Sustaining E-Government Website Services: An Investigation of Dynamic Relationships of Organisational Factors in a Government Agency

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Abstract. The availability of e-government website services can deteriorate over time. Accordingly, persistent quality maintenance is necessary to sustain high availability levels of website services. The government of Surabaya, Indonesia has delivered and sustained website services with a high-level of availability over time. This research aims to reveal important organisational factors and their feedback relationships that influence availability levels. Guided by a previously proposed model, a causal loop diagram on e-government website availability, data was collected by observing the Surabaya website and interviewing the government staff unit that maintains the website. A revised causal loop diagram was constructed and analysed. Some leveraging factors have been identified, such as staff satisfaction over their tasks and rewards, communication and coordination among staff based on trust and legitimate procedures, sufficient staff competence, informal training and communication with leadership. Through several reinforcing loops, these factors both influence and are influenced by the availability of website services.

Keywords: Website availability · Maintenance · E-government of surabaya

1 Introduction

The use of a website to deliver governmental services is ubiquitous. In many countries, most citizens and businesses rely on websites to provide governmental services [1–3]. They access e-government websites (eGW) to obtain information, communicate, participate, or complete transactional services. Therefore, to maximise service benefits, e-government management must sustain consistent availability [4] of the services that are accessible, functional and useful.

However, the availability of eGW services can deteriorate over time due to new requirements, programming errors, invalid hyperlinks, inadequate website maintenance [5], and dynamic changes in laws and regulations [6]. Accordingly, persistent and quality website maintenance is necessary to sustain high availability levels of website services.

Much research has studied website maintenance and eGW services delivery. For example, Ivan and Despa [7] studied web application cost, Nagy et al. [8] investigated a

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decision-making process to maintain or replace an organisation's website, Alsmadi and Abu-Shanab [9] investigated the security of the website, and Al-Jamal and Abu-Shanab [10] researched the involvement of citizens in government policy formulation and government data transparency programs. However, the existing literature in eGW maintenance focuses less on the sustained availability of services. Specifically, they do not examine the importance of organisation-related factors and their feedback-relationships with availability levels.

In Indonesia, most government agencies have used a website to deliver some of their services. This is especially true for Surabaya, which has achieved a significant level of eGW service delivery and several national and international e-government awards over the past years. The role of its eGW has been maintained such that the services delivered highly benefit the city's citizens and business. Therefore, it is important to understand and learn how continuous quality maintenance leads to such an achievement.

Distinct from previous research, and as part of a broader scope of a study, this research aims to identify factors and model feedback relationships that influence eGW service availability over-time in Surabaya based on the previously proposed conceptual model on e-government website availability [11]. This model, which is a qualitative system dynamics model [12], argues that sustaining a high-level of availability of the eGW services over time involves dynamic feedback relationships between the availability level, complexity of eGW maintenance and factors associated with organisational effort, competence, communication and coordination, trust, procedure and resource sharing.

The resulting model could improve understanding of the importance of eGW maintenance, how its success can be achieved, and assist e-government management in understanding the feedback relationships and other factors that sustain the eGW service delivery over time.

The rest of the paper is organised as follows: a review of the existing literature, followed by an adopted method consisting of qualitative system dynamics modelling, the case and data collection, a detailed discussion of the findings, and finally, the conclusion.

2 Literature Review

2.1 E-Government Website Service Availability and Maintenance

An e-government website can be defined as an e-government service delivery media consisting of a collection of government related documents or files that are organised and published on the World Wide Web. It is a virtual space that allows citizens and businesses to interact with the government to obtain information, communicate, or accomplish transactions [13]. Currently, eGW is an important gateway for service deliveries [14] due to its capacity to provide highly efficient processes and effective services [15].

Considering its critical role, and in order to sustain its benefits, an eGW service must be consistently available [16]. The eGW services are available if it is always accessible by citizens and businesses, adaptable to new requirements [15], contain appropriate content and features, function properly and align with e-government processes [13]. However, this level of availability could be affected by additional factors, such as the quality of the website development [17], organisational and external pressures [5], and

the reliability of website infrastructure [18]. Accordingly, e-government managers must undertake continuous eGW maintenance.

