PROPOSING AN ENTERPRISE GOVERNANCE OF INFORMATION TECHNOLOGY (EGIT) STAGE-BASED MATURITY MODEL (MM) DEVELOPMENT METHODOLOGY FOR ARAB COUNTRIES

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Developing and using Maturity Models (MMs) is an important topic for researchers and practitioners due to the importance of achieving enterprise goals in a measurable manner. In developing countries like Middle East and North Africa Region (MENA) region and especially Arab countries, Enterprise Governance of Information Technology (EGIT) plays a greater role in achieving new strategic visions set by emerging economic developing countries which have EGIT limited assigned resources, lack of EGIT knowledge, and higher levels of risk. Although there are many MMs for Information Technology (IT) and EGIT, we could not find any adopting stage-based maturity measurement technique. This study proposes an easy-to-use and scientifically developed EGIT MM development methodology which can develop stage-based MMs. This study is following an experimental approach by using the proposed EGIT Stage-based MM development methodology to develop an EGIT stage-based MM which is deployed and tested in three firms. The proposed MM development methodology will enable researchers in developing countries to build and use scientific EGIT stage-based MMs that can support organizations to measure their compliance to the diverse EGIT respective regulations easily while adapting with their local context needs. The participating firms provided evaluation of the tested MM depicting its value in measuring EGIT compliance.

Keywords: Maturity Model, EGIT, Information Technology Service Management (ITSM), Information Security Management, Business Continuity Management and Compliance Management.

1. Introduction
A specific need for EGIT MMs in Arab developing countries in the MENA region was detected in our last publication, Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region[1], we covered the characteristics of the

MENA region and the existing need for an EGIT MM based on developing, publishing, and analysing two questionnaires [2] and [3] among participants in the same field and related fields. Organizations in MENA are becoming more interested in EGIT, as we discovered that approximately 80% of organizations are trying to implement or have already implemented an EGIT MM based on the questionnaire. These organizations need an MM that enables them to measure their EGIT maturity and guide them in improving their performance to achieve their goals and comply with emerging regulations as the types of fines and impacts vary and, in many cases, are intolerable including large amounts of money and imprisonment, while optimizing resources and risks. None of the MMs examined in this research has a stage-based measurement technique. Therefore, we decided to develop a scientific methodology dedicated to developing stage-based MMs that can be used for EGIT MMs too.

In this study, we present the development and evaluation stages which are the second and third stages which are "MM development and MM evaluation" of our five-stage scientific stage-based MM development methodology that is developed based on Becker et al. procedure model for developing maturity models [4]. While our last publication Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region [1] covers the first stage which is "MM assessment". It is a scientific methodology dedicated to developing stage-based MMs and backed up by a well-known research methodology called design science research developed by Hevner et al. [5].

Based on the importance of EGIT to corporates regardless of their size or type, and the need to have a simple and easy-to-use MM, our proposed stage-based MM development methodology has the following main advantages:

- Stage-based as the processes and respective aspects which are assessed against one stage will not be assessed again in any other stage.
- Managing MMs whole lifecycle which are divided into five stages.
- Supporting continual measurement and improvement of MMs based on stakeholders' feedback.
- Multi-aspect as it encourages aspects like People and Technology in addition to usual processes.
- Developed using a scientific methodology.
- Easy to measure the actual maturity of an organization even if the achieved maturity is scattered on different maturity levels.

This study aims to develop a scientific methodology for developing stage-based MMs that will enable researchers, practitioners, and organizations in developing countries to improve their EGIT maturity measurement in an easy and affordable manner while helping them comply with emerging regulations.

The remainder of this paper is organized as follows. Section 2 presents the background of this study. Section 3 presents the research framework of the proposed MM development methodology. Section 4 presents the results of evaluating the MM development methodology. Section 5 presents conclusions and suggestions for future work.

2. Background

2.1. MMs

Becker et al. [6] defined maturity Models (MMs) as techniques developed and used to determine the level of performance, capability, or maturity of a process or organization. de Bruin et al. [7] defined maturity itself "as a measure to evaluate the capabilities of an organisation in regard to a certain discipline". Becker et al. [6] defined MM as "conceptual models that outline anticipated, typical, logical, and desired evolution paths towards maturity". They are used to discover strengths and weaknesses to enable organizations to define deficiencies or opportunities for improvement. They are also used to determine maturity targets and how to reach them.

