Implementing product data management the first time

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Abstract. The research described in this paper investigates the problems and issues faced by companies implementing Product Data Management (PDM) systems. The aim is to produce guidelines to help managers implement PDM to gain maximum competitive advantage. A pilot study, which illustrates the key factors necessary for the successful implementation of a PDM system, was carried out and this was followed with an in depth survey in a range of engineering companies in differing industrial sectors. The in depth survey results show that the obstacles faced by companies in implementing PDM relate mostly to personnel issues, for example lack of management support, user acceptance and implementation issues. An integrated framework has been developed in the form of an IDEFO operational structure to meet the major need identified from the in depth survey. The IDEFO operational structure illustrates the key processes required to assist management and increase their commitment and support for the PDM implementation project.

1. Introduction

Product Data Management (PDM) systems are about managing product information, throughout the entire lifecycle of a product, in a more efficient, organized way (Little and Lee 1999, CIMDATA 2001, Liu and Xu 2001). A PDM system is used: to store and retrieve product design data in electronic form (called vaulting); to keep track of all possible product configurations (product structure management); to control the release of engineering information (workflow management); and to record a detailed bill of material of every product shipped; known as configuration management. The PDM system helps users such as engineers and others, to manage both data and the product development process. The system keeps track of the masses of data and information required to design and manufacture products and then supports and maintains the data. PDM integrates and manages processes, applications and information that define products across multiple systems and media. As reported by (Gascoigne 1999) PDM assists in the successful implementation of a concurrent engineering strategy through provision of the mechanisms to capture and enforce the specific product development process consistently and according to the way a company does business. Datamation (2002) viewed PDM as a system that manages all product-related information, such as manufacturing products – motor vehicle, computers, mobile phones, projects such as buildings, bridges and motorways. PDM also manages design applications such as geometry, engineering drawings, project plans, part files, assembly diagrams, product specifications and numerical control machine tool programs.

In principle any information required throughout a product’s life can be managed by a PDM system, making correct data accessible to all people and systems that have a need to use them (Liu and Xu 2001) PDM is sometimes confused with other systems such as Enterprise Resource Planning (ERP). PDM is rooted in the world of engineering and design. It manages engineering and product design data and their relationships throughout a product life cycle, whereas ERP is a control system specifically for manufacturing. It is recorded by Miller (1998) that this notion of product life cycle management is one thing that sets PDM systems apart from many other manufacturing systems currently available.

In addition PDM can be used to store and process engineering organizations design information. Other advantages are:

1. PDM projects are the basis for creating an information-sharing environment.
2. The desired effectiveness is achieved through the creation of distributed multi-disciplinary teams (supply chains) that work in a collaborative manner.
3. The desired efficiency is achieved through the creation of a cost effective computing infra-

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structure that supports a distributed multi-

disciplinary collaborative style of work.

(4) It creates an environment that automates

management of work by integrating people,

their tools, processes and information.

PDM can be used in other non-engineering sectors

such as publishing, software development, financial

services or any environment where product information

and processes will benefit from better control.

A company must be able to supply and support the

products that customers require, at the time required

by the customers. These requirements put pressure on

the engineering function to improve product quality

and reduce lead times. One way to do this is to increase

the productivity of individual engineering activities (e.g.

through the introduction of CAD). Another way is to

improve the coordination between activities (e.g.

through concurrent engineering). PDM supports both

these approaches.

In today’s competitive world, where reductions in a

product concept’s time-to-market and product lifecycle

costs are twin concerns, information needs to be shared

and made available to everyone across the enter-

prise and between collaborative partner enterprises

(CIMDATA 1997). The ‘clock-speed’ of business is faster,

time-to-market has to be continuously reduced to gain

market share, and the demand for product quality and

quality assurance, continues to grow (Fan 2000). At the

same time there are government and industry regula-

tions to be met, and greater awareness of product

liability issues. PDM helps reduce the time and costs of

bringing new products to the market (CIMDATA 1997,

DTI 1997, Hameri and Nihtila 1998, Hall 2000). This

reusability of product data is critical to companies

seeking to reduce their product development cycle time

(Hameri and Nihtila 1998).

A PDM system is a mechanism for capturing,

coordinating and managing engineering data relating

to the product, its structure, its life cycle and the workflow

and processes used to create, modify and issue the data. A

PDM system does this by managing the engineering data,

which exists in a range of software applications on a

variety of hardware platforms and non-computer systems

that generate engineering data, i.e. paper documents

(Penhallow and Waters 1994, Little and Lee 1999). PDM

provides a structure in which all types of information are

used to define, manufacture and support how products

are stored, managed and controlled. Typically, PDM will

be used to work with electronic documents, digital files

and databases, including:

(1) product configuration;

(2) specification;

(3) CAD drawings;

(4) images.

