Smart Farming Precision Agriculture Project Success based on Information Technology Capability

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***Abstract*— The imperative of any area to involve technology in anything creates loopholes. In terms of implementing Smart Farming Precision Agriculture, several problems arise, especially in rural areas, one of which is the availability of information technology infrastructure. The solution to these problems requires input for policymakers in the success or failure of implementing Smart Farming Precision Agriculture which is based on information technology capabilities. The aim of this research is to understand the relationship between Information Technology capability and Information Systems Project Success models in terms of applying Smart Farming Precision Agriculture and to integrate Information Technology capability and Information Systems Project Success models in the context of implementing Smart Farming Precision Agriculture. The proposed model is developed by adopting Chen's Information Technology capability model and McLean and DeLone's Information Systems Project Success model. The research result is a new model with 21 influential research hypotheses and aims to assess the success of the application of Smart Farming Precision Agriculture as a decision-making material in a project. Coherent submission of the definitions of variables, indicators, and questions from each measurement item is shown in this paper.**

Keywords—smart farming precision agriculture, information systems project success, information technology capability, models

I. INTRODUCTION

Some areas, especially in rural areas have started to implement Smart Farming Precision Agriculture (SFPA) to assist farmers [1-5] in producing maximum agricultural output and not spending excessive time and energy [2, 4]. SFPA implementation is expected to play an important role in its application [2, 5, 6], bearing in mind that the application process costs a lot of time and money. But in reality one of the problem variables emerged, including those related to the availability of Information Technology (IT) infrastructure [7, 8]. In rural areas in particular the problem raises reluctance in its application and use. The emergence of the threat of food availability in order to address the potential needs of all human societies, causes traditional approaches to be changed with new approaches [6, 9, 10]. Smart Farming Precision Agriculture the key is to increase productivity and profits with the use of technology through minimization of the use of production inputs [1-5]. The availability of IT infrastructure is part of the variable IT capability model [11-13]. The IT capability model refers to the ability of organizations to identify IT business meeting needs, deploy IT to optimize business processes cost-effectively, and to provide IT-based systems with long-term maintenance and support [7, 8, 12].

The benefit of SFPA needs to be ensured in its application and use, so to simplify its measurement we need a model that is used to measure the extent of successful implementation of the SFPA project [1-6] also by involving variables in IT capability [7, 8, 11-13]. To anticipate unsuccessful implementation and use due to gaps that arise in rural areas in the involvement of IT bain in terms of capacity and availability of facilities, a new model is needed.

The purpose of this study is to produce a new model that integrates the IT Capability model with the Information System (IS) Project Success model, with Research Questions (RQ) as follows.

RQ1: How to understand in terms of applying SFPA the relationship between IT capability models and IS Project Success?
RQ2: In terms of implementing SFPA, how to incorporate the IT capability model with IS Project Success?

In answering research questions, reporting is done by raising the problem in the introduction, followed by literature review, research methods, results and discussion, and finally conclusions that are answers to the research questions.

II. LITERATURE REVIEW

Smart Farming Precision Agriculture (SFPA) is part of the development of the Industrial Revolution 4.0 era and is one of the solutions to agricultural revitalization. Broadly speaking, SFPA consists of Smart Farming and Precision Agriculture [1-6]. Smart Farming is the use of devices that involve technology, while Precision Agriculture is more about the use of technology to determine agricultural management [1-6]. SFPA in the field is used by combining the Internet of Things (IoT) with agricultural tools or machines [1, 5]. Agriculture 4.0 is agriculture that is characterized by the use of artificial intelligence technology, robots, the internet of things, drones, blockchain, and big data analytics, to produce superior, precise, efficient, and sustainable products [1, 4, 5].

The study of project evaluation and development has developed significantly. This shows that many studies lead to project management and success [14-19]. An illustration is that the success of a project develops from a limited, simple definition to the application phase in a project cycle. This reflects that the concern about project success is not only related to the project itself or the cycle of a product [14-19] but has evolved towards an organization and a wider environment than it. Generally, the success of a project is

measured using the criteria of achieving timeliness, budget suitability, and meeting the output specifications that have been previously set [15-22].

