

Strategy for Comparing and Adopting Strengths

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Abstract. To perform evaluation and improvement activities, the definition of a goal is usually the starting point of a project. Typically, a goal contains the statement of a purpose. In the Software Engineering literature, different evaluation purposes such as to understand, monitor, predict, improve, control, compare and selection are mentioned. These purposes share distinctive and common aspects as we discuss in the present work. A categorization that helps a better understanding of them is also proposed. Additionally, in order to reach the purpose of a goal, a strategy should be selected. We have envisioned different strategies for different purposes. Basically, a strategy describes a course of action by means of the specification of activities and methods. In order to analyze the applicability of a strategy, we illustrate the strategy for the *compare and adopt* purpose for adopting strengths in a new app comparing four social network applications.

Keywords: Goal, Evaluation purpose, Compare and adopt, Strategy.

1 Introduction

In any mature organization, the continuous quality improvement of its resources, processes, products and services should be ensured. Sometimes, software organizations need to develop new applications or to improve the existent ones, so, it would be desirable to take into account, as a reference, others applications to adopt their strengths. For this end, it is not only necessary to have Measurement and Evaluation (ME) activities which allow to understand the actual or estimated situation of an entity through strengths and weakness analysis, but also is important to have activities which allow to do changes oriented to the improvement (MEC will stand for ME and Change).

An engineering way to organize the ME/MEC activities and to manage resources is by project formulation. Considering project definitions given in [6, 12], both agree on that it is necessary to determine a project plan. During planning and resource allocation, the goal and its purpose are considered as well as the suitable strategy is selected aimed at achieving the goal. The selected strategy should describe the course of action for the goal and the particular purpose, by means of the specification of activities and methods. As a consequence, software organizations that consider ME or MEC projects in a systematic way can ensure process repeatability and consistency of results.

Aimed at illustrating the goal, purpose and strategy concepts, Fig. 1 outlines some

relations between them, which will serve as the basis for understanding this work. An organizational goal can be both business and information need goal. The latter supports the former, and consequently has the *analyze* purpose. Also, an information need goal could require a ME information need goal, which involve ME activities. Furthermore, typical evaluation purposes for business goals can be to understand, monitor, control, improve, adopt, among others. However, we observe that in the state-of-the-art literature there is some lack of consensus in their descriptions and/or definitions.

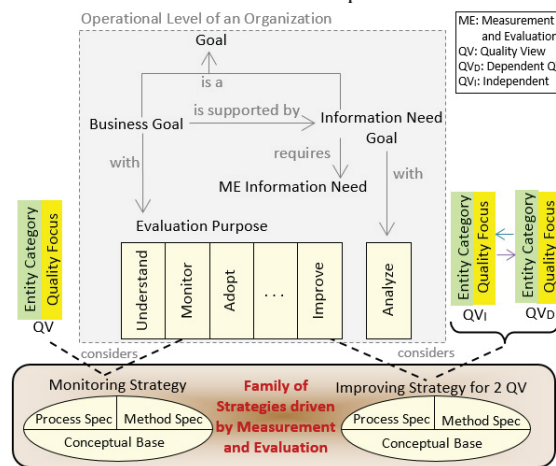


Fig. 1. Schema that relates Business Goal and Information Need Goal with Evaluation Purposes. Also, a Family of Strategies considers different purposes and Quality Views.

On the other side, Fig. 1 shows that a ME/MEC strategy considers an evaluation purpose and, one or more quality views. E.g., the *monitoring* strategy considers the *monitor* purpose and one quality view. According to [11], a strategy should have at least three capabilities such as a domain conceptual base, and the process and method specifications. These allow to have explicitly defined the ME/MEC domain, to know which generic and specific activities intervene, and how to carry out them through methods. As a strategy considers the quality view concept, it is worth saying that it represents an association between an entity category and a quality focus. Examples of quality views with entity category and quality focus names, in addition to the relationships between them are shown in Fig. 2 (see [14] for more details).

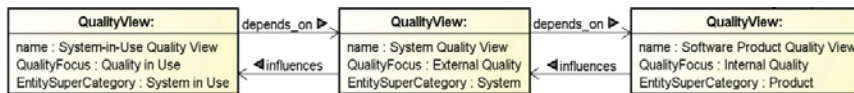


Fig. 2. Example of 'depends on' and 'influences' relationships between different Quality Views.

Therefore, in a specific ME or MEC project, the more suitable strategy should be selected from a family of strategies, taking into account the evaluation purpose of the goal and the amount and types of quality views.