The type of information that can be extracted from

PDM may be in the form of a 3D model, some 2D
drawings, a bill of materials (BOM), test and quality
data related to a particular product, assembly, drawing

or component details.

2. What benefits can PDM provide for companies?

The main benefit of a PDM as outlined by Fan

(2000) is not just the solution of particular information

bottlenecks but in the potential to provide accurate,
timely and relevant product information to any users of

information within and beyond the enterprise. The

factors fuelling the PDM market place are rooted in

both business and technology. From the business

perspective throughout the 1980s and 1990s manufac-

turers in almost every market segment, especially the

automotive, aerospace, consumer products and electron-

cics industries have experienced an increasingly com-

petitive, global marketplace that forces them to

streamline and accelerate their product development.

PDM assists manufacturers such as these, helping them
to shorten product development cycles while increasing

product quality and decreasing overall product cost

(Gascoigne 1999). The PDM system automates many of

the individual processes involved in the design and

manufacture of new products, allowing them to be

implemented with greater speed and precision.

Further advantages that have been claimed (Pen-

hallow and Waters 1994, Mainwaring 1999) for PDM

are:

(1) Improved effectiveness for users: speedier ac-

   cess to and quicker searching among a single

   source of consistent product information.

(2) Improved collaboration among users.

(3) Improved change management: better work

   processes and good access to product data

   reduce expensive and late changes.

(4) Faster time-to-market: arising from speedier

   working and electronic communications, and

   can result in larger market share.

(5) Better product quality: arises from using con-

   sistent and up-to-date data, better checking and

   fewer errors and better opportunities to re-use

   data and designs.

(6) Improved speed and flexibility: speed comes

   from being able to call-up CAD files, as opposed

   to searching the design offices for paper

   drawings that may have long ceased to exist
for one reason or another. Flexibility comes from being able to re-use concepts and core models from old designs in order to overcome time factors on current projects, as well as being able to distribute designs to all kinds of fellow employees for comment.

2.1. What is a successful PDM implementation

In general the types of companies that are implementing PDM as reported by Fan (2000), Little and Lee (1999) and Datamation (2002) are as follows:

1. UK aerospace: 50%;
2. Automotive: 35%;
3. Small high technology, high growth manufacturers, especially if they manufacture and sell outside the UK: 15%.

The main usage of PDM in industry (Tackbrook Consulting 1999 [www.tackbrook-consulting.com/survey1.htm], Fan 2000, Hall 2000) are as follows:

1. 89% CAD management;
2. 49% BOM and configuration management – closely linked to CAD management and is frequently used to provide MRP/ERP systems with good quality information;
3. 17% word-processed documents or spreadsheets

There are number of points described on the website (www.rmdonovan.com/pdf/perfor8.pdf) as possible expectations for successful implementation, these are:

- good preparation and implementation;
- good education and training of employees;
- clear strategy and specification of business processes;
- good evaluation and selection of suitable systems.

In general from the literature, getting the implementation right is the key process that will make a system succeed or fail, many managers lack understanding of the system and the structured approach needed for implementation.

Arvin Exhaust is a global manufacturer of exhaust systems; it examined PDM initiatives in a variety of industries (Mainwaring 1999). It was clear that without high level support, the PDM system could not be fully exploited. Arvin Exhaust noticed that without clear top-down direction, a large PDM implementation could easily be confounded by conflicting user demands, escalating user requirements and by severe resistance to change.

Eighty-nine per cent of respondents from a survey by Tackbrook Consulting considered that PDM provided good benefits and a good return on investment (ROI). Reduced lead-time was seen to be a major benefit of implementing PDM for ICL manufacturing. While Racal made savings of £250 000 in 1 year by in part reducing the time delay on master record access from 1 month to on-demand, changing notes outstanding on a project from 3 days to on-demand and family tree enquiries from 1 day to on-demand.

Mike Segal at PDM vendor MatrixOne commented, ‘to get the whole picture you need to start small’. This approach needs the support from the top. Executive support has proved to be the key success for many enterprise IT initiatives (Mainwaring 1999).

Other systems implementations also emphasize commitment from the top management (Roberts and Barrar 1992, Dale and Cooper 1994, Bingi et al. 1999, Buckhout et al. 1999) PDM implementation data was gathered initially by a survey carried out at the university, together with a literature review in (CIMdata 1998, Mainwaring 1999).