The implementation of an IS project is described as an information processing process. IS projects are identified as a sub-system of the organization referring to the project environmental theory [14, 23]. Besides, referring to the life cycle of a project and the concept of its success [15-22], the success of an IS project is described in three dimensions, namely the success of project management, product use, and its influence on the project owner's organization. The success variable of a project is adopted from the IS success model of DeLone and McLean [22]

It is necessary to link IT to specific business process capabilities to gain a more thorough understanding of the role of IT capabilities in business performance and provide practitioners with actionable guidance for IT growth, acquisition and implementation decisions. [7, 8, 11-13]. In the same way, it indicates that the market advantage of the capacity is to optimize the profit within an enterprise of certain resources and skills (Management capacity and organizational capabilities, for example) [7, 8, 12]. It is generally accepted that IT can not generate market value on its own and must communicate and integrate with other IS and organizational variables to affect success [7, 8, 12]. Since business performance depends on an optimal match between internal organizational frameworks and external influences, companies should develop various levels of strategies to fit Their corporate capital for the simultaneous misuse of market opportunities and risks from the exogenous setting [7, 8, 11-13]. Therefore, it is expected that further analysis of the mediating impact of business process capabilities on the output relationship of IT capabilities would provide valuable insights. This paper explores the potential mediating effect of the capabilities of business processes in an integrated way and the moderating effects of environmental influences on the market value of IT capabilities to address the gaps in existing knowledge [11-13]. Nonetheless, few empirical studies have explored possible ties between IT capability, capability for business processes, and company efficiency. [11-13]. Recent studies support the idea that external environmental factors such as volatility, dynamism, and unpredictability rely on the effect of IT capability on company production. [7, 8, 11-13].

TABLE I. THEORETICAL FOUNDATION THAT SUPPORTS THE FORMATION OF NEW MODELS

Theoretical Basis for Supporting New Models	References
IPO theory	[24, 25]
IT Capability Model (Input)	[13]
IS/SFPA Success Model (Process dan Output)	[22, 26]
Procession and causal models' expansion	[27-30]

III. RESEARCH METHOD

Research on the formation of this new model skips several stages as illustrated in Figure 1. The researcher conducts a literature review (S1) to support research programs and initiates supporting models and theories. Next step Researchers begin to build a new model (S2) whose stages consist of assumption development, model adoption, model combination, and model adaptation, to produce the model draft. The next stage is operationalization (S3) which determines variable definition, indicator definition, and question development. The last stage is reporting.

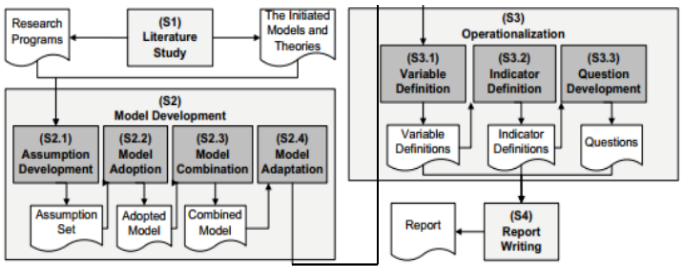

Fig. 1. The research procedure [31]

IV. RESULTS AND DISCUSSION

By integrating Chen's IT Capability model [13] with SFPA Project Success adopted from IS Project Success DeLone [22, 26] is generated as shown in Figure 2.

