the full model operating - major stocks

Although the counteractive loops certainly limit the behaviour and influence mental models of decision-makers, we are facing a situation that the inclination to corrupt further is still stronger that the limiting factors. Also, the reinforcing loops (in particular R1) are stronger and are shifting the dominance of the simulation model. With corruption in the system, the price paid reaches and stabilises at the level of 390 EUR per widget, which means the direct loss of at least 90 EUR per widget if not more.

The fact that the area remaining unprotected stabilises at the level of around 3.500.000 hectares should be a strong indicator to the government decision makers to consider either implementation of suggested policies, or even consideration of the implementation of the new methodologies, such as anti-hail nets of using planes to seed the clouds. On that way, the Effective area protected could increase from the retrieved result of the simulation stabled on the level of around 1.300.000 hectares.

Finally, the behaviour of different effects modelled and simulated in SD model are presented in Figure 55. Effect of Inclination to corrupt has "goal seeking" behaviour. Moreover, it does reach the level of one, meaning that the appetite for additional personal monetary gain raise with historical corruption practice (public bureaucrats get to be more greedy).
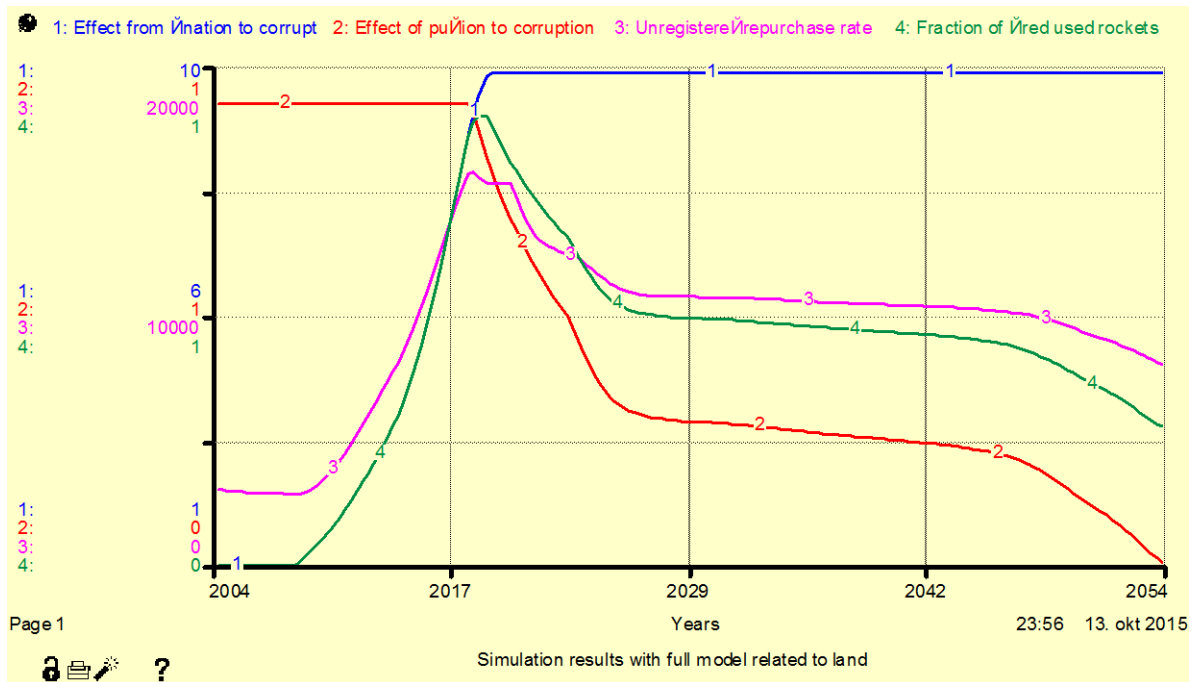

Figure 55 BoT simulation results of different effects

As per effect of public satisfaction to corruption, it is on the initial level in the first quarter of the simulated period. After this delay in perception of corruption, general public starts to be aware, then dissatisfied and finally begin putting some pressure on corruption practice in public procurement. That is the reason both fraction of unregistered usage of the rockets, and unregistered purchase rate in the begging have overshoot and collapse type of behaviour.

