A Multicriteria Methodology for the Selection and Prioritisation of Public Services

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Abstract. The pressing need to deploy the information and communications technology in the public sector effectively and efficiently along with the complexity of the decision making process have thrust research towards the development of public services prioritization models. The purpose of this paper is to outline a general multicriteria decision support method in order to identify the services that, if transformed to electronic ones, would act as ambassadors of the new era. Various technological, social, political and economic criteria have been taken under consideration. The proposed model is based on the Analytic Network Process (ANP), which takes into account both tangible and intangible criteria with interdependencies and feedback among them. A real case scenario concerning a Public Services selection process in Greece has been used to validate the presented model.

Keywords: Public Services, Analytic Network Process (ANP), Analytic Hierarchy Process (AHP), Multicriteria Decision Analysis (MCDA).

1 Introduction

The rapid technological development of the last decades has radically transformed the way government information and services are delivered to the citizens. Web-based telecommunication technologies have been utilized in order to improve and/or enhance the efficiency and effectiveness of service delivery in the public sector [1-2]. The general term "e-Government" was introduced so as to describe this technological penetration and public transformation and, today, it has progressed to the point where it has proven to be a force for effective governance and citizen participation, both at international and local levels [3].

This upward trend in e-Government development [4] has accelerated despite, or maybe in part also due to, the current financial crisis and the pressing need for governments to be competent, transparent, accessible and efficient. The compelling factor and the bitter early lesson learned from the crisis is that trust matters, and lack of confidence in government, as in markets, can lead to calamity. The capacity to respond under difficult conditions and deliver the expected results are cornerstones of effective government and a foundation of public trust.

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In this light, due to the aforementioned global economic crisis [5], the probability of a wrong investment has to be minimized and the spending of public money needs to be targeted and with low risk. In other words, the spawned need of public services prioritization will soon become a pressing challenge which could decide the future of e-Government's embracement and effectualness. The purpose of the present paper is to propose the implementation of a general multicriteria decision making method in the prioritization of public services. The question that is which of the public service scenarios under consideration should be delivered first, partially or fully, in an electronic way [6]. This approach will enable governments take into account, not only historical data, but also the current conditions, the trends and the tacit knowledge of the experts.

In general, the domain of Multiple Criteria Decision Analysis (MCDA) concerns the approach of explicitly taking into consideration the pros and cons of a plurality of points of view, in order to make a decision [7-9]. MCDA is an activity which helps making decisions mainly in terms of choosing, ranking or sorting the potentials [10]. The proposed model is based on the Analytic Network Process (ANP), an advanced MCDA method [11], and is meant to prioritize public services by using both quantitative and qualitative variables.

This paper's object is twofold. It emphasizes on outlining the criteria which need to be considered in public services selection, while, on the other hand, it offers a comprehensive approach on how ANP can be utilized to aid the decision making process in the aforementioned problem. Its practical value is illustrated via an example in the area of the current Greek reality.

The rest of this paper is organised as follows. The second section offers a brief literature review and corresponding analysis of the AHP and ANP methodologies and describes the service scenarios under consideration, while it also defines the criteria which were used for the multicriteria model introduced. Moreover, in this section, the entire methodology application is presented as well as the respective results. The paper concludes with the last section where basic findings are discussed, minor limitations of the approach proposed are underlined and possible future steps are recognized.

2 Proposed Approach and Application

The current financial crisis enforced in a way the commanding penetration of the web-based technologies into the public sector. In this rather restrictive financial reality, the sectors where e-Government would most benefit the government as well as the users of public services (meaning both citizens and businesses) should carefully be examined and scaled. Therefore, the authors have tried to summarize and pinpoint the most important criteria in evaluating the delivered services while proposing the use of a multicriteria decision making approach in this field.

2.1 Methodological Multicriteria Background for Ranking and Prioritising Services

The methodology employed for selecting and prioritising services is based on the Analytic Network Process (ANP), a multiple-criteria decision analysis method which, since its introduction by Thomas L. Saaty, has been used around the world in a wide variety of decision situations, in fields such as government, business, industry, healthcare, and education [12]. The ANP is a generalization of the Analytic Hierarchy Process [13-14]. The Analytic Hierarchy Process (AHP) is designed to structure a decision process in a scenario affected by multiple independent factors. Based on this methodology, a complex problem is divided into sub-problems organized according to hierarchical levels [15], with each level denoting a set of criteria or attributes related to the specific case. The top level of the hierarchy denotes the main goal, the bottom level contains the alternative or actions considered when achieving the goal, and the intermediate levels denote the factors that influence the upper levels. In this context, the AHP methodology makes it possible to compare different factors, where each factor's importance influences the final solution and the rank of the alternative that is to be used for reaching this solution [16-17].

