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Envisioning the Future of Portfolio, Program, and Project Management (P3M): An Ontology

Arkalgud Ramaprasad
University of Illinois at Chicago, prasad@uic.edu

Nagesh Rammurthy
CBRE South Asia Pvt. Ltd., nagesh.ramamurthy@gmail.com

Thant Syn
Texas A&M International University, thant.syn@tamiu.edu

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University of Illinois at Chicago
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Nagesh Rammurthy
CBRE South Asia Pvt. Ltd.
nagesh.ramamurthy@gmail.com

Thant Syn
Texas A&M International University
thant.syn@tamiu.edu

ABSTRACT

The vision of Portfolio, Program, and Project Management's (P3M) future has to be visible in all its sagacity, complexity, and granularity to be effective. It has to be visible and meaningful to all stakeholders – to align them, to avoid dysfunctional conflicts among them, and for them to shape the future collaboratively, systematically, and systemically. Such visibility will help: (a) translate the vision into reality without distortion, (b) provide a coherent framework to manage uncertainty and change, (c) create a culture leading to excellence, (d) serve as a constant reference for assessment, feedback and learning throughout the P3M lifecycle, and (e) sustain the viability of P3M. We present an ontology to make the vision of P3M's future visible. The ontology encapsulates the logic of the vision – its many dimensions, layers of elements, and innumerable components. It is parsimonious and can elucidate the vision's complexity at different levels of granularity.

Keywords

Ontology, project management, program management, portfolio management.

INTRODUCTION

Portfolio, Program, and Project Management (P3M) is a complex domain that transcends the realm of traditional project management. Successful implementation of P3M has strategic implications on organizations (Meskendahl, 2010) because "…through the effective use of portfolio, program, and project management, organizations will possess the ability to employ reliable, established processes to meet strategic objectives and obtain greater business value from their project investments." (Project Management Institute, 2013, p. 15) Information technology (IT) projects are no exception. P3M is fundamental for getting the optimum value from IT projects for an organization (De Reyck et al., 2005). IT infrastructure projects tend to return a negative value when they are considered in isolation (Bardhan, Sougstad, & Sougstad, 2004). The true value of such a project can be appreciated only when we consider the opportunities it would create for other projects in a portfolio (Dai, Kauffman, & March, 2007). Despite its importance to organizations, there is scant evidence of the value of P3M and the vision of its future.

Research and development in project management are mainly driven by practice. Some best practices are institutionalized over time into standard management models and theories while most are not (Garel, 2013). Research in project management is also selective and segmented; "…there is no unified theory of project management" (Garel, 2013, p. 663). Some research concentrates on management models or techniques used in project management such as risk management (Chapman, 1997; Raz & Michael, 2001; Ward & Chapman, 2003) and real-option valuation (Dai et al., 2007; Huchzermeier & Loch, 2001). Others focus on understanding the success factors (Cooke-Davies, 2002; Munns & Bjeirmi, 1996; White & Fortune, 2002) or the interplay of cost, time, and quality in project management (Atkinson, 1999; Babu & Suresh, 1996; Khang & Myint, 1999). We are endowed with a rich collection of research in project management, but encumbered by the lack of systemic and systematic view of the domain.

Research on program management and portfolio management follows a similar trajectory. Both research streams have developed into independent sub-domains of project management. There however remain confusion over the differences and similarities among the domains (Artto, Martinsuo, Gemünden, & Murtoaro, 2009; Lycett, Rassau, & Danson, 2004). What is certain is the importance of the alignment of and synergy among P3M to achieving the desired organizational outcomes (Martinsuo & Lehtonen, 2007; Pemsel & Wiewiora, 2013; Teller, Unger, Kock, &

Gemünden, 2012). The segmentation within and among the domains hinders the effectiveness of P3M in organizations.

