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# The missing link between product data management and organisational strategies

Turo Kilpeläinen

*University of Jyväskylä, Finland, tukilpe@it.jyu.fi*

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# THE MISSING LINK BETWEEN PRODUCT DATA MANAGEMENT AND ORGANISATIONAL STRATEGIES

Kilpeläinen, Turo, University of Jyväskylä, P.O. BOX 35, 40014 Jyväskylä, Finland,  
tukilpe@it.jyu.fi

## Abstract

*This article explores interrelationships between the concepts of Product Data Management (PDM), Enterprise Information Architecture (EIA), and enterprise IT strategy in process industries. The initial purpose of the study was to evaluate the capabilities of PDM development, as well as the existence of PDM strategy, to support the development and introduction of EIA in practice. However, the outcome of the study revealed an iterative relation between the concepts forming a hierarchically shaped value chain, here referred to as the PDM/EIA/strategy continuum, that helps in introducing organisational strategic objectives to operational levels as well as in communicating business needs to the top management level. Information drawn from the related literature, combined with reflections from the practitioners, can provide a number of meaningful insights in the use of the PDM/EIA/strategy continuum as a driving force for total information management through organised and real time vertical information sharing.*

*Keywords: Enterprise Information Architecture (EIA), Product Data Management (PDM), enterprise IT strategy, business-IS alignment.*

# 1 INTRODUCTION

It has long been clear that information technology (IT) and business should be integrated on the strategic level (e.g. King, 1978). In fact, there is a renewed recognition of the necessary linkage between organisational strategies, IT, and business processes (Zisman, 2003). The objective of the integration of the organisational domains have been to better understand and manage the impacts of choices, that are made in one domain, to another domain (Melling, 1994) in order to build synergy between them (Ives, Järvenpää and Mason, 1993; Ross, 2003). Despite the fact that the domains are bi-directionally related (CIO Council, 1999), much of the previous research has focused only on IT requirements as a response to business strategies. However, strategic alignment of the domains should be perceived as continuous, iterative adaptation and change process (Henderson and Venkatraman, 1999). Thus, the impact of bottom-up influences and approaches is equally important.

In business environments, where information concerning inter-organisational operations is seen to be at least as important as tangible outcomes of business processes (Bryan and Sackett, 1997), the role of product information and its management are vital. In general, despite the problems related to system implementation (e.g. Teschler, 1996), Product Data Management (PDM) systems have widely been adopted especially in large manufacturing organisations, to manage product-related data along its lifecycle. The role of PDM systems in such organisations is to act as the central engineering information repository for product development (Liu and Xu, 2001) and enterprise-wide engineering activities (Abramovici and Sieg, 2002). Thus, PDM facilitates the integration of many different areas related to product development (He, Ni and Lee, 2003). However, even though organisational strategies should be taken into account within PDM development and implementation process (e.g. Abramovici and Sieg, 2002), it has traditionally been problematic (Harris, 1996). Especially enterprise IT strategies as such have been perceived as too generic, obscure, and technologically oriented guidelines to introduce the business objectives to lower levels within organisations.

However, a clear statement of the strategic vision is a prerequisite for competitive and persistent business. At the same time, it seems logical to have a broad vision for the systems and technologies that support the strategy (Armour, Kaisler and Liu, 1999). Along with strategic statements, architectural descriptions have been used to enable an integrated vision and a global perspective of informational resources in an enterprise (Niederman, Brancheau and Wetherbe, 1991). The use of architectural descriptions reveals the redundancy and overlap in business processes, and reduces information systems complexity (Cook, 1996). Thereby, architectural descriptions may act as a bridge between business and technical domains (Young, 2001; Goethals et al., 2004) providing a tool to better bring forth the organisational strategic objectives in practice.

