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# Information Systems Evaluation: A Conceptual Framework

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**Information Systems Evaluation: A Conceptual Framework**

by

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The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this creative component. The Graduate College will ensure this creative component is globally accessible and will not permit alterations after a degree is conferred.

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## DEDICATION

Completing a graduate degree is no easy feat; hard work and determination are essential. However, one does not often complete a college degree without some form of support. To that end, I would like to take the time to thank those who have supported me throughout my academic career, especially my family. In particular, my wife, Grisselle, who has been instrumental in my success. All the hours she dedicated to watching our daughter, Leilani, coupled with her unwavering support, motivational words, and encouragement, made it possible for me to achieve high academic success as an undergraduate and graduate student. In addition, members of my immediate family are also owed a deep level of gratitude. In particular, my father, Richard, and my mother, Kristine. The guidance and support they provided to me over my lifetime have allowed me to overcome great odds; to grow and flourish academically.

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## ABSTRACT

Information systems (IS) are essential to the modern-day organization. Unfortunately, many organizations often select an IS that does not optimally match organizational needs and requirements. The mismatch between organizational requirements and an implemented IS often results in a loss of productivity, efficiency, and company morale. One way to address this problem is undertaking a formal IS evaluation process; however, IS evaluation requires complex-multidimensional approaches that present many challenges. Moreover, research literature that could inform the design and conduct of such evaluations is limited. This paper aims to fill the gap in the existing literature by introducing a novel IS Evaluation Framework to guide organizations in the IS selection process.

## INTRODUCTION

The essential functions of an information system (IS) are analogous to the functions of the brain. A brain takes in information (e.g., sensory inputs), processes that information in some manner (e.g., interprets a bird chirping as a sound), and retains it for later use (e.g., next time the sound is heard, it is recognized as a bird). Likewise, an IS takes information from a user or data generated from another source, such as a sale in a POS system, processes it (e.g., calculates applicable taxes for the sale and updates inventory), and stores it (e.g., stores the transaction in a database to be used later in a daily report). The act of capturing, processing, and storing information are the primary functions of both an IS and the brain. This analogy drives home a critical point. That is, favorable outcomes are limited to the capacity to carry out these three essential functions well. Just as the brain is essential to the body, the IS is essential to the modern-day organization – both cannot survive without them.

Despite organizations' leaders understanding IS's critical importance for business success, many choose a "brain" not well suited for their business needs (Olsen & Sætre, 2007). Consequently, productivity, efficiency, and company morale can suffer as detrimental changes occur in organizational procedures, quality of working life, and management (Smithson & Hirschheim, 1998). Moreover, costs associated with the loss of productivity, in addition to identifying and implementing a replacement IS, can be severely damaging to the organization as a whole. Given these consequences, why do organizations continuously fail to select the best suited IS? Is it often the case that a good system that matches organizational needs does not exist, or is there a much more challenging or more troublesome set of issues?

These questions can be addressed by generating solutions to a highly complex multidimensional problem: truly understanding the purpose of IS evaluation. IS evaluation can occur during two phases in the implementation process – pre-implementation, i.e., the vetting and selecting process, and post-implementation. For the context and scope of this paper, however, IS evaluation is concerned with the former. In this context, IS evaluation can be defined as a set of procedures for assessing how well an IS fulfills specific organizational needs, requirements, and goals. This formal definition may be straightforward; however, how an organization carries out an effective IS evaluation is not. For example, imagine the complexities of a large corporation comprehensively and accurately assessing IS requirements for a system impacting the marketing, finance, operations, HR, and IT departments. Moreover, it is difficult and complicated to identify qualified persons to decide both the tangible and intangible IS evaluation criteria, address *how* the criteria will be measured, and specify *who* will measure it objectively.

The example above only begins to clarify the complexities involved in an IS evaluation, and why IS evaluation presents so many challenges. To address some of these challenges, researchers have provided guidance in the form of key constructs, models, frameworks, and case studies (DeLone & McLean, 1992; Symons, 1991; Hochstrasser, 1990; Serafeimidis & Smithson, 2000). However, research in this domain is limited overall, and recent research is especially scarce. In addition, most research is focused on IS evaluation for very narrow applications, such as health care IS evaluation (Haried et al., 2017), which does not generalize well outside of its context. Thus, there is an opportunity to contribute to the existing literature by further exploring IS evaluation's intricacies. Moreover, a novel framework informed by such research could be proposed to guide IS evaluation for a number of applications.

In sum, this paper aims to fill the current gap in the literature by contributing an innovative framework to guide IS evaluation for a variety of contexts. To accomplish this goal, the paper is divided into five sections. They are as follows: IS Evaluation Challenges, Pre-Evaluation Processes, IS Evaluation Literature Review, IS Evaluation Framework, Limitations and Assumptions, and Conclusion.

The IS Evaluation Challenges section will introduce the wide-ranging problems that can occur during an IS evaluation, and in doing so, will make the case for why IS evaluations are so difficult to accomplish efficiently and effectively. In addition, it will present the EC-MOF Taxonomy; a novel way to classify IS evaluation problems.

Following the IS Evaluation Challenges section is Pre-Evaluation Processes. In this section, the processes leading up to the IS evaluation will be briefly described, including conducting a needs assessment and submitting a Request for Proposal (RFP).

After discussion of the Pre-Evaluation Processes, a review of the literature will be presented as it pertains to IS evaluation processes and methodology, particularly the framework present in this paper. Notable approaches covered in this literature review address the Context, Content, and Process construct and the DeLone and McLean IS Success Model.

Subsequent to the literature review, a novel IS Evaluation Framework informed by the literature review will be introduced and discussed. The framework is designed to accommodate different industry contexts and features an Evaluative Team comprised of Experts, an Evaluation Committee, and Other Stakeholders.

Lastly, limitations of the framework and concluding remarks will be made in the Limitations and Assumptions and Conclusion sections, respectively. Some notable limitations of the framework involve contingencies on resource availability and the needs assessment. The Conclusion section will summarize the findings across sections.

## IS EVALUATION CHALLENGES

Insight into the IS evaluation problem can be well articulated by introducing the numerous challenges IS evaluation presents. These challenges can be broadly categorized into a taxonomy of three problem areas; namely, *Evaluator Characteristics, Methodology,* and *Organizational Factors.* For the remainder of this paper, this will be referenced as the EC-MOF Taxonomy.

Evaluator Characteristics concerns the evaluator-related issues including the need to address evaluator biases, evaluator credentials, improper evaluator training, evaluator relationships with staff, and evaluators' adequate understanding of evaluation methodology (Smithson & Hirschheim, 1998).

Issues concerning evaluation Methodology include evaluation design, identifying and engaging prospective participants, addressing errors in measurement (i.e., measurement inaccuracy), selection of the measurement criteria, navigating how to measure intangible criteria, determining the evaluation level (e.g., macro vs. micro), and interpreting results (Smithson & Hirschheim, 1998).

Organizational Factors refer to the organizations' economic, administrative, and structural issues with the evaluation. Examples of these factors are determining the direct and indirect costs of the evaluation, supports for preparation of the evaluation (e.g., conducting an IS requirements assessment), dealing with limited resources, and aligning the evaluation with organizational goals (Smithson & Hirschheim, 1998).

The three categories defined above are not mutually exclusive. In fact, many problems can be construed as cutting across more than one category. For instance, an evaluator misinterpreting an issue regarding a particular measurement criterion has qualities of both a measurement problem (e.g., it causes a measurement error) and an evaluator problem (e.g., the evaluator was confused and failed to clarify the evaluation question). Given how there are these types of crosscutting issues with evaluation, the challenges can be visually represented in a Venn Diagram, depicted below in Figure 1.0.