In our research [1], we found that more than 150 MMs were developed and published in the last few years, as stated by de Bruin et al. [7], to support the IT management field. We also examined how Becker et al. [6] conducted research as they searched ten scientific databases by using a maturity model keyword search and found that during the period from 1994 to 2009, more than one thousand academic articles dealing with MMs. However, when they narrowed their research by searching only 19 pure IS journals, they found only 20 articles that focused on MM. There is no clear scientific guidance or methodology on how to develop or evaluate an MM. Therefore, we consider Becker's procedure model [4] to be the greatest source of guidance for developing any MM because of the eight simple and scientific requirements provided.

2.2. EGIT MMs

We assessed the MMs used in the MENA region for EGIT and found that there are two types of them which are academic, and market/commercial based. We analyzed both types and found that there is a need for an EGIT MM that matches the MENA region requirements based on understanding its special context.

In the commercial MMs we found Information Technology Infrastructure Library (ITIL) v3/2011, [8] and [9] for IT Service Management (ITSM), Control Objectives for Information and Related Technologies (COBIT)5/2019 [10], [11], [12], [13] and [14] for EGIT, International Organization for Standardization/ the International Electrotechnical Commission (ISO/IEC) 15504-2 [15] and [16] for process improvement and process capability determination and ISO 19600 which was replaced by ISO 37301 in 2021 for compliance management.

We discovered that for the MENA region, ITIL framework is considered the best one for ITSM while COBIT framework is considered the best one for EGIT. But they still need to be customized to cover Arab countries specific requirements. For ITIL Process Maturity Framework (PMF) [17], that is an ITSM MM which assesses all the processes against each maturity level of its five levels. For COBIT5/2019 process capability scheme which is called COBIT Performance Management (CPM), it is not an easy-to-use multi-purpose EGIT MM for Arab countries as many organizations do not have enough resources to conduct its complex assessment. COBIT5 has only one aspect which is Process and therefore it measures capability and not maturity, other dimensions are still needed. It assesses all the processes against each maturity level of its six levels. It covers four dimensions, and therefore it measures capability for each dimension and maturity for all of them combined. It covers ITSM, information security, continuity, and compliance as processes and not

as dimensions. COBIT5/2019 assessment is considered very complex and time and resource consuming as it assesses each process against each maturity level of its six levels and in each level, there are four ratings which are Not, Partially, Largely and Fully. For a given process to move from one maturity level to the higher one it must achieve the Fully rating of that level. This type of assessment is not affordable for small and midsize organizations. A simpler version tailored for the needs of MENA region is needed to cover its specific needs.

ISO/IEC 15504-2 needs training and experience to be used. It covers one dimension, which is process. It assesses all the processes against each maturity level of its six levels. ISO 19600/37301 standards could be easily used in MENA region due to their straightforward requirements and maturity measurement technique and the increasing number of emerging regulations in the region related to compliance. They cover the compliance dimension.

In the academic-based MMs we covered three different categories. Although the first category which proposes new MMs and the second category which compares among the already developed MMs are important, the last category which is providing guidance on how to develop a MM is very important for our study as we will use its provided guidance in understanding how to develop a scientific MM for the Arab countries.

The first category includes academic MMs like "GoCoMM : A Governance and Compliance Maturity Model" [18], "Toward an IT governance maturity self-assessment model using EFQM and CobiT" [19], "Maturity Model Architect: A Tool for Maturity Assessment Support" [20], "Using enterprise architecture model analysis and description logics for maturity assessment" [21], "IT Evaluation in Business Groups: A Maturity Model" [22], "Information Governance Maturity Model Final Development Iteration" [23] and "An End-To-End Cyber Security Maturity Model For Technology Startups" [24]. These seven publications propose EGIT MMs which cover one dimension and does not have any deployment in the Arab countries or discuss their specific needs. The proposed MM "The development of an IT governance maturity model for hard and soft governance" [25] deals with EGIT MMs from a different perspective by considering assessing soft part of governance which deals with behavior and organization culture and is cared about less than the hard part which deals with processes by providing four domains which are Collaboration, Structure, Process and Behavior. The authors depicted their methodology in another publication "IT Governance Maturity: Developing a Maturity Model Using the Delphi Method" [26]. The lack of EGIT MM simplicity is depicted in "Toward an IT governance maturity self-assessment model using EFQM and CobiT" [27] where the authors propose a self-assessment model based on just one IT governance pillar based on COBIT maturity levels and the Excellence model EFQM. In the research "Measuring the maturity of Information Technology Governance based on COBIT" [28] the authors measured the maturity of just three processes in the Kingdom of Saudi Arabia and discovered that the private organizations have higher levels of maturity than the governmental and semi-governmental organizations. All these publications propose EGIT MM but none of them covers the needs of the Arab countries, including stage-based maturity measurement or multi-dimensional structure.

