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Intelligent modeling of e-Government initiatives in Greece

Diomidis Spinellis, Athanasia Pouloudi,
George Xirogiannis, Evmorfia Makantasi

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

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Intelligent modeling of e-Government initiatives in Greece

Diomidis Spinellis[1], Athanasia (Nancy) Pouloudi[2], George Xirogiannis[3] and Evmorfia (Fay) Makantasi[4]

ABSTRACT

Over the last two years Greece has employed agile ICT solutions to reduce the administrative burden in front-office G2B transactions. This research supplements historic analysis with fuzzy cognitive maps to offer a multi-dimensional coupling of eGovernment initiatives with digital maturity assessment capabilities and a strategy alignment evaluation framework. This "intelligent x-ray" confirms that front-office technology is important in reducing administrative burden. The digital bypass of bureaucracy seems to be an effective start for Greece. However, this strategy can only serve as a short-term tactical choice. The "intelligent x-ray" provides executive-level quantification and traceable reasoning to show that excessive emphasis on front- office technology will soon fail to support a strong eGovernment maturity. Organizational efficiency, interoperability, regulatory simplifications, and change management must also act as important objectives. Only then will ICT deliver its full potential, and the eGovernment maturity will improve significantly even with moderate ICT investments.

Keywords: fuzzy cognitive maps, eGovernment strategy, digital maturity, evidence-based policy

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1.1 Project objective

Over the last two years Greece has employed agile ICT solutions to reduce the G2C (government to citizen) bureaucracy mainly in front-office transactions. Simple but very effective web applications have digitalized G2C services which used to ask for physical presence, proof of authenticity, submission of documents, one-step approval, etc. It is only fair to say that the covid-19 era accelerated eGov (electronic / digital government) solutions which aimed at offering urgent assistance to citizens and enterprises, like the covid-19 vaccine scheduling, the covid-19 state-aid allocation, the NSRF state-aid allocation, the state-aid allocation due to extra-ordinary physical phenomena, the electronic medical prescriptions, the electronic certificates, etc.

Such applications do not re-engineer in depth the bureaucratic public sector processes, nor do they focus on services with multiple approval steps and extensive organizational interoperability. However, the digital bypass of front-desk bureaucracy seems effective for the time being. Moreover, it is well-received by citizens.

Despite the recent eGov success, Greece traditionally lacks a long-term e-Government (eGov) strategy, with initiatives revised every 2-3 years. eGov strategies usually compile lists of ICT projects, rather than coordinated reforms. Process re-engineering is poorly designed and executed, while legislation and regulations usually constraint paperless transactions. Despite the successful recent steps and the accelerated digitalization during the covid-19 era, public administration still offers costly and time-consuming services to enterprises with reduced transparency.

This research aims to contribute in addressing such well-documented problems like those in references [1-3]. **It aims to augment historic data analysis with soft artificial intelligence soft tools to model the multi-dimensional causal relations in such complex reforms.** Strategy and projects are modelled together with stakeholder needs, process changes, regulatory constraints, procurement tactics, reform coordination, etc to set up a comprehensive "intelligent" x-ray of eGov. The predictive capabilities of this evidence-based model are utilized to identify gaps and compare comprehensive "what-if" scenarios. Cyclical relations which exist widely in such complex environments are modelled as well using feedback loops. The interdisciplinary research concludes with realistic policy recommendations on how to implement eGov reforms in Greece.

This research focuses on the G2B (government to business) services. eGov initiatives tend to prioritize G2C (government to citizen) services but neglect the substantial impact of G2B services on growth. Building on a comprehensive understanding of the status of eGov in Greece, this research proposes a methodology for moving towards effective eGov strategy.

1.2 Content and progress

Part A of the report focuses on documenting the current maturity status of eGov in Greece, with emphasis on G2B services. The first part reviews ICT initiatives and eGov projects and presents an overview of the administrative burden imposed on G2B transactions as well on ICT procurement. It also utilizes key performance indicators (KPIs) to quantify the gap with EU practices. While analysis of KPIs may offer insight of the state of play, the objective of the first part of the research is to comprehend the multi-dimensional causal relations in complex initiatives and identify their impact on digital maturity. Hence, KPIs are analyzed up to the point they contribute to setting up a comprehensive x-ray of eGov.

This research does not underestimate in any way the progress of eGov over the last two years. However, instead of benchmarking the current digital maturity of Greece with its poor past, this research compares the current digital maturity of Greece with that of other EU leaders. This report consists of the following chapters.

- Chapter 1 and chapter 2 offer a short introduction to the project and this report.
- Chapter 3 provides an overview of the digital maturity in Greece. It introduces the various pillars the digital agenda and briefly compares its performance with EU standards.
- Chapter 4 presents the state of play of eGov maturity. It dives deeper into specific eGov characteristics like regulatory environment and ICT effectiveness in the public sector. Also, it presents significant cases of regulatory burden imposed by current G2B services.
- Chapter 5 presents the state of play of eGov projects. It starts with an overview of eGov initiatives since 2014 but focuses on the progress of key ICT projects in the public sector. Emphasis is in G2B projects

only. This chapter also introduces problems associated with ICT projects like lack of process re-engineering and public procurement burden.

- Chapter 6 presents an overview of eGov projects in the EU. Its objective is to identify best practices which have resolved problems like regulatory simplification prior to digitalization or how eGov services can comply with contemporary digital standards. A comprehensive report of eGov projects in the EU falls outside the scope of this project.

Part B of the report focuses on mapping, analyzing, and assessing eGov maturity using intelligent modeling tools. The "intelligent" x-ray augments data analysis with fuzzy cognitive maps (FCMs) to model the multi-dimensional causal relations between strategy objectives, technology, stakeholder needs, operational changes, regulatory constraints, procurement tactics, and reform coordination. Also, this x-ray couples typical eGov strategy methodologies with maturity assessment capabilities and a strategy alignment evaluation framework. This report consists of the following chapters:

- Chapter 7 gives an overview of the intelligent characteristics and the functionality of FCMs which will be utilized in this project.
- Chapter 8 introduces an intelligent framework which assesses the strategic alignment of eGov projects. This framework couples a typical eGov strategy methodology with the FCM functionality to provide an eGov maturity evaluation with intelligent characteristics. This framework is the basis for a comprehensive x-ray of eGov projects in Greece.
- Chapter 9 presents in depth the FCM deployment by migrating key findings of the previous chapters into an intelligent causal model. This deployment is a fully functional x-ray of G2B eGov projects in Greece. It consists of more than 60 maturity concepts spanning across eight (8) maturity maps and a three-level hierarchy and feedback loops. This chapter presents "what-if" scenarios and discusses the output of the FCM calculations.
- Chapter 10 presents realistic policy recommendations to expedite eGov projects.
- Chapter 11 summarizes this project.
- The annex and the bibliography of the research conclude the report.

Regarding the progress of the project the following should be considered:

1. Tasks progressed according to plan.
2. Covid-19 has disrupted most interactions with public sector administration. The project team reached out to the administration to contact interviews and collect information. They have offered reports and provided some guidance, but they have been largely unavailable to investigate into additional requests from the team. This disruption did not affect the content extracted from third-party data bases. However, this disruption has limited any insight or counter arguments by the public sector administration. While the research team presents facts and findings with a firm objectivity, it is fair to say that some insight from the public sector may be missing.
3. The research team faced similar problems with private sector experts. Video-conference applications were used to remedy this problem. Also, the team utilized views and input given by experts during previous workshops organized either by diaNEOsis or SEV Hellenic Federation of Enterprises.

2. Project summary

2.1 Key findings

Over the last two years Greece has employed agile ICT solutions to reduce red tape in front office transactions. Simple but very effective web applications have digitalized eGov services which used to ask for physical presence, proof of authenticity, submission of documents, one-step approval, etc. It is only fair to say that the covid-19 era accelerated eGov solutions. This research does not underestimate in any way this progress. **However, instead of benchmarking the current digital maturity of Greece with its poor past, this research compares the current digital maturity of Greece with that of other EU leaders**. In comparison to EU practices, eGov digital maturity does not seem to improve with the same pace.

The key findings of the first part of the research indicate that:

- **Greece still lags the EU-28 average performance** in many dimensions of digital maturity. Recent reforms are on the right direction, but they need to give additional emphasis on G2B transactions.
- **Regulations and the organizational structures of the public sector fail to support eGov maturity.** The regulatory environment for digital delivery and well as the organizational efficiency stagnate for many years. Recent reforms focus on front-desk transactions to offer quick-wins; however, eGov does not cater for drastic regulatory and operational simplifications to reduce the digital complexity.
- **Public sector interoperability remains low,** as a result eGov does not utilize ICT efficiently.
- **eGov service utilization remain low** (until recently) mainly due to the large number of G2B transactions lacking a single point of entry and interoperability between registries. Access to G2B services remain complex in many cases with few digital documents and interfaces which fail to comply with the "fill-in once only" and "digital-by-default" principles.
- **Usability converges with EU standards**. Similar trend is documented with the number of new G2B services and the access from mobile / portable devices.
- **The recent L.4782/2021 legislation for public procurement**, seeks to simplify and reform the regulatory framework for public procurement, based on observations made by many stakeholders, including business, economic and social actors.
- **Best practices from other EU countries** indicate that (a) effective use of state-of-the-art ICT can reduce administrative burden in front-office transactions but only to a certain extend (b) operational, regulatory and technology coupling is mandatory to increase eGov maturity significantly (c) digital by default process design results to increased utilization of G2B services.
- **Until recently, eGov strategy in Greece remained** largely fragmented, with a short implementation horizon and guided by benefits within the short ministerial lifespan. On the other hand, the interest for well-established digital G2C / G2B services remained was weak.
- **There has been a significant revival of eGov activity during the covid-19 era**, due to the apparent difficulties for physical transactions. Additionally, the mindset of the current administration expedites changes in public sector services.

Regarding eGov strategy, the key findings of the second part of the research indicate the following:

Positive eGov strategy choices:

- **ICT investments play indeed an important role to eGov maturity**. Even without an FCM-based methodology, it is easy to realize that simple, small scale but effective ICT projects improved the eGov services in the last two years, after a long period of eGov maturity stagnation.
- **Focus on front-office ICT**. Investments on new ICT infrastructure currently focus heavily on providing services currently without digitalization. The eGov strategy adopts an incremental use of ICT with agile implementations and focus on quick wins. Such objectives increase the eGov maturity in Greece which has remained stagnated for years. While this approach gives tangible benefits in G2C transactions, it may not have the same results on G2B services.

- **The efficient delivery of G2B services also has a positive impact on eGov maturity**. The eGov strategy should maintain its focus on services designed digital by default, with suitable e-channel usability, transparency, and increased availability.

Strategy update proposals

- **A moderate simplification of eGov regulatory environment improves eGov maturity without excessive technology investments.** Regulatory simplification has not matched at all the pace and momentum of G2B digitalization. This has resulted to significant ICT effort but with stagnated results. For ICT investments to impact fully on eGov maturity, the current eGov strategy mix should be updated to give additional focus on operational and regulatory changes. Even a moderate update in the strategy mix can achieve further increases on eGov maturity.
- **Timely implementation of public policies** that reduce red tape can have a major positive impact on eGov maturity. Hence, the eGov strategy must couple them effectively with new ICT.
- **Operational and process changes must accompany eGov projects to realize the benefits of new ICT infrastructure.** Excessive technology investments are not the proper strategy choice for improving eGov maturity. The eGov strategy must shift focus to remedy long standing regulatory and organizational problems like cross functional silos and conflicting regulations. This will allow ICT infrastructure to couple with operational efficiency and have an additional impact on eGov maturity. Also, the current strategy mix should **stop interpreting new ICT as applications for internal use**.
- **Contemporary G2B services should rely on extensive ICT interoperability**. Additionally, to regulatory changes, the eGov strategy must give strong emphasis on ICT interoperability.
- **Proper change management and migration planning must be integral to complex ICT reforms**. New ICT infrastructure significantly increases the need for effective change management and efficient migration of physical G2B services to digital. The overall eGov maturity will increase if the strategy mix caters for efficient change management and migration planning.
- **Last, but not least, the eGov maturity should not be restricted by changes in front-desk transactions**. A comprehensive strategy setting should allow for any necessary process simplification to roll out along with red tape elimination. In practice, in addition to new ICT infrastructure, the eGov strategy should set administrative burden reduction, organizational efficiency, regulatory simplifications, and service delivery as important eGov objectives as well.

Summarizing, the intelligent x-ray of eGov in Greece indicates that technology plays an important role to eGov maturity, especially in reducing the administrative burden in front-desk transactions. However, such applications do not re-engineer in depth the bureaucratic public sector processes, nor do they focus on services with multiple approval steps and extensive organizational interoperability.

The digital bypass of the bureaucracy associated with physical presence seems to be an effective start. But, under the current eGov strategy mix, front-office technology on its own will soon fail to support a strong eGov maturity. The intelligent modeling indicates that the emphasis on red tape reduction through ICT can only lead to “positively medium” maturity improvement on its own. Hence, any excessive ICT investments of such type are not the proper strategy choice for the medium-term. This emphasis can only serve as a short-term tactical objective.

If the strategy mix sets the organizational efficiency, the interoperability, the regulatory simplifications, and the service delivery as important objectives (along with front-office ICT), then ICT will deliver its full potential, and the eGov maturity will improve significantly.

The updated strategy mix may come at an intuitive recommendation from field experts. **However, the intelligent modeling provides executive-level quantification and traceable reasoning to all policy recommendations. This allows policy makers to change elements of their strategy based on evidence rather than intuition alone.**

The second part also offers the following interesting meta-findings regarding the application of FCMs in modeling "intelligently" eGov in Greece.

- **The intelligent modeling couples effectively** a typical eGov strategy methodology with an eGov maturity evaluation framework. This modeling goes beyond a hierarchical strategy break-down and introduces multi-dimensional relations between objectives, actions, implementation tactics, managerial levels.
- **FCMs effectively supplement the eGov strategy scheme with an alignment evaluation framework.** More than sixty FCM concepts, three hierarchies, eight maturity maps and several multi-dimensional feedback loops can provide an effective x-ray of eGov projects in Greece. Loops between metrics of any level of the FCM hierarchy generate a comprehensive impact assessment simulation as well as a strategy alignment evaluation tool. The alignment evaluation identifies (a) to what extend eGov projects in Greece adopt comprehensive strategy roadmap (b) which elements of the strategy are neglected (c) what is their impact on eGov maturity. The impact quantification and visualization utilize fuzzy variables and calculations to support strategy decisions at an executive level.
- **Scenario building and evidence-based evaluation** support policy recommendations for effective eGov initiatives. The soft artificial intelligence modeling and the predictive capabilities of this deployment identify gaps and compare comprehensive "what-if" scenarios. The scenarios quantify the impact of technology, operational and regulatory characteristics to the overall eGov maturity using fuzzy variables.
- **The intelligent x-ray benefits two groups of stakeholders** in particular (a) senior government officials by providing rapid identification of significant gaps in the strategy, risks, opportunity areas and change management challenges which drive the upgrade of G2B services (b) eGov digital transformation management by providing insights on how to manage ICT implementation, improve the probability of success and mitigate risk.

2.2 Key policy recommendation

The intelligent x-ray of eGov in Greece confirms that technology plays an important role to eGov maturity, especially in reducing the administrative burden in front-desk transactions. However, under the current eGov strategy mix, front-office technology on its own fails to support a strong eGov maturity increase. This is true regardless of budget availability and technology characteristics. The emphasis on red tape reduction through ICT should remain is a key objective however it leads to "positively medium" maturity improvement only. Hence, this emphasis should only serve as a short-term tactical objective.

The intelligent modelling proposes and quantifies an updated strategy mix. If the organizational efficiency, the interoperability, the regulatory simplifications, and the service delivery are set as important objectives (along with front-office ICT), then ICT delivers its full potential, and the eGov maturity improves significantly. In addition to the updated strategy mix, the modeling brings forward the importance of project and change management which bind together ICT with process re-engineering, leadership, and operational efficiency. The modeling quantifies the impact of those two elements in complex digital transformation projects using fuzzy variables and calculations as well.

2.3 Research novelty

As far as research novelty is concerned, the following should be highlighted:

- **Past eGov performance and maturity benchmarking** are largely based on existing reports, and publicly available databases. This project has focused on isolating eGov KPIs that relate to G2B services, has presented their historic trendline and has reached conclusions on how other EU countries have approached similar projects.
- **The intelligent modelling approach of eGov adopted by this research is novel**. This research goes beyond the utilization of FCMs. It offers a multi-dimensional coupling of an eGov strategy methodology with maturity assessment capabilities and a strategy alignment evaluation framework. This coupling supplements the hierarchical strategy break-down with feedback loops between objectives, actions, implementation tactics and managerial levels.

- **This coupling offers new ways to support evidence-based executive decisions with quantifiable objectives and actions.** This intelligent modeling provides executive-level quantification and traceable reasoning to all policy recommendations. The approach offered by this research uses soft artificial intelligence tools to significantly reduce the overhead of complex process simulations or cost / benefit calculations. Instead, this approach quantifies strategy decisions using fuzzy linguistic variables and predicts their impact using fuzzy calculations. This approach upgrades the intuitive strategy choices into quantifiable objectives and roadmap. The fuzzy quantification algorithm offers traceable outputs which address most executive-level "what-if" questions effectively. This allows policy makers to change elements of their strategy based on evidence rather than intuition alone.
- **The utilization of FCMs to model eGov projects is also an interesting output of this research**. FCMs have been known to support organizational reengineering, e-business transformation, or government policymaking. But their combined use appears contemporary. Moreover, this research provides an intelligent and effective x-ray of eGov in Greece which builds on actual eGov indicators and projects.

3. Digital maturity in Greece: An overview

3.1 Introduction

Chapter 3 presents an overview of the digital maturity in Greece with focus on Government to Business (G2B) transactions. It introduces the various pillars of the digital agenda and briefly compares its performance with EU standards. This research does not underestimate in any way the progress of eGov over the last two years. However, instead of benchmarking the current digital maturity of Greece with its poor past, this research compares the current digital maturity of Greece with that of other EU leaders.

Sections 3.2 and 3.3 analyze an extensive set of digital maturity indicators, available from public domain databases. It is important to note that most EU databases with indicators for EU countries span back in time until 2015. Reliable and comprehensive information exists from 2017 onwards. Greece does not maintain local databases with such indicators.

Sections 3.4 and 3.5 comment on the overall digital maturity in Greece versus other EU countries. Section 3.6 summarizes the key findings of chapter 3.

The findings of this chapter are based on information available until March 2021.

3.2 Digital maturity databases

There is a range of digital maturity indicators for EU countries. Figure 1 indicates a list of popular databases, maintained annually. Most databases with indicators for EU countries span back in time until 2015. Reliable and comprehensive information exists from 2017 onwards. Greece does not maintain local databases with such indicators.

Maturity index	Publisher
DESI	EU
Digital Transformation Scoreboard	EU
Global Competitiveness Index 4.0	World Economic Forum
Global Competitiveness Index	World Economic Forum
World Digital Competitiveness Rankings	IMD Business School
Networked Readiness Index	World Economic Forum
Digital Economy Outlook	OECD
European Innovation Scoreboard	EU
Global Entrepreneurship Monitor Global Report	Global Entrepreneurship Monitor
e-Government Benchmark Report	EU
Open Data Barometer	WWW Foundation
Digital Economy & Society Database	Eurostat
Measures of Skills Database	Eurostat
Intellectual Property Rights Database	Eurostat
Digital Maturity Index (DMI)	SEV

Figure 1: Sample list of digital maturity indices

DMI [4, 5] developed by SEV and Deloitte offers a comprehensive view of digital evolution in Greece versus EU. It interrelates KPIs from several other knowledge sources including DESI, WEF, Eurostat, etc and compares each KPI with other best practices available in the EU. Currently, it consists of four levels of hierarchical indicators with bottom-up aggregation using the min-max aggregation model. DMI hierarchies are as follows:

- **Maturity indicators (level 4)**. DMI considers more than 120 indicators from various public domain sources. Analysis and definition of level indicators in appendix.
- **Maturity groups (level 3).** Indicators of similar context are aggregated to provide intermediate sets of digital maturity. Sets are flexible and can easily adapt to available knowledge.
- **Maturity categories (level 2).** Groups are aggregated into seven maturity areas, namely ICT sector (business as ICT providers), Infrastructure, Business as ICT users, Regulations, Society as ICT users, Skills and e-Government (eGov). These seven areas are fixed. They provide a balanced mix of lead and lag maturity as well as a balanced mix of cause-and-effect categories. Also, they can visualize the of gaps in digital maturity at various levels of detail, from strategy to technical information.
- **DMI score (level 1).** All seven maturity areas are aggregated into two numbers, namely maturity score and ranking. Ranking indicates the comparative position of each country versus other EU countries. Score is the absolute value of all aggregated indicators.

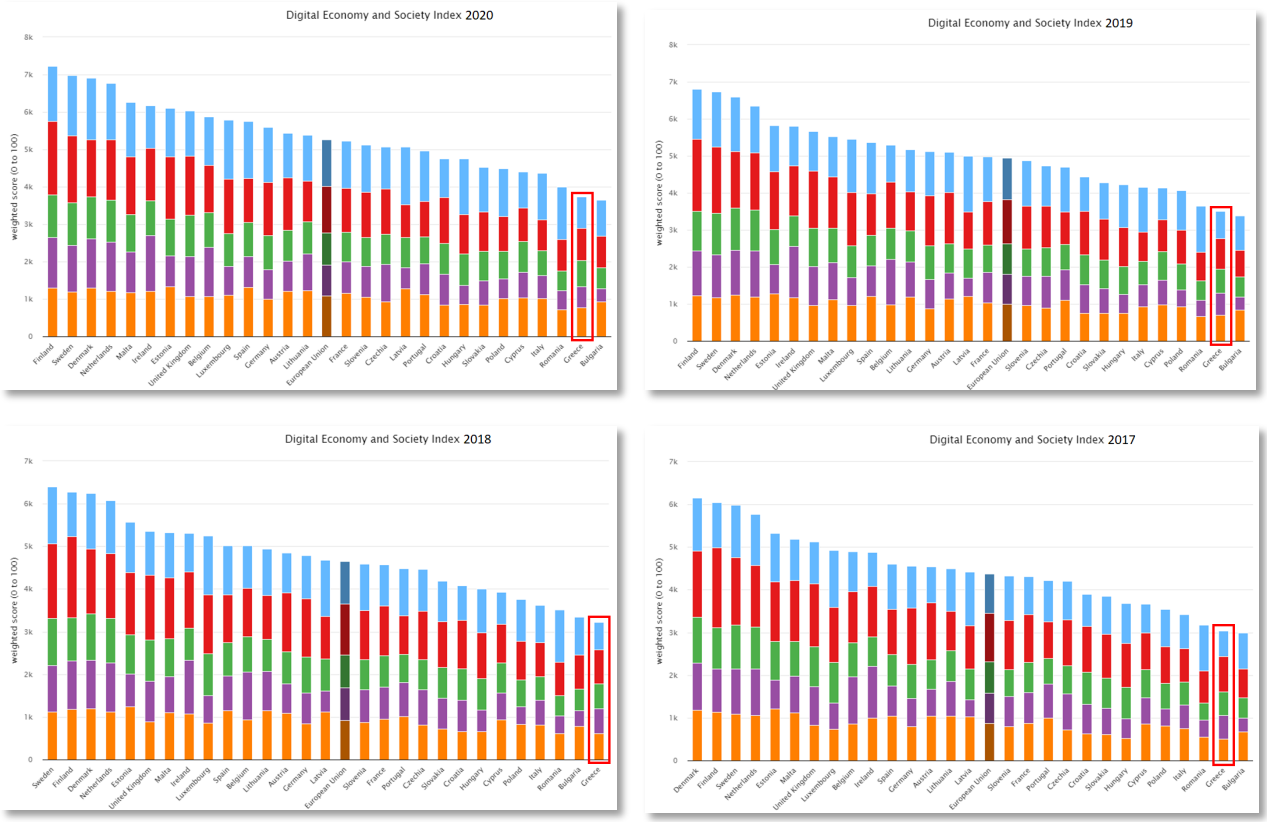
This report utilizes DMI as the main source of identifying digital maturity in Greece for 2017, 2018 and 2019, published in 2019 and 2020, respectively. At the time this report was compiled, DMI for 2020 is still under development.

This project focuses on two key categories, namely eGov digital maturity and regulatory environment. The two categories with their constituent KPIs, cover key aspects of G2B services such as back-office digitalization (public sector as a user of ICT), digital interactions (public sector as a service provider and business as a service user), regulations that govern digital operations (eGov administrative cost), etc.

In addition to its comprehensive nature, the DMI hierarchy is fully consistent with the intelligent tools this research will utilize. For example, the Fuzzy Cognitive Maps definition and intelligent reasoning also build on multi-dimensional and hierarchical causal relationships.

3.3 Overview of digital maturity 2015 – 2017

The evolution of DESI [6-8] from 2015 to 2020 (Figure 2), reveals the extremely low digital maturity of Greece. Despite the increase in the overall score, Greece permanently ranks at the last two positions in the EU, along with Romania and Bulgaria, indicating mediocre improvement compared to other European countries.



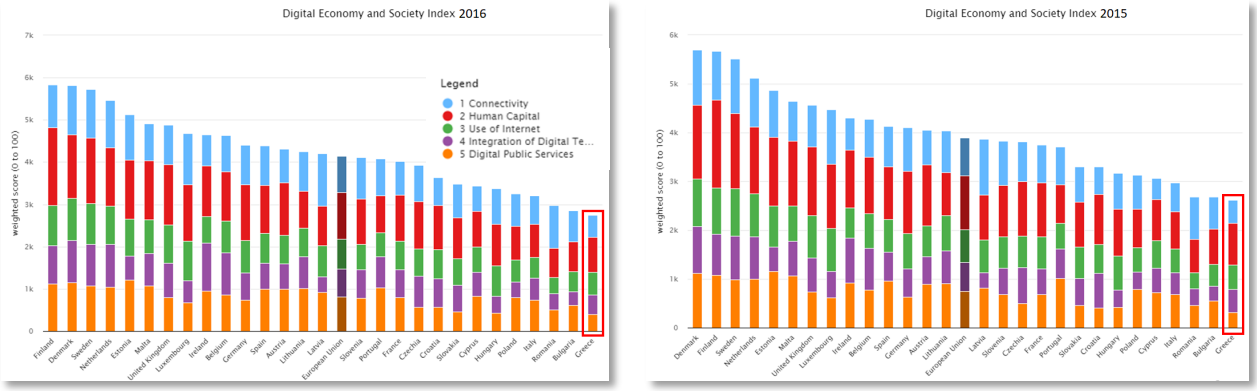


Figure 2: DESI 2015-2020 in the EU, , based on public information

Greece has progressed marginally in all pillars namely connectivity, human capital, use of internet, integration of digital technologies and digital public services (Figure 3a). Regarding Digital Public Services Greece ranks 27th in 2019 (report published in 2020). Despite the progress, digital public services fail to compete with the progress achieved in most EU countries. For example:

- The **provision of online public services** (pre-filled forms) continued to progress (from 7 in 2015 to 25 in 2020), but with a significant gap versus EU (59 forms).
- Similarly, there is progress regarding the **provision of digital G2B public services** (from 29 in 2015 to 63 in 2020 vs 88 in EU).
- A significant gap and backtracking regarding the percentage of **active users** of e-government services is evident (from 44% in 2015 to 39% in 2020 vs 67% in EU).
- The **online service completion** achieves a score very close to EU average (from 48 in 2015 to 84 in 2020 vs 90 in EU).
- **Open data maturity** is probably the best eGov performance. It scores the EU average, 66% in 2020 (the index is not available for previous years).

Greece continuously lags Europe in many eGov indicators, since its digitalization does not utilize best-of-breed technologies (or even better technologies) but outdated ones in comparison to EU (Figure 3b).

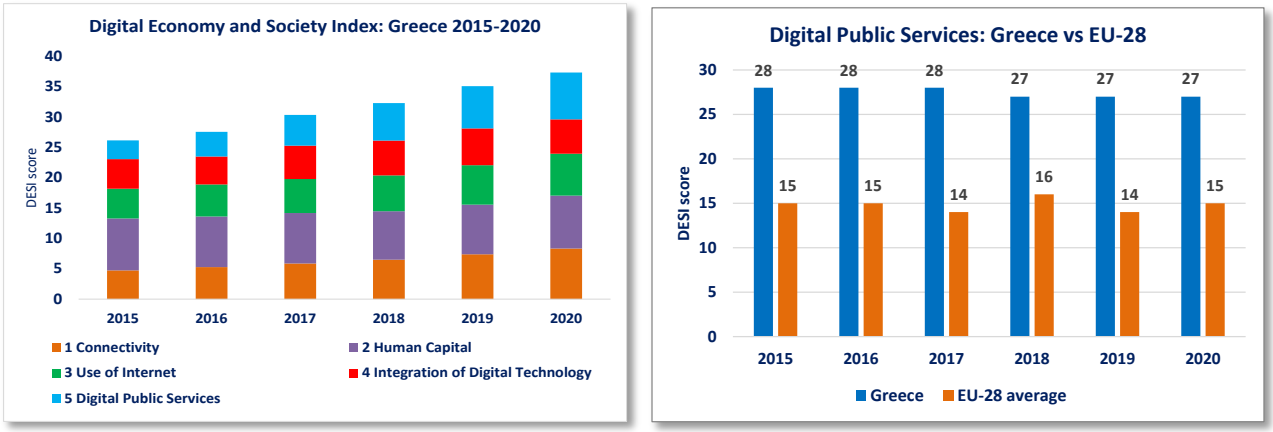


Figure 3: DESI 2015-2020 in Greece, , based on public information

On the other hand, Greece achieves marginal improvement in Human Capital, Use of Internet, and Integration of Digital Technology (25th, 25th and 24th place respectively in 2019). As a result, the overall deviation from EU standards is still evident (41% less that EU average). The digital gap in eGov remains significant (28% less that EU average), although it follows a convergence trend (Figure 4).

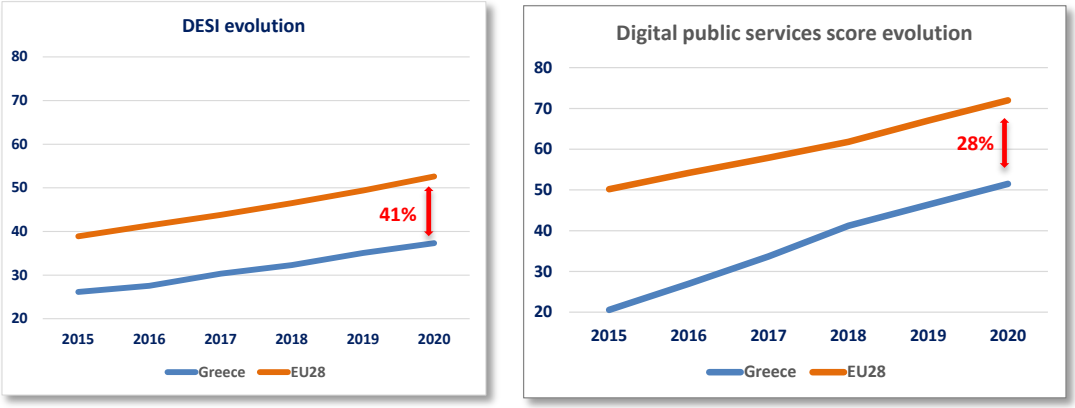


Figure 4: Digital maturity gap in Greece, 2015-2019 (published in 2016-2020), , based on public information

3.4 Overview of digital maturity 2017 – 2018 (DMI)

Greece traditionally lacks digital maturity in all dimensions as recorded in many KPIs in DMI [4, 5]. Some moderate scores are traditionally achieved in digital skills, digital business maturity and society digital maturity. However, most indicators lag EU average scores. A comprehensive overview (category level) of digital maturity in Greece as well as a direct comparison to EU best practices is presented in Figure 5.

1. ICT & High Technology

	2018	2017
Score	2,7	2,6
Ranking	28/28	28/28
E.U. Average	3,7	3,7
Better performance	IE 5,6	IE 5,5

2. Connectivity Infrastructure

	2018	2017
Score	4,0	3,7
Ranking	28/28	28/28
E.U. Average	6,0	5,6
Better performance	NL 7,5	NL 7,2

5. Digital Business Maturity

	2018	2017
Score	3,3	3,4
Ranking	26/28	24/28
E.U. Average	4,4	4,4
Better performance	DK 5,8	SE 5,6

3. Policies & Regulatory Framework

	2018	2017
Score	3,6	3,3
Ranking	27/28	28/28
E.U. Average	5,7	5,7
Better performance	LU 8,3	LU 8,4

6. Digital Society Maturity

	2018	2017
Score	3,5	3,4
Ranking	26/28	26/28
E.U. Average	5,1	4,8
Better performance	UK 7,2	UK 7,2

4. Digital Skills

	2018	2017
Score	4,8	5,0
Ranking	25/28	23/28
E.U. Average	5,6	5,5
Better performance	FI 7,2	FI 7,2

7. Public Sector Digital Maturity

	2018	2017
Score	4,3	3,9
Ranking	28/28	28/28
E.U. Average	6,0	5,9
Better performance	NL 7,9	DK 8,1

Figure 5: Level 1 digital maturity performance in Greece, 2017 – 2018, as presented in references [4, 5], based on public information

Greece lags the EU-28 average performance in all dimensions of DMI. In most of them Greece occupies a poor position. However, eGovernment (eGov) and Regulatory groups of indicators are the primary concern of this project. In eGov digital maturity Greece ranks in 28th in EU-18 similarly to the Regulations group of indicators. Denmark (DK), the Netherlands (NL) and Luxemburg (LU) out-perform all other EU countries on those two categories.

Figure 6 analyzes further the maturity categories of DMI in Greece, as compared to EU average scores and best practices.

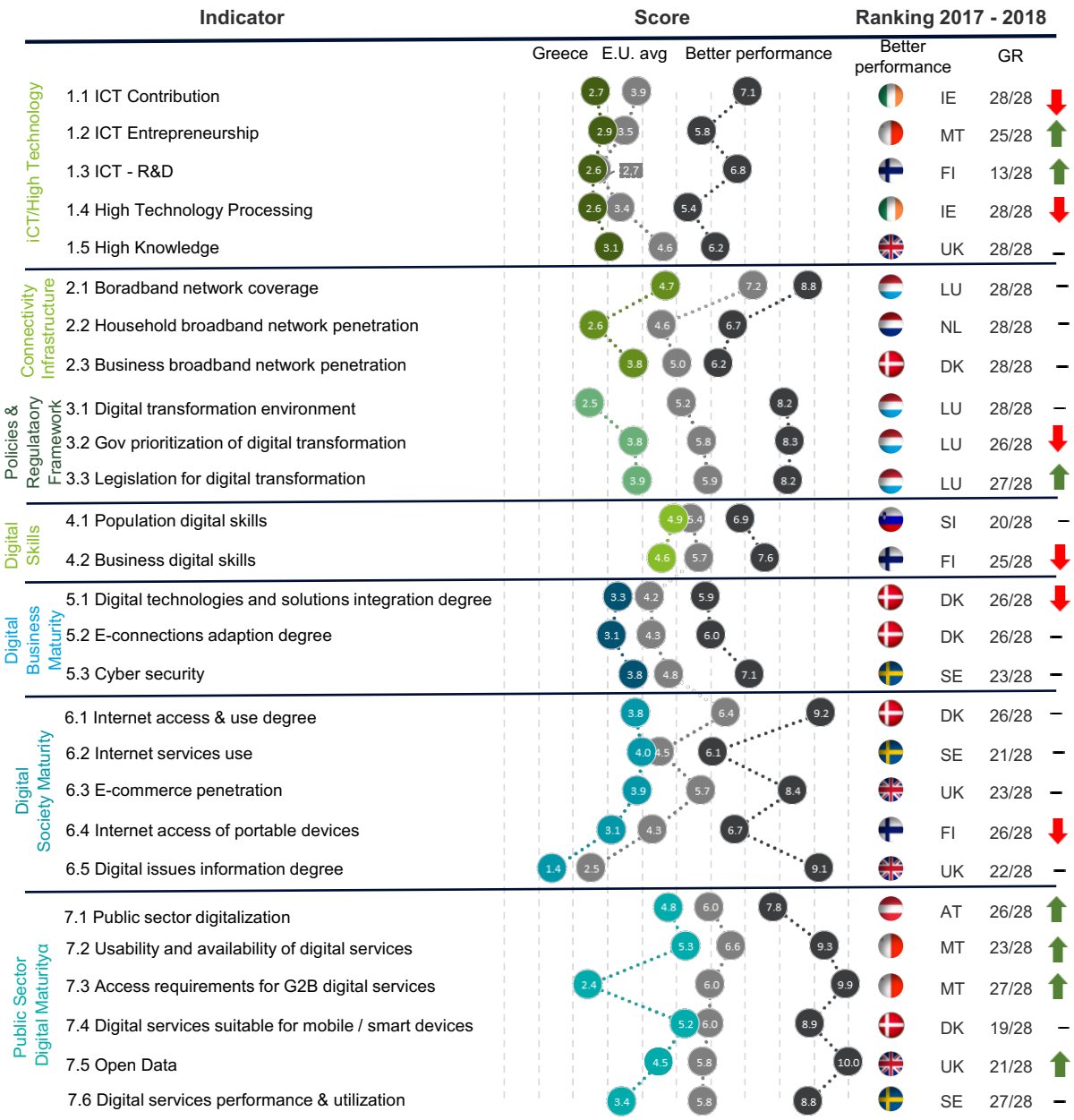


Figure 6: Level 2 digital maturity in Greece, DMI, 2017 – 2018, as presented in references [4, 5], based on public information

The evolution of 27 digital maturity indicators since 2017 shows the following results.

- **Performance deteriorated** in six groups, namely 1.1 ICT Contribution, 1.4 High Technology Processing, 3.2 Government prioritization of digital transformation, 4.2 Business digital skills, 5.1 Digital technologies and solutions integration degree, 6.4 Internet access of portable devices.
- **Performance improved marginally in seven groups**, namely 1.2 ICT Entrepreneurship, 1.3 ICT - R&D, 2.3 Business broadband network penetration, 7.1 Digitalization of public sector operations, 7.2 Usability and availability of digital services, 7.3 Access requirements for G2B digital services, 7.5 Open Data. eGov (groups 7.1 – 7.6) show resilience and drive such improvements, however eGov still ranks well below EU average. Austria (AT), Malta (MT), Denmark (DK), UK and Sweden (SE) lead the eGov initiatives in the EU
- **Performance stagnated** in half of the DMI indicators.