**Non-Exclusivity of EMO Taxonomy Categories**


Figure 1.0

Along with the complexities of the overlapping challenges across categories, there are key bidirectional influences. For example, Organizational Factor problems can influence Evaluator Characteristics problems, which can affect Methodology problems. More specifically, for this particular example, failure to accurately assess IS requirements influences the accuracy of measurement criteria, which, in turn, affects how the evaluator evaluates specific criteria. Another aspect of bidirectional influences is that a problem in one category can create a problem

(or problems) in another. The sum of these problems and interactions ultimately affects the IS evaluation outcome. The visualization of these interactions and the subsequent outcome is depicted in Figure 1.1.

**Relationships Between Evaluation Problem Taxonomic Categories**

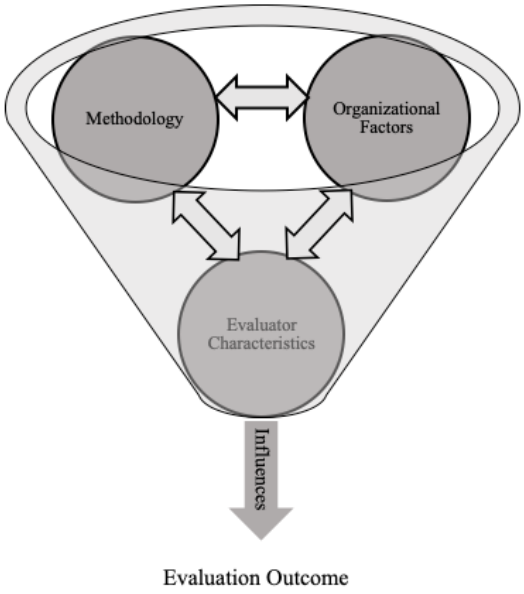



Figure 1.1

The outcome of the evaluation is critical; it is used to determine which IS will be implemented. Therefore, an evaluation must be carried out effectively by paying careful attention to relevant complex interrelations among Organizational Factors, Evaluation Characteristics, and Methodology. A first step in the direction of addressing these issues is setting the stage for an effective evaluation. In other words, it is essential to understand the steps preceding the IS evaluation - the processes involved in selecting which ISs to evaluate. Discussion of these processes will be presented in the subsequent section, Pre-Evaluation Processes.

## PRE-EVALUATION PROCESSES

It is helpful to acknowledge the processes that lead up to an evaluation – they are foundational to the evaluation itself. Although this is not the primary focus of this paper, errors that occur prior to the evaluation often affect which IS is selected, and, therefore, must be considered. For example, if a needs assessment is not adequately performed, then, most likely, the search for suitable ISs will return candidate systems that do not fully match organizational needs. Thus, even if an IS evaluation is conducted sufficiently well, an organization may choose the *wrong* IS. Figure 1.2 highlights the importance of the steps that lead up to an evaluation and introduces the two phases that comprise Pre-Evaluation Processes. Namely, the Specification Phase and the RFP Phase. The adage, "bad data in, bad data out," well articulates what often occurs in evaluations, but can be prevented by carefully considering Pre-Evaluation Processes.

**Pre-Evaluation Processes**

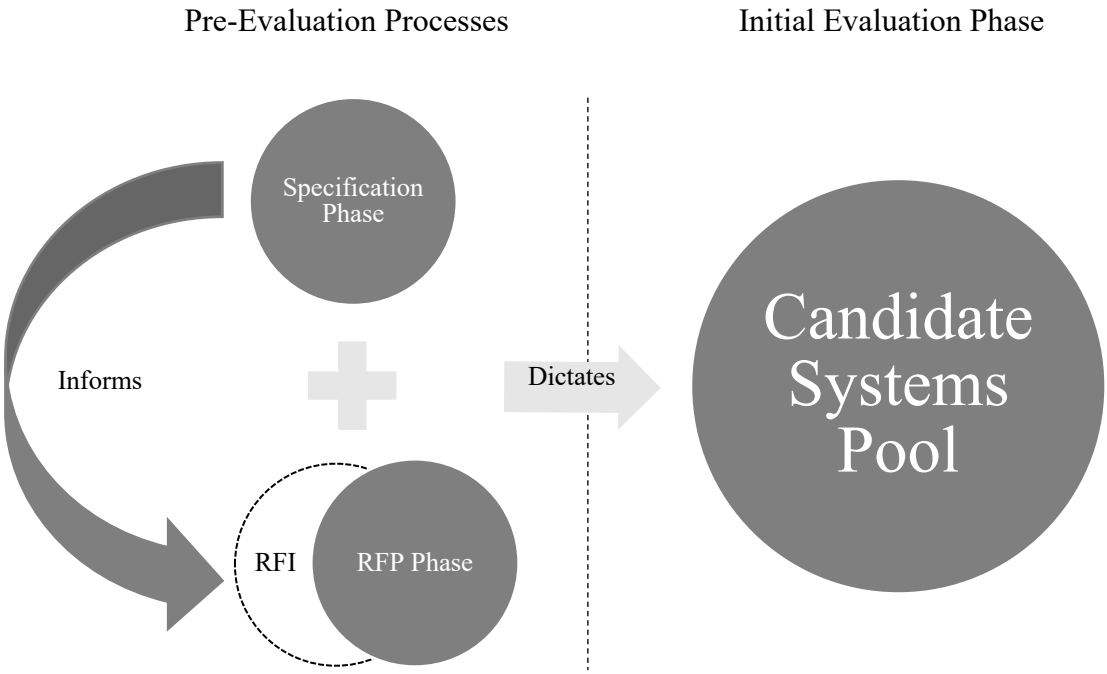



Figure 1.2

In the Specification Phase, the organization performs a needs assessment (also known as a needs analysis). Information obtained from this assessment informs the Request for Information (RFI) and the Request for Proposal (RFP), a formal document for soliciting information and proposals from vendors, respectively (Westfall, 2011). Subsequently, the organization reviews vendor proposals to decide which ISs will make it into the Candidate Systems Pool. Typically, this process consists of evaluating the vendor on predefined criteria specified in the RFP (Westfall, 2011).

The RFI is a step which can precede the RFP or could potentially be used as a sole means to identify ISs for the Candidate Systems Pool. However, the RFP is much more comprehensive than an RFI; it requests specific information on how a vendor will address specific needs. Therefore, discussion in this paper focuses on the RFP.

## Specification Phase

In the IS evaluation context, a needs assessment can be defined as an internal process performed by key stakeholders that comprehensively contrasts the current system state with the desired system state (defined on the basis of a synthesis of the literature).

While there are many different ways to conduct a needs assessment, they generally consist of four steps, which include (1) identifying participants, (2) gathering needs-related information, (3) reviewing and prioritizing needs, and (4) documenting results (NCES, 2006).

As its name implies, the first step entails identifying the participants who will contribute to the needs assessment. A common practice is to enlist two parties. The first includes those familiar with the daily operations and the organization's functions, current needs, and future

goals. The second consists of the system users; the ones most intimate with the currently implemented system (NCES, 2006).

The second step relates to gathering needs-related information. There is a wide variety of techniques that can be used to accomplish this task. A few of the more notable techniques are comprised of interviews (e.g., personal and group), surveys, and focus groups. The most effective method, however, is to use multiple techniques (NCES, 2006).

After all the relevant information is obtained, an identification and prioritization of needs is necessary. This is best accomplished in a sequential process; namely, (1) thoroughly reviewing all needs-related information, (2) identifying needs, (3) classifying the needs into relevant categories, and (4) prioritizing the needs based on their level of importance. The portrayal of needs should be succinct and build towards a feasible solution. However, specific details of how the solution is derived should not be considered (NCES, 2006).

