A hybrid Approach with Balanced Score Card and Fuzzy Topsis Metho

by Aang Darmawan

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A hybrid Approach with Balanced Score Card and Fuzzy Topsis Method for Identifying Critical Factors Affecting Smart Regency Development

1st Aang Kisnu Darmawan
Department of Information System
Universitas Islam Madura
Pamekasan, Indonesia
ak.darmawan@gmail.com

2nd Daniel Oranova Siahaan
Department of Informatics
Institut Teknologi Sepuluh Nopember
Surabaya, Indonesia
daniel@if.its.ac.id

3rd Tony Dwi Susanto
Department of Information System
Institut Teknologi Sepuluh Nopember
Surabaya, Indonesia
tonydwisusanto@is.its.ac.id

4th Hoiriyah
Department of Information System
Universitas Islam Madura
Pamekasan, Indonesia
hoiriyah.file.uim@gmail.com

5th Busro Akramul Umam
Department of Information Technology
Universitas Islam Madura
Pamekasan, Indonesia
busro.umam@gmail.com

6th Tony Yulianto
Department of Mathematics
Universitas Islam Madura
Pamekasan, Indonesia
toniyulianto65@gmail.com

7th Miftahul Walid
Department of Informatics
Universitas Islam Madura
Pamekasan, Indonesia
miftahwalid@gmail.com

8th Betty Dewi Puspasari
Department of Informatics
Sekolah Tinggi Teknik Atlas Nusantara
Malang, Indonesia
betty@sttar.ac.id

9th Achmad Nizar Hidayanto
Faculty of Computer Science
Universitas Indonesia
Depok, Indonesia
nizar@cs.ui.ac.id

***Abstract*—In developing countries, the concept of Smart Cities and Smart Regencies has become the trend and the primary choice in solving increasingly complex and multi-dimensional city governance problems. The idea of smart cities is an integrated ICT-based city governance concept that offers solutions to manage city resources more efficiently. However, in the smart city development process, various problems make the smart city development process fails and is not as expected before. Previous researchers have conducted research on the key and critical factors that have an essential influence in building smart cities, but of the many critical factors, the list has not been made to highlight development. This study aims to identify the priority key factors that need to be considered in the event of smart regencies. The method used is a mixed-method, a combination of qualitative and quantitative research. At the qualitative research stage, critical factor investigation modeling is carried out using the Balanced Scorecard technique. While the qualitative research stage is carried out using the Fuzzy TOPSIS analysis method, a technique in Multi-Criteria Decision Making to rank and prioritize. The results of this study indicate that the factors in the category of Procedure & Bureaucracy Factors (PBF) are very influential factors to consider compared to other factors. This research contributes to two things, methodologically provides a variety of combining the balance scored card and Fuzzy-Topsis methods, then practically, it gives the government and policymakers suggestions that the essential predictors of the growth of smart regencies be given more attention.**

Keywords— Smart Regency, Smart City, Critical Success Factor, Balance Score Card, Fuzzy-Topsis

I. INTRODUCTION

The Smart City architecture is an integrated ICT-based urban planning and management system. This initiative would address an increasingly complex set of urban problems by allowing effective use of community resources[1],[2],[3],[4]. Smart City facilitates the management of people's resources, economic growth, prosperity, and social sustainability in community life and development[5]. Smart cities are typically applicable to local governments in many cities around the world and in Indonesia, like Madura Island[6], [7].

In developing countries, the concept of Smart Cities and Smart Districts has become the primary trend and choice in solving increasingly complex and multi-dimensional city governance problems. The idea of smart cities is an integrated ICT-based city governance concept that offers solutions to manage city resources more efficiently. Several cities in developed countries have competed in applying the theory of smart cities, including Vienna[8], Changsa[9], and various other cities in Europe[10]. The same thing was then imitated by developing countries so that currently, the development of smart cities and districts has become a trend in ICT-based city governance[1][11][12].

