

E-Participation

Modeling and Developing with Trust for Decision Making

Supplement Purpose

Vitri Tundjungsari
YARSI University
Information Technology Faculty (FTI)
Jl. Letjen Suprpto, Jakarta Pusat, Indonesia
1(Student of Department of Computer Science and
Electronics, Gadjah Mada University)

Jazi Eko Istiyanto, Edi Winarko, Retantyo Wardoyo
Department of Computer Science and Electronics
Gadjah Mada University
Jl. Sekip Utara
Yogyakarta, Indonesia

Abstract— ICT has been employed in various areas, including e-Participation to support citizen participation and achieve democracy ideal. Trust as a social behavior can be used as a method to model preferences and facilitate better participation and interaction in a decision making within a group of decision makers. In this paper we present literatures survey related to e-Participation and trust in computer science; we also proposed a Group Decision Support System model and application, which utilizes trust to support decisions in a collaborative team. In brief, the model is based on the synthesis of group members' preferences following an appropriate aggregation procedure.

Keywords- e-Participation; trust; group decision making.

I. INTRODUCTION

Information and communication technology (ICT) has become deeply involved in various studies regarding decision making. Advances in ICT facilitate solution on some of the decision making problems such as in politics, economics, and engineering sciences. Nowadays, decision making is not only based on single decision maker perspectives but also involves several decision makers, also called as a group decision making. In politics, especially in governmental concept, this group usually consists of government staffs who also expert in their fields. However, government today with democratic concepts requires much more citizen participation in decision making to achieve democracy ideals stated by Abraham Lincoln's (the government of the people, by the people, and for the people). Furthermore, we believe that ICT could be applied to enhance citizen participation in the policy process [36]. Macintosh [22] mentions the overarching objectives of e-participation are given as: (1) reach a wider audience to enable broader participation; (2) support participation through a range of technologies to cater for the diverse technical and communicative skills of citizens; (3) provide relevant information in a format that is both more accessible and more understandable to the target audience to enable more informed contributions; (4) engage with a wider audience to enable deeper contributions and support deliberative debate.

There is no clear definition of e-Participation from various literatures, however we can conclude that ICT usage (particularly Internet based) in those participation action and

mechanisms, with the implication that the technology has the ability to change or transform the communication processes between the participants involving citizens in societal decision making, is also called as e-Participation. It is normally associated with some form of political deliberation or decision-making within the formal political process (e.g. voting), or outside it (e.g. political activism) [30].

Our literatures review concentrates on how participatory research can be applied in the decision-making sense, and also includes e-Participation research's state of the art. Moreover, this paper contributes to the work of defining the emerging research area of e-Participation by: (1) describing and categorizing recent set of relevant and important literatures in area of e-Participation; (2) proposing new model of e-Participation for decision making purpose and developing it into a prototype called Par-GDSS.

The rest of the paper is organized as follows. Section 2 provides a brief review of existing e-Participation research. Section 3 and 4 presents our e-Participation model and application. Finally in section 5 we conclude the paper and state our future work.

II. E-PARTICIPATION LITERATURES SURVEY

E-Participation is a technology-mediated interaction between the civil society sphere and the formal politics sphere, and between the civil society sphere and the administration sphere [30]. The main point of e-Participation is the citizen, i.e., the purpose of e-Participation is to increase citizens' abilities to participate in digital governance, including participation in the political process and the transformation of digital government information and services.

Literatures survey shows that e-Participation is an emerging research area and has been studied and implemented in some developed and developing countries ([11], [26], [30]). However, survey also finds out that e-Participation (related to Decision making) still has limited source both in theory development and its practice. In table 1, we present e-Participation research based on its motivation and reference discipline from 29 paper sources.

