Towards PLM maturity assessment in the fashion industry

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Abstract: Product Lifecycle Management (PLM) is a tool supporting product development, an efficient knowledge management system and also a strategic approach ensuring competitive advantage. The fashion industry shows several features that distances it from the traditional approach to PLM deployment. Five fashion companies have been involved in a case study in order to assess PLM maturity and to acknowledge common ground and differences with the cases reported in literature.

Therefore, the aim of this research is to adopt the already validated PLM maturity model to evaluate empirically the PLM maturity of fashion companies, providing industry-specific considerations.

This study strives to describe the characteristics of PLM in fashion companies, more and more interested to implement tools and strategies supporting and enhancing product development. Identifying PLM maturity and improvement areas may be insightful for academics, through literature fulfillment with further cases conducted in a particular business environment, different from the manufacturing industry. This study provides also cause for reflection for entrepreneurs who are trying to reach a full PLM implementation in their business, aligned to the best practices.

Keywords: Product Lifecycle Management; PLM; Maturity model; Fashion industry; Product development.

1. Background for research

Product Lifecycle Management (PLM) is not just a tool supporting product development and an efficient knowledge management system, it is also a strategic approach ensuring competitive advantage. Adopting PLM can help foster a climate of continuous improvement, through standardization and enhancement of business processes.

PLM has originated and developed within the manufacturing industry, well known for its standardized products, proposed year by year, with high predictability. The production environment is MTS (Make to Stock), i.e. products are manufactured for stock based on demand forecasts. This environment characterized by well defined processes and role, has improved the product lifecycle management giving the opportunity to manage all its phases, including beginning of life (BOL), middle-of-life (MOL) and end of life (EOL) (Terzi et al., 2010). PLM has been integrated with design tools, such as CAD/CAM, and ERP, for orders management. PLM has found fertile ground in manufacturing companies, having already learned the lean approach and having internalized the need for continuous improvement. Product development process is managed mainly by engineers, skilled to use Information and Communication Technologies (ICTs), who have successfully embraced innovation.

The present research deals with PLM deployment in the fashion industry, considering it as a technology solution and as a business strategy improving knowledge management, collaboration and inter-functional coordination, reducing the time to develop products and time-to-market.

The acronym “PLM” suggests immediately the link with the product, thus it is essential to consider the differences between a fashion product and a standardized item: we are considering customized or premium products, with high impulse purchasing and low predictability. The production environment is MTO (Make to Order), i.e. manufacturing is performed when demand is confirmed. These dissimilarities have also impacts on business processes, data and enabling technologies.

Therefore, the reason why the research is focused on the fashion industry is due to the product’s features that trigger a completely different approach to PLM, in all its meanings.

We have already analyzed the “P” of the PLM acronym and its emphasis on product data. The “L” refers to the term “lifecycle” which is unique within the fashion industry: it is particularly short (may last up to six months) and, depending on the merchandise considered (leather goods, shoes, apparel, etc…) and to the market segment (luxury, prêt-à-porter, diffusion, bridge, mass (Saviolo and Testa, 2005)), might become even shorter. Just the BOL is managed, because PLM copes all the processes from design to production and it is not integrated with tools related to the MOL or EOL.
Finally, the “M” of management is devoted to consider strategic, tactical and operative goals and issues. Managing operative level in the fashion industry is critical because people involved in product development are not used to adopt IT systems, so they have to be properly trained. Given this resistance, the top management also faces difficulties when performing change management.

Given the relevance of an industry-specific analysis concerning PLM, several product development features will be underlined in order to take into account the overall shades of the product, of the market and the influence on supply chain (SC) management.

The remainder of this paper is organized as follows. The Section two firstly outlines the main issues emerged during the literature review step, describing the reasons that have allowed to select a particular PLM maturity model. Section 3 analyzes the methodology used and the sample of cases considered. The main results are presented in Section 4, examining the maturity of the companies interviewed and how to improve the PLM maturity model. Finally, the paper concludes with several remarks and future challenges

1.1 Product categories and Business Units

Product development in the fashion industry may involve different product categories (e.g. apparel, shoes, leather goods, metal hardware) managed by different Business units (BUs) with different requirements.

Apparel products require several fitting sessions throughout the set of product status, from prototyping, to sampling and pre-production. Moreover, the modeling task is crucial. While in the sampling phase the article is developed in the base size, when the collection is approved for production, a size development is needed. Engineering notes and fittings increase more and more in the production phase.

Shoes products do not require special fitting sessions during prototyping and sampling because sizes have been tested for years. The focal point is on the product structure (i.e. the parts of the shoe), materials and quality controls.

Leather goods, such as bags and other accessories, are not prone to any fitting session. On the other hand, materials and semi finished products need to be selected and codified with consequences on BOM revisions and on the time to develop the product.