Enterprise Architectures (EA) (e.g. CIO Council, 1999) are the present form of enterprise-wide architectural descriptions (cf. Zachman, 1987; Sowa and Zachman, 1992) that consist of hierarchically organised architectural models. Even though the terminology used varies quite significantly in the literature, business, information, application, and technology models, or sub-architectures, are widely applied. These models are divided into segments of which PDM is a good example. The fundamental idea for the use of architectural segments is to allow critical parts of an enterprise to be developed individually, while integrating these segments into a larger EA (CIO Council, 1999). This situation can be illustrated in practice (cf. Drobik et al., 2002): one of the organisational aims might be that all essential product data should be consistent across all information systems, but the inconsistent state of the prevailing data management principles may require too much labour and time so that it might be impractical to collect all the desired data in one database. Thus, the strategic target could be that PDM should be harmonised within the next couple of years during which delays in managing and executing organisational critical business processes would be removed by using up-to-date information. In this way, simple, tangible targets within distinct architectural segments would drive real transformation and reduction of lead-times in business processes providing a synergy effect on total performance also.

As we approach the total organisational information management issue bottom-up in the form of developing Enterprise Information Architecture (EIA) through PDM development (Kilpeläinen and Tyrväinen, 2004; Kilpeläinen, Tyrväinen and Kärkkäinen, 2006), it will be interesting to see how PDM development can support EIA development. Further, as there seems to be a clear need to better integrate PDM to organisational strategic objectives, the role of architectural descriptions as a link, or as a boundary object, between PDM initiatives and top management will be investigated. However, to be able to analyse and compare the intricate aspects of the alignment problem, an extensive conceptual analysis between the disciplines will be provided. Further, because technological solutions are seen as outputs of the strategy formulation process, they do not highlight the fundamental alignment problems as they appear in practice. Thus, the investigation should not concentrate on technological solutions. Instead of applying traditional EA descriptions (e.g. CIO Council, 1999), the issue should be approached in a simpler way. For this reason, information, application, and technology architectures are mapped to make them one entity that is referred to as EIA (Watson, 2000).

The paper is organised as follows. In the next section, we define the essential terminology to make the comparison between the disciplines possible. Following that, we provide methodological comparisons of the disciplines by examining their intended and potential effects on information management in business processes. Then, we move on to discuss the bottom-up and top-down relationships between the concepts of PDM, EIA, and enterprise IT strategy. Finally, we summarise the results.

## 2 RELATED CONCEPTS AND TERMINOLOGY

The concept of architectures with its concomitant terminology has traditionally been somewhat confusing and vague (e.g. Brancheau, Schuster and March, 1989; Periasamy, 1993; Teng and Kettinger, 1995; Periasamy and Feeny, 1997; van den Hoven, 2003). In these days, we talk about *Enterprise Architecture* (EA) that is the overall framework or blueprint for how an enterprise uses information technology to achieve its business objectives (van den Hoven, 2003). *Architecture*, as such, is perceived as a structure formed of components, their interrelationships, and the principles and guidelines governing their design and evolution over time (CIO Council, 1999). As given, EA traditionally consists of business, information, application, and technology architectures that are referred to as architectural models. Thus, *Business Architecture* defines business processes, information flows, and information needed to perform business functions in relation to the organisational mission and goals (CIO Council, 1999). *Information Architecture* is a high-level map of the information requirements of an organisation showing how major classes of logical and physical information assets are related, first, to each other, and, second, to major business processes of the organisation (cf. Brancheau, Schuster, and March, 1989; Pienimäki, 2005). *Application Architecture* is a set of business applications needed to manage (create and use) information and support business functions (van den Hoven, 2003; Pienimäki, 2005). *Technology Architecture* is a physical depiction of the technology environment including procedures and instructions on how to organise IT resources (Seeger and Stoddard, 1993; CIO Council, 1999). Earlier on we stated that Enterprise Information Architecture (EIA) consists of these architectural models regardless of business architecture. Thus, EIA focuses mainly on informational issues but also applies to the technological solutions by which the information is managed. In other words, *EIA* can be viewed as a structured set of multidimensionally interrelated elements that support all information processes (Watson, 2000).