The remaining step is to document the results. This can be done in a variety of ways, all of which benefit from keeping in mind the overall objective of the assessment as well as its limitations. A common practice is to include the following sections: Introduction (where the background, objectives, and scope are detailed), Needs Categories, Functional Needs, Technical Requirement Parameters (e.g., technical standards, system availability and capacity, system access requirements, interface needs), and Ethical and Security Standards (NCES, 2006).

## RFP Phase

After a needs assessment is completed, an organization can start the RFP Phase through which the RFP is drafted and submitted to vendors. Completing an RFP is no easy task; it is a cumbersome and time-consuming process. It often can take anywhere between one and a half months to three months to complete the process in its entirety (ORISE, 2010). RFP components can vary somewhat across industries; however, the key elements to be included remain relatively consistent for the particular context of IS acquisition. They are as follows, Introduction, Background, System Requirements, Project Requirements, Response Format and Contents, and Proposal Evaluation Criteria (Langer, 2016). An overview of each section, their subcomponents, and objectives are detailed in Table 1.0.

| Key Elements of an RFP | | |
|---|---|---|
| **Section** | **Subcomponents** | **Objective** |
| Introduction | Purpose of RFP, Definitions, Point of Contact, Timeline/Schedule, Deadlines, Confidentiality Statement, Scope | States the purpose of the RFP and includes specific details on the scope and timeline |
| Background | Background Information, Budget, Technical Architecture Overview | Provides background information on the organization as well as the budget and current technical infrastructure |
| System Requirements | System Requirements | Details the requirements necessary for the system (identified in needs assessment) |
| Project Requirements | System Warranty, Project Management, Support and Maintenance, Insurance | Outlines the requirements for the implementation of the system, including management, support and maintenance |
| Response Format and Contents | Proposal Preparation, Proposal Submission Instructions (e.g., format), Technical Proposal, Cost Proposal | Provides specific instructions for the submission of proposals, including expected format |
| Proposal Evaluation Criteria | Evaluation Criteria, Selection Process | Specifics what criteria the vendor will be evaluated on |

Table 1.0

A thorough explanation of an RFP and all its intricacies could be a paper in of itself. However, for the context and scope of this research, the primary concern is an RFP's ability to convey an organization's needs to vendors accurately. Moreover, it must relate those needs back to organizational goals and provide a basis to effectively evaluate which ISs will make it into the Candidate Systems Pool.

Once the Pre-Evaluation processes are complete, and the Candidate Systems Pool is populated, it is time to evaluate each IS – the main focus of this paper. Exploration of current methodologies and mitigation of IS evaluation problems will be presented in the following section, IS Evaluation Literature Review.

## IS EVALUATION LITERATURE REVIEW

Problems that are captured in the EC-MOF Taxonomy have long plagued IS evaluation. However, information systems researchers have identified concepts and approaches that can be applied to the IS evaluation process to ensure successful outcomes. To better conceptualize the development of these approaches and their contribution to IS evaluation over time, the literature will be presented chronologically. After all the literature is presented, this section will conclude with a brief summary and discussion to set the stage for the presentation of the IS Evaluation Framework.

The first notable IS evaluation approach is the multi-criteria evaluation method (MCE). This method entails weighting criteria (e.g., usability) based on relative importance; a final score for a particular criterion is a factor of its weight and evaluated score. The summation of the final scores provides an overall ranking of the evaluated IS (Lucas & Moore, 1976).

Adding to the MCE method, Baily and Pearson (1983) developed a tool to measure user satisfaction. They recognized the link between unfavorable user satisfaction and unfavorable IS outcomes. More specifically, if users are unsatisfied with a particular IS, then that IS will be underutilized, which may contribute to its ultimate failure.

Baily and Pearson defined user satisfaction as being the sum of one's positive and negative reactions to a set of factors. As such, they sought to identify the most pertinent factors in determining user satisfaction. The factors they identified are presented below in Table 1.1.

| Factors for Determining User Satisfaction | | | | |
|---|---|---|---|---|
| Top management involvement | Organizational competition with the EDP unit | Means of input/output with EDP Center | Charge-back method of payment for services | Relationship with the EDP staff |
| Communication with the EDP staff | Technical competence of the EDP staff | Attitude of the EDP staff | Schedule of products and services | Time required for new development |
| Processing of change requests | vendor support | Priorities determination | Convenience of access | accuracy |
| Timeliness | Precision | Reliability | Currency | Completeness |
| Format of output | Language | Volume of output | Relevancy | Error recovery |
| Security of data | Documentation | Expectations | Understanding of systems | Perceived utility |
| Confidence in the systems | Feeling of participation | Feeling of control | Degree of training | Job effects |
| Organizational position of the EDP function | Flexibility of the systems | Integration of systems | Response/turnaround time | |

Table 1.1

Baily and Pearson used the factors found in Table 1.1, coupled with four adjective pairs and a subjective reaction, to assess a user's satisfaction. They found their formulated questionnaire to be validated by statistical tests. Moreover, they concluded that for specific situations, a subset of the factors could achieve the same results.

Baily and Persons' method made a significant contribution to IS evaluation, although there are several critical aspects of IS evaluation they did not address. One such aspect is how different ISs may require different evaluative techniques. Hochstrasser (1990) recognized this issue and developed a framework for classifying IS projects. His concept was that the characteristics of the IS project should inform the evaluative techniques. For example, if the IS is being implemented for automation, then there are quantifiable economic benefits. Thus,

evaluating the IS using financial measures is highly advantageous. Conversely, if an IS is being implemented to take advantage of new technology, then intangible benefits derived from system use could not be well evaluated using economic techniques.

While the MCE approach, Baily and Pearson Questionnaire, and the Hochstrasser model can help address problems in the Methodology category, they do not clearly address problems that arise in the Evaluator Characteristics or Organizational Factors categories. An approach that broadly addresses all three categories of the EC-MOF Taxonomy was developed by Symons (1991). Symons takes a less narrow approach in comparison to the previous three methods; he examines IS evaluation from a (1) *content*, (2) *context*, and (3) *process* (CCP) perspective.

The *content* of an evaluation must consider the implications for business strategy and organizational effectiveness. First, it must (1) link the business goals, and (2) consider the implementation process. An effective evaluation will consider the business's goals and what specific qualities of the IS support them.

The second component of *content,* i.e., the implementation process, concerns specification of the requirements, assessment of financial costs and benefits, processes of change, organizational support, and conflict management. In addition, a thorough understanding of *what* is being measured is necessary. Therefore, criteria must be carefully selected with consideration of each stakeholder; what is included or excluded makes up the evaluation's *content*. Furthermore, since the IS is central to the business, especially to business goals and the implementation process, it should not be evaluated separately from the organizational *context* (Symons, 1991).

The *context* of the evaluation includes (1) history (i.e., history of ISs within the organization), (2) infrastructure (e.g., human resources), (3) informal procedures and information flows (i.e., informal flows and procedures are a factor of work patterns and attitudes surrounding the IS), and (4) stakeholder perspectives (i.e., the different perspectives of different stakeholders are critical in a comprehensive evaluation) (Symons, 1991). These components help shape the rationale of the evaluation.

History is an essential element because ISs evolve over time; constraints and opportunities are set by preceding ISs and existing processes (Symons, 1991). For example, an implemented IS that does not fully integrate the payroll and accounting processes presents an opportunity for an IS that could serve that specific function. Navigating through the historical constraints and opportunities set forth by current and preceding ISs is an essential activity in the *context* of an evaluation.

