# PROPOSING A SCIENTIFIC ENTERPRISE GOVERNANCE OF INFORMATION TECHNOLOGY (EGIT) MATURITY MODEL DEVELOPMENT METHODOLOGY FOR DEVELOPING COUNTRIES

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## Abstract

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, 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, there is a scarce in EGIT scientifically developed MMs especially for developing countries. This study proposes an easy-to-use and scientifically developed EGIT MM development methodology by developing an EGIT MM which is tested in three firms. The proposed MM development methodology will enable researchers in developing countries to be able to build and use scientific EGIT MMs that can support their respective context needs.

## Introduction

The huge benefits many organizations made in the 20th century and the unexpected individual failures like the bankruptcies of telecommunications company WorldCom and energy and commodities firm Enron led the US government to start formulating the need to have corporate

governance. This corporate governance can help all stakeholders to have more assurance that the CEOs and their decisions are controlled or have oversight. Starting from the 1970s the US started to pay strong attention to the corporate governance concept while it was there earlier but with less importance. Not only USA, but many other countries like the United Kingdom, India, Australia, Canada, Japan, Germany, Spain, and Ireland as depicted by the Corporate Governance Institute [1]. UK for example stated in the Cadbury Committee many recommendations their most important two are that boards of publicly traded companies shall include at least three nonexecutive directors and that the chief executive officer (CEO) and chairman of the board (COB) positions shall not be assigned to the same person [2]. Information Technology (IT) governance or what Information Systems Audit and Control Association (ISACA) called later the Enterprise Governance of IT (EGIT) is a subset discipline of corporate governance focuses on the increase of stakeholder's goals achievement and the decrease of respective risks and costs of information and related technology within corporates. In the last decade there were many regulations released in the MENA region related to EGIT and respective fields of IT.

A specific need for EGIT MMs in the developing countries represented 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 [3], we covered the characteristics of the MENA region and the existing need for an EGIT MM based on developing, publishing, and analyzing two questionnaires [4] and [5] among participants in the same field and related fields. We concluded that the MENA region needs a specific EGIT MM made for its needs, as the number of new strategic visions in many countries in MENA is increasing with a lot of emerging information/cybersecurity, business continuity, data governance, management, and privacy regulations. The number of organizations that need to have EGIT and continually measure it is increasing enormously, and the types of fines and impacts vary and, in many cases, are intolerable including large amounts of money and imprisonment.

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 can enable them to measure their EGIT maturity and guide them in improving their performance to achieve their goals and comply with emerging regulations while optimizing resources and risks. None of the MMs examined in this research was developed using a scientific methodology dedicated to developing MMs. Therefore, we decided to develop a scientific methodology just dedicated to developing MMs and which can be used for EGIT MMs too if needed.

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 MM development methodology that is developed based on Becket et al. [6] procedure model for developing maturity models. While our last publication Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region [3] covers the first stage which is "MM assessment". It is a scientific methodology dedicated to

developing MMs and backed up by a well-known research methodology called design science research developed by Hevner et al. [7].

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 MM development methodology has the following main advantages:

Developed using a scientific methodology and general design principles (DPs).

Easy to follow to develop different MMs.

Guarantee the continual measurement and improvement of the MMs effectiveness and efficiency based on users' feedback

This study aims to develop a scientific methodology for developing MMs that will enable organizations in any developing country to improve their maturity measurement in an easy and affordable manner while helping them comply with emerging regulations. Publishing MM development methodology in the future to researchers and practitioners who need to develop simple and agile MM for different fields including EGIT.

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 result of evaluating the MM development methodology. Section 5 presents conclusions and suggestions for future work.

Background

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. Rosemann and de Bruin [8] defined maturity itself "as a measure to evaluate the capabilities of an organisation in regard to a certain discipline". Becker et al. [7] define MM as "conceptual models that outline anticipated, typical, logical, and desired evolution paths towards maturity" [6]. 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 publication Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region [3], we covered more than 150 MMs developed and published in the last few years, as stated by de Bruin et al. [8], to support the IT management field. We also examined how Becker et al. [7] 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 probably dealing with MMs were published. 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 [6] to be the greatest source of guidance for developing any MM because of the eight simple and scientific requirements provided.