2.2 Service Scenarios' Description

The proposed model applies the ANP to the problem of evaluating, prioritizing and selecting public services [18]. The model has been validated through a real case implementation [19] concerning the prioritization of five different public services delivered by the Greek public sector. These services have been selected with the contribution of the Ministry of Administrative Reform and e-Government which provided the public service scenarios which are under consideration for improvement and radical transformation of the way they are delivered. The five most important ones which are presented below:

1. *Access extracts of insurance record of Social Security Institutes*: According to almost all European social security systems, every employee (citizen) must be registered to a public security organization. For each working day, a part of employee's salary is paid to the social security institute so that the employee can receive social security services (e.g. hospitalization, allowances). Usually the employer (e.g. a company) keeps a part of employee's salary and adds the employer's contribution so as to pay a specific amount of money to the Social Security institute in charge. The employee can verify that the employer has paid its contribution to the Social Security institute by accessing and getting an extract of his/her record regarding the working days that have been paid for him/her. Currently this service is provided after an electronic or conventional application depending on the each specific case's sophistication level.
2. *Certificates of various civil acts*: Citizens request from e.g. a Citizen Service Centre the indented certificates while providing the necessary supporting documents (e.g. photocopy of the identity card for a birth certificate). This procedure has a wide application since such certificates are prerequisite to many other services (e.g.

changing municipality). The authorized employee of the Citizen Service Centre collects and checks the supporting documents. In case something is missing, the procedure halts and the citizen is informed about the derived issue, otherwise, the Citizen Service Centre employee completes the electronic application and creates a new folder in the Citizen Service Centre's informational system. Then, the employee sends the application along with the supporting documents to the proper authority (via fax, post office etc.). When the Citizen Service Centre receives the certificate from the authority, the citizen is notified to collect it from the desired Citizen Service Centre.

3. *Monitoring compensation procedures of Hellenic Organisation of Agricultural Insurances:* The Hellenic Organisation of Agricultural Insurances - ELGA is a governmental body for supporting agricultural production. ELGA provides social insurance to farmers and agricultural workers while, on the other hand, provides insurance on the agricultural production and compensates the producers in cases of physical disasters destroying their harvest. Whenever the harvest of a farmer is destroyed – on the condition that he/she had applied all the necessary measures to be able to grow his/her products with safe – he/she may claim for compensation. The proposed scenario has to do exactly with the procedure that is being followed by a farmer in order to get compensated after such a disaster. The service has as a main purpose to provide real-time information to the farmers concerning the stage of their requests for compensation, the height of the compensation decided and the time of the deposit. In addition the service provides to the farmer all the relevant certificates needed for his/her tax declaration concerning the compensation. The service is currently operated by the administrative services of ELGA with the involvement of the citizen service centers.
4. *Transferring citizen rights to another municipality:* The proposed scenario refers to the case that a citizen has moved to another municipality and wants to transfer his/her rights in order to be able to vote or to participate to several activities in the municipality he/she has moved.
5. *Monitoring an application submitted through e-Gov procedures:* Citizen Service Centers in Greece act as a mediator between the citizen and the competent authorities. Whenever a Citizen requests a service, Citizen Service Centres create a dossier of the case including the application forms and the supporting documents. This dossier is transferred to the competent authority. Citizen Service Centres are not responsible/authorized for the execution of the service. Usually an estimated time for the execution of the service is announced to the citizen. As long as the response of the competent authority is in the expected timeframe, the result of the case is transferred to the Citizen Service Centre. As a final step Citizen Service Centres contact the citizen announcing that his/her case has been completed and deliver the result to the citizen. A new service has to be designed in order so that the Citizen Service Centres and the Citizen have constant information regarding the status of their case. This service will allow immediate response to the Citizens for the status of their case. Moreover, this service will provide valuable information for the public administration regarding the steps of a process or problems that usually cause delays. This is a valuable tool for indenting areas for public administration reform and simplification of the procedures.