In summary, the main contributions of this work are: i) to identify and categorize a

set of evaluation purposes for business goals and information need goals at operational level, which can be satisfied through the systematic use of strategies driven by ME, analysis and, eventually, change; and ii) to illustrate the applicability of the *comparing and adopting* strategy with the aim of determining Usability strengths from LinkedIn, Instagram, Twitter and Facebook social network apps to be adopted in a new entity.

The rest of the article is organized as follows. Section 2 defines the main terms for a better comprehension of this work. Section 3 analyses evaluation purposes in the context of related literature and proposes three categories for the considered purposes. Section 4 specifies a strategy for the *compare and adopt* purpose, illustrating it with a concrete evaluation scenario, which then is developed in Section 5. Section 6 discusses related work and, finally, Section 7 summarizes conclusions and future works.

2 Definition of some Terms

The terminology used in this work is grounded on conceptual bases structured in ontologies [2, 14]. Terms presented in Fig. 1 are next defined:

- *Goal*: the statement of the aim to be achieved by an organization which considers the propositional content of a *purpose* in a given time frame.
- *Business Goal*: it is the main *goal* that the organization intends to achieve.
- *Information Need Goal*: it is a *goal* intended to get insight for a given *business goal*.
- *ME Information Need Goal*: it is an *information need goal* driven by ME activities.
- *Purpose*: the rationale for achieving a specific *goal*.
- *Strategy*: principles, patterns, and particular domain concepts and framework that can be specified by a set of core processes, in addition to a set of appropriated methods and tools, as core resources, for helping to achieve the project's *goal purpose*.

3 Evaluation Purposes and Categories

As introduced in Section 1, in order to select a strategy from a family of strategies, three key factors should be taken into account, i.e., the business goal purpose, as well as the amount and type of involved views. In this section we address evaluation purposes.

Analyzing the ME literature, it is important to remark that there is still no consensus about definitions on different purposes, particularly, for those purposes which involve evaluation and change activities. Many works consider that *characterize* and *understand* purposes are the same one, which involve to understand or to take a snapshot of the current situation of an entity for establishing baselines for future assessment [3, 7, 8, 10]. However, the *characterize* purpose could be previous to *understand*, since it would allow the characterization of an entity from the relevant nonfunctional requirements identification standpoint. Once identified the relevant characteristics, the understanding of the current entity state can be done by means of ME activities. On the other hand, the *predict* purpose usually is intended to identify and understand cause/effect relationships between characteristics/attributes of entities [7] with the aim of establishing predictive models that could be useful in MEC activities.

Besides, the *monitor* purpose implies tracking the status or performance of attributes

of an entity [3]. That is, it consists of a continuous understanding of an entity over time for analyzing its evolution and possible trends. Note that monitoring involves the *understand* purpose applied in a repetitive way, with some frequency in a defined interval of time. Sometimes, the *control* purpose is related with *monitor* since control addresses the identification of deviations that influence the status or performance of processes and products for reducing risks [3]. Some authors [3, 8] consider the *control* and *monitor* purposes as a single purpose, due to they involve a continual evaluation and occasionally changes for improving the expected performance.

On the other hand, Precece and Rombach [14] categorized evaluation purposes as passive or active: “*passive purposes are aimed at better understanding or visualizing existing software items without influencing them, whereas active ones are aimed at actually influencing them in some way*”. We can infer that purposes for the active category always imply changes on the target entity and/or its context, aimed at improving it. Conversely, evaluation purposes for the passive category imply no changes.

We observe that both categories, however, do not fit well the intention of all evaluation purposes. For example, the *compare* and *adopt* purpose, which involves the determination of strengths and weakness of a set of preselected representative entities, and the adoption of strengths in a new entity or in one that already exist, could be both active and passive. If it is about adopting detected strengths in an existent entity, this purpose implies changes and falls into the active category; otherwise, if the strengths are adopted in a new entity to be developed, it falls into the passive category. Furthermore, exists the *select an alternative* purpose among preselected competitive entities aimed at adopting and installing it. As a result, for purposes that have entity preselection -independently if purposes are active or passive- a new category can be envisioned. Consequently, we represent three categories for evaluation purposes, namely: *Characterize and Understand*, *Control and Change*, and *Adopt an Alternative*.