3.5 *Overview of digital maturity 2019 (DMI)*

Greece once again improved marginally its digital performance from the 28th place to 27th in EU-28 (Figure 7). eGov maturity is the main driver of change, improving its performance by four places (24th place in 2019 vs 28th place in 2018 vs 28th place in 2017). However, Greece still lags EU average performance all categories.

In addition to eGov, the Regulations group dropped to the 28th place (versus 27th in 2018 versus 28th in 2017). Finland (FI) outperforms Denmark (DK) but together with the Netherlands (NL) and Luxemburg (LU) they lead digital maturity in the EU.

1. ICT & High Technology

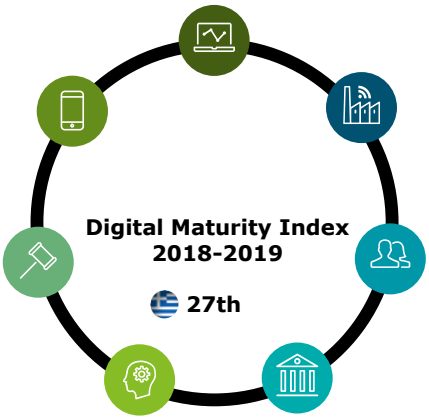
	2019	2018
Score	2,7	2,7
Ranking	28/28	28/28
E.U. Average	3,7	3,7
Better performance	IE 2,7	IE 5,6

2. Connectivity Infrastructure

	2019	2018
Score	4,1	3,8
Ranking	28/28	28/28
E.U. Average	5,9	5,6
Better performance	DK 4,1	NL 7,5

5. Digital Business Maturity

	2019	2018
Score	3,5	3,5
Ranking	25/28	25/28
E.U. Average	4,7	4,6
Better performance	DK 3,5	DK 5,8



3. Policies & Regulatory Framework

	2019	2018
Score	3,3	3,5
Ranking	28/28	27/28
E.U. Average	5,8	5,7
Better perfromance	LU 3,3	LU 8,3

6. Digital Society Maturity

	2019	2018
Score	5,0	4,6
Ranking	25/28	25/28
E.U. Average	5,6	5,7
Better performance	UK 5,0	UK 7,2

4. Digital Skills

	2019	2018
Score	4,9	4,8
Ranking	25/28	24/28
E.U. Average	5,6	5,5
Better performance	FI 4,9	FI 7,2

7. Public Sector Digital Maturity

	2019	2018
Score	5,7	3,6
Ranking	24/28	28/28
E.U. Average	6,6	5,1
Better performance	MT 5,7	NL 7,9

Figure 7: Level 1 digital maturity performance in Greece, 2018 – 2019, as presented in references [4, 5], based on public information

Figure 8 presents an additional analysis of digital maturity categories in Greece, as compared to EU average scores and best practices.

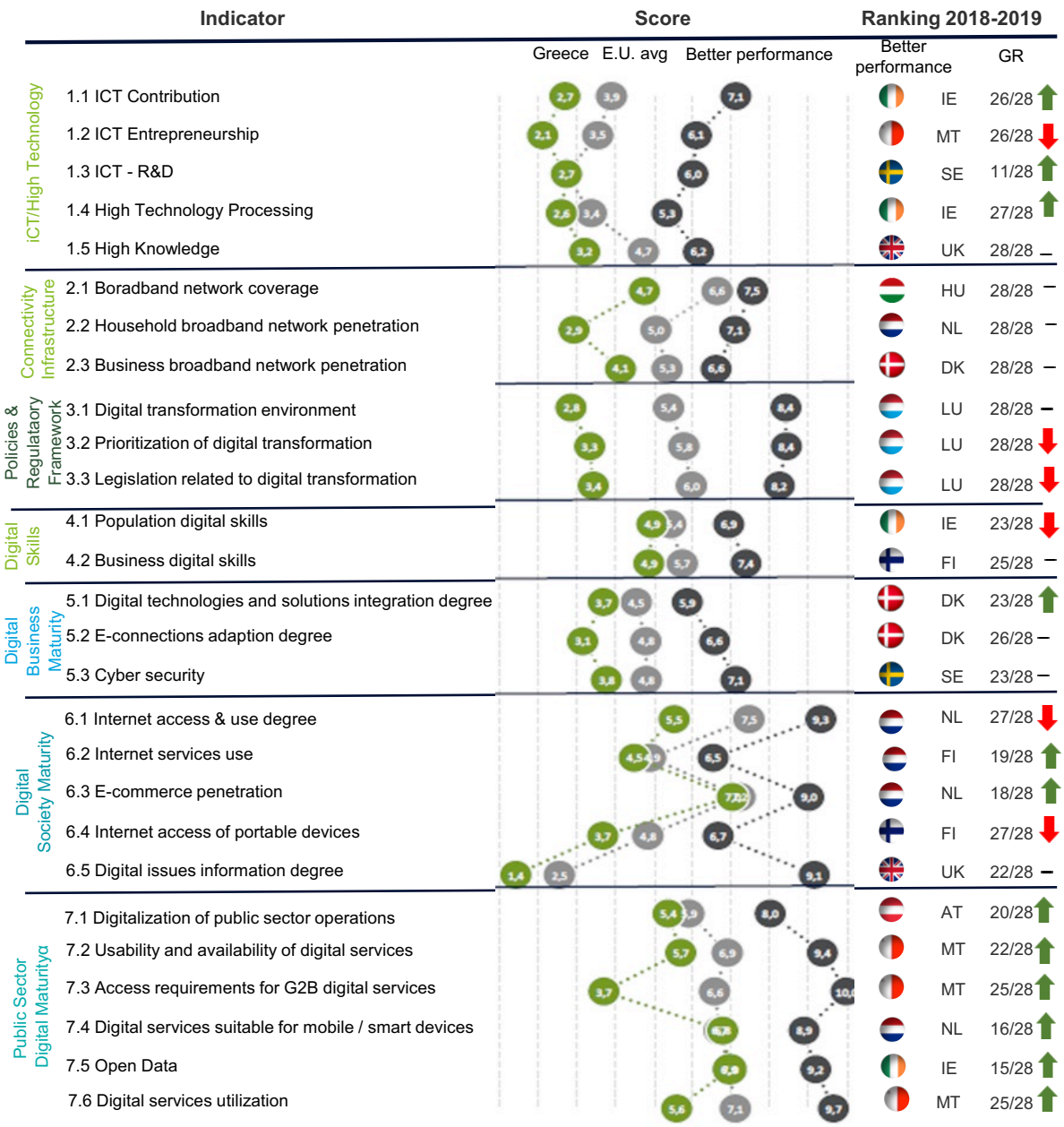


Figure 8: Level 2 digital maturity in Greece, 2018 – 2019, as presented in references [4, 5], based on public information

The evolution of 27 digital maturity indicators since 2018 shows the following results.

- **Performance deteriorated** in six groups, including 1.2 ICT Entrepreneurship, 4.2 Business digital skills, 3.2 Prioritization of digital transformation, 6.4 Internet access of portable devices.
- **Performance improved in twelve groups**, like 1.1 ICT Contribution, 1.3 ICT - R&D, 1.4 High Technology Processing, 5.1 Digital technologies and solutions integration degree whereas all indicators of Public Sector Digital Maturity (7.1-7.6) show improvement, etc.
- **Performance appears stable** for 9 of the indicators.

3.6 Key findings

Over the last two years Greece has employed agile ICT solutions to reduce the G2C (government to citizen) bureaucracy. Simple but very effective web applications have digitalized G2C services which used to ask for physical presence, proof of authenticity, submission of documents, one-step approval, etc. It is only fair to say that the covid-19 era accelerated eGov (electronic / digital government) solutions which aimed at offering urgent assistance to citizens and enterprises, like the covid-19 vaccine scheduling, the covid-19 state-aid allocation, the NSRF state-aid allocation, the state-aid allocation due to extra-ordinary physical phenomena, the electronic medical prescriptions, the electronic certificates, etc.

Such applications do not re-engineer in depth the bureaucratic public sector processes, nor do they focus on services with multiple approval steps and extensive organizational interoperability. However, the digital bypass of the bureaucracy associated with physical presence seems effective for the time being, and it is well-received by citizens.

This research does not underestimate in any way the progress of eGov over the last two years. However, instead of benchmarking the current digital maturity of Greece with its poor past, this research compares the current digital maturity of Greece with that of other EU leaders.

In comparison to EU practices, digital maturity in Greece seems to remain dormant. The analysis from various indicators shows that

- **Greece lags the EU-28 average performance in all dimensions of digital maturity**, regardless of the set of performance indicators or the database. Greece ranks 27th in EU-28 in 2019 versus 28th place in 2018.
- **eGov maturity in Greece progresses slowly**. Open data and online services suitable for mobile devices converge slowly to EU average scores. However, core G2B services fail to converge to EU standards in terms of pre-filled forms, number of public services provided online, ease of online access, transparency, interoperability, etc. In any case, eGov transformation in Greece is a positive step that should be further supported financially and operationally.
- **Public sector interoperability remains very low,** and digitalization does not utilize technologies with the appropriate efficiency. As a result, the digital gap in eGov remains significant (28% less that EU average), despite a convergence trend since 2018.
- **Policies and regulations fail to support digital growth for business and the economy.** Digital transformation regulatory environment (including eGov administrative cost) stagnates for many years.

4. eGov maturity in Greece: State of play

4.1 Introduction

This chapter offers a deep dive into specific eGov characteristics. It focuses on the key digital maturity categories, namely eGov digital maturity and regulatory environment.

Section 4.2 dives deeper into the regulatory maturity for digital operations in Greece. Also, it comments on the impact of eGov initiatives to regulatory simplification. Section 4.3 dives deeper into the maturity of G2B digital services. Also, it comments on the of eGov initiatives to G2B services. Section 4.4 presents significant cases of regulatory burden imposed by current G2B services. Section 4.5 summarizes the key findings of this chapter.

It is emphasized once again that this research does not underestimate in any way the progress of eGov over the last two years. However, instead of benchmarking the current digital maturity of Greece with its poor past, this research compares the current digital maturity of Greece with that of other EU leaders.

The findings of this chapter are based on information available until March 2021.

4.2 Regulatory maturity for digital transformation

The digital regulatory framework and policies implemented by the state can favor or hinder the improvement of G2B digital maturity. Regulations it may impose or eliminate administrative burden during digital transactions (also known as digital bureaucracy), private sector investments, dispute resolution, etc. Deep diving into DMI, indicates that Greece has not coupled properly regulatory changes and ICT applications in the public sector.

Apart from a long-term vision to digital transformation, other key indicators concerning regulatory maturity include policy stability and predictability, regulatory response to G2B digital transformation requirements, legislation concerning the use of contemporary ICT in the private / public sector (e.g. artificial intelligence ethics, anonymous big data analytics, e-health security, etc), public procurement principles, G2B services self-regulation (e.g. single sign-in principle, fill-in once only principle, etc).

In short, eGov in Greece remains at penultimate positions. Policies and regulatory framework fail to promote digital transformation and reduce the G2B administrative burden. While DMI only records digital performance since 2017, other digital maturity indices (e.g. DESI, WEF, OECD) record similar performance in since 2015. G2B eGov reforms concluded by 2019 have had a marginal impact in digital maturity. Figure 9 presents the evolution of the Regulation group of indicators since 2017.

	Ranking, 2019	Ranking, 2018	Ranking, 2017	Top score 2019
	3.1 Digital transformation environment			
Government policy stability	28/28	28/28	28/28	LU
Government's responsiveness to change	27/28 ↑	28/28	28/28	LU
Government's long term vision	27/28 ↑	28/28	28/28	LU
	3.2 Prioritization of digital transformation by the State			
Priority of using ICT	28/28	28/28 ↓	27/28	LU
Promoting the use of ICT	28/28	28/28 ↓	27/28	LU
Public-Private collaboration Gov ICT	25/27 ↓	21/27 ↑	22/27	DK
	3.3 Legislation related to digital transformation			
Adaptability to digital business models	28/28	28/28	28/28	LU
Adaptability to new technologies	28/28	28/28	28/28	LU
Regulation for the application of new ICT	25/27 ↓	21/27 ↑	25/27	DK

Figure 9: Level 3 – Regulatory maturity in Greece, 2017-2019, based on public information

The implementation of policies and a regulatory framework that reduces red tape and supports digital transformation is a critical prerequisite for improving G2B performance. However, the indicators in Figure 9 suggest the following:

- **Lack of continuity in Public Administration** and lack of long-term digital vision for public administration which will be implemented regardless of any changes in governance.
- **High administrative burden** is placed on many public sector services as well as all sectors of the economy, not excluding the ICT and high-tech sectors. Such red tape may act as a deterrent to the implementation of business growth plans, better G2B services and digital transformation investments.
- **Unclear legal and regulatory framework**, legislative gaps, poor quality legislation and duplication that often includes contradictory regulations and shortcomings in the codification of legislation.
- **Delays in the adoption of secondary legislation** which activates many legal provisions (eg circulars, instructions that will clarify to companies how they will be legal in new obligations). For example, Law 4727/2020 is indeed a major reform in eGov services. This legislation however requires more than 120 secondary provisions to be fully enacted. Only a few of them have been finalized until this day.
- **Cross-government coordination**. Until 2019, eGov followed a distributed coordination and implementation scheme. That resulted to operational and data silos. Following the elections in 2019, the new Ministry of Digital Governance gains strategic importance and is given the mandate to design, coordinate and implement the strategy for digital transformation of the country. The ministry is responsible for providing digital services to citizens and businesses based on simplified administrative procedures. It is also responsible for ensuring the interoperability of processes with all other ministries and government agencies. The objective is to transform Greece into 'digital by default' by 2023. Also, the Ministry of Digital Governance assumed control over distributed databases and eGov systems. This is indeed a positive step towards contemporary G2B applications.

4.3 eGov digital maturity

This group of indicators quantify the use of digital services and interfaces between state and businesses. In addition, DMI also includes G2C interactions, however the project focuses on G2B interactions only. This group of indicators quantifies progress in digital services availability, digital transformation of back-office operations, access requirements and conditions, open data utilization and G2B services penetration.

Until 2018 Greece ranked 27th in EU-28 thus received a low ranking in its the digital maturity of its G2B services. eGov services improved in 2019. Netherlands followed by Denmark and Sweden still rank at the top of the group. Figure 10 indicates that Greece improved its performance in 5 of the 14 indicators in 2019, deteriorated in 3, while the other indicators remain stagnated in poor performance.

	Ranking, 2019	Ranking, 2018	Ranking, 2017	Top score 2019
	7.1 Digitalization of public sector operations			
Digitalization of Public Administration	25/28	25/28 ↑	28/28	MT
Online service availability (G2B)	23/28 ↓	22/28 ↑	27/28	MT
Depreciation value of eGov fixed ICT assets	7/17	n/a	n/a	NL
	7.2 Usability and availability of digital services			
Usability factor	14/28 ↑	19/28 ↓	14/28	ES, NL, MT
Transparency & Accountability	25/28	26/28	25/28	MT
Cross-border mobility for business	27/28 ↓	24/28 ↑	27/28	UK
Cross-border mobility for Citizens	20/28 ↓	18/28 ↑	26/28	MT
7.6 Utilization / penetration factor	25/28 ↑	27/28	27/28	MT
	7.3 Access requirements and conditions for G2B digital services			
Electronic ID (e-ID)	28/28	28/28	28/28	MT
Electronic documents (e-Documents)	26/28	26/28	26/28	MT
Authenticity of sources and users	26/28 ↑	27/28	27/28	MT
Digital communication (post)	21/28	n/a	n/a	AT, DK, EE, MT, HU
	7.4 User friendliness: digital services suitable for mobile / smart devices			
Mobile friendliness	16/28 ↑	19/28	n/a	NL
	7.5 Open data			
Open Data	16/22 ↑	n/a	17/22	IE

Figure 10: Level 3 – eGov maturity in Greece, 2017-2019, based on public information

According to e-Government Benchmark Report [9], countries with a level of Penetration and Digitization lower than expected might learn from countries with similar characteristics but better performance in these

absolute indicators. Depending on the Digitization and Penetration scores the countries can be grouped into one of four scenarios: (a) non-consolidated eGovernment: this scenario combines lower levels of Digitization with lower levels of Penetration. (b) Unexploited eGovernment: this scenario combines lower levels of Digitization combined with higher levels of Penetration. (c) Expandable eGovernment: this scenario combines higher levels of Digitization with lower levels of Penetration. (d) Fruitful eGovernment: this scenario combines high levels of both Digitization and Penetration.

Greece is underperforming in Penetration as well as in Digitalization with a marginal improvement in both dimensions since 2017 (Figure 11). Despite the number of key G2B projects designed since 2017, eGov remain stagnated, mainly due to the absence of significant enablers that would allow increased levels of eGov interoperability. In contrast EU on average, as well as most EU countries follow a steep digital growth (GR ω=45° vs EU ω≈58°). e-Government Benchmark Report provides data since 2015. However, it follows a different methodology as compared to data from 2017 onwards. Therefore, they are omitted for compatibility reasons.

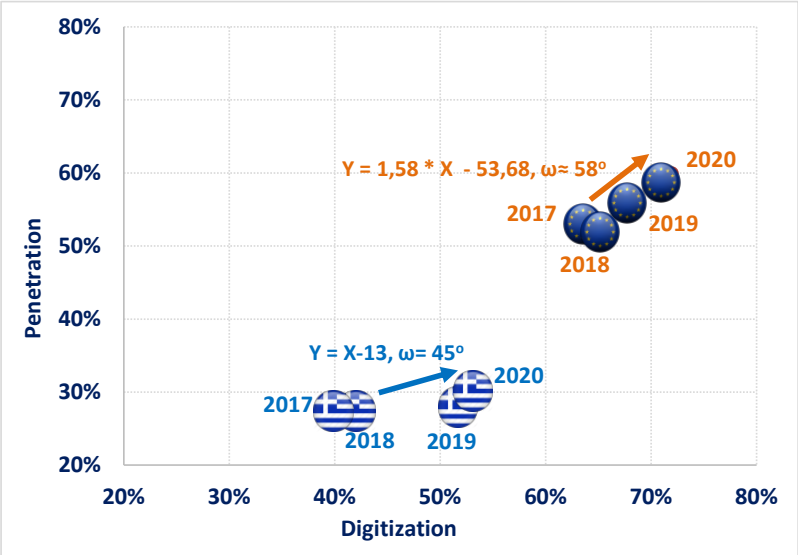


Figure 11: : eGov digital performance. Greece vs in EU, 2017 – 2020, based on public information

As a result of this marginal improvement in eGov digitalization since 2017, Greece still the necessary "user experience" (Figure 12). Hungary on the other hand experienced a similar starting point with Greece in 2017. Due to "user-friendly" G2B services (e.g. digital post-box instead of paper, cross-border mobility, eDocument availability, etc), Hungary advances towards average EU performance.

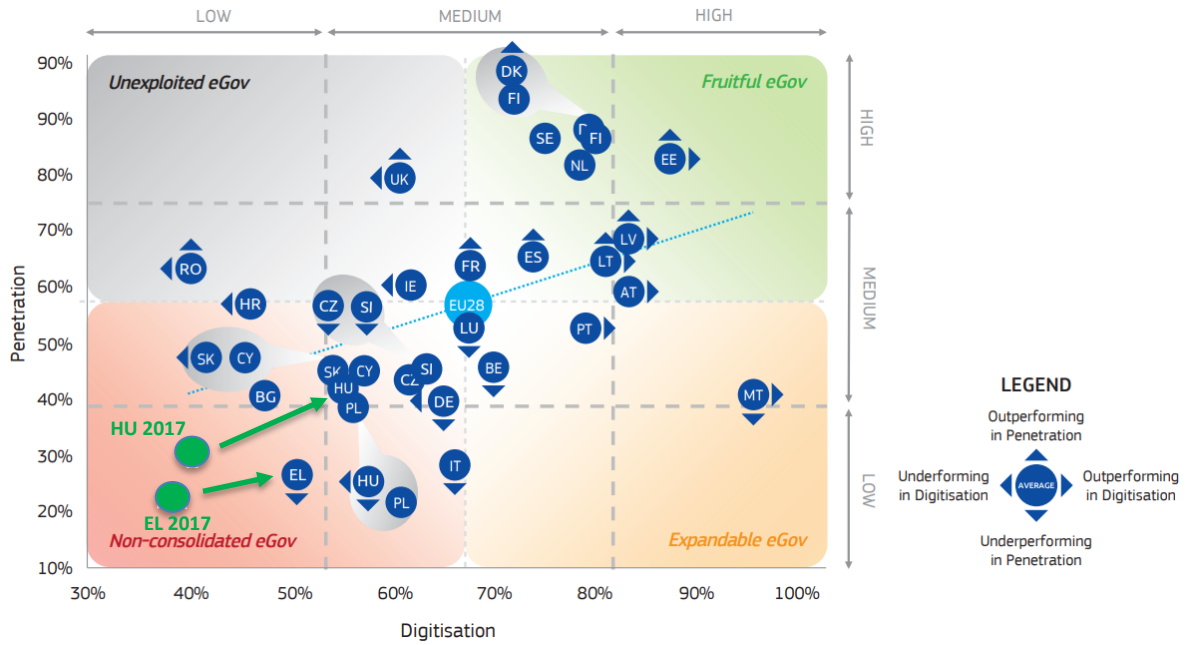


Figure 12: eGov digital performance in EU, 2020, based on public information

The following explain in more detail the main reasons for the low eGov digital maturity:

- **Lack of strategy and action plan continuity**. The limited use of private sector expertise in strategy development and the frequent promotion of projects with unclear results fail to improve e-government performance.
- **Large number of G2B interfaces and processes** lacks digitalization due to absence of a single point of access, reduced interoperability between existing ICT applications, missing "once only" design principle, etc.
- **Long delays from announcement to implementation** of key projects that would improve G2B services. This includes both back-office application (eg CRM) and front-office applications which results in digitalization delays but also to the implementation of technologically outdated systems.
- **Absence of process reengineering** in public sector services. This includes both back-office and front-office functions. For example, the number of pre-filled forms in 2017 was 14, 23 in 2018 and 25 in 2019. The EU average score is 59 for 2019, 60% higher than the score in Greece. This is largely attributed to poor back-office streamlining rather than front office simplification. On the other hand the number of digital public services for business improved marginally since 2017, Namely, 60 digital services in 2017 versus 63 in 2019 versus 88 in EU.
- **Delay of open-data availability** especially in data groups with potentially high utilization by business, like public procurement, commercial and GIS data, anonymized health data, transport data, etc. However, open data readiness quickly converges with EU standards.
- **ICT design** which often does not consider the subsequent needs in financial and human resources to ensure their proper operation, maintenance, and upgrade. This usually makes eGov ICT to function poorly or to become obsolete soon.

4.4 Regulatory burden of eGov in Greece: Typical cases

Independent analysis by Deloitte [10], MRB [11] and EY [12] have identified five G2B transactions with intensive regulatory burden for enterprises in Greece. The burden is generated mainly by poor, outdated or partial digitalization of those transactions.

Case 1: Initiation of a business installation or a business operation (part of investment licensing)

Scope of transaction: Notification procedure for a business installation or a business operation

Sectors involved: All sectors of the economy

Current digitalization status: The transaction is partially digitalized. It is conducted through www.notifybusiness.gov.gr

Legislation:

1. L. 4442/2016 “New statutory framework for economic activity and other provisions".
2. L. 3982/2011 “Simplification of licensing of technical professions and manufacturing activities and business parks and other provisions”.
3. M.D. 483/35/F.15/2012 “Determination of type, documents and procedure for the installation and operation of manufacturing activities of L. 3982/2011, the modification and renewal of licenses and the deadline for transfer or technical reconstruction” .
4. M.D. 64618/856/F15 “Amendment of the decision 483/35/F.15 /2012 (B’ 158) of the Deputy Minister of Development, Competitiveness and Shipping”.

Administrative burden

1. **Notification vs inspection**. The enterprise notifies digitally the authorities for the initiation, without having to submit any physical documents. However, the enterprise is obliged to keep all necessary documents in physical form, in case of inspection or an audit. The inspection or the auditor does not have access to the notification archive. Any document upload is not regarded as proof of documentation.
2. **Partial digital notification for a limited number of licenses**. In cases of multiple licenses (e.g. environmental licenses, hygiene licenses, etc.), the enterprise submits digitally only a Questionnaire, regarding the set of additional documents it should gather according to the type of installation or operation. Since the Licensing Authority does not use a digital archive, the enterprise must keep in physical form all different certificates like the certification of land use, the environmental certificate and approval, the formal declaration of the type of fixed assets, the environmental risk assessment study and report (if necessary), the technical description of the facility, the report of civil engineer, the building permit, etc.
3. **Distributed licensing registries.** The environmental certificate and approval can be accessed via the Digital Environmental Registry https://eprm.ypen.gr. Such documents can be available to all licensing or inspection authorities by intra-government requests. However, the enterprise must re-submit it every time it is asked to.

Case 2: Approval of a business installation or a business operation (part of investment licensing with regards to activities of increased environmental risk)

Scope of transaction: Approval procedure for a business installation or a business operation. It regards activities of increased environmental risk and ready-to-operate installations.

Sectors involved: All sectors of the economy

Current digitalization status: The transaction is partially digitalized for a limited number of licenses or certificates

Legislation:

1. L. 4442/2016 “New statutory framework for economic activity and other provisions".
2. L. 3982/2011 “Simplification of licensing of technical professions and manufacturing activities and business parks and other provisions”.
3. M.D. 483/35/F.15/2012 “Determination of type, documents and procedure for the installation and operation of manufacturing activities of L. 3982/2011, the modification and renewal of licenses and the deadline for transfer or technical reconstruction” .
4. M.D. 64618/856/F15 “Amendment of the decision 483/35/F.15 /2012 (B’ 158) of the Deputy Minister of Development, Competitiveness and Shipping”.

Administrative burden

1. **Physical documentation, submission, and inspection**. The enterprise submits the documents in physical form, which are then checked by the authorities. Authorities inspect physically the facilities

or installations of the enterprise. However, inter-government document flow among different agencies is limited, hence the enterprise must act as the rooter of documents during the inspection

2. **Partial digital procedure for a limited number of licenses**. In cases of multiple licenses (e.g. environmental licenses, hygiene licenses, etc.), the enterprise submits digitally only a Questionnaire, regarding the set of additional documents it should collect according to the type of installation or operation. Since the Licensing Authority does not use a digital archive, the enterprise must collect and submit in physical form all different certificates like the certification of land use, the environmental certificate and approval, the formal declaration of the type of fixed assets, the environmental risk assessment study and report (if necessary), the technical description of the facility, the report of civil engineer, the building permit, etc.
3. **Distributed licensing registries.** The environmental certificate and approval can be accessed via the Digital Environmental Registry https://eprm.ypen.gr. Such documents can be available to all licensing or inspection authorities by intra-government requests. However, the enterprise must re-submit it every time it is asked to.

Case 3: NSRF funding (National Strategic Reference Framework, SMEs state-aid)
Scope of transaction: Application and approval of NSRF funding

Sectors involved: All sectors of the economy, as applicable at NSRF guidelines

Current digitalization status: The transactions of NSRF funding are partially digitalized. They are conducted through the Information System of State-aid Funding (PSKE) (www.ependyseis.gr/mis).

Legislation: NSRF guidelines

Administrative burden

1. **Upload vs documentation**. The enterprise uploads all the necessary documents to PSKE platform, without having to submit them in physical form. However, the enterprise is obliged to keep all necessary documents in physical form. In cases of an inspection or an audit, digital documents are not considered as valid. The burden emerges due to the large number of documents the company must collect and maintain for a minimum of five years. This includes invoices, delivery slips, bank statements, payroll slips, contracts, project deliverables, communication material, etc.
2. **Distributed licensing registries.** Many government digital registries are not linked to PSKE. Documents like tax certificates, employment certificates, balance sheets, VAT registration, BoD registration, operations license, etc, are digitally available but there is limited intra-government document flow. As a result, the enterprise must upload them separately to PSKE. This can be extremely time intensive in cases of complex projects or large enterprises. Also, the enterprise must provide them separately to inspections / audits upon request or re-submit them to different digital registries

Case 4: State-aid funding (mid-caps and large enterprises)

Scope of transaction: Application and approval of state-aid funding

Sectors involved: All sectors of the economy, as applicable at NSRF guidelines

Current digitalization status: The transactions of state-aid funding are partially digitalized. They are conducted through the Information System of State-aid Funding (PSKE) (www.ependyseis.gr/mis).

Legislation: L. 4399/2016 “Framework for the establishment of Private Investment Funding Schemes for the regional and economic development of the country - Establishment of a Development Council and other provisions”

Administrative burden

1. **Physical vs digital documentation**. The enterprise uploads all the necessary documents to PSKE platform, without having to submit them in physical form. However, the enterprise is obliged to keep all necessary documents in physical form. In cases of an inspection or an audit, digital documents are not considered as valid. The burden emerges due to the large number of documents the company must collect and maintain for a minimum of five years. This includes invoices, delivery slips, bank

statements, payroll slips, contracts, project deliverables, communication material, etc. In addition, mid-caps and large enterprises have to collect and maintain in physical form documents like feasibility studies, performance indicators, tax and insurance certifications, shareholding analysis, etc.

2. **Distributed licensing registries.** Many government digital registries are not linked to PSKE. Documents like tax certificates, employment certificates, balance sheets, VAT registration, BoD registration, operations license, etc, are digitally available but there is limited intra-government document flow. As a result, the enterprise must upload them separately to PSKE. This can be extremely time intensive in cases of complex projects or large enterprises. Also, the enterprise must provide them separately to inspections / audits upon request or re-submit them to different digital registries

Case 5: Bankruptcy certificates (similar red tape applies to most Court certificates)

Scope of transaction: Application to verify the bankruptcy status of an enterprise. This certificate is one of the most common legal documents. It is widely used in many entrepreneurial transactions like banking transaction, funding, public procurement, etc.

Sectors involved: All sectors of the economy

Current digitalization status: The transaction is not digitalized. Applications and certificates are all in physical form. The judicial help desk acts as a front desk

Legislation: a variety of legislation regarding justice administration

Administrative burden

1. **First Instance Courts.** The company that intends to declare bankruptcy or asks for the bankruptcy status certificate, must apply to the local Court of First Instance in physical form.
2. **Distributed licensing registries.** In cases of business restructuring because of bankruptcy, the restructuring plan must include documents like balance sheets, tax certificates, payroll certificates, etc. Such certificates are digitally available but there is limited intra-government document flow. As a result, the enterprise provides them separately to inspections / audits upon request or re-submit them to different digital registries.

4.5 Key findings

It is only fair to say that the covid-19 era accelerated eGov solutions. This research does not underestimate in any way the progress of eGov over the last two years. However, instead of benchmarking the current digital maturity of Greece with its poor past, this research compares the current digital maturity of Greece with that of other EU leaders. With that in mind, this chapter indicates that both the eGov maturity and the regulatory environment in Greece remain dormant in comparison to ther EY countries. Analyses from various indicators shows the following:

- **eGov in Greece should not be benchmarked against its poor performance of the past but the performance of other EU countries**. eGov initiatives since 2014 have improved indeed several digital services as well as back-office operations of the public sector. However, all KPIs indicate that eGov projects do not generate a transformation momentum like in other EU countries. When compared to the poor performance of the past, eGov initiatives have improved the G2B services in Greece. When compared to the performance of other EU countries, they seem to have little impact on G2B services, if any at all.
- **Regulatory maturity for digital operations stagnates**. Legislation concerning the use of contemporary ICT in the private / public sector (e.g. artificial intelligence ethics, anonymous big data analytics, e-health, etc), public procurement principles, G2B services self-regulation (e.g. single sign-in principle, fill-in once only principle, etc) cross-agency service coordination, etc have been marginally updated by the various eGov initiatives since 2014. Deep dives into KPIs indicate that new regulations often patch existing legislation and fail to adopt the new ICT standards applied in many EU countries. As s result, Greece ranks 27th or 28th in most regulatory KPIs.

- **Regulatory complexity in digital services also increases** by the unclear legal and regulatory framework and the delays in secondary legislation.
- **eGov service utilization remains low** (25th in EU-28) mainly due to the large number of G2B transactions lacking a single point of entry and interoperability between registries (e.g. investment licensing, state-aid funding, bankruptcy certificates, etc).
- **Access to G2B** services is complex (28th) with few digital documents (26th) and interfaces which fail to comply with the "fill-in once only" design principle (60% less pre-filled forms than EU average). Absence of process reengineering in public sector services reducing transparency and digital accountability (25th).
- **Usability gradually converges with EU** standards. Similar trend is documented at the number of new G2B services and the access from mobile / portable devices.

5. eGov projects

5.1 Introduction

This chapter attempts a concise but comprehensive mapping of key ICT projects implemented in Greece in recent years, as well as the projects that are currently underway or scheduled to begin soon. The aim of the chapter is to highlight the characteristics of the eGov strategy.

Section 5.2 highlights the key ICT projects carried out in the period 2012-2020, pointing out the eGov strategy selected since 2000 and the subsequent changes till 2020. Section 5.3 documents the key ICT projects currently under implementation, along with progress report and an estimate of their completion. Section 5.4 analyses the current eGov strategy for the coming years, especially with regards to the G2B services, and highlights characteristics for improvement. Section 5.5 dives deeper into the public procurement area, analyzing the regulatory framework, the pain-points that existed until very recently, but also recent improvements. Section 5.6 summarizes the key findings of chapter 5.

The findings of this chapter are based on information available until March 2021.

5.2 Overview of eGov initiatives 2012-2020

At the beginning of the 2010s, Greece was at the entrance of a long economic crisis without a strong-solid digital infrastructure. Since the beginning of the previous decade, important initiatives have been taken for the modernization of public administration and the introduction of new technologies, mainly under the 3rd Community Support Framework (CSF, 2000-2006) and the National Strategic Reference Framework (2007-2013); the overall design, however, was fragmentary and not ambitious enough, while public interest was flaccid. Indicatively, the following main projects can be mentioned:

- The "Information Society" project which was funded by the 3rd CSF and aimed at: a) serving the citizen and improving the quality of life and b) development and human resources.
- The “Politeia” program, of the Ministry of the Interior, which was developed every 3 years as a public policy tool and aimed at re-establishing and modernizing the public administration based on EU policies.
- The “Syzefxis” project, financed by 3rd CSF and aimed at the development and modernization of the telecommunications infrastructure of the Public Sector.
- The National online Portal "Hermes" which was initially funded by the 3rd CSF and aspired to be the single web portal of the Public Administration for the information of citizens and businesses and the processing of all their transactions with the public.

With the inclusion of Greece in the Economic Adjustment Programs, a renewed interest was created for the upgrade of the public administration in the new technologies and e-government, mainly as a counterweight to the fiscal austerity measures. However, despite increased political motivation, external pressure, and enhanced surveillance, implementation was particularly slow, public administration resilience was strong and general planning remained poor and fragmented – even if it was clearly more ambitious. The result was a multitude of individual projects, the success of whom was not a given, while in many cases there were overlaps, repetitions, and incomplete interconnections and utilization of existing systems.

Additionally, regulatory simplification has not matched at all the pace and momentum of G2B digitalization, which resulted to significant effort but with stagnated results.

Below are listed the most iconic projects that were completed in the period 2012-2020 (before covid-19 pandemic crisis):

- The Taxis and Taxisnet systems, for the electronic submission of income reports by citizens and businesses, as well as management of their tax obligations.
- The census of all public sector employees, through the webpage apografi.gov.gr, and their registration in a complete public register.

- The "Ergani" information system, that has been the exclusive point submission of all employment changes by businesses since 2012. This system provided the needed real-time information to control mechanisms in order to control undeclared employment and thus mitigate it.
- The electronic prescribing, which not only simplified the process of prescribing drugs in public health system, but also allowed the recording and monitoring of drug prescriptions, thus combating a huge source of waste of public funds.
- The “Rural Broadband” project, which aimed in the development of broadband networks in "white" rural areas (i.e., areas which are rural, underpopulated, and commercially unattractive to broadband providers).
- The data.gov.gr portal, that is the central dictionary of public data that provides access to databases of Greek government agencies.
- The 1st phase of “e-Justice” project, which includes several actions aimed at the digital transformation of justice in Greece, namely: the implementation of the Integrated System of Civil and Criminal Justice Case Management (OSDDY-PP), the development, establishment, and implementation of the Inte-grated System of Administrative Justice Case Management (OSDDY-DD), the implementation of the “National Criminal Record”, etc.
- The “Interoperable eInvoicing in Greece (GRinv)” project, which refers to the development of interoperability with the National System for Online Public Contracts (“ΕΣΗΔΗΣ” - ESIDIS in Greek) for electronic invoices during the execution of public contracts.
- The aforementioned “NotifyBusiness” system, which has been the exclusive point of submission of all notifications regarding the establishment and/or operation of a business, and every change related to it since June 2017.

As analyzed in a relevant study by diaNEOsis, as many ICT projects were Integrated Information Systems and, therefore, followed the conventional linear methodology (waterfall), which treats ICT projects like all other public projects ignoring their particularities. This often leads to failures, as well as time-consuming and rigid processes incompatible with ICT projects and the technology life cycle.

In November 2016, the above situation was largely and officially recorded with the publication of the "National Digital Strategy 2016-2021" [13], by the newly established Ministry of Digital Telecommunications and Information Policy, which sought to provide a roadmap for the digital development of the country and to harmonize it with the respective practices in European level. Specifically, it recorded the absence of central planning of IT and communications projects until then, which has led to fragmentation and overlaps in the services offered. To overcome this problematic situation, the "Unified Design" process was proposed, which focuses on the result and the end user. However, its scheduled update in the first quarter of 2017 never happened, while there is a big gap between the goals it sets and their implementation, which showed huge gaps, and is done inefficiently, without order and coordination.

In recent years there has been a significant resurgence of activity, which can be attributed in part to government change / reconstruction and in part to the covid-19 pandemic crisis.

The beginning was made by the re-establishment of the former Ministry of Digital Policy, under the name "Ministry of Digital Governance". The re-established ministry took over all responsibilities related to e-government, digital transformation and the simplification of procedures in Public Sector. In this way, the Ministry has acquired a strategic role and is responsible for providing digital services to citizens and businesses based on simplified administrative procedures. The goal is for Greece to acquire a "digital by default" character by 2023, in implementation of the proposal formulated by the so-called "C. Pissaridis Committee" in its report "Growth Strategy for the Greek Economy" [14].