The second category includes comparisons among available MMs like "Maturity Models for Information Systems - A State of the Art," [29], "Understanding maturity models Results of a Structured Content Analysis" [30] and "Information Security Management Maturity Models" [31]. We used these publications to understand the actual capabilities of the existing EGIT MMs and what they lack to avoid in our proposed MM.

The third category includes guidance on how to develop MMs like "Developing Maturity Models for IT Management" [4], "Design Science in Information Systems Research" [5], "Maturity assessment models: a design science research approach" [32], "What makes a useful maturity model? A framework of general design principles for maturity models and its demonstration in business process management" [33], "Understanding the Main Phases of Developing a Maturity Assessment Model" [34], "A Design Science Research Perspective on Maturity Models in Information Systems" [35] and "Assessing Organizational Capabilities: Reviewing and Guiding the Development of Maturity Grids" [36]. These publications provided us with great guidance in developing our EGIT MM and avoiding deficiencies other MMs have. We have already used two of them to develop our EGIT MM development methodology.

Arab countries are more interested in the commercial MMs instead of the academic ones as they are well-known for available training courses and qualification exams which are not provided by the academic MMs. Therefore, we compare our stage-based MM development methodology with market-based MMs and standards to know if any has stage-based measurement technique and Table 1 depicts how none of them is stage-based.

Table 1. Measurement technique in existing commercial MMs and standards.

References	Measurement Technique
ITIL PMF	Repetitive Non-Stage-based
COBIT 5/2019	Repetitive Non-Stage-based
ISO/IEC 33003/33020	Repetitive Non-Stage-based
ISO/IEC 20000-1	Non-Repetitive Non-Stage-based
ISO/IEC 27001	Non-Repetitive Non-Stage-based
ISO 22301	Non-Repetitive Non-Stage-based
ISO 37301	Non-Repetitive Non-Stage-based
ISO 31000	Non-Repetitive Non-Stage-based

It is worth mentioning that in addition to the main two types of MMs which are academic, and commercial, we found some other references that talk about EGIT in general without targeting measuring its maturity by MMs like "Enterprise Governance of IT, Alignment, and Value" [37] in which the authors cover the basic relationship between business value and EGIT which was released in 2020 after the release of COBIT 2019. The same authors have published a book about the same topic back in 2015 which is called "Enterprise Governance of Information Technology -

Achieving Alignment and Value, Featuring COBIT 5" [38] that covers how to achieve alignment and value from integrating EGIT and business goals based on COBIT 5.

2.3. MM Development and Evaluation Methodologies

In the research conducted by [4], which covered 20 MMs found in 19 pure respective journals, they decided that "Maturity and maturity models have rarely been conceptualised in detail and can be regarded as scientifically underdetermined." In another study conducted by [6], they tried to contact the developers of 51 MM to know the design process they used in developing their MMs, and only a few provided feedback. They also stated that "The authors only rarely reveal their motivation and development of the model, or their procedural methods and the results of their evaluation." [7] stated that "Practitioners and academics have developed numerous maturity models for many domains to measure competency. These initiatives are often influenced by the capability-maturity model. However, no accumulative effort has not been made to generalize the phases of developing a maturity model in any domain."

It is clear now that most of the available MMs have not been developed or evaluated using a scientific development methodology, as stated by Hevner and Becker, among others. We can exclude major commercial MMs, such as CMMI, PMF, and the process capability model.