The ***Characterize and Understand*** category includes purposes such as to *understand*, *monitor* and *predict*. *Understand* implies getting information about the current state/performance of an entity, taking into account that changes are not performed on this entity. Regarding the *monitor* purpose, as above mentioned, it consists of a continuous understanding over time. The *predict* purpose helps to understand possible cause-effect relationships among characteristics/attributes of entities. This category matches the passive category mentioned by Precece and Rombach.

The ***Control and Change*** category includes purposes such as to *improve* and to *monitor and control*. These purposes are not just intended for understanding the current state or performance of an entity, but also for improving it by introducing changes. In addition, these purposes can be achieved taking into account one or two quality views considering the relationships shown in Fig. 2. The *improve* purpose is related with the identification of problems, vulnerabilities and others opportunities for improving the entity quality. So it always implies changes. In turn, the *monitor and control* purpose implies performing a critical analysis in order to maintain under control the detected performance problems by doing corrective actions, if needed. Control and Change category is similar to the active category considered in [13].

The ***Adopt an Alternative*** category includes purposes such as to *select an alternative* and to *compare and adopt*. These purposes share one activity which is devoted to pre-

select competitive or representative entities. The *select an alternative* purpose implies to understand the current state of each preselected competitive entity and therefore select the one with best performance. Note that the selected entity does not undergo changes, but rather is adopted for installation and/or use. On the other hand, the *compare and adopt* purpose is based on determining strengths and weaknesses of a set of representative entities in order to adopt strengths in an existing entity or in one to be developed. Thus, this purpose may imply changes on the existing entity. In the next Section, the *comparing and adopting* strategy is introduced.

4 One Evaluation Strategy from the Family of Strategies

Given an evaluation goal, the selection of the suitable strategy from a family of strategies is a critical aspect. The strategy defines a specific course of action to be followed for achieving the goal purpose. In order to illustrate a ME/MEC strategy, we use an evaluation scenario for the *compare and adopt* purpose. This scenario includes the business goal purpose, the amount/type of involved views, the description and example of the scenario, and the specification of the generic process of the strategy:

Business goal purpose: Compare and adopt / Amount of views: One / Type: Quality

Scenario description: the business goal purpose at operational level is to compare characteristics and attributes from a set of representative entities, in a given context, with the aim of adopting recommended strengths through the systematic use of a comparing strategy driven by ME, analysis and eventually, change. The measurement activity is performed by quantifying attributes (using metrics) and the evaluation activity is performed by interpreting characteristics and attributes (using indicators). The comparative analysis is based on determining strengths and weaknesses of the preselected entities in a given moment, for recommending and adopting the detected strengths in a new entity or in one that already exists.

Evaluation scenario example:

- *Business goal statement:* compare a set of social network applications for smartphones with the aim of adopting the best Usability characteristics in a new social network application for smartphones.
- *Quality View:* System Quality View / *Entity category:* System / *Quality Focus:* External Quality / *Entity subcategory:* Social network applications for smartphones.
- *Concrete entities:* Facebook, Instagram, Twitter and LinkedIn.
- *Characteristics:* Usability (*Sub-characteristics:* Comprehensibility, Learnability, Operability and User error protection).

Strategy to be applied: GOCAMECom (*Goal-Oriented Context-Aware Measurement, Evaluation and Comparison*).

Generic process specification for GOCAMECom: see Fig. 3.

Process description: The GOCAMECom process begins with the preselection of representative entities to be compared (A0 activity in Fig. 3). The preselection can be based on methods such as expert judgment, case studies, among others. Note that if the strengths will be adopted in an existing entity, this should be one out of the preselected entities. Then, A1 is devoted to define the characteristics and attributes to be evaluated.

In the A2 activity the ME are designed by selecting the most suitable metrics and indicators from a repository. Additionally, the A4 activity is divided into two sub-activities. In A4.1 the analysis is designed, which includes, among others aspects, the establishment of criteria for recommending and adopting. A4.1 can be done in parallel with A3, which involves implementing the ME per each preselected entity (producing measures and indicator's values). In the sequel, A4.2 uses the measures, indicator's values and the analysis specification as input, and produces the recommendation report as output. This report contains the strengths to be adopted in an existing target entity or in a new one to be developed. If the target entity already exists and weaknesses were detected, then changes should be carried out for adopting the strengths of the other compared entities. Consequently, for designing and implementing changes, A5 and A6 must be done respectively. Otherwise, for a new entity, A5 and A6 should not be performed.