The most important development, however, came from the change of mindset and philosophy in the strategy of upgrading and expanding e-government, that has shown some first positive results. A new approach was followed: the design and implementation of a series of short-term projects to achieve "quick wins", as well as the focus on redesigning all needed procedures for a service before its digitization and provision to citizens or businesses. In this work, both the public and the private sector were utilized and an “agile software development methodology” was used.

Recently, the strategy for the promotion of digital governance was formulated in a clear and comprehensive manner, by the publication of the "Digital Transformation Book 2020-2025", which adopts a citizen-centered concept of Public Administration. Lastly, in December 2020 the "National Cyber Security Strategy 2020-2025" was approved by the Ministry of Digital Governance and in June 2021 the Cybersecurity Handbook was published.

During the pandemic, due to the urgency of limiting the transmission, the Public Administration acted based on substantive priorities rather than the regulatory formalism that usually characterizes it. As a result, interventions were promoted very quickly, which under other circumstances would require unnecessary consultations, evaluations, approvals, competitions etc., that could take even years.

More specifically, in the public sector –both internally and in its interaction with the citizens– teleconferences and teleworking, digital signature, electronic issuance of documents through gov.gr, submission of electronic applications to Centers of Service to Citizens ("ΚΕΠ" - KEP in Greek), the remote service of citizens through the "digital appointment" service in a number of public bodies, and the multi-channel user support for the aforementioned electronic services (by telephone, electronic correspondence and internet interaction) were promoted and implemented. At the same time, several new health needs arising from the pandemic were met, such as vaccination arrangements and the registering and support of patients –an application of the "digital by default" principle–, as well as a series of procedure simplifications in the field of social security were executed.

5.3 Current ICT projects

According to the available data[1], there are 15 high priority ICT projects in the public sector which could be related to B2G services. More specifically, the table below presents the digital transformation projects with a brief description, as well as their implementation phase.

Title: Current ICT projects in the public sector

No	Project	Details	
1	Ultrafast Broadband (UFBB)	Description	Development of high-speed broadband infrastructure throughout the country by increasing the availability of NGA telecommunications services in white rural and suburban areas, which do not have high speed internet access of at least 100 Mbps. This project is the largest PPP project ever approved in Greece.
		Budget	€700 million
		Stage	The tender process of the project is in progress.
2	Superfast Broadband (SFBB)	Description	Provision of high-speed internet connection to citizens (originally) and businesses (subsequently) that live / are active in areas where they are developing infrastructures capable of offering such services, by private investments. It is implemented with the voucher method (€360), according to which the beneficiary chooses the services that suit him and the telecommunications provider that provides them.
		Budget	€50 million
		Stage	Ongoing action, till end of March 2022.
3	5G Action Plan	Description	In March 2020, the project "Objectives and strategies for the introduction and operation of 5th generation networks in Greece" of the Ministry of Digital

[1] We have requested any recent data for the ICT projects in the public sector from the Ministry of Digital Governance. Currently, this report uses publicly available information as well data from the Greek government's report "Digital Transformation Book 2020-2025", published in 2021.

No	Project	Details	
			Government was published. The purpose of this project is to create a strategy and design a roadmap for the development, implementation, and use of 5G networks in Greece, as well as specific scenarios for their sustainable introduction and operation. The aim is to develop potential 5G application markets in the country (use cases), appropriate business models for commercial development of 5G networks and best international practices that would apply in Greece.
		Budget	Non applicable
		Stage	Concluded auctions for the 700 MHz, 3.4-3.8 GHz and 26 GHz spectrum; and ongoing network expansion by the licensees.
4	Digitalization of all public services to businesses	Description	A series of projects to develop public information systems that support all B2B, B2G, B2C transaction procedures, especially regarding GEMI (General Commercial Registry), EFKA (National Social Security Entity), AADE (Independent Authority of Public Revenue), Ergani (the information system for declaration of business employment), OAED (Work Force Employment Organization), First Instance Courts and "NotifyBusiness". These systems will serve the establishment, licensing, transfer, and monitoring the operation of businesses through digital interfaces for secure and verifiable transactions, based on the “once only principle”, in which businesses could declare once, in a single point, the information needed by the Public Administration. Of the mentioned projects, only the “Digitalization of GEMI” and the “Digital Transformation of EFKA”, which includes both the digitization of its archives and the integration with Unified Auxiliary Social Security and Lump Sum Benefits Fund (ETEAEP) systems, have well documented progress.
		Budget	N/A *
		Stage	The digitalization of GEMI is in completion of the tender process – pending award. The Digitalization of EFKA is still in early phase (significant delay in the digitization of its archives, integration processes in the initial stage).
5	Next Generation Government Cloud (G-Cloud)	Description	The Information Society SA (IS SA) designed, organized, and implemented (in collaboration with the General Secretariat of Information Systems and Administrative Support) the government cloud computing system, “Government Cloud” or “G-Cloud”. G-Cloud offers digital services based on predefined quality (SLA), mainly private cloud, but also public cloud. Through the Infrastructure as a Service (IaaS) service, public bodies could use one or more virtual machines to meet their needs, without having to procure the corresponding equipment (H/W & S/W), creating significant economies of scale in the Public Administration bodies.
		Budget	€17.2 million
		Stage	The basic infrastructure is completed. Further upgrading and expansion (e.g., of the Storage Area Network (SAN) and backup equipment of the GIS Cloud node) is at an early stage.
6	Single Digital Portal (gov.gr)	Description	In March 2020, in implementation of Article 52 of L. 4635/2019, the Single Digital Portal of Public Administration (gov.gr) was established. The operation started in beta version, and it was expedited, compared to the original planning, due to the covid-19 pandemic.

No	Project	Details	
			Currently[2], the portal hosts over 1,200 services in 11 categories, while information is available for 19 Ministries, 71 Bodies & Organizations and 9 Independent Principles. The goal is to provide more than 2,000 public services to citizens through the gov.gr platform.
		Budget	N/A
		Stage	In beta version, but in continuous updating and upgrading.
7	e-Authentication (e-ID)	Description	The new ID cards of the Greek state will use the format ID-1 (the form of credit cards), display a color photo of the holder, have an electronic circuit which will incorporate the digital signature of the citizen and biometric features and follow the eIDAS standard of the EU. Additionally, they shall be available on each citizen's smartphone through a special application. It is worth noting that, in parallel with the issuance of the new IDs, a new unique and permanent Personal Number will be attributed to each citizen, which shall be used for access to digital services / transactions with the Greek State and potentially with all other entities such as banks.
		Budget	More than €500 million, (for 30 million IDs, over the span of 10 years)
		Stage	Ongoing tender process
8	Registry Interoperability	Description	Many individual initiatives are gradually being implemented to ensure the interoperability between public registers on the basis of the "once only principle". According to this principle, the citizens as well as the businesses must be able to submit once, in a single place, the information asked by the Public Administration and all various information systems will communicate with each other, successfully identify the person / legal entity, and transfer all needed information pieces. Additionally, the "Public Sector Interoperability Center", under the overall responsibility and management of GSIS, operates as an electronic platform through which each public service will be able to receive data relating to a citizen's details directly from any other service, thus relieving the citizen of the need to provide data that is already available to the State.
		Budget	N/A
		Stage	Ongoing implementation
9	e-Justice – 2nd Phase	Description	Since the completion and operation of both OSDDY-PP and OSDDY-DD, the former's expansion has been in progress. According to so called "OSDDY-PP 2nd Phase" plan, the system will be installed, within a period of 3 years, in 321 Courts and another 132 Social Welfare Services and Juvenile Bailiff Services. Furthermore, since April 2020 the solon.gov.gr portal has begun to accept digitally signed electronic registrations by citizens/applicants. Its coverage has been planned to be extended to the whole of judicial branches of the country.
		Budget	€15.7 million
		Stage	Ongoing expansion and extension actions

[2] As of July 2021.

No	Project	Details	
10	National Law Codification Portal	Description	The planned National Law Codification Portal will function as a hub for codified legislation that will be organized according to updated standards, while being available to the general public free of charge as well as easily accessible through a series of search and sorting functions. In addition, through the platform all the law-making and regulatory flow will be standardized, the codification will be facilitated, and the operation of the good legislative structures will be supported.
		Budget	€1.9 million
		Stage	Awaiting procurement
11	Integrated Information System for Exercising Activities and Controls (OPS-ADE)	Description	The Integrated Information System for Exercising Activities and Controls (OPS-ADE) will be the main platform that will support the new institutional framework for conducting economic activities in Greece, as well as their supervision. The OPS-ADE shall support, over the web, the procedures for the exercise of economic activities (notification, approval, etc.), as well as the corresponding audit procedures to be carried out by the General Secretariat of Industry or other Ministries and public authorities. The project is planned to be completed by the end of 2021.
		Budget	~ €1.7 million
		Stage	Pending contracting
12	"KEP-Plus" program	Description	This is an initiative to explore every possible field of utilization and upgrade for the Centers of Service to Citizens ("ΚΕΠ" – KEP in Greek) aiming to the acceleration of the start-up entrepreneurship, as well as the support of the entrepreneurship in general.
		Budget	N/A
		Stage	Ongoing
13	"Digitometer" project	Description	Development of a system for assessing the digital maturity of enterprises and documentation of the planning of state aid for the digital transformation of enterprises. The assessment of the degree of digital maturity of SMEs will be processed through an easy-to-use digital online tool. The tool shall provide, through a structured questionnaire, a high-level assessment of the company's digital maturity and identify potential areas for progress. The aim is to inform the SMEs about the benefits they can reap from the Digital Economy and to raise their awareness to use appropriate support mechanisms. The good understanding of the digital maturity by sector allows the implementation of well targeted policies.
		Budget	N/A
		Stage	Ongoing
14	Database and digital repository of research projects	Description	A series of projects, including: • the upgrade of the existing information system developed by the General Secretariat for Research and Technology with the addition of functions that shall facilitate the search and presentation of information, as well as the interconnection with other European corresponding databases.

No	Project	Details	
			• the development of a cloud-based digital platform, according to open data standards, which will include in a single and functional set all data related to Research & Innovation. • the establishment of a register of evaluators, that will include the evaluators the evaluation of research projects, depending on the research fields in which they operate, and the National Register of Research Infrastructures, that will include all research infrastructures that shall be formed according to the Road Map, the services which they will also provide monitoring of their use.
		Budget	N/A
		Stage	Ongoing
15	National Network of Digital Innovation Hubs (DIH)	Description	Establishment of an organized, reliable, viable, and coordinated network of digital innovation hubs at national level, in accordance with the European strategy. The network shall be the main lever of digital transformation of the businesses, as it will cover issues of utilization of new cutting-edge technologies and ICT adoption in the organization and operation of them. The development and operation of the network is going to be carried out with cooperation of actors from both the public and the private sectors.
		Budget	N/A
		Stage	Ongoing

Source: Authors' analysis based on publicly available information as well as the "Digital Transformation Book 2020-2025".

** There is budget information only regarding "Digital Transformation of EFKA" project, which has an estimated cost of ~€19.2 million.*

In addition to the ICT projects, the Digital Governance Code (L. 4727/2020) promotes further reforms that are expected to contribute to the digital transformation of the Public Sector. Among others, the reforms that are expected to have the greatest impact on Public Sector's interaction with citizens and businesses are the following:

- The first reform refers to the standardization of electronic documents. Integrated regulation shall be established for the issuance of electronic public documents and their electronic distribution, as well as specific rules for the validity of electronic public and private documents after they are printed. The validity of electronic documents extends to proceedings before all courts.
- The second reform is related to trust services and remote authentication. The regulatory framework related to digital certificates and their providers in accordance with the eIDAS Regulation is updated by abolishing the P.D. 150/2001. The use and validity of electronic seals and remote identification are being instituted for the first time.
- The third reform is about the establishment of an electronic registered delivery service. Its aim is to be a secure electronic "channel of communication" of the State with citizens and businesses.
- And the fourth reform concerns the institutionalization of the Register of Public Administrative Procedures. In this Register shall be registered all the digital or physical procedures of the Public Sector (either internal or external i.e., in relation to the citizens) so that all citizens and businesses to be aware, with certainty, for the procedure required for their transaction.

5.4 G2B re-engineering

In June 2021, the Greek government published the "**Digital Transformation Book 2020-2025" [15]** which is its strategy plan for the digitization of the state in the coming years. The plan includes a total of 455 projects and actions divided into 6 strategic axes.

One of the axes is called "**Digital Business Transformation**". This axis is aimed at strengthening and accelerating the process of digital transformation of companies, to fill the gaps that appear in indexes like Digital Economy and Society DESI and Digital Transformation Scorecard as well as to improve their competitiveness. This axis includes seven medium-term projects and actions, four of which are reported as in progress and thus are included in the previous section[3]. The rest three, planned, projects are the following:

- Advanced and integrated systems of production, automation, and robotics.
  The aim of this project is to promote the transition of Greek companies to the use of new technologies and advanced production systems. The achievement of the desired result needs the combination of many specific technologies within the Industry 4.0 spectrum; and therefore, each action should have a wide range of time and funding.
- Development of digital services/systems to support start-ups or established businesses (scale-up).
  The project includes development and implementation of digital platforms, like “Startup Greece”, to provide support services to businesses. These services can cover critical dimensions of the business, such as Digital Transformation & Restructuring, Innovation & Organization, Financial Opportunities, Internationalization & Extroversion, Synergies & Networking.
- Utilization of IT tools for decision making (evidence-based policy) in the public sector.
  The use of aggregated data (business registers, exports, value added, employment, etc.) and especially the interconnection of information may assist more effectively in the formulation of appropriate policies, if they are additionally supported using specific IT tools that will gather information and use it properly.

Another one of the strategic axes is "**Digital Innovation**". The main goal of this axis is the creation of an organized, reliable, viable, and coordinated network of nodes supporting the digital transformation of Greek businesses by strengthening and utilizing nodes of digital innovation at the national level. This axis includes 15 projects and actions, of which four focus on G2B services. One of them is reported to be in progress, thus it is included in the previous section[4]; while the rest, planned projects, are listed below:

- **Development of a central support mechanism for Digital Innovation**
  This central mechanism shall provide guidance to all actors involved in the digital transformation of businesses, coordinate joint actions between actors, develop the ecosystem, and identify and fill gaps with targeted training, information, and transfer of know-how. At the same time, it will act as a reference center of the DIH network, set the framework for its operation and development, promote cooperation between the individual nodes, and monitor their performance through KPIs.
- **ICT4Growth 2**
  This action is a recurrence of an earlier action (ICT4Growth) under the National Strategic Reference Framework (NSRF) 2007-13. Its purpose is to support mature investment plans for the design, development and commercial release of innovative value-added products and services, related to or based on Information and Communication Technologies (ICT).
- **Enhancing the use of supercomputers by SMEs.**
  Through the country participation in Partnership for Advanced Computing in Europe (PRACE) program, SMEs can take advantage of the opportunity to participate in the SME HPC Adoption Program in Europe (SHAPE) program. SHAPE is a pan-European program that supports the adoption of supercomputers by SMEs. The program aims to raise awareness and equip European SMEs with the necessary know-how, so that they can capitalize on the innovation opportunities opened up by supercomputers, thus increasing their competitiveness.

Despite the significant improvement in the rate and activity of eGov projects, there is still considerable room for further acceleration and extension of activities, especially in relation to taking advantage of the significant opportunities that arise for Greek entrepreneurship because of the new technologies. Indeed, many public

[3] Specifically, the following projects: “Digitalization of all public services to businesses”, “KEP-Plus”, “Digitometer”, and “Database and digital repository of research projects”.
[4] Namely, the “National Network of Digital Innovation Hubs”.

debate actors representing businesses and society, such as SEV and diaNEOsis, have attempted to identify the remaining needs and have put forward many proposals. The main ones are summarized below:

- Regarding the regulatory framework of the operation of the public sector, there is a need to ensure the compliance of all public bodies with GDPR, in particular in the areas of security, transparency and legality of processing and data use on the Public Sector's websites. Additionally, it is proposed to complete the activation of the "Bureaucracy Observatory" as soon as possible. The Bureaucracy Observatory, that has been institutionalized in cooperation with OECD, shall have as its main mission the rolling measurement and recording of administrative burden.
- With respect to the infrastructure, there is a need the Superfast Broadband coupon to be extended to technologies other than FTTH and to speeds below 100 Mbps, in order the diffusion to households to be increased, while it is proposed to provide facilitation for the installation of FTTH connections within buildings, and to improve the institutional framework so the transit process for the FTTH network to speed up. In the shorter term, the wider diffusion of fast internet access should be promoted by price-cutting interventions for end-users, both households and businesses.
- The creation of the "National Industry 4.0 Program", which shall include, among others: incentives to accelerate investments in digital technologies, subsidy "coupons" to SMEs to adopt new technologies based on specific selection criteria, and development of "Industrial PhDs" program through which research on upcoming digital technologies with direct commercial application will be subsidized. An integrated national strategy for the 4th Industrial Revolution should also incorporate the development of financial tools to support the formation of industrial innovation ecosystems, with a particular focus on specific technologies (artificial intelligence, IoT, 3D Printing, Analytics, etc.), and the establishment of a national platform for I4.0 which will undertake the planning and coordination of policy implementation for the transition of Greek industry to the I4.0 era.
- The promotion of Greece as a center of ICT services, through the identification of specific tax incentives, and a long-term international campaign to promote the Greek ICT sector. In addition, an Action Plan can be developed to create a favorable environment for start-up ICT companies, through simplifications of the regulatory framework specifically for these companies, tax incentives for the relocation of successful start-ups in Greece, and the promotion of clustering and cooperation actions with large, established, ICT companies.
- The creation of a specific marketplace of ICT suppliers to the public sector, based on the gov.uk example, in which all the necessary documents and specifics of the included companies should be kept and be readily available. This should reduce bureaucracy and speed up public procurement processes greatly. It could also be combined with the development of the "electronic box" of the business, for the uniform retention and submission of supporting documents.
- Development and implementation of an additional service in gov.gr for the signature authenticity validation. Through the strong citizen authentication, the citizen / business shall be able to be served electronically in all cases that he is asked to validate the authenticity of his signature (especially by public sector). Furthermore, the citizen signature will be validated, independently and without disclosure of the attachment contents, in contrast to the current physical process.
- Lastly, the addition of the ability of submitting proposals by both civil servants and citizens into the gov.gr portal, with the simultaneous operation of a central office for the evaluation, prioritization of these proposals, as well as the direct evaluation of services at the portal, will allow much faster improvement of gov.gr user experience on both sides of its use.

5.5 Public procurement burden

The legal framework that regards public works, supply, services, and studies contracts was defined, until recently, by the L. 4412/2016. The L. 4412/2016 incorporated the international experience and the two European Directives on how public procurement should be done (i.e., 2014/24/EU and 2014/25/EU). It had

greatly improved the older regulatory framework, but its strengths and weaknesses are still being debated.[5] Most of the malfunctions leading to delays, annulments of competitions, overpricing, and other familiar phenomena were surviving. A characteristic problem was that the electronic registers used for competitions, such us the Central Electronic Public Procurement Registry and the National System for Online Public Contracts, were cumbersome and neither interoperate between themselves nor with the transparency program initiative (i.e., Δι@ύγεια). To be more specific, the employee of a contracting authority who implemented the award procedure and the one who monitored the execution of the public contract had to enter the necessary data in the three systems separately. Also, it should be noted that an English version has not yet been available in the electronic registers, to facilitate the participation of foreign economic operators and promote competition.

Another major issue was the red tape and the pressing need for simplification of procedures. According to diaNEOsis' (2020) study about public procurement in Greece –although the L. 4412/2016 had improved the regulatory framework– all the involved parties (i.e., the contracting authorities, the economic operators, the audit institutions, and the judges) observed that bureaucratic inefficiencies in phases of search and submission of supporting documents required by tenderers remained. The bureaucratic hurdles seem to be even greater in the European co-financed projects. The time needed for all the procedures to be completed was increased, due to the fragmentation of responsibilities between ministries and administrative units within the ministries, requiring repeated approvals from various services to all phases of a competition.

Furthermore, as the diaNEOsis' report had pointed out "some public authorities have multiple stage signatures that delay the process (e.g., the Greek Armed Forces). Often the same documents are requested again and again. Although the tender has not been required to attach the supporting documents in its submission, the relevant reference could be made to her. Therefore, documents must always be available to the contracting authority."

The delays and inefficiencies during the public procurement procedures rest also to pathogens of the Greek public administration. An important aspect is the lack of professionalism of many public servants. Many of them are under-qualified and have not the specific range of skills required to handle the public procurement procedures. Although some of them are competent enough and experts, their contribution is not recognizable. For instance, the members of evaluation committees are unpaid, so they lack incentive to be effective and efficient in terms of time and maximization of public service interest.

In March 2021, Law 4782/2021 was passed, which revises Law 4412/2016 and attempts to simplify and reform the regulatory framework of public procurement, based on the remarks made by economic and social bodies. Following the new law, in May of the same year, the new "National Public Procurement Strategy 2021-2025" was published, with Joint Ministerial Decision. According to this text, the revision of the law must be followed by a series of necessary reforms and projects to improve the efficiency of the public procurement system, through:

- Accelerating the procedures for the award and execution of public contracts.
- Reducing bureaucratic obstacles and the complexity of public procurement and execution procedures, in order to attract a larger number of SMEs in the field of public procurement.
- Increasing competition and encouraging contracting authorities to adopt public procurement procedures based on optimizing the relation between value and cost.

In the short term, priority is given improve the efficiency of the e-procurement system, systematically monitor excessively low bids, professionalize public procurement staff, and promoting market centralization. In the long run, however, emphasis is placed on further improving the regulatory framework, as if it becomes more effective, it will contribute to a more sustainable and efficient use of public resources.

The "National Public Procurement Strategy 2021-2025" also includes the programming for many eGov projects, that aim to help and achieve the most effective application of the rules of law in public procurement,

[5] Indicative of the legislative and regulatory burden in Greece is that L. 4412/2016 had undergone 401 amendments from its publication on 8/8/2016 until 30/5/2020. In other words, two amendments were done every week, which ranged from simple linguistic to important interventions, such as a new law, L. 4605/2019, which brought changes in almost 80 provisions of the original law.

the adoption of the "once only principle", and the increase of Public-Private Partnerships in digital public procurement. The most indicative of these projects are presented below:

- Development of a complete catalogue of types of procurement contracts (general IT and health services) for which uniform technical specifications need and shall be developed.
- Development of a monitoring system for public procurement planning.
- Electronic declaration, management, and monitoring of the execution of the contract until its completion.
- Development of the "Virtual Company Dossier", which would allow the retention and automatic submission of supporting documents.
- Development of the monitoring of issues related to interoperability in the field of Public Procurement, their evaluation at organizational and technical level in order to implement the "once only principle", and the subsequent implementation of interoperability services that shall be selected by the order of their priority and importance.
- Creation of standard technical specifications, as well as data models, to support the interoperability.
- Electronic issuance and validation of bank guarantees.
- Assessment of the compliance of both public and private e-procurement systems with current international standards for information security management and information systems, consideration of an implementation and monitoring system for GDPR and development of a regulatory framework for the certification of private e-procurement systems.

5.6 Key findings

Over the time, the Greek eGov strategy was fragmentary, had a short time horizon and was guided by the pursuit of immediate political benefits, while the citizens' interest in a well-established digital administration was weak. Specifically:

- In the early 2010s, Greece was entering to the long period of the economic crisis without a strong digital infrastructure, as the important initiatives taken in the previous period had scattered and ambitionless planning, and the public interest was focused to other matters.
- The country's inclusion in the Economic Adjustment Programs has stimulated political interest in upgrading the country's digital infrastructure, as a counterweight to fiscal austerity; however, despite increased political will, external pressure and increased surveillance, the results in practice were scarce. The slow implementation rate, the strong resistance of the public administration to any change, and the bad and fragmented planning have resulted in a multitude of isolated projects, without certain success, with many overlaps and repetitions, and with insufficient interoperability.
- Additionally, legal and regulatory simplification has not matched at all the pace and momentum of G2B digitalization, which resulted to significant effort but with stagnated results.

In recent years there has been a significant resurgence of activity, which can be attributed in part to the change of government and in part to the crisis of the covid-19 pandemic:

- The competent ministry has been re-established and a goal has been set for Greece to acquire a "digital by default" character by 2023.
- There is a very promising change of mindset in the eGov strategy, through the design and implementation of a series of short-term projects to achieve "quick wins", and the simplification of all necessary procedures of a service before its digitization.
- During the pandemic, the Public Administration showed great adaptation to the urgency of the needs, acting based on substantive priorities and not on the regulatory formalism that usually characterizes it.

Regarding the legal framework of public works and procurement, the weaknesses of the previous relevant law (L. 4412/2016), which had led to significant delays, cancellations of tenders and overpricing, seem to be largely addressed by the newer L. 4782/2021. This law seeks to simplify and reform the regulatory framework for public procurement, based on observations made by economic and social actors, but should be supported in practice through:

- speeding up the procedures for the award and execution of public contracts.
- reducing bureaucratic obstacles and the complexity of public procurement procedures; and
- increasing competition and encouraging contracting authorities to seek new processes that minimize the cost-benefit ratio.

6. eGov best practices

6.1 Introduction

Previous chapters identified the key areas of administrative burden in Greece. This burden comes either from poor regulatory simplification prior to digitalization or from eGov services that fail to comply with contemporary digital standards. This chapter identifies best practices in the EU which have resolved those problems, namely regulatory simplification prior to digitalization and standardized G2B services.

The examples satisfy the following criteria:

- **Recent practices, ideally operational after 2015**. While the Estonian eGov paradigm is considered by many as the best digital transformation example in the EU, it is operational for more than 20 years. As a result, it is well documented, thus any additional analysis will provide little insight, if any at all.
- **Leapfrog practices, rather than incremental implementations.** Many EU countries improve the performance of public sector services incrementally and horizontally. Countries like Germany, the Netherlands, Denmark, Sweden, etc built on existing government platforms to provide additional digital G2B services. Such countries offer a uniform digital and regulatory experience throughout the public sector. On the other hand, countries like Portugal, Austria, Spain, Malta, Hungary, etc opt to deep dive into selected government services. They prioritize digital transformation projects according to number of users or administrative cost. This research focuses on the later digital transformation strategy

Section 6.2 presents examples of regulatory simplifications that preceded eGov implementations. Section 6.3 presents examples of contemporary eGov systems while section 6.4 presents an overview of the latest eGov initiatives in Greece that attempts to comply with EU standards. Section 6.5 summarizes the key findings.

The findings of this chapter are based on information available until March 2021.

6.2 Regulatory simplification prior to eGov services

The strategy "Digital Luxembourg" [16] recognizes regulatory framework as well as eGov services as catalysts for digital transformation. The strategy consists of five priority areas, namely Skills, Digital ecosystems, Digital infrastructure, eGovernment and Regulatory framework (digital policy). A contemporary regulatory framework includes the following objectives:

- **Promote digital innovation**. Under the Digital Luxembourg strategy, any drafting of legislation will actively protect innovation.
- **Digital access**. Under the Digital Luxembourg strategy, citizens and business have easy and direct access to any piece of legislation through an open data eGov portal.
- **Utilize smart tools.** As early as 2016, the Digital Luxembourg strategy aims to develop artificial intelligence tools in legislation. Examples include the extraction of regulatory information from legal texts using natural language queries, Q&A regarding regulatory obligations, legislative rulings to standard administrative requests, etc.
- **Assessment of regulatory trends** regarding digital transformation and activation the necessary legislative initiatives to reduce red tape.
- **Legislation and technology coupling**. The Digital Luxembourg strategy promotes technology-based projects and initiatives to facilitate legal compliance.
- **Open data**. Public data is widely available through the data.public.lu platform. For example geospatial data (eg address points, aerial photographs, spatial plans, topographic maps, etc), environmental data (eg weather, water quality, energy consumption, emission levels), road data (eg public transport at national and regional level, road transport, traffic information), statistics data (eg national statistics, key demographic and economic indicators such as GDP, age, health, unemployment, income, training), public health data (eg monitoring of influenza, allergies, various of cancerous cases, etc.).

UK was a part of the EU until 2020, hence it followed EU regulatory principles until that time. The regulatory simplification projects in the UK do not aim exclusively at digital G2B services. But they follow a

comprehensive approach. They start with simplifying regulatory processes before digitalizing them. Typical examples [17] include the following.

- **Sandboxes**. The UK is a pioneer in the use of regulatory accelerators and sandboxes as part of a simplified regulatory process. The Financial Conduct Authority (FCA) is such an example, which as part of the bigger initiative "Project Innovate", launched in June 2016 the first program "Fintech Sandbox". This "sandbox" allows companies to test innovative products and services (especially IT services) in a secure, vibrant environment with the appropriate consumer safeguards, and on a case-by-case basis, some companies are exempt from certain stricter regulatory frameworks for some time. The "sandbox" is of particular interest to ICT projects. It allows testing of ICT before commercialization but also offer the public administration an ex-ante documentation of potential regulatory burden of innovative digital application.
- **Digital by default principles**. The UK leads in the field of open data among EU countries. Also, the public sector in the UK builds its eGov strategy using the "Digital services template» which is a set of 18 digital services standards to help government agencies to develop "user-friendly" digital services. All eGov transactions must follow those standards to determine that a service is ready for public use. The list of standards provides detailed characteristics of principles like the open by default, use of open templates and common platforms, how to manage shared data, publication rules for open data, fill-in once, registry interoperability, etc.
- **Statement of new Regulations: One-in One-Out (2011 – 2012), Two-Out (2012-2015), Three-Out (2016+) principle**. Though not targeted exclusively to eGov services, the "one-in-one-out" principle can apply to them as well. The principle assesses the net administrative cost to business ('in') of complying with any proposed regulation and finds a deregulatory measure ('out), which relieves business of the same net cost as any 'in'. The cost is measured in GBP following the "Equivalent Annual Net Cost to Business" methodology per Ministry. The cost of administrative burden quantifies delays, new procedures, new documents, cost of applications, cost of compliance, cost of transaction, etc. Direct corporate taxation and EU directives are excluded. This principle prohibits legislation to increase the total administrative burden on business. The initial One-in One-Out ratio changed to Two-Out in 2012 and to Three-Out in 2016. The public administration has exceeded the target of zero net burden from new regulations. From 2011 to 2015 it removed additional burden to business of £2.2bn. An aggressive Three-Out principle offers additional £0.9bn administrative cost reduction. The US administration adopted the same rule, in 2017. EU launched a discussion with member states in 2020 to legislate a similar principle.
- **SMEs moratorium.** Many new regulations may impose disproportionately higher compliance costs to SMEs. The public administration estimates the disproportionate administrative cost and can partially exclude SMEs, change the implementation date, set longer transition periods, etc. Though not targeted exclusively to eGov services, the principle can apply to them as well. The cost is measured in GBP following the "Equivalent Annual Net Cost to Business". Initially, the principle applied to micro business. It covers SMEs since 2015, especially from sectors critical to growth.

One-stop shops for investment licensing. Investment licensing usually imposes significant red tape mainly due to the large number of licenses, certificates, authorizations from different government agencies. Most EU countries opt for centralizing the front-office operations. Back office digital interoperability between different government agencies requires intense re-engineering to connect many distributed registries. Many EU countries like Germany, Ireland, Spain and Portugal [10] centralize only the front office operations by setting up one-stop-shops. Countries like the Netherlands put together individual certificates into a "all-in-one" license. While both cases maintain distributed back-office operations, the back office bureaucracy is hidden by offering digital front office interactions. Georgia on the other had has adopted a fully centralized model, where all licensing agencies form a separate government structure. This model allows for very efficient digitalization throughout the licensing value chain; however, it asks for major government restructuring, Greece gradually moves towards the "one-stop-shop" model, trying to digitalize front office licensing operations only.

6.3 Contemporary eGov implementations

ePortugal, Portugal's public service portal operates since in 2019 and provides access to Sigma, a 24/7 chatbot that answers frequent requests from public sector services. Proper understanding of requests as well as documentation of answers are customized through artificial intelligence and natural language processing tools. Sigma may search digital archives, documents, forms, etc to provide the appropriate response to the request. In case that Sigma recognizes that its potential answer may not sufficiently fulfil the request, it directs the user to a public sector employee. Sigma completes around 95.000 requests annually, with no redirection to public servants.

UNA, a similar chatbot developed for the Registry of Enterprises in Latvia. Since 2018 it has completed more than 22.000 conversations with companies, serving 3.700 unique business users. 44% its requests involve general questions while 33% of its cases involve specific business information or business registration.

e-estonia. Estonia's eGov portal may be on the frontier of world's digital government services, because of a considerable effort since the mid-90s. 99% of public services to citizens and businesses are provided online through e-estonia, which is mainly based on highly widespread electronic identification and full interoperability. 98% of Estonians have an electronic ID, while they also have the option to use their mobile phone as an identification element through a system based on a special mobile SIM card ("Mobile- ID") or through a special mobile application ("smart-ID"), for those who do not have a SIM card on their phones. The latter two options have gained a large spread in recent years, as 19% and 44% of the population respectively have chosen them. The real backbone of e-estonia is the "X-tee" ("X-Road" in English) centrally managed distributed data exchange layer (DXL), which provides the information exchange between public organizations over the Internet, with ensured security. All members of X-tee can use the services and data of other members to improve their own business processes. In 2018, Finland also adopted this system and so Finland's and Estonia's data exchange layers have been connected to one another.

The Maltese government presented the project "Maltapps" in 2017, a digital index of government mobile services. "Maltapps" is a uniform digital platform, which provides easy access and use of all government services as well as a single point of entry and interfacing. Following the structure of the government authorities "Maltapps" present twelve application categories like culture, economy, business & commerce, taxation & finance, etc. "Maltapps" also utilizes key digital "enablers" like eID (electronic identification), e-document management, digital postboxes (communication capabilities with government agencies), etc. "Maltapps" have more than 10.000 users, however detailed statistics about requests and responses are not available.

data.gov.uk is the largest open data platform. It was launched in 2010 but reached a critical mass in 2014-2015. The 19.500 datasets in 2015 increased to over 40,000 in 2017. Currently, it contains more than 47,200 datasets from government agencies, local authorities, and various government departments. In addition to the data searchable through the web site, since 2016 an increasing number of datasets has been made available as "registers" through the Registers Service. Registers are structured raw datasets that are intended to be a canonical, reliable, and always up-to-date source of data. Registers share a common API and can be read by both humans and machines. They are offered as JSON, CSV, and RDF files, the latter allowing to link multiple registers together. As of January 2019, the Registers Service is in its alpha phase, with 39 registers published and actively maintained. On January 2010 the city of London, opened an online data warehouse containing more than 200 data sets from London city authorities.

6.4 Recent eGov implementations is Greece.

www.gov.gr aims to become the central web portal of the Greek state. It is online since March 2020 and hosts links to many distributed eGov services of ministries, agencies, organizations, and independent public authorities. For the time being it offers limited interoperability between distributed G2B digital services and acts mainly as a web catalogue for eGov services. It hosts links to the eGov services of 19 Ministries, 68 government bodies / organizations and 7 independent authorities.

It offers 11 groups of eGov services with a total of 1.119 individual links to distributed G2C / G2B services. Most of G2B services involve submission of applications. Responses or the reception of induvial certificates is asynchronous for most of the transactions. The site currently works as a digital front-end since only a few

G2B services involve end-to-end digitalization, interconnected registries, and automated workflow. The list of G2B services includes the following

- Notification of starting a business.
- Application to the extrajudicial mechanism.
- Employer / employee certifications and statements.
- Application for setting up a business.
- Income tax statements.
- Business account statements.
- Electronic invoicing (MyDATA).
- Covid-19 funding.
- NSRF funding.
- Business registration in the commercial register, certificates, and statements.
- Licenses, business certificates and hygiene certificates from various operations.
- Building permits, energy permits, environmental permits.
- Application for various insolvency / bankruptcy certificates. The certificates are not digital yet.
- Application for digital copies of court orders. Currently it applies to selected courts only.

Currently, gov.gr does not offer profile management or user registration. For most services, tax registration or bank registration act as valid login options. There is no open data availability. The monthly visit rate both G2C and G2B services about 1,07 million.

myData stands for Digital Accounting and Tax Application. It is the new electronic platform, with which the Independent Public Revenue Authority (AADE) introduces electronic invoicing and bookkeeping among companies. myData is an important step towards the digital transformation of the tax administration and its relationship with companies. It provides a digital platform for the fulfillment of tax obligations and tax returns. Along with reducing the administrative costs, myData enhances the transparency of electronic transactions and invoicing. myData consists of the following applications

- **e-Invoicing.** Businesses can automatically forward their sale receipts to myDATA at real time. For digital invoices to be regarded as legal they must be certified with a unique registration number. Certified digital invoices form the basis for automated income tax calculation.
- **e-Books.** SMEs can utilize the standardized bookkeeping platform to produce tax statements.

6.5 Key findings

Best practices from other EU countries indicate the following:

- **Legislation and technology coupling is mandatory**. Technology-based initiatives must facilitate legal compliance with reduced administrative burden. Similarly, legislation which disregards technology characteristics usually imposes additional administrative burden.
- **Digital by default process design** result to increased utilization of G2B services. Otherwise, it results to additional administrative burden, also known as digital bureaucracy.
- **G2B administrative burden can be quantified and self-regulated** either in physical or in digital service provision. Centralized public sector functions may achieve higher simplification rates. Hence, one-stop-shops, all-in-one access points and all-in-one certificates are the ideal candidates for effective digitalization.
- **State of the art technologies** like APIs, artificial intelligence, data analytics, and data warehouses increase eGov effectiveness while supporting open-data principles.

7. Modeling eGov maturity with FCMs

7.1 Introduction

This chapter presents the intelligent characteristics and the functionality of FCMs which will be utilized in this project. Section 7.2 gives an overview of contemporary applications of FCMs with emphasis on decision modeling, knowledge representation and multi-level causal relations. Sections 7.3 and 7.4 set the definitions, rules and algorithms that govern FCMs while sections **Error! Reference source not found.** and 7.5 explain w hich FCM characteristics are utilized to model eGov maturity.

This chapter presents generic examples of FCMs with emphasis on feedback loops (section 7.6), multi-level concept decomposition and fuzzy linguistics variables (sections 7.7 and 7.8). These characteristics are key to this research since they can augment historic data analysis with artificial intelligence soft tools to model the multi-dimensional causal relations in such complex reforms.