Research literature (Hayes and Ramchandran 1991, Barrie and Cary 1994, Brian 1995, also www.pdmic.com/studies) indicate that management commitment is a key factor in the successful implementation of PDM. The Penguin English Dictionary comments on commitment as ‘an act of committing to a change or trust; especially a consignment to an institution; an agreement or pledge to do something in the future; something pledged; loyalty to a system of thought or action’.

Goffin and Szwejczewski (1996) state that ‘management commitment is vital, but what exactly does this involve?’ and went on to suggest that it involves active management involvement, a willingness to implement change and a priority for remaining competitive. Ford Motor Co. is making its suppliers a key part of its design team. Ford uses PDM to reach smaller suppliers as well as their larger first tier suppliers. It was commented by Mark Johnson that suppliers gain the latest information they need to design their part of the vehicle (Eggleston 2000). PDM helps Ford design cars that can easily be configured for individual customers. Miller said that there are two trends driving such companies as Ford to invest in PDM (Eggleston 2000):

1. Globalization of their product development efforts to take advantage of resources around the world.
2. Close integration of their supply chains with product development.
Having a PDM system in the organization allows it to extend across the product lifecycle and throughout the enterprise. Also product context data visibility improves from 5–10 to 80–90%. With PDM it is possible to find a drawing of a part and fax it to a new supplier with a request for a price quote. Without PDM it would not be possible to locate the part drawing. Timberjack group, a Finnish manufacturer installed Windchill PDM software to keep track of the 250,000 parts used in its forestry equipment (Abramovici et al. 1998). Timberjack uses PDM to hold information such as documentation and an online parts manual. The goals are to make product data more widely available and to better support customers by keeping track of machines.

2.2. What is an unsuccessful PDM implementation

PDM implementation projects may fail to achieve the desired results for a variety of reasons, as outlined by (Hameri and Nihtila 1998):

- No documented vision for the future.
- Lack of organization ownership.
- Unrealistic expectations by management.
- A focus on technology but not business strategy.
- No independent assessment of need.
- Lack of executive commitment to complete the project.
- Implementation plan not matched to organization’s ability to change.

Research conducted by (Faux et al. 1997) indicates that five out of 10 PDM projects fail. For many industries PDM has been successful at providing benefit in areas such as document management, workflow automation, engineering change management, component management and reuse and concurrent engineering. However, PDM project failure can be due to the system simply not working; not meeting the specification or the expectations. The following are key points from Bryan and Sackett (1997) that focus on common difficulties associated with the implementation of PDM.

- Knowing where to start and what to do first, PDM is a large project requiring a lot of work over a long time span, 18–24 months and companies do not allow sufficient time or resources for the project.
- Scalability of projects to reflect a full organization-wide implementation, in other words the project should consider other areas such as purchasing, manufacturing, etc. where PDM could assist either currently or in the future.
- Maintaining interest and support for a project that may take a long time before showing significant benefits.
- Focus on the implementation of PDM technology at the expense of other related issues.

The researchers Liu and Xu (2001) commented that PDM is complicated, broad in scope and there is a steep learning curve. Also there is a need for an efficient communication infrastructure to allow project teams to communicate within a PDM infrastructure. Some of the main reasons for unsuccessful PDM projects, from (Larsen 2001) follow:

- Little involvement from senior managers during implementation. Comments from Little and Lee (1999) research indicate a lack of awareness of PDM system capabilities particularly by senior management. This suggests the need to introduce and educate UK industry managers about the functionality and potential benefits of PDM.
- Project team members trying to do two jobs at once.
- Senior managers need to commit time in order to develop their own personal understanding of the subject.
- Senior management typically delegate too much responsibility to technical expects. They mistakenly view the PDM implementation endeavour as an information technology project: not a business project.
- Senior management are simply unsure of the role they should play. They focus on objectives and issues, while engineers implementing the PDM system expect to focus on processes. Neither side can ask the right questions of the other.

It was reported by Tackbrook-Consulting (1999) that unless a senior director champions an enterprise-wide feasibility study and is prepared to make managers aware of the business benefits, then PDM will remain for some just a departmental solution. It had been reported in Hall (2000) that one challenge for the UK is to overcome the lack of information technology awareness in the boardrooms of our manufacturing companies. The complexity of implementing the process throughout the organization has proved to be a major obstacle in achieving anticipated results: implementing PDM is a painful process in which a complete top to bottom understanding of an organization’s processes is needed (Gascoigne 1995, CIMdata 1998).