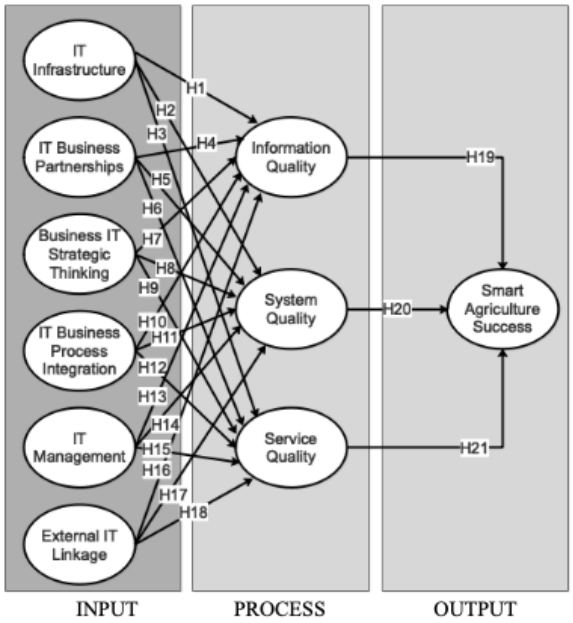

Fig. 2. The proposed IT capability and IS/SFPA success model

In the Input section which is an IT Capability model is an exogenous variable consisting of IT Infrastructure (ITI), IT Business Partnerships (ITBP), Business IT Strategic Thinking (BITST), IT Business Process Integration (ITBPI), IT Management (ITM), and External IT Linkage (EITL). While the process and output parts are endogenous variables that adopt from IS Project Success consisting of Information Quality (IQ), System Quality (SQU), Service Quality (SEQ), and Smart Farming Precision Agriculture (SFPA) Project Success variables.

TABLE II. PROPOSED HYPOTHESIS

H	Variables Relationship	Previous Research That Supports Hypothesis Forming	Ref.
1	ITI-IQ	Studies validate an expanded paradigm of acceptance of technology that combines IQ and support from top management. The findings confirm that through perceived external influence, perceived ease of use, and perceived utility, IQ influences behavioral purpose and use of text mining tools; top management	[11, 32, 33]

