

The Impact of Governance Approaches on SoS Environments

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Abstract – Governments worldwide are turning to Information and Communication Technology (ICT) based systems of systems, commonly termed Electronic Government (eGovernment), to enable more timely, efficient and effective interaction with their citizens and with the business community. Citizens and businesses have dynamic and evolving demands related to the complexity of their lives and operational environments, respectively. A major challenge for government is to be able to understand the value derived from investment in eGovernment in order to improve its consequent ability to respond to the variety of demands of its citizens and businesses. To be able to understand the value derived from planned investments in eGovernment, their analysis needs to extend beyond the familiar approaches that address economies of scale and scope to encompass economies of alignment. These economies of alignment arise from being able to reduce the costs of the multiple forms of collaboration needing to be supported by systems of systems in providing greater responsiveness.

Key-words: systems of systems; eGovernment; multi-sided relationships; distributed governance

I. INTRODUCTION

The SEI is exploring the policy, acquisition and management issues raised by Ultra-Large-Scale (ULS) Systems [1]. A key issue is the challenge that systems of systems present to governance within these environments, in particular how they are able to sustain alignment with dynamic and evolving user demands within their operational environment. In this paper, we present a case study concerned with investment in the systems supporting eGovernment, the goal of which is to enable the particular Government to become more responsive to its citizens and businesses, while at the same time reducing its costs. The challenge of this case is to be able to relate the value of the investment in systems to the impact of those systems on the Government's way of responding to its citizens and businesses.

II. THE GOVERNANCE CHALLENGE OF MULTI-SIDEDNESS

The distinguishing characteristic of a system-of-systems is the operational and managerial independence of its component systems, and not their complexity or geographic distribution [2]. In this eGovernment case it was the collaborations that were the socio-technical systems-of-systems [3], bringing together operationally and managerially independent departments, supported by a systems platform providing

thematic analysis of full text data and web-enabled searching. The systems platform had to support direct relationships with all of its users, but it also had to support the indirect collaborative relationships existing between its direct users. This ability of the platform to support both direct and indirect relationships amongst its users made it a 'multi-sided' platform [4]. This capability for supporting multi-sidedness was crucial to the value of the investment, given the extent of the variation in the complexity of the responses needed.

The differences between the direct and indirect relationships supported by the systems platform are summarized in figure 1:

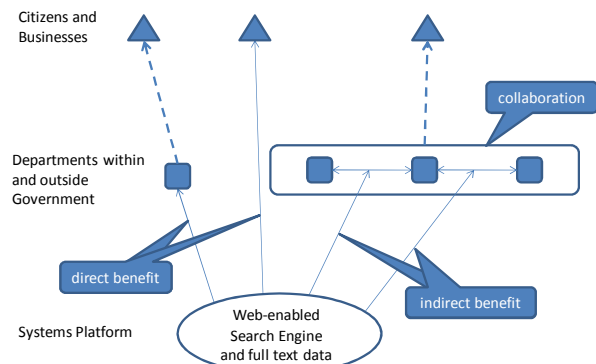


Figure 1. Supporting direct and indirect relationships

The dotted line relationships are between departments and citizens or businesses, both of which can derive direct benefit from using the platform. But the departments also derive indirect benefit from the way the platform is able to support the collaborations between them.

An important further characteristic of systems of systems is whether its collaborations are of a closed or open nature [5]. If closed, then no variation is possible in the organization of the collaboration itself. If open, then both the collaborators and their organization can adapt as the situation requires. For the collaboration to be open, its leadership must therefore have the authority to organize it in a way that can be made specific to the nature of the question. And for this to be possible, the Government has to delegate this authority to the point of contact with the citizen or business, i.e. to its 'edge' [6]. As a result, although within the Government there is ultimately a single source of authority, it has to be 'distributed' so that each

collaboration has the power to organize itself [7]. Where there is no such single source of authority, because organizations outside of Government are involved, the source of authority itself becomes collaborative.

The result is a 4-way classification of ideal types of governance, depending on how authority is exercised. With the ‘closed’ forms of collaboration, the organization of the collaboration is fixed, and ‘directed’ by Government retaining sole authority, or ‘acknowledged’ through a contractual process between Government and the other organizations involved [8]. With the ‘open’ forms of collaboration, the authority is either ‘distributed’ to the edges of the organization where the citizen’s questions can be best understood, or the assumption of authority has to be ‘collaborative’. These four forms are summarized in figure 2.

Departments not all falling under the Government (multiple enterprises)	Acknowledged	Collaborative
Departments all falling under the Government (single enterprise)	Directed	Distributed
	Collaboration defined independently of the particular question (closed)	Collaboration defined by the particular nature of the question (open)

Figure 2. Four forms of governance of system-of-system collaboration

These four possible forms of collaboration reflect different approaches to the governance of the Government’s responses. In this case, even though the departments fell under a single Government, the complexity of many of the questions was such that the collaborations had to be open, demanding a distributed approach. And where the collaborations had to go outside organizations in formulating a response; the responses demanded a collaborative response. Equally, there were many responses that were recurrent, enabling a closed approach by Government departments, or by those it contracted to act on its behalf (e.g. through hotlines).