2.3 Criteria Definition

In our effort to develop a public service evaluation ANP model, the most critical point was to define the criteria which need to be taken into consideration [20]. Towards that direction, the authors performed an extended research work concerning evaluation criteria in the public sector and proceeded to selecting the common criteria that were common among the most relevant approaches [29-32] and reflect in the best way the cases examined. These criteria, combined with the ones extracted from the Services Description Template, introduced in [21], aim to document the various facts and details of every public service scenario analysed. The criteria were reviewed and categorized into clusters that were later on communicated and evaluated by the executive officers of the Greek Ministry of Administrative Reform and e-Government, hereafter referred as decision makers. This procedure concluded in the formation of the final model.

In the following table, a detailed description of the criteria used is presented combined with their categorization into clusters:

Table 1. Criteria Description

Cluster	S/N	Criterion	Possible Values	Description
SERVICE FLOW	A	Public (Final) Service	Yes / No	Indicates whether the service is public (final) or if it is an intermediate process.
	B	Self-appointed call of Service	Yes / No	Defines whether the service could be called only with the acquiescence of service receiver or, alternatively, automatically by a public organization.
	C	Re-usability by other services	High/Medium/Low	Indicates whether this service, although final, is also prerequisite to other public services – so it can be reasonably considered as more important
	D	Service Execution Domain	Internal/ External	Indicates whether this service is executed within the boundaries of an organization (e.g. a municipality), or it includes interaction with other, «external» organizations (e.g. the police) as well.
SERVICE COMPLEXITY	E	Legal Framework Implication	High/Medium/Low	States in which degree legislation is affecting the operation of a service.
	F	Level of compliance with National Interoperability Frameworks	Yes / No / No Interoperability Framework existing	Indicates whether the delivery of the service is compliant with the correspondent interoperability framework.
	G	Requirement for Personal Presence	Yes / No	Indicates whether physical presence at the submission of the application, the delivery or any other step of the service is required.

Table 1. (*continued*)

	H	Level of Support by IT systems	Full / Semi / No support	Indicates if the service is fully automated, if some steps are done manually, or if there is no support at all – depending on the maximum level of support the specific service could provide.
SERVICE IMPORTANCE	I	Based on European Policies	Yes / No	Indicates whether the service is aligned with the i2010 list of 20 Basic Public Services and the overall European eGovernment Action Plan. The list consists of 12 services for citizens and 8 for businesses.
	J	Existence of a pan-European dimension	Yes / No	Indicates whether a pan-European dimension of the specific service exists. An indicative list of public services which have a pan-European dimension and shall be taken into account in the present task includes, i.e.: Request and delivery of birth, marriage, death certificate, Services related to nomadic work, Declaration to the police
	K	Potential to deliver value within a certain short time frame	High/Medium/Low	It is vital to select a service that can deliver value within a specific short time frame. A selection of an interesting but time-consuming public service could lead to a failure of keeping the time frame.
	L	Importance for the Service Provider Organization	High/Medium/Low	States if the service is important and probably a part of the strategic plan of a public organization.
	M	Political dimension	High/Medium/Low	Indicates the compliance of the service to the Organisation's Mission and the Strategic Policies as well as the projected Public Perception of the service and its political impact [22].
SERVICE LOAD DATA	N	Total Service Duration	Duration in hours/days	Indicates how many hours/days does it take for the service to complete – no matter if the service is provided conventionally or electronically.
	O	Frequency	Requests/ year	Indicates the number of the requests of the specific service in a given amount of time.
	P	No of Inputs	Number	Defines the number of prerequisites of the service.

At this point, a reference should be made to the need to adjust the criteria proposed via the Services Description Template so as to generalize their application. More specifically, the criteria "Requirement for Personal Presence at the submission of the

application" and "Requirement for Personal Presence at the delivery of the service" were unified to lead to the more generic one "Requirement for Personal Presence" mainly due to the different nature of each public service scenario under investigation. Moreover, the Services Description Template seems to totally overlook the political dimension of a public service [23] downgrading its role to the decision making procedure in the public sector.