Several researchers have conducted previous research on critical factors that are important for stakeholders to pay attention to in building smart cities/districts, including the critical success factor review by Meiyanti et all (2017) [13], Napitupulu 's critical success factor in the implementation of e-government (2014) [14][15][16][17], research by Supangkat et all, (2018) Key Success Factor in Smart City Governance [18], research by Surya et all (2017) about model critical success factors for the implementation of eGovernment in Indonesia[19], Handayani et all (2018), Mobile health deployment in Indonesia has important success factors[20], Ansyori et entirely (2018) on Essential performance factors to incorporate business architecture A systematic literature review[12], and Subiyakto study (2018) on Assessing IS-system integration[21], Readiness Model for Assessing IS Integration[22], [23].

However, the studies and research conducted by these researchers have not yet explained and elaborated on the priority of critical factors that must take precedence in

building smart cities and districts, especially for their application in developing countries.

This research is relevant because, according to the author's observations in the field, there are obstacles that make the development of smart cities/districts not run well. In some areas, it did not work even if master plans and funding were well available. This means that technological factors and adequate funding alone are not sufficient to build smart cities and districts. There are other factors in the Critical Success Factor that need to be prioritized in its application in developing countries.

This study aims to identify and discuss the investigation of the main priority factors that need to be considered in developing smart districts by building models and ranking critical factors of CSF smart city/district builders in developing countries to find out which factors should be prioritized for development in the case of the district on the island of Madura. The method used is a mixed-method, a combination of qualitative and quantitative research. In the qualitative research stage, critical factor investigation modeling is carried out using the Balanced Scorecard technique. While the qualitative research phase was carried out using the Fuzzy TOPSIS analysis method, a technique in Multi-Criteria Decision Making to rank and prioritize.

The findings of this study reflect that regional governments in developing countries must prioritize coordination factors between state institutions and facilitate bureaucracy in developing smart districts. This research is expected to be able to contribute to smart city/district researchers, stakeholders, and local governments in developing countries to pay more attention to the coordination factor between government institutions and facilitate the bureaucratic process in the development of smart cities and districts. These two things are contributing to this study, which methodologically combines a balanced scored card with Fuzzy-Topsis methods, and then provides local governments and policymakers practically with recommendations to pay more considerable attention to critical factors which influence the creation of intelligent regeneration

II. Literature Review

A. Critical Success Factor in e-Government, Smart City and Smart District Development

To reduce the failure of the smart city and district implementation process, determining the success factor becomes an important activity and becomes an added value so that it also leads to the successful implementation of services. Numerous previous studies have been carried out to describe as well as gather the factors that are key to the successful implementation of a smart city/district development and e-government implementation.

Including research by Soni Fajar Surya[19], by constructing CSF e-Government models. Meiyanti's research[13], by conducting a Systematic Review of CSF e-Government which produced a list of 52 CSFs that influenced e-government development. Research by Napitupulu[14][15][17], 55 factors that influence the implementation of eGovernment are generated using a meta-ethnographic method. Yudatama's research[24], examining the benefits and barriers, produces a list of CSFs in the implementation of IT Governance. Research by Anindra[18], by researching 15 smart cities in Indonesia, resulted that Smart Governance is one of the CSFs that is very influential in the development of smart cities and districts.

Then research by Napitupulu[16] by validating using the Factor Analysis approach produces 39 valid and reliable CSFs in e-government development. Research by Handayani[25], which produced a list and validation of CFS mobile health implementations. and Ansyori's research[12] which produced a CSF list of Enterprise Architecture in the public sector

B. Balanced Score-Card Approach

The Balanced Scorecard (BSC), developed by Kaplan and Norton, strengthens the phases of traditional financial reporting and offers a view and balance of the company's financial and operational activities[26]. The BSC Model provides four holistic outlooks for performance: financial perspective, security, internal organizational perspective and growth, and learning outlook. Once an organization establishes a BSC, it must set general goals, concrete priorities, and reasonable steps based on the objectives for each viewpoint on the BSC. Limiting the number of measures in each of the four BSC viewpoints allows businesses to focus on main strategic priorities and overlapping agendas[27].