In the USA 67% of companies have an IT professional on their board, while in the UK it is only 8% as reported by Tackbrook (www.tackbrook-consult-
 directors are not aware of technology and its business implications and do not seek advice, they tend to be reactive and are not convincing champions of PDM. As reported by Hall (2000) a recent survey of attendees of technology seminars run by the Computer Suppliers Federation (CSF) over the past two years, half of those responding said that they had done nothing since the seminar. By far the most cited reason for failure was ‘lack of management support’. In this situation, it seems that a number of UK companies believe that they can survive without managing their information. Also a lack of skills was a constraint preventing effective implementation of PDM.

What are the risks associated with collaborating with other employees without having PDM? As Adami-Sampson interviewed in Dwyer (2000) comments that the biggest design process time waste is file duplication, one person might work on different copies of one file at a time without knowing it. Also security is another issue; avoiding making drawings available to all suppliers as they may be competitors. There is a requirement for control and access that needs to be incorporated into such an environment, where the viewers do not have, the CAD tools that PDM does.

3. What is the future of PDM?

It is reported in Fan (2000) that growth in the PDM market increased by 26% during 1999 especially in the automotive and aerospace sectors. He emphasizes that growth is expected to accelerate further and it is important that the correct preparation is in place. In 2001 Palmer predicted that by 2003, all successful manufacturers would have adopted collaborative approaches; leading to competitive parity. What it calls collaborative product commerce (CPC) would be the norm; a necessary step for survival, but not necessarily a guarantee for success. PDM may even be starting to replace ERP as the real enterprise backbone. Such a trend is taking place because issues like time-to-market and globalization are driving everybody towards PDM (Palmer 2001). So what may the future hold? Perhaps customers will go directly to the portal of a manufacturer’s website to design their own product variant rather than purchasing a mass-produced one from a dealer.

4. Survey

A pilot study was carried out; the aim of which was to identify the difficulties that companies encountered in the implementation stage of PDM. The questionnaire focused on issues relating to the success of PDM, the types of difficulties experienced and key issues surrounding successful implementation. The questionnaire was distributed by email. It was targeted at managers and champions of PDM projects. These company contacts were obtained from the Kompass, Institution of Electrical Engineering – Flashpoint presentation PDM implementation – pains and gains RSA, manufacturing company directory, PDM England membership and through membership of an International Product Data Management User Group.

The first stage in the PDM implementation project was to review companies’ experience of implementing PDM. An email survey was sent out that targeted companies that had implemented and currently were using PDM systems. The audience that participated in the project varied from SMEs to large organizations, representing a cross-section of industries such as aerospace, defence technology solutions, mining machinery manufacture, medical and pharmaceutical industries. The number of employees varied from 100 to 8500. A questionnaire approach was used. Email was sent to organizations that had implemented PDM. The researcher requested that the questionnaire should be forwarded to the most relevant person, probably the project manager, who had the most involvement in the PDM project.

The following key questions were asked in the pilot study:

- How successful was the PDM implementation at the company? Both in terms of management’s view of the success and in terms of satisfying business requirements.
- What were the difficulties experienced in implementing PDM?
- What were the key issues surrounding successful PDM implementation?

The results of the pilot study are shown in table 1, which illustrates the key factors necessary for the successful implementation of a PDM system. The pilot study raised a number of comments made by project managers who had led teams implementing PDM concerned with getting the correct level of support for the project. A summary of the comments is given in table 1. The pilot study was also useful for identifying organisations for more in depth interviewing.

After the pilot study was completed and analysed a full survey questionnaire was sent to industrial managers. The full survey incorporated further clarification of all the problems identified in the pilot study, for example: reasons for choosing PDM, benefits after implementation, factors convincing senior management, reasons for lack of management support. The questionnaire con-
sisted of a total of 21 questions. Seventy companies were approached of which 30 companies responded, a response rate of 42%. Eleven companies agreed to participate further in the research and provide more detailed analysis of their systems. Chosen questions were developed that could provide answers to the root cause of PDM implementation difficulties.

The following key questions were asked in the full survey questionnaire:

- What obstacles did your company face in implementing PDM?
- What lessons have been learnt by the implementation?
- What could be the reason for a lack of management commitment?
- What further questions would you consider important to convince senior management to support PDM?

5. Results

Results were obtained from the targeted companies as shown in table 2. A summary of the results obtained for the pilot survey, the full survey and the detailed interviews are provided in the following sections.

5.1. Results obtained from the pilot survey

The first stage in the PDM implementation project was to review companies experience of implementing PDM.