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 covered Information Technology Infrastructure Library (ITIL) v3/2011 [9-11] for IT Service Management (ITSM), Control Objectives for Information and Related Technologies (COBIT)5/2019 [12-18] for EGIT, International Organization for Standardization/ the International Electrotechnical Commission (ISO/IEC) 15504-2 [19-21] for process improvement and process capability determination and ISO 19600 [22] which was replaced by ISO 37301 [23] 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 MENA region specific requirements. For ITIL Process Maturity Framework (PMF) [24], it is an ITSM MM while it can be used to measure any other IT domain. It 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 MENA region as many organizations do not have many of its processes and do not have enough resources to conduct its complex assessment. COBIT5 has only one dimension which is Process and therefore it measures capability and not maturity, other dimensions are still needed like information security, business continuity and compliance. It assesses all the processes against each maturity level of its six levels. Although Many researchers have been trying to use COBIT 2019 in many cases to measure the EGIT governance, COBIT 2019 needs training, experience, and many resources to be implemented. 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. It assesses all the processes against each maturity level of its six levels. 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, 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. 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 one dimension and therefore other dimensions are still needed.

In the academic-based MMs we covered three different categories which we could find. 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 MENA region.

The first category includes academic MMs like "GoCoMM : A Governance and Compliance Maturity Model" [25], "Toward an IT governance maturity self-assessment model using EFQM and CobiT" [26], "Maturity Model Architect: A Tool for Maturity Assessment Support" [27], "Using enterprise architecture model analysis and description logics for maturity assessment" [28], "IT Evaluation in Business Groups: A Maturity Model" [29], "Information Governance Maturity Model Final Development Iteration" [30] and "An End-To-End Cyber Security Maturity Model For Technology Startups" [31]. These seven publications propose EGIT MMs which cover one dimension and does not have any deployment in the MENA region or discuss its specific needs.

The proposed MM "The development of an IT governance maturity model for hard and soft governance" [32] 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" [33]. The lack of EGIT MM simplicity is depicted in "Toward an IT governance maturity self-assessment model using EFQM and CobiT" [34] 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 publication "Measuring the maturity of Information Technology Governance based on COBIT" [35] 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 MENA region, including stage-based maturity measurement or multi-dimensional structure.

The second category includes comparisons among the MMs available in the market like "Maturity Models for Information Systems - A State of the Art," [36], "Understanding maturity models Results of a Structured Content Analysis" [37] and "Information Security Management Maturity Models" [38]. 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" [6], "Design Science in Information Systems Research" [39], "Maturity assessment models: a design science research approach" [40], "What makes a useful maturity model? A framework of general design principles for maturity models and its demonstration in business process management" [41], "Understanding the Main Phases of Developing a Maturity Assessment Model" [42], "A Design Science Research Perspective on Maturity Models in Information Systems" [43] and "Assessing Organizational Capabilities: Reviewing and Guiding the Development of Maturity Grids" [44]. 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. The organizations in the MENA region are more interested in the commercial MMs instead of the academic ones as they are well-known for available training courses, exams and qualification levels which are not provided by the academic MMs. Therefore, later we will compare our MM against the commercial MMs to depict the actual needed features and aspects.

It is worth mentioning that in addition to the main two types of MM 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" [45] 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" [46] 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 Becker et al. [7], 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 Becker et al. [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." de Bruin et al. [8] 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 MENA region 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 MENA region countries that necessitate compliance. Some of these regulations are developed in MENA like the Saudi National Cybersecurity Authority (NCA) [47] 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) [48] 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) [49], National Center for Archives and Records (NCAR) [50] and National Data Management Office (NDMO) [51] regulators. Other Arab countries have some other regulations like the Egyptian Personal Information Protection Act by the Central Bank of Egypt [52], Central Bank of Jordan (CBJ) [53], National Electronic Security Authority (NESA) [54] and The Supreme Council for National Security National Emergency Crisis and

Disasters Management Authority (NCEMA) [55] in United Arab Emirates (UAE) among many others.