The *infrastructural* needs of an IS is another critical aspect of the *context* of the evaluation. It includes the necessary physical, financial, and human resources required to support the IS (Symons, 1991). The capability to access these infrastructural needs builds a framework in which the evaluation can take place.

*Informal flows and procedures* is a more obscure, less defined component of the *context* of an evaluation. Using the payroll example above, existing informal flows (e.g., information flows that existed via face-to-face communication) between the HR Department (the department that completes the payroll) and the Accounting Department may be detrimentally affected by an IS that integrates payroll and accounting processes. Consequently, beneficial relationships that boosted departmental cohesiveness and company morale (and, in turn, organizational

productivity) may no longer be viable. A keen look into these informal information flows and procedures is a more cumbersome process; however, a comprehensive and robust elevation considers their impacts.

The last component of *context* is where conflicts of interest and difference of opinions arise – it is the *stakeholder perspectives*. The reason for this is that perceptions of stakeholders are subjective; value judgments amongst stakeholders are likely to differ (Symons, 1991). Moreover, interests relative to departmental or managerial needs may skew perceptions of a particular IS. Thus, having diverse stakeholder groups that encompass all the wants and needs of the organization is instrumental to a well-orchestrated evaluation.

Lastly, *process* entails the actions, reactions, and interactions of the stakeholders. In this context, stakeholders refer to the managers, IS professionals, and users at all levels of the IS operation. Furthermore, *process* also involves ensuring involvement, commitment, and access to data for all stakeholder groups. In addition, examining the mechanisms representing different stakeholder interests, and having a medium for discussion amongst stakeholder groups, allows for an evaluation that considers feedback from all invested parties (Symons, 1991).

The CCP approach is heavily concentrated on the social and qualitative facets of an evaluation rather than the technical, administrative, and quantifiable economic impacts – elements that have proven limitations (Symons, 1991). By collectively examining the what, why and who, and how of an evaluation, one is able to expand beyond the customary and into the unanticipated, i.e., the relevant influential facets that are deeply ingrained within the organization, yet often forgotten.

The CCP approach provides a means to broadly address problems that occur in the EC-MOF Taxonomy. However, one limitation is its lack of specificity in determining the evaluation criteria. Filling this gap, researchers Delone and McLean provisioned a robust and comprehensive model for IS evaluation. It is known as the IS Success Model and includes the six most pertinent dimensions for successful IS outcomes. The six dimensions are System Quality, Information Quality, Use, User Satisfaction, Individual Impact, and Organizational Impact (DeLone & McLean, 1992). A visual representation of the IS success model is depicted below in Figure 1.3.

**DeLone and McLean IS Success Model**

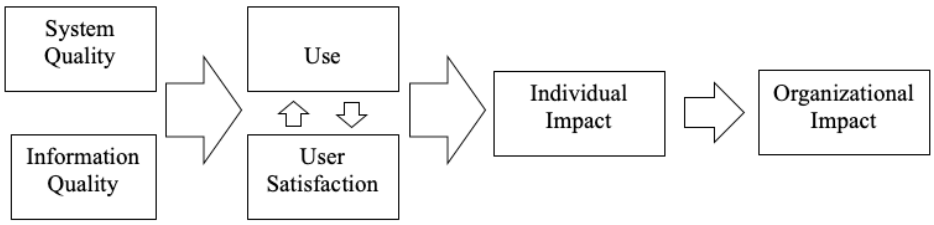



Figure 1.3

As one can see, an IS is evaluated in terms of Information Quality and System Quality. These dimensions singularly or jointly affect subsequent Use and User Satisfaction. Use and User Satisfaction are highly interrelated (e.g., a positive experience with Use influences User Satisfaction). Resultant of Use and User Satisfaction is the Individual Impact, which subsequently affects the Organizational Impact (e.g., collective individual performance having an impact on organizational productivity) (DeLone & McLean, 1992).

In addition to identifying the six most pertinent dimensions for IS success, DeLone and McLean identified measures for each dimension. These measures, coupled with the IS success

model's guidance, can be used to inform the selection of criteria for an IS evaluation. Table 1.2 is a summary of the IS success measures for each respective Success Model category.

| Summary of IS Success Measures by Category | | | | | |
|---|---|---|---|---|---|
| **System Quality** | **Information Quality** | **Information Use** | **User Satisfaction** | **Individual Impact** | **Organizational Impact** |
| Data Accuracy | Importance | Amount of use/duration of Use: | Satisfaction with specifics | Information understanding | Application Portfolio: |
| Data Currency | Relevance | Number of inquiries | Overall satisfaction | Learning | Range and scope of application |
| Database Contents | Usefulness | Amount of connect time | Single-item Measure | Accurate interpretation | Number of critical applications |
| Ease of use | Informativeness | Number of functions used | Multi-item measure | Information awareness | Operating costs reductions |
| Convenience of access | Usableness | Number of records accessed | Information satisfaction: | Information recall | Staff reduction |
| Human factors | Understandability | Frequency of access | Difference between information needed and received | Problem identification | Overall productivity gains |
| Realization of user requirements | Readability | Frequency of report requests | Enjoyment | Decision effectiveness: | Increased revenues |
| Usefulness of system features and functions | Clarity | Number of reports generated | software satisfaction | Decision quality | Increased sales |
| System accuracy | Format | Charges for system use | Decision-making satisfaction | Improved decision analysis | Increased market share |
| System flexibility | Appearance | Regularity of use | | Correctness of decision | Increased profits |
| System reliability | Content | Use by whom?: | | Time to make decision | Return on investment |
| System sophistication | Accuracy | Direct vs. chauffeured use | | Confidence in decision | Return on assets |
| Integration of systems | Precision | Binary use: Use vs. nonuse | | Decision-making participation | Ratio of net income to operating expenses |
| System efficiency | Conciseness | Actual vs. reported use | | Improved individual productivity | Cost/benefit ratio |
| Resource utilization | Sufficiency | Nature of use: Use for intended purpose | | Change in decision | Stock price |
| Response time | Completeness | Appropriate use | | Causes: management action | Increased work volume |
| Turnaround time | Reliability | Type of information used | | Task performance | Product quality |
| | Currency | Purpose of use | | Quality of plans | Contribution to achieving goals |
| | Timeliness | Levels of use: | | Individual power or influence | Increased work volume |

| | | | |
|---|---|---|---|
| Uniqueness | General vs. specific | Personal valuation of IS | Service effectiveness |
| Comparability | Recurring use | Willingness to pay for information | |
| Quantitativeness | Institutionalization/ routinization of use | | |
| Freedom from bias | Report acceptance | | |
| | Percentage used vs. opportunity for use | | |
| | Report acceptance | | |
| | Percentage used vs. opportunity for use | | |
| | Voluntariness of use | | |
| | Motivation to use | | |

Table 1.2

Shortly after the IS Success Model was developed, Renkema and Berghout (1997) sought to identify the existing IS investment evaluation methodology in a review of the literature. They identified four basic approaches; namely, the financial approach, the multi-criteria approach, the ratio approach, and the portfolio approach.

The financial approach focuses heavily on the quantifiable financial aspects of an IS investment – the incoming and outgoing cash flows resulting from the IS implementation. Within this domain, the three most commonly used methods are: the payback period (i.e., time until the investment is paid back), the internal rate of return (i.e., determining if the investment will be profitable by discounting incoming and outgoing cash flows), and the net present value (i.e., if an investment exceeds a net present value of zero, then it is a viable investment) (Renkema & Berghout, 1997).

