

IT SUPPORT TO PRODUCT VARIETY MANAGEMENT:
A Comparison of Product Data Management Systems, Product
Configuration Systems and Customer Relationship Management Systems

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Abstract

Offering to customers a high variety of products while guaranteeing competitive prices and reasonable delivery times is an ever-increasing necessity for companies. At the same time, the growing technological content of products contributes further to this complexity, introducing new challenges to management. As for any area of company activity, the creativity of software producers has brought about the development of information science systems, such as Product Configuration Systems, Product Data Management systems (PDM) and Customer Relationship Management Systems (CRM), which all promise to alleviate the problems caused by this complexity.

Indeed, such systems do not operate independently, as they may have multiple interactions. The present paper explores the interfaces supporting such interaction, as well as possible overlaps, complementarities and synergies between the Product Configuration Systems, Product Data Management systems and Customer Relationship Management Systems.

INTRODUCTION

Product configuration systems

Software configuration systems are directed towards supporting the *configuration process*, defined as the set of activities that go from the supply of information on the company offer to the collection of information regarding the variant detail that is desired by the client and then to generation of the product data necessary for variant creation. As a result, the configuration process needs the information supplied by the client regarding the desired variant as *input* and supplies the documentation necessary for describing the requested product with enough detail to guarantee its correct realisation as *output*. Logically, the configuration process can be separated into two main stages: a) sales negotiations and b) product dimensioning and documentation (see fig. 1). The sales negotiations, if necessary supported by “advice” from the technical department, should define the product specifications according to the client’s needs, guaranteeing completeness and correctness. In the *product dimensioning and documentation phase*, however, the exact configuration of the product is defined and documented from a technical point of view.

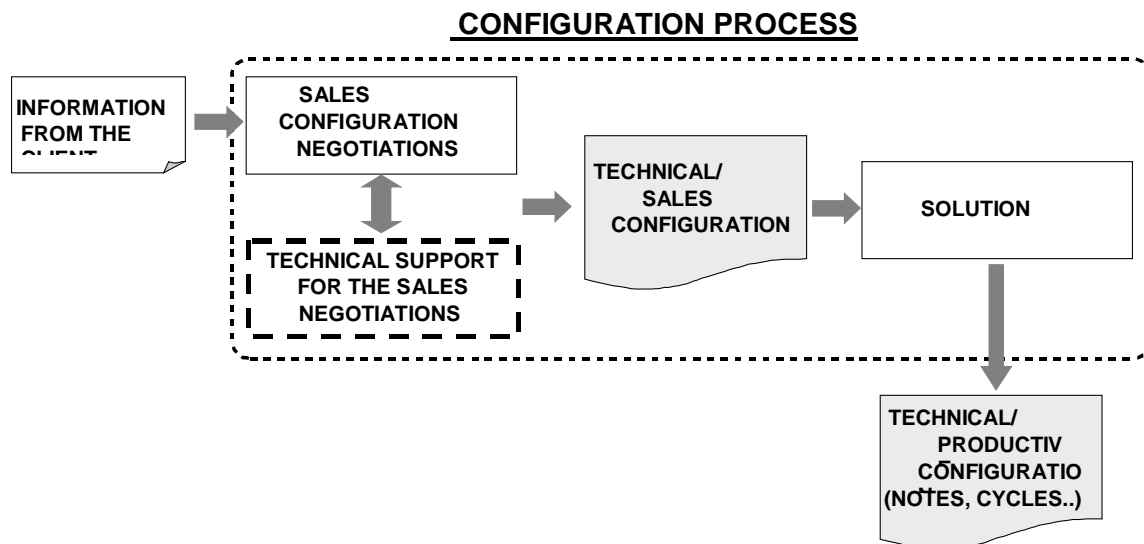


Figure 1: configuration process structure

The process shown in figure 1 maintains its validity both if the configuration activities have been carried out “manually” and also if they have been supported by a configuration system. If a configuration system is used, the necessary knowledge must be formalised in order to carry out these activities automatically using suitable logic structures, namely the *negotiation model* and the *product model*.

- **Negotiation model.** The negotiation model consists of a sequence of questions which make it possible to progressively define all the product characteristics. These questions guide the client or the sales agent who is effecting the sales transaction towards the definition of a set of product specifications that are as close as possible to the client’s needs, thanks to the fact that these questions are expressed in the language used by the client to describe the product. At the same time it is possible to verify the compatibility of these specifications, making sure that the client does not express requirements that contrast or which are not offered by the company. Finally, these logic structures make it possible to ensure that no specifications are missing, which would make further contact with the client necessary and cause possible product configuration variations, above all in the case of complex products with many client specifications. Modern configuration

systems offer appropriate *negotiation modellers*, which are programmes that support the creation and modification of the negotiation model without the need for specialist programming activities.