APPENDIX F: MODEL VARIABLES AND RELATED EQUATIONS

Accumulated_Dispersion (t) = Accumulated_Dispersion (t - dt) + (Direct_Public_funds_dispersion) * dt

INIT Accumulated_Dispersion = 0

UNITS: Euros (EUR)

INFLOWS:

Direct_Public_funds_dispersion = Procurement_value-Real_rocket_price*Rockets_purchase_rate

UNITS: EUR/yr

Accumulated_Procurement (t) = Accumulated_Procurement (t - dt) + (Procurement_value) * dt

INIT Accumulated_Procurement = 0

UNITS: Euros (EUR)

INFLOWS:

Procurement_value =
Standard_rocket_price*(rockets_purchase_rate+unregistered_rockets_repurchase_rate)

UNITS: EUR/yr

Cumulative_corruption_History_of_corrupt_cases (t) =
Cumulative_corruption_History_of_corrupt_cases (t - dt) + (Additions_to_cumulative_corruption) * dt

INIT Cumulative_corruption_History_of_corrupt_cases = 0

UNITS: Euros (EUR)

INFLOWS:

Additions_to_cumulative_corruption = unregistered_rocket_price *
Unregistered_rockets_repurchase_rate

UNITS: EUR/yr

Public_satisfaction (t) = Public_satisfaction (t - dt) + (Change_in_public_satisfaction) * dt

INIT Public_satisfaction = Initial_public_satisfaction

UNITS: Unitless

INFLOWS:

Change_in_public_satisfaction = (indicated_public_satisfaction - public_satisfaction) /
Time_to_adjust_public_satisfaction

UNITS: per year (1/yr)

Rockets_to_be_used (t) = Rockets_to_be_used (t - dt) + (Rockets_purchase_rate +
Unregistered_rockets_repurchase_rate - Rockets_usage_rate - Unregistered_rockets_usage) * dt

INIT Rockets_to_be_used = 30000

UNITS: widgets (widget)

INFLOWS:

Rockets_purchase_rate = MIN (Rockets_purchase_rate_indicated_by_agriculture, Rockets_purchase_rate_indicated_by_budget)

UNITS: widget/yr

Unregistered_rockets_repurchase_rate = MIN (Unregistered_rockets_to_be_smuggled, unregistered_rockets_repurchase_rate_indicated_by_budget)

UNITS: widget/yr

OUTFLOWS:

Rockets_usage_rate = rockets_to_be_used / rockets_usage_time - Unregistered_rockets_usage

UNITS: widget/yr

Unregistered_rockets_usage = rockets_to_be_used * Fraction_of_unregistered_used_rockets/Time_to_smuggle_rockets

UNITS: widget/yr

Unregistered_rockets_to_be_smuggled (t) = Unregistered_rockets_to_be_smuggled (t - dt) + (Unregistered_rockets_usage - Unregistered_rockets_repurchase_rate) * dt

INIT Unregistered_rockets_to_be_smuggled = 3000

UNITS: widgets (widget)

INFLOWS:

Unregistered_rockets_usage = rockets_to_be_used * Fraction_of_unregistered_used_rockets/Time_to_smuggle_rockets

UNITS: widget/yr

OUTFLOWS:

Unregistered_rockets_repurchase_rate = MIN (Unregistered_rockets_to_be_smuggled, unregistered_rockets_repurchase_rate_indicated_by_budget)

UNITS: widget/yr

Area_coverage_by_a_rocket = 160

UNITS: hectare/widget

Corruption_Switch = 0

UNITS: Unitless

Cumulative_corruption_threshold = 3600000

UNITS: Euros (EUR)

Desired_protected_land = 4800000

UNITS: hectares/year

Dispersion_Switch = 0

UNITS: Unitless

Effective_area_protected = Rockets_usage_rate * Area_coverage_by_a_rocket

UNITS: hectares/year

Effective_pressure = Pressure_Switch*Pressure_to_buy_more_rockets+ (1-Pressure_Switch)

UNITS: Unitless

Effect_from_cumulative_corruption_on_inclination_to_corrupt = GRAPH (Relative_cumulative_corruption)

(0.00, 1.00), (1.00, 1.00), (2.00, 2.35), (3.00, 3.48), (4.00, 4.78), (5.00, 6.13), (6.00, 7.43), (7.00, 8.56), (8.00, 9.42), (9.00, 9.91), (10.0, 9.91)

UNITS: Unitless

Effect_of_money_dispersion_on_public_satisfaction = GRAPH (Accumulated_dispersion/Threshold_money_dispersion*Dispersion_Switch + (1-Dispersion_Switch))

(0.00, 1.00), (0.25, 1.00), (0.5, 1.00), (0.75, 1.00), (1.00, 1.00), (1.25, 1.00), (1.50, 0.981), (1.75, 0.921), (2.00, 0.876), (2.25, 0.832), (2.50, 0.721), (2.75, 0.511), (3.00, 0.267)