7.2 Applications of Fuzzy Cognitive Maps

In the past two decades, FCMs have gained considerable interest (examples in references [18], [19], [20]). This technique is especially attractive when modeling systems that are characterized by ambiguity, multi-modality, and non-trivial causality. They are widely used to analyze causal complex systems [21], to model and analyze the behavior of qualitative systems [22] and rule-based historical data analysis [23]. A variety of FCMs are used for capturing - representing knowledge and intelligent information in production applications [24], geographical information systems [25], fault detection [26] and digital transformation [27]. FCMs are used in modeling the supervision of distributed systems [28]. FCMs are been used in operations research [29], data mining [30, 31], as a back end to computer-based models [32], medical diagnosis [33], occupational and health risks [34], navy targeting systems [35], business process re-engineering and organizational modeling [36-38].

Several research reports applying basic concepts of FCMs are also present in the field of business and other social sciences (examples in references [39], [40]). FCMs are successfully applied to various fields such as decision making [41], scenario analysis [42, 43] strategic planning, regional development [44], stock market analysis and financial planning [45]. FCMs are integrated with case-based reasoning technique to build organizational memory in the field of knowledge management [46]. Earlier research adopts FCMs to support the core activities of highly technical functions like urban design [47].

Research like that in references [36, 37, 45] has extended traditional FCM algorithms to cope with multi-level causal relations. Such relations are very frequent in strategy or business simulations.

Summarizing, FCMs can contribute to the construction of more intelligent systems, since the more intelligent a system becomes, the more symbolic and fuzzy representations it utilizes.

7.3 FCM definitions

Fuzzy Cognitive Maps (FCM) is a modeling methodology for complex decision systems, which originated from the combination of Fuzzy Logic [48] and Neural Networks. FCMs are used to represent and to model the knowledge on the examining system. Existing knowledge of the behavior of the system is stored in the structure of nodes and interconnections of the map. An FCM describes the behavior of a system in terms of concepts; each concept represents an entity, a state, a variable, or a characteristic of the system [49].

Kosko [50] defined a concept $\mathbf{C_i}$ that constitutes causal relationships in FCM as $\mathbf{C_i} = (\mathbf{Q_i} \cup \sim \mathbf{Q_i}) \cap \mathbf{M_i}$

where $\mathbf{Q_i}$ is a quantity fuzzy set and $\sim\mathbf{Q_i}$ is a dis-quantity fuzzy set. $\sim\mathbf{Q_i}$ is the negation of $\mathbf{Q_i}$. Each $\mathbf{Q_i}$ and $\sim\mathbf{Q_i}$ partitions the whole set $\mathbf{C_i}$. Double negation $\sim\sim\mathbf{Q_i}$ equals to $\mathbf{Q_i}$, implying that $\sim\mathbf{Q_i}$ corresponds to $\mathbf{Q_i^c}$, the complement of $\mathbf{Q_i}$. However, negation does not mean antonym. Therefore, if a dis-quantity fuzzy set $\sim\mathbf{Q_i}$ does not correspond to the complement of $\mathbf{Q_i}$, we will call it as anti-quantity fuzzy set to clarify the subtle meaning in the dis-quantity fuzzy set, as proposed by [51]. $\mathbf{M_i}$ is a modifier fuzzy set that modifies $\mathbf{Q_i}$ or $\sim\mathbf{Q_i}$

concretely. The modifier fuzzy set fuzzily intersects the fuzzy union of a quantity fuzzy set and a dis-quantity fuzzy set.

This project adopts a more practical approach of FCMs as proposed initially in research like that in references [36, 38]. A similar approach has also been adopted by research like that in reference [52] later on. FCM nodes are named by such concepts forming the set of concepts $C=\{C_1, C_2, \ldots, C_n\}$. Arcs (C_j, C_i) are oriented and represent causal links between concepts; that is how concept C_j causes concept C_i. Arcs are elements of the set $A=\{(C_j, C_i)_{ji}\}\subset C\text{x}C$. Weights of arcs are associated with a weight value matrix W_{nxn}, where each element of the matrix $w_{ji}\in[-1,..,1]\subset R$ such that if $(C_j, C_i)\notin A$ then $w_{ji}=0$ else excitation (respectively inhibition) causal link from concept C_j to concept C_i gives $w_{ji}>0$ (respectively $w_{ji}<0$). The proposed methodology framework assumes that $[-1,..,1]$ is a fuzzy bipolar interval, bipolarity being used as a means of representing a positive or negative relationship between two concepts.

7.4 FCMs as a modeling technique

This project adopts the modelling techniques proposed initially in research like that in references [36, 38]. A similar technique has also been adopted in research like that in reference [52] later on.

The graphical illustration of an FCM is a signed graph with feedback, consisting of nodes and weighted interconnections (e.g. $\xrightarrow{\text{Weight}}$). Signed and weighted arcs (elements of the set A) connect various nodes (elements of the set C) representing the causal relationships that exist among concepts. This graphical representation illustrates different aspects in the behavior of the system, showing its dynamics [50] and allowing systematic causal propagation (e.g. forward and backward chaining).

Positive or negative sign and fuzzy weights model the expert knowledge of the causal relationships [53]. Concept C_j causally increases C_i if the weight value $w_{ji}>0$ and causally decreases C_i if $w_{ji}<0$. When $w_{ji}=0$, concept C_j has no causal effect on C_i. The sign of w_{ji} indicates whether the relationship between concepts is positive ($C_j \xrightarrow{w_{j,i}} C_i$) or negative ($C_j \xrightarrow{w_{j,i}} \sim C_i$), while the value of w_{ji} indicates how strongly concept C_j influences concept C_i. The forward or backward direction of causality indicates whether concept C_j causes concept C_i or vice versa (e.g. Figure 13).

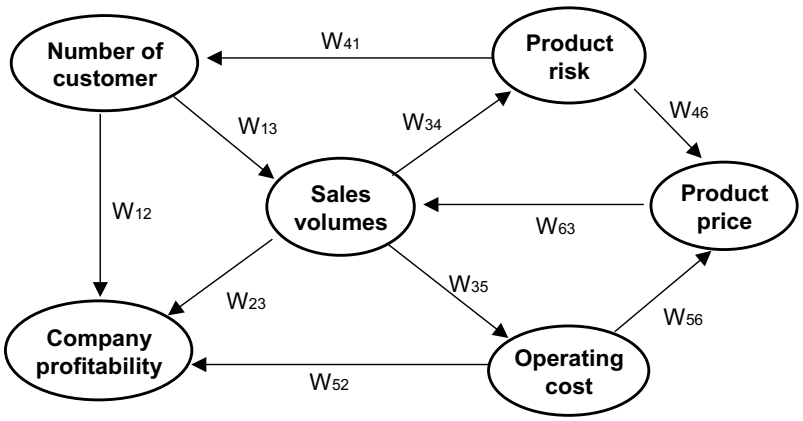


Figure 13: Simple FCM (generic example)

Simple variations of FCMs mostly used in business decision-making applications may take trivalent weight values $[-1,0,1]$. This paper allows FMCs to utilize fuzzy word weights like strong, medium, or weak, each of these words being a fuzzy set to provide complicated FCMs. In contrast, traditional approaches (based on the [54] analysis) adopted only a simple relative weight representation in the interval $[-1,..,1]$. To this extend, such models offer reduced functionality since they do not allow fuzzy weight definitions.

Generally speaking FCM concept activations take their value in an activation value set $V=\{0,1\}$ or $\{-1,0,1\}$ if in crisp mode or $[-\delta,1]$ with $\delta=0$ or 1 if in fuzzy mode. This research framework assumes fuzzy mode with $\delta=1$. At step $t\in N$, each concept C_j is associated with an inner activation value $a_j^t\in V$, and an external activation value $e_{a_j}^t\in R$. FCM is a dynamic system. Initialization is $a_j^0=0$. The dynamic obeys a

general recurrent relation $a^{t+1} = f(g(e_a^t, W^T a^t))$, $\forall t \geq 0$, involving weight matrix product with inner activation, fuzzy logical operators (**g**) between this result and external forced activation and finally normalization (**f**). However, this paper assumes no external activation (hence no fuzzy logical operators). In practice this paper assumes that all eGov agents (e.g. KPIs, concepts, etc) are mapped internally in order to be assigned with weighs and values. This approach simplifies the interpretation of the causal relations by reducing any "unclassified" external factors which may decrease considerably the clarity of the model. As a result, this research utilizes the following base formula for calculating the values of concepts of FCM:

$$a_i^{t+1} = f\left(\sum_{j=1, j\neq i}^{n} w_{ji} a_j^t\right) \qquad (1)$$

where a_i^{t+1} is the value of concept C_i at step $t+1$, a_j^t the value of the interconnected concept C_j at step t, w_{ji} is the weighted arc from C_j to C_i and $f: R \rightarrow V$ is a threshold function, which normalizes activations. Two normalization functions are usually used. The unipolar sigmoid function where $\lambda>0$ determines the steepness of the continuous function $f(x) = \frac{1}{1+e^{-\lambda x}}$. When concepts can be negative ($\delta<0$), function $f(x)=\tanh(x)$ can also be used.

While the normalization function $f(x) = \frac{1}{1+e^{-\lambda x}}$ typically transposes values to **[0,1],** it does so without significant loss of generality. Hence, it is the function utilized in this project.

In contrast to other research practices, this research assumes independent weight value and concept value definitions, which translates to the following numerical assumptions.

$$\sum_{j=1, j\neq i}^{n} w_{ji} \neq 1$$

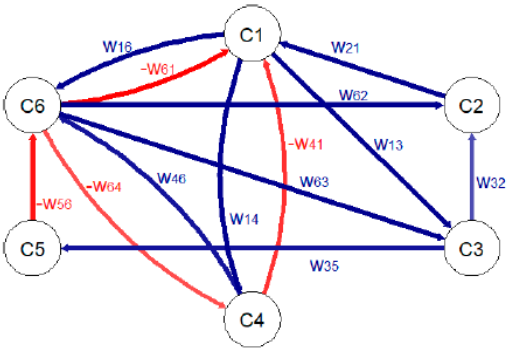
and

$$\sum_{j=1}^{n} a_j \neq 1$$

This assumption increases considerably the flexibility of user input. See section 7.7 for further detail.

To understand better the analogy between the sign of the weight and the positive/negative relationship, it may be necessary to revisit the characteristics of fuzzy relation [30, 55]. A fuzzy relation from a set A to a set B or (A,B) represents its degree of membership in the unit interval $[0,1]$. Generally speaking, sets A and B can be fuzzy sets. The corresponding fuzzy membership function is $\mu f: A x B \rightarrow [0,1]$. Therefore, $\mu f(x,y)$ is interpreted as the "strength" of the fuzzy membership of the fuzzy relation (x,y) where $x \in A$ and $y \in B$. Then this fuzzy relation concept can be denoted equivalently as $x \xrightarrow{\mu f} y$ and applied to interpret the causality value of FCM, since w_{ji} (the causality value of the arc from nodes C_j to C_i) in a certain FCM is interpreted as the degree of fuzzy relationship between two nodes C_j and C_i. Hence, w_{ji} in FCMs is the fuzzy membership value $\mu f(C_j, C_i)$ and can be denoted as $C_j \xrightarrow{w_{j,i}} C_i$.

However, we understand that the fuzzy relation (weight) between concept nodes is more general than the original fuzzy relation concept. This is because it can include negative (-) fuzzy relations. Fuzzy relations mean fuzzy causality; causality can have a negative sign (*Figure 14*). In FCMs, the negative fuzzy relation (or causality) between two concept nodes is the degree of a relation with a "negation" of a concept node. For example, if the negation of a concept node C_i is noted as $\sim C_i$, then $\mu f(C_j, C_i) = -0.6$ means that $\mu f(C_j, \sim C_i) = 0.6$. Conversely, $\mu f(C_j, C_i) = 0.6$ means that $\mu f(C_j, \sim C_i) = -0.6$.



$$W = \begin{bmatrix} 0 & 0 & w_{13} & w_{14} & 0 & w_{16} \\ w_{21} & 0 & 0 & 0 & 0 & 0 \\ 0 & w_{32} & 0 & 0 & w_{35} & 0 \\ -w_{41} & 0 & 0 & 0 & 0 & w_{46} \\ 0 & 0 & 0 & 0 & 0 & -w_{56} \\ -w_{61} & w_{62} & w_{63} & -w_{64} & 0 & 0 \end{bmatrix}$$

Figure 14: Fuzzy cognitive map (left) and the correspondent weight adjacency matrix (right). Generic examples

7.5 Modeling eGov maturity with FCM

This research utilizes Quanta, a robust visual FCM tool, to expedite multi-modal and multi-level map creation. The initial version of Quanta has been funded by the EU ESPRIT programme.

In order to comply with this recuring knowledge flow, this research extends the base FCM algorithm (typically used in cases like those in reference [54]), by utilizing the following updated algorithm aiming at modeling more effectively the distributed, multi-level and multi-modal nature of eGov domain:

$$A_i^{t+1} = f(k_1 A_i^t + k_2 * \sum_{j=1, j\neq i}^{n} W_{ji} A_j^t) \qquad (2)$$

The coefficient k_1 represents the proportion of the contribution of the value of the concept A_i at time t in the computation of the value of A_i at time $t+1$. In practice, this is equivalent to assume that $W_{ii}=k_1$. The incorporation of this coefficient can indicate the stability or resilience of concept A_i over time, in the sense that a higher value at k_1 makes the value of A_i^{t+1} to rely heavily on the value of A_i^t. In any case, k_1 results in smoother variation of concept values during the iterations of the FCM algorithm.

Coefficient k_2 expresses the "influence" of the interconnected concepts in the configuration of the value of the concept A_i at time $t+1$. In practice, it indicates the hierarchical importance (loosely interpreted as the decentralization distance or the hierarchical distance) of the concept A_i in comparison to other concepts of the same level. Figure 15 presents a generic example of the use of the k_2. Also, k_2 is particularly useful in cases of incomplete maps, missing concepts, incomplete estimation of concept values, etc). In such cases it can also indicate the sufficiency of the set of A_j $j\neq i$, in the estimation of the value of A_i.

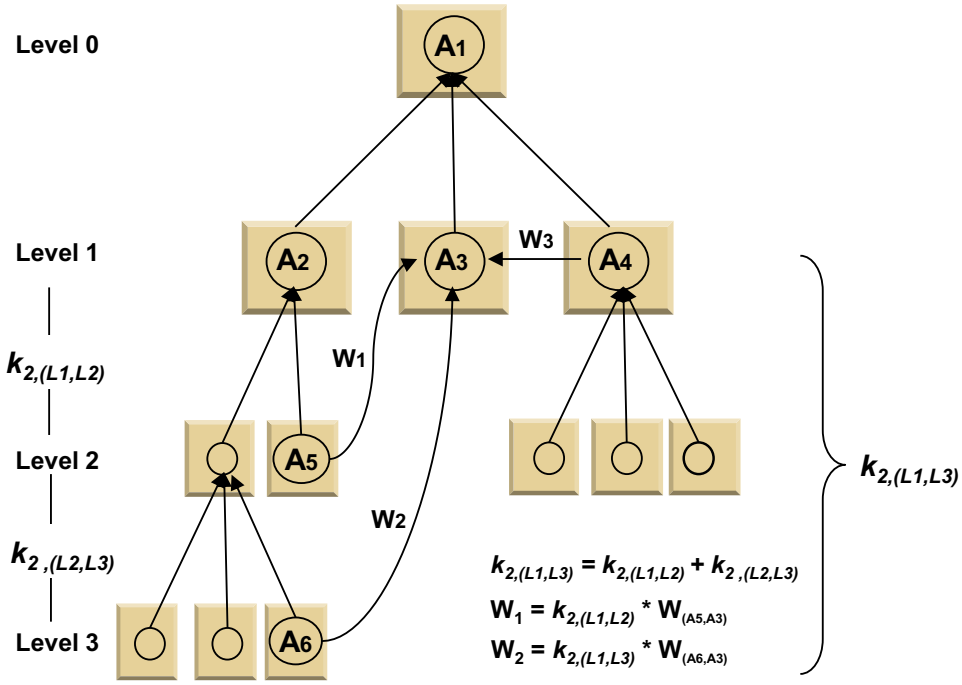


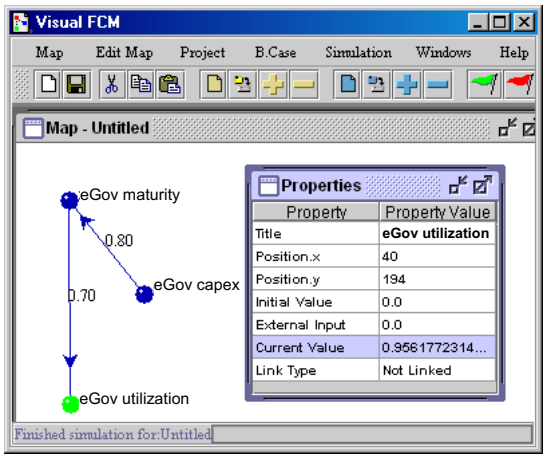
Figure 15: Top-down maturity decomposition with bottom-up decentralization coefficients (generic example)

Ideally, $\mathbf{k_2}$ can break down into weighted sub-coefficients (e.g. $k_2 = x * k_2^x + y * k_2^y + \ldots$), with parameters **x**, **y** to present the relative importance of $\mathbf{k_2^x}$ and $\mathbf{k_2^y}$ in multi-level interconnection problems like **(A_6, A_3)** in Figure 15. However, preliminary experiments show that this approach imposes initialization overheads without significantly increasing the accuracy of the FCM algorithm.

This paper also assumes that $\mathbf{k_1}$ and $\mathbf{k_2}$ can be fuzzy sets, extending previous relevant research.

7.6 FCM feedback loops

To demonstrate eGov modeling using FCMs, consider Figure 16, which depicts a graphical example of fuzzy relationships with no feedback loops followed by sample numerical calculations using formula (2), with $\mathbf{k_1}=\mathbf{k_2}=\mathbf{1}$ and $\boldsymbol{\lambda}=\mathbf{5}$ as the steepness of the normalization function.



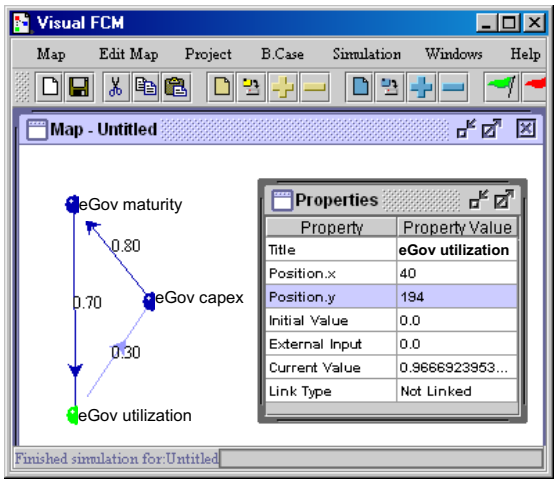
Concept	Initial (input) value (t=0)		Current (output) Value	
	Scenario A	Scenario B	Scenario A	Scenario B
eGov capex	0.5	0.2	0.5	0.2
eGov maturity	0	0	0.8807	0.5986
eGov utilization	0	0	0.9561	0.8904

Figure 16: Sample FCM calculations with no feedback loop (generic example)

Setting the input (initial) value of "eGov capex" to 0.5 (1st scenario) triggers the FCM formula. The formula then calculates the current (output) values of all related concepts. A "zero" concept value indicates that the concept remains neutral, waiting for causal relationships to modify its current value. A generic interpretation of the first scenario indicates that if eGov capex increases by 50% then the eGov maturity may increase by

88,07% and the utilization of eGov services by 95.61%. In contrast, if eGov capex increases by 20% (2nd scenario), then the eGov maturity and utilization may increase by 59.86% and 89.04% respectively.

Figure 17 presents a typical example of a feedback loop. Similarly, to Figure 16, changing the input value of "eGov capex" triggers the FCM formula. However, the feedback loop dictates those calculations stop only when an equilibrium state for all affected concepts has been reached, modifying all input values accordingly.



Concept	Input value (t=0)		Current (output) Value	
	Scenario A	Scenario B	Scenario A	Scenario B
eGov capex	0.5	0.2	0.81	0.5128
eGov maturity	0	0	0.9623	0.8860
eGov utilization	0	0	0.9666	0.9569

Figure 17: Sample FCM calculations with feedback loop (generic example)

A generic interpretation of this feedback loop indicates that increased eGov capex results to increased eGov utilization. It also indicates that the increased utilization of eGov services triggers additional eGov investments (capex) to satisfy the increased eGov appetite. Scenario A shows that if eGov capex increases initially by 50% then the eGov maturity may increase by 96.23% and the utilization of eGov services by 96.66%. This scenario also indicates that eGov capex must increase to 81% (instead of 50%) to cope with the increased eGov appetite. Similar interpretations hold for the second scenario.

7.7 Assigning linguistic variables to FCM weights and concepts

To define weight value of the association rules in an adaptive and dynamic manner, the following methodology is utilized by this research. Users are asked to describe the interconnection *influence* of concepts using linguistic notions. *Influence* of one concept over another, is interpreted as a linguistic variable in the interval **[-1,1]**. Its term set is **T(influence)**={negatively very-very high, negatively very high, negatively high, negatively medium, negatively low, negatively very low, negatively very-very low, zero, positively very-very low, positively very low, positively low, positively medium, positively high, positively very high, positively very-very high}.

This research utilizes a semantic rule **M** to be defined at this point. The above-mentioned terms are characterized by the fuzzy sets whose membership functions **μ** are shown in Figure 18.

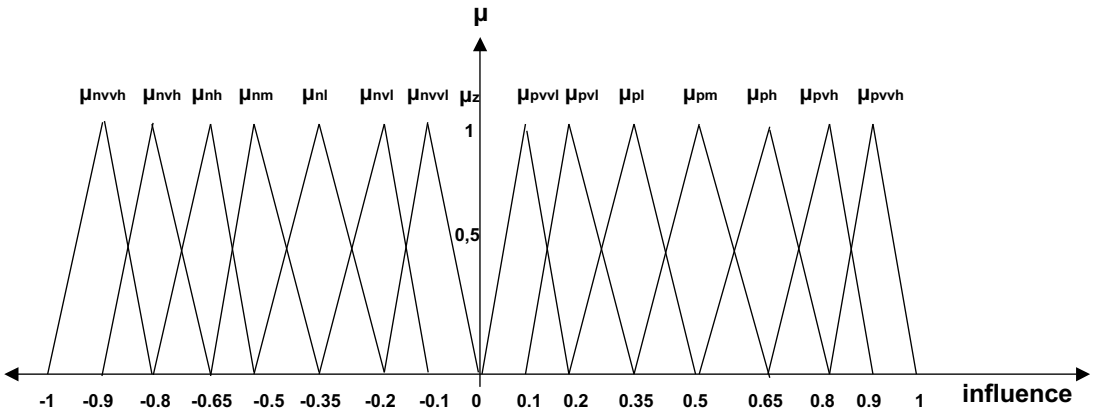


Figure 18: Membership functions of linguistic variable influence

- **M(negatively very-very high)=** the fuzzy set for "an influence close to -90%" with membership function μ_{nvvh}
- **M(negatively very high)=** the fuzzy set for "an influence close to -80%" with membership function μ_{nvh}.
- **M(negatively high)=** the fuzzy set for "an influence close to -65%" with membership function μ_{nh}.
- **M(negatively medium)=** the fuzzy set for "an influence close to -50%" with membership function μ_{nm}.
- **M(negatively low)=** the fuzzy set for "an influence close to -35%" with membership function μ_{nl}.
- **M(negatively very low)=** the fuzzy set for "an influence close to -20%" with membership function μ_{nvl}.
- **M(negatively very-very low)=** the fuzzy set for "an influence close to -10%" with membership function μ_{nvvl}.
- **M(zero)=** the fuzzy set for "an influence close to 0" with membership function μ_z.
- **M(positively very-very low)=** the fuzzy set for "an influence close to 10%" with membership function μ_{pvvl}.
- **M(positively very low)=** the fuzzy set for "an influence close to 20%" with membership function μ_{pvl}.
- **M(positively low)=** the fuzzy set for "an influence close to 35%" with membership function μ_{pl}.
- **M(positively medium)=** the fuzzy set for "an influence close to 50%" with membership function μ_{pm}.
- **M(positively high)=** the fuzzy set for "an influence close to 65%" with membership function μ_{ph}.
- **M(positively very high)=** the fuzzy set for "an influence close to 80%" with membership function μ_{pvh}.
- **M(positively very-very high)=** the fuzzy set for "an influence close to 90%" with membership function μ_{pvvh} .

The membership functions are not of the same size since it is desirable to have finer distinction between grades in the lower and higher end of the influence scale. As an example, three users propose different linguistic weights for the same interconnection w_{ij} from concept C_i to concept C_j. User A proposes a "positively very low" linguistic weight, user B proposes a "positively strong" weight and user C proposes a "positively very strong" weight. The three linguistics are integrated using a sum combination method coupled with the defuzzification method [56, 57] of center of gravity (CoG) to produce a "crisp" weight in **[-1,1]**, as follows.

- The linguistic variable "positively very low" (see Figure 19, triangle A) with a membership function μ_{pvl} has a $CoG_A = 0.216$.

- The linguistic variable "positively strong" (see Figure 19, triangle B) with a membership function μ_{ph} has a $CoG_B = 0.65$.
- The linguistic variable "positively very strong" (see Figure 19, triangle C) with a membership function μ_{pvh} has a $CoG_C = 0.783$.
- The defuzzified linguistic variables produce a "crisp" weight $w_{ij} = \frac{GoC_A+GoC_B+GoC_C}{3} = 0.55$ in $[-1,1]$.

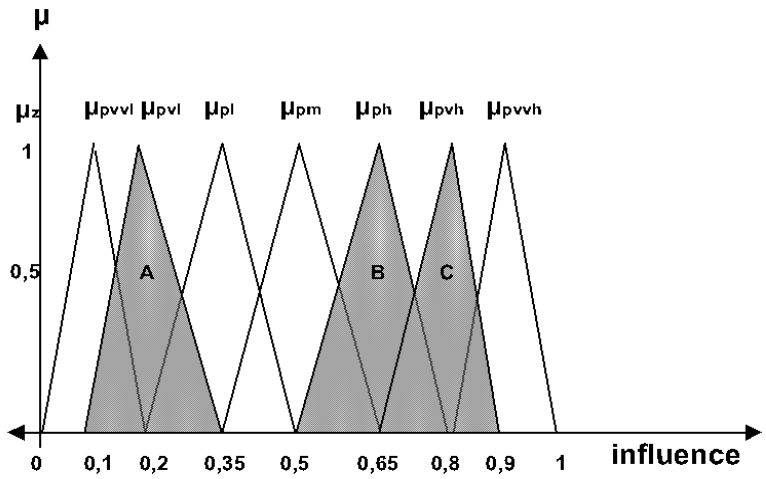


Figure 19: Linguistic assignments

This approach has the advantage that users do not have to assign numerical causality weights but to describe the degree of causality among concepts. The same semantic rule and term set can be used to define the coefficients k_1 and k_2.

A similar methodology can be used to assign values to concepts as well as coefficients k_1, k_2. The users are also asked to describe the *measurement* of each concept using once again linguistic notions. *Measurement* of a concept is also interpreted as a linguistic variable with values in the interval **[-1,1]**. Its term set **T(Measurement)** equals to **T(Influence)**. A new semantic rule M_2 (analogous to **M**) is also defined, and these terms are characterized by the fuzzy sets whose membership functions μ_2 are analogous to membership functions μ. A similar methodology applies to coefficients k_1, k_2.

The fuzzy definitions in cognitive maps at such a eGov domain are considered to be novel. In contrast to other research practices the proposed utilization of fuzzy variables:

- Departs from the crisp or probabilistic definition of weight and concept values. In contrast, other research practices support only crisp definitions (e.g. –1, 0 or 1) asking for substantial information analysis which may not be available during ex-ante decision making.
- Departs from accurate arithmetic definitions of concept / weight values. It requires term set estimations (e.g. very high, high, etc) which couple closely to the human representation of expert knowledge.
- Caters for independent weight value definition. In contrast, other research practices support relative weight definitions (that is $\sum_{j=1}^{n} w_{ji} = 1$), reducing the flexibility of user input. Similarly, this research caters for independent concept value definitions.
- Caters for qualitative definitions to align with the soft modeling characteristics of cognitive maps. It also aligns with the trend-based decision support usually required for eGov strategic level decisions. The interpretation of fuzzy linguistic variables to arithmetic values is transparent to the user of the tool. In contrast, the quantitative approach offered by relevant research practices usually asks for substantial information analysis which may not be available during ex-ante decision making.

7.8 Learning algorithms

The linguistics assignments assume that the weight and value matrix is based on expert input. Essentially, experts provide individual matrices, which are combined using a simple unsupervised inference law. The FCM deployment that skeleton FCMs (i.e FCMs with concepts and arcs but no value assignments) remain stable enough during the analysis. Skeleton FCMs change only when the underlying eGov strategy changes. Similarly, eGov strategy scenarios (i.e skeleton FCMs with value assignments) change every time the underlying hypotheses (i.e. concept values) change.

Recent research activities indicate that this unsupervised "training" operation can be replaced by the automated creation (and modification) of FCMs from raw data. Kosko [58] discussed that traditional learning laws (e.g. differential hebbian learning law) can provide conditionally stable dynamic systems able to express the hidden patterns of adaptive causal networks. Other variations of automated creation / modification techniques include balanced differential learning, learning rules with generalized hebbian synapses, pseudo outer-product learning algorithms to reduce the work in identifying fuzzy rules, generalized hebbian rules for activity-dependent modifications, etc.

The integration of such a learning inference technique currently falls out of the scope of this project, however it is considered as a future research direction.

8. The evaluation framework for strategic alignment

8.1 Introduction

To provide a comprehensive x-ray of eGov projects in Greece this research couples typical eGov strategy methodologies with an eGov maturity evaluation framework. Section 8.2 explains how this research goes beyond a hierarchical strategy break-down and how multi-dimensional relations between objectives, actions, implementation tactics, managerial levels are introduced. Section 8.3 highlights how FCMs will be used.

This framework is the basis for a comprehensive x-ray of eGov projects in Greece.

8.2 Coupling FCMs with strategy methodologies

Developments in eGov services during the covid-19 era have a significant impact mainly on citizens. However, chapter 4 indicates that the G2B digital maturity still emerges. Despite the rhetoric surrounding ICT integration in the public sector, articulated mechanisms that support a holistic assessment of eGov strategy, a proactive identification of associated risks and an understanding of the impact of ICT on G2B processes are still emerging. Furthermore, contemporary eGov indicators (as presented in chapter) focus on an *ex-post* maturity and performance assessment of ICT investments, rather than a comprehensive review of strategic risks and failures.

A typical eGov strategy methodology (as presented by consulting houses like McKenzie, PwC, Deloitte, Accenture, etc) consists of a series of phases, hierarchical layers of objectives, implementation roadmaps, KPIs, etc (Figure 20). Usually, such methodologies follow a hierarchical break down which typically aligns with the strict managerial hierarchy of the public sector. This approach presents the inherent advantage of a clear decomposition of strategy objectives to actions and implementation tactics. At the same time, this approach presents the inherent disadvantage of missing multi-dimensional relations between objectives, actions, implementation tactics, managerial levels.

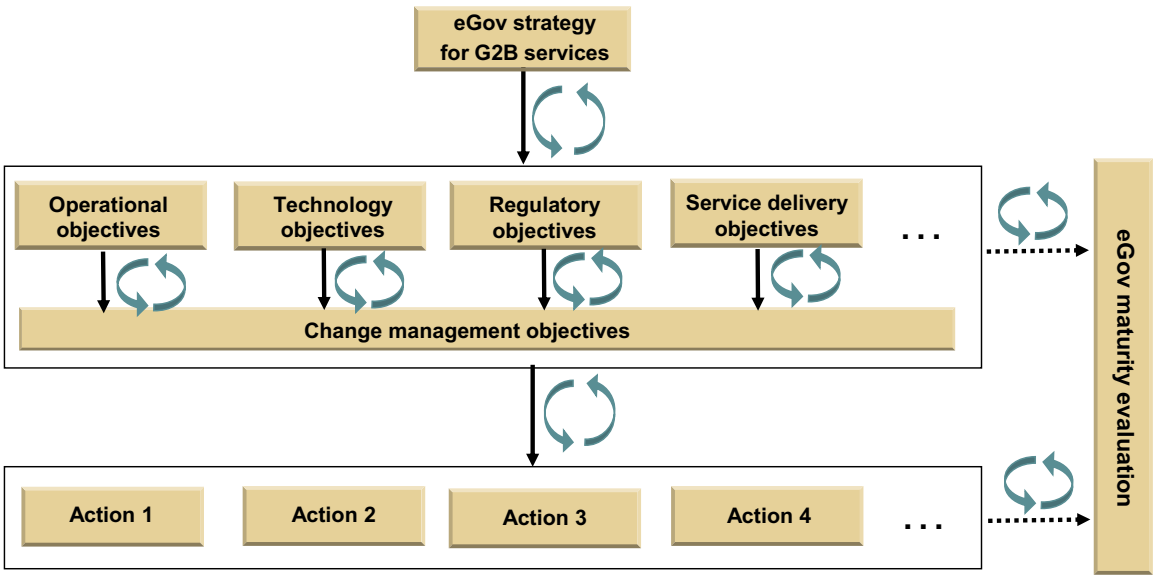


Figure 20: Overview of eGov strategy (generic example)

Even though such comprehensive methodology frameworks are commonly used in various eGov projects in the EU, it remains unclear if Greece adopts them to same extend.

The FCM tool focuses on supplementing such a strategy methodology by providing an alignment evaluation framework (Figure 21**). The alignment evaluation aims at identifying (a) to what extend eGov projects in Greece adopt a comprehensive strategy roadmap (b) which elements of the strategy are neglected (c) what is their impact on eGov maturity.**

While such alignment evaluation frameworks may consist of various KPIs, this research builds on the eGov maturity indicators adopted by SEV DMI (see section 3.5). In addition, this research brings forward the elements of project and change management. In complex digital transformation projects those two elements usually have a major impact on successful implementations since they bind together ICT with process re-engineering, leadership, and operational efficiency. As a result, DMI set of indicators are supplemented with strategy, tactical and change management KPIs.

Like any FCM tools, this deployment does not estimate the absolute value of the maturity metrics or the overall eGov performance. It only allows the stakeholders to reason about the qualitative state of maturity metrics and identify potential divergence from the eGov vision.

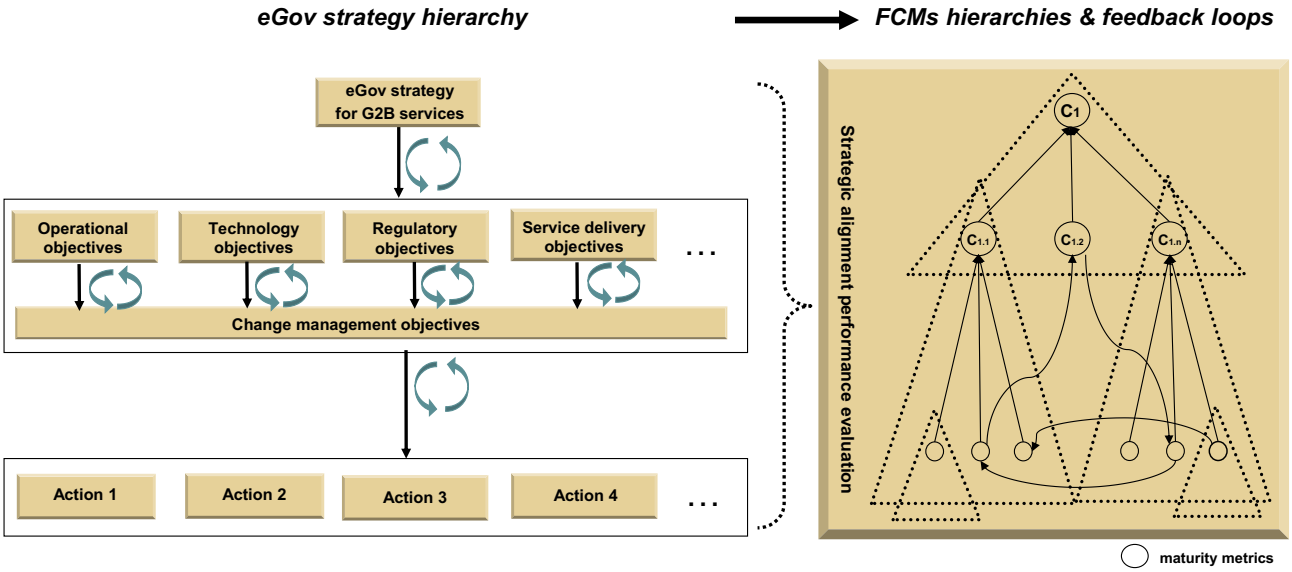


Figure 21: Inherent relationships between eGov strategy and FCM hierarchies (generic example)

8.3 FCM utilization

The FCM tool offers a holistic understanding of eGov challenges through a broad coverage of several strategy areas any ICT project at the public sector must consider. To this extend, the purpose of the FCM tool is multi-fold.

- Assessment of eGov strategy gaps:
  - The FCM tool aims at providing an interdisciplinary framework to benchmark the eGov characteristics. It utilizes an extended set of maturity metrics (see chapter 4) to re-create a strategic map with objectives and actions. The tool uses a multi-dimensional, though practical, perspective which includes "customer" facing metrics, technology metrics, operational metrics, HR metrics as well as project management metrics. In contrast, other research approaches (as presented in section 7.1) follow a single dimensional approach.
  - The FCM framework offers a new source of tangible strategic requirements for eGov based on a multidimensional analysis and a holistic viewpoint of the "customer", rather than the public sector. Also, it aims at encompassing both traditional and contemporary ICT, without being either product or solution centric.
- Assessment of eGov impact and scenario analysis:
  - The FCM tool can be used to quantify the impact of eGov strategic changes to the efficiency of G2B services.
  - The predictive capabilities of this model will be utilized to identify gaps and compare comprehensive what-if scenarios. FCMs should be perceived as a decision aid to support strategy decisions at an

executive level, rather than a sophisticated process simulator. Keep in mind that the unipolar sigmoid function restricts calculations to **[-1,1]** at all iterations.

This tool benefits two groups of stakeholders in particular:

- **Senior government officials**: The FCM deployment aims at providing rapid identification of significant gaps in the strategy, ex-ante impact assessment of the implementation road map, risk, opportunity areas and change management challenges which drive the upgrade of G2B services
- **eGov digital transformation management**: The FCM deployment aims at ensuring broad coverage of eGov maturity issues, while providing insights on how to manage ICT implementation, improve the probability of success and mitigate risk.

