TRANSFORMING G2C/C2G RELATIONS THROUGH VIRTUAL COLLABORATION: an E-Government Application in Transportation Service

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ABSTRACT

This paper proposes a collaboration model among user, government and transportation services. User involvement is put into focus and gain more signiﬁcant role in decision making in transport management. This is done by transforming information processing carried in a Traveler Information System (TIS) system operated by government. We develop Smart-ATIS, ATIS with two-way communication system that allows user feedback for more effective and efﬁcient traffic management. In the e-government framework, Smart-ATIS opens up opportunities of citizen participation in urban transportation management.

Keywords: Transformational System, Virtual Collaboration, E-Government, Intelligent Transport System, Advanced Traveler Information System, Smart-ATIS.

1 INTRODUCTION

In the era of technological advancement, numerous new information and communication technologies (ICTs) innovation has been introduced to the public sector [1]. An important phase of e-Government implementation is the transformation of government and government organizations to provide better services. E-Government era implies fundamental knowledge redistribution and requires a careful rethinking of the management of information resources and knowledge bases [2]. Within e-Government, the focus of managing information resources is predominantly on the management of interactions among the government, citizens or business [21].

In the transportation area, the concept of Intelligent Transportation System (ITS) grows out of the need to enhance the efﬁciency and safety of the current transportation system. [5,6,7,8]. Typically ITS solution involves three major functions: Monitoring, Automated Analysis and Action. Based on analysis, ITS allows us to make many changes that affect real transportation services, for example: changing of traffic signal timing, posting a message to overhead changeable message signs, modifying transit schedules and rerouting buses, dispatching emergency services, providing information to the media and public electronically, plowing and salting a roadway [9].

Providing information in transportation area is not enough, it is imperative that this delivery satisﬁes customers of government services [24]. In order to provide various service levels and to meet rising expectations, government needs to utilize recent advances in technological development [23]. In the near future, technology will permeate almost every business practice. By embedding microprocessors and sensors in materials and physical devices, Organizations will also be able to create objects that respond to their internal or external environment [4].

The services not only have the function as an information provider but also indirectly increase the user involvement of public services. User satisfaction can be achieved by providing opportunities for user involvement related to trafﬁc management decision-making, in this case illustrated by Area Trafﬁc Control System (ATCS). ATCS is the system that focuses on trafﬁc signals, ramp metering, and the dynamic message signs. Generally, trafﬁc light settings depend on trafﬁc counting and trafﬁc surveillance. Providing information based on real time condition, occasionally not suitable with the real condition when traveler passed that intersection, because of the differences time. This paper tries to describe the new model which enables intervention of ATCS by processing user information.

In this paper we propose a model in which improve collaboration among user and government in transportation services. The idea is to inject an intervention to the system that creates a communication channel for common users to participate in the trafﬁc management system (represented by ATCS), which in...
turn improves better decision making in traffic management and information provision for users.

2 RELATED RESEARCH

ITS is a state-of-the-art approach based on information, communication and satellite technologies in mitigating traffic congestion, enhancing safety, and improving quality of environment [3] and is mandatory to provide access based on human spontaneous communication ability [15].

In the early days of ITS deployment, Advanced Traveler Information System (ATIS) was used to provide basic information for travelers (e.g., routes). ATIS is an integral component of ITS. It carries out data collection, aggregation and processing, communications and operates with traveler interface devices to improve both of safety and efficiency of existing transportation system [10]. ATIS delivers data directly to travelers or citizens, empowers them to make better choices about alternate routes or modes of transportation. Researchers classified articles into 5 classes of ATIS’s, These Five categories were: In-Vehicle Routing and Navigation Systems, In-Vehicle Motorist Services Information Systems, In-Vehicle Safety Advisory and Warning Systems, In-Vehicle Signing Information Systems and Commercial Vehicle Operations specific Funtions[9].

The important aspects of information are the content and the type of information. Information in ATIS can be categorized as (a) historical, real-time, or predictive, (b) qualitative and quantitative, and (c) accurate, timely, relevant, and reliable. Huang et al further investigated from their view point of evaluation; the ATIS’s affects in saving driver’s travel times and the travelers dynamic responses, like purchasing the ATIS services and believing the ATIS advice. According to J.L Adler, model of Intelligent Traveller Information System provides ITIS in which artificial intelligence techniques

Involvement of users in current ATIS improves their confidence in using freeways and it is not only an effective method of information presentation but also allows more efficient navigation and less off-route, lost time, and driver exposure [8]. Several models for estimating link travel times on basis of individual data sources (i.e. detectors, probe vehicles and driver reports) was implemented to anticipate the problem based on current conditions [14]. Users are generally appreciative of traffic information that gives them a choice to make decisions regarding their travel behavior as long as they perceive the information to be accurate, timely and inexpensive [11].

