

A Draft Neutral Syllabus

for

PLM Practitioners

Version 1.0

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Synopsis

If there is to be a recognised Profession for Product Lifecycle Management (PLM) practitioners, then there will need to be a neutral, agreed definition of the knowledge, skills and experience that a certified practitioner will need to possess.

At present, no such definition exists. PLM training and education courses are defined by the institutions that provide them, with no coordination or collaboration, resulting in a random patchwork of offerings that can only confuse the student.

Gaining agreement about the Body of Knowledge and standards of performance can only be achieved by discussion. The Working Group of the Professional PLM Initiative has therefore produced this draft of a Neutral PLM Syllabus as a starting point.

PLM practitioners from any type of organisation, in any role, and from any country, are invited to offer input as to how it should be developed and improved. Such feedback is welcome at syllabus@professionalplm.org.

Professional PLM Neutral Syllabus

Level 1: Practitioner

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# Introduction

If there is to be a formalised profession for Product Lifecycle Management (PLM) practitioners, then there must be a written and agreed definition of the skills and expertise that a practitioner needs to achieve.

At the time of writing, there is no neutral or independent definition of this. Every educational establishment or training provider creates their own course material, with no reference to any kind of standard scope or depth.

The Working Group of the Professional PLM Initiative has therefore created this neutral Syllabus as a first point of discussion. Interested stakeholders from any part of the world are invited to give feedback and advice, which will be incorporated to develop this PLM Practitioner Syllabus into a future agreed standard.

This is a Syllabus (a definition of what needs to be taught or learned); and not a specification for a Certification exam. Notes on assessment and certification are included at the end of the document.

# Normative References

This document is a stand-alone working model for a neutral PLM Syllabus. There are therefore no other documents that must be read in order to understand this one.

# Change History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date** | **Vers** | **Author** | **Update Notes** | **Reason For Change** |
| 2020-07-24 | 1.0 | Professional PLM Working Group | First release for general dissemination and feedback. |  |

# About This Document

This PLM Practitioner Syllabus has been produced by the Professional PLM Initiative, which was formed in support of a straightforward premise:-

* PLM is a specialty in its own right;
* of sufficient complexity that its practitioners should be certified to carry it out;
* of sufficient value to the business world to warrant its being recognised as a profession; and,
* steps should be taken to establish that professional status.

The Professional PLM Initiative aims to bring together PLM practitioners and PLM-related organisations in order to establish a recognised PLM Profession in response to this premise. The Initiative has a worldwide scope, and is entirely open and neutral. It is guided by a Steering Group, and has an active Working Group that has generated this document. Anyone can participate, and full details can be found at [www.professionalplm.org](http://www.professionalplm.org/index.shtml).

The underlying logic is very simple. If there is to be a PLM Profession, then the knowledge and skills required of a professional practitioner must be clearly defined and agreed, in order that training can be provided and that candidates can be certified.

At present, although there are academic and industrial training courses in PLM, there is no independent definition of what should actually be learned. This document begins the process of creating such a definition, and should act as the starting point for an inclusive debate.

The structure and content presented herein shows the complexity of the PLM Practitioner's role in a way that has not been visible before, but there are no rules or preconceptions. Neither should any endorsement or criticism be inferred of existing training courses or educational institutions. This document is not intended as something to be complied with, but should be used for reference and comparison.

This document will be developed through future versions via an iterative process of feedback and review, and will lead to an internationally-agreed view of what a PLM Practitioner should know at this level.

# Definitions

## Practitioner/Candidate

The word 'practitioner' in lower case is used to refer to any person who works in the field of PLM, in any role, and for any kind of organisation.

The word 'Practitioner' (capitalised) is used to refer to the person who is attempting to become, or is attempting to be qualified as, the standard grade of 'Practitioner' as defined in Section 6.3.

The word 'Candidate' may be used to refer to the Practitioner at the time of assessment or certification.

Throughout this document, 'he' refers to 'he/she', and 'his' refers to 'his/her'.

## Product/Service

PLM applies to almost every industry in which a company or organisation produces something that a customer buys. This is often a physical product, but it may also be a non-physical product (such as a credit card); a product sold as a service (such as 'aircraft hours in the air'); or a pure service (such as a formula production of a touring stage show).

Throughout this document, 'product' refers to 'product or service that the customer buys'.

Parts of this Syllabus refer to features such as CAD (Computer Aided Design) and BOM (Bill of Materials). This is simply because, where they apply, they are important and complex parts of PLM. If a PLM Manager works in a company or industry that does not use these, then appropriate alternatives will apply.

## PDM vs. PLM

There are many theories about how the terms 'PDM' and 'PLM' relate to each other, but this document follows the convention established by the PLM Interest Group as a result of a decade of running interactive workshops.

PLM and PDM are separate but inter-dependent, and it is impossible to talk about one without talking of the other.

Whatever the definition of PLM that is used:-

*"PDM is the IT Platform for PLM"*

... or (expressed from the opposite viewpoint):-

*"PLM is the business context in which PDM is implemented"*

A corollary of this is that terms 'PLM System' and 'PDM System' mean the same thing, and are interchangeable."