- **Product model.** The configuration process accepts that the characteristics of the product that the client can choose, as well as the ties between these characteristics and the product components, have been determined. It is therefore necessary to define what is called a *product model*, namely a logical structure that formally represents the type of product offered in terms of characteristics, imposing that certain ties on these characteristics are verified. There are, in general, two types of tie: the first deals with the effectiveness of the values that have been introduced in absolute terms or relatively to other characteristics, while the second guarantees the entirety of the inserted values. The product model not only traces the specifications of the client regarding the components, but makes it equally possible to express this information in a structured form, generating the base note of the product variant. Product model creation and maintenance is also supported by suitable modellers which, even in this case, render the company that uses the configuration independent from the software house that supplies the program.

A common software configuration system, therefore, makes it possible to:

- Guide the user in generating or searching for complete and valid configurations.
- Supply information in real time on the feasibility of a variant, on the prices, or on the technical characteristics of components and configurations.
- Generate sales proposals/offers.
- Generate in output the data sequences (configuration) that are necessary for obtaining the order, create an article code for product identification or the automatic generation of planning notes, base notes and process notes.

By way of the *modellers*, it also permits the advanced user company to:

- Construct a negotiation model and, therefore, define the structure of the questions, ties, phrases, images and films explicitly used during the sale.
- Construct or modify a product model, defining the product characteristics, the ties that govern the relationship between the characteristics and the values that these characteristics can assume.

The **advantages** associated with using a software configuration system are numerous and concern both product development and order acquisition. Concerning *order acquisition*, the use of a software configuration system obviously makes it possible to simplify handling a large number of variants and reduce the errors that are generated during the order definition and execution phase. The system also makes up for the sales personnel's possible lack of technical knowledge, reducing the number of designer interventions during the sales negotiation. In general terms, the consequence of all this is a reduction in the order acquisition process times and costs, as well as a reduction (which may arise from configuration errors) in the subsequent production activity costs. Finally, the fact of incorporating a whole series of feasibility checks inside the sales dialogue reduces the time, and therefore the cost, of sales personnel training.

There are two different types of advantage that using a configuration system inside the technical department can bring. In the first place, in the light of what was mentioned previously, the technical personnel no longer has to support the sales personnel. The automation of some product documentation activities also further increases this benefit,

increasing the time available for more innovative activities. In the second place the use of a configuration system, which needs product modelling that is necessarily governed by the technical department, represents an occasion for reflecting on the architecture of the company's product family and on the possible need to rationalise it. To conclude this analysis of software configuration systems, it is important to highlight the main **problems** associated with them. Using the system very often needs a personnel role change: many activities associated with sales and designing, in fact, can be carried out automatically by the system. This can generate resistance among the relevant personnel, which feels itself menaced by the new instrument. As mentioned above, product model definition can cause a very high workload, above all if the lines are very extended and the products complex. In some cases it could be necessary to redesign the company offer, making suitable use of the concepts of modularity, standardisation and, if necessary, product platform during the development phase. It should be remembered, in fact, that implementing a configuration system is easier if the offer is characterised by a high number of parts and options and by a high level of modularity. Finally, even if modern software is extremely versatile, it may happen that the user has special needs that have not been contemplated by the supplier. In this case, therefore, the problem of software personalisation according to the specific needs of the individual company arises.

1. CONFIGURATION SYSTEMS AND PRODUCT DATA MANAGEMENT SYSTEMS

The configurator is fed with product data and elaborates product data, in the form of bills of materials, production cycles, drawings, etc. However, the goal of managing product information in an integrated way is pursued by the so-called Product Data Management (PDM) systems. Therefore, the question is, how do the functions expected from a configurator relate to the functions expected from a product data management system? Since there is not a clear-cut distinctions between functionalities of PDM and configuration systems, the present section aims at identifying points of overlapping, of divergence and areas of possible integration between both systems (see Figure 1).