While other regulations are developed out of MENA like General Data Protection Regulation (GDPR) [56] which was developed in European Union (EU) though it is effective worldwide. All these new regulations among others motivate governmental and private organizations in MENA region 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 countries including the MENA region based on understanding its 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 of organizations

Rare use of MM is 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 MM is needed for maturity measurement and improvement.

For all these reasons, we considered our proposed MM development methodology to develop MMs capable of measuring the maturity of developing counties easily and scientifically. The proposed MM development methodology should be evaluated by developing an EGIT example 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 MM, and whether it was developed and deployed properly to cover the needs of organizations of Arab countries in MENA region that need to measure and improve their EGIT. The recommendations of these organizations will be documented and analyzed to make clear plans for the needed improvement or changes to the proposed MM development methodology.

 Research framework

3.1 Research Method

This research adopts an experimental approach which is progressed by developing an exemplary EGIT MM using our EGIT MM development methodology and test it in three organizations. The experiment will cover the need of the MENA region for an EGIT MM that can cover the newly released EGIT respective regulations.

The design science in Information Systems research introduced by Hevner et al. in 2004 [39] 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, and they have already been used by researchers. The guidelines are:

G1: Design as an artifact.

G2: The relevance of problem.

G3: Design evaluation.

G4: Research contribution.

G5: Research rigor.

G6: Design as a search process.

G7: Communication of Research.

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 during the development of the proposed MM development methodology because it has scientific and chronological characteristics that will effectively guide the development process.

Becker et al. [6] 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 which are:

R1: Comparison with existing maturity models.

R2: Iterative procedure.

R3: Evaluation.

R4: Multi-methodological procedure.

R5: Identification of problem relevance.

R6: Problem Definition.

R7: Targeted presentation of results.

R8: Scientific documentation.

It should be noted that although we are using existing MMs as reference models with all their processes and guidance, we are creating a new scientific MM development methodology and testing it by building a new EGIT MM and not customizing any of the used reference MMs. Our development methodology (Fig. 1) combines the methods of Hevner and Becker to obtain the maximum benefit. Our MM development methodology includes five chronological stages covering the life cycle of assessing, developing, evaluating, communicating, and retiring MMs when needed.

The first stage, 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. This will help in defining the components needed to be developed in any new MMs or the customization required to improve the existing MMs. 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 components will be developed. To develop a new MM, there will be a group of five activities to develop a new MM and its components. The context of the MM and its purpose shall be determined from the beginning; in our case, the context is based on Arab countries in MENA region 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. The last activity in this stage is the integration of all components of the newly developed MM or customized MM.
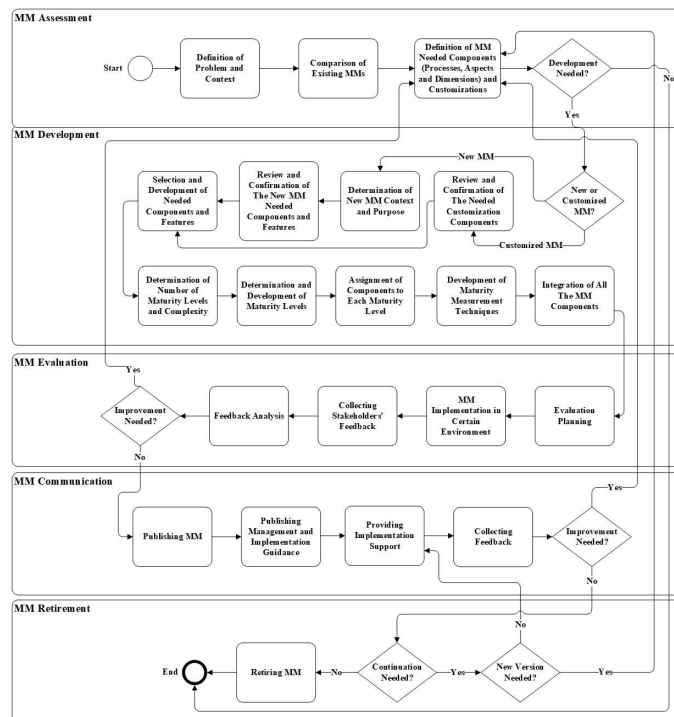


**Figure 1: MM development methodology and lifecycle stages**

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 will try to have about three organizations of different types and nature to widen the scope of the experiment. Organizations that would like to participate in the MM evaluation will be carefully selected, and their needs and feedback will be 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. Although we consider our MM to be easy-to-use, some organizations may need some support in the implementation process if EGIT is new to them or if they do not have competent staff. 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.