Fashion companies also manage metal hardware components, e.g. through galvanization processes. First of all, a technical assessment is required, then an assembly test is provided and finally the components are aesthetically evaluated. The supplier selection and quality control are the most critical tasks.

1.2 Fast fashion vs. Luxury brands

Product development in the fashion industry is also affected by the market positioning of the brand. From fast fashion to luxury companies, different critical success factors (CSFs) and processes acquire relevance.

Time-to-market is the main CSF for fast fashion companies: their challenge is to select suppliers that are able to respect the dealt lead time, besides the costs. The purchasing BU plays an important role because it is in charge to secure alliances with strategic suppliers, to control their activity and to negotiate costs. Due to the target margin that fast fashion companies define, they always try to minimize costs, even if the supplier is located far away and they can lose control on quality. The effort is to reduce the transportations time to and from the factory.

Moreover, a fast fashion company may decide to buy raw materials and then to ship these to a factory or to outsource the entire production process. In the first case, lead time is longer because supplier and manufacturer have different needs: the raw material supplier has its own lead time to produce leather or fabrics; then, the manufacturer may require the complete set of materials before starting to produce, thus he has to wait the arrival of the most time consuming item.

Outsourcing the entire production process exposes the company to a higher risk in terms of quality but lead time is surely reduced.

SC issues are often softened thanks to a product development aligned to customer needs and streamlined through the reduction of approval processes.

Luxury companies compete mainly on quality and, secondly, on timing. Quality is the evidence of the handcrafted tradition beyond the company and has to be ensured throughout the value chain processes. Suppliers are located in surroundings so that the company can have major control on their outputs and lead time. The reason of their proximity is not guided by the “cost” driver, but they have been selected for their skills and the quality of products they supply. Outsourcing is not per se a competitive advantage or disadvantage, but just a cost/effectiveness tool, as long as the control over the whole logistic process remains closely managed by the company.

Product development is the core process: stylists play for time in designing different prototypes of the same product and the shift to sample and production status are slow, to ensure that all the product’s features are premium.

2. Literature review

The topic of PLM has been widely debated in the last decades (Ball et al., 2011, Chen et al., 2008, Garetti et al., 2005, Hans et al., 2010, Pol et al., 2008, Subrahmanian et al., 2005, Terzi et al., 2010 and Verhagen et al., 2012).
Actually, little is known in literature about PLM implementation in the fashion industry while most of the papers are related to manufacturing (d’Avolio et al., 2015). This is due to the previously discussed peculiarities of the fashion companies.

PLM maturity models have been so far developed with a general-purpose intent (Batenburg et al., 2005, Batenburg et al., 2006, Kärkkäinen et al., 2009, Silventoinen et al., 2011, Silventoinen et al., 2013, Vezzetti et al., 2014).

We have only analyzed the maturity models related to PLM because they better fit the aim of the present research.

Batenburg et al. (2006) have described a PLM framework based on the two concepts of PLM maturity and business/IT alignment. The framework helps companies to define a clear focus for their PLM activities, that is a certain maturity level, and to take into account the alignment of the different business dimensions (strategy and policy, monitoring and control, organization and processes, people and culture, information technology).

A benchmarking between PLM maturity models has been provided by Vezzetti et al. (2014). The authors have tested different models, concluding that Batenburg’s result is a complete model from every front.

Batenburg’s model has been also validated by Kärkkäinen et al. (2009) in two manufacturing companies and by Silventoinen et al. (2013). The latter, has proposed several improvements and highlighted the importance of variants dedicated to specific types of industry.

Literature review suggested that adopting Batenburg’s model to assess PLM maturity in the fashion industry might be a starting point to analyze PLM implementation and to customize the framework for industry-specific needs.

3. Methodology

The aim of this research is to adopt the already validated PLM maturity model to evaluate empirically the PLM maturity of fashion companies, providing industry-specific considerations.

In order to reach the goal of the study, five case studies, all belonging to the fashion industry, have been conducted. The case study is a research strategy, which focuses on understanding the dynamics present within single settings (Eisenhardt, 1989). The authors have investigated longitudinal cases (Voss et al., 2002): a period of four months per case has offered the opportunity to observe the sequential relationship of events. Structured and unstructured interviews and interactions have constituted the basis of the research, then the authors have been involved in the PLM implementation projects.

The sample is composed of big companies, belonging to the luxury and, just in one case, to the fast fashion industry. In Table 1 we have also highlighted other context variables, as the Business Units (BUs) involved in the project, including apparel, leather goods (LG), shoes and metal hardware (MHW). Luxury companies outsource mainly production process, while the fast fashion case purchases materials or finished products, proving what has been stated in the Background section.

