# A Methodology Framework for Calculating the Cost of e-Government Services

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**Abstract.** This paper proposes a structured framework for calculating the cost of e-Government services, based on the complementary application of the IDEF0 modelling tool and the Activity-Based Costing technique. The motivation for this research effort was derived by the need to use an alternative method for the annual cost calculation of the TAXISnet e-Government services, since the relevant report published from the Greek Ministry of Finance in 2003 was based on traditional accounting approaches. The first step of the proposed methodology is the IDEF0-supported identification of the activities corresponding to the e-Government services and their initial classification as value-added or non value-added. Data collection follows, concerning cost elements and their activities using Activity-Based Costing. The paper concludes with a discussion concerning the added value of the proposed methodology framework and further research.

## 1 Introduction

E-Government has proven to be a durable and popular public management reform option over the last decade, attractive to elected officials and stakeholders who see its political benefits [1]. Public management scholarship on e-Government focuses on the beneficial effects of new technologies and examines the reasons why and how technology adoption occurs [2], [3], [4], [5].

Research in the e-Government field has not directly questioned the basic premise that using Information Technology (IT) in public administration is a positive and inevitable route to improvement, progress and cost effectiveness. Certain e-Government proponents argue that declining rates of trust in government can be reversed through the use of technology, either indirectly because of greater citizen satisfaction with more convenient services or directly through enhancing civic participation in the public sphere. The latter approach has been referred to as "digital democracy," "e-civics," and "e-democracy" [6] and argues that information technologies can enhance democracy by making public information more accessible and by enabling a range of civic discourse that otherwise would not occur: from facilitating citizen-initiated contacts through the Web [7], to enabling a representative and meaningful discourse that replaces complicated administration processes [8]. However, the potential of e-Government in this area has remained largely unfulfilled [9].

In the context of public sector reform, Heeks & Davies [10] identify four approaches to the use of IT in their entitled "four-eyes model". One of these is the "idolise" approach, in which public sector officials use computers but are "over-aware" of technology's potential. They believe IT can transform the business of government, and are dimly aware that information is something important. In consequence, the public sector becomes swamped in IT-driven projects, many of which have proved spectacular failures [11], [12]. The change expected has not occurred and the systems have fallen into disrepute and disuse, if indeed they ever worked in the first place – amounting to a gross waste of scarce resources.

Considering the struggle of public administration to maintain a high degree of transparency in the implementation of e-Government services projects, the justification of their budgets is realised through studies that describe comparative analyses of cost information between the traditional way of serving citizens and the IT-supported solutions. However, due to the lack of established methodologies for calculating the costs and assessing the benefits of implementing e-Government services, it is a common phenomenon for these studies to contain analyses that do not reflect the cost reality.

The motivation for this paper was a cost analysis report concerning the TAXISnet e-Government services project [13], published from the General Secretariat for Information Systems of the Greek Ministry of Finance [14]. In this report the traditional accounting approach has been followed to exhibit the value-added features of the project. TAXISnet offers a web-based interface, from which end-users (citizens, companies and public organisations) initiate transactions that provide electronic services [15]. This system is the evolution of a six-year IT project called TAXIS (TAXation Information System-named after the Greek word for order). It was initiated by the Greek Ministry of Finance, representing one of its strategic IT investments with an overall budget of approximately 90 million euros contributed by national and European Union (EU) funds and aimed at IT support to tax agencies all over Greece for carrying out tax filing, calculation and payment transactions with citizens and businesses.

Motivated by the afore-mentioned report for TAXISnet, the present paper proposes a structured methodology for calculating the cost of e-Government services projects, based on the complementary application of the IDEF0 modelling tool and the Activity-Based Costing technique. The next paragraphs refer to the description of these tools from a strategic point of view and their integration is presented afterwards in detail. Finally, the paper concludes with a discussion concerning the added value of the proposed methodology framework and further research.

