

Towards A New Maturity Model for Information System

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Abstract

Information System has become a strategic lever for enterprises. It contributes effectively to align business processes on strategies of enterprises. It is regarded as an increase in productivity and effectiveness. So, many organizations are currently involved in implementing sustainable Information System and, a large number of studies have been conducted during the last decade in order to define the success factors of information system. Thus, many studies on maturity model have been carried out. Some of these studies are referred to the maturity model of Information System. In this article, we report on development of maturity models designed specifically for information system. This model is based on three components derived from Maturity Model for Information Security Management, OPM3 for Project Management Maturity Model and processes of COBIT for IT governance. Thus, our proposed model defines three maturity stages that incorporate a strong Information System to support objectives/goals of organizations. It provides a very practical structure with which/that enables to assess and improve Information System Implementation.

Keywords: Information System, Maturity Models, Information Security Management, OPM3, IT Governance.

I. Introduction:

In recent years, the world has undergone rapid changes due to technological advances. In order to be the winner in this race, firms and companies should be more active and powerful [1]. Therefore, many companies today use information as a basis to increase productivity, producing quality products, providing quality services, creating customer confidence, and making timely decisions [2]. In this context, Information systems have been the greatest force for productivity improvement in the last half century [3].

IS (Information Systems) are a key component for any organization [4]. It Collects, processes, stores, analyzes and disseminates information for a specific purpose [5]. An **information system (IS)** is a system composed of people and

computers that processes or interprets information [6][7][8]. An Information System is a man-made system that facilitates an organization's operational functions and supports management decision making by providing information that managers can use to plan and control the activities of the firm [9].

Information systems (IS) are strategic in so far as they are used to realize strategic intent [10]. Therefore, it's necessary to be aware of the role that an information system in the company plays and its impact on individual processes [11]. So, information system can help you make better decisions by delivering all the information you need and by modeling the results of your decisions [12]. An information system provides each user the information he needs to make decisions or take actions [13]. It (Information system) directly contributes to performance, efficiency and profitability of freight forwarders and logistics companies in the process of forwarding and logistics products [14]. Through IS, companies could squelch competition, secure suppliers, obtain customer loyalty, and reduce the threat of new entrants [15]. Moreover, some of the benefits business organizations seek to achieve through information systems include: better safety, competitive advantage, fewer errors, greater accuracy, higher quality products, improved communications, increased efficiency and productivity, more efficient administration, superior financial and managerial decision making [16].

However, Implementation of information systems is usually resource intensive, but the results are often less than satisfactory. The industry is full of horror stories where, after spending millions of dollars and enduring protracted delay, organizations are forced to abandon an IS project. Even if a system is delivered on time and within budget, it is not guaranteed that it will be used or liked by its intended users; nor will it achieve the expected benefits [17].

In this context, our study aims to develop a maturity model, specifically dedicated to the area of Business Information Systems, which can be used easily and objectively to measure the current maturity of any Information System that supports Business. We give a new approach that may better identify, explain, and improve IS assessment. Also, our research is conducted to identify determinants of success of information systems implementation.

In this article, we proposed a new maturity model for information system, which is based on three components. The first is derived from Maturity Model for Information Security Management created by O. Matrane and M. Talea. The second is OPM3 for Project Management Maturity with some recommendations dedicated to the Small and Medium-Sized Enterprises. And the final component is derived from processes of IT governance.

II. Maturity Models:

The concept of maturity models is increasingly being applied within the field of Information Systems (IS), both as approach for organizational development [18, 19, 20] or as means of organizational assessment [21, 22].

Maturity model (MM) acts as a structured framework for the revolutionary growth of performance within projects or programmes in organizations. It helps in assessing the organizational strengths and weaknesses and in bringing the organization to the next level of maturity or achievement in accordance to the goal to be achieved [23].

Maturity models have become an important topic in both Information Systems (IS) research and practice [24]. In practice, international consortia, software companies, and consultancies have developed a huge number of maturity models during the past few years [25] [26] [27]. One of the most prominent examples is the Capability Maturity Model Integration (CMMI) [28], which has already been used in about 3,000 companies [29].