5.1.1. How successful was PDM? Eighty percent of the respondents indicated that PDM has a good reputation with companies fulfilling their initial requirements and meeting business needs. Comments such as ‘extremely successful’, ‘effective control’ and ‘high throughput of data’ typify those received. This indicates that PDM has made a positive impact in the sample companies that have decided to introduce this technology, shown in figure 1.

Twelve companies out of total of 15 indicated that PDM had been very successful, while just three responded that they had got a reasonable return. Several organizations defined very successful as communications made easy, allowing access to external vendors, another primary tool for communication with manufacturing, later used by all in the company for document storage and retrieval. One company commented:

The implementation was very fast, the system operated as required. Functionality and cost saving being identified in the initial justification, taking longer than expected but was again successful. The PDM provides many opportunities for improving processes for managing data.

For this company there appeared to be numerous reasons why their project was successful. They made comments such as ‘the implementation must be driven by the company executive’, ‘the benefits achieved from the implementation must be promoted by the company executive’ and ‘achieve absolute buy-in from management prior to implementation’.

The PDM learning curve can be substantial and management must be willing to accept this. They must also develop a clear implementation plan, which includes resource requirements and time estimates. The implementation project must be able to demonstrate the benefits of PDM in terms of reducing the design cycle and comparing that to the pre-PDM methodology to show the potential benefits.

5.1.2. What were the difficulties experienced in implementing PDM? Interestingly, the difficulties encountered during implementation were not technical, most of the difficulties clustered around change management, i.e. especially senior management involvement in implementing PDM. Key themes were lack of buy-in from users and senior management and the difficulty in changing working practices.

Sample comments from respondents about important concerns were: ‘getting management support prior to deployment’, ‘ensure management understand all the implications of the rollout’, ‘get project momentum by management support’ and ‘lack of executive commitment to complete’.

Comment on lack of management support was passed by one company as ‘make sure management
understand all the implications of the rollout and the impact on the design teams’ another comment on lack of buy-in was ‘must get buy-in from the users before they start to use the system’ and finally on working practice, ‘a global environment requires designing a system that will work in different cultures as well as different venues. All three quotes, as shown in figure 2 indicated key difficulties captured by the pilot study. These findings when compared with the literature have confirmed the types of most common difficulty influencing companies when implementing PDM. The results obtained from the pilot survey agree with the survey carried out by Whittaker (1999) on unsuccessful information technology projects that revealed that one of the three most common reasons for project failure was ‘lack of top management involvement and support’.

Consultants, Tackbrook (1999) identified the reason for lack of management commitment, in their view, top management see other things as higher priorities, that either are less risky or offering better ROI. Their commitment is tied to their lack of understanding of the business benefits of PDM.

From the pilot study, figure 2 shows the key difficulties in implementing PDM.

5.1.3. What were the key issues surrounding successful PDM implementation? The key issues identified by companies from the pilot survey once again focused on change management but also highlighted the need, not only for ‘buy-in’, but for appropriate training delivered at the right time and also the need for user-friendly systems. An overall response of 25% indicated that the third most important issue was support for training for successful implementation. From the survey, it may be argued training is essential to make sure everyone uses the system in the same way, as there may be confusion in its operation if one is taught in a different way or by another vendor at a later time. As one company commented ‘it was difficult to get back to the vendor, which meant contacting another vendor who had a similar system to the one currently used’.

A response of 25% denoted importance of the champions for user-friendly systems. Using champions will get greater acceptance by the people who are going to use it. Typical comments received from champions, project managers, PDM managers on how to achieve successful PDM implementation were as follows:

- ‘The benefits achieved from the implementation must be promoted by the company executive’ – PDM manager.
- ‘Training – there is a need to make sure everyone uses the system in the same way’ – champion.
- ‘The implementation must be driven by the company executive’ – champion.
- ‘Must get buy-in from the user before they start to use the system’ – project manager.

Figure 3 indicates the key quotes about what is required to provide support for successful implementation. The diagram indicates the issues covered in the quotes captured from the pilot study. The diagram indicates management support to be the key area of concern to successfully implement PDM, followed by buy-in from users and finally in equal place, both training and user-friendly systems. In numerous sources of literature management support was seen to be vital for successful implementation and the need for top management support appears to be widely recognized. Literature indicates, lack of top management involvement and support has resulted in many organizations failing in implementing PDM. Having senior management involved in the implementation program reduces the resistance to change by users; this demonstrates that senior management are familiar with the subject and taking it seriously to make it work.
5.2. Results obtained from the full survey

The distinction and purpose of both the pilot study and full survey was that the pilot study gathered overall data influencing the implementation of PDM, while the full survey incorporated further clarification of the problems identified from the pilot study.