9. FCMs deployment

9.1 Introduction

This chapter migrates key findings of the previous chapters into an intelligent causal model. This deployment is fully functional x-ray of G2B eGov projects in Greece. Section 9.2 explains how FCM definitions and rules setup the maturity maps. Section 9.3 introduces the FCM hierarchy, essentially the map of FCM maps. Sections 9.4 - 9.7 introduce each skeleton map, essentially the concept interconnections (including feedback loops) without any value and weight assignments.

Sections 9.8 - 9.14 present alternative eGov scenarios (case studies). Each scenario utilizes the same skeleton maps but with different value and weight assignments. The FCM algorithm calculates values for all concepts and then the fuzzy results are interpreted. These interpretations form the basis for policy recommendations for effective eGov project implementation.

Scenarios can fulfill multiple objectives at the same time. For example, identify potential gaps in eGov strategy, benchmark eGov characteristics, assess the impact of "customer" requirements to ICT options (and vice versa), assess the impact of eGov strategic changes to the efficiency of G2B services, etc. In any case, the predictive capabilities of this model will be utilized to supplement "what-if" strategic reasoning either by senior administration or digital transformation management. Therefore, FCMs and the scenario presented in this chapter should be perceived as a decision aid to support strategy decisions at an executive level, rather than a sophisticated process simulator or cost / benefit calculator

Section 9.15 summarizes the findings of this chapter.

9.2 Setting up eGov maturity FCMs

The maturity FCMs are generated by the following steps:

- **Step 1: FCM concepts**. The research team initially identifies the relevant maturity indicators utilized by various digital maturity databases like DMI, DESI, WEF, etc (see section 3.2 for more detail). The research also employs input from external experts as well as reports published by diaNEOsis to supplement and validate the list of maturity indicators. All these eGov maturity metrics are transposed into FCM concepts (graphically represented as nodes).
- **Step 2: FCM concept relations**. Many digital maturity databases describe the inherent relations between their indicators. The research team also employs input from external experts as well as reports published by diaNEOsis to supplement and validate the relations between indicators. These relations are transposed into FCM skeleton relations, that is causal links between concepts but without any actual value assignment (graphically represented as arrowhead lines or arcs between nodes).
- **Step 3: FCM Skeleton maps**. Each skeleton map consists of a group of concepts with skeleton relations, without any value assignment.
- **Step 4: FCM Hierarchies.** Hierarchical layers of objectives, actions, and implementation roadmaps transpose the eGov strategy into FCM maps. In practice, the research teams with the support of external experts prepare and validate a hierarchical decomposition (top-down decomposition) of concepts within skeleton maps to interpret the decomposition of maturity indicators to constituent sub-metrics. This interpretation follows the typical eGov strategy (Figure 20) and allows stakeholders to comprehend the traditional top-down span of control. However, this interpretation also allows the stakeholders to realize in a bottom-up manner the impact of constituent maturity indicators (lower level FCMs) to higher-level eGov maturity metrics (affected metrics). In addition, the FCM hierarchy supplement the eGov strategy with alignment evaluation capabilities (Figure 21).
- **Step 5: Feedback loops.** The research teams with the support external experts identify multi-dimensional feedback loops between concepts or skeleton maps of any level of the hierarchy. The feedback loops generate a comprehensive impact assessment simulation as well as an alignment evaluation tool. This interpretation extends the hierarchical strategy approach and allows stakeholders to visualize the change of eGov maturity given a broad set of interrelated metrics.

- **Step 6: Value assignment.** The research team with the support external experts assign values to concepts and relations. They use the semantic rules and functions presented in section 7.7. The change in the value of a concept is interpreted by the FCM as this concept being the input decision variable that triggers the FCM calculations. All remaining concepts acts as output decision variables.
- **Step 7: Scenario calculations**. Each scenario utilizes the same skeleton maps but with different value assignments and different input decision variables. Isolated or partial calculations in any part of the FCM hierarchy are presented as deep dives into specific maturity characteristics. In practice, the tool can isolate parts of the hierarchy to provide partial calculations. This is analogous to seeing the eGov strategy either as a single "big bang" event or as an ongoing exercise of setting successive objectives and rolling out actions gradually.
- **Step 8: Equilibrium results.** Equilibrium values are presented as the threshold values for each concept or decision variable. Essentially, the equilibrium value can be interpreted as the minimum viable value for each concept for the model to run. The tool initially assigns the max value (i.e 1) as the initial value to all concepts. Any change to this value to any concept triggers the FCM algorithm and the feedback loops. At the end of the calculations every concept receives its current value (namely the final or the equilibrium value) which may differ from the initial one. The change between the initial and the equilibrium value in a concept denotes that (a) this concept is affected by other concepts (b) an attempt to impose a value different than the equilibrium value to the concepts is completely unnecessary since the model will return to its equilibrium state once again after the new calculations (c) an attempt to impose a value lower that the equilibrium value to the concepts renders the model unable to operate.

All steps were conducted by combining input from the research team, external experts from private sector companies and external experts from the academia. The research teams also utilized indirectly input from workshops conducted by SEV Hellenic Federation of Enterprises and diaNEOsis.

9.3 FCMs hierarchy overview

FCMs are deployed following the provisions of section 9.2. The deployment encodes skeleton maps that can supplement the eGov maturity modeling by storing concepts under different map categories (Figure 22-left), namely:

- Business category: all concepts relating to organizational or process-oriented activities of eGov.
- Social category: all concepts relating to civil society concepts.
- Technical category: all infrastructure and ICT related concepts.
- Integrated category: mainly high-level concepts (e.g. a concept $\mathbf{C_i}$ with no backward causality such that $\forall \mathbf{j}:\mathbf{w_{ji}=0}$), or concepts which may fall under more than one main categories.

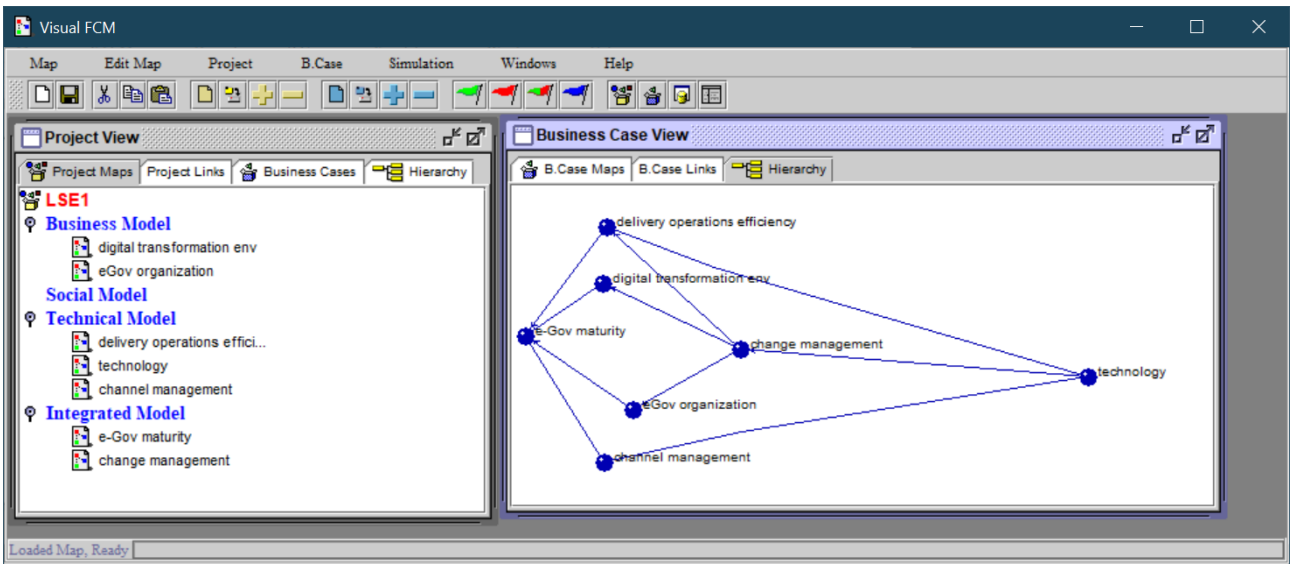


Figure 22: Map categories & a sample FCM hierarchy

The dynamic nature of the deployment allows easy reconfiguration. Further maturity concepts may be added, while maturity concepts may be decomposed further to comply with specialized requirements. This categorization is compatible both with the "process view" or the "technology view" of the public sector to allow greater flexibility in modeling dispersed knowledge flows. The hierarchical decomposition of maturity concepts generates a set of dynamically interconnected hierarchical maturity maps. Each map analyzes further the relationships among concepts at the same hierarchical level. Figure 22-right presents such a sample map hierarchy, which also serves as the FCM overview.

Currently, the mechanism integrates more than 60 concepts, forming a hierarchy of more than 8 maps. The dynamic interface of the mechanism allows the eGov stakeholders to utilize a sub-set of these concepts.

The tool can portray the maturity model following either a holistic ("big bang") or a scalable ("successive" or "incremental") approach. The Quanta implementation can accommodate both approaches. It also allows the user to specify the degree of FCM decomposition during the map traversal. Instead of waiting for a lower level FCM to traverse its nodes and pass its value to higher level map hierarchies, the user may directly assign an external value to nodes which link hierarchies. In practice, the simulation is carried out as if there are no links with other FCMs. Also, the current implementation allows:

- Easy customization of the function **f, λ** and coefficients $\mathbf{k_1}$**,** $\mathbf{k_2}$**.** Easy re-configuration of the formula A_i^{t+1} to adapt to the specific characteristics of individual enterprises.
- Generation of scenarios for the same skeleton FCM.
- Automatic loop simulation until a user-defined equilibrium point has been reached. Alternatively, step-by-step simulation (with graphical output of partial results) is also available to provide a justification for the partial results.

The following sections present the skeleton maps for all categories. The "Technology" map currently serves as the lower part of the hierarchy. Its concepts act as the activators of the FCM modeling. All scenarios employ the same skeleton maps.

The Quanta tool iterated a set of more than 60 concepts spread over 8 hierarchical maps to calculate their equilibrium values. All scenarios run on a typical PC with a i5 Intel processor. As far as the number of iterations is concerned, concepts on lower-level maps reached their equilibrium values after 50 iterations on average. The average number of iterations decreased to 15 for middle and upper-level maps. The process time is negligible on typical PCs, namely one minute or so.

9.4 Skeleton maps – business model

The mechanism proposes two (2) different maturity maps each consisting of generic eGov maturity metrics and arcs as follows:

- The **Digital transformation environment** map (Figure 23) reasons on the maturity of issues like policies and regulations that affect eGov and its strategic prioritization by the public sector administration. This set consists mainly of "back-office" maturity concepts.
- The **eGov organizational competencies** (Figure 24) map summarizes concepts related to process management and organizational efficiency of eGov projects. This set consists mainly of "back-office" maturity concepts.

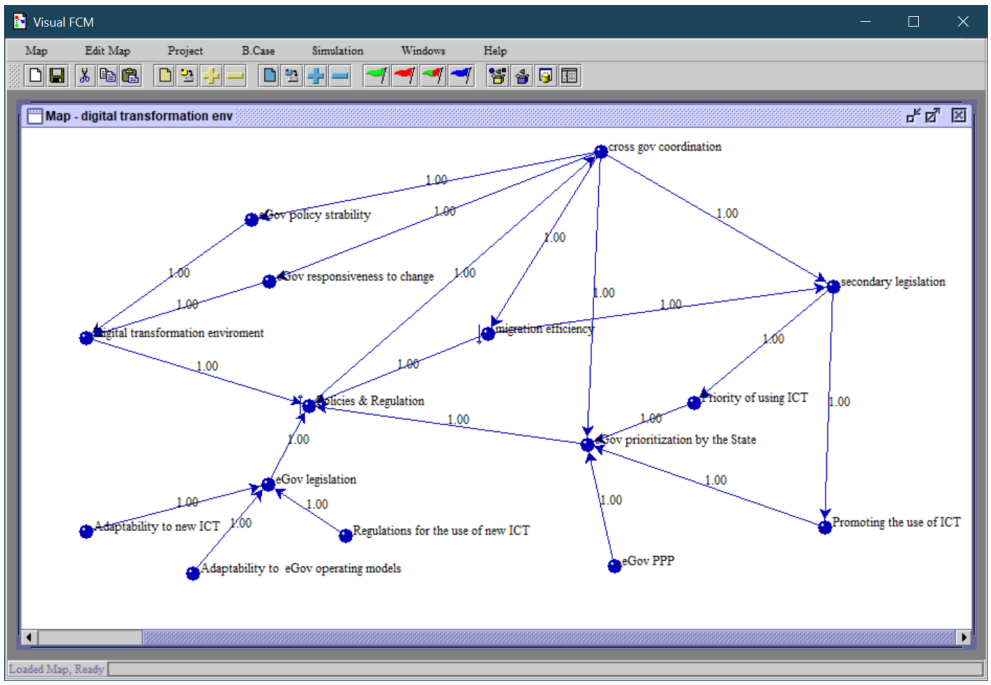


Figure 23: Skeleton map – Digital transformation environment

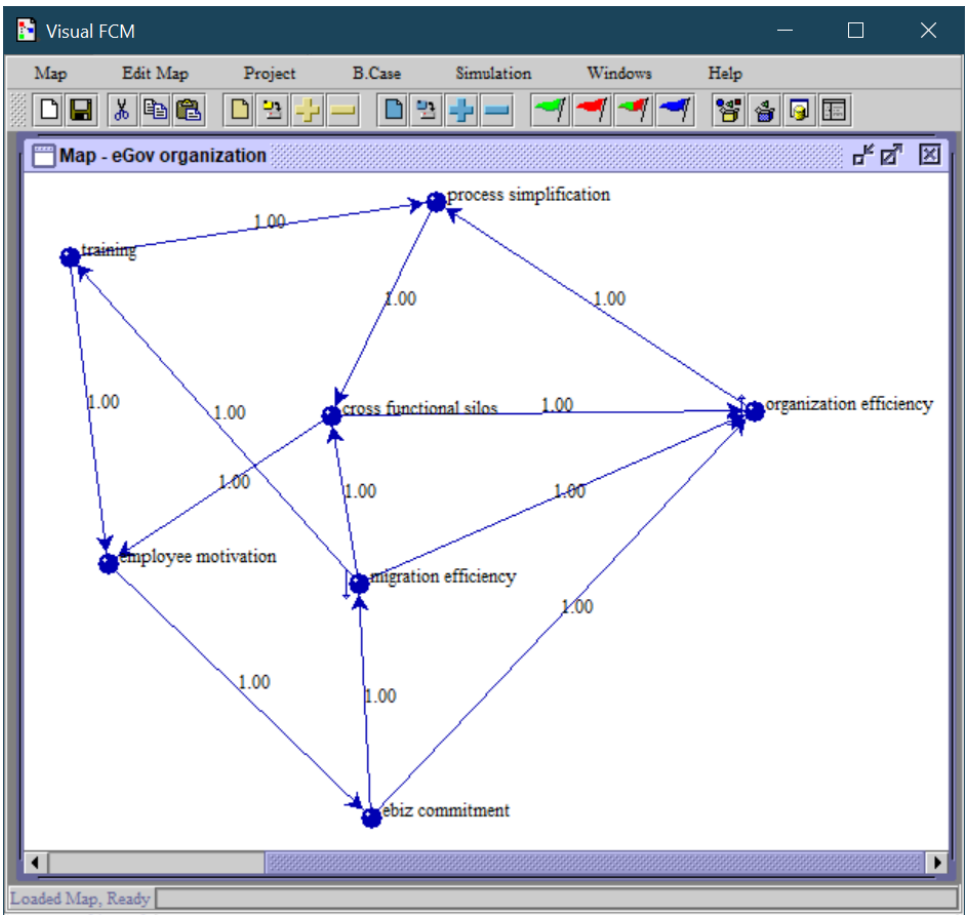


Figure 24: Skeleton map – Organizational competencies

Concepts denoted as "↓" expand further to lower-level maps. Similarly, "↑" denotes bottom-up causal propagation.

9.5 *Skeleton maps – technical model*

The mechanism proposes four (4) different maturity maps each consisting of generic eGov maturity metrics as follows:

- The **Delivery operations efficiency** map (Figure 25 Figure 26) reasons on the maturity of issues like digitalization efficiency, eGov utilization and optimization, use of digitalization rules, etc. This set consists mainly of "front-office" maturity concepts.
- The **Technology** map (Figure 26) reasons on the impact of new ICT scope on change management, ICT investments, ICT interoperability, etc. While emphasis is on front-office ICT, this map introduces ICT scope for back-office operations as well. The "Technology" map currently serves as the lower part of the hierarchy. Its concepts act as the activators of the FCM modeling.
- The **Channel management** map (Figure 27) reasons on the impact of access characteristics to the eGov efficiency. This set consists mainly of "front-office" maturity concepts.

Concepts denoted as "↓" expand further to lower-level maps. Similarly, "↑" denotes bottom-up causal propagation.

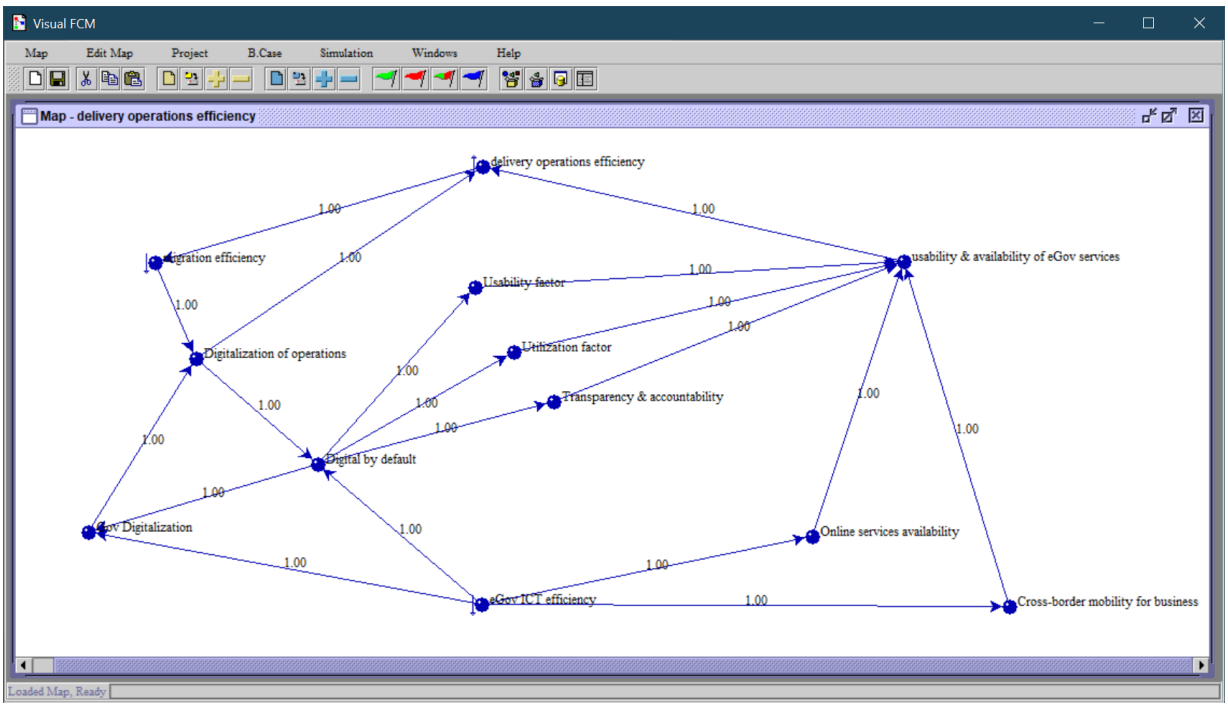


Figure 25: Skeleton map – delivery operations efficiency

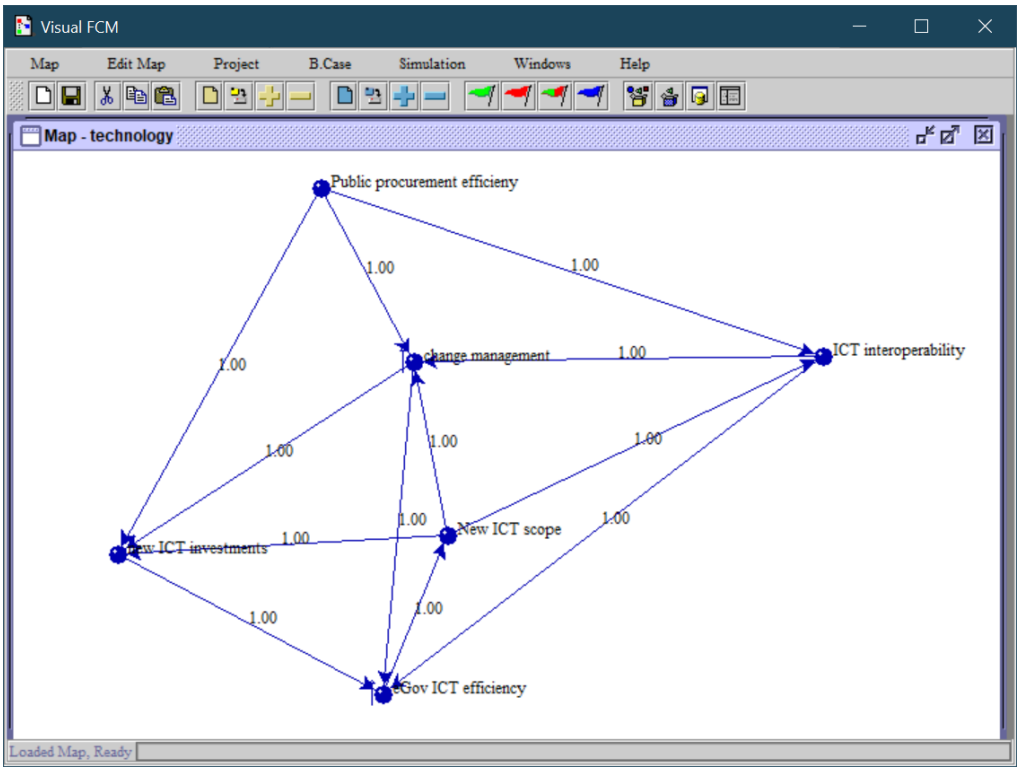


Figure 26: Skeleton map – Technology

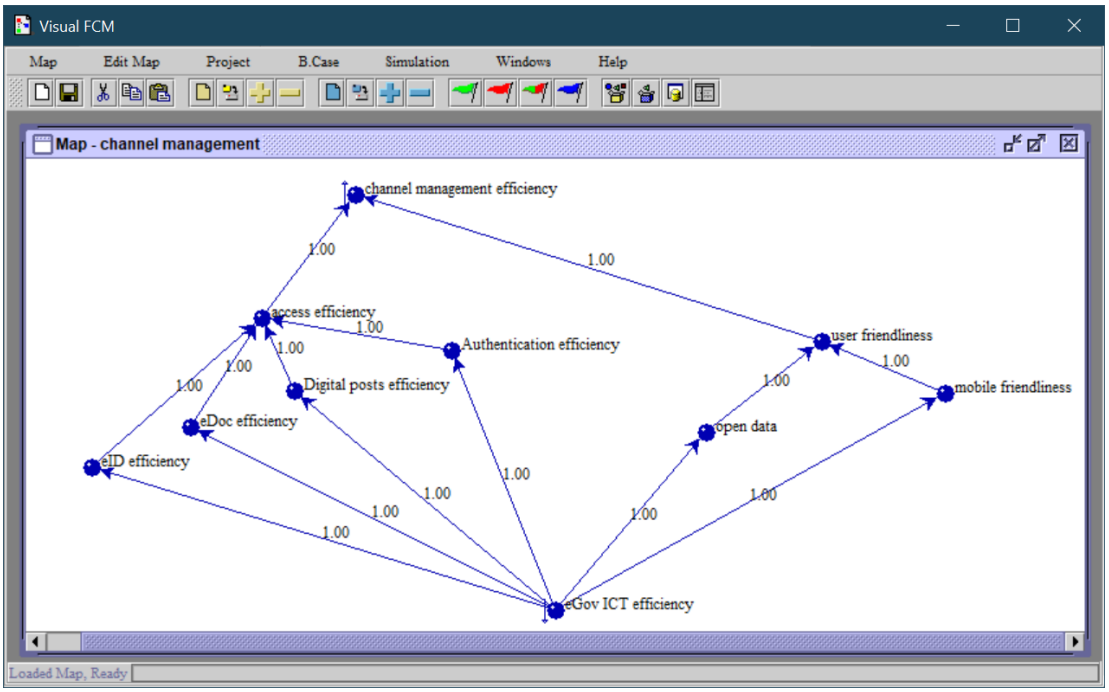


Figure 27: Skeleton map – channel efficiency

9.6 Skeleton maps – integrated model

The mechanism proposes two (2) different maturity maps each consisting of generic eGov maturity metrics as follows:

- The **Change management** map (Figure 28) reasons on the maturity of concepts like project leadership, project continuity, budget, migration efficiency, etc. This set consists mainly of "back-office" maturity concepts.

- The **eGov maturity overview** map (Figure 29) interconnects all maturity domains to reason on the overall eGov maturity. It can either as the maturity aggregator (bottom-up value calculations) or the maturity initiator (top-down directed calculations). This map visualizes the emphasis put in administrative burden reduction. One can easily argue that the current eGov strategy relies heavily in admin burden reduction in front-desk G2B transactions, but disregards comprehensive reforms and process simplifications to utilize fully the power of doing business digitally. Red tape elimination in front-desk operations plays a key role to eGov projects by offering quick-wins. However, it comes with the danger to limit eGov maturity to "average" improvements by disregarding longstanding structural problems.

Concepts denoted as "↓" expand further to lower-level maps. Similarly, "↑" denotes bottom-up causal propagation.

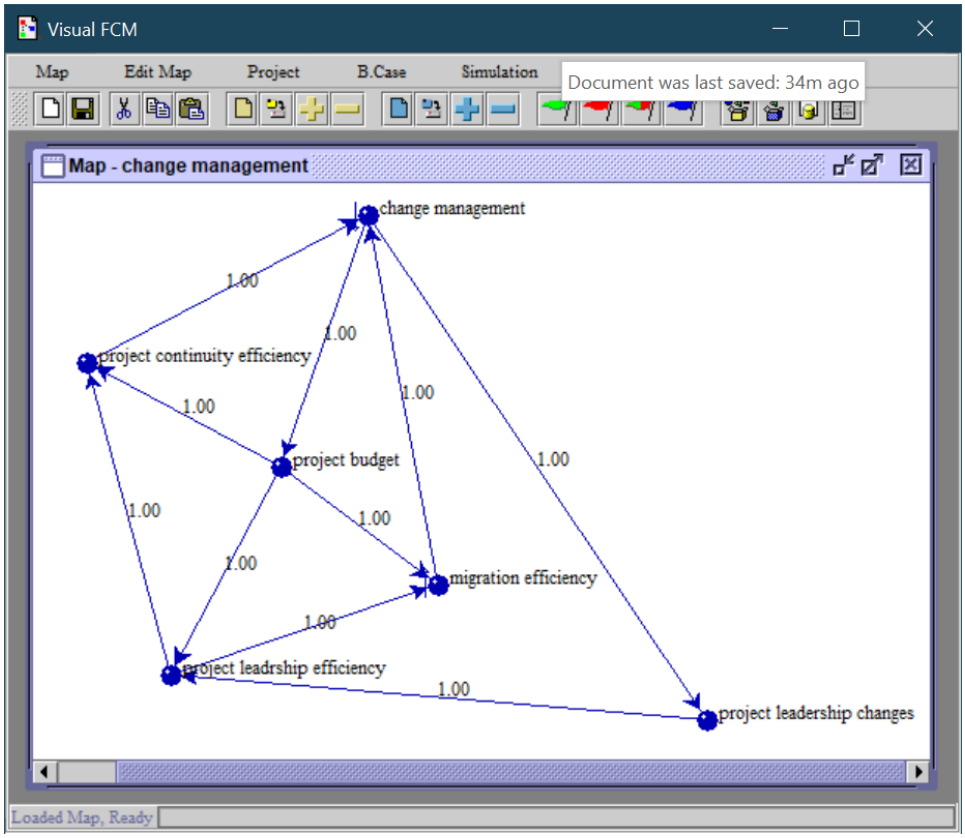


Figure 28: Skeleton map – Change management

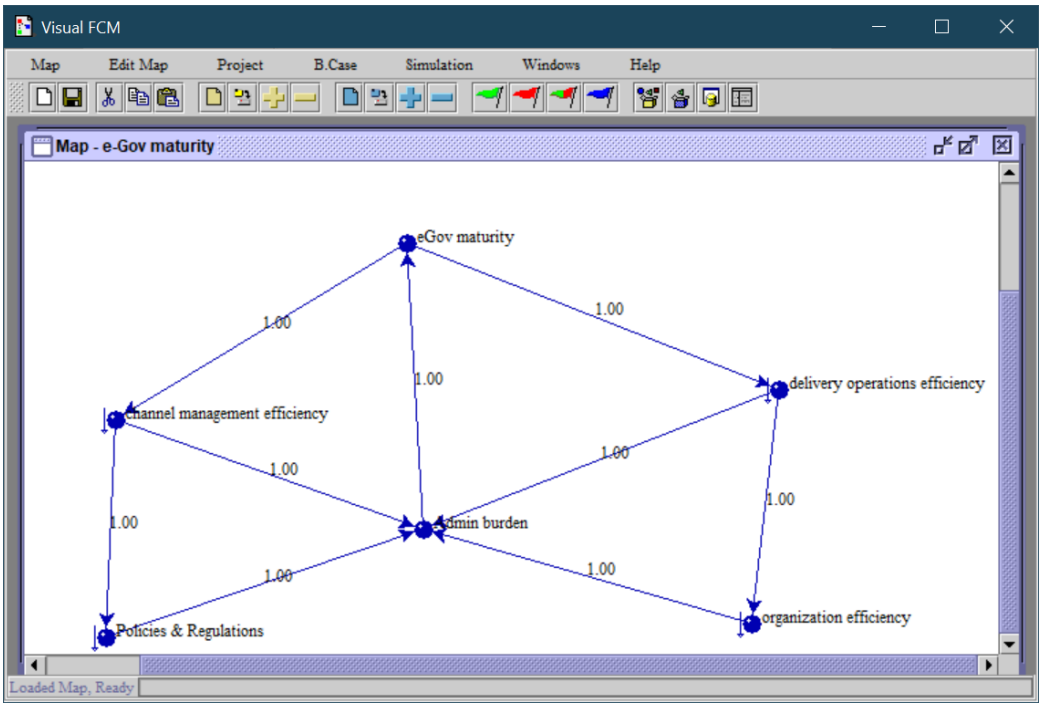


Figure 29: Skeleton map – eGov maturity overview

9.7 Skeleton maps – Map interconnections

All previous skeleton maps are interconnected as follows (Figure 30 - Figure 32):

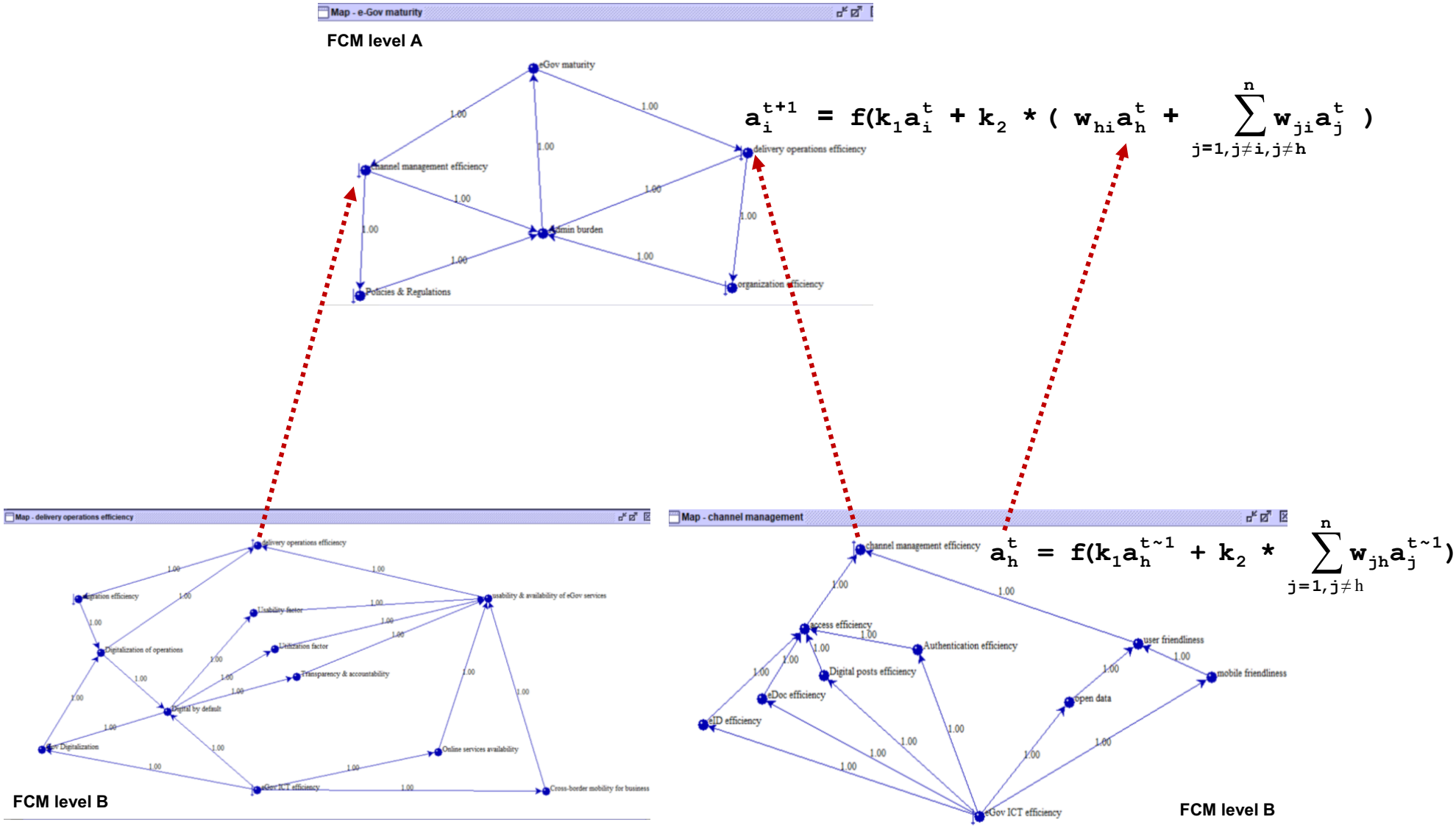


Figure 30: Bottom-up map interconnections (part 1a)

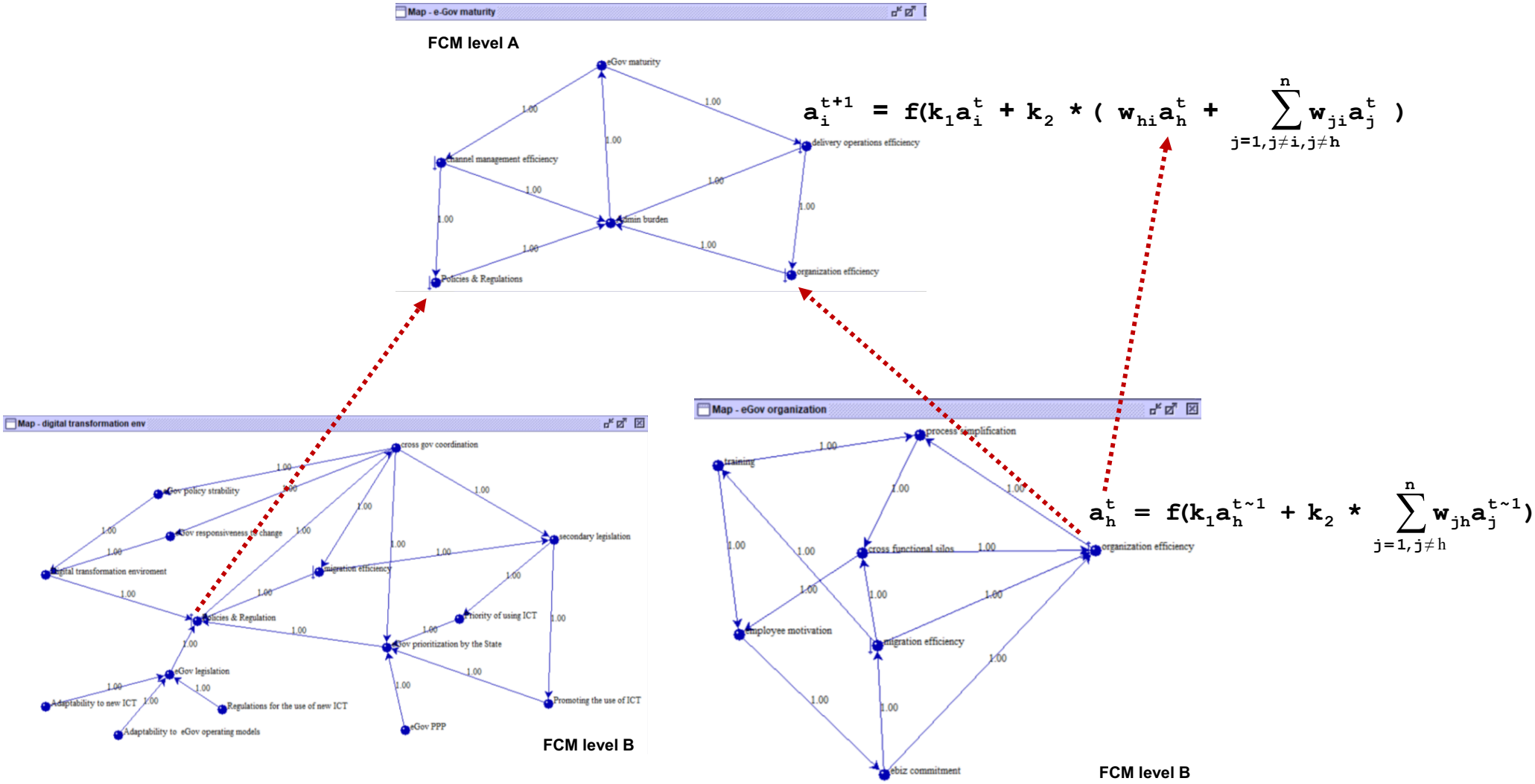


Figure 31: Bottom-up map interconnections (part 1b)

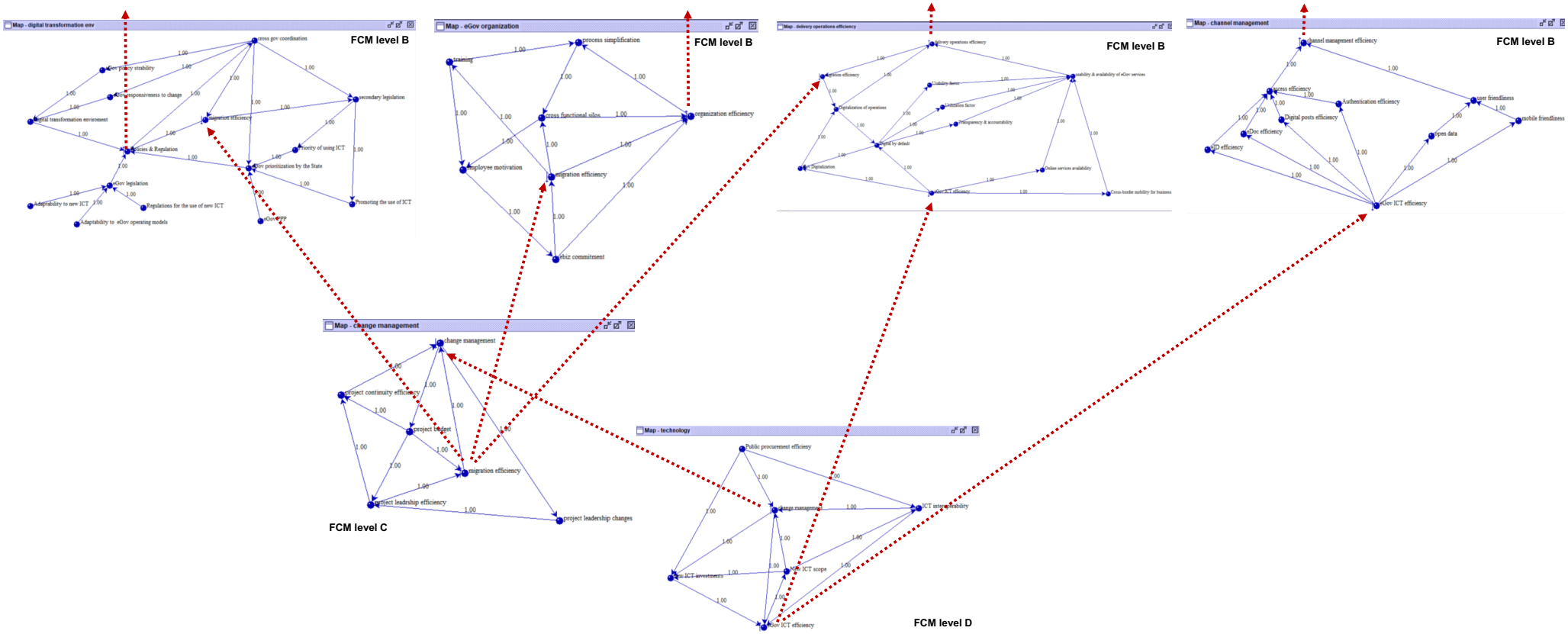


Figure 32: Bottom-up map interconnections (part 2)

9.8 Scenario 1: Base case study

FCM scenarios are deployed following the provisions of section 9.2. This scenario assumes the following functionality:

- **Bottom-up and incremental calculations** are employed to identify the impact of lower-level technical choices into the FCM hierarchy, including the overall eGov maturity.
- **Top-down and "big bang" calculations are also engaged.** They indicate the necessary concept values (maturity metrics) that must be achieved throughout the FCM hierarchy so that the value of the top-most concept (i.e., eGov maturity objective) is met.
- **Technology view**. Bottom-up calculations are triggered by changes in the technology map, in particular the "new ICT scope" concept. This is equivalent to a "technology view". Essentially, this scenario assumes that the eGov strategy rolls out as soon as the public administration identifies gaps in the ICT infrastructure, it documents the ICT scope that is expected to increase the eGov capabilities and then it initiates the ICT project.
- **Isolated impact and reasoning.** Other key concepts are initialized with maximum values. This is equivalent to assuming that other key maturity metrics start with "best intentions". This assumption may seem unrealistic in practice, since no ICT project rolls out in ideal conditions, especially in the public sector. However, this assumption allows the model to isolate a critical concept and reason on its impact on the eGov maturity independently of other concepts.