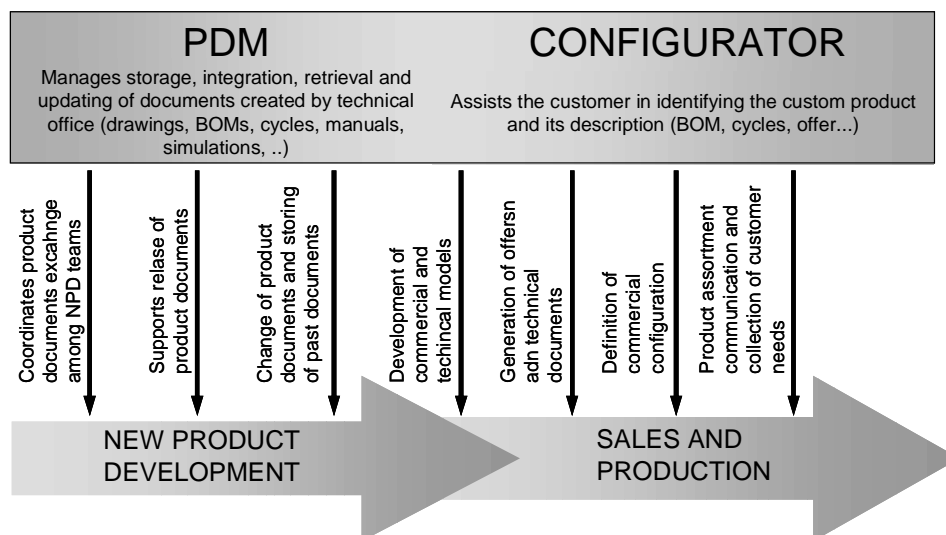


Figure 1: Configurator and PDM

2. PDM FUNCTIONS

In the 80s, many advanced companies, while adopting JIT and TQM approaches to boost their operations productivity, realized that they also had to improve product design processes. Unfortunately, the advantages of Information Technology in product design activities, using tools such as CAD/CAM/CAE were limited by the paper-based document management systems in use at that time in most technical offices.

A crucial point was the engineering-manufacturing interface. Deficiencies were found both in management of engineering change process and in the way technical documents were released to production. Consequently, the first PDM were developed. At the beginning, they were developed in-house by the companies interested in improving their management of technical documentation. Later on, specialized software vendors entered the market of PDM applications. These PDM supported the generation and storage of technical documentation released to production and helped the management of engineering changes. With the passing of time, the range of product document types managed by PDM increased: blueprints, diagrams, sketches, schemes, circuits, manuals, lists of materials, production BOM, etc. In their evolution, the scope of PDM system embraced product data throughout the whole product life-cycle, from concept to disposal.

A second generation of PDM was capable of handling the revision status of product documentation, thus allowing also to manage documents in progress. In this way, PDM goal was to support the design team, disciplining the circulation of documents in progress through different departments and people. Some systems add to this function the capability to support the whole design procedures underlying product development. This function is called *workflow*.

Current PDM systems aim at managing the systematic filing, integration, availability and updating of the documents produced by the technical office (designs, BOM, cycles, manuals, numerical simulations, etc.) Their main functions are to store data in an *electronic vault* and to make it promptly available to users. The system controls the way in which the operators create and modify data, defining the sequence of events that must be verified before allowing any modification. Among the stored data, it is possible to define links or associations that reflect the product structure, supplying to different users the tools and product views that best fit their needs. Finally, the data of the electronic vault can be classified according to a particular physical characteristic or similarity in the production cycle. For example, a designer may need a certain component. Instead of designing it, he may look for a functionally and morphologically similar one across the already designed components. Alternatively, he may pick a similar one and modify it, rather than designing from scratch the required component. This functionality consents to re-utilize the existing components, to standardize them and to reduce the design activities needed to develop a new product.

2.1 Similarities and differences between PDM and product configurators

If we compare what has been said about PDM systems to what has been said about configurators, it is evident that between both tools there are some common functionalities. Nevertheless, the numerous differences between them are enough to confirm that these tools are complementary, not substitutive.

There are some overlapping functionalities because both software have mechanisms that store, create and retrieve product data. Furthermore, in both systems it is possible to classify stored data according to various attributes. Finally, PDMs and configurators permit the definition of the different relationships between the multiple parts of the product, helping to define the bill of materials and associating with each code the documentation necessary to identify and produce a specific product variant.

However, the two systems differ on other functionalities. This is due to the fact that they were created with different aims. PDM systems, in fact, were conceived to manage engineering product data, while configurators were envisaged to gear sales process with engineering and production when custom products are offered. In particular, the main difference between both tools is that PDM systems mostly do not provide an adequate support to sales product configuration. On the other hand configurators, due to their essence, do not support workflow management, i.e. they do not provide any support to manage product development process.

2.2 Integration between PDM systems and product configurators

The conclusion made in the preceding sections brings up a second question. These two complementary tools have common functions and, in part, manage the same data, how should they be connected? There is not an exclusive answer to this question and many possible solutions have to be taken into consideration, according to the particular characteristics found in the company's context.

The easiest solution, apparently, consists of letting the two systems operate independently. In this case, there must be a complete duplication of the common product data, which have to be stored separately in the vault of the PDM system and in the configurator database. This approach may cause some problems and, above all, requires the implementation of special mechanisms or procedures to assure coherence between the different databases. Most likely such mechanisms or procedures have to be performed manually, as it would be difficult and expensive to develop a specific interface software and logical structures that have not been conceived in an integrated fashion.