The valuation of the investment therefore had to be able to support both closed and open forms of governance, as opposed to the case where eGovernment was to be associated with just the closed forms, for which securing greater cost efficiencies in existing methods of distributing information was sufficient. This placed the much more challenging multi-sided demand on the performance of the systems platform, necessitating that any evaluation of investment had to consider the full variety of forms of collaboration across all four forms of governance.

III. GOVERNANCE AS MANAGING ALIGNMENT

Defining the multi-sidedness needed of the systems platform meant separating out the benefits of direct support from the indirect benefits of supporting the collaborations between departments. The first of these meant understanding what would be technologically feasible (for example in the

search capabilities), while the second required an understanding of the variety of forms of governance needed given the variety of forms of collaboration. From the perspective of Government there was then a third kind of limitation to be added, namely what would be best economically in sustaining the alignments within the different forms of collaboration [9]. This third kind of limitation was defined by the costs of alignment. The greater the variety of forms of collaboration needed, the greater these costs of alignment were likely to be. The value of the investment could therefore be assessed in terms of its impact on these costs of alignment [10].

IV. CASE STUDY

A. Context

In this case study the role of the SEI was to advise the particular Government on the value of the investment in the systems platform needed to support its eGovernment objective. The Government is organized into Departments, each one made up of many offices, and each office dealing with some particular aspect of the government’s business with its citizens or businesses. Questions raised by citizens or businesses that could be met directly by a search engine, or by a single office using a search engine, demanded a one-sided relationship with the supporting search engine.

Many questions however involved more than one office needing to collaborate in order to provide a satisfactory response to a question. Such questions demanded collaboration between multiple government departments and potentially organizations outside government. Under these circumstances, the support provided by the systems platform to the relationships between the offices involved became as important as the direct relationship that a search engine could have with any one of them.

For the purposes of an initial pilot study, a particular aspect of eGovernment was examined, namely its responsiveness to the questions asked by citizens and businesses relating to Swine Flu. This focus was chosen because of the relative ease with which such questions could be identified and tracked. The objective, however, was to use the sample data gathered as a basis for evaluating the impact of proposed investment options to improve the responsiveness of the Government to questions raised by citizens and businesses. The process followed is given in figure 3.

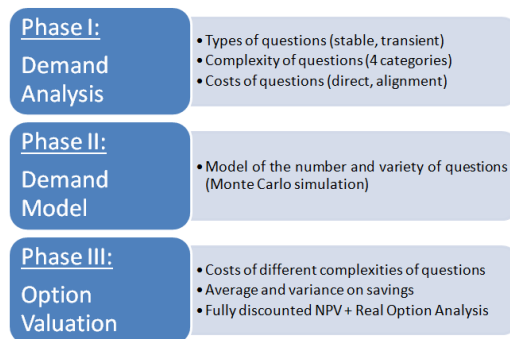


Figure 3. Process followed in initial pilot study

B. Phase I: Demand Analysis

The process of demand analysis started with determining how questions were distributed over stable and transient themes. Stable themes were recurring themes on, for instance, an annual basis and were therefore anticipated forms of demand, whereas transient themes were unanticipated forms of demand. It turned out that more than one-third of all themes were related to transient themes like Swine Flu. Secondly, an analysis of the complexity of questions asked was made, for which four levels of variation were observed in the required complexity of response:

- i. wholly standardized responses (i.e. frequently asked questions);
- ii. responses that had to be customized to the particular circumstances (but still only involving one office);
- iii. responses dependent on specialist knowledge from more than one office, and
- iv. problems needing wholly new responses, frequently requiring collaboration with offices outside government.

About half the questions could be answered by standardized responses, the remainder needing a mix of the other types of response, heavily weighted towards the most complex. In the case of transient themes, however, this whole process had to take place within the life of the theme itself, so that the large numbers of transient themes clearly established the importance of supporting these processes of knowledge generation [11].

The standardized responses associated with frequently asked questions (FAQs) could be found by citizens using the search engine directly ('i' above), and offices could also use the search engine directly to find the material needing to be customized ('ii' above). But the responses requiring collaboration between departments within and outside government ('iii' and 'iv' above) needed support for creating new kinds of response that might or might not become FAQs. In these cases, the platform needed to provide a capability for thematic analysis of full text material in order to support the knowledge generating processes, and to support the generation and organization of material under the themes that emerged as a result.

This need for both direct and indirect forms of support was a clear confirmation of the multi-sided character of the demands to which the Government had to respond. The original investment option could only support standardized responses associated with stable themes. A key result of the project was therefore to add a second investment option that could address the need for support to the indirect relationships within collaborations.

Finally, in order to account for the impact of both investment options, it was necessary to determine the costs associated with each question type in a way that included modeling the collaborative responses of the Government (figure 4). These response models could then be used to quantify the particular costs of alignment incurred by collaborating offices for the different types of response. These costs of alignment, when combined with the underlying direct costs of each office and of the systems platform, provided an overall cost of responding to questions.