From a technical point of view, the structure of the ANP model is described by its clusters and elements and the connection between them. These connections indicate the flow of influence among the elements. The resulting model is illustrated in the following figure and consists of five clusters:

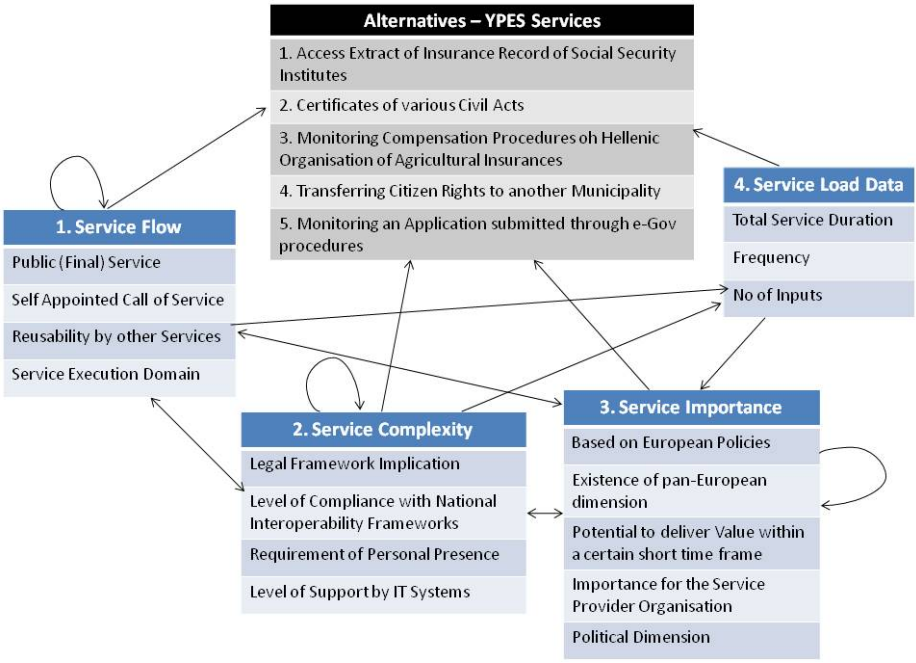

Fig. 1. The Public Service Evaluation ANP Model

For the ANP implementation, Super Decisions[1] software was employed, developed by the ANP Team (working for the Creative Decisions Foundation), to alleviate the mathematical burden. The figure depicted above represents the Public Service Evaluation ANP Model as constructed with the usage of Super Decisions software [24] so as to implement our example case study for the Greek public sector.

[1] http://www.superdecisions.com/

2.4 Analysis Approach and Paired Comparisons

Having decided to adopt the influencing analysis approach (recommended and broadly used in bibliography) and with the valuable contribution of the decision makers, the connections among the clusters and elements were defined (depicted in Figure 1 with arrows) to reflect the interaction of the different factors in the real environment. For instance, the bidirectional arrow from cluster "1. Service Flow" to cluster "3. Service Importance" captures the notion of outer dependence on ANP and is interpreted in means of influence among their elements. On the other hand, the concept of inner dependence is depicted with a feedback loop such as the one present in cluster "2. Service Complexity" and represents the influence among different elements of the same cluster.

Following the final formation of the public service MCDA model, the collaborating officers of the Ministry of Administrative Reform and e-Government were asked to respond to a series of pair wise comparisons with respect to a control criterion. "Super Decisions" software is able to calculate the inconsistency ratio for each comparison matrix, so the most consistent value for the entries can be determined. The inconsistency measure is useful for identifying possible errors in judgments as well as actual inconsistencies in the judgments themselves. Afterwards, the Clusters Priority Matrix is constructed; whose columns consist of the weighted priorities derived during the pair wise comparisons.

Table 2. Clusters Priority Matrix

	1. Service Flow	**2. Service Complexity**	**3. Service Importance**	**4. Service Load Data**	**Alternatives**
1. Service Flow	0.002652	0.558299	0.487794	0000	0000
2. Service Complexity	0.681786	0.121505	0.121957	0000	0000
3. Service Importance	0.079742	0.110766	0.195125	0.500000	0000
4. Service Load Data	0.233168	0.087925	0000	0000	0000
Alternatives	0.002652	0.121505	0.195125	0.500000	0000