An *enterprise IT strategy* is a high level plan for improving the way an enterprise leverages its IT, allowing the enterprise to support and promote business processes. The IT strategy is a critical aspect of an organisational *business strategy*, which describes the overall business vision and objectives. As EIA consists of information, application, and technology models, only technological issues are usually addressed in an enterprise IT strategy. On the other hand, business requirements, including process descriptions, may be adopted from *PDM strategy*, which describes how an organisation manages and values its product data (Sackett and Bryan, 1998). Historically, Product Data Management (PDM) has been focusing on hardware development (Crnkovic, Dahlkvist and Svensson, 2001) for managing

CAD files effectively (Aarons, 1995). However, the overall movement towards organisation-wide information and knowledge management in the area of IS has reflected to PDM also. *PDM* today is a management approach for data, applications, and processes throughout the product lifecycle (CIMdata, 1998; Object Management Group, 2000; Abramovici and Sieg, 2002) helping engineers and others to design and control the evolution of part design (Crnkovic, Dahlkvist and Svensson, 2001). *Product Lifecycle Management* (PLM) is an extension of PDM towards a comprehensive approach for product-related information and knowledge management including planning and controlling of processes that are required for managing data, documents, and enterprise resources throughout the entire product lifecycle (Abramovici and Sieg, 2002).

Federal Enterprise Architecture Framework (FEAF) (CIO Council, 1999) is elaborated in Figure 1, showing how it meets the needs of the research and demonstrating the association with the concepts described earlier. In general, Federal Enterprise Architecture (FEA) (CIO Council, 2001) is a strategic information asset base that defines the business, information necessary to operate the business, technologies necessary to support the business operations, and transitional processes for implementing new technologies in response to the changing needs of the business (CIO Council, 1999). Figure 1 is a modified combination of the original Level II and Level III in the FEAF. This means that the original Design Architecture, which consists of information, application, and technology architectures in Level III, is referred to as EIA in line with our earlier description. Information Drivers and Information Models refer, accordingly, to the original Design Drivers and Design Models. The other components of the FEAF are adopted as such.

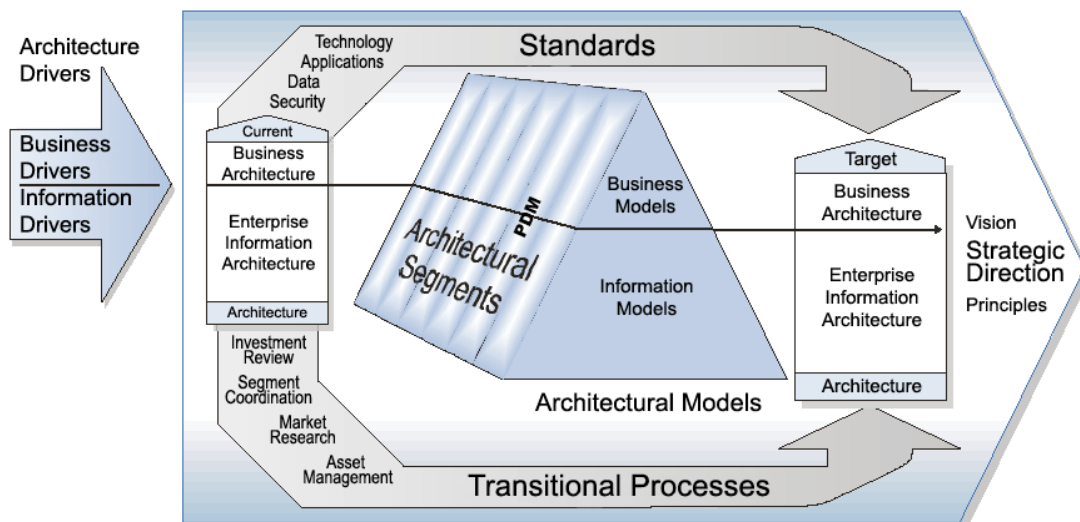


Figure 1. The related terminology (adapted from (CIO Council, 1999)).