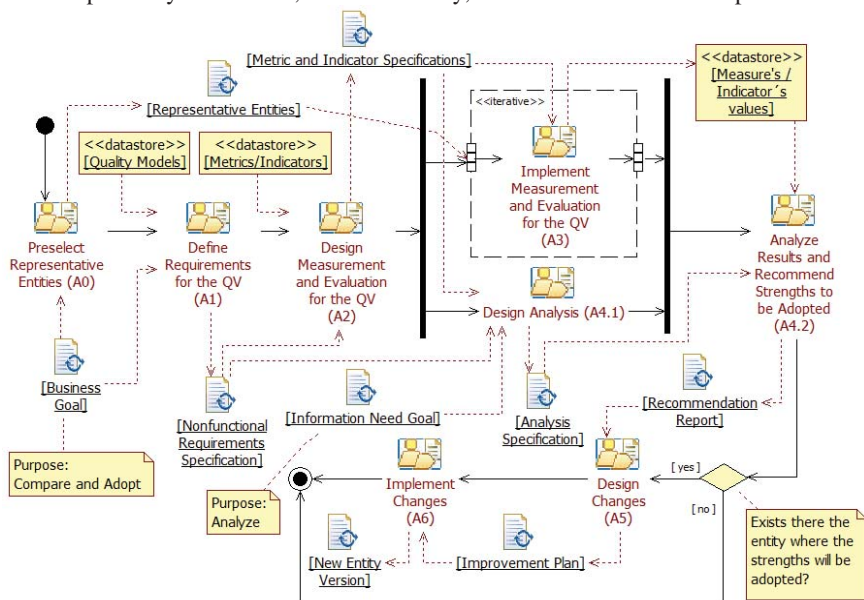


Fig. 3. Generic process specification for the GOCAMECom strategy for one Quality View (QV)

5 Application of the *Comparing and Adopting* Strategy

In the above scenario example, the statement of the business goal contains the *compare and adopt* purpose. This belongs to the *Adopt an Alternative* category. Also, the amount of involved quality views is one: The *System Quality View*. So, GOCAMECom is the strategy to be instantiated for achieving this goal purpose. Let's describe its activities.

The first performed activity was A0, which allowed to select a set of representative entities to be evaluated for analyzing their strengths to be adopted. The selection was done at random from the 15 most popular social network apps listed at www.ebizmba.com/articles/social-networking-websites. As a result, four representative

entities were selected: Instagram (v.10.0.0), Facebook (v. 106.0.0.26.28), Twitter (v. 4.0.100) and LinkedIn (v. 6.28.0). Note that the Android version per each selected app was the most recent at the time of this study (in Dec., 2016).

Name: Performance Level of the Foreign Language Support (P_FLS)	
Author: Santos L.	Version: 1.1
Elementary model: Specification: the mapping is: P_FLS=0 iff FL _{SL} =0; P_FLS=80 iff FL _{SL} =1; P_FLS=100 iff FL _{SL} =2.	
Decision criterion (3 acceptability levels):	
Name 1: Unsatisfactory; Range: if $0 \leq P_FLS < 80$	
Description: Indicates that it is not advisable to be adopted.	
Name 2: Marginal; Range: if $80 \leq P_FLS < 90$	
Description: Indicates that it could be adopted.	
Name 3: Satisfactory; Range: if $90 \leq P_FLS \leq 100$	
Description: Indicates that it is advisable to be adopted.	
Numerical Scale: Value Type: real Scale Type: ratio Unit: Name: percentage Acronym: %	

Fig. 4. Elementary indicator specification for the *Foreign Language Support* attribute. Note that FL_{SL} stands for the *Foreign Language Support Level* metric, with 0, 1 or 2 allowed values.

Table 1. Evaluation results (in [%]) for the Usability characteristics and attributes for the 4 selected apps. The green color means “satisfactory”; yellow “marginal”, and red “unsatisfactory”.