5.2.1. What obstacles did your company face in implementing PDM? The full survey also included interviews from those companies that indicated that they wanted to take part in the research. Discussions were held with project managers in areas of technical, manufacturing and engineering using a questionnaire format. Eight obstacles to successful implementation were identified, which are as follows:

5.2.1.1. Implementing issues. A typical response was not knowing the structured approach for implementing PDM, i.e. not knowing where to start. Other issues were: Who will administer the system? Who will know what resources (people and time) are required? How will success be measured?

5.2.1.2. Lack of management support. In total 65% of respondents questioned indicated that this was important. The main concern was lack of management support and this seemed to result from the uncertainty of what PDM can provide to the organisation. The feedback indicates that there is a need for a structured approach to assist senior management to decide whether or not to implement PDM, this would provide support and help to overcome the rate of failures of PDM projects as indicated by Barrie and Cary (1994), Barkeyer (2002), Buckout et al. (1999), Hall (2000) and Roberts (1992). The CSF carried out a survey in their technology seminars, which illustrated that nothing had been done since the last seminar (previous two years ago). It was noted that the most common reason was due to ‘lack of management support’. Another case was lack of information technology awareness in the boardroom of manufacturing companies.

5.2.1.3. User acceptance. In total 40% of respondents questioned indicated that this was important. The respondents indicated that often the implementation method was insensitive to the people’s needs and fears and this often resulted in resistance to change. Understanding the business needs, careful planning, involving the users and good communications will gain support from users (Preece 1991).

5.2.1.4. Cost. In total 35% of respondents questioned indicated that it was difficult to produce a cost–benefit analysis, as there are many factors that contribute to the cost of PDM and these cannot be represented in a simple cost benefit analysis. This tends to indicate that there is a case for guidelines that provide a framework for cost analysis.

Figure 4 indicates the obstacles that prevent successful implementation of PDM.

5.2.2. What lessons have been learnt from the implementation? The lessons learnt relate to ‘understanding’ before starting to implement PDM such as ‘knowing your processes’, defining requirements, and getting the backing of a corporate sponsor.

Sample comments from project managers in a range of companies were:

- ‘A full and complete understanding of the processes used in the company is more important than anything else at all’ – senior manager, aerospace/defence.
- ‘Plan, think big for long term but implement small’ – project consultant, local government, and engineering function pilot document management.
- ‘Get key players on board early and keep them informed’ – project manager, engineering function.
- ‘Define every requirement known’ – PDM champion, technology solution.
- ‘A PDM implementation takes time, documentation and training are very important’ – PDM/ENG applications co-ordinator, mining machinery manufacturer.
- ‘In order to be successful, your project must be backed by a corporate sponsor’ – consulting engineering.

Although the literature has mentioned some of these same issues in relation to other disciplines such as the implementation of MRP and ERP (Roberts and Barrar 1992, Bingi et al. 1999, Buckhout et al. 1999) there is not a great deal of literature related to PDM that has mentioned the many implementation difficulties identified by this survey.

5.2.3. What could be the reason for lack of management commitment? From the full survey, as indicated in (figure 4) 65% of respondents indicated lack of management support as a reason for PDM system failure in meeting the requirements.
This lack of support may be because management are not yet aware of the capabilities of PDM. This belief is supported by Reinertsen interviewed in Mainwaring (1999) who posed the question ‘how important are PDM tools for business success’ 72% of senior executive respondents did not know. This shows that the message about PDM may not be getting through to senior management.

The following are significant comments about the reason for lack of management commitment. These were again obtained from a range of companies. The comments were received from PDM champions and project managers.

- ‘lack of belief that requirements are desirable or achievable’
- ‘lack of resources’
- ‘not having the real benefits properly described’
- ‘having a short-term view on investment’
- ‘high cost to implement and lack of vision’
- ‘lack of understanding of what the PDM system can do’

As one company in the technology solution sector commented:

Incomplete understanding of what it is, how it works and benefits derived. Too many times management teams simply don’t understand well when users in the field communicate their problems and needs, being in management doesn’t necessarily make people IT-smart.

Some other comments made relate to management lack of understanding of what the technology is and what it can provide the organization in terms of benefits and revenue.

5.2.4. What further questions were considered as important to convince senior management to support PDM? The comments received were from champions and project managers from a variety of industries such as the aerospace, defence, and automobile sectors indicating their view on implementing PDM.