## True vs. Nominal PLM

‘True PLM’ is the discipline of managing the ‘As-Designed’ product configuration. The True PLM System is the single or collective set of computer systems, applications and hardware that are actually used to enact the real, complete PDM (as above).

The ‘Nominal’ PLM system is that which is labelled as such within the organisation. This definition is usually congruent with what has been bought from the PLM vendor.

# What is a PLM Practitioner?

Everyone who works in or teaches PLM has an idea of what a 'PLM Practitioner' is, but in fact the term covers several different roles, and several different levels or types of expertise.

## Roles

The overall skill set of a PLM Practitioner will vary depending on whether they are:-

* a PLM Manager, in charge of implementing PLM within the business;
* an IT specialist, responsible for the PLM system and legacy environment;
* a vendor, finding opportunities for PLM and supporting customers;
* an integrator or consultant, advising clients and guiding them to solutions;
* an academic or educator, conveying knowledge and skills to students.

## Grades

The PLM Practitioner may follow a career path of increasing levels of seniority and competence, such as:-

* Level 1: Practitioner - competent to run PLM projects;
* Level 2: Advanced Practitioner - devises, proposes and achieves business improvement via the development and enhancement of PLM initiatives;
* Level 3: Fellow - extensive experience and track record, recognised by his or her peers.

Different grades such as this may involve different Syllabus content, so this document has focused on the 'Practitioner' level, as below.

## For This Document

This document has been written from the point of view of a PLM Manager at Practitioner Level in a user company. This is a starting point, for simplicity and to enable focused discussion as the Professional PLM Neutral Syllabus is initially developed.

However, a Neutral Syllabus will also need to apply to PLM Practitioners in any type of role (management, technical, business); in any kind of organisation (user, vendor, consultancy, integrator etc.). This document should also be read from those viewpoints when considering how it should be developed.

Eventually the scope will need to be extended, and new sections added, to cover these other roles; after which elements of the Advanced Syllabus can be developed.

## Future Development

There are at least three ways in which this Level 1 PLM Practitioner Syllabus will need to be developed in order to reach completion.

The first is to extend it to other roles than an in-house PLM Manager. PLM Practitioners in IT, vendor, integrator, consultant or educator roles need the same overall level of expertise, and each must have some skills that the other roles do not need. As this Syllabus evolves through future Versions, its Scope must be extended until all roles are covered at Level 1.

The second is to decide on 'modularity': which of the related disciplines that a PLM Practitioner must be competent in (such as Lean, Project Management, Quality etc.) can be learned and certified by existing institutions in those specialisms; and to what extent each module applies at Level 1.

The third is obviously content. The text in this Version 1.0 document is a first pass, intended to flesh out the respective headings, but not intended to be complete or fully correct at this stage.

Beyond this, Levels 2 and 3 will need to be agreed and defined, which may involve different skill sets (such as financial understanding, or business transformation); and different levels of ability in the various modules.

As explained in Section 4, this document is a starting point for an industry-wide discussion, and the areas above will be addressed as it moves through future Versions.

# Document Overview

The Level 1: Practitioner Syllabus must encompass all aspects of the PLM Practitioner's work, and this has several facets.

The PLM Manager is a manager in his organisation in the same general sense as are his colleagues and peers from other disciplines. As a manager, he needs to apply PLM to the business, and must apply his specialist knowledge to the workings of the company.

These elements are covered in:-

|  |  |  |
| --- | --- | --- |
| **8 PLM Business Role: Manager** | - | How the Practitioner acts as a manager within the business organisation |
| **9 PLM Business Role: Specialist** | - | How the Practitioner applies his specialised knowledge as part of company operations |

The PLM Manager must also fulfil a very technical role, requiring some very specific knowledge and skills. These elements are covered in:-

|  |  |  |
| --- | --- | --- |
| **10 PLM Technical Role - Elements of PLM** | - | Detailed knowledge in the skill set |
| **11 PLM Environment** | - | Understanding of the overall context in which PLM is being applied |
| **12 The PLM System** | - | Looking at the purchase, operation and upkeep of PLM as a working enterprise computer system. |

The role of the PLM Manager is so broad that a professional Practitioner will require skills in disciplines that may already have their own professions. These elements are covered in:-

|  |  |  |
| --- | --- | --- |
| **13 PLM Extensions - Complementary Skills** | - | Skills and expertise that may be part of other professions, but which are necessary for PLM |

The final Section refers to how the skills and expertise of the Candidate may be assessed:-

|  |  |  |
| --- | --- | --- |
| **14 Assessment and Certification** | - | How competence in the Syllabus can be assessed in a neutral and standard way. |

# PLM Business Role: Manager

The PLM Manager should comprehend the worth that the PLM modern technology gives each division and also the enterprise as a whole.

Enterprise applications that enhance each other like PLM, ERP and MES play an essential role in improving and sustaining product advancement and achieving operational benefits. The PLM Manager must help to maintain a balance by supporting PLM in this mix.