Maintenance is defined as the activities undertaken, after the website development and launch, that ensure that the information accessible to the user is current, accurate, relevant [19], legally reliable, free of programming errors and demonstrates a perfected website design to suit new requirements [5, 20]. Maintenance activities may consist of 'exploration, development, testing and deployment of web features', [21, p. 5] which are continuous activities unless a complete redevelopment takes place. Lack of quality maintenance may decrease the dynamic availability [21, 22] of the eGW.

In general, the literature indicates that successful maintenance is influenced by the motivation, competence and collaboration of e-government staff [23, 24]. By considering the complex nature of e-government, for which a systems thinking approach [25] is deemed appropriate [26, 27], understanding the complexity of the eGW maintenance and its level of availability requires recording dynamic feedback relationships of these factors [24]. Especially, much research suggested the use of causal loop diagram (CLD) of System Dynamics method to capture and reveal the complexity of these factors and their feedback relationships structure [24, 28, 29] in influencing the level of eGW services availability over time. The resulted CLD indicates the leveraging factors and how a factor eventually influences and is influenced by the availability level.

3 Method

3.1 Qualitative System Dynamics

Per the model, which adopts a qualitative system dynamics (SD) method, a causal loop diagram (CLD) was constructed based on the data collected from the case study. The model was built with the following steps: formulating a dynamic problem, identifying the main factors, constructing a conceptual CLD, collecting field data, revising the CLD and analysing the functionality of the CLD [25, 30]. In this research, the first three steps have been undertaken and presented in [11].

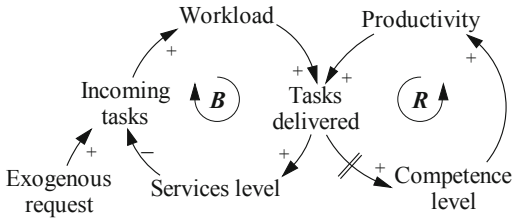

Fig. 1. An example of a causal loop diagram

A CLD consists of words or phrases that are linked by curved arrows and attached to each of which are polarity and time delay symbols [29, 31] (see Fig. 1). The arrow denotes a causal relationship between two factors. The polarity (+/–) indicates the direction, either in the same direction or in different directions, of two related variables. The time

delay (//) is shown by crossing the arrow. Tracing a chain of causality arrows can form two types of loops: reinforcing (R) or balancing (B) loops. Reinforcing loops express exponential growth or decaying behaviour, and balancing loops indicate a goal-seeking behaviour of a system.

3.2 The Case

This research investigates the e-government system of Surabaya (eGoS), the capital city of the East Java Province of the Republic of Indonesia. Its website address is http://www.surabaya.go.id. This case was selected as a result of its performance achievements, the eGoS has received several national and international awards, and its ability to meet the case study selection criteria [32].

The eGoS website is an important gateway for government services by providing public information, facilitating communication between the citizens and government and allowing citizens and businesses to make use of government services.

The eGoS website is managed by the Management of Public Communication Section (MPCS). This unit is headed by a head of section and supported by information technology (IT) and non-IT staff. The staff, in many cases, must collaborate within the MPCS as well as with staff from other units. The organisational structure of the management of the eGoS is shown in Fig. 2.

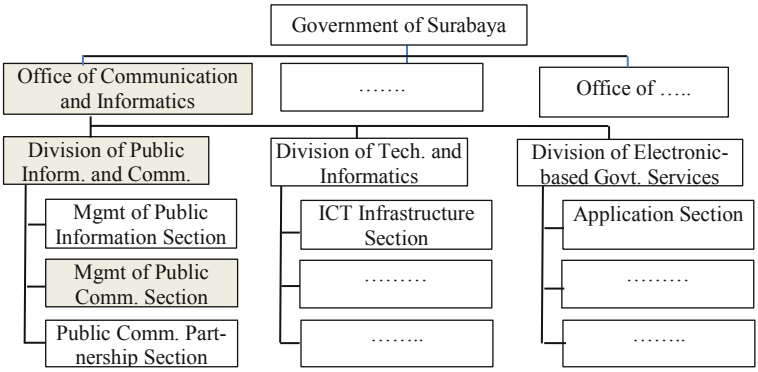

Fig. 2. The organisational structure of the management of the eGoS

3.3 Data Collection

To answer the research question, data was collected by observing the eGoS website and interviewing the eGoS staff. The eGoS website observation sought to obtain a level of the eGW services availability over time. The interviews sought to collect qualitative data to understand and identify possible causal loops among key factors that could explain the eGW services availability level.