Comments such as:

- ‘Ensure that you have “true support” from senior management i.e. they do not just agree but actively promote its usage’ – project manager, aerospace/defence, 3000 employees.
- ‘Develop a vision and assess if PDM can help get you there, if so, ask and answer the basic questions: Why, When, Where, How, What, every detail’ – PDM manager, technology solution, 100+ employees.
- ‘What direction is the company going? To sustain business at a low level or to become competitive in the future market?’ – champion PDM, aerospace/defence, 8500 employees.
- ‘What we didn’t “sell” to management but discovered how huge the benefits were in:’
  
  (a) Tracking and reporting, (b) interface with outside vendors – consultant, medical device and pharmaceutical industry, 650 employees.
- ‘PDM is a solid concept and will provide significant ROI even though it may be long term’ – project manager, manufacturing cables system, 500+ employees.
- ‘That it will provide tangible competitive advantage in time-to-market’ – senior manager, aerospace/defence, 2000 employees.
To summarize this section, the pilot survey indicated that the major issues affecting the implementation of PDM concern senior management support. While the in-depth survey questionnaire provided more detailed reasons why companies have difficulties implementing PDM. The in-depth survey tries to answer the question: Why there is lack of management support for PDM? The main reason from the surveys appears to be that senior management in companies are not yet aware of the capabilities of PDM. Resulting from this there is a need to educate organizations and their management in particular about PDM, so that it is hoped senior managers will increase their support. This requires clear guidelines providing information such as, how much will it cost, what is the ROI, what are the business performance benefits.

Comments from the survey, such as ‘lack of top management commitment’, ‘lack of management understanding’ present a problem that needs to be addressed and rectified. From the survey it can be concluded that management has responsibility for many projects. They will tend to base their understanding on the experience of their counterparts in other companies in terms of the actual benefits achieved by PDM and at what cost. Lack of management understanding could probably be exampled by a general lack of IT understanding with respect to its impact and importance to a modern engineering company. Senior managers that strategically organise the business should be aware that PDM is an expensive technology requiring significant capital and resource to gain benefits over time. It can only be considered, as a priority over other projects when the extent of the strategic advantage that it can provide is clearly understood.

Further work is being undertaken to develop a structured approach for senior management that will assist both understanding and commitment to successfully implement PDM.

6. An integrated framework

The overview integrated framework (figure 5) was developed in conjunction with the feedback from the questionnaire and interview survey. The overview framework illustrates the key processes that will assist management to commit to the project. A key part of the guidelines is their evaluation technique for assessing what PDM will provide for the organization if successfully implemented.

The main objective of the framework is to assist senior management to become aware of what PDM can do for their business. The framework has gained support in those companies that are using PDM and those that have gone through the implementation stage. These comments have provided feedback and reassurance of a need for a structured approach towards implementing PDM.

A brief outline of each of the individual phases of the integrated framework is discussed below.

6.1. Reason for considering a PDM business strategy

It is important to use the business strategy as the starting point from which to make the case for implementation. Knowing what is being offered by the PDM will extend the scope and the vision of the business plan. There could be technology already being used within an organization that possibly integrates with PDM allowing an opportunity to challenge existing processes and redesign them, but guided by the business needs. It is important that the PDM plan is owned and driven at a senior level in the organization.
6.2. Understanding the processes

It is essential that before PDM implementation can start or be discussed with a vendor, that one examines the organization processes. As one company commented: ‘A full and complete understanding of the processes used in the company is more important than anything else’, ‘many people avoid to examine business processes and move straight onto software functions and features’.

6.3. Develop a strategic vision

This is the first and most important element to be addressed before embarking on PDM. Every company must have a particular business need; otherwise the only system you will get is the one the vendor suggests. In the absence of a known business need you may get an inefficient system that costs too much, takes a lot of time and most importantly does not deliver any benefits that the company actually would want.

6.4. Understanding the capability of PDM

There are three key issues that need to be considered before embarking on PDM.

1. To consider the reason why PDM is required.
2. To develop a vision for PDM in your organization.
3. To identify what is it like working in a PDM environment?

6.5. Identify stakeholders

One of the most important issues is the make-up of the project team, as commented by one company:

It is helpful to have in the team, members who recognize the problem and drive the project also someone who can offer a good case for implementing PDM within the organization.

One of the important factors is the development of the project team, there is a need for someone who can sell it to users, and at the same time relates to the people in the business, someone with technical ability, i.e. understands the needs of the server. An action plan can be completed by department, section, team and groups of individuals to gain an overview perspective of requirements.