The first scenario is based on the following maps with value assignments (Figure 33 - Figure 39).

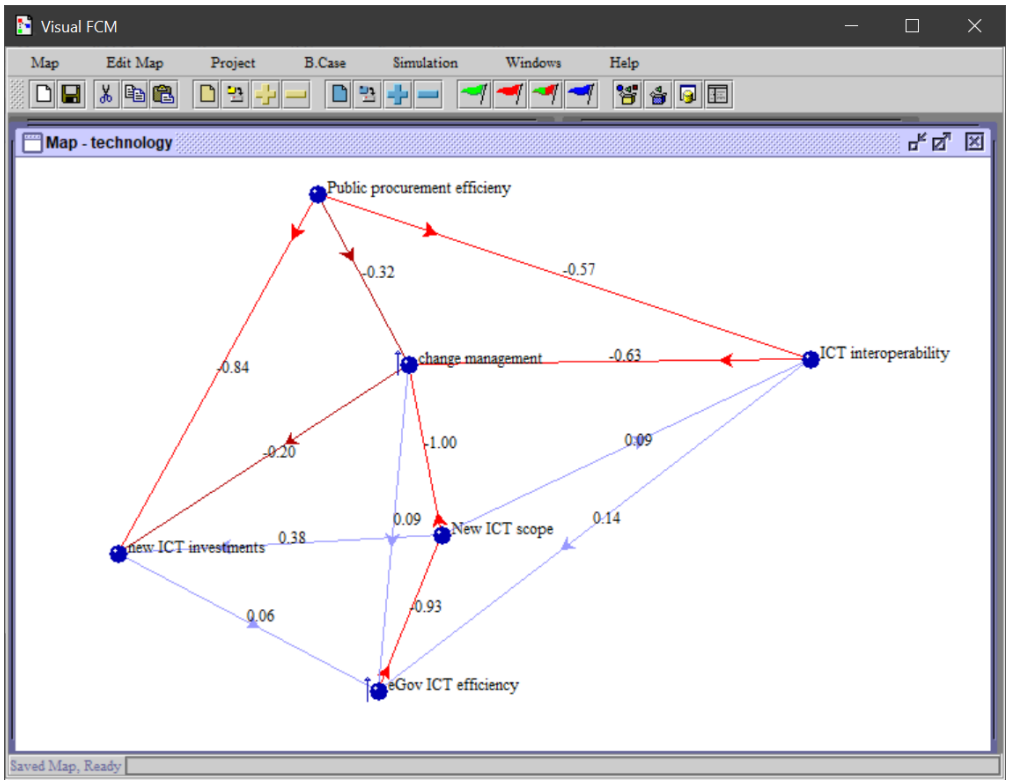


Figure 33: Technology map

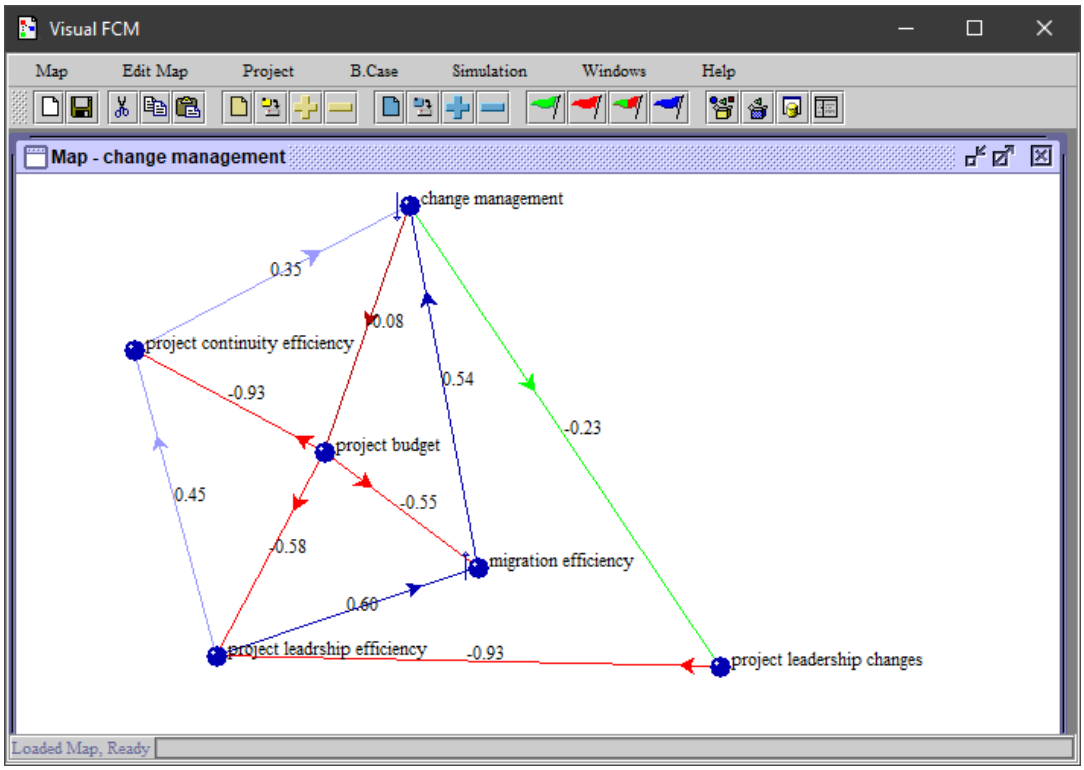


Figure 34: Change management

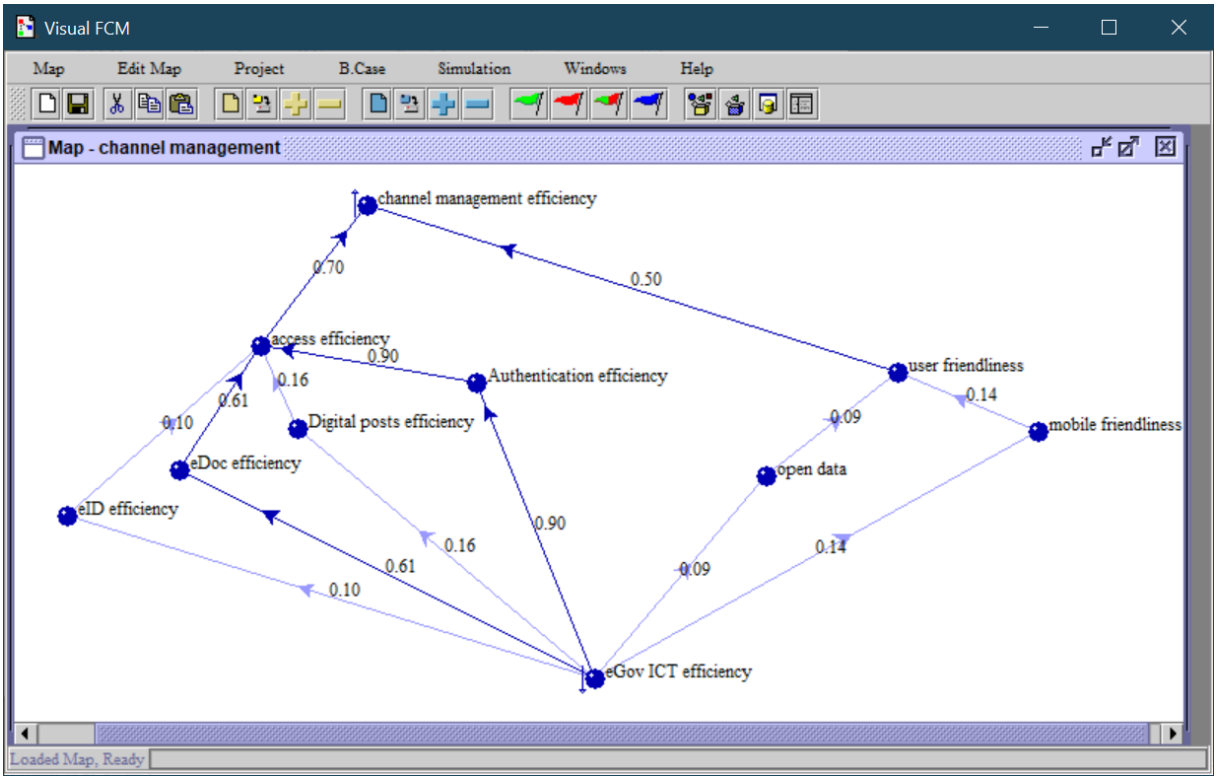


Figure 35: Channel efficiency

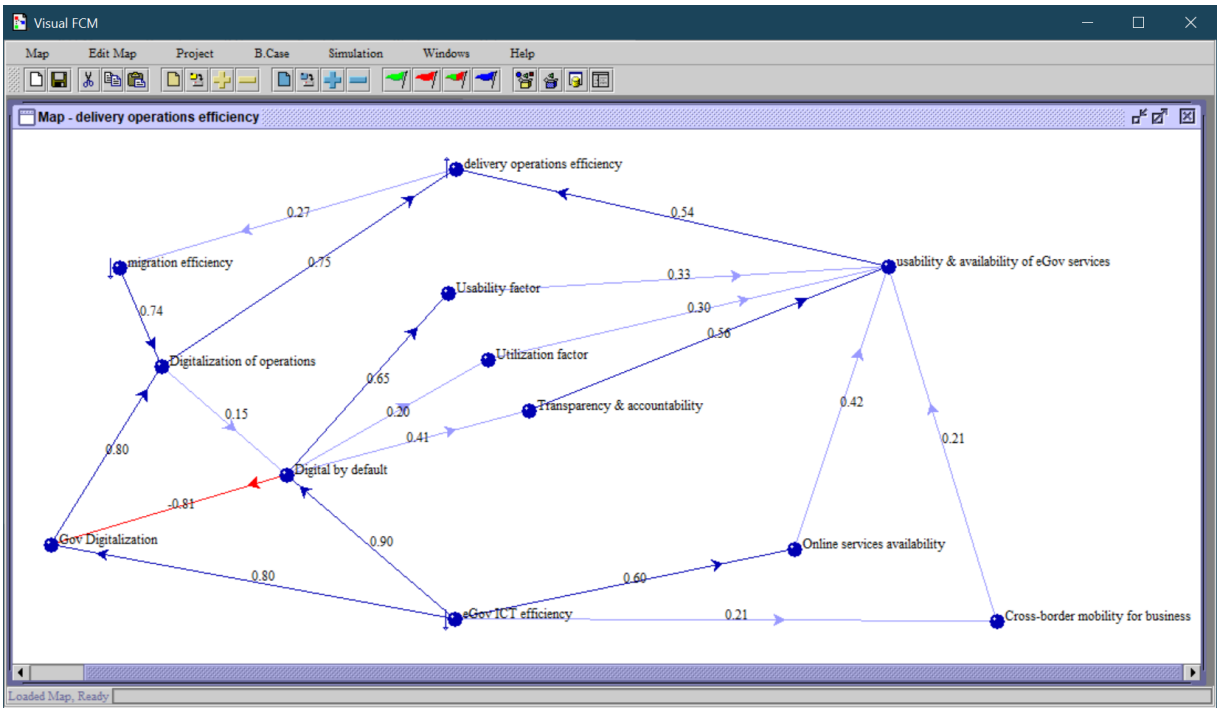


Figure 36: Delivery operations efficiency

This map should be interpreted in a different manner. The way it is setup and the weight values identified by the experts present the changes in G2B service provision that must supplement any eGov project. Therefore, the modelling for this set of concepts acts a "proof of concept" rather than as an impact assessment tool. It is intended to verify if the delivery optimization changes suffice to support large scale eGov projects. The closer the output value of each concept is to its initial value the more significant this concept remains to the success of the eGov maturity.

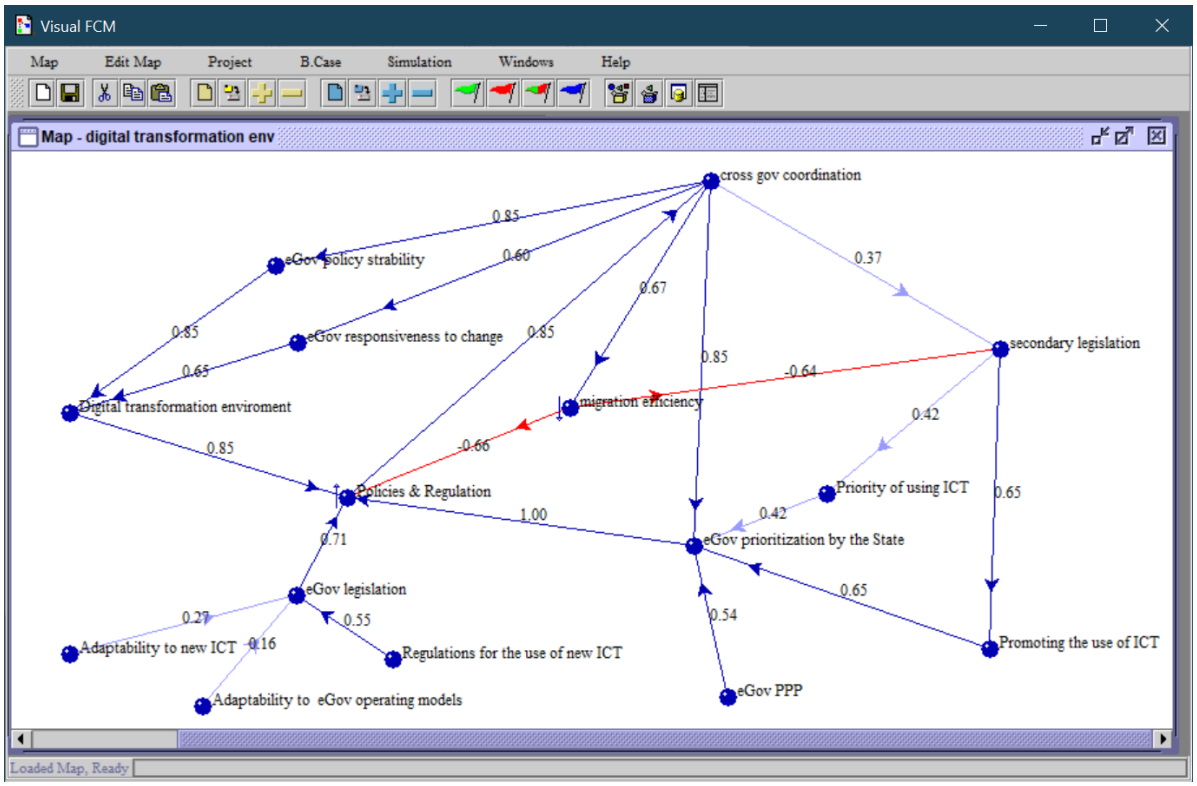


Figure 37: Digital transformation environment

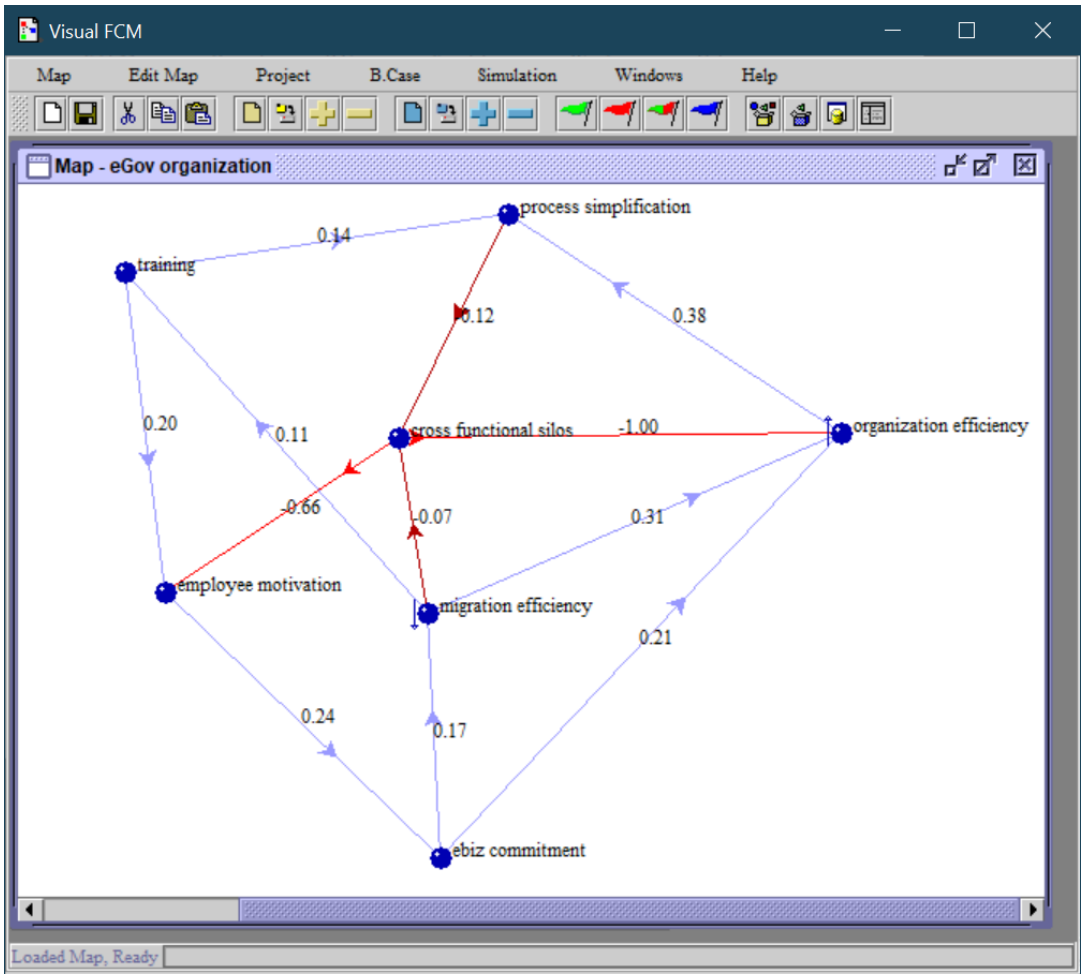


Figure 38: Organizational competencies

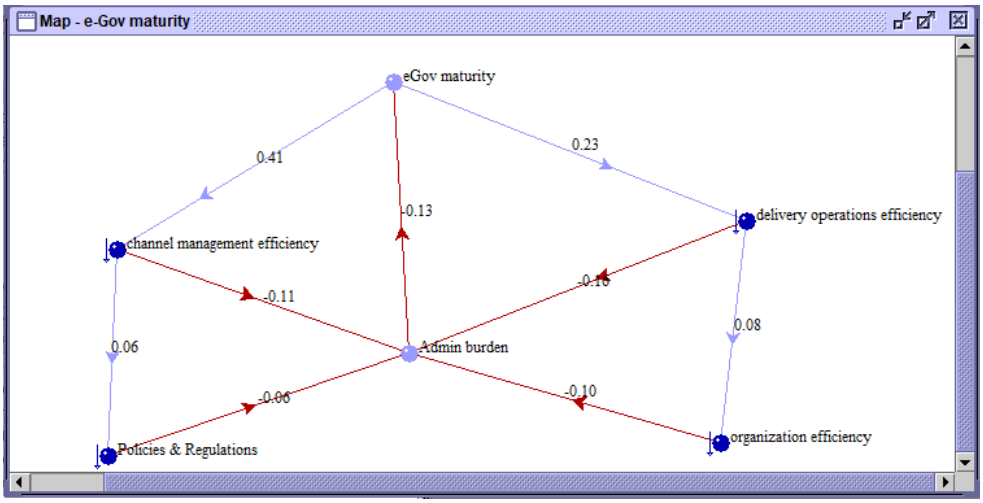


Figure 39: eGov maturity overview

The results of the bottom up FCM calculations per map follow.

Concepts Map: Technology	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
new ICT investments	1.00	0.11	-89.28%	M(positively very very low)
eGov ICT efficiency	1.00	0.56	-44.03%	M(positively medium)
ICT interoperability	1.00	0.20	-80.22%	M(positively very low)
New ICT scope	1.00	0.07	-93.08%	M(positively high)

Concepts Map: Technology	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
Public procurement efficiency*	0.00	0.0	0.00%	M(zero)
change management	1.00	0.15	-85.45%	M(positively very-very low)

*Note: Concepts marked with * are not part of a local feedback loop.*

With "New ICT scope" as the concept to trigger the calculations within the Technology map, the FCM alignment evaluation framework identifies that the current eGov strategy (i.e. concept interconnections and weight assigments) can't support drastic ICT infrastructure upgrades. In fact, the existing eGov strategy roadmap will change the technology maturity (concept "eGov ICT efficiency") about 44% less than the initial objective, resulting to a "positively very very low" output value. This equilibrium value holds regardless of the initial value of the of the "New ICT scope" concept. This is loosely interpreted to a linguistic indication that under the current eGov roadmap, no ICT scope can increase the ICT efficiency drastically.

Moreover, the ICT interoperability remains reduced (80% less than expected, with an "positive very low" output" value), since the current eGov strategy mix has not focused enough to this issue. This is indeed a major issue for contemporary eGov services and is reflected at FCM calculations.

The feedback loops generate two interesting equilibrium results. The first one refers to the level of expected ICT investments. For the current eGov strategy interconnections, the same eGov maturity (see table below) can be expected with 89% less investments. This is true since current ICT investments do not target digital G2B services but internal public sector operations. The second equilibrium result refers to impact on "change management". The current eGov strategy imposes additional barrier to change management efforts. The change efficiency in expected to reduce by 85% (resulting to a "positive very very low" output value). This is key to ICT projects in the public sector since major operational changes often prerequisite ICT projects.

Concepts Map: Change management	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
change management	0.15	0.73	398.86%	M(positively high)
project continuity efficiency	1.00	0.15	-85.15%	M(positively very-very low)
migration efficiency	1.00	0.28	-72.20%	M(positively very low)
project budget	1.00	0.42	-57.94%	M(positively low)
project leadrship efficiency	1.00	0.07	-93.10%	M(zero)
project leadership changes	1.00	0.30	-70.42%	M(positively low)

Change management impacts heavily on project continuity (85% less than necessary, resuting to a "positively very-very low" output value), budget (57% more than expected, resulting to a "positively low" output value), and migration efficiency (72% less than necessary, resulting to a "positively very low" output value). Even though the feedback loops on this map ratify the reduced change management efficiency, the migration efficiency remains reduced. This is attributed mainly to project leaderships pitfalls and frequent changes.

Concepts Map: eGov organization	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
organization efficiency	1.00	0.49	-51.26%	M(positively medium)
ebiz commitment	1.00	0.61	-39.23%	M(positively high)
migration efficiency	0.28	0.63	125.18%	M(positively high)
employee motivation	1.00	0.37	-62.92%	M(positively low)
training	1.00	0.58	-41.53%	M(positively high)
cross functional silos	1.00	0.34	-66.37%	M(positively low)
process simplification	1.00	0.79	-21.09%	M(positively very high)

Reduced migration efficiency has a major impact on organizational changes that typically must supplement ICT projects. Currently eGov strategy does not realize fully the operational changes that must accompany eGov projects and usually interpret them as ICT applications for internal use. As a result, the feedback loops indicate that cross functional operational silos remain largely intact (66% less improvement than targeted, resulting to a "positively low" output value), employee motivation to eGov projects is limited and training on its own can't overturn eGov maturity (41% less efficiency than expected, despite the resulting "positively high" output value). The feedback loops also show that the overall organizational efficiency of public sector administration remains average (51% less than targeted, with a "positively medium" value), even though eGov applications usually reduce internal bureaucracy radically. This is a major setback, since the existing eGov strategy does not remedy structural problems in public sector operations. Process simplification remains "positively high" though less than expected (-21%). However, process simplification benefits from new ICT in any case.

Concepts Map: channel management	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
channel management efficiency	1.00	0.99	-0.56%	M(positively very-very high)
access efficiency*	0.00	1.00	-0.03%	M(positively very-very high)
eID efficiency*	0.00	0.62	-38.23%	M(positively high)
mobile friendliness*	0.00	0.66	-34.08%	M(positively high)
user friendliness*	0.00	0.68	-32.27%	M(positively high)
eDoc efficiency*	0.00	0.95	-5.27%	M(positively very-very high)
Authentication efficiency*	0.00	0.99	-1.44%	M(positively very-very high)
Digital posts efficiency*	0.00	0.68	-31.99%	M(positively high)
open data*	0.00	0.61	-39.28%	M(positively high)
eGov ICT efficiency	0.56	0.94	68.42%	M(positively very-very high)

*Note: Concepts marked with * are not part of a local feedback loop.*

Digital channel management is key to any G2B service provision. The current eGov strategy seems to favor access efficiency. The marginal deviation (-0,03%) from the target is practically negligible. The current eGov strategy seems to favor new G2B services like electronic documents, eID, digital posts, single login capabilities, etc. On the other hand, user friendliness remains "positively high" but rather stagnated (32% less than expected) since the current eGov architecture focuses on basic electronic transactions and electronic document generation.

Overall, channel management maturity seems to meet the eGov strategy objectives (with a negligible drop by 0,5%), since it can provide digital functionality to several G2B services. In terms of FCM characteristics, this map does not rely heavily on internal feedback loops but on loops between maps of the hierarchy. This reduces the number of iterations to reach the equilibrium values within the map, but also provides calculations with straightforward interpretations.

Concepts Map: Digital transformation env.	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
Digital transformation enviroment	1.00	0.999	-0.07%	M(positively very-very high)
eGov policy strability	1.00	0.99	-1.49%	M(positively very-very high)
eGov responsiveness to change	1.00	0.95	-5.03%	M(positively very-very high)

Concepts Map: Digital transformation env.	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
eGov prioritization by the State	1.00	1.00	-0.01%	M(positively very-very high)
Priority of using ICT	1.00	0.61	-38.70%	M(positively high)
Promoting the use of ICT	1.00	0.67	-32.78%	M(positively high)
eGov PPP*	0.00	0.50	-50.00%	
eGov legislation*	0.00	0.92	-7.94%	M(positively very-very high)
Adaptability to eGov operating models*	0.00	0.0	0.00%	M(zero)
Adaptability to new ICT*	0.00	0.0	0.00%	M(zero)
Regulations for the use of new ICT*	0.00	0.0	0.00%	M(zero)
Policies & Regulation	1.00	0.9999	-0.01%	M(positively very-very high)
migration efficiency	0.28	0.96	246.63%	M(positively very-very high)
cross gov coordination	1.00	0.99	-1.41%	M(positively very-very high)
secondary legislation	1.00	0.22	-77.90%	M(positively very low)

*Note: Concepts marked with * are not part of a local feedback loop.*

The simplification of the digital transformation environment is yet another key success factor for any eGov strategy. This map should be interpreted in a different manner. The way it is setup and the weight values identified by the experts present the length and depth of regulatory changes that must supplement any eGov project. Therefore, the modelling for this set of concepts acts a "proof of concept" rather than as an impact assessment tool. It is intended to verify if the regulatory changes suffice to support large scale eGov projects. The closer the output value of each concept is to its initial value the more significant this concept remains to the success of the eGov maturity.

The FCM calculations verify that concepts like eGov policy stability, eGov responsiveness to change, eGov regulatory prioritization, cross government coordination, adaptability to new ICT, introduction of new regulations to expedite new ICT, etc remain key the regulatory efficiency. Timely implementation of public policies that reduce red tape for G2B services have a major positive impact on ICT migration efficiency as well (246% increase).

On the other hand, the promotion of G2B services to users (i.e private sector enterprises) remains important but the same result can be achieved with 32% less effort.

Once again, in terms of FCM characteristics, this map does not rely heavily on internal feedback loops but on loops between maps of the hierarchy. This reduces the number of iterations to reach the equilibrium values within the map, but also provides calculations with straightforward interpretations.

Concepts Map: Delivery operations efficiency	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
Delivery operations efficiency	1.00	1.00	-0.16%	M(positively very-very high)
Digitalization of operations	1.00	0.99	-0.81%	M(positively very-very high)
usability & availability of eGov services	1.00	0.9996	-0.04%	M(positively very-very high)
Gov Digitalization	1.00	0.44	-53.26%	M(positively medium)

Concepts Map: Delivery operations efficiency	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
Online services availability*	0.00	0.94	-5.15%	M(positively very-very high)
eGov ICT efficiency	0.56	0.94	68.42%	M(positively very-very high)
Usability factor	1.00	0.96	-3.81%	M(positively very-very high)
Transparency & accountability	1.00	0.88	-11.73%	M(positively very-very high)
Cross-border mobility for business*	0.00	0.73	-26.64%	M(positively very high)
Utilization factor	1.00	0.73	-26.62%	M(positively very high)
Digital by default	1.00	0.99	-0.58%	M(positively very-very high)
migration efficiency	0.28	0.79	184.82%	M(positively very high)

*Note: Concepts marked with * are not part of a local feedback loop.*

Strong digitalization of G2B operations, services designed digital by default, usability, transparency, and availability of eGov services impact positively on the efficiency of G2B services. The maturity metrics of those concepts align with the overall eGov maturity objectives. Output values approximate a "positive very-very high" outcome in many cases.

On the other hand, the migration efficiency impacts directly to the effectiveness of digital G2B operations. For the operational efficiency to remain strong, G2B services must satisfy several digital delivery standards.

Concepts Map: e-Gov maturity	Initial Value	Current Value	Δ (current vs initial value)	T(current value) approximation
eGov maturity	1.00	0.47	-53.22%	M(positively medium)
organization efficiency	0.49	0.56	15.77%	M(positively medium)
channel management efficiency	0.99	0.72	-27.36%	M(positively high)
delivery operations efficiency	0.99	0.63	-36.74%	M(positively high)
Policies & Regulations	0.99	0.56	-44.23%	M(positively medium)
Admin burden	1.00	0.20	-79.58%	M(very low)

The base-case scenario indicates that technology plays indeed an important role to eGov maturity, as channel management efficiency experiences a "positive high" output value.

However, technology on its own does not support a strong eGov maturity increase despite budget and ICT availability. That is because the current strategy mix does not effectively couple the technology benefits with operational efficiency and regulatory simplifications (36% and 44% less than the objective, respectively). It is also evident that the current policy mix disregards the impact of operational and regulatory changes to administrative burden. The FCM modeling verifies that the current strategy mix has a "very low" impact on administrative burden reduction.

Undoubtedly, eGov maturity increases due to new ICT infrastructure, but it straggles to exceed a "positively medium" result. At the same time, state of the art ICT strangles to deliver its full potential without complimentary organizational and regulatory changes.

The base-case scenario produces similar concept values when run in a top-down manner. The interpretation is that given the current eGov strategy mix, the overall eGov maturity (top-most concept) can't reach its initial value (objective), regardless of changes in the technology map (bottom map). The current eGov strategy mix will achieve some 45% of the objective unless the strategy mix itself changes significantly.

9.9 Key findings of Scenario 1

Over the last two years Greece has employed agile ICT solutions to reduce red tape in front-office transactions. Simple but very effective web applications have digitalized eGov services which used to ask for physical presence, proof of authenticity, submission of documents, one-step approval, etc. It is only fair to say that the covid-19 era accelerated eGov solutions. However, such applications do not re-engineer in depth the bureaucratic public sector processes, nor do they focus on services with multiple approval steps and extensive organizational interoperability. In any cases, the digital bypass of the front-office bureaucracy associated with physical presence seems effective for the time being, and it is well-received by citizens.

In the long term, the FCM modeling indicates that investments on new ICT infrastructure don't have a major impact on eGov maturity under an eGov strategy mix with the following characteristics:

- **ICT investments play indeed an important role to eGov maturity**. Even without an FCM-based methodology, it is easy to realize that ICT projects improved the eGov services in the last two years, after a long period of eGov maturity stagnation.
- **Excessive focus on ICT infrastructure**. Investments on new ICT infrastructure focus heavily on digitalizing G2B services. The eGov strategy adopts an incremental use of ICT with agile implementations and focus on quick wins. Such objectives increase the eGov maturity in Greece which has remained stagnated for years. While this approach gives tangible benefits in G2C transactions, it may not have the same results on G2B services.
- **The lack of ICT interoperability remains an obstacle to contemporary G2B services**. The current eGov strategy must give strong emphasis on this technical element.
- **New ICT infrastructure significantly increases the need for effective change management and efficient migration of G2B services from physical to digital provisions**. The overall eGov maturity will remain stagnated if ICT infrastructure will not couple with operational changes in service provision.
- **The currently eGov strategy does not realize fully the operational changes that must accompany eGov projects and usually interpret them as ICT applications for internal use**. eGov maturity relies heavily on organizational changes and process simplification. Hence the current eGov strategy must shift focus to remedy long standing structural problems like cross functional silos.
- **The eGov maturity is restricted due to limited simplification of eGov regulatory environment**. Timely implementation of public policies that reduce red tape for G2B services can have a major positive impact on eGov maturity however, the current eGov strategy does not couple them effectively with new ICT.
- **Training on new ICT can't deploy its full potential** and can't have a major to employee motivation if the organizational and process burden remains intact.
- **The efficient delivery of G2B services also has a positive impact on eGov maturity**. The eGov strategy should maintain its focus on services designed digital by default, with suitable e-channel usability, transparency, and increased availability.

Key finding for the base scenario: Technology changes play indeed an important role to eGov maturity, especially in front-office transactions. However, under the current eGov strategy mix, technology on its own will fail to support a strong eGov maturity increase. This is mainly attributed to the fact that the current strategy mix fails to couple the technology benefits with back-office operational and regulatory simplifications. As a result, ICT strangles to deliver its full potential, hence eGov maturity straggles to improve beyond a "positively medium" range.

The current eGov strategy mix should be updated to give additional focus on operational and regulatory changes to achieve further increases in eGov maturity.

9.10 Scenario 2: Increased ICT interoperability

This FCM model builds on the same skeleton maps and assumes the following functionality to create "what-if" scenarios on the impact of increased ICT interoperability on technology maturity:

- **Bottom-up and incremental calculations** are employed to identify the impact of lower-level technical choices into the FCM hierarchy.
- **Technical view**. Bottom-up calculations are triggered by changes in the technology map.
- **Isolated impact and localized reasoning.** Other key concepts are initialized with maximum values. This is equivalent to assuming that other key maturity metrics start with "best intentions". This assumption may seem unrealistic in practice, since no ICT project rolls out in ideal conditions, especially in the public sector. However, this assumption allows the model to isolate a critical concept and reason locally on its impact on the local technology maturity independently of other maps.
- The increased interoperability is realized be increasing 3X the impact of the concept "ICT interoperability" to other concepts in the technology map (Figure 40). This is interpreted as if the eGov strategy mix initiated a new ICT scope that inherently improves the ICT interoperability.
- This scenario operates independently of other alternative scenarios. Concepts in all other maps assume the bottom-up calculations of the base scenario.