The next step of the method was the computation of the SuperMartix, the Weighed SuperMatrix and the Limiting Matrix. These matrixes represent the impact or influence of each elements on other elements of the problem and are computed by the Super Decision software. Indicatively, the Weighted SuperMatrix of the examined problem is presented in the following table:

Table 3. The Weighted SuperMatrix

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	1	2	3	4	5
A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	1.000	0	0	0	0.333	1.000	1.000	0	0	0.500	0	0	0	0	0	0	0	0	0	0	0
C	0	1.000	0	0	0.333	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0.333	0	0	0	0	0.500	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0.500	0	0	0	0	0	0	0	0	0	0	0	0
F	0	1.000	0	1.000	0	0	1.000	0	0.500	0.750	0	0	0	0	0	0	0	0	0	0	0
G	0	0	0	0	0	0	0	0	0	0.250	0	0	0	0	0	0	0	0	0	0	0
H	0	0	0	0	1.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	0	0	0	0	0	0	0	0	0.333	0	0	0	0	0	0	0	0	0	0	0	0
K	0	0.500	0	1.000	0	0	0	0	0.333	0	0	1.000	0.500	0.167	0	0	0	0	0	0	0
L	1.000	0.500	0	0	0	0	0	1.000	0.333	0	0	0	0.500	0.833	0	0.500	0	0	0	0	0
M	0	0	0	0	0	0	1.000	0	0	0	0	0	0	0	0	0.500	0	0	0	0	0
N	0	1.000	0	0	0.333	0	0.500	1.000	0	0	0	0	0	0	0	0	0	0	0	0	0
O	0	0	0	0	0.333	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	0	0	0	1.000	0.333	0	0.500	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0.429	0.140	0.238	0.200	0.243	0.243	0.292	0.080	0.048	0.048	0.286	0.113	0.091	0.478	0.253	0.303	0	0	0	0	0
2	0.048	0.554	0.238	0.200	0.243	0.027	0.089	0.152	0.429	0.429	0.286	0.339	0.091	0.203	0.139	0.303	0	0	0	0	0
3	0.048	0.054	0.238	0.200	0.243	0.243	0.292	0.152	0.048	0.048	0.071	0.401	0.091	0.042	0.139	0.303	0	0	0	0	0
4	0.429	0.188	0.238	0.200	0.243	0.243	0.036	0.096	0.429	0.429	0.286	0.059	0.091	0.053	0.052	0.031	0	0	0	0	0
5	0.048	0.065	0.048	0.200	0.027	0.243	0.292	0.519	0.048	0.048	0.071	0.088	0.636	0.224	0.418	0.060	0	0	0	0	0

2.5 Final Prioritization Results

The final results, prioritization (normalized values) of public services under evaluation as derived from the limit matrix are presented in Table 4 and, for a more representative overlook of the outcome, in Figure 2.

Table 4. Final Public Services Prioritization Results

Alternatives	Total	Normal	Ideal	Ranking
1. Access, extracts of insurance record in Social Security Organisation	0.0700	0.2867	1.0000	1
2. Certificates of various civil acts	0.0532	0.2177	0.7593	2
3. Monitoring compensation procedures of Hellenic Organisation of Agricultural Insurances	0.0402	0.1647	0.5746	4
4. Transferring citizen rights to another municipality	0.0446	0.1828	0.6375	3
5. Monitoring an application submitted through e-Gov procedures	0.0362	0.1482	0.5168	5

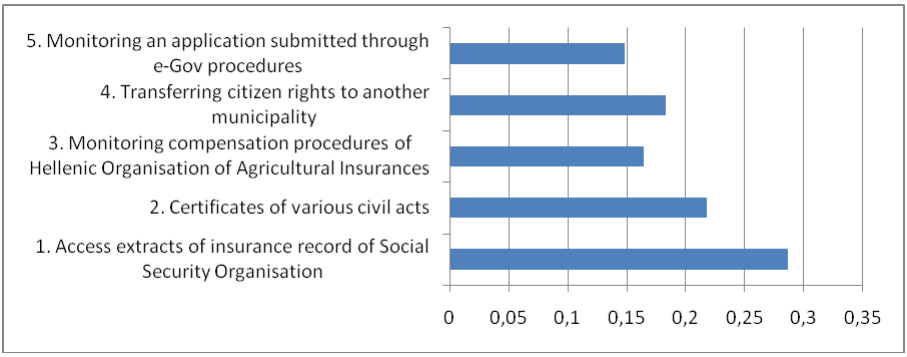

Fig. 2. Prioritization of Proposed Public Services

As shown above, the priorities of the services which were derived after applying the multi-criteria analysis do not represent only their importance for the Ministry of Administrative Reform and e-Government but also how much appropriate they are based on the technical implementation requirements. It becomes obvious that services like the prevailing one (Access extracts of insurance record of Social Security Organisation), which affect a large number of end users but are also compatible with the public authorities' initiatives and frameworks, take precedence against other scenarios that do not meet these standards.