Each company manages Product Development in Italy and has implemented or is implementing a PLM solution.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Turnover (Million €)</th>
<th>Fashion Market Segment</th>
<th>Involved BUs</th>
<th>Buy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1100</td>
<td>Luxury</td>
<td>LG, Shoes, MHW</td>
<td>Production process</td>
</tr>
<tr>
<td>2</td>
<td>300</td>
<td>Luxury</td>
<td>LG, Shoes, MHW</td>
<td>Production process</td>
</tr>
<tr>
<td>3</td>
<td>1200</td>
<td>Luxury</td>
<td>Apparel, LG, Shoes, MHW</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>98</td>
<td>Fast Fashion</td>
<td>Apparel, LG, Shoes</td>
<td>Materials, Products</td>
</tr>
<tr>
<td>5</td>
<td>1200</td>
<td>Luxury</td>
<td>Apparel, LG, Shoes, MHW</td>
<td>Production process</td>
</tr>
</tbody>
</table>

All the interviews and the group discussion were documented by filling out an evaluation form, as well as writing down any comments and answers to open questions.

All respondents were asked to complete the questionnaire to assess their organization according to the PLM framework. Each item contained in the business dimensions has been considered and also the maturity level has been investigated, examining if the software is integrated:

- on an ‘ad-hoc’ basis only
- on departmental level only (‘silo’ orientation)
- on the organisational level (cross-departments)
- on the inter-organisational level (cross supply chain partners).

Taken together, every question was coded as 0 (‘no’), 1 (‘ad-hoc’), 2 (‘departmental’), 3 (‘organisational’) or 4 (‘inter-organisational’).

The case studies allowed to reach a wider understanding of the PLM maturity, going beyond the basic assessment and deepening causes and consequences of phenomena.

4. Findings

First of all, we have applied data collected during the case studies to the PLM framework, in order to analyse the
status of fashion companies with respect to implementing PLM. The average PLM maturity and PLM alignment scores can be calculated: these are 2.40 and 2.30 respectively.

From the maturity viewpoint, companies are transitioning from the departmental level to the organizational level in PLM implementation. In particular, Case 4 has not yet implemented a PLM solution, but is considering to deploy it in the immediate future: the IT team is defining functional requirements. Case 3 has already selected a PLM solution but the implementation project is still on going and the only one department involved is the IT one. Cases 1 and 2 have implemented a PLM solution on the organizational level and Case 3 represents the best practice, sharing to supply chain partners PLM adoption.

Figure 1 shows the results of the PLM assessment.

Considering the business/IT alignment, the cases interviewed demonstrate a lack in “people and culture” dimension: users are not actively involved in the implementation of PLM software and the concept of PLM is not clearly understood. The industry we are taking into account is composed of users that are not skilled in PLM usage and often consider it as a threat stifling their creativity. Therefore, it is up to the top management to spread the benefits achievable through PLM implementation and to clarify which will be the short-term issues they have to face.

![Figure 1: results of the PLM assessment](image)

The other dimensions appear to be better developed, depending on the case considered.

We have used this framework mainly as a qualitative assessment, capable to underline areas of improvement and best strategies to perform.

The second step of the assessment is represented by the “customization” of PLM maturity model within the fashion industry. Each case considered has implemented an ERP solution to manage orders and production data. Moreover, fashion companies (especially apparel BU) require CAD systems supporting modelling and product development. What is lacking is an integration of PLM with CAD and ERP that, in our opinion, should be considered.

We suggest a modification of the “information technology” dimension, as highlighted in Table 2. The first item is an information that we already have from the maturity level (PLM usage may vary from 0 to 4). The third item is taken for granted in the cases analysed, because the core objective of PLM is to manage the overall set of product information. We would like to deepen the concept of software integration, explicating in the second item. Given the fact that ERP is always implemented within the cases, we have added an item investigating if the CAD software is used in the company. Then, we have asked if ERP and CAD are integrated with PLM.

<table>
<thead>
<tr>
<th>Original Information Technology Dimension</th>
<th>New Information Technology Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLM software is used in the company</td>
<td>CAD software is used in the company</td>
</tr>
<tr>
<td>PLM software is integrated with other information systems</td>
<td>PLM software is integrated with CAD</td>
</tr>
<tr>
<td>PLM software includes functionality to manage product configurations</td>
<td>PLM software is integrated with ERP</td>
</tr>
<tr>
<td>PLM processes are automated by workflow management functionality</td>
<td>PLM processes are automated by workflow management functionality</td>
</tr>
<tr>
<td>PLM software includes functionality to manage documents</td>
<td>PLM software includes functionality to manage documents</td>
</tr>
<tr>
<td>A roadmap for the implementation of new PLM software is defined</td>
<td>A roadmap for the implementation of new PLM software is defined</td>
</tr>
<tr>
<td>PLM software is based on compatible industry and technological standards</td>
<td>PLM software is based on compatible industry and technological standards</td>
</tr>
<tr>
<td>PLM software includes functionality to manage product changes</td>
<td>PLM software includes functionality to manage product changes</td>
</tr>
</tbody>
</table>

Due to the modified dimension, the result of the assessment is more realistic, getting worse from the IT perspective. Indeed, sketch, patterns and silhouette are often not supported by CAD solutions and, when the latter are implemented, these are not integrated to PLM. Besides, more common is the integration between PLM and ERP. The case studies examine the fashion industry, but probably the modification of the IT dimension may fit every industry placing emphasis on design and prototyping.