2.4. Research Gap

We could not find any EGIT MM developed in or for Arab countries that cares about its special EGIT needs and context. What we found was just a group of commercial MMs which were developed in the west and some governmental regulations which are developed in some Arab countries that necessitate compliance like the Saudi National Cybersecurity Authority (NCA) cybersecurity controls which include Essential Cybersecurity Controls, Organizations' Social Media Accounts Cybersecurity Controls (OSMACC), Cloud Cybersecurity Controls (CCC), Telework Cybersecurity Controls (TCC), Critical Systems Cybersecurity Controls (CSCC), Operational Technology Cybersecurity Controls (OTCC) and Data Cybersecurity Controls (DCC) which are applicable to all governmental bodies in KSA. There are also the Saudi Central Bank (SAMA) Information Technology Governance Framework, Cyber Security Framework and Business Continuity Management Framework which are applicable to all banks, insurance companies and finance companies working in KSA. In KSA we still have the Digital Government Authority (DGA), National Center for Archives and Records (NCAR) and National Data Management Office (NDMO) regulators. Other Arab countries have some other regulations like the Egyptian Personal Information Protection Act by the Central Bank of Egypt, Central Bank of Jordan (CBJ), National Electronic Security Authority (NESA) and The Supreme Council for National Security National Emergency Crisis and Disasters Management Authority (NCEMA) in United Arab Emirates (UAE) among many others.

While other regulations are developed out of MENA like General Data Protection Regulation (GDPR) [39] which was developed in European Union (EU) though it is effective worldwide. All these new regulations among others motivate governmental and private organizations in Arab

countries to measure their EGIT maturity for compliance purposes while there is no dedicated MM in the region to support them.

We analyzed both types of EGIT MMs and found that there is a need for an MM development methodology that matches the MM requirements of the developing Arab countries based on understanding their special context, which can be summarized in:

• Lack of processes and their proper documentation
• Lack of a unified MM for measuring enterprise governance and respective goals
• Using different frameworks and standards
• Lack of awareness about maturity measurement importance among different levels of employees.
• Rare use of MM due to their resource and time intensive-consuming nature which many organizations in developing countries cannot afford, especially when there is more than one regulation to comply with.
• Based on the fast emergence of new regulations of IT Governance, cybersecurity, business continuity, data, and privacy, among others, a unified and scientific stage-based MM is needed for maturity measurement and improvement.

For all these reasons, we built our stage-based MM development methodology to develop a stage-based MMs capable of measuring the maturity of Arab countries easily and scientifically. It should be evaluated by developing an EGIT prototype stage-based MM and deploying it in three organizations. The feedback of these participating organizations will be collected and analyzed to measure the actual need for the proposed stage-based MM, and whether it was developed and deployed properly to cover the needs of organizations of Arab countries that need to measure and improve their EGIT. The recommendations of these organizations will be documented and analyzed to make clear plans for improving the proposed stage-based MM development methodology.

3. Research framework
3.1. Research Method

This research adopts an experimental approach which is progressed by developing a prototype EGIT stage-based MM using our stage-based MM development methodology and test it in three organizations. The experiment will cover the needs of the Arab Countries for an EGIT stage-based MM that can cover the newly released EGIT respective regulations.

The design science in Information Systems research introduced by [5] in 2004 has seven guidelines that are used to shape our MM development methodology. Hevner's seven guidelines represent a scientific methodology to follow in Information Systems artifact design.

These seven guidelines cover the requirements of developing a design-science artifact, which in our case is an MM development methodology, starting with designing the MM development methodology that is relevant to a specific problem that does not have any available solution. The design should then be evaluated, and Hevner provided five types of evaluation: observational, analytical, experimental, testing, and descriptive. Although Hevner's design science methodology

can be generically used in information systems, we prefer to use it in the proposed MM development methodology because it has scientific and chronological characteristics that will effectively guide the development process.

Becker et al. [4] introduced a procedure for developing maturity models for management, which is the second reference methodology we use in developing our MM development methodology because of its scientific method for developing MMs, which is considered more dedicated to our research than Hevner's. It provides eight requirements for developing an MM.