UNITS: Unitless

Effect_of_public_satisfaction_on_inclination_to_corruption = GRAPH (public_satisfaction / Threshold_public_satisfaction *Public_Satisfaction_SWITCH + (1-Public_Satisfaction_SWITCH))

(0.00, 0.1), (0.0833, 0.1), (0.167, 0.1), (0.25, 0.5), (0.333, 0.7), (0.417, 0.8), (0.5, 0.9), (0.583, 1.00), (0.667, 1.00), (0.75, 1.00), (0.833, 1.00), (0.917, 1.00), (1.00, 1.00)

UNITS: Unitless

Effect_on_unregistered_price = GRAPH (Relative_cumulative_corruption)

(0.00, 1.00), (1.00, 1.00), (2.00, 1.01), (3.00, 1.03), (4.00, 1.07), (5.00, 1.12), (6.00, 1.17), (7.00, 1.23), (8.00, 1.28), (9.00, 1.30), (10.0, 1.30)

UNITS: Unitless

Fraction_of_unregistered_used_rockets = (Initial_inclination_to_corruption * Effect_of_public_satisfaction_on_inclination_to_corruption * effect_from_cumulative_corruption_on_inclination_to_corrupt)*Corruption_Switch

UNITS: Unitless

Indicated_public_satisfaction = MAX (Initial_public_satisfaction * relative_rockets_usage_effectiveness*Effect_of_money_dispersion_on_public_satisfaction, 0.2)

UNITS: Unitless

Initial_inclination_to_corruption = 0.1

UNITS: Unitless

Initial_public_satisfaction = 1

UNITS: Unitless

Min_acceptance_rockets_usage_effectivenss = 1

UNITS: Unitless

Pressure_Switch = 0

UNITS: Unitless

Pressure_to_buy_more_rockets = GRAPH (Relative_Area_remaining_unprotected)

(0.00, 1.00), (0.1, 1.00), (0.2, 1.00), (0.3, 1.00), (0.4, 1.04), (0.5, 1.06), (0.6, 1.13), (0.7, 1.16), (0.8, 1.30), (0.9, 1.30), (1.00, 1.30)

UNITS: widget/hectare

Price_Control = 0

UNITS: Unitless

Price_Switch = 0

UNITS: Unitless

Public_Satisfaction_SWITCH = 0

UNITS: Unitless

Real_rocket_price = 200

UNITS: Euros/widget

Relative_Area_remaining_unprotected = (Desired_protected_land-effective_area_protected)/Desired_protected_land

UNITS: Unitless

Relative_cumulative_corruption = Cumulative_corruption_History_of_corrupt_cases / Cumulative_corruption_threshold

UNITS: Unitless

Relative_rockets_usage_effectiveness = GRAPH (Rockets_usage_effectiveness / Min_acceptance_rockets_usage_effectivenss)

(0.00, 0.00), (0.125, 0.0702), (0.25, 0.221), (0.375, 0.359), (0.5, 0.546), (0.625, 0.741), (0.75, 0.928), (0.875, 1.00), (1.00, 1.00), (1.13, 1.00), (1.25, 1.00), (1.38, 1.00), (1.50, 1.00)

UNITS: Unitless

Rockets_purchase_budget = 6000000

UNITS: EUR/year

Rockets_purchase_rate_indicated_by_agriculture = (Desired_protected_land)/ Area_coverage_by_a_rocket *Effective_pressure

UNITS: widget/yr

Rockets_purchase_rate_indicated_by_budget = MAX ((Rockets_purchase_budget - Unregistered_rockets_repurchase_rate * unregistered_rocket_price) / Real_rocket_price, 0)

UNITS: widget/yr

Rockets_usage_effectiveness = Effective_area_protected / Desired_protected_land

UNITS: Unitless

Rockets_usage_time = 1

UNITS: years (yr)

Standard_rocket_price = 300

UNITS: Euros/widget

Threshold_money_dispersion = 70000000

UNITS: Euros (EUR)

Threshold_public_satisfaction = 1

UNITS: Unitless

Time_to_adjust_public_satisfaction = 5

UNITS: years (yr)

Time_to_repurchase = 1

UNITS: years (yr)

Time_to_smuggle = 1

UNITS: years (yr)

Unregistered_rockets_repurchase_rate_indicated_by_budget = Rockets_purchase_budget / unregistered_rocket_price

UNITS: widget/yr

Unregistered_rocket_price = (Standard_rocket_price*effect_on_unregistered_price*Price_Switch+Standard_rocket_price*(1-Price_Switch))*(1-Price_Control) + Price_Control*200

UNITS: Euros/widget