This section concentrates on the function of the PLM Manager in recognising the distinguishing characteristics provided by PLM together with various other business technologies, and the advantages of developing an integrated atmosphere to help the business to run optimally.

## Role Knowledge

The PLM Manager acts as an interface between the Business and the PLM Domain within the organisation supporting the PLM strategy, as well as being accountable for the coordination of Business Analyst activities for PLM. He must understand and be able to oversee the PLM software support budget, ensuring requirements are challenged and value for money is achieved through strategic procurement. The PLM Manager must be adaptable and driven to succeed.

## Company Knowledge

Business understanding is required to drive PLM within the organisation, and the way to do this effectively will depend on the particular features of the company. It will be accomplished by bringing cross functional groups to incorporate their expertise of company and inter-business processes. It may be necessary to redefine business processes, or run conceptualising sessions about the new means of functioning.

## Client/Customer Knowledge

PLM extends along the Customer and Supply chains, and the PLM Manager must understand these from both a technical and a commercial perspective. Making sure ideal consistency of customer interaction, using continual renovation activity and demonstration of brand-new modules/functionality to ensure that the customer is making best use of the benefits got from the PLM application; and giving exposure of task/ effectiveness to sustain up to date product and process knowledge.

For Practitioners in vendor, integrator or consultancy roles, knowledge of the Client is fundamental to providing the best solution.

## Supply Chain Knowledge

The Supplier ecosystem is likely to include companies with widely differing levels of PLM adoption, and yet Supplier relationships need to be as deeply integrated into PLM as possible. The PLM Manager needs to manage this from a technical and from an extended business viewpoint, in sync with the commercial and Purchasing relationships that exist.

Practically it involves collaboration between buyers and suppliers, during product development, common systems and shared information working for the internal or end customer. It will also include the technical interfacing issues of supporting IT systems.

# PLM Business Role: Specialist

The PLM Practitioner must apply extensive specialist knowledge to his role as manager, and convince his colleagues to act or react according to PLM needs. Compared to other disciplines, this can be more difficult with PLM because the colleagues may not immediately understand the logic or reasoning. It is the responsibility of the PLM Manager to ensure, on behalf of the company, that these specialist aspects are well implemented.

## Role Knowledge

The PLM Manager must possess and utilise:-

* In-depth knowledge of tools and technologies (IT systems, paper forms, concurrent engineering methods, etc.) enabling processes for the Product Lifecycle (steps/stages) and the Product Workflow (possible orders in which work may occur)
* In-depth knowledge of and working relationships with document/data/artifact creators, approvers, and users. This role responsibility information can be documented in the form of a "RACI" model (Responsible, Accountable, Consulted, Informed) or in other ways
* Familiarity of industry products, vendors, competitors, and technology/product general directions (what major changes are happening in the industry)

## Company Knowledge

The PLM Manager must possess and utilise:-

* Familiarity of content of documents such as a general knowledge of the company's products, markets, active programs, and product initiatives
* Knowledge of Working and Quality procedures
* Knowledge if any of "heightened concern" for specific products, services, or products
* General knowledge of 'Back Office' and Health & Safety rules, regulations, and impacts

## Client/Customer Knowledge

The PLM Manager in user companies need to understand the specific technical requirements, in terms of PLM and of the product, that each Customer deems to be important.

The PLM Practitioner in the supply side needs a general understanding of the industry of the client, and any special regulatory requirements, confidentiality requirements (even within a team), or project/initiative background.

# PLM Technical Role - Elements of PLM

PLM elements comprise different modules ranging from the design process associated with the life of a product from its conception through its manufacture, to its retirement and disposal. They include managing all product information data integrated with product development team; forming a collaborative process between product stakeholders; and taking care of functional areas of PLM and its implication in Product Development through Manufacturing.

## Access and Security

The PLM Manager must be able to understand the importance of providing the appropriate user access to the data, and practices that vary from business to business. Some of the practices are driven by International Security Standards. There are also interdependencies between such standards and how PLM should be implemented. This differs from industry to industry.

It is important for the PLM Manager to understand the differences between authorization (access) and authentication (security), and this leads the PLM Manager to answer questions such as: "should the data be accessed on a Need To Know Basis? or "should the PLM systems be cloud based or on premise?"

The section covers also basic security needs such as use of password and username login as well as the different type of access and explain or refer to material about segregation of duties, different type of data access (Create, Edit, Delete, Move etc.) and security around system integrations and its consistency when such processes are supported by several IT systems and the implication of the collaboration with IT teams.

## Application Lifecycle management (ALM)

Understanding the different areas in a PLM environment is key and recently application development has increasingly become more and more important in product development. In other words, products are less and less exclusively made of mechanical parts only and software are now taking more and more importance as part of the definition of the products. Managing the lifecycle of the software is called in the PLM world ALM for Application Lifecycle Management.

This section provides definition of the term Application Lifecycle Management (ALM) and differentiate it from Product Lifecycle Management (PLM)

It covers aspects of Applications and Software development including determination of test strategies and their significance in PLM projects with ramification to systems engineering architecture.

What the best practices are in describing the functionalities of ALM systems with differentiation from PLM systems as well as describing best practices of the supporting business processes.