Viewing Figure 1 horizontally, the top half of the architectural models (business models) deals with the business of the enterprise and includes a common set of definitions, diagrams, and, sometimes, automated tools that facilitate understanding of business functions, information inputs, processes, and products (CIO Council, 1999). The bottom half (information models), on the other hand, deals with the informational issues used to support the business. As PDM is a junction (architectural segment) between bi-directional models, examination of the alignment problem described earlier becomes possible. However, the hierarchical nature of the models, business models driving information models, means that different stakeholders are responsible for the models. Further, different kinds of development processes, methods, and tools are needed (Armour, Kaisler and Liu, 1999). Thus, a *development process* is perceived as a specific ordering of work activities across time and place, with a beginning, an end and clearly identified inputs and outputs (Davenport, 1993). *Methods* should be understood as predefined and organised collections of techniques and sets of rules that state by whom, in what order, and in what way the techniques are used (Smolander, Tahvanainen and Lyytinen, 1990).

### 3 METHODOLOGICAL COMPARISON OF THE DISCIPLINES

The Shell model (Tolvanen, 1998) is primarily developed to characterise different methodological facets that are neither exclusive, nor orthogonal. Thus, according to Tolvanen (1998) each type of facet complements the others and all types are required to yield a “complete” method. The Shell model builds upon the idea that all methods are, or at least should be, based on some conceptual structure. The *conceptual structure* of the method is represented with some modelling technique through what the models are formulated with some *notation*. Further, the *processes* a method includes are defining how and in which phase of the method the modelling techniques are used. These processes are based on the notation of the method. *Participation and roles* are concerning the different roles in the process. Every method should also have some *development objectives and decisions* to meet the need of the development process. Further, there are some *values and assumptions* of the reality that are modelled during the method use. All together, we feel the knowledge categorisation of the Shell model is valid in our case also, providing a tool to compare development processes of EIA and PDM with each other.

The results of the methodological comparison of the disciplines are shown in Table 1, where the rows represent different levels, or shells (facets), of the Shell model. In the right-most column the main similarities and differences between the disciplines are highlighted. The characteristics of EIA are mainly adapted from the Information FrameWork (Evernden, 1996), which aims to manage information as a valuable asset with the aid of a strategy. The framework is built upon the ideas of Zachman’s Framework for Information Systems Architecture (Zachman, 1987; Sowa and Zachman, 1992) leveraging, however, the objects and scope of the original Zachman framework. The framework of (Sackett and Bryan, 1998) is used to state the key issues that should be taken into account in PDM development. Further, due to the application-centred nature of the discipline, the issues in the PDM development framework (product data creation and manipulation, lifecycle, inputs and outputs, data travel, data use, and technology) are directed towards IS development. Other sources were also used to explicate all the underlying characteristics for both disciplines.

Methodological relationships between the disciplines seem to be evident when investigating the underlying values and assumptions (“Values and assumptions” and “Participation and roles” in Table 1) even when the disciplines exist in different conceptual domains (Jonkers et al., 2004), dimensions (Pulkkinen and Hirvonen, 2005), and hierarchical levels in organisations, or are driven by different interest groups (Crnkovic, Dahlkvist and Svensson, 2001; Langenberg and Wegman, 2004). This means that even if the disciplines are mastered by different people from different (organisational) cultures speaking different (domain-specific or natural) languages, they share the same aim, i.e., to manage and use key information in the best possible way (“Development objectives and decisions”). However, the issue is approached from different viewpoints, with different goals, and with different levels of abstraction. Further, due to the nature of strategic elements within organisations (Niederman, Brancheu and Wetherbe, 1991; Peltonen, Pitkänen and Sulonen, 1996), both disciplines require investments that are, in many case, hard to justify (to be discussed further later).