Maturity describes a “state of being complete, perfect or ready.” [30]. To reach a desired state of maturity, an evolutionary transformation path from an initial to a target stage needs to be progressed [31]. MMs are used to guide this transformation process. More than a hundred MMs have been published in the field of IS up to date [32, 33]. As these high numbers led to a certain arbitrariness of the design process [32, 33, 34], methods for the design of MMs were developed.

III. Project Management Maturity Model P3M:

The Project Management Maturity Model (P3M) is a formal tool used to assess, measure and compare an organization’s own practices against best practices or those employed by competitors, with the intention to map out a structured path to

improvement [35]. Besides, the assessment of the Project Management Maturity (PMM) level shows the company how good it is at managing projects [36]. In general, the purpose of the Project Management Maturity Model is to improve the enterprise’s efficiency by identifying, analyzing, and by optimizing the processes governing the work. The Project Management Maturity Model allows assessing how the work is organized and improves existing practices [37]. The Project Management Maturity Model is considered as tool to evaluate the performance of organizations in project management [38].

IV. Maturity Models for Information Security Management 2MISM:

2MISM includes a series of processes for systematically establishing, documenting and continuous managing procedures to improve the safety and reliability of the assets of an enterprise, and for realizing information confidentiality, integrity and availability which are the goals of information security, and includes the continuous enhancement of information security [39]. It (2MISM) consists of processes, procedures, and resources that can be software. It does not provide a method for assembling the necessary information or a pattern on how to structure that information [40].

In the literature, there are many 2MISM standards widely used for information security, such as; ISO27001, BS 7799, PCIDSS, ITIL and COBIT, Which are imperatively integrated in organizations to effectively, manage their information security [41]. This standard aims to establish, implement, monitor and improve the effectiveness of an organization’s ISMS [42], and provides a model for “establishing, implementing, operating, monitoring, reviewing, maintaining and improving an Information Security Management System (ISMS) [43]. Besides this, it can help you make intelligent security investments, quickly react to changes within IT and keep your business secure [44].

V. Governance IT:

IT governance is an integral part of corporate governance and addresses the definition and implementation of processes, structures and relational mechanisms in the organization that enable both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value from IT-enabled business investments [45]. It is (ITG) defined as the processes that ensure the effective and efficient use of IT in enabling an organization to achieve its goals [46].

IT Governance has been defined by the ITGI “IT governance is the responsibility of the board of directors and executive management. It is an integral part of enterprise governance and consists of the leadership and organizational structures

and processes that ensure that the organization's IT sustains and extends the organization's strategy and objectives" [47]. To achieve success in this information economy, governance of IT is a critical facet of enterprise governance. Therefore, the IT Governance Institute (ITGI) exists to help enterprise leaders understand why IT goals must align with those of the business, how IT delivers value, and how its performance is measured, its resources properly allocated and its risks mitigated. ITGI's original research helps illuminate global perspectives and practices relating to the use of IT in enterprise [48].

VI. Maturity Models for information system in enterprises:

Over the past years, a wide range of maturity models have been developed by practitioners as well as academics for the purpose of measuring and prescribing certain aspects of information systems "maturity" [49]. And Since the Software Engineering Institute has launched the Capability Maturity Model almost twenty years ago, hundreds of maturity models have been proposed by researchers and practitioners across multiple application domains [50]. Some of this maturity models are shown in literature and applied to various fields such as Project Management, SPICE, People, Testing Organization, Data Management, Helpdesk, Systems Security Engineering, and so on [51]. Besides, Literature overview shows that models for different domains evolve gradually, that these same models are improved and changed over time and that authors often build and improve their models based on the past experience of other authors [52]. However, in literature, there is a few of maturity model for information system which is not applied in enterprises. Besides, despite the growing number of IT investments, there is a lack of attention in the literature on how to govern IT investments effectively [53]. Therefore, and Based on the literature review, there seems to be a lack of researches in the field of Information System and maturity models in enterprises. Hence, there is a need for a model that assesses the maturity of information system.