Various e-government related awards have been received by the eGoS for more than seven consecutive years until 2018 [33] indicating that the eGW service availability

always at a high-level over time. The observation took place for approximately 12 consecutive weeks in 2018 to obtain the actual quantitative data of the availability level. Observers were required to open the website and click through the available menus, sub-menus, sub-sub-menus and down to the lowest level of hyperlinks, buttons and application names. The observers then noted whether the facilities were functional.

Each week, each observer calculated the percentage of the working website services out of the total available services. The plot of the sum of these percentages over the observation periods defines the level of the eGoS website service availability over time.

Qualitative data was collected by interviewing six staff members and two managers from the Division of Public Information and Communication of the eGoS, who were responsible for maintaining the availability of website services. The staff responsible included a news content contributor, a website and communication designer, a content administrator, a website programmer, a website database administrator and an e-government infrastructure employee. These respondents were deliberately chosen to obtain data that reflected the true operation of the website maintenance system. These interviews were guided by a semi-structured open-ended questionnaire which was created based on the model in [11]. Each of these on-site interviews lasted about one hour.

4 Findings

4.1 Availability of eGW Services Over Time

The observations indicated that the government of Surabaya has been utilising its eGW to deliver various quality services to its citizens and businesses. External users can access information, communication, and transactional services via the eGW. They can obtain government-related news and announcements as well as various downloadable documents. Furthermore, they can communicate, report or request solutions about city-related problems and receive a response directly. They may complete business permit applications, access online procurements systems or obtain tickets for public health services.

While the website is complex in the type and number of services delivered, its availability level over time is relatively high as shown in Fig. 3. Its overall availability level was above 90%.

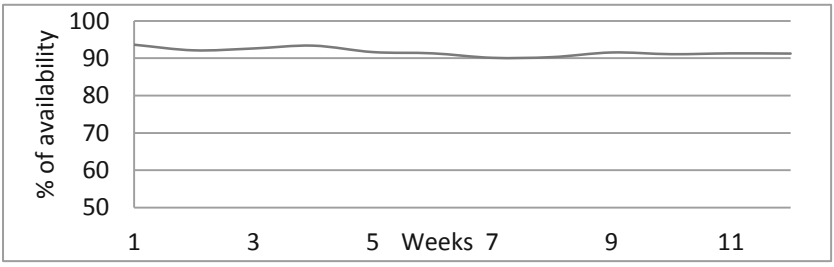

Fig. 3. eGoS website services availability level over time

4.2 Factors and Their Feedback Relationships

Figure 3 indicates the ability of the management of the eGoS to sustain the eGW over time. This section explores feedback relationships of important factors using a CLD from the organisational dimension as shown in Figs. 4 and 5. The exploration is based on a proposed CLD in [11].