The fundamental starting point in the PDM and EIA development processes is to investigate the present state of information management and technology issues in business processes (Niederman, Brancheu and Wetherbe, 1991; Abramovici and Sieg, 2002) in order to clarify source information of the internal activities. In other words, the requirements for both disciplines are derived from and refined in terms of business processes and their bottlenecks (“Process”). The Information FrameWork provides extensive tools and viewpoints (“Notation” and “Conceptual structure”) for requirements engineering. However, there is no established practice for analysing the relevant/existing business processes nor for combining the needs of personnel towards the current state of business processes in the domain of PDM. Moreover, a clear and concrete idea about how organisational strategies should be taken into account during PDM development, or even whether it could be done properly, is missing. Because of a great diversity of the requirements between industries (Roberts Jr. et al., 1998; Abramovici and Sieg, 2002) and difficulties in PDM implementations (e.g. Sackett and Bryan, 1998)

that have been reported, the lack of such methods and tools is somewhat surprising. However, methods from software development including object-oriented approaches and UML, have been reasonably successfully applied in practice notwithstanding some difficulties and incompatibilities in applying UML to business process descriptions (Jonkers et al., 2003).

Type of knowledge	EIA development process	PDM development process	Similarities and differences
Conceptual structure	EIA is seen from several viewpoints including organisational, business, and technical information viewpoints.	No established practice.	
Notation	Domain, logical, and implementation modelling techniques.	No established practice.	
Process	Top-down, holistic modelling of processes and related technologies.	Top-down modelling of business processes and related technologies from the viewpoint of a product lifecycle.	PDM focuses on product information. It forms only one part of EIA.
Participation and roles	Top management (facilitator), IS department (implementer), division of labour based on providing proper knowledge over organisational, business, and technical views. Researcher-driven discipline.	Top management (facilitator), business, especially R&D department (implementer). Vendor-driven discipline.	Within organisations, PDM is a business and EIA an IS driven issue. Due to its holistic nature, EIA calls for wider participation.
Development objectives and decisions	Formulation of EIA so that it presents the state and future target of information management acting at the same time as a strategic tool for top management. Development choices are made based on the actions required to meet the future target.	Formulation of PDM strategy so that it provides all the essential product data to everybody when they need it. Development choices are made based on the needs in different lifecycle stages in product data management.	Traditionally EIA is a tool and PDM a deliverable of information systems development.
Values and assumptions	Providing a high-level strategy for managing information as a valuable asset so that the potential value of the information will be realised.	Providing strategy for managing product data effectively. Product as well as process development activities will be intensified.	Both are strategic, information-centred tools within organisations.

*Table 2. The results of methodological comparison of EIA and PDM development processes.*

Traditionally, PDM has been a business-oriented discipline with clear implications to information management conventions and to business processes (Kilpeläinen, Tyrväinen and Kärkkäinen, 2006). Although EIA is considered as a high level IS and strategic component without a concrete outcome in the form of information systems for example, there have been cases where information architects have been engaging in streamlining business processes while designing shared databases (Martin, 1982). Thus, in addition to architectural descriptions, EIA triggers the need and facilitates not only information management but also business process modifications. However, the effect of EIA on business processes is often indirect, which is a result of IS/IT utilisation. In case of product information, the change process takes place through PDM principles. For example, automated data entry might be required, to be implemented by utilising bar-code systems, RFID, and smart chips.

Partly because the disciplines are practiced in different domains within organisations, the terminology used is somewhat incompatible. One clear and significant difference can be found in how the terms of data and information are perceived. In general, the difference in emphasis can be gauged from the name of the discipline: PDM focuses on data, EIA on information. Nevertheless, the overall need in the field of organisational information management is to reach and integrate all intellectual resources that are embedded in organisational processes to make them part of the organisational information resource (Kilpeläinen, Tyrväinen and Kärkkäinen, 2006). Thus, talking about distinct terms, especially when approaching the issue on a higher level, seems somewhat superfluous (cf. Tuomi, 1999), because all the relevant aspects should be present.