## 2 The IDEF0 Modelling Tool

The IDEF0 modelling method is designed to model the decisions, actions, and activities of an organisation or system. It is not only the most widely used, but also the most field proven function modelling method for analysing and communicating the functional perspective of a system [16]. IDEF0 was derived from a well-established graphical language, the Structured Analysis and Design Technique –

SADT [17]. The IDEF0 modelling method establishes the scope of analysis either for a particular functional analysis or for future analyses from another perspective. As a communication tool, IDEF0 enhances domain expert involvement and consensus decision-making through simplified graphical devices. As an analysis tool, IDEF0 supports the identification of the functions performed and what is needed to perform them.

The basic activity element of an IDEF0 model diagram is represented by a simple syntax. A verb-based label placed in a box describes each activity. Inputs are shown as arrows entering the left side of the activity box while the outputs are shown as exiting arrows on the right side of the box. Controls are displayed as arrows entering the top of the box and mechanisms are displayed as arrows entering from the bottom of the box. Inputs, Controls, Outputs and Mechanisms (ICOMs) are all referred to as concepts.

An IDEF0 model diagram is then composed of several activity boxes and related concepts to capture the overall activity. IDEF0 not only captures the individual activities, but also reveals the relationships among activities through the activities' related concepts. For example, the output of one activity may in turn become the input, control or even a mechanism of another activity within the same model.

A strategy for organising the development of IDEF0 models is the notion of hierarchical decomposition of activities. A box in an IDEF0 model represents the boundaries of an activity. Inside that box is the breakdown of that activity into smaller activities, which together comprise the box at the higher level, as shown in Figure 1. This hierarchical structure helps the analyst keep the scope of the model within the boundaries represented by the decomposition of the activity. This organisation strategy is also useful for hiding unnecessary complexity from view until a more in-depth understanding is required.

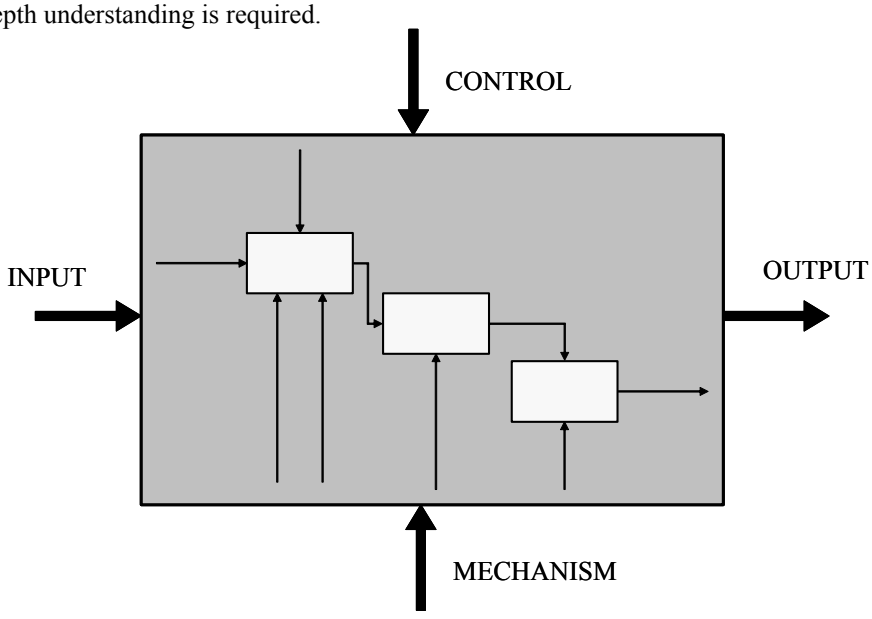


**Fig.1**: Hierarchical decomposition of an IDEF0 model diagram

## 3 The Activity-Based Costing Technique

Activity-based costing (ABC) was introduced by Cooper & Kaplan [18] as an alternative to traditional accounting methods. It models the relationships between products/services and the resources used in their production at all stages, as depicted in Figure 2. In recent years, academics and management accountants have demonstrated a great interest in ABC [19]. However, surveys have shown that the diffusion process for ABC has not been intense [20], [21], [22].