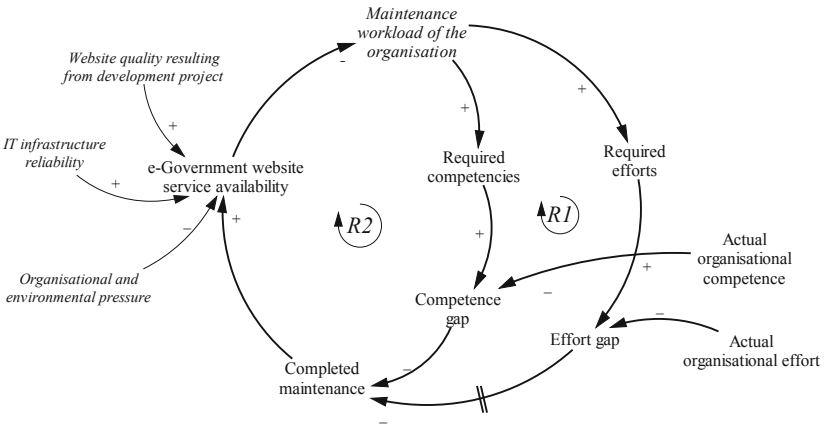

Fig. 4. Maintenance model

Organisational Effort (*R1*) and Competence (*R2*). The data supports the CLD that to sustain the level of *eGW services availability* the eGoS management has to carry out continual website maintenance due to the persistence of *organisational and environmental pressures*, the *website quality resulting from development project* and the *IT infrastructure reliability* (see Fig. 4). Website maintenance included creating new service features, overcoming errors, and improving website content and design. Any maintenance requests became *maintenance workloads of the organisation*, which increased the level of both *required competencies* and *required efforts* of the organisation.

In response to this need, the eGoS management has provided levels of *actual organisational competence* and *actual organisational effort* in such a way that they can close the *competence gap* and *effort gap,* respectively. This improved the quality and quantity of completed maintenance and kept the *eGW service availability* at a high level over time. These feedback relationships explained the importance of the effort and competence factors through two reinforcing loops: *R1* and *R2*. These loops persuaded the management to maintain these factors at sufficient levels. The eGoS management employs and organises staff who, simultaneously, are highly motivated toward effort and are equipped with the required and appropriate competencies (see Fig. 5).

The *actual organisational effort* Factor. The level of the *actual organisational effort* factor over time is positively influenced by *staff effort*, *total staff collaboration*, and *communication and coordination* between them. The *staff effort* factor represents the

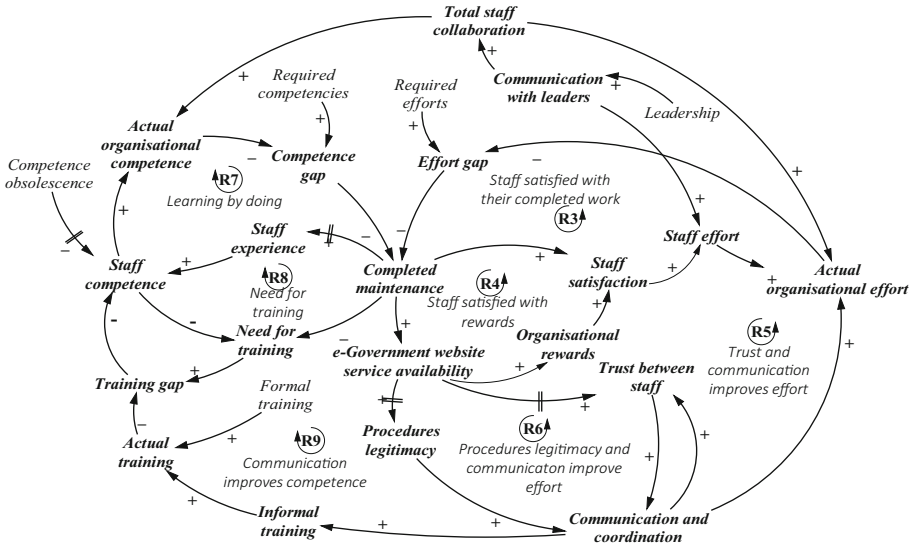

Fig. 5. Feedback relationships of organisational factors

effort exerted by staff members of the eGoS in response to the maintenance workload. The time required to complete the maintenance tasks depended on the complexity of the tasks. In some cases, staff were willing to work overtime. Normally, completing a maintenance task required collaboration from several staff members, and they needed to communicate and coordinate their responsibilities.

Staff Satisfied with Their Completed Work (*R3*). At the eGoS, successfully *completed maintenance* improved *staff satisfaction*. They wanted to do more tasks, and therefore, they completed jobs quickly. This satisfaction improved *staff effort* and, consequently, the *actual organisational effort*. Ultimately, this upheld the high-level of *eGW service availability*.

Staff Satisfied with Organisational Rewards (*R4*). The top leaders of the eGoS provided *organisational rewards* by promoting the website to a broader audience. This improved *staff satisfaction*. Staff members were highly motivated as a result of the rewards and were aware that it was their responsibility to complete the maintenance tasks. Therefore, they were willing to exert more effort when maintenance was urgent. This kept the *actual organisation effort* at a high level.