## 4 DISCUSSION

The indication seems to be that the disciplines of PDM and EIA share some major similarities to make them feasible candidates for integration and to provide synergy between them. Next, we will approach the issue of PDM/EIA alignment bottom-up and demonstrate how PDM development can support EIA development. Then, we move on towards top-down influences by taking strategic side of an organisation, and its relation to PDM and EIA, under consideration.

### 4.1 The role of PDM development in EIA development process

To demonstrate the potential impacts of PDM development and the existence of PDM strategy to the EIA development, we examine PDM along the facile steps of the architecture development process presented in (Ross, 2003). The process starts with the definition of the organisational strategic objectives reflecting the present state of an organisation. Because PDM is a strategic tool within organisations, it should reflect the enterprise IT strategy (cf. Harris, 1996) in terms of product data management principles. Further, because the main objective of PDM strategy is to define business processes and related technologies, it can provide an extensive, overall picture of horizontal and vertical business requirements. Thus, the knowledge of the operational side of an organisation, including the use and aim of the present IS that PDM strategy provides, is a vital element in refining, selecting, and applying appropriate technologies for future needs (Bryan and Sackett, 1997). While EIA initiatives may oversee the business requirements and organisational culture without PDM strategy descriptions, PDM seems to bring business to a more concrete level in EIA development. Further, PDM strategy descriptions seem to reflect the in-depth state of some of the most important aspects of the total organisational information management conventions that helps EIA development.

The second step in the architecture development process is to define the key IT capabilities for enabling the organisational strategic objectives. In general, the development of PDM, or any other strategic issue within organisations, provides valuable knowledge on how distinct issues, such as business processes, IT infrastructure, and applications, should be developed in parallel. This helps EIA in encompassing all the business-related informational aspects in addition to product data. Thus, if product data is to be managed comprehensively, PDM systems will act as a backbone IS (Karcher and Wirtz, 1999) along the logistics (SCM and ERP) as well as customer (CRM) related IS. However, in practice, it seems logical to leverage PDM toward PLM to provide an extensive production-related information resource instead of mere product information. Nevertheless, one might expect that lessons learned from PDM development would provide a great degree of support to EIA development in defining the key IT capabilities with which to enable organisational strategic objectives.

The third step in the architecture development process is to define the policies and technical choices for developing IT capabilities. As PDM systems are strategic backbones within organisations, the definition of the future needs should be based, first, on the state of the PDM, and, second, on its development needs. However, in addition to developing the PDM as such, a need for enterprise application integration is often triggered during this phase in order to provide data integration between existing IS if possible. Thus, the emphasis is gradually directed towards holistic and pervasive organisational information management that is the fundamental target of EIA. However, PDM as a strategic element has already drawn the line for the main policies to be used. Further, one of the most important aspects of the third step in the architecture development process is to justify the needed investments. PDM systems are often regarded as infrastructure systems in an enterprise, and their main problem is seen in the early investments and late benefits (Peltonen, Pitkänen and Sulonen, 1996). They are, nevertheless, much more concrete than EIA because they are related to actual production of goods aided by the IS. Investments spent on creation, introduction, and maintenance of architectures are hard to measure and, as a result, the figures do not show what a critical survival issue it is for an enterprise. Unlike PDM, EIA is not often associated with expensive software. IT investments for PDM are, therefore, more concrete than they are for EIA development process.



However, it is worth noticing that relying indiscriminately on PDM strategy descriptions in the EIA development phase and in further IT strategy refinements may create some fundamental problems while offering no solutions. For example, a PDM system development may be based on wrong arguments if the PDM strategies and IS utilisation are planned from the viewpoint of available off-the-shelf solutions and their functionalities. Thus, internal processes might sometimes become accommodated to the needs of IS. Consequently, the requirements do not always reflect the actual business needs and requirements. However, technology solutions must be driven by business requirements, and the functionality and features of any solution must be in line with the organisational strategy (Abramovici and Sieg, 2002). Thus, developing the requirements from available features and functionality may lead to a system being selected that does not meet the operating environment. For this reason, if EIA descriptions are based on expectations from a defective PDM strategy, the mistakes will be repeated and they might even escalate. Therefore, it is of overriding importance that PDM specifications are based on business requirements and reflect organisational strategies.