H	Variables Relationship	Previous Research That Supports Hypothesis Forming	Ref.
		support also has a key role in deciding the use of text mining tools. Another study aims to enhance the awareness of the characteristics of versatile IT infrastructure associated with the efficient implementation of the construction industry by defining the crucial success factors involved in providing the construction industry with IT Infrastructure Flexibility.	
2	ITI-SQU	There is a study on the ongoing challenges of deciding what IT capabilities should be built to ensure IT performance, highlighting the IT performance paradox and proposing that businesses handle this paradox by creating capabilities of IT ambidexterity. Other study includes rare studies of the efficient implementation in the public sector of these schemes to encourage more government agencies to introduce Citizen Relationship Management systems to increase their productivity and provide people with more creative, efficient, and effective services, leaving us with an almost unexplored field of research.	[34, 35]
3	ITI-SEQ	Since success in information technology (IT) is so critical and difficult to understand, researchers and practitioners face the ongoing challenge of deciding what IT capabilities should be built to ensure IT success, researchers highlight the IT success paradox and suggest that businesses handle this paradox by developing IT capabilities of ambidexterity. Researchers hypothesize that IT ambidexterity capabilities increase IT performance and that this relationship is improved by an unpredictable climate and leads to the conceptualization of IT performance paradoxes and the development of theory for a more detailed understanding of the effect of IT ambidexterity capabilities. On the other hand, information management management organizations are increasingly concerned with their ability to co-create digital services with business network customers. However, practitioners and researchers lack an understanding of which organizational structures contribute effectively to the practice of organizational innovation in IS. Researchers hypothesize, based on the prevailing service logic, that process reference frameworks, such as the IT Infrastructure Library (ITIL), serve as organizational structures through their specifications, rules and practices, enhancing the capacity of IS organizations to innovate digital services.	[11, 14, 34]
4 5 6	ITBP-IQ ITBP-IQ ITBP-SEQ	The resulting mathematical models can be used to make predictions and plans for the future implementation of information technology and to provide an overview of how to use factor analysis and regression analysis approaches to measure the performance of the application of information technology in an enterprise. The concept was derived from the IT Balanced Scorecard (IT BSC) theory, which was derived by constructing each of the current perspectives to obtain indicators which were then used as a research instrument in the form of a questionnaire. The results of the study show that four factors affect the efficiency of IT implementation, namely: IT competence, IT service capability, business continuity, and IT enhancement.	
7 8 9	BITST-IQ BITST-SQU BITST-SEQ	There is a thesis that incorporates IT capacity analysis into the Relational Model Theory. A description of the effect function of the social capital of an organization on the building of IT capabilities was sought by applying RMT. Four basic modes of the relational model are suggested by RMT. The relationship between	[36, 37]
		structural, social, and cognitive capital that underlies IT capabilities is clarified by this relational model. His findings indicate that the chosen relational model may promote IT capabilities or cause and undermine conflict.	
10 11 12	ITBPI-IQ ITBPI-SQU ITBPI-SEQ	There is a study aimed at identifying the determinants of the effectiveness of the adoption of cloud computing and further exploring how the effectiveness of cloud computing affects the performance of companies. The conceptual framework developed by researchers is focused on the incorporation of many literature strands into business studies and information systems. The findings showed that the performance of cloud computing was significantly influenced by end-user satisfaction, knowledge quality, system quality, managerial information technology (IT) capabilities, and IT technological capabilities. In addition, cloud computing 's growth has a powerful and beneficial influence on business results. This study is one of the few attempts to combine multiple theoretical frameworks (i.e. IT capabilities and resource-based opinions, the theory of confirmation expectations, and the theory of success of information systems) to build a systematic model for understanding the primary determinants of success and performance effects of cloud computing. This research also makes a valuable contribution to the literature and Its management methods of traditional IS.	[38]
13	ITM-IQ	A core focus of inquiry in the field of information management is the characterization of IT works in organizations. The main objective of these studies is to forecast the IT function's contribution to organizational success by focusing on the primary determinants of IT centrality and IT management profile. A cross-sectional study of CIOs employed in Canadian hospitals showed that the strategic focus of the IT management model is positively influenced by IT centrality. In turn, the stronger the IT management models strategic focus, the greater the IT functions contribution to organizational success.	[39]
14 15 16 17 18	ITM-SQU ITM-SEQ EITL-IQ EITL-SQU EITAL-SEQ	The effectiveness of information technology (IT) in other studies is very critical and challenging to understand, and researchers and practitioners face the ongoing challenge of deciding what IT capabilities should be built to ensure IT effectiveness. Based on the theory of paradox and ambidexterity, we illustrate paradoxes in the performance of IT and recommend that businesses handle this paradox by creating ambidexterity capabilities for IT. We hypothesize that IT ambidexterity capabilities improve IT performance and that this relationship is enhanced by an unpredictable climate. This research leads to the conceptualization of Its success paradoxes and to the development of the theory for a more detailed understanding of the effect of the capabilities of IT ambidexterity.	[34]
19	IQ-SAS	Failures in applications are currently dominant in information systems and software engineering studies. Device failure rates, and high user frustration with the absence of an acceptable structure that can be used in context as a measure of performance. With mixed outcomes in assessing the systems success. By proposing the characteristics of a quality framework appropriate for the purpose and context of designing a new system quality framework to assess the performance and quality of the system, based on the adaptation of DeLone and McLean, ISO 25010, and TAM. In another debate, if predetermined completion	[26, 40-42]

H	Variables Relationship	Previous Research That Supports Hypothesis Forming	Ref.
		time, scope, and costs are enforced, a project is assumed to be successful. The mentioned research seeks to decide how project stakeholders perceive the progress of a project in the field of information systems (IS). This study identifies ten IS project performance (SM) measures: scope of the project, project schedule, project expense, quality of project management, system quality, user satisfaction, quality of knowledge, quality of service, use of the system, and net benefits.	
20 21	SQU-SAS SEQ-SAS	In another debate, if predetermined completion time, scope, and costs are enforced, a project is assumed to be successful. The mentioned research seeks to decide how project stakeholders perceive the progress of a project in the field of information systems (IS). In order to evaluate the performance and readiness of each SI in the public sector, other studies have assumed that measuring the information system (SI) is essential. The findings suggest that to further validate the proposed model, the survey instrument can be relied on to perform real empirical studies.	[26, 41, 42]

Following Figure 2 and Table II, 21 hypotheses were generated from the integration of the two models supported by information processing theory [24, 25] and processional and causal models' development [27-30]. Regarding the list of variables along with the definitions presented in Table II. Table III represents a list of indicators and their definitions, and Table IV represents a list of questionnaire statements.