In this context, many studies suggest that high information systems effectiveness is associated with high organizational performance. While research measuring the success of information systems has proliferated, models, measurements, definitions, and perspectives, it employs vary greatly, leading to little consensus on how to measure IS success [54]. So, Information systems are vital to the operation and management of every organization. Managers who invest large amounts of money and other resources in information systems often do not know which information systems applications will benefit the organization [55]. Therefore, we introduce in this article a new maturity model for information system in organizations that contributes to improve the performance and the processes of Enterprises' business.

Purpose of the paper is to extend current knowledge and understanding of Information system into the context of

maturity model. In particular, the paper aims to develop a new approach to improve the performance of information system based on Maturity model for information security management, Project Management maturity model, and governance of information system.

We created a new maturity model for information system in order to identify and explore the strengths and weaknesses of Information System (IS) initiatives, managers in charge need to assess the maturity of their IS. So with the new Technologies and Practices, we explore new approaches which may better identify, explain, and improve IS assessment. It encourages successful IS implementation in organizations [54]. Based on this new maturity model for IS, we seek to achieve through it include: better safety, competitive advantage, fewer errors, greater accuracy, higher quality products, improved communications, increased efficiency and productivity, more efficient administration, superior financial and managerial decision making [54]. Also, we seek to help the managers to design, build and implement information systems that accurately reflect the flow of the business processes in their organization, adjust quickly to support critical functions and provide efficient and effective value added services to employees to maximize the profitability of the company [56]. Our new model of maturity offers the opportunity to explore the potential of information system in enterprise.

The structure of our maturity model is built upon the following four dimensions:

1) Maturity level dimension:

- *Level 1 (initial)*: there is no process area and process is chaotic.

- *Level 2 (defined)*: is the level where implementation processes are documented, standardized, and integrated into a standard implementation process for the organization.

- *Level 3 (managed)*: Process and activities are controlled and managed based on quantitative models and tools.

2) Maturity Model for Information Security Management.

3) Maturity Model for Project Management.

4) Governance of Information System.

Maturity Model for Information System gives the possibility for managers of organizations to see where it stands and how it can improve its information system. Thus, it provides a methodology for an organization to develop an improvement roadmap to its Information System.

VII. Component 1: Project Management maturity Model OPM3:

There are many maturity models like OPM3, CMMI, P3M3, PRINCE, BPMM, and Kerzner's Project Management Maturity Model etc. These models are different from each other in terms of their factors and characteristics and also there is no standard related to these models. And accordingly to study of M. Khashgoftar, he has compared the models and the result shows that OPM3 is a more suitable model than

others [57]. OPM3 focuses on the comparison of organizational activities to best practices, defined by PMI as the optimal method of meeting a particular stated objective [58]. Besides, OPM3 assesses best practices in Project, Program and Portfolio management by analyzing:

- Capabilities* – Presence of specific organizational activities that have been identified as part of a best practice.

- Outcomes* – The beneficial results that organizations obtain from performance of those activities.

- Key Performance Indicators (KPIs)* – Measures that are used to determine the existence and strength of a capability.

Organizations can then be classified into four stages of development in each process area at the Project, Program and Portfolio level:

- 1) Standardize: Structured processes are adopted.
- 2) Measure: Data is used to evaluate process performance.
- 3) Control: Control plan developed for measures.
- 4) Continuously Improve: Processes are optimized.

However, the existing Project Management maturity models are only for one single organization and cannot deal with the specific problems of each enterprise. So, based on the literature review O. Matrane and al. they have found that the majority of companies don't have a process management. For example, in the Small and medium Moroccan enterprises, near of 80 % are on the level 1 of maturity of project management. Only 11 % of companies can be on the level 2. Therefore, they recommend that organizations have to focus their efforts on the process of project management to improve it. The managers must pay more attention for the concept of project management. And, manager of enterprises must be involved and give more importance to project management methods [59].

As result and according to the literature review, we based our component on the Project Management Maturity Model OPM3 and recommendations of O. Matrane and al.