The first stage in our five-stage MM development methodology, MM Assessment, covers the problem and context definition, as the development of a new MM should be based on the actual demand in a specific market, and there should be a comparison with similar existing MMs to know what features and components need to be developed or customized in the new one. Therefore, the initial MM development is based on the market exact demand and the weakness of existing MMs. The context of the organizations or region that will be using the MM is a very important aspect to cover at this stage to understand its specific needs, limitations, and challenges.

The second stage, MM development, covers the development of new MMs or the customization of existing MMs based on the need. The first activity in this stage is to review and confirm the required customization components in any existing MM or the needed components and features of a new MM. To customize an existing MM, the required changes will be made. The context of the MM and its purpose shall be determined from the beginning; in our case, the context is based on Arab countries and emerging regulations, while the purpose is to help organizations, especially small and medium ones, measure their current EGIT maturity level and support them in choosing and targeting expected or needed maturity levels. Selected components, including principles, dimensions, processes, and other MM components, should be developed based on a well-determined and defined context and purpose. The development of maturity levels is based on the required number of levels, the complexity of the context, and the potential audience in the future. Measurement techniques that enable the audience to use MM to measure their respective maturity levels should be developed. Then the integration of all components of the newly developed MM or customized MM.

In the third stage, MM evaluation, the evaluation of MM will be offered to a selected group of organizations by providing their top management with the benefits of its implementation. We have got three organizations of different types and nature to widen the scope of the experiment. Organizations that would like to participate in the MM evaluation were carefully selected, and their needs and feedback were collected and analyzed objectively during the evaluation stage. The MM will be implemented in these organizations with the support of top management and respective middle management to measure the level of their EGIT maturity and increase it if required. Measurements will be collected, and the results will be produced based on all stakeholders' feedback. If MM improvement is needed, then the required updates will be implemented by returning to the first stage. If improvement is not required, the fourth stage can be started.

In the fourth stage, MM Communication, MM will be published onto the market with proper guidance to support organizations' management and practitioners. Implementation support will be provided to organizations with less preparedness to enable them to benefit like other organizations with higher maturity and preparedness levels. Feedback will be collected regularly every six months to analyze and decide whether the MM needs any improvement. Being a free MM, that can support many organizations of different sizes and nature, will enable many organizations to use it and provide feedback for evaluation and improvement purposes. If improvement is needed, then the required updates will be implemented by returning to the first stage. If improvement is not required, the fifth stage can be started.

In the fifth stage, MM Retirement, the decision of MM continuation should be made every two years based on the market needs and organizations' feedback. If the MM is no longer needed in the market, then a retirement decision is made. If the MM is still needed, then the provided support to users will continue, and if a new version is needed, then the first stage will be instigated again.
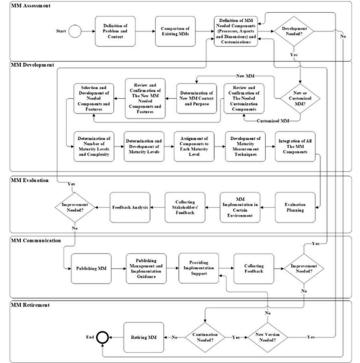

Fig. 1. MM development methodology and lifecycle stages.

3.2. The Proposed MM Development Methodology Evaluation

To evaluate our proposed stage-based MM development methodology, we built an MM dedicated to measuring EGIT maturity in Arab countries and deployed it in three organizations to measure its effectiveness. The proposed MM (Fig. 2) has main components which are principles, pillars, processes, aspects, and stage-based maturity levels. It has five principles, which are basic and core values that any organization should have and maintain to demonstrate compliance with its goals and objectives. It also has four maturity dimensions which are called maturity pillars to be used during any assessment whether it is a first-party, second-party or third-party assessment. These

dimensions enable organizations to use an easy and affordable integrated MM instead of many. Organizations can use one maturity pillar at a time based on their context and needs but to measure EGIT maturity the four pillars should be combined. Each maturity pillar has four stages of maturity which are somehow like other existing MMs already used for many years now. The experimental evaluation approach best suits our MM, and it was used to support us in collecting and analyzing feedback from stakeholders in the participating organizations in the MM evaluation experiment.
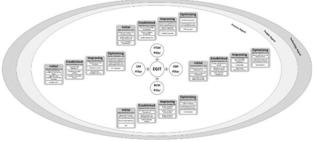

Fig. 2. The Proposed MM Mian Components.