We can think of envisioning P3M's future as being akin to the blind men imagining the elephant in the proverbial story of the five blind men and the elephant – each stakeholder has a different 'right' view of the 'elephant'. Unfortunately, unlike in the story, there is no tangible 'elephant', and no single wise man or woman who knows the whole 'elephant'. The metaphorical 'elephant' has to be made visible to the P3M stakeholders – to be seen by and be meaningful to all of them, to align them, to avoid dysfunctional arguments among them, and for them to use it collaboratively, systematically, and systemically. Detailed natural-language descriptions can run into hundreds of pages as can often happen with project, portfolio, and program projections. By the same token, detailed schematics, drawings, and images too can be voluminous. Both are unwieldy. They do not encapsulate the core logic of the P3M parsimoniously and completely, as a vision should. They do not make the 'elephant' visible.

We present a method of making the vision of P3M's future – the 'elephant'– visible using an ontology. The ontology is like a multidimensional blueprint on a standard sheet of paper. It encapsulates the logic of the vision – its many dimensions, layers of elements, and innumerable components. It is parsimonious and can elucidate the vision's complexity at different levels of granularity. It is also extensible and scalable and can be adapted as P3M evolves. Such visibility will help: (a) translate the vision into reality without distortion, (b) provide a coherent framework to manage uncertainty and change, (c) create a culture leading to excellence, (d) serve as a constant reference for assessment, feedback and learning throughout the P3M lifecycle, and (e) sustain the viability of P3M.

In the following we will first discuss the concept of an ontology. Then we will describe an ontology of P3M. Based on the ontology we will discuss seven potential transformations of P3M in the future. We will conclude with a brief discussion of how the ontology can be used to map the P3M body of knowledge (P3MBoK) to determine where it should go in the future to be effective.

ONTOLOGY

Ontology is the study of being in contrast to epistemology which is the study of knowing. Its focus is on objects, their categories, and the relationships between them. Ontologies represent the conceptualization of a domain (Gruber, 2008); they organize the terminologies and taxonomies of a domain. An ontology is an "explicit specification of a conceptualization." (Gruber, 1995, p. 908) It is used to systematize the description of a complex system (Cimino, 2006). "Our acceptance of an ontology is… similar in principle to our acceptance of a scientific theory, say a system of physics; we adopt, at least insofar as we are reasonable, the simplest conceptual scheme into which the disordered fragments of raw experience can be fitted and arranged." (Quine, 1961, p. 16)

Ontologies "… provide a shared and common understanding of a domain that can be communicated between people and heterogeneous and widely spread application systems." (Fensel, 2003, p. 1) They "… make it possible to understand, analyze, exchange or share knowledge of a specific domain and therefore they are becoming popular in various communities. However, ontologies can be very complex and therefore visualizations can support users to understand the ontology easier. Moreover, graphical representations make ontologies with their structure more manageable. For an effective visualization, it is necessary to consider the domain for which the ontology is developed and its users with their needs and expectations." (Kriglstein & Wallner, 2013, p. 123)

Our method of ontological analysis is based on Ramaprasad and Mitroff's framework (Ramaprasad, 1987; Ramaprasad & Mitroff, 1984) for formulating ill-structured problems; it is in turn based on the model proposed by Piaget (Piaget, 1974) for understanding causality. It is a new method for analyzing and synthesizing a domain (Ramaprasad & Syn, 2015; Tate, Furtmueller, Evermann, & Bandara, 2015). The process is further explained by Ramaprasad and Papagari (2009) and Ramaprasad and Syn (2014a, 2014b). Developing an ontology is an iterative process that systemically and systematically deconstructs P3M into its dimensions and elements. Domain and subject-matter experts are generally best-positioned to contribute to the deconstruction of a domain. In fact, the ontology simply reorganizes the traditional bodies of knowledge derived from traditional methods in a new way to provide a holistic understanding of the domain. We consider an ontology as a visual representation of the logical structure of the domain.

The challenge was to construct an ontology which is a logical, parsimonious, and complete description of P3M. It had to be logical in the deconstruction of P3M into its dimensions and elements, and parsimonious yet complete in the representation of P3M. It had to be a closed description of P3M. There can be multiple points of views to study a complex domain like P3M. Each view can be represented in its own ontology. It is a wicked problem (Churchman, 1967) with many potential formulations (Ramaprasad & Syn, 2014a). Each ontology can be seen as a lens by which one may study P3M.