TABLE III. VARIABLES AND DEFINITIONS

Var	Definitions
ITI	The degree about foundation or framework that supports a system or organization.
ITBP	The degree about IT business with many owners, each of whom has invested in the IT business.
BITST	The degree about thinking Strategically about IT Business
ITBPI	The degree about the process of integrating IT Business Processes
ITM	The degree field of management that manages information technology resources by company needs.
EITL	The extent to which external organisations, such as clients, suppliers, universities or research organizations, provide information on technology, for example.
IQ	The level of knowledge provided by the SFPA consistently complies with user requirements.
SQU	The level to define the content of the SFPA quality.
SEQ	The level of SFPA services that its users will benefit from.
SFPAS	The degree of progress of SFPA project development.

TABLE IV. INDICATORS AND DEFINITIONS

Indicators	Definitions
Data Architectures (ITI1)	The suitability of the data architectures
Network Architectures (ITI2)	Suitable network architectures
Architecture Flexibility (ITI3)	Suitable for architectural versatility
Workgroup (ITBP1)	Multidisciplinary teams to integrate market and technology know-how
Relationship (ITBP2)	IT Service Provider and Management Partnership
Initiatives (ITBP3)	Level management funding of information technology programs
Risk Management (ITBP4)	An environment which encourages risk-taking and IT experimentation
IT Project (ITBP5)	Weather championship supporting IT ventures
Consistency of IT Application (BITST1)	IT product portfolios are compatible with the company processes
Opportunities for business (BITST2)	Restructuring market processes to leverage opportunities
Opportunities for IT (BITST3)	IT job cycle optimization to exploit incentives
IT Contributes (ITBPI1)	Clarity of vision and IT relates to company success
Integrated (ITBPI2)	Integration of strategic business and IT planning
Understanding (ITBPI3)	The capacity of management to consider the importance of the IT investments
Effectiveness (ITM1)	Efficient in IT preparation
IT Project Management (ITM2)	Management strategies for IT ventures
Disaster Recovery (ITM3)	Planning for security control, standard compliance, and disaster recovery
System Development (ITM4)	System development practices
Consistency of IT policies (ITM5)	Consistency of IT policies throughout the enterprise
Evaluation (ITM6)	IT evaluation and control systems
Customers links (EITL1)	Technology-based links with customers
Suppliers links (EITL2)	Technology-based links with suppliers
External Collab (EITL3)	IT-based entrepreneurial collaborations with external partners
Accuracy (IQ1)	Conformity of SFPA-generated knowledge with real standards.
Timeliness (IQ2)	The consistency of information processing by SFPA over the planned duration.
Completeness (IQ3)	Data created by SFPA is absolutely or without missing parts.
Consistency (IQ4)	The degree of propensity of SFPA to continue to display the same information, or price, in service.
Relevance (IQ5)	The relevance of the information given by the SFPA to the subject.
Ease-of-use (SQU1)	The degree of independence of the SFPA from difficulties and problems when using it.
Maintainability (SQU2)	The degree is related to the ease of management of the SFPA.
Response time (SQU3)	The level is related to the amount of time that the SFPA will need to respond to the consumer's instructions.
Functionality (SQU4)	Associated with the SFPA it is possible to function exactly as expected.
Safety (SQU5)	The SFPA immune from an attack, danger, or unforeseen injury.
Responsiveness (SEQ1)	SFPA reaction to representing its customers in the correct manner, time, and circumstance.
Flexibility (SEQ2)	The degree to which the SFPA adapts to support its users according to the demands necessary.
Security (SEQ3)	An integrated level of security for SFPA to be protected from attacks.
Functionality (SEQ4)	The degree is related to the scope of SFPA programs by functional criteria.
Extension (SEQ5)	The degree is related to the level of additional SFPA services.
Creativity (SFPAS1)	Degree correlated with innovation promotion
Benefits (SFPAS2)	The degree correlated with advantages
Problem solve (SFPAS3)	The standard of solving problems associated with