In detail this could include:-

* Classification of SW testing in the application lifecycle and determination of test strategies and their significance in PLM projects
* Description of the functionalities of ALM systems and differentiation from PLM systems
* Understand the term Application Lifecycle Management (ALM) and differentiate it from Product Lifecycle Management (PLM).

## Attributes / Metadata

Attributes and Metadata exist in all IT systems and in particular product development systems such as PDM. In order to be used efficiently attributes and metadata must be organised in such a way to avoid duplication, allow ease of use, reliability and retrieval as they support decision making.

## BOM Management

Bill of Material (BOM) is the backbone for defining the definition of a product and managing its lifecycle. In its most elementary form, the BOM contains the list of elements needed to make the product and the quantity for each one. However, in order to have a complete and central source of information for the definition of the product definition the BOM can contain far more information such as related information to each of its elements (specifications, change objects, history etc…) and be also presented under different views/filter to provide the right information and structure to the right people. For instance a design engineer will view the eBOM (engineering or design bill of material) a production engineer will view the mBOM (manufacturing bill of material), a service engineer will view the sBOM (service bill of material).

This section explains in details what a BOM is, what different types (views) of BOM exist and why they are needed in addition to relationship to documentation to form the full product definition.

This section covers many subsections from basic to advanced:

1. What are parts, BOM and why they are needed.
2. How many different BOM (eBOM, mBOM are the most commonly used by companies but there are Use the 7 views from PLM IG) and the relationship between the different BOM.
3. What are the different ways to create BOM (CAD centric, part centric, use BOM to create a PBS and possible link to WBS)
4. How to manage traceability
5. How manage replacements parts (substitute and alternate)
6. What is Product Configuration
7. What is Configuration management
8. How to compare BOMs (how, what could be compare, why should we compare BOM)
9. How to revise BOM and its dependencies
10. How to manage Quantity and Occurrences of parts within a BOM
11. How to design and create parts in Context
12. How to manage attributes (such as Assembly Mode, Configurable, Gathering Part, Phantom, Traces (Lot, Serial, untrace))

## CAD / CAx

The section covers CAD, and more generally CAx, and how they contribute in the life of the product, the relationship between CAD structure and Product Structure and give industry best practices for integration with PLM systems.

The section is concerned with the relationship with CAD data and how it fits within the lifecycle of the product. It is not a CAD training. However, a PLM Manager needs to know enough about CAD to know how they contribute to the end to end life of products and what a PLM Manager can expect from CAD software (eg interoperability, auto generation of CAD data (eg link with product configurators).

The section also covers the possible potentials of CAE and the basic principles in particular of CAx data management in the context of PDM and PLM.

In detail this could include: Knowledge of the possible potentials of computer-aided product design (Computer Aided Engineering / CAE). Understanding the principles of Computer Aided x / CAx, in particular CAD and CAD data management in the context of PDM and PLM.

## Change Management

Change management in the context of engineering changes for product development. The section covers understanding and conception of version and release mechanisms as well as their support by PDM systems. The section refers to international standard or practices of engineering change management such as CMII. Nowadays it is important to have a process linked to the data and the PLM Manager must understand how this can be made possible. The section covers the different stages of engineering change (problem/issue reports, change request, impact analysis, change notices, implementation plan, change review board, change implementation board).

Changes should be linked to version/iteration control. Any change should be traceable, using the appropriate system and it is managed automatically by the system.

## Configuration Management

The PLM Manager must be able to understand the differences between configuration management in software development and configuration management of mechanical products.

The section covers Configuration Management as per CMII. It explains the importance of configuration manager roles and how it is essential to develop the appropriate working methodology to ensure the right information is provided at the right time to the right people. It covers the relationship between information and objects. The section provides best practices and guidance how to improve configuration management within an organisation.

## Digital Mock-Ups (DMU) and Simulation

The introduction a couple of decades ago of 3D has enabled the visualization of the products in 3D and has provided a great advancement in the way team collaborated. Recently, the technology has evolved to add functionalities and become what is now known the digital mock up (DMU for short). This is sometimes also referred to digital prototyping or virtual prototyping.

The technology supporting DMU must be accessible company wide as many teams and functions need to contribute to the creation and review of the DMU. Consequently, using DMU must also include reviewing the business processes to ensure efficient use of the technology and improve collaboration and decision making. The section provides general guidance of Dos and Don’ts for the implementation of digital mock-ups as well as the benefits to integrate them as part of the business process.

## Data/Information Management

Managing the life of products from cradle to grave generates an enormous amount of data and information in many different formats. Data or information are typically created in several database or location and using formats such as attributes, parameters, classification, office files, pictures, 3D, 2D. Understanding of the data and information are created, managed, how it flows throughout the lifecycle of the products is key to the success of a PLM implementation. The PLM manager must therefore understand how businesses use the data and information and how it can be optimized for searching, reporting, comparing and decision making while ensuring the right technology is used to support the processes.

The PLM Manager, supported by known techniques such as lean management for information management must know and understand the business processes, the methodology, the technology and also the competences and knowledge of the staff are sufficient to ensure the right efficiency in managing the related data and information of the product full lifecycle.