3.2 The Proposed MM Development Methodology Evaluation

To evaluate our proposed MM development methodology, we will build an MM dedicated to measuring EGIT maturity in the MENA region and deploy it in three organizations to measure its effectiveness. The developed EGIT MM has five principles, which are basic and core values that any organization should have and maintain to demonstrate compliance with its goals and objectives. The EGIT MM also has four maturity dimensions, called maturity pillars, to be used during any assessment. These dimensions enable organizations to use an easy and affordable integrated MM instead of assessing each maturity pillar separately at a time. However, to measure EGIT maturity, the four pillars should be used in combination. Each maturity pillar has four stages of maturity, which are like other existing MMs stages/levels of maturity that have been used for many years. The experimental evaluation approach best suits our MM, and it will be used later to support us in collecting and analyzing feedback from stakeholders in the participating organizations in the MM evaluation experiment.

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 proposed MM interfaces are covered in Section 3.2.3.

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 [3], the MM will be built on five principles (Fig. 2)

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.



**Figure 2: The Proposed MM Principles**

3.2.2 Dimensions
Our MM is based on the concept of multiple dimensions to enable organizations to measure their maturity from different perspectives, as an organization's maturity cannot be depicted by measuring only one dimension. The proposed MM has the most necessary dimensions for MENA region (Fig. 3): 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. 4). What is new in the proposed MM is how the three measurement aspects are used to measure the maturity of the four dimensions.
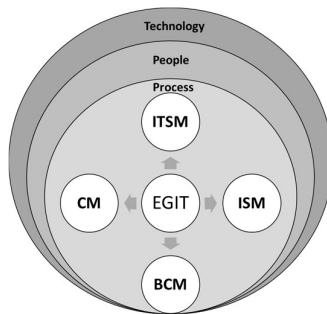


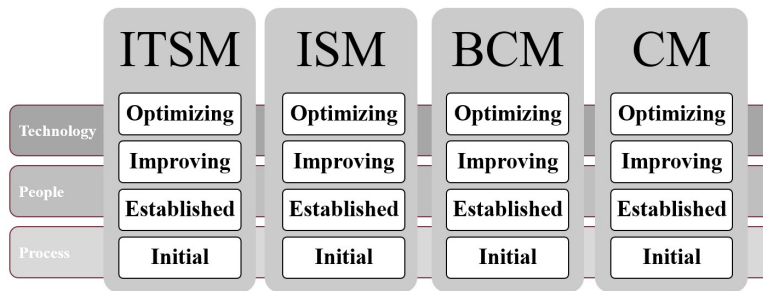**Figure 3: The Proposed MM Pillars (Dimensions)**



**Figure 4: 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, which stands for not achieving the process requirements,

P, which stands for partial achievement of the process requirements, and

F, which stands for the full achievement of the process requirements.

3.2.3 Proposed MM Interfaces

The proposed 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 MENA region organizations. The proposed MM uses the following references:

ITIL v3/2011/v4 ITSM framework and ITIL PMF MM.

COBIT 5/2019 and process capability/CPM MM.

M_o_R and ISO 31000:2009 [57] management of risk MM.

PRINCE2 [58] and MSP [59] frameworks and P3M3 MM [60].

ISO 37301:2021 [61]

ISO/IEC 27001:2013 [62-64]

ISO 22301:2019 [65-66]

ISO/IEC 20000-1:2018 [67-69]

ISO/IEC 33003:2015 [70]

ISO/IEC 33020:2014 [71]

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

Although there are many other related MM frameworks and ISO standards, these are considered direct sources of guidance based on their success and familiarity in the MENA region market. These four frameworks and their respective MMs and the six ISO standards will affect the proposed MM, which has been developed to match the market needs while enabling the organizations to use whatever pillar/s they really need to assess.