VIII. Component 2: Maturity Model for Information Security Management:

For the second component of our new maturity model for information security, we suggest the Maturity Model for Information Security Management of Matrane and al. It is considered as tool, intended to assess the degree of maturity of organizations, in the ability to meet the objectives of security, namely, confidentiality, integrity, and availability, while preventing attacks and achieving the organization's mission despite attacks and accidents. We aim by this new maturity model to help effectively all type of organization, to implement simply this model in their business strategies. It can be seen as a high-level roadmap for large organizations. The proposed model is built essentially on the following three dimensions:

- 1) Maturity level dimensions for CSF:

- *Level 1 (initial)*: there is no process area and process is chaotic.

- *Level 2 (defined)*: is the level where Information System processes are documented, standardized, and integrated into a standard implementation process for the organization and managed based on quantitative models and tools.

- *Level 3 (managed)*: Process and activities are controlled and managed based on quantitative models and tools.

- 2) Standard life cycle stages of Information Security Management.

- 3) The critical success factors (CSFs) of RSA Framework.

The new maturity model for information security management is composed of 5 distinct phases that encompass historical practices and future aspirations. It is called The 5 Managements (5M) of information security.

- **Level 1** → Business Management: This is to synthesize the key objectives and resources that must be protected to achieve them. This allows to integrate the security into all the processes and structures and to support external requirements (regulatory compliance, etc...) and internal (business lines, policies, etc...).

- **Level 2**: → Risks Management: This is to quantify the actual level of risk and to bring closer to the acceptable level by the company. This helps to identify, order risk and control project to reduce risk.

- **Level 3**: → Operations Management: This is to evaluate the daily running of security operations and their ability to provide an optimum ratio cost /security. This aligns processes and controls policies to reduce the rate of conversion of risk in incidents.

- **Level 4**: → Incidents Management: This is to assess the ability of the company to respond to security incidents to ensure that the level of risk tolerance is never exceeded. This allows detecting, analyzing, processing and communicating security events to minimize their effects and costs of resolution. It is vital to be able to detect and analyze very quickly for taking appropriate measures to limit its impact.

- **Level 5**: → Problems Management: A 'Problem' is the unknown cause of one or more incidents, often identified as a result of multiple similar incidents. The objective of Problem Management is to minimize the impact of problems of security on the organisation. Problem Management plays an important role in the detection and providing solutions to problems (work arounds & known errors) and prevents their reoccurrence.

Matrane and al. have contributed in creating a new concept of maturity model in information security management. It helps organizations by proceeding through the five levels of Maturity Management, to have a better understanding of where they are and how to proceed. It facilitates the detection and providing solutions to problems of information security in enterprises [60].

And based on the pilot test and the empirical investigation, Matrane and al. have demonstrated the effectiveness of the proposed model of information security management in the organizations. It gives the opportunity to be more effective and efficient in assessing maturity level and developing roadmap [58].

So, we found this maturity model for information security management very suitable for the component of the new maturity model for information security. We considered it as an important part of our new maturity model for Information System.

IX. Component 3: Governance IT

For the second component of our new maturity model for information security, we suggest COBIT (Control Objectives for Information and related Technology) which is currently in its fifth edition, is a good-practice framework for the enterprise governance of IT [61]. COBIT is commonly used framework for developing and evaluating technology intensive information systems. This framework was originally a benchmark of best control practices developed and maintained by the Information Technology Governance Institute, the umbrella organization to the Information Systems Audit and Control Association [62]. COBIT developed by the IT Governance Institute, includes the COBIT Framework 5 which defines 34 IT processes, spread into four IT domains—planning and organization (PO), acquisition and implementation (AI), delivery and support (DS) and monitoring (M) [63].

Based on the literature review and our study of maturity model, we found that the process “Align, Plan and Organize (APO)” and “Monitor and Evaluate (ME) of COBIT 4.1 are very suitable to our new Maturity Model for Information System.