Our MM will measure the EGIT principles, management processes and aspects too.

In Section 3.2.1, the principles are briefly explained, and the maturity pillars and their measurement aspects are explained in Section 3.2.2. The four-pillars four-stage-based maturity levels EGIT MM are covered in Section 3.2.3. The proposed MM interfaces are covered in Section 3.2.5.

3.2.1. Principles

Based on an analysis of the two questionnaires developed, shared, and analyzed in our publication Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region [1], the MM will be built on five principles (Fig. 3) that any organization should have if it would like to continue in the market and remain competitive in the age of disruptive technologies and startups.

Fig. 3. The Proposed MM Principles

3.2.2. Maturity Pillars (Dimensions) and Measurement Aspects

Our MM is based on the concept of multiple dimensions to enable organizations to measure their maturity from different perspectives. The proposed MM has the most necessary dimensions for Arab countries (Fig. 4): ITSM, Information Security Management (ISM), Business Continuity

Management (BCM), and Compliance Management (CM). Simultaneously, there are three aspects of maturity measurement: process, people, and technology (Fig. 5).
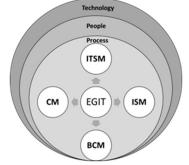

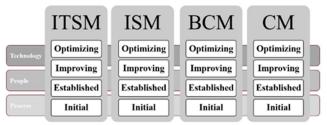Fig. 4. The Proposed MM Pillars (Dimensions)

Fig. 5. The Proposed MM Four-Pillars Four-Stage-Based Maturity Levels EGIT MM

Although the four pillars are essential in measuring organizations' EGIT maturity, technology, people, and processes, three aspects are used to enable the achievement of maturity in each pillar. It is impossible to have actual maturity if any maturity pillar is not built on processes that are effectively and efficiently automated and run by competent people. Therefore, we choose these three critical aspects to be used during the assessment and improvement of an organization's EGIT maturity. Although only four dimensions are chosen, which are the most important, there is still a belief that some organizations may have a special need to add, remove, or change some of these dimensions based on their specific context.

Each process can have one of three achievement levels:
-     N/A, for not achieving the process requirements,
-     P, for partial achievement of the process requirements, and
-     F, for the full achievement of the process requirements.

3.2.3. Four-Pillars Four-Stage-Based Maturity Levels EGIT MM

The prototype MM is a multi-dimension one which has four dimensions (pillars) and four stage-based maturity levels as depicted in (Fig. 6) for measuring organizational governance maturity respective to information and technology. It has been decided not to use the same six maturity levels used in many MMs as it will not be easy for many small or medium organizations to measure all its processes and aspects in four pillars against each level of the six levels. Therefore, we decided to use only four maturity levels and make each level represents a dedicated stage containing a specific group of processes. The four stage-based maturity levels are Initial,

Established, Improving and Optimizing. This is considered one of the three main differences between the proposed MM and all the others. This will enable small and medium organizations to have a simple to use maturity measurement levels without having faraway destinations of maturity which may not be needed for many organizations.

The second one is the difference in the names of the maturity levels by using simple four names which depict the maturity of each level while two of these level names mainly Initial and Optimizing are already used by ITIL PMF, COBIT 5 Process Capability Model and CMMI. The third difference, which is unique, is the introduction of stage-based maturity levels instead of normal maturity levels. Existing MMs assume that an organization cannot reach a specific level of maturity unless it meets all requirements of the previous maturity levels because each level has a different group of requirements for the same process/aspect/component. These requirements are not shared among the maturity levels as they are divided among them starting with the simplest requirements at the starting level, and then the difficulty increases as the maturity levels increases. Our MM does not divide the maturity requirements of each process among different maturity levels, as each process is assessed against only one maturity level. Therefore, all requirements of any given process are included in the maturity level, which includes this specific process. This will enable organizations to safeguard a lot of time and resources to assess and improve their EGIT. Table 2 represents the four maturity stages of the ITSM, ISM, BCM, and CM pillars, respectively, with their respective processes.