E-PARTICIPATION CLASSIFICATION BASED ON RESEARCH MOTIVATION

Research Motivation: Participative Imperative		
Examples	Reference discipline	Reference
Participatory design and ethnographic action research	Information systems (socio-technical)	Watkins & Tacchi (2008)
Political and economic effects on Participatory budgeting	Politics, socio-economics	Spada (2008)
Implementing participative research in German	Socio-economics	Mambrey (2008)
Improving public participation in politics (Obama case)	Information systems, socio-politics	Kes-Erkul & Erkul (2009)
Participatory approach for IS development in developing countries	Information systems	Puri et al. (2004)
Participatory approach in Decision making	Information systems	Byrne & Alexander (2006)
Increasing participation in online communities	Information systems	Bishop (2007)
Research Motivation: Instrumental justification		
Examples	Reference discipline	Reference
Proposed framework to evaluate e-Participation	Information systems	Aichholzer & Westholm (2009)
Assessment of e-Participatory budgeting	Information systems	www.participatorybudgeting.org.uk
Policy-making lifecycle and key dimensions of e-Participation	Public policy	Macintosh (2004)
Proposed framework for mapping, assessing and clustering e-Par projects in EU	Information systems	Charalabidis et al. (2008)
Overview e-Participation projects	Information systems	Ahmed (2006)
Proposed framework ICT tools for e-Par objectives	Computer Science	Phang & Kankanhalli (2008)
e-Governance as dynamic and open socio-technical systems	Information systems (socio-technical)	Dawes (2008)
Overview e-PB in Brazil	Socio-economics	Peixoto (2008)
Overview e-Participation domain	Information systems	Kalampokis et al. (2008)
e-Government usage assessment from socio-technical perspectives	Information systems (socio-technical)	Belanger & Carter (2009)
Proposed framework assessing e-par project and tool	Computer science	Tambouris et al. (2007)
Proposed multidimensional framework of wide participation and common understanding	Information systems	Wang & French (2008)
Improving GDSS and NSS	Computer science	Jinbaek (2008)
Research Motivation: Technology focus		
Examples	Reference discipline	Reference
e-administration and e-politics	Computer science	Grima-Izquierdo & Insua (2006)
Bridging the gap PD & IS methodology	Information systems, computer science	Pekkola et al. (2006)
Searching strategies for citizen-centered e-Government	Information systems	Bertot et al. (2007)
Improving citizen interaction in an e-Deliberation environment (city map online)	Information systems	De Cindio et al. (2008)
Overview e-Voting in the UK	Computer science	Xenakis & Macintosh (2003)
Improving e-Gov interoperability and consistency	Computer science	Davies et al. (2007)
Proposed draft of e-Par ontology	Information systems	Wimmer (2007)
Guide to online participation (social networking software)	Information systems	Sommer & Cullen (2009)
Online participation with social networks	Information systems	Hwang & Mohammed (2008)

Sanford and Rose [30] categorize e-Participation motivation into:

1. The participative imperative. This motivation emphasize in participation principle where stakeholders in society (citizens in various roles and stakeholder groupings) have an intrinsic right to participate in the formation and execution of public policy, especially when it involves their interests. This principle is derived by argumentation from principles in philosophy and political science, and is commonly protected in democratic societies by law, convention, and practice. However, the extent of this intrinsic right, the nature of the participation, and the democratic forms which enable it are open to debate. This research motivation can therefore be associated with a desire to understand, improve or reshape societal participation forms.
2. Instrumental justification. This motivation relate to the study of the effectiveness of government and policy

- making is, and how to improve it. Stakeholder participation in public affairs can be instrumental in more effective policy making and governance. This is because consultation with societal stakeholders can lead to improved public policies and encourage adoption and implementation of policy and services.
3. Technology focus. This motivation point out the role, effectiveness of information and communications technology to improve participation in the political process through: enhanced reach and range (inclusion); increased storage, analysis, presentation, and dissemination of contributions to the public policy and service debate; better management of scale; and by improvements to the process of organizing the public sphere debate.

However in practical implementation, those motivations often overlap with each other's, thus we present only the dominant motivation of the research paper as described in table 1.

In reference discipline related to e-Participation, Sanford and Rose [30] identify several related fields, i.e.: (1) information systems, (2) political science, (3) social and political philosophy, (4) social and economic philosophy, (5) public policy, (6) computer science. Further explanation of e-Participation can be found in [30]; [22]; [34]; [44]; [28]; [17].

Phang and Kankanhalli [28] in their paper stated that e-Participation initiatives have several objectives, such as: to provide citizens information, to support citizens' participation, to utilise citizen's input in decision making processes, and to investigate citizens' needs. Table 4 shows e-Participation initiatives categorization based on its objectives, i.e.: (1) information exchange, (2) education and support-building, (3) decision-making supplement, and (4) input probing. Our work focuses on how technology can support decision making processes as an e-Participation objective.