Nevertheless, it needs to be noted that, in order to reach a justified and viable result, a time consuming and possibly tiring effort is needed both by the Public Sector (which has to provide all respective data) and by the supporting technical user (who operates the suitable software) [25].

2.6 Sensitivity Analysis

In order to check the stability of our results, a sensitivity analysis is performed with a series of a "what if" kind of questions to verify that the final classification is stable

when the inputs, whether judgments or priorities, are changed. Therefore, the authors have proceeded by radically altering the responses received during the pairwise comparisons.

The first and most important part of our sensitivity analysis was the one regarding the "Level of compliance with National Interoperability Frameworks", which is the dominant criterion based on our ANP analysis. The procedure showed that irrespective of its value, the rank of the public services scenarios is preserved.

The rest of our analysis consisted of similar sensitivity tests for the rest of the criteria used in our model and the results led to the conclusion that the outcome is sufficiently stable and does not change the overall rank [26].

3 Conclusions

The prioritization of public services is a rather difficult endeavour as it considers many conflicting criteria, both tangible and intangible. The present paper introduced an MCDA approach, based on the ANP methodology, capable of capturing this complex decision environment. In more detail, the proposed model enables the decision maker to better comprehend the various factors that influence the final outcome while, at the same time, documents the evaluation results in an indisputable way. The case study used to evaluate the effectiveness of the proposed model referred to a limited number of scenarios; however, the presented methodology is also applicable to sets of numerous alternatives with the cost of complexity. In our example, the highest priority was assigned to the "Access extracts of insurance record of Social Security Organisation" while the most dominant criteria were proven to be the "Level of compliance with National Interoperability Frameworks" and the "Re-usability by other services" demonstrating the importance service complexity and flow factors bear in this field.

The authors feel the obligation to underline the fact that the ANP methodology proposed bears a few limitations which mainly derive from the subjectivity of the input by the decision makers and the time-consuming nature of the pairwise comparisons which may lead to inconsistencies and, consequently, to doubtful and wrong results. Yet these limitations are not considered to be restrictive mainly due to the complexity of the e-Government field.

The present paper raises several important issues that could spark further research concerning the evaluation of the model and its implementation at additional case studies in different European countries.

In the near future, it would be useful if a coordinated pan European initiative among Public Institutions took place so as to define common and mutually accepted criteria for the prioritization of public services in order to formulate a unified model for the sophistication of public service delivery.

Last but not least, an ICT tool [27-28] could be developed in order to apply the aforementioned methodology efficiently and effectively to any kind of service providing useful results and guidelines to its final users.