## Data Management Issues and Pitfalls

Following section 9.9 this section focuses on potential issues a PLM Manager/team may face be it technical or business. The extensive experience of a PLM Manager is key in quickly identifying issues and pitfalls. However, across businesses and industry similar issues exist because all companies had to move from a paper base organisation to an IT driven, from silo organisation to a more global organisation, it is consequently possible to identify typical issues or pattern occurring across industries. (eg business want to keep using decades old classification system based on folder structure and very manual intensive).

The section covers those pattern and common issues.

## Document Management

Some information generated by the product development teams is saved in files which are then uploaded into documents. The documents are then link to parts to form the definition of the parts and products. The PLM Manager must understand how the files are created and managed, how the relationship between a file and a document works. This section covers the basic principle about document management to more advanced concepts such as document structure, document relationships, the advantage of integration with MS Office. What best practices exist across industries to manage the documents (document number, document name, classification, attributes, revision control, collaboration, approval, KPI)

## Intellectual Property Protection (IPP)

Manufacturing firms across all sectors - defense, electronics, medical, auto, aerospace, heavy design etc. - have actually long realised that the success of their business revolves around benchmarking and cutting-edge product design. Loss of information in any type of form is damaging to a company's growth. The Practitioner must know how sensitive item information is protected by regulating access to as well as usage of information across the PLM system, and associated systems such as CAD, with the assistance of IP protection components in traceability, audit of the IP relevant concerns.

## Mechatronics

Classification of terms mechatronics or mechatronic products as well as special features with regard to their lifecycle and lifecycle management

Digitization of the market needs smart product. Smart products comprise mechanical, mechatronics, electronics components with an increasing amount of software. PLM helps in generating much better product growth competence, improvisation ability and also device expertise to execute reliable product design, technological competence to handle a smart product, industrial applicability to improve consumer complete satisfaction, better collaborative engineering options to preserve and also run existing procedures effortlessly in practical NPD/NPI.

## Part Numbering

Accurate, consistent, unambiguous recognition over the whole lifecycle of a product is vital for complete product development team from design layout with screening, production and also maintenance. Part numbering is a really typical need. Part numbering plan in PLM aids the cross functional product development team to relocate the best path with component naming and searching capabilities.

## Planning

Multi-layered planning is fundamental to the effectiveness of a PLM implementation. The PLM Practitioner must not just spread PLM awareness and ideas, but must lead the adoption of good PLM throughout the enterprise.

The Candidate must therefore demonstrate an understanding of PLM Strategy, and how it applies to his or her company; be able to define the phases and tasks of a PLM project, and be able to plan and control the implementation and rollout of a PLM solution

## Product Development

Determination of phases and tasks within the product development process.

PLM work flow capacity assists the manufacturing company right from the Ideation stage to Design, Simulation, right through to Production and also launching the product to the customer. Innovation, time to market, consumer interaction and price are the crucial factors of developing a product that drives the market. PLM deals with all the vital locations of Product design development along with data management along the different phases. PLM incorporates the whole product development cycle, thereby form a streamlined process of product development.

## Product Structure

Product structure is one of the most important ways to understand and manage the creation and development of a product or service, starting with its relationship to the BOM and extending across its entire lifecycle. PLM helps in developing a precise product structure; the product development team need the input from design, procurement, manufacture as well as sales to ensure the file is one hundred percent precise. PLM includes all the components needed to produce and also make product to a customer's particular needs, which are commonly made use of in sectors that have extremely configurable items such as hi-tech industry, heavy equipment and commercial machinery.

In detail this could include: definition of construction kits, series and other modular product concepts, discussion of their significance for the product lifecycle and their consideration in PLM projects; understanding and conception of a variant and configuration management as well as its support by PDM systems; and understanding of view formation in product management and determination of different structure types for product structuring in PDM systems

## Product Lifecycle

Self-evidently, the Lifecycle is fundamental to Product Lifecycle Management, and the Practitioner must be able to explain and expand upon the product lifecycle and its essential technical processes

PLM's major purpose is to eliminate and determine waste in the product design, manufacturing and support process. Benefit of making use of PLM modern technology is that manufacturing organisation can streamline the entire procedure of designing, establishing, manufacturing and refining. Take into consideration the first action to share and also handle product design, files, BOMs and information with PLM.

## Product Workflow

Processes and product related workflows are extremely essential for a company as they become life blood of business processes and also making overall execution of the business. Process monitoring is a really important part of PLM. Workflow brings an organized strategy to activities, which automates as well as speeds up repeatable production service procedures like design change requests, sales order processing approvals, change orders and so on.

## Solution Architecture

This section describes the PLM solution roadmap for the functional area, in close alignment with cross functional business stakeholders. Also helps in translating enterprise business needs into architectural, functional and technical designs working with PLM domain architects and business process owners.