Although Non-government organization (NGO) and private sector are also relevant to e-Participation but basically e-Participation is a citizen focused research. Macintosh [22] has identified e-Participation as part of e-Democracy. E-Democracy is defined as ICT usage involving citizens, in order to support a democratic decision making process and to strengthen a representative democracy.

A democratic decision making process is divided into two categories, which are: e-Voting and e-Participation (Macintosh, 2004). Therefore, it can be concluded that technology involved in e-Participation should deliberate citizens' opinion, reform government's citizen and furthermore provide better government's service to its citizens.

In spite of several pro and contra regarding the prospects of ICT towards better governance and democracy, this paper believes that ICT can facilitate participation in decision making processes and also supports collective deliberation.

III. PROPOSED E-PARTICIPATION MODEL

As stated above, the main objective of this study is to support and facilitate wider participation using ICT (e-Participation) as decision-making supplement. For this reason, we propose a model utilize multi-criteria decision analysis (MCDA) aiming to assist decision makers on the entire process following a structured approach (specifically in process 1, figure 1); trust and reputation mechanisms to encourage and assist in knowledge sharing and education process (process 2, figure 1) also group decision making process (process 3, figure 1); and consensus with centrality approach to construct group decision (process 3, figure 1).

Moreover, the model consists of three main processes (figure 1), i.e. [38]:

1. Agenda setting process. This process mainly contains of clarification of the decision context, i.e.: problem and objective definition, criteria and alternatives exploration, and identification of participants.
2. Knowledge sharing and education process. This process involves iterative learning process by providing advice taking service. A decision maker can find and ask advisors using trust and

reputation mechanisms, in order to improve her decision's quality. This process also aim to inform participants about the why and how decision is made from other participants' (e.g. experts) perspectives.

3. Group decision making process. This process includes evaluation of decision criteria and alternatives. All alternatives are measured with regard to every decision criterion using a related measurement scale. These evaluations based on subjective judgments by participants themselves. This process also supports participants' decisions iteration and refinement in order to reach consensus, facilitating by supra decision maker role.



Figure 1. The Proposed Model

Related to computer science, trust has been used in various fields, e.g. data/information filtering and collecting strategy [21], [13], [39], [40]; security mechanism [35], [6]; information/ knowledge sharing [19], [4]; and recommender system [42], [24], [46], [32]. Table 2 summarizes several literatures in trust related to computer science application.

As we can see from table 2, trust model has not been utilized in decision making area; while it has been used widely in data/ information collecting and filtering and recommender systems. Our effort is employed trust into our e-Participation development. Reputation and recommendation are the common terminologies used in trust model. Further explanation of how our trust model works within our decision making model can be found in [37] and [38].

For implementing our model into Par-GDSS application, we follow framework of ICT exploitation for e-Participation initiatives described by Phang and Kankanhalli [28]. The framework in table 4 shows there is no single participatory technique and ICT tool that can satisfy all four objectives of e-Participation initiatives. Therefore it is important to first identify the objective to be served by the initiative to improve the probability of success of an e-Participation initiative,

followed by a careful selection of the best-matching techniques and ICT tools for the objective [28].

TRUST MODEL AND APPLICATION USED IN COMPUTER SCIENCE

Application	Used terminology			Environment	Author
	Reputation	Recommendation	Others		
Data/ Information collecting and filtering	No	Yes	No	decentralized networks distributed systems distributed systems social networks distributed systems	Lin et al. (2007)
	Yes	Yes	No		Umhoza et al. (2008)
	No	Yes	No		O'Donovan & Smyth (2008)
	No	Yes	No		Walter et al. (2007)
	No	Yes	No		Lifen (2008)
Security mechanisms	Yes	No	penalty evaluation	P2P networks	Tian et al. (2006)
	Yes	Yes	No	grid environment	Bhanwar & Bawa (2009)
Information/ knowledge sharing	Yes	No	risk evaluation	P2P networks	Liang & Shi (2007)
	No	No	No	web-based	Bencina (2007)
Recommender systems	Yes	Yes	No	P2P networks distributed systems	Wang & Vassileva (2003)
	No	Yes	No	ubiquitous environment	Montaner et al. (2002)
	No	Yes	No	P2P networks	Yuan et al. (2006)
	No	Yes	No	P2P networks	Song et al. (2004)

Our paper is oriented toward e-Participation efforts with the decision-making supplement objective aim to extract specific information from citizens, such as, citizens' preferences on the use of an empty plot of land in the city. In these e-Participation efforts, citizens are given an opportunity for direct input into the planning process, as mentioned by Phang and Kankanhalli (2008).