Using an ontology, we will discuss seven potential transformations of P3M in the future. They are: (1) from a linear to a learning system, (2) from a flat to a layered system, (3) from a segmented to a full-cycle system, (4) from a fragmented to an integrated management system, (5) to an automated to informated to a transformed system, (6) from a lagged-time to a real-time system, and (7) to a systemic, systematic, and synoptic system. We will articulate the components and implications of these transformations using the ontology.

In the following we present an ontology of P3M and discuss how it can be used to envision its future transformations. The formulation of the ontology started with the object of analysis – P3M. It is also based on the ontology for a construction project management system (Ramaprasad, Prakash, & Rammurthy, 2011). The initial problem elements were abstracted from the domain based on the literature and personal knowledge of the authors. The next step was to extract the logic underlying these elements by (a) grouping related elements into dimensions, (b) the elements within each dimension into taxonomies, and (c) organizing the dimensions left to right with suitable connecting words and phrases so that the concatenation of elements across the columns is a natural English sentence. They visually represent the core logic of P3M.

Hitherto there has not been a comprehensive visualization of P3M as the one we present. Our visualization of P3M has two advantages. On the one hand, it represents the combinatorial complexity of P3M in a parsimonious fashion. On the other, it does so using structured natural English. The latter makes the visualization easy to read and understand. The visualization can be used to elucidate all potential components of P3M in natural English.

P3M ONTOLOGY

P3M can be deconstructed into the six dimensions by the six columns in Figure 1. They are, in order from left to right: (a) Process, (b) Level, (c) Resource, (c) Stage, (d) Objective, and (e) Management Technique. They comprehensively define the domain of P3M. In P3M the processes at different levels are applied to the resources at each stage to attain the objectives using various management techniques. These dimensions are derived from existing bodies of knowledge in traditional project management, program management, and portfolio management literature such as Project Management Institute (2013).

The dimensions and corresponding taxonomies are fluid. If necessary, new dimensions can be added to the ontology. For example, should location or industry be a critical factor in determining the nature of P3M, Location or Industry could be an added dimension. Adding a dimension will increase complexity multiplicatively. By the same token, an existing dimension can be deleted to simplify the ontology. For example, if P3M is insensitive to the different stages then the Stage dimension can be deleted. It will correspondingly decrease the complexity.

Each dimension is further articulated as a taxonomy of the elements constituting the dimension. The taxonomies are based on the Project Management Body of Knowledge (Project Management Institute, 2013), an extensive review of the literature, as well as the industry experience of the two of the authors of Ramaprasad, Prakash, and Rammurthy (2011); they are inclusive. Thus, the taxonomies encapsulate knowledge based on both theory and practice. An ontology organizes them in structured natural English. If necessary, the taxonomies can be (a) extended by adding new elements or abridged by deleting existing ones, and (b) refined by adding sub-elements or coarsened by aggregating current ones to super-elements.

The Process dimension includes the three classic elements of P3M – Planning, Monitoring, and Controlling. We added Assessing – an important step for feedback to and learning by the P3M organization (Ramaprasad, 1983) – to complete the P3M lifecycle. The four elements are circular and sequential – Planning usually precedes Monitoring, Monitoring usually precedes Controlling, Controlling usually precedes Assessing, and Assessing usually feeds back into Planning. (Note: We will capitalize the words which refer to the individual dimensions and elements in the ontology, except in describing full or partial components.) The feedback from Assessment to Planning, and possibly Monitoring and Controlling too, makes their sequence circular and also enables learning.