Trust and Communication Improved Effort (*R5*). Website maintenance of the eGoS invariably involved more than one staff member. A high-level of *eGW services availability* meant that staff collaboration over time was functional. As a result, *trust between staff* gradually grew, which meant that they believed their colleagues will commit to and complete their responsibilities. Improving trust eased *communication and coordination* between them, which was adequate, quick and positive, and it was often informal, direct and flexible. This eased the way they collaborated, therefore improving the level of *actual organisational effort*.

Procedures Legitimacy and Communication Improved Effort (*R6*). At the eGoS, the staff had to understand and closely adhere to organisational procedures to coordinate effort. This adherence made communication easier, although many of the operational procedures were not formally written. A high-level of *eGW services availability* meant that the procedures they followed were proven to be workable and, therefore, legitimate. This gradually increased the *procedure legitimacy* and made staff communicate seamlessly using the same procedure, therefore, improving *communication and coordination* and, accordingly, improving *actual organisational effort.*

The *actual organisational competence* Factor. Several factors influenced the levels of *actual organisational competence*, such as *staff competence* and *total staff who collaborate*. The eGoS management employed staff that met a specific level of *staff competence*, such as in a database, programming, design, front-end website programming and graphic design. Their competence levels were sufficiently high for undertaking maintenance so that any required maintenance tasks could always be completed. Effective collaboration between staff improved *actual organisational competence*.

Learning by Doing (*R7*). As the *completed maintenance* increased in number and quality over time, *staff experience* also gradually increased. In some cases, this experience improved *staff competence* of up to 50%. Experience obtained by staff caused maintenance work to become easier and faster.

Need for Training (*R8*). In some cases, the advancement of IT is still beyond the achieved experience level. Therefore, *competence obsolescence* decreased *staff competence* level. This happened when the staff was assigned a new maintenance job but they did not have the required knowledge and skill to complete it. Eventually, this caused the staff of the eGoS to become unable to complete their maintenance tasks properly. This reduced *completed maintenance,* which led to low quality or late completion. This, in turn, increased the *need for training* and the widening of the *training gap*. Consequently, this can further lower the *staff competence level.* Fortunately, the staff of the eGoS were aware that they needed to renew their competencies regularly due to the persistent advancement of IT.

Communication Improves Competence (*R9*). At the eGoS, the *training gap* could be closed by the *actual training* factor, therefore, improving *staff competence*. The training was predominantly informal as *informal training* was always available from other staff members. They were available to share their knowledge skill, which included web design, server troubleshooting, programming language, database synchronisation and so on. The impact of this *informal training* was quite significant. For example, training on a website could improve a skill by up to 50%. This kind of training was realised as a result of seamless *communication and coordination* among staff members, and, ultimately, let to a high-level of *eGW services availability* over time.

Leadership Factors. Leadership at the eGoS played an important role in improving *communication with leaders*, especially operational managers. Good communication both motivated staff to further exert effort and encouraged them to fruitfully collaborate. This factor was critical to the eGoS as any required maintenance needed approval from the leadership.

5 Concluding Discussion

Findings showed that the e-government of Surabaya city was able to sustain the e-government website services at a high and valuable level of availability over time, but they did not fully support the proposed CLD model [11]. For example, the resulting model indicated that the staff tended to submit a task once it was completed. Moreover, reinforcing loops dominated the model as was predicted. This suggests that management should focus on the leveraging factors in the loops to prevent them from decreasing.

Some of the leveraging factors can be determined from the model. First, the organisation should provide rewards to the staff so that they have a sense of pride in their completed maintenance tasks. Second, communication and coordination among staff should be seamless by developing trust between them and establishing reliable procedures. This enables various staff members with varied competencies to fruitfully collaborate and perform informal training.

Overall, the resulting CLD can improve understanding of important factors and how they causally relate to each other. It suggests strategies for e-government management on how to sustain a high-level of availability of the eGW services. This CLD will be used as a basis for developing a simulation model of quantitative system dynamics.

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