In detail this could include: describe the essential steps in the systemic design of products, associated business objects and supporting IT systems; knowledge of strategies for integrating development service providers and customers as well as support within the framework of PLM; naming the information flows between product development and production and discussing the significance for a PLM concept; and determination of basic architectural approaches of IT systems

## Strategy and Roadmapping

Strategic approach and roadmap of PLM rollout needs a clearly-defined PLM Vision, identifying the accurate service situation for execution of PLM, extensive understanding of the processes, business frameworks, product development techniques, and people that are called for to make organisation work. Also, it aids to identify voids in current practices in addition to the methodical and also business modifications needed to accomplish measurable improvements in automating business processes.

The PLM Vision should be in line with the overall company vision and strategy, so that PLM contributes to and is not hindered by the company's strategic initiatives.

## Supplier Management

PLM takes a thorough method to managing design and also development data with a system to exchange info with numerous systems such as ERP as well as supplier data management. Supplier data management aids business track their supplier components, along with it improves the part option process by enabling designers to collaborate with suppliers as an expansion of internal sources at an early stage, making it possible to remove or decrease design iterations and boost quality. Adding a totally electronic supplier data management operations to the organisation PLM system will increase the organisation's design-to-source process.

# PLM Environment

One of the most important characteristics of the PLM Manager is that he must be an 'Agent of Change'. This may be the most significant distinction between the PLM Manager and his or her colleagues at the same level.

In order to affect change, and to advance PLM, the Practitioner must understand the environment in which PLM is being applied. This will be specific to every company, and will include issues such as management priorities, perceived drivers and barriers, other ongoing projects, and the overall technical roadmap.

This Section covers the high-level 'environmental' subjects that must be understood in order for work on the PLM implementation to be effective.

## General PLM Knowledge

The PLM Practitioner needs a sufficient breadth of PLM knowledge to be able to work with Practitioners in other PLM roles, or from other companies, with understanding and competence. He needs to be able to 'walk, talk and act' like a PLM Professional.

Specific evaluation points include:-

* Understanding and defining the terms Product Lifecycle (PLC), Product Lifecycle Management (PLM) and Product Data Management (PDM)
* Communicating the potential benefits of PLM
* Discussion of PDM and PLM system solutions
* Assessment of the (core) functionalities of a PLM system
* Discussion of the tasks of a PLM professional

## High Level Requirements

Whoever operates as a PLM Practitioner must have a certain amount of background experience on which to build their PLM training. Prerequisites could be a first degree at university level, and/or a specified period of general PLM experience.

Given that some companies can only fill their PLM roles by selecting keen young members of staff and having them work as intern-type members of the PLM Team, it seems undesirable to restrict the entry requirements too far. If the training is good enough and the candidate has the aptitude, then the eventual certification will show the necessary competence.

Therefore, for a neutral Syllabus, possession of a degree should not be a requirement. Two years' work experience in a PLM-related or PLM-facing role should be sufficient.

Note that, if a 'Foundation Level' is ever established (to bring non-core PLM stakeholders up to speed to work on projects) then this might stand in place of the work experience.

## Tools / IT

Some Practitioners may work in a business-oriented role, and some may be IT-oriented (configuring and running the PLM system, for example). In both cases the Practitioner needs to have a good general understanding of IT methods and issues.

The Practitioner must show understanding of the different types of business objects and IT systems used in virtual product creation; knowledge of the lifecycle of IT systems (application lifecycle) and the essential phases of the IT development process; and be able to illustrate the procedure for the conception of an IT landscape development and implementation. The Practitioner must understand the principles and application of system configuration, security, data protection and IP protection.

## Digital Thread / Digital Twin

The Practitioner must understand and be able to define the tasks and vision of the Digital Factory; and understand how this may impact his or her company.

This should include a general understanding of Digital tools and processes; and specific understanding of how PLM supports concepts such the Digital Thread and the Digital Twin. As with Section 11.3, the Practitioner should understand the principles and application of cybersecurity and data protection.

## Industry Knowledge

The PLM Practitioner must display a thorough understanding of the industry in which he or she works, how this shapes their company, and its specific impact on the PLM implementation.

## Activity

The level of performance of a PLM Practitioner should be that he is able to define, organise, carry out and manage PLM operational tasks.

While being trained, the Practitioner should be given practical tasks to perform, and should gain the ability to respond immediately to new tasks. The Assessment and Certification (Section 14) should include a practical session in order to demonstrate this.

## Internal Consultancy

In comparison with other disciplines at a similar management level, PLM is different because it reaches throughout the business, and often requires that people change their working methods or culture. The PLM Practitioner must therefore display skills that are normally associated with external consultants.

This will include a general knowledge of how a service professional works, and competencies such as analytic thought, organisation skills, interpersonal skills, team skills. Practitioners in advisor roles may need skills in communication methods, how to get things done, and high performance interaction.

In practice, the PLM Practitioner must be able to communicate the potential benefits of PLM; and describe the goals, approaches and benefits of user experience as well as the interaction with the approach in and influence on the chances of success of PLM projects.

It extends to the application of procedures and methods in the recording and evaluation of the 'As Is' and definition of the 'To Be' situations in a company, e.g. by means of process and vulnerability analysis. The Practitioner must understand how this can be supported by business information systems, and how these are applied within their own organisation.