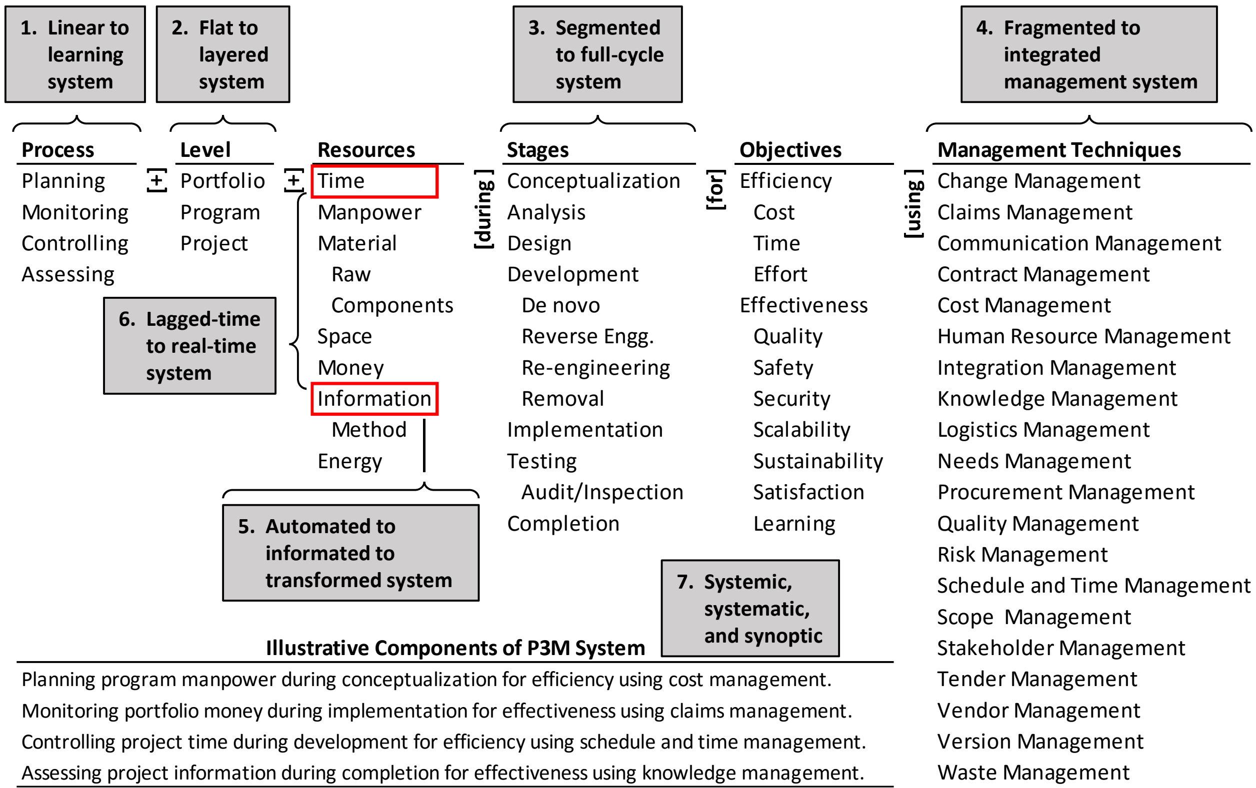

Figure 1. Ontology of Portfolio, Program, and Project Management (P3M)

The Level dimension includes the three levels of P3M – Portfolio, Program, and Project. Usually Projects are parts of Programs, and Programs are part of Portfolios. The hierarchical relationship among these elements is integral to managing their Planning, Monitoring, Controlling, and Assessing. The processes at the three levels will be at different levels of abstraction. True translation between the layers will be necessary for successful P3M. The absence of such translation will result in a highly disconnected P3M instead of an integrated one – where the portfolio, program, and project managers may be disconnected. It is the translation between the three layers that distinguishes P3M from the three Ps being managed separately.

The Resource dimension includes the seven basic resources critical to P3M: Time, Manpower, Material, Space, Money, Information, and Energy. It is important to include Information explicitly as a resource not only because of its own intrinsic value but also its value in managing other resources and as the substrate for all P3M. Information is the resource that ties the three Ps together, facilitating translations between them. It also connects the Processes and is the basis of feedback for learning. Further, the management of all the resources (including Information) is based on information (or information about information – meta-information). By the same token, it is necessary to consider Time as a resource, not simply as the context for P3M. As a resource its value is not inextricably linked to the clock (clock-time) but is based on the interrelationship of events (event-time) (Ramaprasad & Stone, 1992).