This feature can succeed only if the selected processes could be arranged in the four maturity stages properly. This is what we have done by arranging basic and simple processes in the first level of maturity and then more sophisticated processes are assigned to high maturity levels based on clear and logical dependency. Although we consider our order of processes to be logical this does not mean that all organizations implement all the selected processes in the proposed order. Therefore, we recommend measuring all the processes regardless of their assigned maturity stage to have a full image of the organization EGIT maturity. The explanation of the requirements of the MM processes is provided in Supplementary Information SI-1Text depicting the processes and their requirements arranged in respective maturity levels.

Table 2. The prototype MM four pillars, and four stage-based maturity levels with respective processes.

Pillars	Stage-Based Maturity Levels			
	Initial	Established	Improving	Optimizing
ITSM	Organization Context, SM Strategy and Policy	Capacity and Availability Management	Service Level and Business Relationship Management	Portfolio Management
	Incident, Request and Change Management	IT Service Catalogue Management	Release, Testing and Deployment Management	Audit Management and Top Management Review
	Event and Problem Management	Supplier Management	Financial Management	EGIT Integration
ISM	Organization Context, ISM Strategy and ISPs	Network and Teleworking Security	System Acquisition, Development and Maintenance	Outsourced Processes and Supplier Security
	Information Security Risk Management	HR Security and ISM Knowledge Program	Cryptography	Audit Management and Top Management Review
	Information Security Incident Management	Asset and Access Management	Physical and Environmental Security	EGIT Integration
BCM	Organization Context, BCM Strategy and Policy	Business Continuity Risk Management	Business Continuity Communication	Outsourced Processes and Supplier Continuity
	Define Critical Assets	Business Continuity Strategies and Plans	Business Continuity Exercises/Tests	Audit Management and Top Management Review
	BIA	BCM Knowledge Program	Business Continuity Incident Response	EGIT Integration
CM	Organization Context, Compliance Strategy and Policy	Compliance Risk Management	Internal Controls and Procedures	Outsourced Processes and Suppliers Non-Compliance
	Applicable Laws, Regulations and Contracts Definition	Business Compliance Strategies and Plans	Compliance Exercises/	Audit Management and Top Management Review
	Compliance BIA	Compliance Knowledge Program	Managing Non-compliance Incident	EGIT Integration

Each stage-based maturity level covers only three processes, which are not covered by any other level. Table 2 depicts the four pillars and the respective 12 processes of each and how these processes are carefully included in the stage-based maturity level.

3.2.4. Proposed MM Interfaces

The prototype MM will not reinvent the wheel as it uses current MMs, best practice frameworks, and ISO standards, and adds more features and capabilities. The proposed MM merges, integrates, and improves some existing MMs to provide a more efficient and effective MM for the Arab countries. The prototype MM uses the following references:
1. ITIL 2011/v4 and ITIL PMF MM.
2. COBIT 5/2019 and process capability/CPM MM.
3. M_o_R and ISO 31000:2018 [40].
4. PRINCE2 [41] and MSP [42] and P3M3 MM [43].
5. ISO 37301:2021 [44].
6. ISO/IEC 27001:2013 [45], [46] and [47].

7. ISO 22301:2019 [48] and [49].
8. ISO/IEC 20000-1:2018 [50], [51] and [52].
9. ISO/IEC 33003:2015 [53].
10. ISO/IEC 33020:2014 [54].

All these selected MMs, best practice frameworks, and ISO standards will provide support to some components of the prototype MM.

4. Results

4.1. The Prototype Stage-Based MM Development Methodology Evaluation Results

The EGIT prototype MM that was built by our MM development methodology has undergone an evaluation process in three organizations, and the evaluation results are presented below. The evaluation process, which is the 3rd stage in the proposed MM development methodology lifecycle, constitutes a full stage and covers the evaluation of the MM before it can be published to the research community. The evaluation will start by planning the introduction of MM to a sample of three organizations that are interested in implementing EGIT MM. These organizations will undergo an experimental implementation of the MM with our support. The introduction procedure included providing awareness sessions to different levels of stakeholders, including the top management and IT staff, to introduce the MM to them and explain its importance and impact on the organization and its objectives.