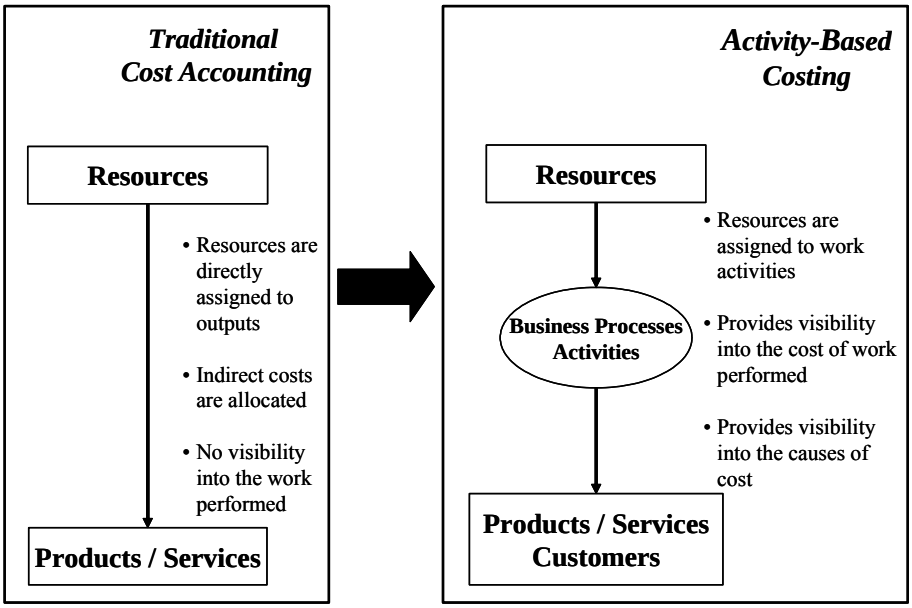


**Fig.2**: Comparison of Traditional Cost Accounting and Activity-Based Costing

The ABC paradox lies in the fact that even though it has demonstrated strong benefits and advantages, it has not been employed by the majority of the organisations comprising both the private and public sectors [22], [23], [24]. A plethora of parameters have been tested in the literature in order to explain this paradox. These parameters include strategic posture and organisational structure [23], environmental uncertainty [25], the role of demand factors (e.g. percentage of overhead and product complexity) or supply factors (e.g. consultants and firm size), as well as factors that influence the diffusion of innovations, considering ABC as a form of administrative innovation (e.g. efficient choice, forced selection, fad and fashion perspectives) or the perception of relative advantage of the innovation over previous practices.

ABC is a technique that measures the cost and performance of activities, resources and costs objects, including overhead. The task of differentiating the organisation's activities as either value-added or non value-added is perhaps the most important theme in ABC. Non value-added activities are those that cause delay, excess, or variation, and therefore are targets for elimination or reduction in improving the

business process. On the other hand, value added activities become targets for improvement, perhaps through streamlining or automated support.

# 4 Integrating IDEF0 and ABC

It is impractical to create an ABC model without a proper design tool that clearly identifies all the individual activities that take place in a system from the beginning to the end. Such a tool can greatly help to reduce time used for modelling and overcome the difficulties present in creating a cost model [26].

Documenting and understanding activities is necessary in order to calculate the cost of a business process, since activities are the building blocks of business processes. When employees understand the activities they perform, they can better understand costs based on the activities. Traditional financial information is reorganised by ABC into a form that makes sense to the functional user: in addition to the information that tells them how they allocate resources, it also tells them what to do with these resources. This ability to place costs on activities and their outputs provides a clear metric for depicting the real cost of the system and serves as a reference level for continuous improvement, whether for determining improvement priorities in the long-term or for measuring near-term success. ABC allows functional users to characterise the value of, or need for, each activity, eliminating the waste before automating (or reengineering) business processes.