#### **4.2 The relationship between PDM, EIA, and organisational strategies**

The relationship between the concepts of PDM, EIA, and organisational strategies can be illustrated with an example. On one hand, changes made in the PDM, or operational, level should trigger changes in the EIA level, which, in turn, communicates alterations to the strategy level as changed business requirements. On the other hand, refined strategy will change EIA descriptions, which reflect to the PDM level as development directions. Taking the PDM/strategy alignment problem back into consideration, EIA seems, thus, to provide a link, reducing the gap between the concepts. In fact, integrating and joining the concepts together in one way or another, would allow the awareness of each other's operations emerge (Teo and King, 1996), which is a prerequisite for a purposeful strategy (Ross, 2003). As information is the connective element between the concepts, linking the operational side of an organisation to its business goals becomes possible (e.g. Spender, 1996). Further, because competency in EIA has a positive effect to aligning organisational strategies and IT capabilities the alignment will be accomplished in a structured and standard way. Thereby, EIA can be regarded as a boundary object between PDM and business initiatives.

To put it another way, the concepts seem to form a two-way value chain where all the elements support, facilitate, and refine each other (Figure 3). Because the concepts stand on different levels within organisations, the relationship is hierarchically shaped, which leads us to refer to the relationship as the PDM/EIA/strategy continuum. The iterative nature of the continuum is crucial because requirements tend to change over time (Sommerville and Sawyer, 1997). Further, through the process of meeting the needs of changed requirements at any level, an organisation will be able to adapt its strategy (Sackett and Bryan, 1998). The iterativeness sets, thus, the scene for total information management principles throughout an enterprise (Moynihan, 1990), which has multiple prospects especially as a tool of strategic decision making. For example, providing a proper awareness of and access to critical information (e.g. Teece, 1998) managers do not have to reinvent solutions to existing problems (Clark and Wheelwright, 1994) and to repeat past mistakes (Dillon, 1997).

In addition to facilitating PDM/strategy alignment, the continuum seems to have a positive effect on business/IS alignment problem also, which, especially within functionally managed organisations, is partially caused by managerial perspectives. For example, business managers usually think of processes in terms of workflows and human resource management to accomplish specific tasks in order to produce a desired end product. In other words, the key issue for business managers is to ensure that the input of a process (i.e. customer's needs) correlates with the output of the same process (i.e. the quality of an end product). IS managers usually think of processes only as they relate to technical aspects of the total EA (applications, databases, and technologies) they must support. Even if the IS/IT personnel have been instructed on business and vice versa, the gap still exists (e.g. Peppard, 1999). As a result of the existence of the gap, the PDM strategy descriptions, even if they were accurate and truly useful, are never looked at on the top management level, which deepens the gap

further. Thus, there is a clear need for a well-managed real-time correlation between PDM, EIA, and enterprise IT strategy to build a synergy between them. In practice, for example, practical correlation may provide an umbrella to all IS development projects within an organisation aiming at making elaborated data integration possible. In other words, the continuum seems to support the fundamental changes necessary to realise the IT strategy through organised and real time vertical information sharing in a persistent and consistent way.