Implementation was performed by arranging and conducting a group of workshops with all respective stakeholders to assess their processes. At the beginning of these workshops, an example was elaborated to all participating stakeholders to cover how to use the MM and all its maturity levels. Then, an assessment of their respective processes was conducted with our support. All results of the assessed components were reviewed by top management to validate the results.

The MM was introduced to three participating organizations of different sizes and nature, and they were provided with the supplementary file (SI-1 MM processes requirements explanation) to provide them with the requirements of each process. The first organization is working in the field of security printing and solutions; the second is managing seaports; and the third is an IT service integrator providing consultancy services. The first is in seven countries, but the evaluation occurred with the stakeholders of the two headquarters in Egypt and the UAE. The second manages approximately 70 ports worldwide, but the evaluation occurred with the stakeholders of the headquarters in Egypt. The third one works in Egypt, Sudan, and the UAE, and the evaluation covers all of them. Everyone delivers different services to their customers, but all of them are interested in measuring the maturity of their EGIT easily. The first two received support in conducting the evaluation as they requested to have third-party evaluation, while the third one chose to have it first party self-assessment by managing it by themselves after getting an introduction. The three supplementary files (SI-2 1st Organization answers, SI-3 2nd Organization answers and SI-4 3rd Organization answers) represent the answers collected from the three organizations.

4.2. The Prototype MM Development Methodology Evaluation Discussion

At the end of the stage-based MM evaluation procedure, there was a feedback collection from all participating stakeholders. All stakeholders provided feedback covering whether the MM still needs improvement and in which aspect. Table 3 depicts how the three organizations evaluated EGIT MM after using it for the first time. They were provided with eight questions, six of which could be answered by selecting a level from one to ten. Level one is the lowest while ten is the highest. The seventh question was about whether they wanted to use the EGIT MM on their own in the next time. The eighth question asked them about what the EGIT MM lacked and asked them to provide feedback and comments.

5. Conclusion

Table 3. The results of EGIT MM evaluation in the three participated organizations.

The EGIT MM Evaluation Questions	The Answers of the Participating Organizations			
	1st Org	2nd Org	3rd Org	Average evaluation
Do you think that the stage-based feature of the EGIT MM is easier to use and saves your time?	7	8	9	8
Do you think that the multidimensional feature of the EGIT MM is easier to use and saves your time?	9	8	9	8.6
Do the ITSM, ISM, BCM, and CM dimensions of the EGIT MM suite your organization EGIT needs?	9	8	8	8.3
How much do you think the assessment of the EGIT MM is easy?	8	8	7	7.6
Is the selection of the processes suitable?	8	7	8	7.6
Is the order of the selected processes suitable?	9	8	9	8.6
Do you like to use the EGIT MM in the future on your own?	Yes, 3rd Party Assessment	Yes, Self-Assessment	Yes, Self-Assessment	N/A
What does the EGIT MM lack?	Detailed assessment and recommendations.	should be automated	should be automated	N/A

Many organizations are interested in having a scientifically developed stage-based MM in developing countries and especially the Arab countries which needs an EGIT MM due to the emerging regulations and laws related to the governance of IT, Information Security/Cybersecurity and Business Continuity among others. Complying with these regulations and laws does not only protect them from legal penalties and fines as it guarantees survival in an ever-changing market with different types of attacks and pandemics. In this study, we propose a scientific stage-based MM development methodology that can support researchers in developing new stage-based MMs to cover the need in developing countries for maturity measurement with special context requirements. The selection of Arab countries was a good choice, making it easy for us to evaluate a prototype EGIT MM built using our proposed MM development methodology. The evaluation of the EGIT MM showed that the proposed MM development methodology was developed properly and could build an effective and usable prototype EGIT MM.

Although we have developed and evaluated the EGIT MM with three participating organizations to evaluate our MM development methodology, there are some needed activities in the future:

1. Develop an online website to automate the MM development methodology and all its components to enable researchers to use it to build their own MMs.
2. Develop guidance for those who would like to use the MM development methodology.
3. Collect feedback from the researchers using the proposed MM development methodology continuously and analyze it every three to six months to extract trends and respond to comments and recommendations.

Author contributions

Mostafa Alshamy:Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing - original draft, Writing and review and editing, Visualization and Project administration.
Walid Abdelmoez:Validation, Writing - review and editing, Visualization and Supervision.
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Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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