Results

The Proposed MM Development Methodology Evaluation Results

The EGIT 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 internally with our

support. The introduction procedure included providing awareness sessions to different levels of stakeholders, including the organization's top management and IT staff, to introduce the MM to them and explain its importance and impact on the organization and its objectives. The need for their participation and cooperation is explained in the awareness sessions and was practiced in workshops to increase their preparedness.

Implementation was performed by arranging and conducting a group of workshops with all respective stakeholders to assess their processes with the MM. 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 on the MM with our support. All results of the assessed components were reviewed by top management to validate the results. If any differences are discovered, the respective components will be reassessed to reach the actual performance.

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 security solutions; the second is managing seaports; and the third is an IT service integrator providing consultancy services. The first is located 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 the 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.

Assessing the maturity of EGIT in each organization has specific challenges based on their respective maturity and interests. This also reflects their achieved maturity level, although all of them were interested in increasing their maturity after the assessment. The assessment helped them understand their current state and weaknesses.

The Proposed MM Development Methodology Evaluation Discussion

At the end of the MM evaluation procedure, there was a feedback collection from all participating stakeholders. Each type of stakeholder would have a specific feedback as top management can be asked about if the MM helped them measure their organization's EGIT maturity level and enabled them to move forward, while process and component owners and IT technical staff can be asked about whether the MM is easy to use and if it covers their expectations. At the same time, both levels are asked whether the MM still needs improvement and in which aspect. Table 1 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. The eight questions are:

**Table 1. 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 |
| Do you think that the stage-based feature of the EGIT MM is easier to use and saves your time? | 7 | 8 | 9 |
| Do you think that the multidimensional feature of the EGIT MM is easier to use and saves your time? | 9 | 8 | 9 |
| Do the ITSM, ISM, BCM, and CM dimensions of the EGIT MM suite your organization EGIT needs? | 9 | 8 | 8 |
| How much do you think the assessment of the EGIT MM is easy? | 8 | 8 | 7 |
| Is the selection of the processes suitable? | 8 | 7 | 8 |
| Is the order of the selected processes suitable? | 9 | 8 | 9 |
| Do you like to use the EGIT MM in the future on your own? | Yes, 3rd Party Assessment | Yes, Self-Assessment | Yes, Self-Assessment |
| What does the EGIT MM lack? | Detailed assessment and recommendations. | should be automated | should be automated |

Based on the results of the analysis and how the MM has been accepted by the three organizations, it will be published to the community. Table 2 depicts the average evaluation of EGIT MM received from the three participating organizations on a scale of 10.

**Table 2. The results of EGIT MM evaluation in the three participated organizations.**

| Feature | Average evaluation out of ten |
|---|---|
| Stage-based | 8 |
| Multi-dimensional | 8.6 |
| ITSM, ISM, BCM and CM dimensions | 8.3 |
| Multi-purpose suitability | 7 |

| | |
|---|---|
| **EGIT MM easiness** | 7.6 |
| **Process selection suitability** | 7.6 |
| **Selected processes order suitable** | 8.6 |

## Conclusions

Many organizations are interested in having a scientifically developed MM in developing countries and especially the MENA region which needs an EGIT MM due to the emerging regulations and laws related to the governance of IT, Information Security/Cybersecurity and Business Continuity. 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 paper, we propose a scientific MM development methodology that can support researchers in developing new MMs to cover the need in developing countries for maturity measurement with special context requirements. The selection of Arab countries in MENA region was a good choice, making it easy for us to evaluate a sample 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 EGIT MM as a prototype.

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:

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.

Develop guidance for those who would like to use the MM development methodology.

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.

Conflict of Interest

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

Funding Statement

The research and publication of this article was not funded by any financially supporting bodies.

## Data Availability

The assessment of EGIT maturity data used to support the findings of this study are included within the supplementary information files.

## Supplementary Materials

SI-1 includes the MM processes requirements explanation.
SI-2 includes the 1st Organization answers.
SI-3 includes the 2nd Organization answers.
SI-4 includes the 3rd Organization answers.

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