Characteristics and Attributes (in <i>italic</i>)	Facebook	Twitter	Instagram	LinkedIn
1. Usability	87.56 ●	85.65 ●	70.47 ●	69.85 ●
1.1. Understandability	91.15 ●	85.12 ●	89.82 ●	35.88 ●
1.1.1. Familiarity	91.15 ●	85.12 ●	89.82 ●	35.88 ●
1.1.1.1. <i>Global Organization Scheme Understandability</i>	100 ●	100 ●	100 ●	0 ●
1.1.1.2. <i>Control Icon Ease to be Recognized</i>	77.88 ●	87.80 ●	74.56 ●	89.71 ●
1.1.1.2.1. <i>Main Control Icon Ease to be Recognized</i>	85.71 ●	80 ●	80 ●	85.71 ●
1.1.1.2.2. <i>Contextual Control Icon Ease to be Recognized</i>	66.67 ●	100 ●	66.67 ●	95.83 ●
1.1.1.3. <i>Foreign Language Support</i>	100 ●	0 ●	100 ●	0 ●
1.2. Learnability	88.22 ●	81.34 ●	77.10 ●	81.23 ●
1.2.1. Feedback Suitability	86.46 ●	79.38 ●	74.25 ●	87.65 ●
1.2.1.1. <i>Current Location Feedback Appropriateness</i>	66.67 ●	100 ●	80 ●	83.33 ●
1.2.1.2. <i>Alert Notification Feedback Appropriateness</i>	100 ●	62.50 ●	100 ●	87.50 ●
1.2.1.3. <i>Error Message Appropriateness</i>	93.75 ●	75 ●	37.50 ●	92.86 ●
1.2.2. Helpfulness	90 ●	83.33 ●	80 ●	75 ●
1.2.2.1. <i>Context-Sensitive Help Appropriateness</i>	90 ●	83.33 ●	80 ●	75 ●
1.3. Operability	80.96 ●	98.15 ●	71.76 ●	89.19 ●
1.3.1. Data Entry Ease	80 ●	100 ●	60 ●	80 ●
1.3.1.1. <i>Defaults</i>	100 ●	100 ●	100 ●	100 ●
1.3.1.2. <i>Mandatory Entry</i>	50 ●	100 ●	50 ●	50 ●
1.3.1.3. <i>Widget Entry Availability</i>	100 ●	100 ●	0 ●	100 ●
1.3.2. Visibility	77.99 ●	90.92 ●	78.05 ●	86.91 ●
1.3.2.1. <i>Color Visibility Appropriateness</i>	77.99 ●	90.92 ●	78.05 ●	86.91 ●
1.3.2.1.1. <i>Brightness Difference Appropriateness</i>	78.33 ●	91.40 ●	79.70 ●	87.08 ●
1.3.2.1.2. <i>Color Difference Appropriateness</i>	77.65 ●	90.44 ●	76.44 ●	86.74 ●
1.3.3. Consistency	83.45 ●	100 ●	81.13 ●	100 ●
1.3.3.1. <i>Permanence of Controls</i>	83.45 ●	100 ●	81.13 ●	100 ●
1.3.3.1.1. <i>Permanence of Main Controls</i>	84 ●	100 ●	80 ●	100 ●
1.3.3.1.2. <i>Permanence of Contextual Controls</i>	81.25 ●	100 ●	85.71 ●	100 ●
1.4. User Error Protection	91.67 ●	77.50 ●	55 ●	75 ●
1.4.1. Error Management	91.67 ●	77.50 ●	55 ●	75 ●
1.4.1.1. <i>Error prevention</i>	83.33 ●	80 ●	60 ●	50 ●
1.4.1.2. <i>Error recovery</i>	100 ●	75 ●	50 ●	100 ●

Then, the A1 activity produced the “*Specification of nonfunctional requirements*” document. For the *Usability* characteristic, 17 attributes were used -see their definitions in [9]. These are related to some of the following sub-characteristics: *Comprehensibility*, *Learnability*, *Operability* and *User Error Protection*. In the first column of Table 1, the resulting *Usability* requirements tree can be observed.

For the A2 activity, a metric and an elementary indicator from the Metrics/Indicators repository were selected per each attribute, as well as a derived indicator for the *Usability* characteristic. Fig. 4 specifies the elementary indicator for the “*Foreign Language Support*” attribute (coded 1.1.1.3 in Table 1). It is worth mentioning that all indicators have the percentage scale interpreted by three acceptability levels, viz. “*Satisfactory*” in the [90-100%] range; “*Marginal*” [80-90); and “*Unsatisfactory*” [0-80).

In the analysis design (A4.1), a set of criteria was agreed for deciding whether an entity attribute should be considered as a strength to be adopted or not. Thus, an attribute is considered a strength if its indicator value falls in the “*Satisfactory*” acceptability level. When several entities have the same strength attribute, the one with the highest score is recommended to be adopted. In case that they have the same score, any of them could be recommended. For those attributes which are not benchmarked satisfactorily in any selected entity but fall in the “*Marginal*” level, their adoption could be considered taking into account that some kind of improvement must be included.

Concurrently to A4.1, the A3 activity was carried out. This produces the values which were stored in the *Measure’s and Indicator’s values* repository. Table 1 shows all the indicators values for each evaluated social network app.