3 THE PROPOSED MODEL : SMART-ATIS

3.1 The role of ATIS

Some information which are required by travelers are: the current state of the network based on real-time information across all transports modes, where congestion exist and any particular conditions (such as weather or incidents) and travel option.

Yurdaer, R., et.al, states that ATIS plays an important role because the quality of the defined routes has an in-depth impact on the performance of whole transport system. ATIS highlights existing conditions on our transportation system that we act on. It also highlights historical patterns used for planning the system and leads to travel choices for the traveler. Advanced Traveler information involves the traveler into the decision process [16].

Actually, the impact of ATIS in traffic pattern and network performance is controversial for several reasons [18]:
1. Even if all users had a perfect knowledge of the travel cost associated to each available path and user equilibrium was achieved, this could be very far from an optimum configuration of the whole network in terms of total cost sustained by all users;
2. Even if we find how to distribute traffic on the different paths and over time in order to minimize the total network cost, and provide the appropriate information what will the driver reactions be to our suggestions?
3. How will the proportion of equipped and not equipped drivers with ATIS impact the network performance?
4. An overreaction can occur if too many drivers respond to the information.

The new model will provide information in the context of transportation system that requiring correspondence between user expectation and the information. Virtual collaboration explains interaction among government, citizen and government services (ATIS). Advanced technology will assist to get information about users need and process with analytical tools. Analytical tool associated with data modeling and predictive analytics.
3.2 Virtual Collaboration in Advanced Traveler Information System

The essence of virtual collaboration is to break up the unity of time, location and trade using information and communication technology application.

In our model of ATIS we identify three typologies of collaboration: government rules, context of system, and user needs. Government rules are related to list of activities, context of system is related processing process and user needs is related output of ATIS (Table 1).

Transformation process in government also relates to collaboration between stakeholders. The idea of collaboration corresponds with the concept of an organization which includes collectiveness. It is obvious that these collaboration instances have some benefits: saves time or money, increases quality, innovating or provides decision support ease of access to experts on subject matter [13].

<table>
<thead>
<tr>
<th>No</th>
<th>Activities</th>
<th>Information Processing</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Collect, process, store, and disseminate</td>
<td>• Provide General data warehouse function</td>
<td>• Route Choice</td>
</tr>
<tr>
<td></td>
<td>transportation information</td>
<td>• Collecting information from transportation system operator</td>
<td>• Prediction of travel time, etc</td>
</tr>
<tr>
<td>2</td>
<td>Deliver of traveler information to citizen</td>
<td>• Provide realtime traffic condition</td>
<td>• Route Guidance</td>
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<td></td>
<td></td>
<td>• Transit schedule information</td>
<td>• Multimodal Choice in Trip Planning</td>
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<td></td>
<td></td>
<td>• Ride matching information</td>
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<td></td>
<td></td>
<td>• Parking Information</td>
<td>• Parking area and capacity</td>
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</table>

Fig. 1 illustrated common interaction between Traffic Management System which represents Government (c), Advanced Traveler Information System (ATIS) representing Government product (a) and User (b).

Each component possesses a relevant description of subject (ATIS), task (activities of ATIS), owner (government) and output (information service of ATIS).

In existing model of ATIS, every component has its own specific purpose in collaboration. Intersections between sets illustrate that collaboration occurs. ATIS (a) will interact with government, represented by ATCS (c) in process of presenting related information about route selection and guidance. c serves as a source of data for a in describing existing traffic condition, based on output of information processing in ATCS. a can give b (users) an advice about path selection, related paths, and estimated travel time through web based application interfaces. b can then use the information to decide his or her trips.

Our proposed model transforms the interactions among a, b, and c. Intervention of advanced technology (x) in the processing information will lead to changes the business process. The intervention will be conducted by addicting the function of a (ATIS), not only as an information provider, but also as intelligent tool.

Figure 2 illustrates the establishment of a new model of virtual collaboration. In our model, a, b, and c intersect each other by means of advanced technology intervention (x). Variable x identified as transformational process in processing information caused by advanced technology.