The Balanced Score Card is now widely used in various fields, including healthcare organizations[28], dairy supply chains[29][30], public organizations[31], non-profit organizations[32], intellectual property strategic competitiveness[33], service industries[34], agri-food chain logistics[35], private companies[36], steel industry performance[37], project executive[38], strategic budget management[39], website user experience[40], design of evaluation for digital education[41], drive performance[26], information selection[42], and electronic enterprise[43].

C. Fuzzy-Topsis Approach

Fuzzy TOPSIS was introduced and developed by Hwang and Yoon as a multi-criteria decision-making method[44], Where the answer to the question is the nearest to the Euclid with the best hypothesis, the most promising solution is the most distant with the worst hypotheses[45]. Fuzzy TOPSIS requires information and data on each weighting criterion's relative importance.

Sustainable suplier selection[46] and sustainable energy planning[47], Maturity appraisal index and governance risk management[48], failure mode[49], student's online habits[50], software requirement[51], Human Resource Manager selection[52], evaluating transportation service quality[53], career choice[54], medical tourism adoption[55], network supplier selection[56], cloud computing in e-commerce[57], e-commerce satisfaction[58], sosmed preference[59], evaluating supply chain performance[60][61], grocery retail [62] and Rail transit system[63].

III. Methodology

This research uses a mixed approach, which combines qualitative and quantitative studies. Qualitative work is conducted through literature reviews and in-depth field interviews concerning critical factors affecting the performance of intelligent cities/districts. At the same time, quantitative work is carried out using the fuzzy-topsis

method by carrying out a quantitative analysis of questionnaire results.

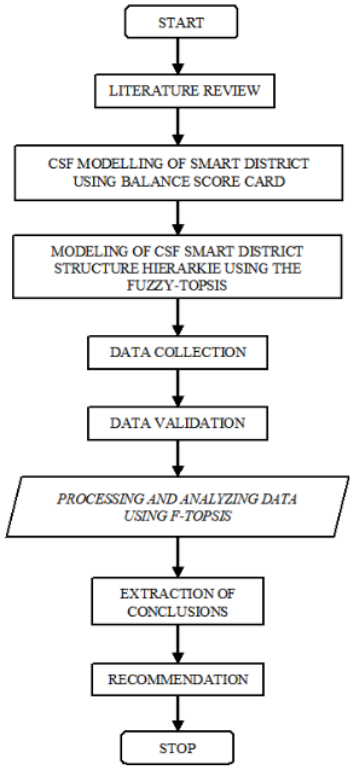

Fig. 1. Flowchart of Research

The steps in this research are as follows:

1. *Literature Study*. This research phase is carried out by conducting a study of journals, research reports, which are relevant to the Critical Success Factors (CSF) in developing smart cities/districts.
2. *CSF Investigation Modeling for Smart District using the Balance Score Card (BSC) approach*. At this stage, the modeling is carried out by classification and identification of critical factors that influence the development of the city/district. Modeling is done using the model framework in the Balanced Score Card (BSC), so that perspective in the BSC framework can be mapped properly
3. *Hierarchy Structure Modelling of CSF Smart District using the F-Topsis Approach*. At this stage, a hierarchical structure model is developed using the Fuzzy-Topsis approach. This modeling is beneficial for simplifying the mapping of criteria and alternatives in the Smart District Investigation Model
4. *Data Collection*. This process was done with detailed interviews and questionnaires previously developed using the BSC model and the hierarchy structure. Resource of 38 persons who were asked to interview and fill out the questionnaire were the coordinators responsible for implementing smart City/regency, stakeholders, business actors, government employees, and the community.
5. *Data validation*. This stage is carried out by checking the results of data processing by comparing the known realities of the field with previous in-depth interviews
6. *Processing and analyzing data using F-TOPSIS*. At this stage, data processing is performed based on data obtained previously by using the steps in Fuzzy Topsis.
7. *Extraction of Conclusions.*

IV. Result & Findings

A. Proposed Model Of CSF Smart District Development

Based on the study of literature on the Critical Success Factor above, then after studying and selecting we propose a list, classification, and CSF model of smart city/district implementation as the table and figure below:

TABLE I. Proposed List And Classification Of Csf

Dimensions	Indicators
Technology Factors (TF)	ICT Infrastructure
	System Quality
	Service Reliability
	System Accessibility
Procedure & Bureaucracy Factors (PBF)	Alignment of Organizational Goals and ICT direction
	Defuzzification-Cultural Environment
	E-Leadership & Participation
	Government Policy and Regulation
Employment & Competencies Factors (ECF)	Skill & Expertise
	Regular & Continous Training
	ICT Literacy
	Service Innovation
Information Factors (IF)	Usefulness
	Ease of Use
	Public Satisfaction & Intention to Use
	Privacy & Security
IT Governance & Management Factors (ITGMF)	Vision & Top Management Support
	Masterplan/Blueprint/Roadmap
	Monitoring & Evaluation
	Organization Structure
	Project Coordination
	Citizen Relationship Management
	Inter-Governmental Relationship
Objective & Value Factors (OVB)	Trust & Responsibility
	Appreciation
	Empathy & Loyalty
	Citizen Empowerment
Supporting Factors (SF)	Funding Continuity
	Stable Government

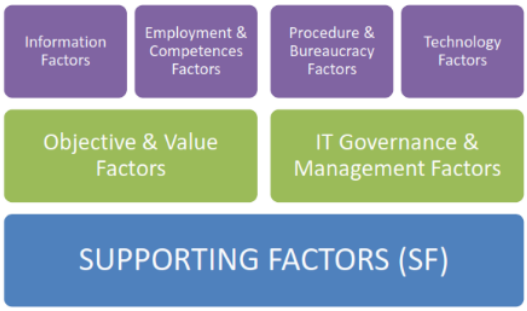

Fig. 2. Proposed Model Of CSF Smart District Development

In this model, we propose, 29 CSFs influence the development of smart cities/regencies, which are divided into seven (7) CSF categories. The model proposed is a model development and adaptation of the Capabilities and requirements model in the Public Sector Agency for the Evaluation of Business Architecture by Azaliah et al. (2016)[64], which is adjusted and developed by looking at the conditions of smart regencies enterprise architecture. The seven categories are Technology Factors, Procedure & Bureaucracy Factors, Employment & Competence Factors, Information Factors, IT Governance & Management Factors, Objective & Value Factors, and Supporting Factors. Factors in the Supporting Factors (SF) category, such as Funding Continuity and Stable Government, are at the bottom because they are the necessary foundation in smart city development. From the supporting factors above, they are then supported by two other factors, namely Objective & Value Factors (OVB) and IT Governance & Management Factors (ITGMF). Then after that, the other factors will be useful after the two previous factors are built well. These factors are Information Factors (IF), Employment & Competence Factors (ECF), Procedure & Bureaucracy Factors (PBF), and Technology Factors (TF).

B. Proposed Investigation Criteria of Smart District Development using extended BSC Approach

After studying the previous studies, we propose a list of assessment categories, criteria models, and CSF investigation models of smart cities/districts using the Balanced Score Card approach as figure and table follows:

Fig. 3. Proposed Investigation Criteria of Smart District Development using extended BSC Approach