TABLE V. THE QUESTIONNAIRE STATEMENTS

Statements of the Questionnaire
ITI1-SFPA is compatible with data architecture
ITI2-SFPA is compatible with network architecture
ITI3-SFPA is quite flexible in architecture
ITBP1-The multi-disciplinary team is involved in combining business and technology expertise
ITBP2-Line management and IT service providers always work together
ITBP3-Sponsors always take the initiative regarding IT
ITBP4- A environment that promotes risk-taking and IT help experiments
ITBP5-IT project championships always maintain the climate
BITST1-IT application portfolio with consistent business processes
BITST2-Opportunities are often improved by reforming company job processes
BITST3-Restructuring of IT job processes often take advantage of opportunities
ITBPI1-The vision of how IT contributes to business value is very clear
ITBPI2- Company strategic planning is combined with IT planning.
ITBPI3-Management's ability to understand the value of IT investment
ITM1-IT planning is very effective

Statements of the Questionnaire
ITM2-IT project management is implemented
ITM3-Safety controls and disaster recovery are implemented
ITM4-System development practices are implemented
ITM5-IT policies throughout the company are very consistent
ITM6-IT evaluation and control systems are implemented
EITL1-There are technology-based links with customers
EITL2-There are technology-based links with suppliers
EITL3-IT-based entrepreneurship collaboration with external partners exists
IQ1-Information is reliable.
IQ2-Data on time.
IQ3-The knowledge is generated without having less left.
IQ4-Truly reliable knowledge
IQ5-User expectation knowledge.
SQU1-SFPA is simple to use.
SQU2-SFPA is simple to maintain.
SQU3-SFPA is easy to react
SQU4-SFPA can execute any task
SQU5-SFPA is free to run
SEQ1-SFPA delivers very quickly on its services.
SEQ2-SFPA is very versatile in offering their services.
SEQ3-SFPA provides stable service.
SEQ4-SFPA provides services that meet the requirements of instruction.
SEQ5-SFPA offers services to meet the requirements of a feature.
SFPAS1-SFPA helps improve innovation
SFPAS2-SFPA accounts for the advantages
SFPAS3-SFPA helps to fix any problems

From Table III, the variables were defined and continued to decrease to several indicators based on the references involved. Table IV is an indicator and its definition which is derived from the outcome variable from combining the two models. After the variables and indicators are defined, it is lowered into a list of statements that will be used as questions in the use of the questionnaire required in the analysis and data collection process (Table V).

As far as the viewpoints of the model turn of events, the investigation shows two featured focuses, i.e., the trust and legitimacy issues. To put it plainly, it very well may be unmistakably observed that the lucidity of the model improvement process study may demonstrate the trust purpose of the turn of events. The perusers can perceive how the creators utilize the improvement suspicions, receive the IT capability [13] and IS/SFPA Project Success models, consolidate the two models, and adjust the factors, markers, and questions, regarding the framework use, builds [22, 26]. In outline, the straightforwardness of the model advancement process and the levelheadedness of the created model may two commitments to the investigation. Along these lines, it is suggested that other than the assessment studies may in any case be should have been accomplished for surveying the model and its exploration instrument, the restrictions will likewise turn into the thought focuses for the future works. On the opposite side, it might likewise evident that the utilization of the other getting, presumption, and viewpoint focuses will show the diverse model recommendations.

V. CONCLUSION

After conducting a literature review and the stages in the formation of a new model, the relationship of each variable in the IT Capability and IS Project Success models can be understood and produces 21 hypotheses that are useful for the needs of analyzing the success of implementing SFPA. For the investigation restrictions around the getting, presumption, and viewpoint issues of the creators; other than the constraints are prescribed to be the thought focuses for the future works, the proposed model, and its instruments are likewise prescribed to have proceeded into the assessment stages. The writers propose a mixed model by incorporating the six factors of the IT Capability model and the four factors of the IS/SFPA Project Success models, as far as SFPA Project Success evaluation. The investigation tells the best way to comprehend the connection between the elements of the IT Capability and SFPA Project Success develops as far as the utilization of an SFPA and how to join the status and SFPA Project Success models regarding the framework use. The formation of a new model will contribute to the SFPA developer in determining user needs with the help of the IT Capability model, especially in rural areas, so that in terms of time and costs will be minimized.

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