6.6. Cost and benefits

Firms frequently underestimate computer installation costs. A major cost in the early stages is running the existing system alongside the new system. The firm cannot risk the failure of untested procedures unless a back-up system is available and it often has to operate the two systems simultaneously for some time period.

Once the competitors in a market have utilized PDM the time frame for introducing new products will be shortened, control of changes and contracts will be improved, delivery times will be decreased and quality will be improved. A company that cannot respond to the competition will lose market share and profit margin. You cannot stand still and expect to remain viable if your competition is moving forward.

6.7. Advice for top management

The advice of a good vendor provides for a successful implementation and enables correct first-time processes. Also it is beneficial to have a good consultant at the start, if you are a small company, there are a number of options, reading articles, attending conference or short courses, visiting companies that use PDM or workbooks. These approaches possibly may convince management that PDM is right for the company.

Research is leading to the development of guidelines that will overcome the difficulties identified by these surveys although substantive testing is still needed to validate the guidelines.

From this survey research the senior management should show commitment in the following ways:

- Communicate their view about PDM and be personally involved in the implementation project.
- Decide how the company should approach the introduction and development of PDM.
- Fund the project and commit resources to PDM, i.e. releasing people and also taking an active role in leading the change.
- Visit most areas of the organization; in order to update themselves about what is happening in relation to PDM.
- Provide direction to the implementation team and monitor the progress of the project.

Management must be able to ask questions before starting the project, questions such as:

- Does PDM strengthen the company’s competitive position?
- How does PDM affect the organizational structure and the culture?
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- What is the scope of PDM implementation: only a few functional units or the entire organization?
- Are there any alternatives that meet the company's needs better than PDM systems?

Studying the survey indicates that, it is important that senior management take time to understand the technology together with the briefing from the project management, so any uncertainty can be bounced back to the project manager for clarification. This finding from the survey agrees with that of Roberts and Barrar (1992): that good management support is needed in the following domains:

- allocation of resources;
- approval and establishment of new organizational structures, roles and responsibility;
- set up of polices to anchor the new systems within the company;
- communication to company employees of a 'shared vision' of the organization and the role of the new system and structures.
- Arising from the survey results the following recommendations have been made for senior management:
  - To get involved in the planning and goal setting of the PDM system and make the goals known to all employees.
  - To view the PDM system as an important management tool to improve productivity and profitability.
  - To place the PDM system reports on the top management meetings agenda and get reports from the project manager, reviewing the results and the future plans.
  - To make top management involvement known to lower levels of management and to the employees by setting up policies to anchor the new systems within the company.
  - To appoint a high calibre person to be the PDM system manager.

7. Activity analysis of the PDM framework

The operational structure of the proposed PDM framework has been modelled using the formal integrated definition modelling methodology, which is commonly known as IDEF0 (Meta Software Corporation 1995). Figures 6 and 7 illustrate the overall page and its subsequent decomposition subpage respectively of the IDEF0 framework model illustrating the main activities and their associated input and output requirements for the PDM framework.

Three key activities have been identified as being required in order to fulfil the basic requirements of the PDM framework such as: (1) preparation and strategy for management; (2) implementation preparation; and (3) management to support project.

8. Conclusion

This paper is concerned with the successful implementation of PDM. PDM helps to organize, track

![Figure 6. Overview IDEF0 representation of the PDM framework.](image-url)
and control access to product information as the information is created and it assists a team-oriented approach to product development. PDM helps to accelerate the process in which products are designed and approved, also compressing the time for new products to get to market.

From the surveys, eight obstacles to successful implementation of PDM were identified: implementation issues; lack of management support; user acceptance; and cost. Comments on the lessons that have been learnt by the implementation relate to ‘understanding’ such as current processes, requirements and having a corporate sponsor and management awareness of the technology. Comments on lack of management support lie in poor awareness of PDM, i.e. benefits, cost of implementing, resources required and taking a short-term view on investment.

When asked about what would be considered important to convince senior management to support PDM, typical comments received were ‘have support from senior management and having them actively promote its usage’.

The data from this survey is being incorporated into a framework to assist companies who are considering implementation of PDM. The framework would overcome the awareness problem and also provide a structured approach for senior management to follow.

In further work, it is proposed that the IDEF0 operational structure will be applied in a case study. In the near future the framework will be tested in companies that have indicated a willingness to participate in the research project. This research has identified the main problems associated with PDM implementation and developed a framework to overcome the problems. The project confirms previous research that identifies why companies not implemented PDM (Little and Lee 1999, Mainwaring 1999).

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References