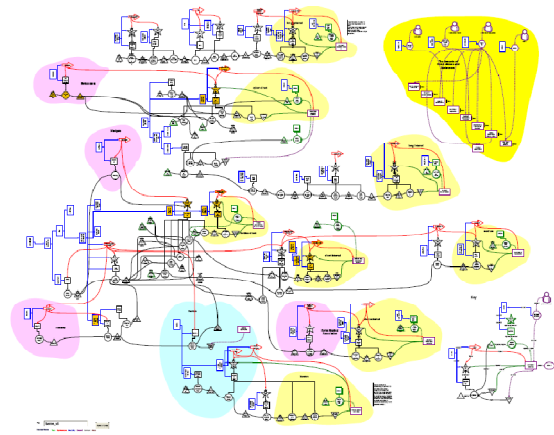


Figure 4. The model of the Government's collaborative responses

C. Phase II: Demand Model

In order to understand the dynamic effects of the systems platform on the overall costs of eGovernment, the next step between the demand analysis and the valuation of the investment options was to construct a model reflecting the variety of demands being generated by citizens and businesses. Parameters in this model were the number of stable and transient themes, the profile for the numbers of questions generated by transient themes, and the mix of question types raised. To refine demand forecasts and set realistic expectations about the range of possible outcomes, Monte Carlo simulation was used to determine probability distributions of the incidence of questions and therefore of the overall costs of eGovernment.

D. Phase III: Option Valuation

The traditional basis for justifying an investment is in terms of the supply-side economies of scale or scope generated by the direct effects of the investment on existing working practices and/or with respect to new revenues that can be captured. In the case of eGovernment projects, no such justifications are possible because all the effects are indirect, given the multi-sided nature of the demands being met. In their place demand-side economies have to be identified, being economies in the costs of aligning government activities to the needs of particular citizens and businesses.

The traditional approach defines these demand-side economies to be 'externalities' - costs incurred by users that are not part of the direct relationship the systems platform has with its users. If these demand-side costs of alignment are included in the total cost of the Government's responses, then the variation in the numbers and types of questions generates variation in the total costs. This variation is represented in figure 5 as curve 'a'. By including these costs, the impact of introducing new eGovernment investments on the total costs can be represented by the change in the shape of this curve ('b' in figure 5). This change in shape reflects the fact that both the average costs and the spread of the variation in those costs is reduced. Real option analysis enables us to attach a value to these changes in the way costs vary with variations in demand, arising as a consequence of an investment.

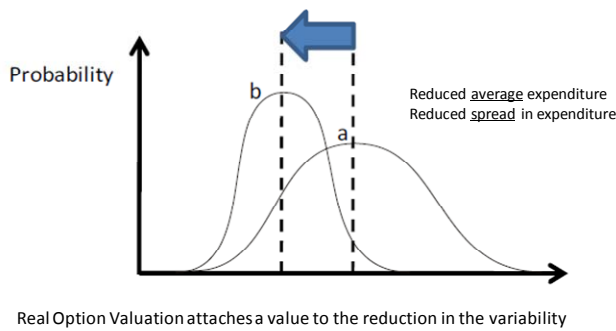


Figure 5. Real Option Valuation

In this case study, the two different investment options corresponding to closed and open approaches were considered and compared to the “status quo” situation or base case. For each option considered, the direct costs and indirect costs or costs of alignment were determined as well as a real option value to reflect variations in demand. Using this approach, the open option turned out to be most favourable. The analysis revealed that it had a lower investment cost, and given the numbers of transient themes, it also generated a much higher reduction in the costs of alignment. As a result, the effectiveness of the Government in responding to the variety of demands of its citizens and businesses could be improved dramatically.

V. CONCLUSION

The costs of alignment depended on the way the supporting systems could be dynamically aligned to changing and evolving demands, whether within Government alone, or collaborating with other organizations. The approach had therefore to consider not only the economies of scale and scope available from any particular supporting technology, but also the governance approaches needed to align the Government’s activities to the needs of its citizens and businesses, and the economies of alignment that were possible in sustaining these governance approaches. The impact of this approach was therefore in determining the particular way in which these three kinds of limitation (technology, governance and economics) could be balanced with each other.

In the case study considered, an important study outcome was the fact that the Government could clearly identify a preferred investment option: investment in the open option increased the agility of the Government in responding to the turbulent and dynamic environment in which it had to respond to the questions of its citizens and businesses. However, an even more important outcome was the way the Government came to perceive the role of collaborative processes and their supporting systems platform. It became clear that improving responsiveness by investing in a better search engine alone was not enough. The multi-sided character of the demands on the platform created a clear need to take into account the costs of alignment and the corresponding need to support the collaborative processes of knowledge generation. It became apparent that reducing the costs of supporting these multiple

forms of collaboration was essential to providing greater responsiveness.

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