The evaluation of the maturity level appears improvable: we have effectively observed that a business might not implement any PLM solution, or implementation is still...
on going in a department, or PLM is implemented and used within the entire organization or, finally, it is shared with partners. However, none of the companies interviewed has an “ad hoc” basis only. PLM investment is usually remarkable: the implementation project will initially involve the IT BU and then the entire organization, in order to justify the expenditure. Silventoinen et al. (2013) reported this issue too, so it might not be a peculiarity of the considered industry.

As a concluding analysis, we have mapped strategies and improvement areas from the case study (Figure 2). Strategies are deduced from the industry background: luxury companies prioritize quality as main CSF, while fast fashion ones focus on time-to-market. Luxury firms prefer to outsource production processes to inshore or nearshore suppliers. On the other hand, a fast fashion firm outsources production of materials and product to offshoring suppliers.

Combining the BUs (shoes/leather goods and apparel) with the market segments (from fast fashion to luxury), we are able to identify different improvement areas for IT management. We have not collected cases belonging to the fast fashion market segment managing shoes and leather goods, but the companies managing apparel products show actually a poor PLM implementation without any integration. They should move to an organizational PLM maturity, integrating PLM with CAD and ERP, both essential in the BU considered.

Luxury companies managing a shoes/leather goods BU have a complete approach to PLM, but they should involve also SC partners. PLM is already integrated with ERP, while no solutions supporting design are implemented. These companies should consider a CAD solution to case design and modelling and integrate it with PLM. Luxury apparel companies have already acknowledged the importance of CAD, but they are not able to integrate it with PLM. These firms should involve SC partners in PLM adoption and integrate PLM with CAD, since ERP is already integrated.

5. Conclusions and future challenges

The present study has investigated the topic of PLM implementation in the fashion industry. A background for research has enabled the description of many features of the fashion industry and their impact on PLM adoption. The goal has been to adopt the already validated PLM maturity model to evaluate empirically the PLM maturity of fashion companies, providing industry-specific considerations.

Literature review has allowed the authors to find and select the appropriate maturity model, matching the goal of the research: it includes analyses of PLM maturity level and of the business/IT alignment.

A case-based research has constituted the heart of the maturity assessment. Five fashion companies, managing different products and belonging to different market segments, have been interviewed and have detailed their choices about PLM.

The results in terms of PLM maturity show that companies are transitioning from the departmental level to the organizational level in PLM implementation. Considering the business/IT alignment, the cases interviewed demonstrate a lack in “people and culture” dimension, stressing the importance of the human factor in technical-originated concepts like PLM. It confirms that PLM also needs to be culturally embedded as an enterprise-wide system and concept.

The achieved results have also triggered several considerations. The dimensions identified in the selected model may be “customized”: e.g. when implementing PLM in the fashion industry, one of the main issues is the interface with other systems, so CAD and ERP integrations with PLM are crucial. The maturity evaluation scale is improvable, through specification of the development path for the company and through an open description of what is required for reaching each level. Moreover, each industry may adopt different scales, because the idea of “full implementation” is related to the type of product managed.

In order to summarize the main results, we have mapped the main strategies and improvement areas for companies managing shoes/leather goods/apparel products in the fast fashion or in the luxury industry. It is up to the single business to define the priority of enhancement and identify proper actions.

This research represents just a starting point for PLM maturity assessment in the fashion industry. It is still improvable from different viewpoints. First of all, other business cases should be included, mainly to cover the area of fast fashion companies managing shoes/LG. Collecting more results may also enable the researchers to improve the model and to better explain findings. Other cases, conducted in different geographical areas, would constitute a valid benchmarking and comparisons may highlight important issues for the fashion industry.

Identifying PLM maturity and improvement areas may be insightful for both academics and entrepreneurs. Indeed,

![Figure 2: Strategies and improvement areas from the case study](image-url)
literature might benefit from a further set of cases conducted in a particular business environment, different from the manufacturing industry. This study provides also cause for reflection for entrepreneurs who are trying to reach a full PLM implementation in their business, aligned to the best practices.

References