TABLE II. PROPOSED INVESTIGATION CRITERIA OF SMART DISTRICT DEVELOPMENT USING EXTENDED BALANCED SCORECARD APPROACH

Category of Assessment	Code	Criteria for Assessment	Description
Internal Process (IP)	IP1	Business Determined Approach	Its organization approach drives CSF
	IP2	Strategic Plan Approach	CSF is related to strategic planning for companies
	IP3	Execution Roadmap	Secure communication and roadmap on CSF execution
	IP4	Governance	Sharp and clear CSF authority survive
	IP5	Guidelines and Procedure	Standard organization rules and process exists
	IP6	Organization Value	CSF is related to business organization value
Learning and Growth (LG)	LG1	Assessment	CSF execution assessment and appraisal be existent
	LG2	Records and Documentation	CSF documentation is comprehensive and presented
	LG3	Learning Ethos and culture	CSF is authorized and distributed in the organization learning culture
	LG4	Ability of Planner	Adequate and expert CSF planner is in residence
	LG5	Training and qualifications	Relevant CSF responsiveness program, exercise, and qualifications delivered throughout the organization
	LG6	Group of Exercise	CSF communities of exercise are shaped, to gain information from personnel and distribute it in the organization
Authority Support (AS)	AS1	Stakeholder Backing	CSF gain continuous backing from entirely stakeholders
	AS2	Stakeholder Advantage and Profit	Entire stakeholders recognize CSF advantages
	AS3	Roadmap/Blueprint and Plans Recognition	Blueprint and plans significance is accepted and recognized by entire stakeholders
	AS4	Comprehensive Authorization	CFS procedures and methods are assigned

Category of Assessment	Code	Criteria for Assessment	Description
	AS5	Political Impact	CSF received constructive political impact
	AS6	Awareness of stakeholders	A collective interpretation of all stakeholders takes place
Cost (C)	C1	Financial Supplies	Sufficient financial resources are given
	C2	Non-Financial Properties	There is sufficient allocation of specific resources (e.g., staff, equipment, training)
	C3	Principal Funding	Essential funding on CSF execution is given
Technology (TEC)	TEC1	Applied CSF Technology	CSF instruments, procedure, list are available, appropriate, easy to be used and understand
	TEC2	CSF Technology Backing	CSF equipment, instruments, process, schedule, and repository can be assisted and secure by supplier/customer
	TEC3	CSF Repository	CSF repository is existing
Talent Management (TM)	TM1	Blueprint For Talent Management	There is a comprehensive strategy to retain the organization's knowledge
	TM2	Business incorporated	The integrated team of experts creates and maintains a core service
	TM3	Maintenance Agenda	CFS knowledge remembering programs are formed to confirm the sustainability of the CSF program
Total	**6 Variable Criteria and 27 Indicators**		

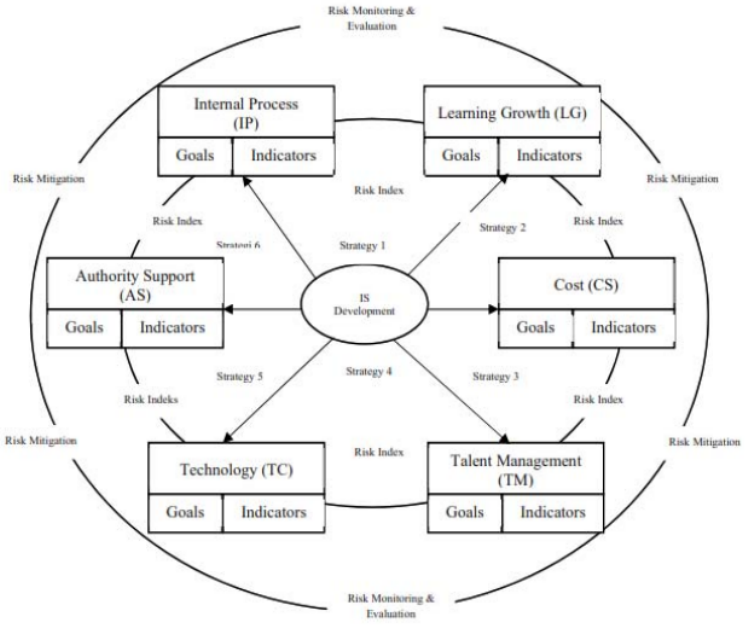

Fig. 4. Proposed Model Investigation of CSF Smart District Development based on Extended BSC Approach

C. *Proposed Investigation Model of CSF Smart District Development based on BSC Approach*

In Figure 4, the Proposed Smart District Development CSF Investigation Model is given based on the Extended BSC Approach. In this model, it explains that in the development of a smart regency information system, there are six enablers or dimensions that must be considered the objectives and indicators. The six enablers are Internal Process, Learning Growth, Cost, Talent Management, Technology, and Authority Support. The six enablers are interconnected and mutually reinforcing one another. In applying the six enablers above, some strategies must be carried out, which are described in a model with strategies 1-6. Then, in the outer circle, there are two critical things to do in developing smart regency, namely Risk Mitigation and Risk Monitoring & Evaluation. These two enablers are essential factors that must be considered at all times, which are an external aspect in maintaining the stability of the smart regency system.