The Practitioner must be competent in the determination of the tasks of Organisational Change Management and its significance in PLM projects; being able to discuss the essential success factors for PLM projects and typical reasons for failures as well as reflection on the task of a PLM professional and the organisation of PLM projects.

The Practitioner must have knowledge of the procedure and essential results when deriving an IT concept to support the 'To Be' process.

Note that Practitioners in a consultancy or adviser role will need extra emphasis on this, which might need to be specified more fully in a future version of this document.

# The PLM System

The PLM Practitioner should understand the background and evolution of PLM, from the early days of EDM onwards, leading to the current landscape of vendors and service providers.

He should be able to explain the designation of standard PDM systems and their manufacturers, understanding the scope and general positioning of the various offerings, and being able to fit them into the context of his or her company.

This understanding should extend to include the identification of current trends in the development of PLM and related IT systems, and a view of how the future landscape may impact the company's technology path.

## PLM Solution Evaluation & Selection

Where a company has an existing Nominal PLM environment of vendor applications, the Practitioner should be aware of and understand the reasons why these systems were purchased; their scope and capability; the maintenance arrangements; and opportunities and plans for improving the IT platform.

Where a company needs to adopt or enhance its PLM platform with a new system purchase or upgrade, the Practitioner should be able to apply a structured methodology for requirements setting, comparisons and benchmarking, and detailed specification of the resulting choice.

## PLM Monitoring and Continuous Improvement

The PLM Practitioner should be able to actively improve the PLM system in terms of shortfalls in or opportunities with the current configuration; and should use the knowledge set out above to identify how the PLM system and the overall IT platform could be enhanced.

As part of the general drive to succeed (Section 0) he should aim for a state of continuous improvement of the PLM environment.

## Data Cleansing

The PLM Practitioner must display competence in understanding the structures of data in general, and the specific data integrity issues that arise in his or her company.

The Practitioner must be familiar with data cleansing methods, and should be actively engaged in maintaining and improving data integrity throughout the heterogeneous PLM environment.

## Legacy System Rationalisation

The Practitioner must be aware of and understand all of the legacy systems (PLM and otherwise) that are in use within the overall True PLM environment of his organisation.

The Practitioner should be able to plan for, and execute, transition processes to maximise the data contained within the current PLM system and phase out the use of older and superseded systems. This implies coordinating and supervising data cleansing activities, process re-engineering, data cleansing and training.

## Excel Skills

A specific aspect of Legacy System Rationalisation leads to the requirement for skills in understanding and manipulating Excel spreadsheets.

Any mid-level manager would be expected to be able to use PowerPoint, Teams, Webex, MS Project etc., and would also be expected to use Excel.

However, competence in Excel is particularly important for the PLM Practitioner, and must be in a much greater depth than non-PLM colleagues of a similar level. Use of spreadsheets to store and manipulate product data is widespread and endemic. Excel spreadsheets may be used extensively for complex applications such as BOM processing, and spreadsheets can be a large element of legacy data.

Furthermore, in-house spreadsheets are often customised with advanced features such as macros and fixed menu options; and their users may regard these features as 'essential'.

The PLM Practitioner needs to understand how colleagues are using and customising Excel, and how that data is input, worked on, shared, sorted and exported.

# PLM Extensions - Complementary Skills

Products are ending up being much more innovative, and also smarter. Businesses require more advanced techniques to sustain their product advancement in this age of fast development and low cost.

PLM manages all elements of the product lifecycle, from concept design (Design Data Management) to product retirement (Service management to Obsolescence). This section focuses on product-centric processes in the advancement of a new product, as it is separated into its various stages; beginning of product life (BOL), middle of product life (MOL), and end of product life (EOL).

## Business Knowledge

Integration of product and process design within the enterprise as well integration of the design and engineering function with the Process Engineering , Quality, Testing, Supplier Quality. Application of information technology along with integration of the engineering function in PLM with customers and suppliers.

In detail this could include:

* Determination of different types of business objects and IT systems in the production environment
* Determination of suitable contract forms and contract contents for the assignment of external service providers in PLM projects
* Knowledge of the basic tasks of modelling and identification of business objects in the process, their use, states and state transitions as well as their mapping in IT systems
* Presentation of the economic motivation and amortization of PLM projects, methods for identifying amortization effects and typical ROI argumentations in PLM projects

## Lean Transformation Processes

A good knowledge of lean thinking and methodology helps the PLM Practitioner and it is recommended that PLM Practitioner has undertaken some kind of lean training. Reliable management of PLM value streams for organisation needs a clear sight of exactly how each activity and also procedure adds or lowers worth to the end-user, along with boosting productivity for the company as a whole.

## Business Change Management

The PLM Practitioner needs to understand Change Management in the context of the business, as a separate subject to Engineering Change. In addition to the technical aspects of data and IT, PLM development is also about people and how to make them embrace the changes.

With specific training in Change Management, the Practitioner will be better able to lead PLM improvement and transformation projects.