The Process “Plan and Organize (PO)” covers the use of information & technology and how best it can be used in a company to help achieve the company’s goals and objectives. It also highlights the organizational and infrastructural form IT in order to achieve the optimal results and to generate the most benefits from the use of IT. The following table lists the high-level IT processes for the Planning and Organization

domain. So, in this process, we take for the MMIS only the following domains that could be integrated:

Plan and Organize	
PO1	Define a Strategic IT Plan
PO2	Define the Information Architecture
PO3	Determine Technological Direction
PO4	Define the IT Processes, Organization and Relationships
PO5	Manage the IT Investment
PO6	Communicate Management Aims and Direction
PO7	Manage IT Human Resources

The process “Monitor and Evaluate (ME)” domain deals with a company’s strategy in assessing the needs of the company and whether or not the current IT system still meets the objectives for which it was designed and the controls necessary to comply with regulatory requirements. Monitoring also covers the issue of an independent assessment of the effectiveness of IT system in its ability to meet business objectives and the company’s control processes by internal and external auditors. The following table lists the high level control objectives for the Monitoring domain which we integrated in our MMIS.

Monitor and Evaluate	
ME1	Monitor and Evaluate IT Performance
ME2	Monitor and Evaluate Internal Control
ME3	Ensure Compliance with External Requirements
ME4	Provide IT Governance

The suggested Maturity Model for Information System (MMIS) makes possible for an organization to see where it stands and how it can improve its IS. Thus, it provides a methodology for enterprises to develop an improvement roadmap to its IS, making it easier for managers to understand and use this model when implementing improvements. When the component of MMIS reaches a specified maturity level in a process (Key) component, the improvement roadmap includes the next level. If level 3 is reached, the organization must keep it.

Table1: Maturity Model for Information System.

Component Maturity Model For Information System MMIS	Process (Key) component of MMIS	Maturity level 1 (Initial)	Maturity level 2 (Defined)	Maturity level 3 (Managed)
Governance IT	Plan & Organize	The process Plan and Organize are not defined	Some process of Plan and Organize are defined	All process of Plan and Organize are very well defined
	Monitor & Evaluate	The process Monitor and Evaluate are not defined	Some process of Monitor and Evaluate are defined	All process of Monitor and Evaluate are very well defined
Maturity Model For Information Security Management	Business Management	The process Business Management are not defined	Some process of Business Management are defined	All process of Business Management are well defined
	Risks Management	The process Risks Management are not defined	Some process of Risks Management are defined	All process of Risks Management are well defined

	Operations Management	The process Operations Management are not defined	Some process of Operations Management are defined	All process of Operations Management are well defined
	Incidents Management	The process Incidents Management are not defined	Some process of Incidents Management are defined	All process of Incidents Management are well defined
	Problems Management	The processes Problems Management are not defined	Some processes of Problems Management are defined	All processes of Problems Management are well defined
Project Management Maturity Model OPM3	Standardize	The processes are not structured and not adopted	Some processes are adopted and structured	All processes are structured and adopted
	Measure	No data are used to evaluate process performance	Some data are used to evaluate process performance	All data are used to evaluate process performance
	Control	No control plan developed for measures	Control plan is not well defined and developed for measures	Control plan are very well developed for measures
	Continuously Improve	The processes are not optimized	Some of processes are optimized	All of processes are optimized

XII. Contribution:

Based on the literature review, there seems to be a lack of researches in the field of Information System linked to the maturity models. And in our study, we have found that Information System plays a vital role in enterprises. So, we aim by this article to enrich the research area and develop a new approach for organizations to achieve their objectives with effectiveness and efficiency. In addition to that, we contribute by our research to offer to managers, professionals and any person interested in study of Information System a roadmap and models of best practices in order to improve their Information System and to align strategies of enterprise with business process.

By integrating Concept of Governance IT, Maturity Model for Project Management Maturity OPM3 and Maturity Model for Information Security Management, we have developed a new Maturity Model for Information System. It provides a methodology and new concept for enterprises to develop an improvement roadmap to its Information System by reaching specified maturity level.

XIII. Conclusion:

The paper is released to contribute in creating a new maturity model for Information System MMIS. Each component of MMIS and three levels in each process of component have been developed to evaluate and provide a roadmap to improve its ability in deploying an Information System. The new maturity model is considered as tool and a set of best practices that allows identifying, analyzing,

creating and validating the Information System of organizations.

For the future work, we will present an empirical study in order to aid in validating and to demonstrate the effectiveness of the proposed Model of maturity for information system. Hence, we will distribute a survey to different Moroccan organizations to evaluate its maturity and to help it in deployment of Information System. The result will be published in the near future.

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