The Stages dimension includes a synthesis of eight common stages of the P3 lifecycle. They are applicable to a wide variety of domains – from construction to information systems. Managers may adopt variations of these stages, eliminating/refining some, and adding others. The Stages as presented are sequential and circular from Conceptualization to Completion and then back to Reconceptualization. A systemic approach requires the consideration of all the stages as a circular sequence rather than as separate segments.

The Objectives dimension includes the two classic objectives. Efficiency – How well the resources are utilized? Effectiveness – How well the desired effect is achieved? The articulation of these will be context specific. We have listed the most common subcategories. The objectives are interdependent and not independent. Their interdependence has to be mapped for a synoptic approach to P3M.

The Management Techniques dimension includes a list of 20 techniques commonly used today in P3M. These may change over time and vary by context. We have listed some of the most common ones in alphabetical order.

The six dimensions (columns) are interleaved with the concatenation symbol (+) and words. Using them we can articulate the components of P3M in natural English as shown at the bottom-left of Figure 1 and listed below:

1. Planning program manpower during conceptualization for efficiency using cost management: This could include planning manpower at the program level at the conceptualization phase based on the skills of the personnel available and their associated costs.
2. Monitoring portfolio money during implementation for effectiveness using claims management: Optimal management of claims at the portfolio level for financial effectiveness.
3. Controlling project time during development for efficiency using schedule & time management: Controlling project development time with minimal expenditure of resources.
4. Assessing project information during completion for effectiveness using knowledge management: Project based feedback on effectiveness.

There are 192,000 (4*3*8*10*10*20) most detailed-level first-order components encapsulated in the ontology. The number will be much larger if one considers the second-order components based on interaction among the elements in a dimension. The number of fragments, parts of components, too is very large. While these components define the domain of P3M, some of them may be very important, some less important, some unimportant, and some infeasible. The ontology provides a logical lens to study P3M and filter the components by importance while minimizing both the errors of omission (excluding an important component) and errors of commission (including an unimportant or infeasible component).

The validity of the ontology will determine the quality of the description and visualization of the domain. We draw upon traditional constructs of validity and asset the face, content, semantic, and systemic validity of the P3M ontology. The dimensions and categories are derived from the existing literature and best practices on project/ program/portfolio management. Most of the terms used in the ontology are already familiar to both experts and novices; thus, the face validity is high. The content validity is also high due to the iterative process of developing the ontology carried out by domain experts. Further, error of omission and commission can be easily corrected by adding or removing dimensions and categories. The components of P3M which are expressed in natural English sentences are easily understandable to anybody regardless of one's experience and knowledge in P3M. Each component is semantically meaningful; hence, the semantic validity of the ontology is high. Last, the ontology is a complete, close description of P3M, a lens to study P3M from a specific perspective. Its dimensions and categories are well-founded in the extent literature and current practices. They are inclusive and parsimonious. It encapsulates all possible components of P3M; its systemic validity is high.

FUTURE OF P3M

The ontology can be used to envision the future of P3M systemically and systematically. The present vision of P3M is partial and fragmented. There are significant gaps in the research on and conceptualization of P3M. We will discuss the future of P3M in terms of seven transformations highlighted in Figure 1. We will briefly describe the transformation, and the drivers of and barriers to each.