Therefore our model provides characteristics, which are: control of participation processes, interactions among planners and participants, mechanisms for data collection. Those characteristics aim to support decision-making supplement as e-Participation objectives.

Related to our e-Participation application (namely as Par-GDSS), we construct and integrate trust model into our proposed decision making model. Table 3 describes trust properties in our model and application. The user as actors in the model consists of four different level, categorized by its trust level (tl) which are:

- Citizen with trust level=1;

- Citizen with trust level=2;
- Citizen with trust level=3;
- Citizen with trust level=4.

TRUST PROPERTIES WITHIN THE PROPOSED MODEL

User/ Actor	Trust Properties	Environment
Citizen, i.e.:	<ul style="list-style-type: none"> • Always between two entities (Trustee dan Truster) • Non-symmetrical (e.g.: if A trust B, then doesn't mean B trust A) • Conditionally transitive (e.g.: if A trust B, B trust C, then A trust C under condition that B as a recommender to C, based on C's reputation). • Context-based (a trustee only can be trusted in one/ several specific categories) • Reflexively (a truster has to trust system and his/ her own judgment to determine trustee's trust value) • Dynamically (trust value is dynamically changed). 	<p>Trust</p> <ul style="list-style-type: none"> • Decentral peer • Partial trust algorithm
<ul style="list-style-type: none"> • Regular citizen (tl=1 dan tl=2) • Expert citizen (tl=3 dan tl=4) 		

Environment in this trust model consists of decentral peer and partial trust algorithm. Decentral Peer in this model works for all of the peers within the network can act as end-peer or recommender for other peers.

This is a simple but the least reliable model since there is no need for any recommenders in the system to prove the recognition of its recommendation. While partial trust algorithm applies when a peer uses only some of the recommendations to measure trust value of another peer [25].

For the next step, we then implement our model into an application named Par-GDSS. Par-GDSS is a web based application which can be reached online at www.pargdss.com. We follow a three-step procedure proposed by Phang and Kankanhalli [28] as presented in figure 2.

We define Par-GDSS objective as a decision-making supplement. The participatory technique used is group decision making with consensus achievement. Consensus achievement is produced by the role of Supra decision maker as the leader of the group.

Finally, we then decide Group Decision Support Systems (GDSS) with trust and reputation mechanisms as the ICT tool to support the technique and, in turn, the objective.

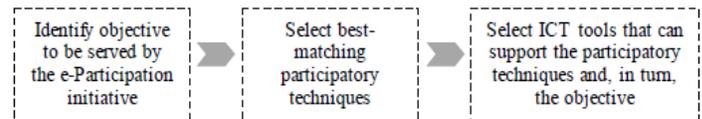


Figure 2. A three-step procedure to implement e-Participation [28]

TABLE I. A FRAMEWORK OF ICT EXPLOITATION FOR ICT INITIATIVES [28]

E-Participation Initiatives					
		E-Participation Objectives			
		Information exchange	Education and Support-building	Decision-making supplement	Input Probing
Features Desired		Avenue for citizens to participate freely, Opportunity for two-way open exchange of information	Formal selection and engagement of participants from target demographic population, Maintenance of contact with participants over time	Control of participation processes, Mechanisms to obtain specific set of information useful for decision making (e.g., ranked preferences) from relevant group	Mechanisms for systematic collection and analysis of citizens' input, Collection of citizens' opinion that is neither biased nor influenced by others
Example(s) of Best-fitting Participatory Techniques		Drop-in center, Public hearing	Citizen advisory committee, Citizen panel	Nominal Group Process, Value analysis	Citizen survey
Characteristics*	Restriction on number and target of participants	No	Yes	Yes	Depends on sample size needed and resources available
	Control of participation processes	No	No	Yes	No
	Maintenance of long-term contact	No	Yes	No	No
	Interaction among planners and participants	Yes	Yes	Limited (mainly one direction)	No
	Mechanisms for data collection	No	No	Yes	Yes
	Statistical analysis of data	No	No	No	Yes
ICT Tools that Provide the Features Desired		Web portal with Online discussion forum, Online chat	Electronic profiling, Online chat, Discussion forum with login feature, Teleconferencing, Videoconferencing, E-mail	Group support systems with process restrictiveness feature, Online pair-wise structured survey, Visualization tools	Online survey questionnaire, Web comment form, Data analysis tools
Example of E-Participation Initiatives		Denmark's Democracy on the Web, Singapore's REACH Portal	UK's Askbristol E-Panel, Canadian's Youth Connection Forum	Netherlands' Almere Co-Production of Interactive Policy and Technological Policy Solution for Societal Problems	Sweden's Kalix Consultation