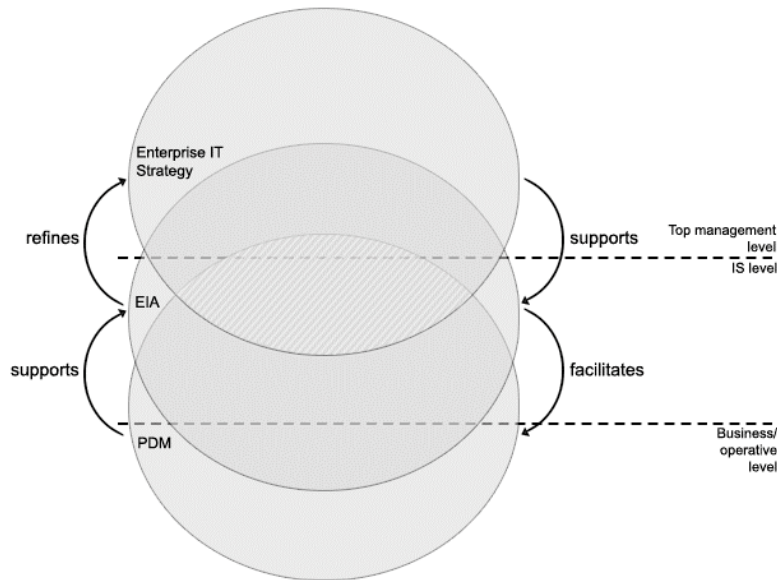


Figure 3. The PDM/EIA/strategy continuum.

However, in order to accomplish a functional PDM/EIA/strategy continuum, the organisational culture should be transformed towards a direction where information sharing is encouraged in order to provide all the essential explicit and tacit information and make it accessible for anyone. Further, there is a clear need to adopt an existing or introduce a new method to express the needed information in a convergent form in architecture level. Thus, the method should provide different levels of abstractions of presenting information in order to provide tools for different interest groups (Armour, Kaisler and Liu, 1999) in both vertical (business, IS, and top management personnel) and horizontal (business units within a geographically dispersed business process) directions to support decision making. This would lessen misunderstandings in situations where people from different disciplines plan scenarios without a shared vocabulary. The resulting blueprints may be misapprehended leading to decisions based on false arguments. As an example, in addition to UML (Armour et al., 2003; Shu, 2003) one promising solution seems to be to adopt ontologies and their description languages as information representation mechanisms to specify organisational conceptualisation (Gruber, 1993) in a coherent form in architecture descriptions. This would provide a common ground (highlighted intersection of the disciplines in Figure 3) for holistic organisational information management development practices.

## 5 SUMMARY

Development and implementation of a backbone information system, such as PDM, is, in most cases, a strategic decision within organisations. Other reasons, such as political, intuitive, and irrational non-strategic reasons, may also take place in practice. In all cases, the development should reflect organisational strategic objectives because PDM systems manage strategically important information. However, aligning the strategic goals with PDM development, while contributing to that development, has been surprisingly difficult. At the same time, timely feedback from the utilisation and usage of the backbone information systems to management level has been insufficient. For these reasons, the study focused on exploring the aspects of the linkage between PDM and organisational strategies through

architectural descriptions. However, the lack of such architectures in practice has lead us investigating the capabilities of PDM development that support EIA development also.

The methodological comparison revealed major similarities and differences between the disciplines of PDM and EIA. For example, both were seen as strategic concepts that concentrate on key information management and, further, are driven by organisational strategic goals and objectives even if they are practiced in different levels within organisations. Further, the lining up of PDM principles along the steps of a traditional EIA development method revealed that comprehensive PDM is a central ingredient in EIA and seems to provide a key driver for EIA development in large manufacturing organisations. Further, EIA was seen as the missing link between business/operative and top management levels within organisations with the effect of reducing the gap between them. The relationship between the concepts of PDM, EIA, and enterprise IT strategy was, thus, called the PDM/EIA/strategy continuum, which is a continuum that may set the scene for total information management principles throughout an enterprise especially in cases where the role of product as well as production information is highlighted. The relationship was seen valuable especially in creation, evaluation, and refinement of an enterprise IT strategy as well as in supporting the fundamental changes necessary to realise it. However, it is worth noticing that the continuum is just one segment in the total EA. Thus, other segments, i.e., ERP, SCM, and CRM should also be taken into account when refining the total business/IT strategy. Anyhow, the continuum may, as given, provide a starting point in a holistic business development where information management is a pivotal element.

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