1. Linear to learning system

The success of P3M in the future will depend upon the conceptualization of Planning, Monitoring, Controlling, and Assessing processes as a cyclical learning sequence instead of as an open-ended linear sequence. While the focus on learning today is implicit it should become explicit in the future. There are many potential drivers of this transformation. We will discuss two for illustration: a) the advances in data, information, and knowledge management which can facilitate a continuous feedback process with large volumes of a variety of data – qualitative and quantitative, textual and numerical, and unstructured and structured; b) the recognition and understanding of the importance of organizational learning and knowledge management (Ramaprasad & Prakash, 2009). On the other hand, there are many potential barriers too. First, there is likely to be resistance to moving from experience-based P3M to evidence-based P3M. In the former the learning is internalized and not subject to external validation; in the latter, the learning is externalized and subject to external validation. Second, learning systems entail more cognitive effort – to think, reflect, and correct – than entailed in linear systems. There may be resistance to expending the cognitive effort, especially by those who are steeped in action, as many P3 managers are likely to be.

2. Flat to layered system

There is a hierarchical relationship between Portfolios, Programs, and Projects layers. This relationship will introduce dependencies within each layer and across them, and these dependencies have to be explicitly addressed in P3M. The elements of each layer cannot be considered independently; they have to be considered as an element in a multi-layer ecosystem. In such an ecosystem, some projects may have to be sub-optimized to optimize a program, and some programs may have to be sub-optimized to optimize a portfolio, and some portfolios may have to be sub-optimized to optimize the overall portfolio. A layered system introduces greater complexity and uncertainty, and hence risk into P3M decision-making. Managing these risks will require that the P3M managers have a systemic and synoptic perspective. While emerging tools for analysis of very large volumes of data and their visualization can help develop such a perspective, these innovations have to be adopted and implemented. Moreover, since this is likely to be a novel domain for the P3 managers, the emphasis on learning and feedback (discussed in the previous section) too will increase proportionately. The P3M ecological changes are likely to be major drivers of this transformation; the short-term security and comfort of ecological isolation may be the major barriers.

3. Segmented to full-cycle system

A P3 manager may plan, monitor, control, and assess each stage individually, sequentially, or cyclically. The individual, segmented approach is likely to be structured and simple; the integrated, cyclical approach is likely to be ill-structured and complex. The boundaries in the former are likely to be sharp and the time horizons short; the boundaries in the later are likely to be fuzzy and the time horizon very long. There are fewer dependencies to consider in the former than in the latter. The traditional focus of P3M is biased towards the segmented; the future focus should be biased towards the full-cycle for a number of reasons.

Long-term success of P3M will depend heavily upon strengthening the full-cycle; otherwise the weakest link in the cycle will limit the success. As a corollary, such success will also depend on learning from and about the full-cycle, and not just the individual segments. These drivers combined with the development of enterprise wide information systems can mobilize the transformation. Yet, there will likely be many barriers similar to the ones mentioned earlier. Moreover, the success rate of implementation of enterprise wide information systems has been only about 50%, and the enterprise information silos have not disappeared despite the possibility of eliminating them.

4. Fragmented to integrated management system

Starting from PERT and CPM the number of management techniques used in P3M has proliferated and continues to grow. We have listed 20 of them in Figure 1; it is likely we have not listed many and there will be more which will need to be listed in the future. While many of the techniques have emerged to address specific, specialized problems such as cost management and waste management, they cannot operate independently. They are inter-dependent. The silos of techniques are likely to be as dysfunctional as the silos of information. To ensure the success of P3M it will be necessary to (a) ensure that all of them use a common information platform, (b) there is a systematic method for resolving the conflicts between their recommendations, and (c) there is a systemic method of integrating the recommendations. The cost of fragmentation will be the significant driver of integration. However there are significant barriers both for creating a common information platform and reconciling the conflicting decisions. The various stakeholders, inside and outside the P3M system, are likely to be deeply protective of their information, techniques, and the recommendations.

5. Automated to informated to transformed system

A major transformative force will be the power of information unleashed by the developments in information technology and associated information systems. It will not only help automate large swaths of P3M but also informate it (Zuboff, 1988), that is generate extraordinary amounts of information about it – information which is deep and detailed. This rich information, in turn, will help P3M personnel to understand the processes at a level of granularity hitherto impossible and consequently transform it. It will make possible true micro-management of P3 without loss of efficiency or effectiveness, as with mass customization in the automobile industry and personalized medicine in healthcare.