The multi-criteria approach is a method for converting multiple qualitative and quantitative measures into a single aggerated score. As noted earlier, a particular criterion is weighted by its relative importance. The most common multi-criteria approaches are:

information economics (i.e., an enhanced version of ROI; one that includes value linking, value acceleration, value restructuring, and innovation valuation techniques) and strategic investment evaluation and selection tool Amsterdam (SIESTA) (i.e., a tool for determining evaluation criteria) (Renkema & Berghout, 1997).

The ratio approach considers a series of ratios in determining how viable an IS investment is. For example, total IS expenditures against total turnover, or IS investment yields against total profits. An important element of the ratio approach is that it includes non-financial figures. The most commonly used methods are: return on management (ROM) (see Figure 1.4) and IT assessment (i.e., a method developed by Van der Zee and Koot that uses ratios and compares them to benchmarks) (Renkema & Berghout, 1997).

**ROM Calculation**

$$\begin{aligned} \text{ROM} &= \frac{\text{yieldings} - \text{full operating costs}}{\text{total costs} - \text{full operating costs}} \\ &= \frac{\text{value added by management}}{\text{full cost of management}} \\ &= 1 + \frac{\text{economic profit before taxes}}{\text{full cost of management}} \end{aligned}$$

Figure 1.4

Lastly, the portfolio approach is a method taken from the management literature. It entails differentiating between the wild cats, stars, cash cows, and dogs, i.e., plotting IS investment projects against several evaluation criteria. The common methods are: the Bedell's method (i.e., calculating the contribution of the IS), investment portfolio (i.e., simultaneously evaluating its contribution to the business and technology domains, and the financial

consequences), and investment mapping (i.e., plotting the investment orientation and the benefits of the investment) (Renkema & Berghout, 1997).

Renkema and Berghout addressed problems that occur in the Methodology category of the EC-MOF Taxonomy. The techniques they identified facilitate *how* an IS can be evaluated. Further addressing Methodology problems, Changchit et al. (1998) examined the role of benefit identification in IS evaluation. Similar to the characteristics of Symons' History and Information Flows and Procedures, their focus was centered on business processes and how an implemented IS might affect them. They interviewed IS managers and developed a model for benefit identification. The model is comprised of four iterative activities, which are depicted below in Figure 1.5.

**Benefit Identification Model**

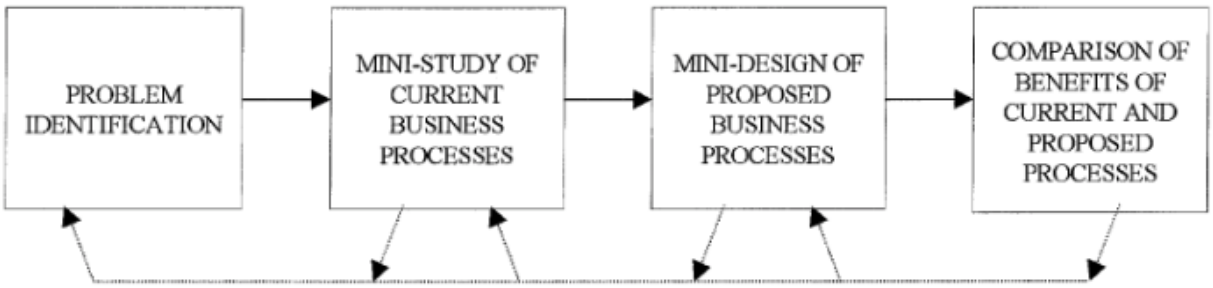



Figure 1.5

First is problem identification, where proactive identification of opportunities and initiatives occurs. Second, is the study of current processes and how they relate to the identified problem. Third, the proposed processes that rectify the problem are analyzed. Lastly, contrasting the benefits of existing processes with the proposed processes is carried out (Changchit et al., 1998).

In terms of its contribution to IS evaluation methodology, the key takeaways from this particular study are that a comparative analysis of the benefits derived from specific business processes can be an effective means of evaluating an IS. Additionally, it provided sixty diverse activities used by organizations for ascertaining items in each step of the model. The top ten activities for each respective category can be found in Table 1.3.

| **Top Ten Special Activities** | | | |
|---|---|---|---|
| **Problem Identification** | **Mini-Study of Current Business** | **Mini-Design of Proposed Business Processes** | **Compare Benefits of Current and Proposed Processes** |
| Discussion meetings | Process evaluation | Discussion meetings | Work measurement |
| Identify user's needs | Discussion meetings | Site visits (vendors' references) | Compute payback period |
| Interview users | Interview users | Vendors' presentations | Compute cost of storage that can be saved |
| Rank the priority of problems | Identify user's needs | Identify functions provided by the system | Find out what has been done in other plants |
| Identify problems | Create and study the flowchart of current processes | Discuss with vendors | Encourage proposers to quantify benefits |
| Create a task force | Develop a functionality list | Prototype testing | Prototype testing |
| Create a cross-functional team | Consult external consultants | Find out what has been done in other plants | Proposers' presentation |
| Create a re-engineering team | Identify various costs incurred in current processes | Interview users | Ask proposers to prepare benefit justification form |
| Weight all requirements given by users | Quantitative analyses of current process | Talk with company using proposed system | Compute cost of paper that can be saved |

Table 1.3

A chronological ordered review of the literature illustrates how IS evaluation has developed over time - each article building on its predecessor while adding unique perspectives and approaches. The timeline depicted below in Figure 1.6 shows each article's publishing year and summarizes its contribution to IS evaluation.

**IS Evaluation Literature Timeline**

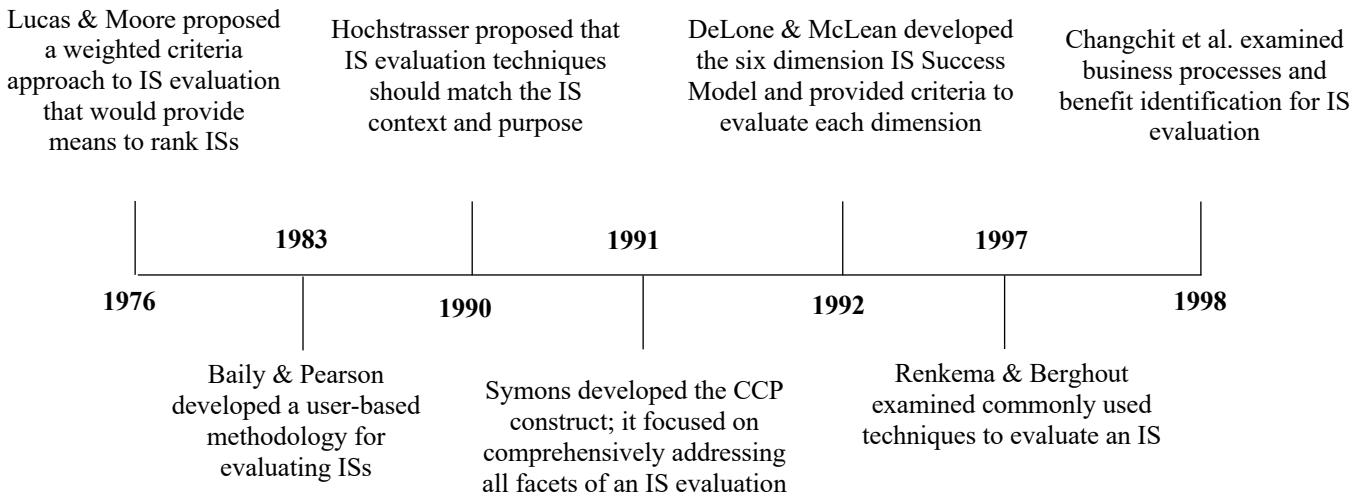



Figure 1.6

As one can see, IS evaluation initially focused on methodology for facilitating the process of ranking an IS amongst alternatives (MCE). Shortly thereafter, the concept of a user-emphasized approach to evaluation was introduced. The MCE method and the user-emphasized concepts can be seen later down the timeline in the Symons, DeLone and McLean, and Changchit et al., and the Renkema and Berghout articles, respectively.