A structured approach for the identification and analysis of the activities performed in the context of a certain business process can be provided by the IDEF0 function modelling technique. Even though ABC can be attempted without the use of IDEF0 modelling, it accomplishes the most complex task of identifying discrete activities and then defining the primary output measure for each activity.

Resources are assigned to activities so that they can be carried out: performing the activity results in a cost that can be priced, which can be assigned to the primary output. It is through ABC, that an organisation can visualise actual costs against individual activities, and find opportunities to streamline or reduce the costs, or eliminate the entire activity, especially if there is no added value.

The framework for calculating the cost of e-Government services, based on the complementary application of the functional modelling tool IDEF0 and the ABC technique, is comprised of the following steps: analysis of activities, cost collection, costs to activities assignment, definition of output measures and cost calculation.

## 4.1 Analysis of Activities

In the beginning, the scope of the activities to be analysed must be clearly defined. The depth and detail of analysis should be determined by activity decomposition, since the latter is complete when one common or homogeneous primary output per activity is reached. The IDEF0 function modelling tool is employed in this step to perform activities' analysis. Various data collection methods should be used (interviews, documentation, etc.) in order to provide the model with the correct input.

A decision is then made if an activity is value-added or non value-added. Additionally, whether the activity is primary or secondary, and required or not needed. An activity is considered as value-added when the output of the activity is directly related to the service requirements. Primary activities directly support the organisation's mission, while secondary activities support primary activities. Required activities are those that must always be performed while discretionary activities are performed only when allowed by the operating management.

### 4.2 Cost Collection

During this step costs are gathered for the activities which concern the e-Government services. These costs should be salaries, expenditures for software development, hardware infrastructure, leasing of communication lines, depreciation of fixed assets, etc.

These costs are used as the baseline activity costs. When documents for the costs incurred are not available, cost assignment formulas should be used. A classification of these cost elements is described in the Appendix.

### 4.3 Costs to Activities Assignment

The input for this step comes on the one hand from the results of activities' analysis based on the constructed IDEF0 models and on the other hand from the gathered organisational inputs and costs. Bringing all these elements together, results to the assignment of the input cost per activity. A simple formula for costs is used: outputs consume activities that in turn have consumed costs associated with resources. This reflects the philosophy of the activity-based costing technique.

During this phase of the proposed methodology, a simple method is utilised in order to calculate the total costs consumed by an activity - multiply the percent of time expended by an organisational unit, e.g. branch, division, on each activity by the total input cost for that entity.

It is important to point out that during this phase of the methodology, the origin of the costs takes places and not their calculation.

### 4.4 Definition of Output Measures

In this step the actual activity unit cost is calculated. Even though activities may have multiple outputs, only one is identified as the primary output. Activity unit cost is calculated by dividing the total input cost, including assigned costs from secondary activities, by the primary activity output volume: the primary output must be measurable and its volume or quantity obtainable. From this, a bill of activities can then be calculated which contains or lists a set of activities and the amount of each activity consumed. The amount of each activity consumed is extended by the activity unit cost and is added up as a total cost for the bill of activities.

### 4.5 Cost Calculation

In the final step, the calculated activity unit costs and bills of activities are used to identify the actual costs. A Pareto analysis is recommended to follow, in order to calculate the percentage of activities that consume the majority of costs. The confirmation of the previously identified non value-added activities occurs during this step with a clarity that allows us to eliminate them. Furthermore, this classification of activities permits the e-Government services to be provided to the citizen with greater efficiency.

## 5 Discussion

E-Government services should be characterised by:

- Ubiquity: offering services to citizens at any place (workplace, domestic, public), any time (24x7 availability), through multiple communication channels (Internet, phone, fax) and independently of IT skills (e.g. ability to type).
- Uniqueness of reference: single point of service for all cases, single sign-on for all services, single session for any service, transparent complexity, virtual integration.
- De-materialisation: no paper documents, no physical transport, no physical waiting in queues.
- Quality and cost effectiveness: maximum reliability of results, maximum quality of service, minimum time of completion, minimum difficulty of access, minimum cost of use.