The transformation produces two types of output, route guidance and route prediction, without changing the interacting participants. x will contains set of new rule in processing information.
Variable x is the application that is associated with advanced technologies and this application can be adaptive to the current context and the user context. The applications have tools to acquiring and representing the current context (location, traffic conditions, and thus sensors sometimes needed. Also, the application needs to acquire and represent the next condition in path network to get additional inputs in order to facilitating the new scenario in managing of traffic system. The application has value added that become autonomous and proactive which can free users from initiating processes and tuning them to suit the current context and current interest. In this system x also has a function as analytical tools.

The next parts of this paper describes the detail of the proposed model of ATIS, providing travel time prediction and route choices and also process the information with analytical tool, in order to predict traffic condition. The result of forecasting information will be handed over to ATCS for further decision on the timing of traffic lights. The new scenario will causes a change in Traffic Management System autonomously.

Future model experiencing transformation model in processing information which allow the process of collaboration between user (community), government application (ATIS) and Government services (Traffic Management System) to describe the process of creating a virtual communities supported by advanced technology. The proposed model is Smart-ATIS.

### 3.3 Framework of SmartATIS with Dual Engine

Smart-ATIS uses Dual Engine, Route Selection Engine (RSE) and Route Prediction Engine (RPE). RSE is working together with ATIS to provide optimum route alternatives for traveler. RPE provides traffic forecasting based on routes accepted by the traveler, determine where traffic congestion will occur, and then sends the intervention message to ATCS for pre-emptive countermeasures.

Figure 4 explained conceptual framework of Smart-ATIS. When traveler accesses route selection in Smart ATIS, (1) RSE will calculate several optimum routes (a route is composed of several path) based on current traffic information available from ATCS data sources, then presented back to the traveler (step 2). If traveler accepts one of the recommended routes (step 3), RSE will store and accumulate paths in storage. This storage is part of RSE. Each path has a lifetime, only stored during a definite period of time; this is called an active path. Each route has estimated travel time (step 4); this will be the path’s lifetime. The collection of active path is then processed by RPE (step5).

![Figure 4: Framework of Smart-ATIS with dual Engine](image-url)

RPE continuously performs forecasting based on the collection of active path from the storage. During forecasting, each path would have a new information attribute, which is the future estimation of traffic load (named “future traffic load”). This information then compared to the threshold value indicating the maximum traffic load on each path. If a path's future traffic load is beyond threshold value, then a path can be determined as congested (this attribute is named “future traffic state”). Future traffic state value can be “congested” or “normal”. The output of forecasting is a collection of path along with the future traffic state attribute, transferred to ATCS (step 6,7,8). Based on this feedback information, ATCS can adjust the duration of traffic light on each path according to the value of future traffic state in attempt to achieve an optimal traffic flow state.

### 3.4 Implementation Architecture

We have so far discussed business process of Smart-ATIS as a new paradigm in processing information. To further understand the transformation model of Smart-ATIS, it is helpful to view a Smart-ATIS as special case and implemented in the real condition. In order to acquire Smart-ATIS intervention, a pilot testing should be done to districts/municipalities which already have implemented ATIS and ATCS, for example Jogjakarta Special Region. Existing ATCS in Jogjakarta operates based on input from traffic surveillance and traffic counting sensors.

Existing ATIS in Jogjakarta mainly provides shortest route selection without considering real time traffic conditions. Therefore, the existing ATIS needs to be enhanced with a Route Prediction Engine which will
capture user preferred route selections, provide traffic load forecasting on preferred routes, and then handover the forecasting information to ATCS for further decision on the timing of traffic lights. (Fig. 5).

Our proposed model illustrated a collaboration model in government application in transportation represented transformation process while a (ATIS), b (user), and c (ATCS) affected each other. Intervention of advanced technology (x) as analytical tool in the processing information will lead to changes ATCS automatically.

3.5 Implementation Architecture

![Implementation Model of Smart-ATIS](image)

Figure 5 .Implementation Model of Smart-ATIS

4 CONCLUSION

We have discussed transformational of existing services to create virtual collaborations among government-operated system (ATCS), transportation services (ATIS) and users. Smart-ATIS allows government to provide traffic information which suits user needs, based on real-time traffic condition. At the same time, the system also allows users to give feedback to the ATCS system to be used for optimizing traffic management in a specific area. In our future research, we will develop traffic light simulation that models the mechanism of Smart-ATIS.

REFERENCE

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