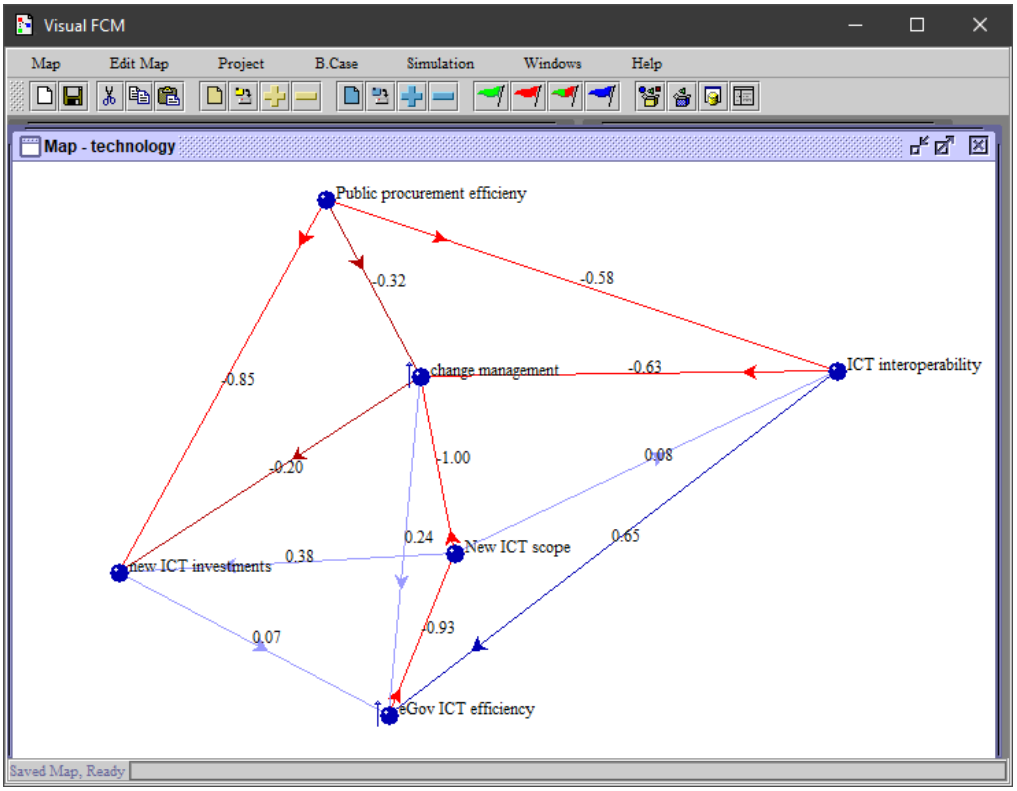


Figure 40: Technology map – Increased interoperability scenario

The results of the bottom up FCM calculations follow.

Concepts Map: Technology	Current Value (base scenario)	Current Value (2nd scenario)	Δ between scenarios
new ICT investments	0.11	0.10	-10.65%
eGov ICT efficiency	0.56	0.72	29.07%
ICT interoperability	0.20	0.40	102.38%
New ICT scope	0.07	0.03	-51.24%
Public procurement efficiency*	0.00	0.00	0.00%
change management	0.15	0.20	39.35%

*Note: Concepts marked with * are not part of a local feedback loop.*

The impact of increased ICT interoperability into the eGov maturity is convincing enough. The updated eGov strategy mix asks for reduced investments (10% concept value reduction) and streamlined ICT scope (50% less than before) while offering 29% increased ICT efficiency and 39% increased change management efficiency in comparison to the base scenario. This results to "positively high" and "positively very low" output values in contrast to "positively medium" and "positively very-very low" values respectively.

The impact on change management efficiency is expected to increase the maturity metrics on other maps as well. Increased interoperability results to increased cross functional organizational efficiency. This is indeed another positive by-product of the updated strategy mix without applying organizational changes directly.

The feedback loops indicate that the interoperability itself will benefit significantly by the updated eGov strategy mix, by doubling its output value.

The overall eGov maturity does not increase significantly, as expected. The rest of the eGov strategy mix remains the same with several other barriers to maintain the red tape in G2B services.

Key finding for the 2nd scenario: Increasing the focus on ICT interoperability impacts positively on technology maturity and efficiency. It reduces the need for extended ICT investments since existing distributed applications are utilized more efficiently.

9.11 Scenario 3: Increased organizational efficiency

This FCM model builds on the same skeleton maps and assumes the following functionality to create "what-if" scenarios on the impact of increased organizational efficiency on the operational maturity:

- **Bottom-up and incremental calculations** are employed to identify the impact of lower-level organisational choices into the FCM hierarchy.
- **Technical view**. Bottom-up calculations are triggered by changes in the eGov organization map.
- **Isolated impact and localized reasoning.** Other key concepts are initialized with maximum values. This is equivalent to assuming that other key maturity metrics start with "best intentions". This assumption may seem unrealistic in practice, since no ICT project rolls out in ideal conditions, especially in the public sector. However, this assumption allows the model to isolate a critical concept and reason locally on its impact on the local organizational maturity independently of other maps.
- The increased organizational efficiency is realized be decreasing 3X the impact of the concept "cross functional silos" to other concepts in the map (Figure 41). This is a moderate change, given the existing red tape between the various functions of the public administration when it comes to ICT that support G2B services.
- This is interpreted as if the eGov strategy mix applied major re-structuring that reduced operational silos. Also, the scenario assumes that the increased organizational efficiency has an increased impact (2X) on process simplification.
- This scenario operates independently of other alternative scenarios. Concepts in all other maps assume the bottom-up calculations of the base scenario.

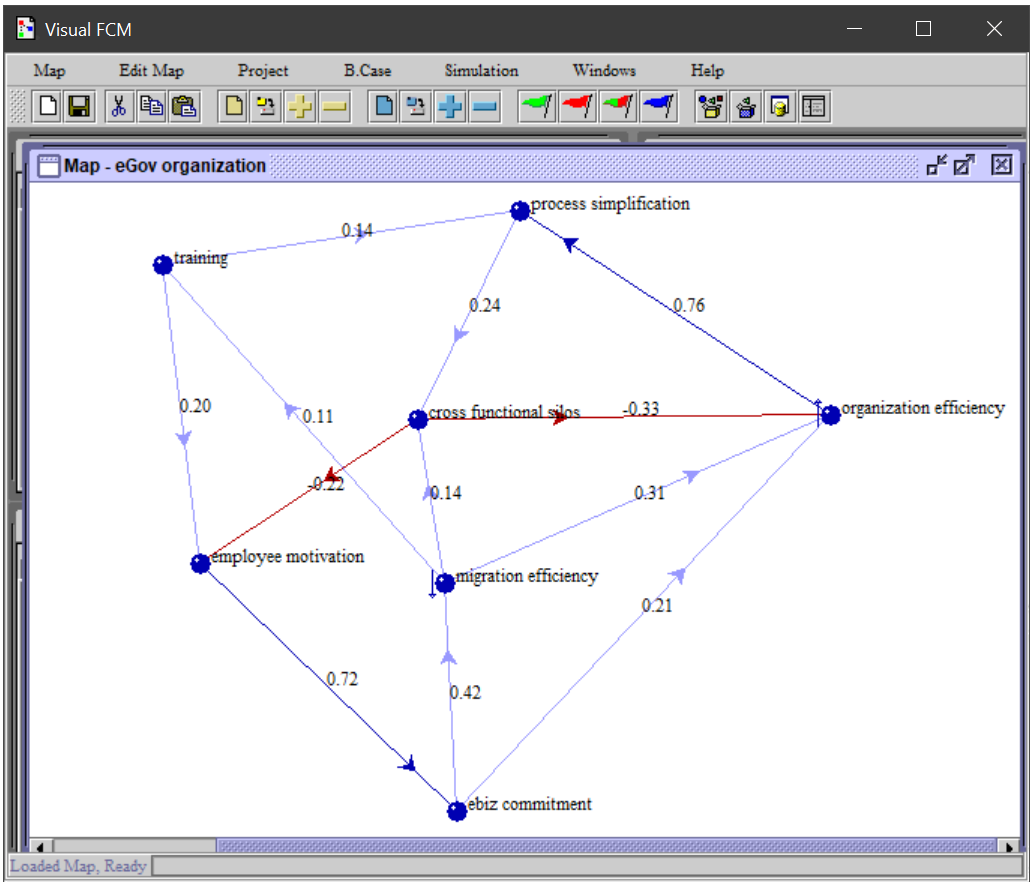


Figure 41: eGov organization map – Increased operational efficiency scenario

The results of the bottom up FCM calculations follow.

Concepts Map: Technology	Current Value (base scenario)	Current Value (3rd scenario)	Δ between scenarios
organization efficiency	0.49	0.69	41.69%
ebiz commitment	0.61	0.82	35.13%
migration efficiency	0.63	0.85	35.67%
employee motivation	0.37	0.42	14.28%
training	0.58	0.61	5.01%
cross functional silos	0.34	0.85	153.00%
process simplification	0.79	0.95	21.01%

*Note: Concepts marked with * are not part of a local feedback loop.*

The impact of removing organizational silos to the organizational maturity is also convincing enough. The updated eGov strategy mix provides increased organizational and process efficiency (41% and 21% respectively), even with a mild reduction of cross functional red tape. This results to "positively high" and "positively very-very high" output values in contrast to "positively medium" and "positively very high" values respectively.

Employee commitment and motivation experience a moderate increase (35% and 14% respectively) since it is also affected by training which remains stable. Training is affected marginally as expected. It is the job of a separate scenario to examine its impact on organizational maturity.

The impact on migration efficiency (+35%) is also worth mentioning. The output value increases from "positively high" to "positively very high". Efficient organization results to easier migration to new eGov models. Increased migration efficiency results to increased maturity of the delivery operations, channel

management and technology utilization. This is indeed another positive by-product of the updated strategy mix without applying additional technology or other operational changes directly.

Once again, the rest of the eGov strategy mix remains the same with several other barriers to maintain the red tape in G2B services.

The feedback loops indicate that the cross functional red tape itself will benefit significantly by the updated eGov strategy mix, by increasing its output value by 1,5 times (from "positively low" to "positively very high".

Key finding for the 3rd scenario: Using ICT projects to remedy structural problems within public administration impacts positively on G2B service maturity and efficiency. It may reduce the need for extended ICT investments since new applications digitize simpler organizational and process structures. This scenario loosely proves the argument that eGov projects should not digitize existing bureaucracy, but the eGov strategy should engage into structural changes together with technology upgrades.

9.12 Scenario 4: Increased regulatory efficiency

This FCM model builds on the same skeleton maps and assumes the following functionality to create "what-if" scenarios on the impact of increased policy efficiency on the regulatory maturity:

- **Bottom-up and incremental calculations** are employed to identify the impact of lower-level policy choices into the FCM hierarchy.
- **Technical view**. Bottom-up calculations are triggered by changes in the digital transformation environment map.
- **Isolated impact and localized reasoning.** Other key concepts are initialized with maximum values. This is equivalent to assuming that other key maturity metrics start with "best intentions". This assumption may seem unrealistic in practice, since no ICT project rolls out in ideal conditions, especially in the public sector. However, this assumption allows the model to isolate a critical concept and reason locally on its impact on the local regulatory maturity independently of other maps.
- **The increased policy efficiency** is realized by increasing 3X the impact of the concept "migration efficiency" to other concepts in the map (Figure 42). This moderate change is interpreted as if the eGov strategy mix pushed policy changes that simplify G2B digital service delivery together with new ICT infrastructure. Keep in mind that this map works as in a "proof of concept" mode, similarly to base scenario (section 9.8).
- This scenario operates independently of other alternative scenarios. Concepts in all other maps assume the bottom-up calculations of the base scenario.

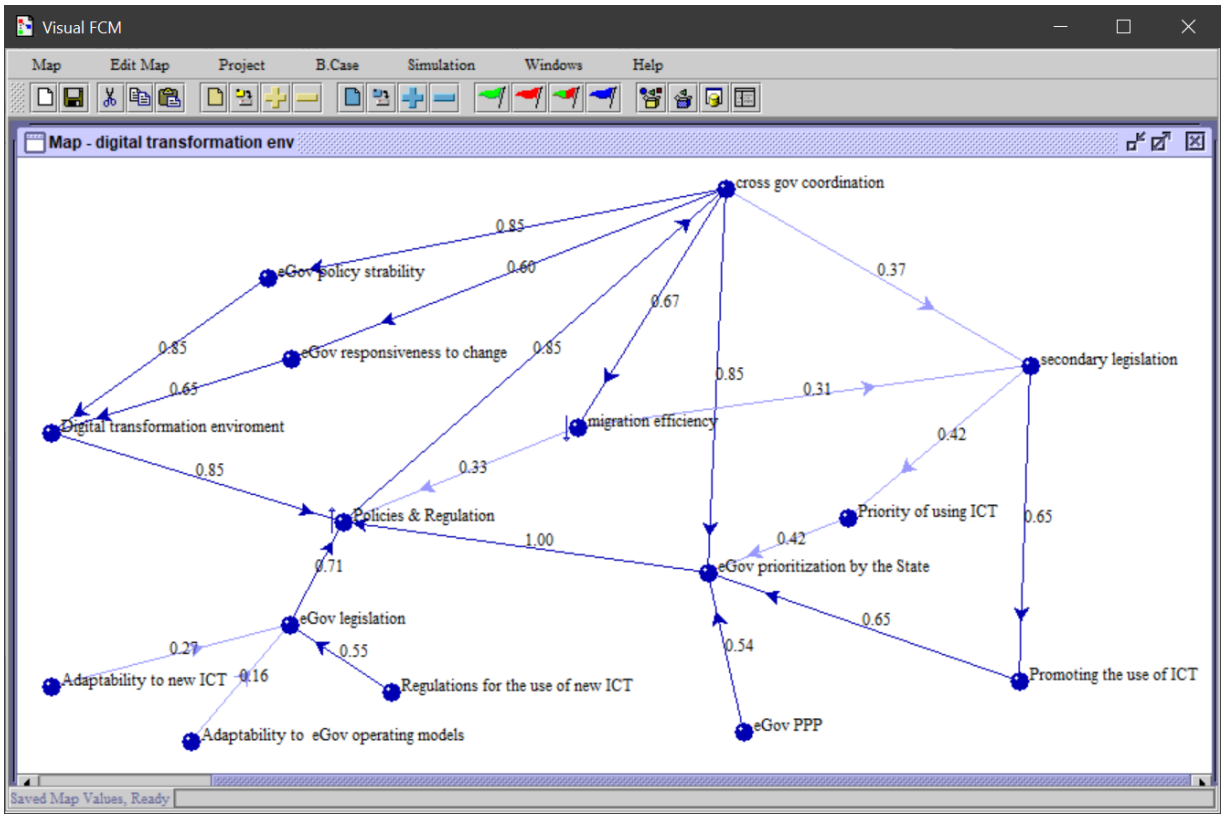


Figure 42: Digital transformation environment map – Increased regulatory efficiency scenario

The results of the bottom up FCM calculations follow.

Concepts Map: Digital transformation env.	Current Value (base scenario)	Current Value (4th scenario)	Δ between scenarios
Digital transformation enviroment	0.999	0.999	0.00%
eGov policy strability	0.99	0.99	0.00%
eGov responsiveness to change	0.95	0.95	0.00%
eGov prioritization by the State	1.00	1.00	0.01%
Priority of using ICT	0.61	0.88	43.86%
Promoting the use of ICT	0.67	0.96	42.58%
eGov PPP*	0.50	0.50	0.00%
eGov legislation*	0.92	0.92	0.00%
Adaptability to eGov operating models*	0.50	0.50	0.00%
Adaptability to new ICT*	0.50	0.50	0.00%
Regulations for the use of new ICT*	0.50	0.50	0.00%
Policies & Regulation	0.9999	1.0000	0.01%
migration efficiency	0.96	0.96	0.00%
cross gov coordination	0.99	0.99	0.00%
secondary legislation	0.22	0.97	336.97%

*Note: Concepts marked with * are not part of a local feedback loop.*

As expected, the need for policies that reduce administrative barriers and simplify G2B digital services remains strong. The eGov strategy mix should take this into constant consideration.

It is worth noting that the increased migration efficiency increases the maturity (efficiency) secondary legislation significantly (from "positively very low" to "positively very-very high"). This maturity increase impacts positively (+42%) on eGov promotion to private sector companies (from "positively high" to positively very-very high"). Similarly, the prioritization of using ICT increases as well (+43%).

In terms of FCM modelling, this map does not rely heavily on internal feedback loops but on loops between maps of the hierarchy. This reduces the number of iterations to reach the equilibrium values within the map, but also provides calculations with straightforward interpretations. The same is true for the "channel management" and "delivery operations efficiency" map.

Key finding for the 4th scenario: Regulatory changes remain critical for successful eGov projects. Effective migration planning may expedite new policies that simplify G2B digital services. In any case, regulatory simplifications must be in effect together with operational ad technology changes.

9.13 Scenario 5: Setting a different strategy mix

This FCM model builds on the same skeleton maps and assumes the following functionality to create "what-if" scenarios on the impact of a different strategy mix on the overall eGov maturity:

- **Top-down and "big bang" calculations** are employed to identify the impact of new strategy choices into the FCM hierarchy.
- **Process / customer view**. Top-down calculations are triggered to identify how the high-level strategy mix affects other concepts.
- **Isolated impact and localized reasoning.** Other key concepts are initialized with maximum values. This is equivalent to assuming that other key maturity metrics start with "best intentions". This assumption allows the model to isolate a critical strategy choices and reason locally on its impact on the overall eGov maturity independently of other maps.
- **Updated strategy mix**. The increased eGov strategy efficiency is realized be adopting a different high-level strategy mix (e.g. different concept weighs). This scenario does not change the technology focus of the current eGov strategy. This scenario does not assume extensive process re-engineering and structural changes. Such changes may take considerable time and usually fall under major public sector changes. This scenario allows for moderate process simplifications which reduce eGov red tape. In practice, in addition to new ICT infrastructure, this scenario provides a moderate administrative burden reduction, organizational efficiency, regulatory simplifications, and simplified G2B service delivery. As a result, this strategy mix of this scenario assumes a balanced view of the eGov maturity (Figure 43).
- This scenario builds on the value and weight allocations of all the previous alternative scenarios.

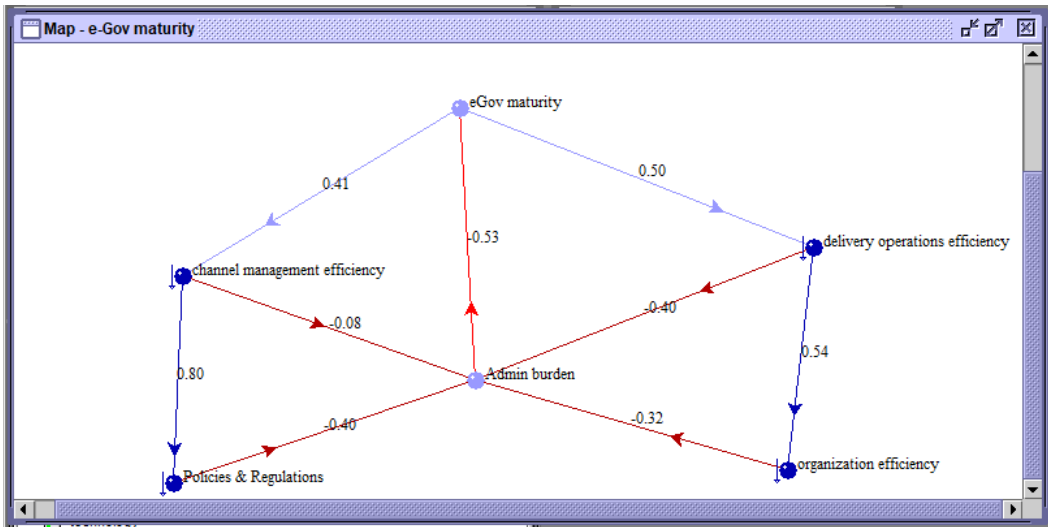


Figure 43: eGov maturity map – Updated eGov strategy scenario

The results of the top down FCM calculations follow.

Concepts Map: e-Gov maturity	Current Value (base scenario)	Current Value (5th scenario)	Δ between scenarios
eGov maturity	0.47	0.59	26.09%
organization efficiency	0.56	0.89	57.86%
channel management efficiency	0.72	0.73	1.49%
delivery operations efficiency	0.63	0.78	22.72%
Policies & Regulations	0.56	0.95	70.33%
Admin burden	0.20	0.01	-97.12%

As expected, this scenario visualizes the positive impact of proper operational and regulatory changes to the eGov maturity. The overall eGov maturity increases by 26%, reaching a "positively high" output.

Regulatory and organizational improvements (very close to the target values, with "positively very-very high" output) reduce eGov further the administrative burden. This is because back-office simplification couples effectively with front-office changes.

Delivery operations also improve and reach a "very high" output value. The FCM model reassures that channel management efficiency does not have to change significantly for eGov maturity to increase. The output value of channel management efficiency remains "positively very high" with a marginal change.

A separate simulation with **bottom-up and incremental calculations** was also employed to identify the impact of lower-level policy choices into the FCM hierarchy. The similar results confirm that the alternative strategy mix may improve eGov maturity as expected.

Key finding for the 5th scenario: Front-office technology on its own fails to support a strong eGov maturity increase. The emphasis on red tape reduction through ICT is a key objective however it can lead to "positively medium" maturity improvement on its own. The emphasis on front-office improvement can only serve as a short-term tactical objective.

An updated strategy mix which compliments technology with moderate regulatory, interoperability, and operational changes can improve eGov efficiency without excessive technology investments while maintaining the emphasis on quick wins.

9.14 Scenario 6: Setting a different strategy priority

The calculations on the base scenario and the 5th scenario visualize the emphasis put in administrative burden reduction. It supports the argument that the current eGov strategy relies heavily in admin burden reduction in front-desk G2B transactions but disregards comprehensive reforms and process simplifications to utilize fully the power of doing business digitally.

Red tape elimination in front-desk operations plays a key role to eGov projects by offering quick-wins. However, it comes with the danger to limit eGov maturity to "average" improvements by disregarding longstanding structural problems.

This scenario proposes a different skeleton map at the top of the hierarchy to visualize a different strategy to improve eGov maturity. It builds on strategy settings which expedited eBusiness transformation projects over the last twenty years (examples in references [36, 37]). A **comprehensive strategy mix** with a different strategy focus, allows for any necessary process simplification which can improve eGov maturity along with red tape. In practice, in addition to new ICT infrastructure, this scenario considers administrative burden reduction, organizational efficiency, regulatory simplifications, and service delivery as important eGov objectives as well.

This FCM model builds on a new skeleton map and assumes the following functionality to create "what-if" scenarios on the impact of the different strategy setting on the overall eGov maturity:

- **Top-down and "big bang" calculations** are employed to identify the impact of new strategy choices into the FCM hierarchy.
- **Process / customer view**. Top-down calculations are triggered to identify how the high-level strategy mix affects other concepts.
- **Isolated impact and localized reasoning.** Other key concepts are initialized with maximum values. This is equivalent to assuming that other key maturity metrics start with "best intentions". This assumption allows the model to isolate a critical strategy choices and reason locally on its impact on the overall eGov maturity independently of other maps.
- **Comprehensive strategy mix**. The increased eGov strategy efficiency is realized be adopting a different strategy option (e.g. different concept links). This scenario does not change any lower-level maps but assumes a different strategy focus.
- This scenario utilizes the value and weight allocations of all the previous alternative scenarios.

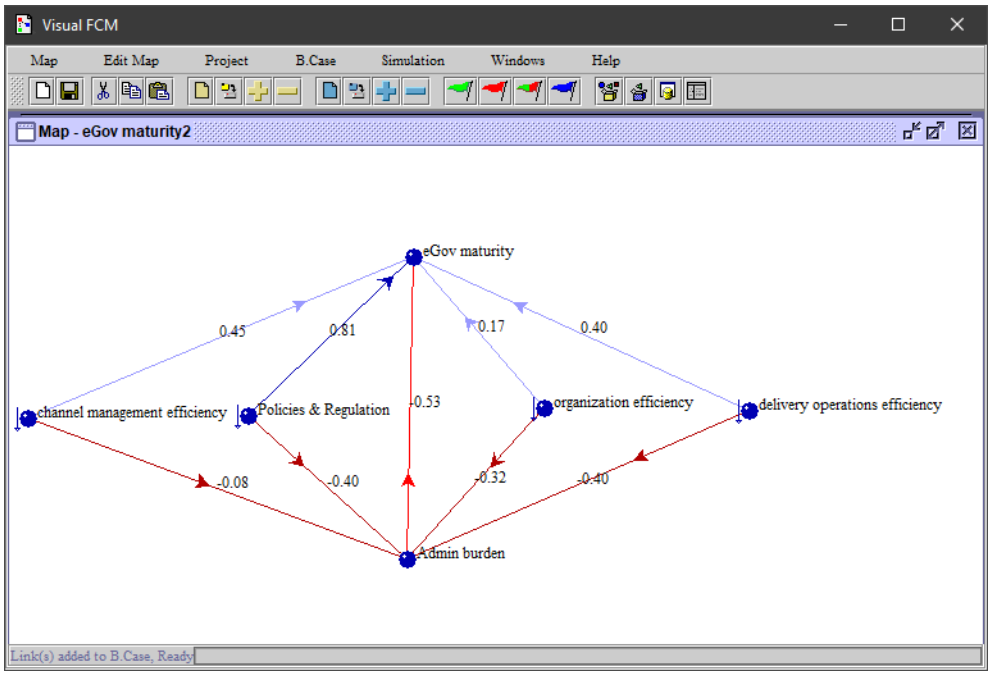


Figure 44: Figure 45: eGov maturity map – Comprehensive eGov strategy scenario

Concepts denoted as "↓" expand further to lower-level maps. Similarly, "↑" denotes bottom-up causal propagation. The results of the top down FCM calculations follow.

Concepts Map: e-Gov maturity	Current Value (base scenario)	Current Value (5th scenario)	Current Value (6th scenario)	Δ 5th and 6th scenarios	Δ base and 6th scenarios
eGov maturity	0.47	0.59	0.91	54.27%	94.52%
organization efficiency	0.56	0.89	0.88	-0.98%	56.32%
channel management efficiency	0.72	0.73	0.90	23.27%	25.11%
delivery operations efficiency	0.63	0.78	0.90	16.61%	43.11%
Policies & Regulations	0.56	0.95	0.90	-4.84%	62.08%
Admin burden	0.204	0.006	0.002	-58.52%	-98.80%

The results of this scenario comply with previous research on eBusiness transformation. eGov maturity reaches its full potential if the strategy mix sets the sssorganizational efficiency, the regulatory simplifications, and the service delivery as important objectives (along with front-office ICT). With such a balanced eGov strategy, ICT can deliver its full potential, hence the eGov maturity can further improve.

This is evident when comparing the 6th scenario with the updated strategy mix of the 5th scenario.

Similarly, to the 5th scenario, regulatory and organizational improvements (very close to the target values, with "positively very-very high" output) reduce eGov further the administrative burden. This is because back-office simplification couples ideally with front-office changes.

A separate simulation with **bottom-up and incremental calculations** was also employed to identify the impact of lower-level policy choices into the FCM hierarchy. The similar results confirm that the alternative strategy mix may improve eGov maturity as expected.

Key finding for the 6th scenario: Front-office technology on its own fails to support a strong eGov maturity increase. This emphasis can only serve as a short-term tactical objective.

If the strategy mix sets the organizational efficiency, the interoperability, the regulatory simplifications, and the service delivery as important objectives (along with front-office ICT), then ICT will deliver its full potential, and the eGov maturity will improve significantly.

9.15 Summary of key findings

Over the last two years Greece has employed agile ICT solutions to reduce red tape in front office transactions. Simple but very effective web applications have digitalized eGov services which used to ask for physical presence, proof of authenticity, submission of documents, one-step approval, etc. It is only fair to say that the covid-19 era accelerated eGov solutions. However, such applications do not re-engineer in depth the bureaucratic public sector processes, nor do they focus on services with multiple approval steps and extensive organizational interoperability. In any cases, the digital bypass of the bureaucracy associated with physical presence seems effective for the time being, and it is well-received by citizens.

In the long term, the FCM modeling indicates that investments on new ICT infrastructure don't have a major impact on eGov maturity under an eGov strategy mix with the following characteristics:

Positive eGov strategy choices:

- **ICT investments play indeed an important role to eGov maturity**. Even without an FCM-based methodology, it is easy to realize that simple, small scale but effective ICT projects improved the eGov services in the last two years, after a long period of eGov maturity stagnation.
- **Focus on front-office ICT**. Investments on new ICT infrastructure currently focus heavily on providing services currently without digitalization. The eGov strategy adopts an incremental use of ICT with agile implementations and focus on quick wins. Such objectives increase the eGov maturity in Greece which has remained stagnated for years. While this approach gives tangible benefits in G2C transactions, it may not have the same results on G2B services.
- **The efficient delivery of G2B services also has a positive impact on eGov maturity**. The eGov strategy should maintain its focus on services designed digital by default, with suitable e-channel usability, transparency, and increased availability.

Strategy update proposals

- **A moderate simplification of eGov regulatory environment improves eGov maturity without excessive technology investments.** Regulatory simplification has not matched at all the pace and momentum of G2B digitalization. This has resulted to significant ICT effort but with stagnated results. For ICT investments to impact fully on eGov maturity, the current eGov strategy mix should be updated to give additional focus on operational and regulatory changes. Even a moderate update in the strategy mix can achieve further increases on eGov maturity.
- **Timely implementation of public policies** that reduce red tape can have a major positive impact on eGov maturity. Hence, the eGov strategy must couple them effectively with new ICT.
- **Operational and process changes must accompany eGov projects to realize the benefits of new ICT infrastructure.** Excessive technology investments are not the proper strategy choice for improving eGov maturity. The eGov strategy must shift focus to remedy long standing regulatory and organizational problems like cross functional silos and conflicting regulations. This will allow ICT infrastructure to couple with operational efficiency and have an additional impact on eGov maturity. Also, the current strategy mix should **stop interpreting new ICT as applications for internal use**.
- **Contemporary G2B services should rely on extensive ICT interoperability**. Additionally, to regulatory changes, the eGov strategy must give strong emphasis on ICT interoperability.
- **Proper change management and migration planning must be integral to complex ICT reforms**. New ICT infrastructure significantly increases the need for effective change management and efficient migration of physical G2B services to digital. The overall eGov maturity will increase if the strategy mix caters for efficient change management and migration planning.
- **Last, but not least, the eGov maturity should not be restricted by changes in front-desk transactions**. A comprehensive strategy setting should allow for any necessary process simplification to roll out along with red tape elimination. In practice, in addition to new ICT infrastructure, the eGov strategy should set administrative burden reduction, organizational efficiency, regulatory simplifications, and service delivery as important eGov objectives as well.

Summarizing, the intelligent x-ray of eGov in Greece indicates that technology plays an important role to eGov maturity, especially in reducing the administrative burden in front-desk transactions. However, such applications do not re-engineer in depth the bureaucratic public sector processes, nor do they focus on services with multiple approval steps and extensive organizational interoperability.

The digital bypass of the bureaucracy associated with physical presence seems to be an effective start. But, under the current eGov strategy mix, front-office technology on its own will soon fail to support a strong eGov maturity. The intelligent modeling indicates that the emphasis on red tape reduction through ICT can only lead to "positively medium" maturity improvement on its own. Hence, any excessive ICT investments of such type are not the proper strategy choice for the medium-term. This emphasis can only serve as a short-term tactical objective.

If the strategy mix sets the organizational efficiency, the interoperability, the regulatory simplifications, and the service delivery as important objectives (along with front-office ICT), then ICT will deliver its full potential, and the eGov maturity will improve significantly.

The updated strategy mix may come at an intuitive recommendation from field experts. **However, the intelligent modeling provides executive-level quantification and traceable reasoning to all policy recommendations. This allows policy makers to change elements of their strategy based on evidence rather than intuition alone.**

10. Policy recommendations

10.1 Reforms state-of-play

Over the last two years Greece has employed agile ICT solutions to reduce the bureaucracy mainly in front-office transactions. This research does not underestimate in any way the progress of eGov over the last two years. Simple but very effective web applications have digitalized G2C services which used to ask for physical presence, proof of authenticity, submission of documents, one-step approval, etc. It is only fair to say that the covid-19 era accelerated eGov (electronic / digital government) solutions which aimed at offering urgent assistance to citizens and enterprises, like the covid-19 vaccine scheduling, the covid-19 state-aid allocation, the NSRF state-aid allocation, the state-aid allocation due to extra-ordinary physical phenomena, the electronic medical prescriptions, the electronic certificates, etc.

Such applications do not re-engineer in depth the bureaucratic public sector processes, nor do they focus on services with multiple approval steps and extensive organizational interoperability. However, the digital bypass of front-desk bureaucracy seems effective for the time being. Moreover, it is well-received by citizens.

Despite the recent eGov success, Greece traditionally lacks a long-term e-Government (eGov) strategy, with initiatives revised every 2-3 years. eGov strategies usually compile lists of ICT projects, rather than coordinated reforms. Process re-engineering is poorly designed and executed, while legislation and regulations usually constraint paperless transactions. Despite the successful recent steps and the accelerated digitalization during the covid-19 era, public administration still offers costly and time-consuming services to enterprises with reduced transparency.

10.2 Policy proposals

The intelligent x-ray of eGov in Greece together with the findings of all scenarios and simulations support the following argument.

ICT plays an important role to eGov maturity, especially in reducing the administrative burden in front-desk transactions. However, excessive technology investments are not the proper strategy choice for improving eGov maturity.

Front-office ICT on its own fails to support a strong eGov maturity increase. The emphasis on red tape reduction through ICT is a key objective however it leads to “positively medium” maturity improvement only. This can only serve as a short-term tactical objective.

If the strategy mix sets the organizational efficiency, the regulatory simplifications, and the service delivery as important objectives (along with front-office admin burden reduction), then ICT will deliver its full potential, hence the eGov maturity will further improve.

Building on this argument, the intelligent x-ray highlights the following policy recommendations.

Functional and regulatory reforms must couple with ICT projects. The Greek eGov strategy should incorporate functional and regulatory simplifications to digital services.

Considerable migration planning and change management are crucial for the efficient transition to digital services. Care should be taken to ensure that the organizational and procedural burden on employees is reduced because of the transition of G2C and G2B services from physical to digital.

Interoperability remains key to effective G2B digital services. High priority should be given to improve the interoperability of ICT, which remains the Achilles’ heel of the Greek eGov system; as well as some care should be taken to ensure that the organizational and procedural burden on employees is reduced because of the transition of G2C and G2B services from physical to digital.

The recently published **"Digital Transformation Book 2020-2025"**, which is the official depiction of the current government's eGov strategy, addresses some of the above needs. More specifically, one of its main guiding principles is the “interoperability-by-design”, which concerns not only the technical level, but also the semantic and the organizational levels. Interoperability, in fact, is recognized as one of the "accelerators"

of the plan, that are theoretically emphasized and prioritized. However, only 4 interoperability projects are incorporated, of which only 2 have started.

Another explicit guiding principle of government planning is the "Simplification of Procedures". This principle, which governs all the projects contained in the Book, provides for the constant and systematic review of the administrative practices, and the laws and regulations, that determine administrative procedures. The current structure and responsibilities of the Ministry of Digital Governance, which is responsible for the central and horizontal coordination of all actions for the simplification of procedures through a special General Secretariat ("General Secretariat for Digital Governance and Simplification of Procedures"), and the experience of the recently implemented projects confirm the emphasis placed on this principle. In this context, new tools have been established such as the "National Programme for the Simplification of Procedures"[6] and the "Observatory of Bureaucracy", which is supported by the OECD (that had measured the administrative burdens, in 2012-2014 period, in 13 policy areas and made recommendations to reduce them by 25%). These tools, in conjunction with the "National Register of Procedures", will be permanent structures for mapping and reduction of bureaucracy, ensuring the continuity of the relevant interventions.

Despite the significant improvements introduced by the Digital Transformation Book 2020-2025, since it includes many provisions in the right direction, as is pointed out in Chapter 4.4, there is still considerable room for further improvement. For Greek businesses, even more, that are called to be competitive in a particularly demanding international environment, after an extremely deep and long-lasting economic recession that has not yet been fully overcome, and in a time of a global crisis due to the covid-19 pandemic, any possibility for improvement of the G2B services is a necessity. In this context, there are several policy proposals at the level of eGov strategy that can contribute significantly to its quality and coherence and described in detail below.

Inherent interoperability

As shown in scenario 1, investments in ICT projects do have a positive impact on the maturity of eGov; but there is a significant deficit in the interoperability of ICT applications that limits the benefit of additional ICT projects. This conclusion is reinforced in scenario 2, thus it is more emphatically highlighted that covering this deficit should become the main priority of the eGov strategy. To improve the inherent interoperability of the upcoming ICT projects, some design changes are needed in the eGov strategy:

- In previous years the focus of the Greek eGov strategy has been on large digital infrastructure projects. Given that the country's digital infrastructure has indeed grown in recent years, there is a need to revise the priority in funding, and the now limited resources to be allocated to interoperability projects as well as to the redesign and improvement of digital services, instead of repeating the approach of major projects. This can be done with small-scale projects, which are easily manageable and redefined according to the needs that are constantly changing and evolving.
- In the same framework, and in accordance with the Digital Transformation Book 2020-2025's guiding principle for interoperability-by-design, the creation of ICT applications based on framework agreements should be preferred, instead of the procurement of turnkey systems. These applications should also follow the open platform approach, the principles of flexible software development, and data and interface standards. The supply of turnkey systems is generally more expensive, has long implementation time and it is very difficult to be compatible with full interoperability, while it is usually ad-hoc chosen for internal use, aiming at digitization of existing procedures without their prior simplification or revision.
- The assurance of interoperability-by-design can also be enhanced at the design level by selecting systems with centralized architecture, which can of course have the option for local expansions.