After the foundation was laid by these first two articles, the introduction of the evaluation processes was considered in the subsequent two articles; in the matching of specific evaluative techniques to the IS context and in the content, context, and process (CCP) construct

(Hochstrasser and Symons, respectively). In addition, the need for more robust methodology and approaches were filled by these two articles.

While these four articles' concepts and approaches made a significant contribution to the IS literature, DeLone and McLean realized that the success of an implemented IS is multi-faceted. Therefore, the components most essential to IS success need to be evaluated. Moreover, if those essential components could be quantified and measured, it would greatly reduce the uncertainty involved in determining whether or not an IS will be successful.

Further adding to the considerations regarding the dimensionality of success, Renkema & Berghout reviewed techniques utilized by organizations to evaluate how successful an IS might be, while also recognizing the value of the MCE method (Lucas and Moore).

Lastly, Changchit et al. built upon evaluation as a process (Hochstasser and Symons) by proposing the analysis of business processes and then identifying what benefits would be derived from their modification.

In addition to discussing the way in which each article contributed to IS evaluation over time, each article can be classified by how it addresses problems that occur in the EC-MOF Taxonomy. Figure 1.7 depicts the placement of each article within the EC-MOF Taxonomy Venn Diagram (Figure 1.0).

**Classification of IS Literature Addressing Problems in EC-MOF Taxonomy**

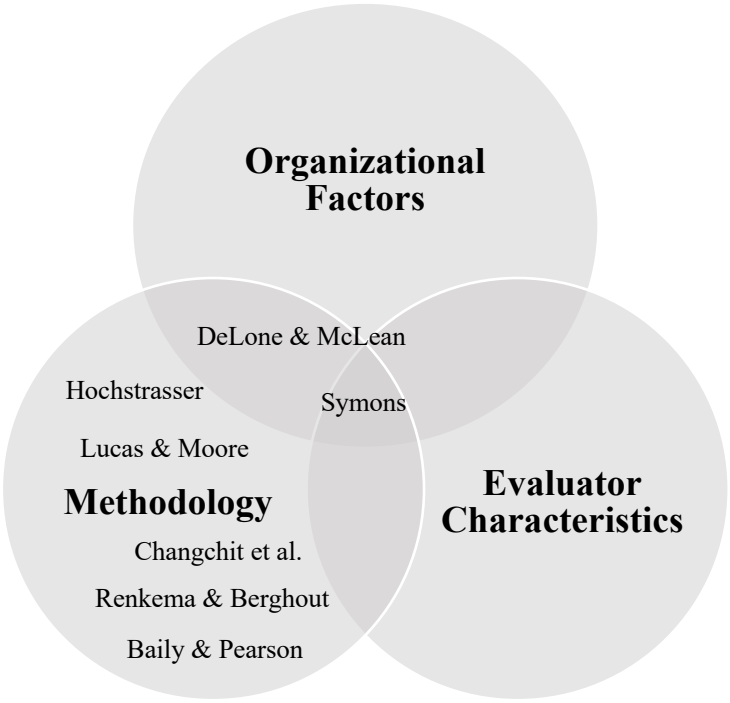
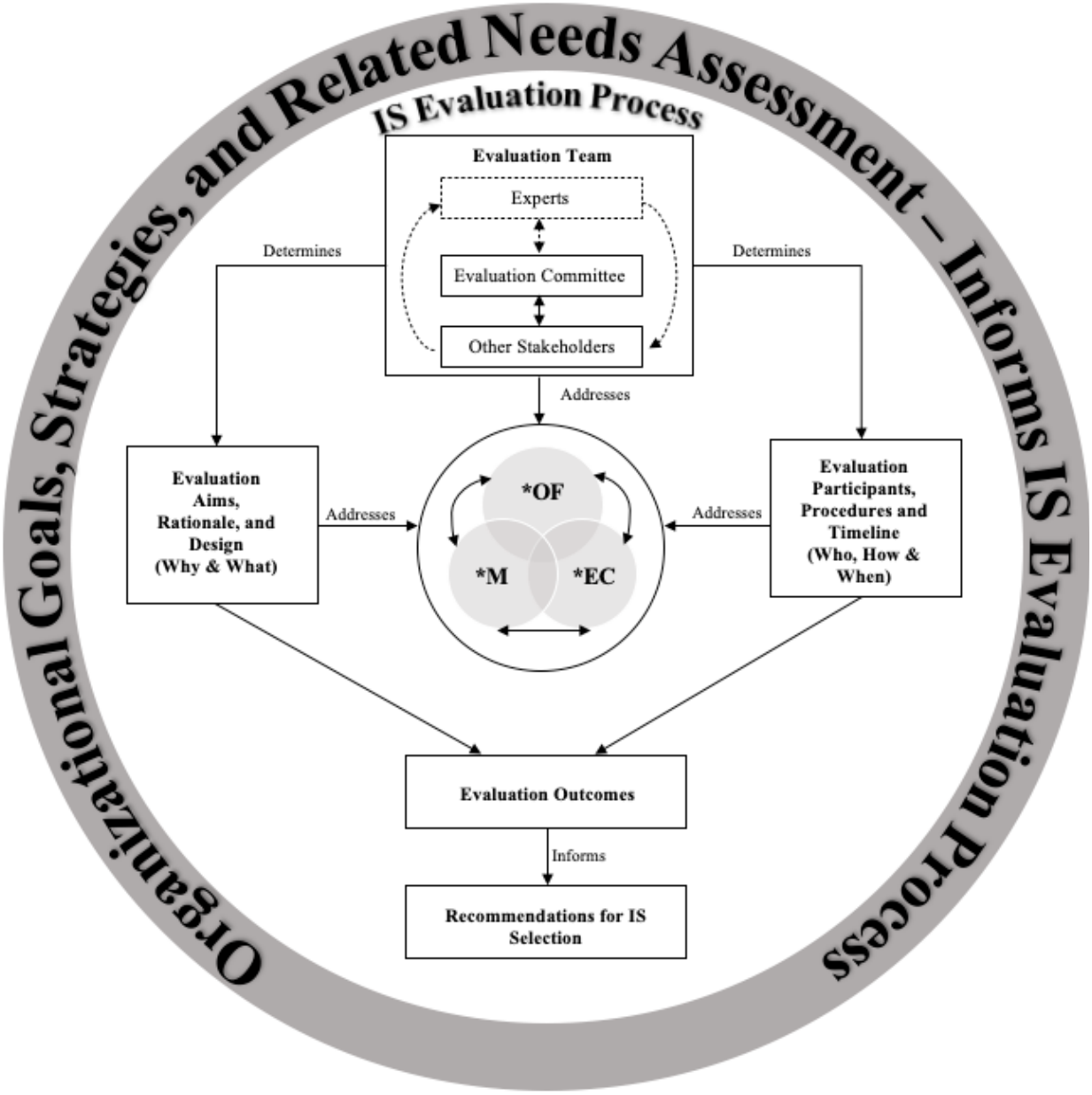



Figure 1.7

As one can see, the literature heavily focuses on problems that arise in the Methodology category. This emphasis signifies a need to consider other approaches and concepts that can address Evaluator Characteristics and Organizational Factors problems. Nonetheless, the reviewed literature can be used to inform a framework that comprehensively guides organizations through the evaluation process. Development of such a framework will be discussed in the subsequent section, IS Evaluation Framework.