It is deduced from the description of the proposed methodology framework, that the combination of IDEF0 and ABC can be utilised as a toolkit for providing accurate cost information concerning the operation of e-Government services. The IDEF0 maps all the activities performed for the delivery of these services and ABC proves to be a more credible costing system in comparison to traditional accounting, since it traces cost from resources according to the way they are consumed by the activities defined, rather than by some arbitrary basis.

Furthermore, this methodology provides more than an e-Government services specific pricing system. It serves as a reference model for future reuse when legislation is changed. It is a common phenomenon in Greece that taxation rules and laws are altered from year to year, according to government decisions and initiatives. Consequently, the activities supporting tax services provision to the citizens are enriched or lessened, resulting in a different workflow. For example, a circular was published [27] concerning tax refund, obliging the citizens who submitted their tax statement through TAXISnet and had a tax refund over 1.500,00 euros, to bring all documents to tax agencies within 10 days after receiving the relevant note. The number of citizens belonging to this category is close to 500.000. As a result, the cost of the e-Government services is highly increased due to the involvement of the tax agencies in the processing of the statements. It could also be argued that in this case, TAXISnet's role is limited from an e-Government services integrated system to a

mere data collection intermediate with secondary information processing tasks after tax agencies enter the documented input from the citizens.

Therefore, the proposed structured methodology framework could face these legislative transformations, by simply adding or removing the corresponding activities from the IDEF0 model. Furthermore, it could serve as a tool for what-if scenario analysis in the legislation transformation process: before the introduction of a new tax law, its impact (cost or benefit) could be estimated on the whole taxation system, by arranging differently the workflows of activities in the IDEF0 model.

Another use of this framework would be in the launch of new e-Government services or design of new components. With its ability to relate investment to utilisation through various activities in which an individual might be involved, it could help justify such investments in the preliminary stage of such efforts. Concerning TAXISnet, the General Secretariat for Information Systems recently decided to deactivate some of its modules, because they were not as efficient as initially planned, although their development cost was over 70 million euros [28], [29], [30].

In the context of further research, a dedicated information system could be developed that would support the process mapping of the e-Government services with the IDEF0 tool and the allocation of costs using ABC technique. That could be used as a decision-support system for the various needs and requirements of public administration: accurate cost calculation of e-Government services, strategic management, automated what-if scenario analysis for legislation transformation purposes and development of organisational knowledge.

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## Appendix: Cost elements' classification of e-Government services

| Cost Element | Initial Cost | Operating Cost |
|---|---|---|
| Hardware<br>– Computing Platforms<br>– Networking Devices<br>– Security Devices<br>– Data Storage Devices | Depends on whether, or how, existing infrastructure can be used to support e-Government application(s) | New hardware may be required as the e-Government system scales. Expected ongoing maintenance costs. |
| Software<br>– Development<br>– Security<br>– Monitoring & Management<br>– Data Access & Storage | Depends on whether, or how, existing infrastructure can be used to support e-Government application(s) | New software may be required as the e-Government system scales. Expected ongoing maintenance and license costs. |
| Facility Expenses<br>– Physical Modifications for Hosting or Security<br>– Electricity, Plumbing, Heating & Cooling | Depends on whether, or how, existing infrastructure can be used to support e-Government application(s) | Facility upgrade expenses may be incurred as the e-Government application scales. Expect ongoing maintenance costs. |
| Service Provider Costs<br>– System Development<br>– Application Hosting<br>– Telecommunications<br>– Transaction Processing | | |
| Organisation Labour Costs<br>– System Manager(s)<br>– System Developer(s)<br>– System Operator(s) & Maintainer(s)<br>– User Support Staff<br>– Customer Support Staff<br>– Functional Manager(s)<br>– Administrative & Contracting Support | | |