D. *Proposed Hierarchical Model of CSF using BSC & Fuzzy Topsis Approach*

In Figure 5, the CSF Hierarchy Model Proposal using the Extended BSC & Fuzzy Topsis Approach is given. In the proposed hierarchical model, there are six enablers as criteria derived from the development of the Balanced Scored Card method, namely Internal Process, Learning Growth, Authority Support, Cost, Technology, and Talent Management. Then there are seven alternatives proposed in investigating critical factors in smart regency development, namely Technology Factors (TF), Procedure & Bureaucracy Factors (PBF), Employment & Competencies Factors (ECF), Information Factors (IF), IT Governance & Management Factors (ITGMF), Objective & Value Factors (OVB) and Supporting Factors (SF).

Assessment of factors The weighting of each criterion on the balanced scorecard is carried out by managers and policymakers in the development of smart regencies.

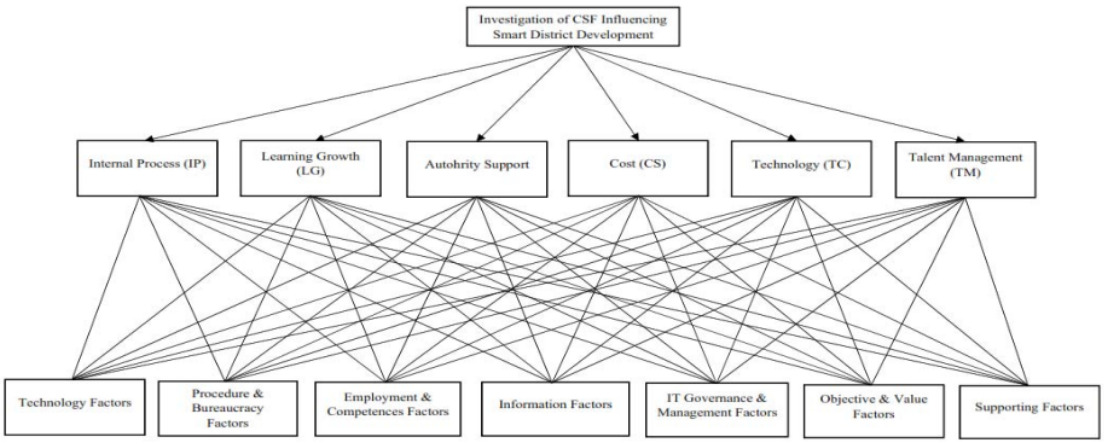

Fig. 5. Proposed Hierarchical Model of CSF using Extended BSC & Fuzzy Topsis Approach

V. Conclusion

The objectives of this research are to define and discuss the main priority factors to be considered appropriately by building models in the creation of smart regions and the critical factors for Csf smart city and district builders in developing countries to decide which factor for smart districts should be prioritized in County Development. In the paper, four basic things have been achieved in the research objectives, namely the Proposed CSF Smart District Development Model, the Proposed Investigation Criteria for Smart District Development using an expanded BSC Approach, the Proposed Investigation Model from CSF Smart District Development based on the BSC Approach and the Proposed CSF Hierarchy Model using the BSC & Fuzzy Topsis Approach. These four basic things will be a reference in future research to explore the main priority factors in the development of smart regency.

VI. Future Works

In further research, testing, and running models that have been generated will be carried out by collecting data on respondents who use smart regency services. Data collection will be carried out on policymakers, managers, developers, and the community of smart regency service users based on a previously developed model. The data to be obtained will then be modeled and run with a hybrid method combining the Balance Scored Card method for determining the criteria and Fuzzy Topsis in the ranking.

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