**IS EVALUATION FRAMEWORK**




OF = Organizational Factors EC = Evaluator Characteristics M = Methodology

Figure 1.8

Presented in Figure 1.8 is the IS Evaluation Framework. Informed by the extant literature, the framework provides general guidelines that are not specific to any particular setting or context. Rather, it takes an all-encompassing approach, which accounts for the diverse and varying needs across many industries. Prior to discussion of the IS Evaluation Framework, it is important to note a reoccurring theme in the IS evaluation literature. That is, IS evaluation is critical for successful IS outcomes; the literature shows a strong and positive relationship between an effective IS evaluation and IS success (DeLoan & McLean, 1992). Therefore, a well-defined but flexible IS evaluation process incorporated into the organizational strategy is essential (Symons, 1991) – addressing the relevant organizational strategic goals effectively largely depends on it. Notably, in this context, an organizational culture that supports IS evaluation and recognizes its importance is a contributing factor (e.g., if employees feel it is a waste of time, the benefits of their participation could be limited, undermining the value of the evaluation). In sum, IS evaluation should flow naturally from organizational goals and strategies; especially when coupled with a culture that supports it, there is a strong foundation for an effective IS evaluation to be carried out. As such, this concept is woven into the foundation of the IS Evaluation Framework, illustrated in the circle that surrounds the IS Evaluation Process. As one can see, the organizational strategy and goals, along with the related needs assessment, inform the development of the IS evaluation aims, and subsequently, its design, methods, and timeline.

The most important component of the IS Evaluation Process, beyond aims informed by organizational goals, strategies, and needs assessment, is the specification of *why* and *what* - the rationale for an evaluation addressing specific aims and what evaluation design can effectively address those aims. To guide the clarification of the *why* and the *what* benefits from the

specification of three subgroups articulating the evaluation performance. The first is comprised of Experts (an IS expert and an evaluation expert), an Evaluation Committee (selectively formed by the organization), and Other Stakeholders (identified by the needs assessment, e.g., users). Experts are not always necessary (as indicated by the dashed line) – some evaluations may not require them, or they may not be affordable. In these instances, a qualified candidate (or candidates) from within the organization should be identified to become well versed in these domains and serve as resident experts. Evaluation experts are highly recommended for carrying out evaluations until evaluation processes are well understood and established.

The Evaluation Committee oversees the IS evaluation – from start to finish. As such, they are critical for facilitating each step of the evaluation and ensuring it is carried out comprehensively with integrity, precision, and active participation. They should be viewed as the "coach" of the evaluation; calling the plays and ensuring each team member contributes meaningfully to team goals.

Given the role the Evaluation Committee plays, it is essential to have a diverse and motivated set of individuals who will be objective and enthusiastic about the evaluation process. A good approach would be to include members of the management team that have these qualities and adequately represents the Other Stakeholders' diverse needs.

The Other Stakeholders group is comprised of individuals who will be impacted by the implementation of the IS. This includes, for example, users (customers and employees), management (lower, mid, and upper), and entities external from the organization (e.g., investors). The needs assessment should inform the identification of these individuals. Just as the Evaluation Committee is essential to the Evaluation Process, so are the Other Stakeholders,

particularly the users. The literature suggests that users' inputs can be a key factor in IS success (Baily & Person, 1983; DeLone & McLean, 1992; Symons, 1991). As such, the IS users should make up a significant portion of the Other Stakeholders group, and their input weighted accordingly.

As one can see, there are information flows between the three groups that comprise the Evaluation Team. Such open and active communications among stakeholders and others is supported by the CCP model (Symons, 1991). Experts can interact with the Evaluation Committee or individual stakeholders to help guide the evaluation or provide pertinent IS knowledge. Likewise, Other Stakeholders interact with the Evaluation Committee to provide relevant information on needs and system use. Collectively, there should be open and transparent communication flows across all three groups.

After the Evaluation Team is established, and the evaluation aims are clarified, the rationale should be specified. Although informed by the relevant literature and guiding models, the heart of the rationale lies in the specification of expected benefits to the organization (Changchit et al., 1998) and the organizational goals positively affected. Following the articulation of the rationale, the *what* can be determined. Namely, the evaluation design required to address each of the evaluation aims can be detailed. One of the most essential elements of the evaluation design is selecting evaluation outcome criteria; it is the basis for how an IS will be judged and ranked amongst alternatives. The literature supports context-specific criteria (i.e., different systems will require different criteria) and emphasizes intangibles (DeLone & McLean, 1992; Baily & Person, 1983). Moreover, the literature also supports selecting criteria focused on system use (i.e., the system user) (DeLone & McLean, 1992; Baily & Person, 1983). A collective

effort from the Evaluation Team should inform the selection of this criteria. Furthermore, there should be well-defined linkages among the criteria, organizational goals and strategy, and, in particular, the needs assessment.

Also involved with the evaluation design are the different approaches one can take. Renkema and Berghout (1996) contribute to this particular component of the framework in their specification of four different approaches. Namely, the financial approach, the multi-criteria approach, the ratio approach, and the portfolio approach. The selection of an appropriate approach should be contingent on the particular IS context (Hochstrasser, 1990). For example, an IS that primarily has quantifiable economic benefits should be evaluated using a financial approach. However, most evaluations will benefit from the use of a variety of techniques and approaches.

The *who, how,* and *when* are the specifics of the evaluation. The *who* refers to the evaluation participants – including the users (identified by the Evaluation Team and informed by the needs assessment). Ideally, when applicable, the evaluation participants should be randomly selected (e.g., stratified random sample) and be representative of the population that uses the system. Selecting participants in this manner allows for the evaluation of the system to be accurately assessed by who uses the system the most. Furthermore, randomly selecting the participants ensures the capturing of diverse inputs and helps to instill the evaluation culture within the organization (i.e., users feel that they are meaningfully contributing to the selection of the IS).

The *how* of the evaluation is concerned with the manner in which the evaluation participants are involved in the sequence of evaluation procedures. More specifically, it is the

evaluation participants following the evaluation protocols. These procedures should be developed by the Evaluation Team and fit the specific needs of the organization. One procedure noted in the literature entailed the identification of business processes affected by the implementation of the IS through problem identification, studying current and proposed business processes, and comparing them (Changchit et al., 1998). Other common procedures include discussion groups or other focus groups, surveys, interviews, and systematic observation (Pearce et al., 2016).

The need for an IS evaluation will largely dictate *when* an evaluation takes place; however, it is advantageous to plan ahead. Effective evaluations take a significant amount of time, especially those large in scope. Part of designing evaluations responsive to organizational strategies and goals is continually recognizing the organizational needs and planning accordingly. Once the Evaluation Team is established, there should be ongoing communication amongst the stakeholders and evaluation committee, even when an evaluation is not taking place. This communication provides an active feedback mechanism, which allows for needs to be continually assessed in a less formal matter (in comparison to the needs assessment). Thus, the potential for an evaluation to be carried out can be foreseen well ahead of time.

Developing a timeline for an evaluation can help the evaluation to stay on track; by setting time-specific objectives for each step of the evaluation. Moreover, it can serve as a motivational factor and foster an environment that supports accountability. This can be accomplished in a formal document that specifies the goals, objectives, activities involved, the deadline, and who is responsible. The timeline should be developed with input from each group of the Evaluation Team.

Performing the IS evaluation in this manner helps to address the problems in the EC-MOF Taxonomy. More specifically, having the organizational goals, strategies, and related needs assessment inform the evaluation process helps to mitigate problems that occur in the Organizational Factors category. Comprising an Evaluation Team containing Experts, an Evaluation Committee, and Other Stakeholders establishes a basis to effectively address problems that arise in the Methodology and Evaluator Characteristics categories.