The most significant driver of this transformation will be the developments in information technology, as mentioned earlier. While information is power for P3M, the recognition of the very same principle by the providers of information may be the most significant barrier. The stakeholders may not want to part with information for fear of loss of power. In addition, concerns about confidentiality and security of information may further impede their sharing, and hence the transformation.

6. Lagged-time to real-time system

At the core of many of the transformations we have discussed above is the feedback process. The feedback has to be timely in order to be effective. The ability to obtain data with very little time delay from a large number of sources, and to process them into information and knowledge with very little lag will transform P3M from lagged-time to real-time. The developments in information technology and information systems are the biggest drivers of this transformation. However, such a transformation will likely impose a very heavy cognitive load on P3M as well as introduce new risks – they will be significant barriers. An indicator of these barriers can be seen in the dynamics of program trading in the stock market which has moved even beyond real-time to predictive-time.

7. Systemic, Systematic, and Synoptic P3M

In the age of the big data and panoptic vision, it is inevitable that P3M becomes more systemic, systematic, and synoptic. The six transformation discussed above, taken together, will result in such a transformation. It will be driven by the very same drivers and impeded by the very same barriers. It is unlikely to be stopped, but may be slowed. The economies of scale and scope promised by such a transformation of P3M are too significant to be ignored.

DISCUSSION

The ontology encapsulates the holistic view of the dimensions and elements of P3M. It envisions P3M in its sagacity, complexity, and granularity. It is visible and meaningful to all stakeholders – to align them, to avoid dysfunctional conflicts among them, and for them to shape the future collaboratively, systematically, and systemically. The seven transformations envisage the future of P3M. Such visibility will help: (a) translate the vision into reality without distortion, (b) provide a coherent framework to manage uncertainty and change, (c) create a culture leading to excellence, (d) serve as a constant reference for assessment, feedback and learning throughout the P3M lifecycle, and (e) sustain the viability of P3M. We have demonstrated the feasibility and value of mapping a domain's knowledge using an ontological framework in the context of electronic commerce (La Paz, Ramaprasad, Syn, & Vasquez, 2015) and public health informatics (Ramaprasad & Syn, 2015). The same method can be used for the meta-analysis and synthesis of research and practice in P3M.

The P3M ontology is a roadmap for research and practice in P3M. The landscape of the P3M can be visualized by mapping P3M bodies of knowledge to the ontology. It provides a framework to manage twists and turns in translating research into practice, and vice versa. It is a reference model to reconcile any variation in research and practice alike, and between the two. It is a flexible scaffold that can be adapted to the changing landscape of P3M over time. Finally, its seven transformations enable a culture of excellence through real-time feedback, integrated management, and continuous improvement.

CONCLUSION

We have presented an ontology of P3M and used it as a framework to envision its future. The next challenge will be to generate a body of knowledge to catalyze the transformation. The present P3M body of knowledge (P3MBoK) can be mapped onto the ontology. A research article or a practitioner's experience, for example, can be mapped to (a) one or more complete components, or (b) one or more partial components of the ontology. Such a mapping will highlight the 'bright', 'light', and 'blank/blind' components of P3MBoK. The 'bright' spots are highly emphasized, the 'light' spots are lightly emphasized, and the 'blank/blind' spots are not emphasized at all. A component may be 'blank' because it is unimportant or 'blind' because it has been overlooked. The mapping of research articles on P3M will depict the state-of-the-research whereas that of practitioner's experience the state-of-the-practice. A comparative analysis of the two mapping will reveal the alignment, or lack thereof, between the two states. The gaps between the two states should inform researchers and practitioners alike the need for action to advance P3MBoK.

The landscape of a domain can change over time as new management theories and practices become available. The plastic nature of the ontology makes it easier to adapt to the changing landscape. New categories and dimensions can be added, obsolete ones discarded, and existing ones modified. The ontological mapping and analysis will help illuminate where the P3MBoK needs to be focused in the future to be effective.

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