[6] The "National Programme for the Simplification of Procedures", established by L.4635/2019, is the central interministerial framework for the design and implementation of actions to redesign and simplify administrative procedures, with the aim of combating bureaucracy and reducing the administrative burdens of G2C and G2B services as well as the internal functions of public administration. The Programme has obtained funding from the European Social Fund through its inclusion in the Partnership Agreement for the Development Framework 2014-2020; and considerable interest for the advisory support of its implementation has been expressed by many relevant private firms.

Systems that follow architecture with strong central structures seem to be more suited to the culture of the country and to be compatible with the structures and practices of public administration (diaNEOsis 2018).

- In the same context, it is proposed to integrate systems around universal and horizontal support services. These, for instance, may include the development and provision of digital services for the submission of applications to public administration bodies and local authorities. This will ensure the interoperability with certain basic registers and the compliance of the service with the standards of the gov.gr, as well as various key components such as the authentication of the citizen and his electronic dossier.
- Finally, the absence of a uniform way of mapping and managing ICT projects should be addressed. Internationally recognized practices, standards, or methodologies, such as the European Commission's PM² project administration[7], could be adopted. The choice of a European uniform way of mapping, especially, would bring collateral benefits by the inclusion of some ICT projects in EU funding, in addition to the obvious benefits in the integrated monitoring of their development and in making better use of the available resources.

Operational and regulatory simplification

The second key conclusion of chapter 8, which emerges emphatically from scenarios 3 and 4, is that the digitization of public procedures should follow their prior simplification. Simplification must concern both operational procedures (scenario 3) and the regulatory framework (scenario 4) and should be carried out before their digitization, as the mere digitization of the current complex and inefficient procedures of public administration will have both limited benefits and hinder their ex-post simplification.

The simplification of procedures and framework cannot consist of any separate projects, but instead it is a general principle that should govern all ICT projects and be implemented on a case-by-case basis. Nevertheless, its implementation can be enhanced with the appropriate management structure, through the synergy of all ministries whose operational needs will be served by an ICT project as well as the Ministry of Digital Governance. In particular, the executives of the Ministry of Digital Governance could participate in Integrated Project Teams with executives from other relevant ministries and public bodies, with the aim of involving the latter (internal end-users) more effectively in all phases of the life cycle of the ICT project and subsequently enhancing the assumption of its essential ownership by them. These interministerial synergies should have as an objective to simplify jointly and to the maximum extent the operational procedures, their structure, and their relative regulatory framework; and then properly design the ICT project that will digitize them, based on the experience of the external end-users: citizens and businesses.

Considerable migration planning, human management and broader eGov strategy

A secondary conclusion of scenario 4 concerns the effectiveness of migration planning and its importance in the rate of implementation of new policies that simplify G2B digital services. Law 4622/2019 imposes the annual update of the Digital Transformation Book, depending on the particular circumstances and technological developments. The corresponding provision of Law 4369/2016 for the annual update of the operational objectives of the Directorates-General, Directorates, and Departments, which specify the provisions of the Bible as to their practical implementation, should be ensured. Failure to comply with this provision will have a catalytic negative impact on the effectiveness of migration planning. In the same logic, the broad sharing of the gov.gr roadmap is also proposed, in order to keep all other public bodies informed and ensure its timely implementation.

In the same framework, for the improvement of migration planning, it would be useful to legally shield the use of information systems, both in terms of its obligatoriness and regarding the issues of responsibility management and protection of personal data. Moreover, the conducting of extensive testing before the public launch of a new ICT service as well as its continuous evaluation by the end-users (both internal and

[7] https://ec.europa.eu/isa2/solutions/open-pm2_en

external) with successive feedback loops could accelerate the migration process, as the necessary hotfixes, adjustments, and changes will be made earlier and more efficiently.

As pointed out in scenario 1, the training of civil servants in new ICT has limited effectiveness on the adoption of the new technologies, unless there is a payoff in terms of reduced workload for them. Thus, any new digital service that is utilized by public administration should have incorporated in its design, as necessary specification, the provision for easier, shorter, and lighter workload of its internal users, in comparison to the equivalent physical service, so it offers a strong motivation for its adoption.

Finally, as noted in the conclusions of scenario 1, current ICT projects focus on the digitalization of services that are currently not digital and thus the eGov strategy adopts a gradual use of ICT with agile implementations focused on quick wins. This approach should continue as it brings tangible benefits to G2C transactions, but it should be improved to focus equally on G2B transactions. Short-term actions focused on quick wins could be directly linked to the concept of "life events", which is particularly important not to weaken. However, this concept should be extended to include not only the citizens' "life events", but also the businesses' "life events". Moreover, there is still room for even shorter and faster actions, such as small interventions in existing systems.

11. Conclusion

This research went beyond historic analysis of eGov maturity and proposed a new intelligent approach for modeling the effectiveness of eGov strategy. It employed fuzzy cognitive maps to offer a multi-dimensional coupling of eGov initiatives with maturity assessment capabilities and a strategy alignment evaluation framework. This modelling supplemented the hierarchical strategy break-down with feedback loops between objectives, actions, and tactics. Fuzzy variables and calculations set up an "intelligent" x-ray and model together ICT characteristics, user needs, operational efficiency, regulatory constraints, procurement tactics and reform coordination. The predictive capabilities of this model identify strategy gaps, assessed the impact of "what-if" scenarios, and quantify realistic policy recommendations for effective eGov initiatives in Greece.

The key findings of the research regarding eGov maturity progress indicate the following:

- **Over the last two years** Greece has employed agile ICT solutions to reduce red tape in front office transactions. Simple but very effective web applications have digitalized eGov services which used to ask for physical presence, proof of authenticity, submission of documents, one-step approval, etc. It is only fair to say that the covid-19 era accelerated eGov solutions. This research does not underestimate in any way this progress.
- **Instead of benchmarking the current digital maturity of Greece with its poor past,** this research compares the current digital maturity of Greece with that of other EU practices. In comparison to EU practices, eGov digital maturity does not seem to improve with the same pace.
- **There has been a significant revival of eGov activity during the covid-19 era**, due to the apparent difficulties for physical transactions. Additionally, the mindset of the current administration expedites changes in public sector services.

The key findings of the research regarding eGov strategy mix in Greece indicate the following:

Positive eGov strategy choices:

- **ICT investments play indeed an important role to eGov maturity**. Even without an FCM-based methodology, it is easy to realize that simple, small scale but effective ICT projects improved the eGov services in the last two years, after a long period of eGov maturity stagnation.
- **Focus on front-office ICT**. Investments on new ICT infrastructure currently focus heavily on providing services currently without digitalization. The eGov strategy adopts an incremental use of ICT with agile implementations and focus on quick wins. Such objectives increase the eGov maturity in Greece which has remained stagnated for years. While this approach gives tangible benefits in G2C transactions, it may not have the same results on G2B services.
- **The efficient delivery of G2B services also has a positive impact on eGov maturity**. The eGov strategy should maintain its focus on services designed digital by default, with suitable e-channel usability, transparency, and increased availability.

Strategy update proposals

- **A moderate simplification of eGov regulatory environment improves eGov maturity without excessive technology investments.** Regulatory simplification has not matched at all the pace and momentum of G2B digitalization. This has resulted to significant ICT effort but with stagnated results. For ICT investments to impact fully on eGov maturity, the current eGov strategy mix should be updated to give additional focus on operational and regulatory changes. Even a moderate update in the strategy mix can achieve further increases on eGov maturity.
- **Timely implementation of public policies** that reduce red tape can have a major positive impact on eGov maturity. Hence, the eGov strategy must couple them effectively with new ICT.
- **Operational and process changes must accompany eGov projects to realize the benefits of new ICT infrastructure.** Excessive technology investments are not the proper strategy choice for improving eGov maturity. The eGov strategy must shift focus to remedy long standing regulatory and organizational problems like cross functional silos and conflicting regulations. This will allow ICT

infrastructure to couple with operational efficiency and have an additional impact on eGov maturity. Also, the current strategy mix should **stop interpreting new ICT as applications for internal use**.

- **Contemporary G2B services should rely on extensive ICT interoperability**. Additionally, to regulatory changes, the eGov strategy must give strong emphasis on ICT interoperability.
- **Proper change management and migration planning must be integral to complex ICT reforms**. New ICT infrastructure significantly increases the need for effective change management and efficient migration of physical G2B services to digital. The overall eGov maturity will increase if the strategy mix caters for efficient change management and migration planning.
- **Last, but not least, the eGov maturity should not be restricted by changes in front-desk transactions**. A comprehensive strategy setting should allow for any necessary process simplification to roll out along with red tape elimination. In practice, in addition to new ICT infrastructure, the eGov strategy should set administrative burden reduction, organizational efficiency, regulatory simplifications, and service delivery as important eGov objectives as well.

The research also offers the following interesting meta-findings regarding the application of FCMs in modeling "intelligently" eGov projects.

- **The intelligent modeling couples effectively** a typical eGov strategy methodology with an eGov maturity evaluation framework. This modeling goes beyond a hierarchical strategy break-down and introduces multi-dimensional relations between objectives, actions, implementation tactics, managerial levels.
- **FCMs effectively supplement the eGov strategy scheme with an alignment evaluation framework.** More than sixty FCM concepts, three hierarchies, eight maturity maps and several multi-dimensional feedback loops can provide an effective x-ray of eGov projects in Greece. Loops between metrics of any level of the FCM hierarchy generate a comprehensive impact assessment simulation as well as a strategy alignment evaluation tool. The alignment evaluation identifies (a) to what extend eGov projects in Greece adopt comprehensive strategy roadmap (b) which elements of the strategy are neglected (c) what is their impact on eGov maturity. The impact quantification and visualization utilize fuzzy variables and calculations to support strategy decisions at an executive level.
- **Scenario building and evidence-based evaluation** support policy recommendations for effective eGov initiatives. The soft artificial intelligence modeling and the predictive capabilities of this deployment identify gaps and compare comprehensive "what-if" scenarios. The scenarios quantify the impact of technology, operational and regulatory characteristics to the overall eGov maturity using fuzzy variables.
- **The intelligent x-ray benefits two groups of stakeholders** in particular (a) senior government officials by providing rapid identification of significant gaps in the strategy, risks, opportunity areas and change management challenges which drive the upgrade of G2B services (b) eGov digital transformation management by providing insights on how to manage ICT implementation, improve the probability of success and mitigate risk.

As far as research novelty is concerned, the following should be highlighted:

- **The intelligent modelling approach of eGov adopted by this research is novel**. This research offers a multi-dimensional coupling of an eGov strategy methodology with maturity assessment capabilities and a strategy alignment evaluation framework.
- **This coupling offers new ways to support executive decisions** with quantifiable objectives and traceable reasoning to all policy recommendations. The approach quantifies strategy decisions using fuzzy linguistic variables and predicts their impact using fuzzy calculations. This approach upgrades the intuitive strategy choices into quantifiable objectives and roadmap. The fuzzy quantification algorithm offers traceable outputs which address most executive-level "what-if" questions effectively.
- **The utilization of FCMs to model eGov projects is also an interesting output of this research**. FCMs have been known to support organizational reengineering, e-business transformation, or government policymaking. But their combined use appears contemporary. Moreover, this research provides an intelligent and effective x-ray of eGov in Greece which builds on actual eGov indicators and projects.

Summarizing, the intelligent x-ray of eGov in Greece indicates that technology plays an important role to eGov maturity, especially in reducing the administrative burden in front-desk transactions. However, such applications do not re-engineer in depth the bureaucratic public sector processes, nor do they focus on services with multiple approval steps and extensive organizational interoperability.

The digital bypass of the bureaucracy associated with physical presence seems to be an effective start. But, under the current eGov strategy mix, front-office technology on its own will soon fail to support a strong eGov maturity. The intelligent modeling indicates that the emphasis on red tape reduction through ICT can only lead to "positively medium" maturity improvement on its own. Hence, any excessive ICT investments of such type are not the proper strategy choice for the medium-term. This emphasis can only serve as a short-term tactical objective.

If the strategy mix sets the organizational efficiency, the interoperability, the regulatory simplifications, and the service delivery as important objectives (along with front-office ICT), then ICT will deliver its full potential, and the eGov maturity will improve significantly.

The updated strategy mix may come at an intuitive recommendation from field experts. **However, the intelligent modeling provides executive-level quantification and traceable reasoning to all policy recommendations. This allows policy makers to change elements of their strategy based on evidence rather than intuition alone.**

12. Annex A: DMI indicators

This annex presents the initial set of DMI indicators considered at this project. Currently, the set consists of three levels of hierarchical indicators with bottom-up aggregation using the min-max aggregation model. DMI hierarchies are as follows:

- **Maturity indicators (level 4)**. DMI considers more than 120 indicators from various public domain sources.
- **Maturity groups (level 3).** Indicators of similar context are aggregated to provide intermediate sets of digital maturity. Sets are flexible and can easily adapt to available knowledge.
- **Maturity categories (level 2).** Groups are aggregated into seven maturity areas, namely ICT sector (business as ICT providers), Infrastructure, Business as ICT users, Regulations, Society as ICT users, Skills, and e-Government (eGov). These seven areas are fixed. They provide a balanced mix of lead and lag maturity as well as a balanced mix of cause-and-effect categories. Also, they can visualize the of gaps in digital maturity at various levels of detail, from strategy to technical information.
- **DMI score (level 1).** All seven maturity areas are aggregated into two numbers, namely maturity score and ranking. Ranking indicates the comparative position of each country versus other EU countries. Score is the absolute value of all aggregated indicators.

Maturity category 3: Policies & regulatory framework

Maturity group 3.1: Digital transformation environment

	Indicator	Description	Source
3.1.1	Government's policies (policy stability)	Long-term thinking capacity within governments and mechanisms to deliver public services (G2C and G2B) and support policy interventions digitally.	WEF – Global Competitiveness Index 4.0
3.1.2	Government's responsiveness to change	Government responds effectively to change (e.g. technological changes, societal and demographic trends, security and economic challenges).	WEF – Global Competitiveness Index 4.0
3.1.3	Government's long-term vision	Improve the long-term thinking capacity within governments and mechanisms to deliver public services and support policy interventions digitally	WEF – Global Competitiveness Index 4.0

Maturity group 3.2: State (Gov) prioritization for digital transformation

	Indicator	Description	Source
3.2.1	Priority of using ICT	Extent to which government foster investment in emerging technologies	WEF – Networked Readiness Index
3.2.2	Promoting the use of ICT	The index indicates the degree the Public Administration promotes the use of Information and Communication Technologies.	WEF – Networked Readiness Index
3.2.3	Public – private sector collaboration in Gov ICT	Public and private sector ventures supporting technological development	IMD – World Digital Competitiveness Ranking

Maturity group 3.3: Digital Transformation Legislation

	Indicator	Description	Source
3.3.1	Legal framework's adaptability to digital business models	How fast is the legal framework of your country adapting to digital business models (e.g. e-commerce, sharing economy, fintech, etc.)	WEF – Global Competitiveness Index 4.0
3.3.2	Legal framework's adaptability to emerging technologies	Extent to which the legal framework is adapting to of emerging technology	WEF – Networked Readiness Index

3.3.3	Regulatory Framework for the application of new ICT	Development and application of technology supported by the legal environment	IMD – World Digital Competitiveness Ranking

Maturity category 7: Public sector digital maturity

Maturity group 7.1: Public Sector Digitalization

	Indicator	Description	Source
7.1.1	Digitization of Public Administration	Digitalization level of the back and front office	EC – eGovernment Benchmark Report
7.1.2	Online services	Digital public services for businesses (G2B) including the cross-border dimension	EC-DESI
7.1.3	Depreciation value of eGov fixed ICT assets	Public sector investments in ICT	Eurostat- National Accounts, Deloitte Analysis

Maturity group 7.2: Digital services usability and availability

	Indicator	Description	Source
7.2.1	Usability factor	To what extent users have access to online support, on government websites.	EC – e-Government Benchmark Report
7.2.2	Transparency & accountability	Transparency of Service Delivery, Public Organizations and Personal Data.	EC – e-Government Benchmark Report
7.2.3	Cross-border mobility for Business	The index indicates whether businesses can use G2B online services to do business on another country. It consists of electronic pointers and portals, usability of G2B services, electronic identity tools (e-ID), electronic documents, etc	EC – e-Government Benchmark Report
7.2.4	Cross-border mobility for Citizens	The index indicates whether citizens can use G2C online services to do business or travel to another country. It consists of electronic pointers and portals, usability of G2B services, electronic identity tools (e-ID), electronic documents, etc	EC – e-Government Benchmark Report

Maturity group 7.3: Access requirements for G2B digital services

	Indicator	Description	Source
7.3.1	Electronic ID (e-ID)	Government-issued documents for online identification, and authentication.	EC – e-Government Benchmark Report
7.3.2	Electronic documents (e-Documents)	Authenticated by the issuer using any means recognized under applicable national law, specifically through the use of electronic signatures, e.g. not a regular pdf or word document	EC – e-Government Benchmark Report
7.3.3	Authentic Sources	Base registries used by governments to automatically validate or fetch data relating to citizens or businesses.	EC – e-Government Benchmark Report
7.3.4	Digital communication (Post)	Option to receive communications digitally only, through e.g. personal mailboxes or other Digital Post solutions.	EC – e-Government Benchmark Report

Maturity group 7.4: Digital services suitable for mobile / smart devices

	Indicator	Description	Source
7.4.1	Mobile friendliness	Website compatibility to mobile devices	EC – e-Government Benchmark Report

Maturity group 7.5: Open Data

Indicator	Description	Source

7.5.1	Open Data	Impact of open data at country level on four dimensions: political, social, environmental, and economic.	EC-DESI, Open Data Barometer
		Maturity group 7.6: Digital services performance & utilization	
	Indicator	**Description**	**Source**
7.6.1	Penetration & utilization	Internet use: submitting completed forms (last 12 months). Percentage of individuals who need to submit official forms to administrative authorities	EC – e-Government Benchmark Report

13. Annex B: FCM weight value assignments

The annex presents the FCM value assignments by team member and external expert. This research utilized an external expert on FCM applications from the academia, an external expert on human-computer interaction also from the academia, and two external experts from local companies. Also, this research took indirectly into account the views and the input given by various industry experts during previous workshops organized either by diaNEOsis or SEV Hellenic Federation of Enterprises.

Base scenario

Technology / Relationships - Weight Values						
	new ICT investments	eGov ICT efficiency	ICT interoperability	New ICT scope	Public procurement efficieny	change management
new ICT investments	X	X	X	V1	V2	V3
eGov ICT efficiency	V4	X	V5	X	X	V6
ICT interoperability	X	X	X	V7	V8	X
New ICT scope	X	V9	X	X	X	X
Public procurement efficieny	X	X	X	X	X	X
change management	X	X	V10	V11	V12	X

Technology / Relationships - Weight Values						
Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,35	0,2	0,5	0,5	0,2	0,5
V2	-0,8	-0,8	-0,8	-0,9	-0,9	-0,9
V3	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2
V4	0	0,1	0,1	0,1	0,1	0
V5	0,65	0,8	0,5	0,5	0,65	0,65
V6	0,2	0,35	0,2	0,2	0,2	0,35
V7	0,1	0,2	0,1	0	0,1	0
V8	-0,65	-0,5	-0,65	-0,65	-0,35	-0,65
V9	-1	-1	-0,9	-0,9	-0,8	-1
V10	-0,65	-0,8	-0,65	-0,65	-0,35	-0,65
V11	-1	-1	-1	-1	-1	-1
V12	-0,35	-0,2	-0,5	-0,5	-0,2	-0,2

change management / Relationships - Weight Values

	change management	project continuity efficiency	migration efficiency	project budget	project leadrship efficiency	project leadership changes
change management	X	V1	V2	X	X	X
project continuity efficiency	X	X	X	V3	V4	X
migration efficiency	X	X	X	V5	V6	X
project budget	V7	X	X	X	X	X
project leadrship efficiency	X	X	X	V8	X	V9
project leadership changes	V10	X	X	X	X	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,35	0,35	0,35	0,5	0,35	0,2
V2	0,65	0,5	0,5	0,2	0,5	0,8
V3	-1	-0,9	-0,9	-0,9	-0,8	-0,9
V4	0,5	0,65	0,35	0,35	0,5	0,35
V5	-0,65	-0,5	-0,65	-0,5	-0,35	-0,65
V6	0,65	0,65	0,5	0,65	0,35	0,8
V7	-0,1	-0,1	0	-0,1	-0,1	-0,1
V8	-0,65	-0,5	-0,65	-0,65	-0,35	-0,65
V9	-1	-1	-0,9	-0,9	-0,8	-1
V10	-0,2	-0,2	-0,2	-0,35	-0,2	-0,2

channel management / Relationships - Weight Values

	channel management efficiency	access efficiency	eID efficiency	mobile friendliness	user friendliness	eDoc efficiency	Authentication efficiency	Digital posts efficiency	open data	eGov ICT efficiency
channel management efficiency	X	V1	X	X	V2	X	X	X	X	X
access efficiency	X	X	V3	X	X	V4	V5	V6	X	X
eID efficiency	X	X	X	X	X	X	X	X	X	V7
mobile friendliness	X	X	X	X	X	X	X	X	X	V8
user friendliness	X	X	X	V9	X	X	X	X	V10	X
eDoc efficiency	X	X	X	X	X	X	X	X	X	V11
Authentication efficiency	X	X	X	X	X	X	X	X	X	V12
Digital posts efficiency	X	X	X	X	X	X	X	X	X	V13
open data	X	X	X	X	X	X	X	X	X	V14
eGov ICT efficiency	X	X	X	X	X	X	X	X	X	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,8	0,8	0,65	0,65	0,5	0,8
V2	0,35	0,5	0,35	0,5	0,65	0,65
V3	0,1	0,1	0,2	0	0	0,2
V4	0,65	0,9	0,5	0,65	0,35	0,65
V5	1	0,9	0,9	0,8	0,9	0,9
V6	0,1	0,2	0,1	0,1	0,1	0,35
V7	0,1	0	0,2	0,1	0	0,2
V8	0,1	0,2	0,2	0,1	0,1	0,2
V9	0,1	0	0,2	0,2	0,35	0
V10	0,1	0	0	0,2	0,35	0,2
V11	0,65	0,35	0,5	0,65	0,9	0,65
V12	1	0,9	0,9	0,8	0,9	0,9
V13	0,1	0,2	0,2	0,1	0,2	0,2
V14	0,1	0,1	0,1	0,1	0	0,2

eGov organization / Relationships - Weight Values

	organization efficiency	ebiz commitment	migration efficiency	employee motivation	training	cross functional silos	process simplification
organization efficiency	X	V1	V2	X	X	V3	X
ebiz commitment	X	X	X	V4	X	X	X
migration efficiency	X	V5	X	X	X	X	X
employee motivation	X	X	X	X	V6	V7	X
training	X	X	V8	X	X	X	X
cross functional silos	X	X	V9	X	X	X	V10
process simplification	V11	X	X	X	V12	X	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,1	0,2	0,35	0,2	0,2	0,2
V2	0,35	0,35	0,35	0,35	0,35	0,1
V3	-1	-1	-1	-1	-1	-1
V4	0,2	0,35	0,2	0,2	0,2	0,35
V5	0,2	0,2	0,2	0,2	0,1	0,1
V6	0,2	0,2	0,2	0,2	0,2	0,2
V7	0,1	0,2	0,1	0	0,1	0
V8	0,1	0,1	0,2	0,1	0,1	0,1
V9	-0,1	-0,1	0	0	-0,1	-0,1
V10	0,35	0,35	0,35	0,35	0,35	0,5
V11	-0,1	0	-0,2	0	-0,2	-0,2
V12	0,1	0	0,2	0,1	0,1	0,35

delivery operations efficiency / Relationships - Weight Values

	delivery operations efficiency	Digitalization of operations	usability & availability of eGov services	Gov Digitalization	Online services availability	eGov ICT efficiency	Usability factor	Transparency & accountability	Cross-border mobility for business	Utilization factor	Digital by default	migration efficiency
delivery operations efficiency	X	V1	V2	X	X	X	X	X	X	X	X	X
Digitalization of operations	X	X	X	V3	X	X	X	X	X	X	X	V4
usability & availability of eGov services	X	X	X	X	V5	X	v6	v7	V8	V9	X	X
Gov Digitalization	X	X	X	X	X	V10	X	X	X	X	V11	X
Online services availability	X	X	X	X	X	V12	X	X	X	X	X	X
eGov ICT efficiency	X	X	X	X	X	X	X	X	X	X	X	X
Usability factor	X	X	X	X	X	X	X	X	X	X	V13	X
Transparency & accountability	X	X	X	X	X	X	X	X	X	X	V14	X
Cross-border mobility for business	X	X	X	X	X	V15	X	X	X	X	X	X
Utilization factor	X	X	X	X	X	X	X	X	X	X	V16	X
Digital by default	X	V17	X	X	X	V18	X	X	X	X	X	X
migration efficiency	V19	X	X	X	X	X	X	X	X	X	X	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,8	0,8	0,65	0,65	0,8	0,8
V2	0,35	0,5	0,5	0,65	0,65	0,65
V3	0,8	0,8	0,8	0,8	0,8	0,8
V4	0,65	0,8	0,8	0,65	0,8	0,8
V5	0,35	0,2	0,35	0,2	0,5	0,35
V6	0,35	0,2	0,35	0,2	0,5	0,35
V7	0,5	0,5	0,65	0,35	0,65	0,65
V8	0,1	0,2	0,2	0,35	0,2	0,2
V9	0,35	0,2	0,2	0,35	0,2	0,5
V10	0,8	0,8	0,8	0,8	0,8	0,8
V11	-0,8	-0,8	-0,8	-0,8	-0,8	-0,9
V12	0,5	0,5	0,65	0,65	0,65	0,65
V13	0,5	0,5	0,65	0,65	0,8	0,8
V14	0,35	0,35	0,35	0,35	0,35	0,65
V15	0,1	0,2	0,2	0,35	0,2	0,2
V16	0,2	0,2	0,2	0,2	0,2	0,2
V17	0,1	0,1	0,2	0,2	0,2	0,1
V18	1	0,9	0,8	0,8	0,9	1
V19	0,35	0,2	0,2	0,35	0,2	0,35

digital transformation env / Relationships - Weight Values

	Digital transformation enviroment	eGov policy strability	eGov responsiveness to change	eGov prioritization by the State	Priority of using ICT	Promoting the use of ICT	eGov PPP	eGov legislation	Adaptability to eGov operating models	Adaptability to new ICT	Regulations for the use of new ICT	Policies & Regulation	migration efficiency	cross gov coordination	secondary legislation
Digital transformation enviroment	X	V1	V2	X	X	X	X	X	X	X	X	X	X	X	X
eGov policy strability	X	X	X	X	X	X	X	X	X	X	X	X	X	V3	X
eGov responsiveness to change	X	X	X	X	X	X	X	X	X	X	X	X	X	V4	X
eGov prioritization by the State	X	X	X	X	V5	V6	V7	X	X	X	X	X	X	V8	X
Priority of using ICT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	V9
Promoting the use of ICT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	V10
eGov PPP	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
eGov legislation	X	X	X	X	X	X	X	X	V11	V12	V13	X	X	X	X
Adaptability to eGov operating models	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Adaptability to new ICT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Regulations for the use of new ICT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Policies & Regulation	V14	X	X	V15	X	X	X	V16	X	X	X	X	V17	X	X
migration efficiency	X	X	X	X	X	X	X	X	X	X	X	X	X	V18	X
cross gov coordination	X	X	X	X	X	X	X	X	X	X	X	V19	X	X	X
secondary legislation	X	X	X	X	X	X	X	X	X	X	X	X	V20	V21	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,8	0,8	0,9	0,9	0,8	0,9
V2	0,65	0,5	0,8	0,65	0,65	0,65
V3	0,9	0,9	0,8	0,8	0,8	0,9
V4	0,5	0,5	0,65	0,65	0,65	0,65
V5	0,35	0,5	0,5	0,35	0,5	0,35
V6	0,65	0,8	0,5	0,65	0,65	0,65
V7	0,5	0,5	0,65	0,35	0,65	0,65
V8	0,8	0,8	0,9	0,9	0,8	0,9
V9	0,35	0,5	0,35	0,35	0,5	0,5
V10	0,5	0,8	0,65	0,65	0,65	0,65
V11	0,35	0,2	0,2	0,35	0,2	0,5
V12	0,35	0,2	0,2	0,2	0,2	0,5
V13	0,65	0,65	0,65	0,35	0,5	0,5
V14	0,8	0,8	0,9	0,9	0,8	0,9
V15	1	1	1	1	1	1
V16	0,8	0,65	0,9	0,8	0,5	0,65
V17	-0,8	-0,65	-0,8	-0,8	-0,5	-0,5
V18	0,65	0,8	0,65	0,65	0,65	0,65
V19	0,8	0,8	0,9	0,9	0,8	0,9
V20	-0,65	-0,65	-0,8	-0,8	-0,5	-0,5
V21	0,35	0,5	0,5	0,35	0,2	0,35

e-Gov maturity / Relationships - Weight Values

	eGov maturity	organization efficiency	channel management efficiency	delivery operations efficiency	Policies & Regulations	Admin burden
eGov maturity	X	X	X	X	X	V1
organization efficiency	X	X	X	V2	X	X
channel management efficiency	V3	X	X	X	X	X
delivery operations efficiency	V4	X	X	X	X	X
Policies & Regulations	X	X	V5	X	X	X
Admin burden	X	V6	V7	V8	V9	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	-0,65	-0,65	-0,65	-0,65	-0,5	-0,5
V2	0	0,2	0	0,1	0,1	0,1
V3	0,35	0,35	0,5	0,35	0,5	0,35
V4	0,2	0,35	0,2	0,35	0,2	0,1
V5	0,1	0,2	0,2	0,1	0,1	0,1
V6	-0,35	-0,5	-0,35	-0,2	-0,35	-0,35
V7	-0,5	-0,5	-0,65	-0,65	-0,5	-0,5
V8	-0,8	-0,65	-0,9	-0,8	-0,9	-0,9
V9	-1	-1	-0,9	-0,9	-1	-1

Scenario 2

Technology / Relationships - Weight Values - Scenario 2						
	new ICT investments	eGov ICT efficiency	ICT interoperability	New ICT scope	Public procurement efficieny	change management
new ICT investments	X	X	X	V1	V2	V3
eGov ICT efficiency	V4	X	V5	X	X	V6
ICT interoperability	X	X	X	V7	V8	X
New ICT scope	X	V9	X	X	X	X
Public procurement efficieny	X	X	X	X	X	X
change management	X	X	V10	V11	V12	X

Technology / Relationships - Weight Values - Scenario 2						
Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,35	0,2	0,5	0,5	0,2	0,5
V2	-0,8	-0,8	-0,8	-0,9	-0,9	-0,9
V3	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2
V4	0	0,1	0,1	0,1	0,1	0
V5	0,35	0,5	0,5	0,5	0,35	0,35
V6	0,2	0,1	0,1	0,1	0	0,1
V7	0,35	0,2	0,2	0,2	0,2	0,5
V8	-0,2	-0,2	-0,2	-0,2	-0,2	-0,1
V9	-1	-1	-0,9	-0,9	-0,8	-1
V10	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2
V11	-1	-1	-1	-1	-1	-1
V12	-0,35	-0,2	-0,5	-0,5	-0,2	-0,2

Scenario 3

eGov organization / Relationships - Weight Values - Scenario 3							
	organization efficiency	ebiz commitment	migration efficiency	employee motivation	training	cross functional silos	process simplification
organization efficiency	X	V1	V2	X	X	V3	X
ebiz commitment	X	X	X	V4	X	X	X
migration efficiency	X	V5	X	X	X	X	X
employee motivation	X	X	X	X	V6	V7	X
training	X	X	V8	X	X	X	X
cross functional silos	X	X	V9	X	X	X	V10
process simplification	V11	X	X	X	V12	X	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,1	0,2	0,35	0,2	0,2	0,2
V2	0,35	0,35	0,35	0,35	0,35	0,1
V3	-0,35	-0,35	-0,35	-0,35	-0,35	-0,2
V4	0,8	0,65	0,65	0,8	0,65	0,8
V5	0,35	0,5	0,5	0,35	0,5	0,35
V6	0,2	0,2	0,2	0,2	0,2	0,2
V7	-0,1	-0,1	-0,2	-0,2	-0,35	-0,35
V8	0,1	0,1	0,2	0,1	0,1	0,1
V9	0,1	0,1	0,2	0,1	0,2	0,2
V10	0,35	0,35	0,35	0,35	0,35	0,5
V11	0,8	0,65	0,65	0,8	0,65	0,8

Scenario 4

The increased policy efficiency is realized only by increasing 3X the impact of the concept “migration efficiency” to other concepts in the map.

Scenario 5

e-Gov maturity / Relationships - Weight Values - Scenario 5						
	eGov maturity	organization efficiency	channel management efficiency	delivery operations efficiency	Policies & Regulations	Admin burden
eGov maturity	X	X	X	X	X	V1
organization efficiency	X	X	X	V2	X	X
channel management efficiency	V3	X	X	X	X	X
delivery operations efficiency	V4	X	X	X	X	X
Policies & Regulations	X	X	V5	X	X	X
Admin burden	X	V6	V7	V8	V9	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	-0,5	-0,5	-0,65	-0,5	-0,5	-0,5
V2	0,5	0,5	0,5	0,65	0,5	0,65
V3	0,35	0,35	0,5	0,35	0,5	0,5
V4	0,5	0,5	0,5	0,5	0,5	0,5
V5	0,9	0,9	0,65	0,8	0,65	0,9
V6	-0,35	-0,35	-0,35	-0,2	-0,35	-0,35
V7	-0,5	-0,5	-0,65	-0,65	-0,5	-0,5
V8	-0,1	0	-0,1	-0,2	-0,1	0
V9	-0,5	-0,5	-0,35	-0,35	-0,35	-0,35

Scenario 6

e-Gov maturity / Relationships - Weight Values - Scenario 6						
	eGov maturity	organization efficiency	channel management efficiency	delivery operations efficiency	Policies & Regulations	Admin burden
eGov maturity	X	V1	V2	V3	V4	V5
organization efficiency	X	X	X	X	X	X
channel management efficiency	X	X	X	X	X	X
delivery operations efficiency	X	V6	V7	X	V8	V9
Policies & Regulations	X	X	X	X	X	X
Admin burden	X	X	X	X	X	X

Causal link	Research team 1	Research team 2	Expert 1 - Academia	Expert 2 - Academia	Expert 1 - Company	Expert 2 - Company
V1	0,2	0,35	0,1	0,1	0,2	0,1
V2	0,5	0,5	0,35	0,35	0,5	0,5
V3	-0,5	-0,5	-0,65	-0,5	-0,5	-0,5
V4	0,35	0,35	0,5	0,5	0,35	0,35
V5	1	0,9	0,65	0,8	0,65	0,9
V6	-0,35	-0,35	-0,35	-0,2	-0,35	-0,35
V7	-0,1	0	-0,1	-0,2	-0,1	0
V8	-0,5	-0,5	-0,35	-0,35	-0,35	-0,35
V9	-0,35	-0,35	-0,35	-0,35	-0,5	-0,5

14. Annex C: Research team

The team consists of the following researchers:

Professor Diomidis Spinellis, Project Coordinator, Principal Researcher

Diomidis Spinellis is the Head of and a Professor in the Department of Management Science and Technology at the Athens University of Economics and Business, Greece. His research interests include software engineering, IT security, and cloud systems engineering. He has written two award-winning, widely translated books: "*Code Reading*" and "*Code Quality: The Open-Source Perspective*". In 2016 he published the book *Effective Debugging: 66 Specific Ways to Debug Software and Systems.* Dr. Spinellis has also published more than 300 technical papers in journals and refereed conference proceedings, which have received more than 8000 citations. He served for a decade as a member of the *IEEE Software* editorial board, authoring the regular "Tools of the Trade" column, and as the magazine's Editor-in-Chief over the period 2015–2018. He has contributed code that ships with Apple's macOS and BSD Unix and is the developer of *CScout, UMLGraph*, *dgsh*, and other open-source software packages, libraries, and tools. He holds an MEng in Software Engineering and a PhD in Computer Science, both from Imperial College London. Dr. Spinellis has served as an elected member of the IEEE Computer Society Board of Governors (2013–2015), and is a senior member of the ACM and the IEEE.

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Nancy Pouloudi is Professor of Information Systems Management in the Department of Management Science and Technology at the Athens University of Economics and Business, Greece. She holds a PhD in Information Systems from the London School of Economics. Her research focuses on organizational and social issues in information systems adoption and implementation. She is a member of the Editorial Boards of the Journal of the AIS, Information & Management, Health Policy & Technology, and the International Journal of Society, Information, Communication & Ethics. She has served on the editorial boards of the European Journal of Information Systems and IT & People as well as on the Committees of the European (ECIS) and the Mediterranean (MCIS) Conference on Information Systems. In the period 2010-2013 she was Region 2 (Europe/Middle East/Africa) Representative of the Association for Information Systems (AIS). In 2016 she received the Sandra Slaughter Service Award of the AIS.

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Dr George Xirogiannis, Senior Advisor

George is currently the Deputy Director General at SEV Hellenic Federation and Enterprises and CEO at SEV's research institute. He is also a BoD member at private sector companies in Greece. George has extensive professional experience in industrial policy, digital transformation, industrial investments, growth strategies, and international trade. He has also substantial management consulting experience. As a Senior Manager at PwC, he directed large scale strategy and operations projects in the private sector and complex reforms in the public sector.

His current academic research focuses on intelligent business modeling. In the past he also researched on distributed execution of artificial intelligence programs. He has lectured as an Adj. Assistant Professor at the University of Piraeus, Department of Informatics, and the University of the Aegean, Department of Financial Management Engineering. His research has been published in international journals and conference proceedings. He has co-authored several books on modern entrepreneurship.

He holds a Ph.D. in Artificial Intelligence from Heriot-Watt University, Edinburgh, UK and an M.Sc in Artificial Intelligence from Bristol University, UK. He graduated with a B.Sc (Hons) in Mathematics from the University of Ioannina, Greece.

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Fay is the Senior Research Analyst at diaNEOsis and an Adj. Assistant Professor at Athens University of Economics and Business (AUEB). She completed her PhD thesis on a game theoretic approach of international trade at AUEB. As a Postdoctoral Fellow she focused on public sector reform in Greece, the country's export performance and the measurement of its human capital. During her studies she was awarded grants for excellence and research from the Greek State Scholarships Foundation (IKY), the Bank of Cyprus, the Georgios and Victoria Karelia Foundation, the AUEB and the European Research Funding Program -"Heracleitus II". Her research has been published in international journals and she has presented her work in national and international conferences. She has also co-authored and edited socio-economic research about Greece's exit from the crisis.

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