Lastly, A4.2 produces a “*Recommendation Report*” following the criteria documented in the “*Analysis specification*”, as depicted in Fig. 3. Looking at the resulting *Usability* indicator values in Table 1, no app reached the “*Satisfactory*” acceptability level. Nevertheless, within the “*Marginal*” level, Facebook got the best score (87.56%) followed by Twitter (85.65%). While Instagram and LinkedIn fell into the “*Unsatisfactory*” acceptability level, with 70.47% and 69.85% values respectively.

Looking the analysis at attribute level, only Twitter obtained the maximum score (100%) for *Contextual Control Icon Ease to be Recognized* (1.1.1.2.2.), *Current Location Feedback Appropriateness* (1.2.1.1.) and *Mandatory Entry* (1.3.1.2.). Also, it has the highest score for the *Brightness Difference Appropriateness* (1.3.2.1.1.) and *Color Difference Appropriateness* (1.3.2.1.2.) attributes, which reached 91.40% and 90.44% respectively. These five attributes are strengths in the Twitter app and therefore are recommended to be adopted in the new entity.

On the other hand, Facebook met the highest score for the *Error Message Appropriateness* (1.2.1.3.) and *Context-Sensitive Help Appropriateness* (1.2.2.1.) attributes, i.e., 93.75% and 90% respectively. Thus, these attributes should be adopted from the Facebook mobile app.

In this way, the rest of the attributes were analyzed in order to decide their adoption. Once A4.2 was finished, the GOCAMECom process for this case study finished as well. Recall that change activities (A5 and A6) are just performed when the target entity already exists, as shown in Fig. 3.

6 Related Work and Discussion

Every organization seeks to achieve its business goals successfully. Therefore, it is advisable to have an approach which allows the establishment of goals at different organizational levels, as well as organizing the work by means of projects and strategies for helping to reach goals. For this, it is desirable that the approach includes the following characteristics: i) the definition of business goals and information need goals at different organizational levels; ii) the definition of different evaluation purposes for goals, and; iii) the conception of a family of ME/MEC strategies that helps to achieve goals. In this sense, we have developed the approach called *Holistic Quality Multilevel and Multipurpose Evaluation Approach* [15].

In the present work, we have considered aspects of the two latter approach's features. Regarding the evaluation purposes, many of them are documented in several works [3, 4, 7, 8, 12, 13]. However, there is no broad consensus yet in some purpose definitions. Even more, just in [13] a classification for purposes is presented, but it does not allow to encompass the intentionality of some purposes. Therefore, in Section 3 we proposed three new categories that permit this.

Regarding the third approach feature, in the current literature there is few papers which address the importance of having a family of ME/MEC strategies for helping to achieve different evaluation purposes, considering also quality views. For example, a MEC strategy that integrates simultaneously the domain conceptual base, the process specification and the method specification is presented in [11]. But in this work a family of strategies for different purposes is not considered. Also, in [5] the *Cloud MoS@RT* strategy is presented to *monitor* services in the cloud. This strategy has the process specification modeled in SPEM in addition to a set of methods and models. However, authors do not discuss about a family of strategies for different evaluation purposes.

7 Conclusions and Future Work

In this paper we have analyzed a categorization for a set of evaluation purposes in which business and information need goals can be satisfied through the systematic use of a family of strategies driven by ME, analysis and, eventually, change. Also, the GOCAMECom strategy has been illustrated for the comparison of four social network apps, which helps us to determine the strengths to be adopted in a new smartphone app.

With regard to the first paper contribution, three categories for evaluation purposes have been proposed. The first category, *Characterize and Understand*, includes the understand, monitor and predict purposes. The second one, *Control and Change*, includes the improve, and monitor and control purposes. The last category, *Adopt an Alternative*, embraces the compare and adopt, and select an alternative purposes. We argue that the proposed categories may foster a clearer understanding and communication of the purposes' intention to different stakeholders. We can also highlight that purposes in the *Characterize and Understand* category serve as a basis for the remainder category purposes. For example, it is necessary to understand the current state of an entity before

implementing changes for improvement; likewise, it is necessary to understand the current state of representative/competitive entities before making thoughtful decisions. Regarding the second contribution, the usefulness of a specific strategy has been illustrated for helping to achieve the *compare and adopt* purpose.

Lastly, a limitation of the current work is the lack of a broader validation that the different ME/MEC strategies fit well to the corresponding purpose and category. Hence, as an ongoing work, we are designing surveys in order to confirm their appropriateness with domain experts.

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