## Manufacturing Knowledge

Using organisation process management to the locations of manufacturing facility and also supply chain activity administration within throughout the comprehensive venture. It connects manufacturing procedures by using procedure flow along with product and process design, thereby maps quality management techniques have been essential in manufacturing techniques. It is a collection of approaches as well as developments used to define specifically just how products are to be manufactured.

In detail this could include:

* Determination of the phases and tasks of the production process
* Understand the interactions between product, factory and IT lifecycles and their key business processes.
* Understanding the lifecycle of factories

## Product Costing

Costing activities are part of PLM and are important for optimising the profitability of a product. The PLM manager must understand how businesses cost product and how to integrate these activities as part of product development processes. This should include a clear understanding about the creation and update of cost data between PLM and ERP.

Value Evaluation is an important Component of New Product Development:, companies interact with customers as well as recognise the product includes that consumers worth most, beyond those that produce little market rate of interest. Based upon this info, designers can upgrade their products, adding brand-new attributes that advertise sales while removing unnecessary features.

## Production Planning

Production Planning is both a human activity, in which manufacturing engineers decide how to produce what the engineers have designed; and a technical challenge of integrating the MBOM and process plans across PLM and ERP. The PLM Practitioner must understand and be able to apply both aspects to support the effective realisation of the product.

## Project and Programme Management

Program and project management process of the company provides a top down technique to strategy and also execute programs and projects in an integrated PLM environment. It perfectly leverages the basic PLM capabilities like PDM while complementing thorough planning capabilities provided in to enhance productivity with a standard for continuous enhancement.

This section, therefore, covers two things:-

1) Project Management as a skill and competence that a PLM manager must have in order to be able to lead change; and,

2) Project/Program management as part of PLM.

In detail this could include:-

* Determination of the object and essential phases of product change management (Engineering Change Management (ECM), its significance for PLM projects and approaches to IT support
* Understanding of workflows as well as their areas of application and structure.

Project management is part of PLM as it is one way among others to take a product from cradle to grave.

## Requirements Management

Requirements Management occurs throughout an NPD Process. It encompasses documenting, analysing, tracing, focusing on, and also settling on product requirements or customer voice and then controlling modification and also communicating to appropriate stakeholders.

This includes describing the essential components of a requirement specification as well as naming the contents of a requirement specification for IT-side implementation

Requirements Management is an efficient way for information to flow from the requirements system (whether in True or Nominal PLM) to the design team.

This is where the V model makes all its sense as it forces the PLM Manager to come up with an efficient way to loop back to the initial requirements (and its correct version) from the proposed solution.

The product develop process must include a check that what the designers came up with corresponds to what the customer wanted. In order to achieve this, the PLM Manager must see Requirements Management as part of the PLM process

## Training and Development

As well as being trained himself, in general and PLM-specific aspects of his work, the PLM Manager may also be required to teach or mentor younger colleagues who are learning about the discipline.

This may include any of the topics in this Syllabus, at an entry level, to guide the trainee towards their own Practitioner status; and also wider topics such as new processes, working methods, data models and technologies.

# Assessment and Certification

## Prerequisites

PLM Professionals do not have to prove any additional training, experience, or certification by any other institution. The PLM Certification is self-contained.

PLM professional should be assessed in terms of understanding about the PLM subject, how the general principles of professionalism apply, and what has actually been learned. Resulting information helps to recognise where PLM professional are right now, where the professional wish to enter the future, as well as what it is most likely to take to arrive.

## Method

It is anticipated that assessment and certification of Candidates will be carried out by training or educational institutions that have themselves been accredited by a future Professional PLM Body – rather than by the Professional PLM Body itself.

## Application

Applicants will decide which accredited institution to apply to, and will do so following the process set out by that institution.

## Examination Procedure, Questions and Tasks

Whilst not being prescriptive about the exact examination procedure and content, the Professional Body should ensure a consistency of approach and rigour across accredited institutions.

The examination should include both theoretical questions and a practical task, with similar emphasis placed on each.

The location and test conditions of the exam should provide a secure environment in which the Candidate can work effectively.

## Evaluation and Assessment of Exams

The scoring system of the examination should match the difficulty and rigour of the testing, and the Pass level should be set so that the Candidate has a similar chance of certification whichever institution provides the assessment.

It will be important for each accredited institution to maintain a team of examiners or assessors who are equipped and competent to mark each assessment consistently.

## Certification

After successfully passing the exam and fulfilling the admission requirements, the Candidates will receive their Certificate from the accredited institution.

As each of these institutions will be accredited to the same standard set by the PLM Professional Body, the qualification should be recognized internationally throughout the PLM industry.

## Continuing Professional Development

Being a PLM Professional is not a constant state – the aim is to benefit the organisation by doing good and effective PLM work, and to learn from so doing.

Training, while being a neutral Syllabus, should be made relevant to ongoing work; and learning opportunities from undertaking new tasks should be taken advantage of.

It should be borne in mind that a PLM career can move on from Practitioner Level to higher grades in the future, and that this should be a planned career path. Conversely, the Professional should take care to refresh areas of his or her experience that may have been untouched for a while, to keep skills up to date.