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References

1. Jeong, C.H.: Fundamental of Development Administration. Scholar Press, Selangor (2007) ISBN 978-967-504-5080
2. Beynon-Davies, P., Martin, S.: Electronic Local Government and the Modernisation Agenda: Progress and Prospects for Public Service Improvement. Local Government Studies 30(2), 214–229 (2010)
3. United Nations: Department of Economic and Social Affairs, United Nations E-Government Survey (2010)
4. Millard, J.: Reorganisation of Government Back-Offices for Better Electronic Public Services. In: Traunmüller, R. (ed.) EGOV 2004. LNCS, vol. 3183, pp. 363–370. Springer, Heidelberg (2004)
5. Niemira, M., Saaty, T.L.: An analytic network process model for financial-crisis forecasting. International Journal of Forecasting 20(4), 573–587 (2004)
6. Lenk, K.: Electronic Service Delivery - A driver of public sector modernization. Journal Information Polity 7(2-3) (2002)
7. Guitouni, A., Martel, J.M.: Tentative guidelines to help choosing an appropriate MCDA method 109(2), 501–521 (September 1, 1998)
8. Laaribi, A., Chevalier, J., Martel, J.: A spatial decision aid: a multicriterion evaluation approach. Computers, Environment and Urban Systems 20(6), 351–366 (1996)
9. Hanne, T.: Intelligent Strategies for Meta Multiple Criteria Decision Making. International Series in Operations Research & Management Science. Kluwer Academic Publishers, Dordrecht (2000)
10. Kirytopoulos, K., Voulgaridou, D., Platis, A., Leopoulos, V.: An effective Markov based approach for calculating the Limit Matrix in the analytic network process. European Journal of Operational Research 214, 85–90 (2011)
11. Saaty, T.L.: Decision Making with Dependence and Feedback: The Analytic Network Process. RWS Publications, Pittsburgh (1996)
12. Figueira, J., Greco, S., EhrGott, M.: Multiple Criteria Decision Analysis: State of the Art Surveys. Springer (2005)
13. Saaty, T.L.: The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. McGraw-Hill (1980)
14. Saaty, T.L., Vargas, L.G.: The Analytic Hierarchy Process Series. University of Pittsburg, Pittsburg (1990)
15. Zahir, S.: Geometry of decision making and the vector space formulation of the analytic hierarchy process. European Journal of Operational Research 112(2), 373–396 (1999)
16. Saaty, T.L.: Decision Making in Complex Environments: the Analytic Hierarchy Process (AHP) for Decision Making and the Analytic Network Process (ANP) for Decision Making with Dependence and Feedback. RWS Publications, Pittsburgh (2003)
17. Saaty, T.L., Vargas, L.G.: Decision Making with the Analytic Network Process. Springer Science, New York (2006)
18. Weber, R., Werners, B., Zimmerman, H.J.: Planning models for research and development. European Journal of Operational Research 48, 175–188 (1990)

19. Whitaker, R.: Validation examples of the analytic hierarchy process and analytic network process. Mathematical and Computer Modelling 46(7-8), 840–859 (2007)
20. Huang, J.J., Tzeng, G.H., Ong, C.S.: Multidimensional data in multidimensional scaling using the analytic network process. Pattern Recognition Letters 26(6), 755–767 (2005)
21. Koussouris, S., Kokkinakos, P., Panopoulos, D., Askounis, D., Jain, A., Hartman, A., Zirpins, C., Georgousopoulos, C.: A Selection and Prioritisation framework for Collaborative Public Services Design. In: 5th International Conference on Methodologies, Technologies and Tools enabling e-Government, Camerino, Italy, June 30-July 1 (2011)
22. Bellos, E., Voulgaridou, D., Kirytopoulos, K., Panopoulos, D.: An MCDA Approach for Project Selection in Public Sector, Heraclion, Crete, Greece (2010)
23. Medaglia, A., Hueth, D., Mendieta, J.-C., Sefair, J.: A multiobjective model for the selection and timing for public enterprise projects. Socio-Economic Planning Sciences 42, 31–45 (2008)
24. Saaty, T.L.: Super decisions software. RWS Publications, Pittsburg (2004)
25. Bekkers, V., Zouridis, S.: Electronic Service Delivery in Public Administration: Some Trends and Issues. International Review of Administrative Sciences 65, 183–195 (1999)
26. Saaty, T.L.: Principia Mathematica Decernendi: Mathematical Principles of Decision Making. RWS Publications, PA (2010)
27. Lee, J.W., Kim, S.H.: Using analytic network process and goal programming for interdependent information system project selection. Computers & Operations Research 27, 367–382 (2000)
28. Lee, H., Kim, C., Cho, H., Park, Y.: An ANP-based technology network for identification of core technologies: A case of telecommunication technologies. Expert Systems with Applications 36(1), 894–908 (2009)
29. Jackson, P.: Public Service PerformanceEvaluation: A Strategic Perspective. Public Money & Management, 9–14 (October-December 1993)
30. Hock, L.C., Lim, J.: What Does It Mean to Optimise Public Service Delivery? Ethos (4) (April 2008)
31. Dignan, J.: What does "good enough" mean in public sector IT? OVUM (March 30, 2012), http://ovum.com
32. Sharma, A.: Evaluating public service delivery in emerging markets. In: 2011 IEEE International Conference on Service Operations, Logistics, and Informatics (SOLI), July 10-12, pp. 214–219 (2011)