The Evaluation Outcome is the sum of the evaluated ISs - flowing from the (1) evaluation aims, rationale, and design (why and what), and (2) the evaluation participants, procedures, and timeline (who, how, and when). The Evaluation Outcome allows the ISs to be ranked amongst alternatives and subsequently informs the Recommendations for IS Selection. Each group of the Evaluation Team should be involved in the Recommendations for IS Selection; the selected IS should not be chosen solely by management responsible for its implementation.

## LIMITATIONS AND ASSUMPTIONS

Given the complex nature of IS evaluation, coupled with the plethora of diverse ISs and industry contexts, it is challenging to design a robust framework that will comprehensively address every organization's evaluative needs. In this connection, there are several notable limitations to the proposed IS Evaluation Framework, beginning with the organizational needs assessment. More specifically, the framework assumes that the needs assessment is completed comprehensively and accurately and conveys the most important organizational needs. The needs assessment supports the specification of the evaluation aims, rationale, design, and evaluation participants. Therefore, it is imperative that it is conducted sufficiently.

In addition to the needs assessment assumption, the framework also assumes that the organization is willing to incorporate IS evaluation practices into the organizational strategy and foster a culture that supports and values it. The objective of this IS evaluation model should be seen as a long-term strategy, rather than a short-term goal. In an organization's lifetime, it is feasible that it will undergo many IS evaluations, whether they be large or small in scope. Additionally, ISs will become more essential as technology continues to develop at an exponential rate. Therefore, incorporating IS evaluation is not only imperative for the IS Evaluation Framework; it also can factor into an organization's ability to survive.

A third assumption that also is critical for the IS Evaluation Framework is that the organization has the resources necessary to implement it. While the framework can be tailored to fit organizations of varying sizes and contexts, it may not necessarily be feasible for small organizations; namely, those with few employees. For example, an organization with fewer than five employees may not be able to carry out the essential procedures of the evaluation, nor may it

have a resident expert (assuming the organization cannot afford to hire one). These challenges illustrate how navigating the evaluation process with the proposed framework as a small business would not necessarily be a viable option. However, for these organizations with limited resources (i.e., few employees), they can still use the framework's primary principles to carry out an effective evaluation.

In the same vein as the resource limitation, the costs associated with implementing the IS Evaluation Framework were not explored. Due to the varying sizes and different organizational contexts, it is hard to estimate these costs. However, one can assume that devoting resources to such a framework would involve substantial costs – including the time it takes to develop initially. Therefore, this can be seen as another limiting factor.

Another limitation alluded to above concerns the specifics of the framework; the framework is not overly detailed. Thus, there is a lot of need for clarification of particular applications of the defined evaluation processes, especially those concerning the methodology. It is up to the Evaluation Team to interpret and better define the framework's subcomponents, fit them into the organizational context, and make informed choices based on existing IS literature.

The responsibilities of the Evaluation Team members and their integral and vital roles in the IS Evaluation Framework highlight how they are instrumental in the success of the entire IS evaluation process. By implication, there is a related limitation to note. That is, successful IS evaluation outcomes are contingent on the composition and development of this team; poor evaluation outcomes are likely to occur if members are not carefully selected. Taking from the bad apple proverb, "one bad apple spoils the bunch."

Another noteworthy limitation was indicated in the literature review that was used to inform the conceptual framework. While the literature review was thorough, there may have been pertinent literature that was missed – literature that could have provided a more well-informed framework. In addition, the limited scope of the literature reviewed possibly constrains the specification of the pre-evaluation processes. The literature required to examine these processes in-depth was not uncovered; therefore, it is possible that relevant information that could have added to the validity and relevance of these processes was not found.

Also relevant to limited pre-evaluation processes, is how an organization ascertains candidate ISs. There are other conceivable ways that an organization might use to populate their candidate system pool. For instance, a small business may not have the resources to go through the RFP process. Thus, the only viable option they have to populate the candidate system pool is to conduct their own research.

Lastly, the proposed framework does not address all of the ways in which evaluation processes can go wrong; there are a plethora of complex interactions that occur within an organization that cannot be well articulated and accounted for in the framework. Some further examples include upper management not caring for evaluation, misalignment of organizational goals (e.g., goals that do not embrace a technology infrastructure), or a manager or group manipulating participants into favoring a particular IS.

## CONCLUSION

The introduction to this paper began with a brain-related analogy, comparing its primary functions to that of an IS. Circling back to this analogy, another similar analogy can be made; one that is very applicable to the subject of this paper. This similar analogy is about the complexities of the brain and IS evaluation. More specifically, just because we know the parts of the brain, what the parts are responsible for, and how they interact, does not mean one can easily explain all of its functional intricacies. Likewise, knowing the parts of an IS evaluation, what they are responsible for, and how they interact does not fully address all of its inherent complexities. Both IS evaluation and the brain have been studied for many years; however, their functional complexities are so significant that much further research is needed to better understand them.

The research for this paper entailed identifying and articulating the IS evaluation problem, developing a taxonomy to classify problems that occur in the IS evaluation context, reviewing the existing literature on IS evaluation problems and approaches to their resolution, formulating a conceptual IS Evaluation Framework, and determining its limitations. Each component will be briefly summarized.

IS evaluation was characterized as highly complex and multidimensional. More specifically, it was defined as the set of procedures for assessing how well an IS fulfills specific organizational requirements and goals. The problems of IS evaluation are well articulated by specifying intricacies involved in assessing an IS that impacts various levels of users and organizational departments.

Within this evaluative context, many problems can occur; problems that can be classified into a taxonomy that includes the problem domains of Evaluator Characteristics, Methodology, and Organizational Factors (EC-MOF Taxonomy). Classifying the IS evaluation problems in this manner facilitates organization, which allows a directed approach in identifying mitigative factors.

In a review of the literature, many proposed solutions to the evaluation problem were identified. Most notable was the IS Success Model (DeLone & McLean, 1992) and the CCP construct (Symons, 1991). The IS Success Model identified the six most pertinent factors in IS success and provided empirically studied criteria for an evaluation. The CCP provided guidance in the specification of the content, context, and process of an IS evaluation. Other evaluation approaches and methods treated in the literature included the MCE method (Lucas & Moore, 1975), the user satisfaction questionnaire (Baily and Pearson, 1983), technique matching (Hochstrasser, 1990), investment evaluation (Renkema & Berghout, 1996), and benefit identification (Changchiet et al., 1998).

Informed by the literature review, a conceptual IS Evaluation Framework that can be used in a variety of contexts was developed. The key elements of the framework include incorporating organizational goals and strategies into the evaluation. This, coupled with the needs related assessment, inform the evaluation processes. The evaluation processes began with the organization of an Evaluation Team comprised of Experts, an Evaluation Committee, and Other Stakeholders. The Evaluation Team determines the evaluation aims, rationale, and design (*why* and *what*). In addition, they also determine the evaluation participants, procedures, and timeline (*who, how,* and *when*). Performing the Evaluation in this manner helps to address

problems that occur in the EC-MOF Taxonomy. Flowing from completion of the above processes are the Evaluation Outcomes. The Evaluation Outcomes informs Recommendations for IS Selection.

Despite efforts to design a comprehensive framework, there were some notable limitations and weaknesses. Namely, the framework is contingent on the needs assessment and organizational resources necessary to complete the IS Evaluation. In addition, other limitations are implementation issues with small organizations, the selection of the Evaluation Team, unpredictable costs associated with implementing the framework, non-specificity of some evaluation processes, issues with pre-evaluation processes, and not accounting for all conceivable evaluation errors.

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