IV. PAR-GDSS: E-PARTICIPATION APPLICATION

The architecture of the GDSS (named as Par-GDSS) employs M (Model), V (View), C (Controller) design pattern, which adopted from software engineering approach. MVC separates web application's logic from layer presentation so then it has components to manipulate data, user interface, and application control.

Figure 2 describes the systems architecture of Par-GDSS. At the user side, there are many functionality elements (such as: create account, view event, etc) that could be done by user/citizen with various role, i.e.: (admin, citizen with tl=1, citizen with tl=2, citizen with tl=3, citizen with tl=4).

There are several modules have been developed for Par-GDSS, i.e.:

- **Citizen:** This module handles all requests related with (1) retrieve, add, delete, update Citizen; (2) trust and reputation mechanisms and theirs calculation.
- **Event:** This module handles all requests related with (1) retrieve, add, delete, update Event; (2) individual decision; (3) trust and reputation mechanisms and theirs calculation;

- (4) document and information related with an *Event*;
- (5) control and *feedback mechanisms*.

- **Dashboard:** This module handles all information related with an *event* involving a *citizen (user)*, e.g.: received message (inbox), newest comment, and upload document.
- **Modul Forum:** This module handles all activities related with Discussion Forum, e.g.: *post topic, post thread, post discussion, view discusssion*.
- **Modul Message:** This module handles all activities related with sending and receiving messages between users (*one to one user*).
- **Modul Session:** This module handles *user session*.

Par-GDSS is a web based application which can be accessed through a login page, where users have to provide appropriate password. The system recognizes two roles: Supra decision maker and citizen.

Supra decision maker works on a fully functional mode of the system, while citizen work on a mode presenting a subset of functionality based on their trust level. Figure 3 shows the functionality for each citizen.

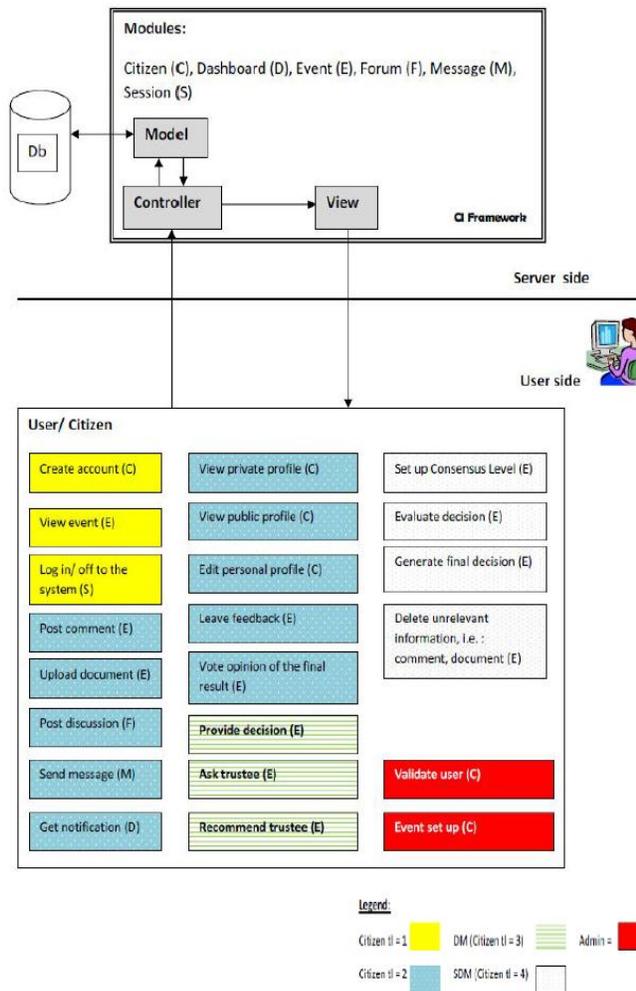


Figure 3. Par-GDSS Overall Architecture

Figure 4 shows the beginning of the systems, i.e. login to system, until the end of the system, i.e. view the result and provide feedback. The event in Par-GDSS changes several times related to the decision making progress, which consists of:

- Discussed event: this feature is model's interpretation of Agenda Setting process.
- Ongoing event: this feature is model's interpretation of Knowledge Sharing and Education process.
- Resolved event: this feature is model's interpretation of Group Decision Making process.

For every event changes, we provide two kinds of mechanisms, i.e.: trust and reputation mechanisms, consensus achievement mechanism.

V. CONCLUSION

Our literatures survey finds that e-Participation in decision making area is still lack of research and implementation. Therefore, this paper proposes an e-Participation model using trust to assist participatory decision making, while enhances collective deliberation among citizens. The idea of trust

mechanism utilization is coming from the possibility of any doubtful has been taken by decision maker. Unlike expert decision makers, citizens as decision makers could have no prior information regarding what and how decision should be made of.

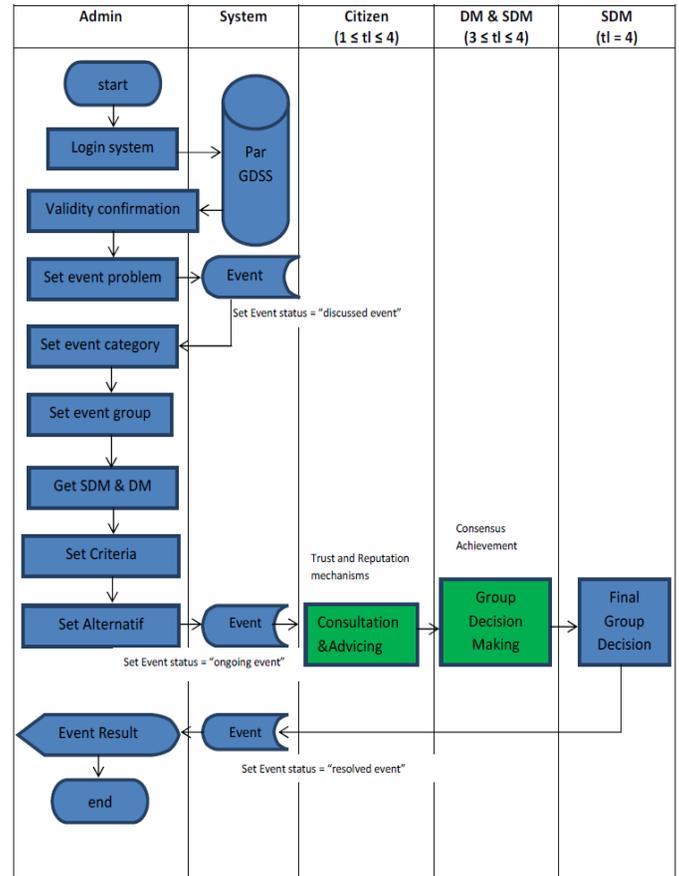


Figure 4. Par-GDSS Features and Activities Diagram

This paper then proposes to adopt the 'real life' behavior, by providing interaction and consultation between citizens in order to produce better decision's quality. Focusing on the process of making decisions on public matters with citizen participation, this paper also investigates state-of-the art researches related to e-Participation.

The advantages of our proposed approach are:

- (1) it provides a transparent control mechanisms by employing trust and reputation mechanisms, so that it can promote democracy aspects and not only works as group decision support systems,
- (2) it can support various decision makers with different backgrounds and skills by providing information and knowledge through trust and reputation mechanisms (a beginner decision maker can learn how to decide from other trusted and recommended sources),
- (3) it can enhance participation level to some extent by providing wider participation access and resources and also supports better interaction among decision maker (learning and sharing process to achieve final group decision). Our

future works will be concentrated on our proposed model testing and evaluation.

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