The second possible solution consists in integrating the PDM system with the product configurator. In this way, the configurator technical model and PDM product model partially coincide, avoiding duplicated activities and databases. PDM-configurator integration may allow product design improvements to be promptly fed to manufacturing and sales. In fact, this integration gives the technical staff the possibility of transferring, in a very simple and fast way, their knowledge to the configuration system.

The advantages of integration are potentially numerous, but there are still many technical problems to be solved before meeting the goal of a complete integration. At present, there are some industrial research projects that try to integrate PDM and configurators. Some PDM suppliers are including in their systems an appropriate configuration module, or are expanding the configuration capacity of the configuration section within the PDM.

3. CONFIGURATION SYSTEMS AND CUSTOMER RELATIONSHIP MANAGEMENT

The configurator, as mentioned before, plays a key role in supporting the interaction with the customer when customized products are offered. However, the goal of managing the relation

with the customer in an integrated way is pursued by the so-called Customer Relationship Management (CRM) systems. Therefore, the question is, how do the functions expected from a configurator relate to the functions expected from a customer relationship management system? Since there is not a clear-cut distinction between functionalities of CRM and configuration systems, the present section aims at identifying points of overlapping, of divergence and areas of possible integration between both systems (see Figure 8-3). This section will briefly explore CRM main functionalities, particularly referring to those contexts with high variety and customization.

Essentially, CRM is a managerial approach focused on the relationship between the company and the customer. The basic idea is that managing this relationship, which changes in time and is specific for each customer, the company will be able to improve its profits. CRM can obtain such a goal by means of three strategies:

- improving the way new customer relationships are started
- streamlining existing customer relationships
- studying and redefining existing customer relationships

When custom products are offered, the interaction with the customer has to deal with product-related issues as well. After all, customization is intrinsically a relationally-intensive activity. Consequently, when product customization is offered, it is unthinkable for a CRM system not to include some of the typical features of a sales configurator (see §2.1). As shown in figure 8.3 configurators support each of the three above mentioned CRM strategies, as will be detailed in the following sections.

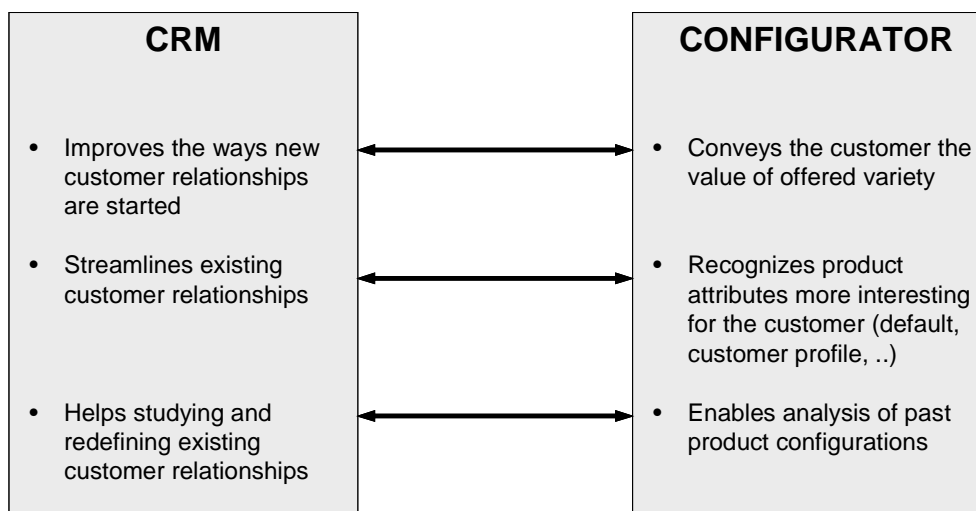


Figure 8-3: Configurator and CRM

3.1 Improving the ways new customer relationships are started

According to CRM, the relationship with the customer must be carefully managed from its very beginning. In fact, choosing the appropriate customers and giving them a positive impression from the start, allows the company to save time and avoids the risk of losing potential customers.

To contact potential customers and persuade them to buy is a crucial and difficult task, especially when customized products are offered. Under these circumstances, in fact, it is more difficult to understand what the customer actually needs and to communicate, in a convincing way, what the company is offering (see Chapter 5). Customized products require an intensive communication with the customer, which implies longer times and increased efforts in order to establish a customer-supplier relationship.

When a potential customer contacts a company for the first time, he does not have a clear idea of how the product offer may fit his needs. In other words, he needs to learn what product families, variants and options are available. In the meantime, he cannot invest too much time and effort on this learning process, as he needs to quickly spot the right product in the ocean of potential alternatives. The sales dialogue of a configurator, indeed, specifically serves the purpose of helping customers to browse the company's product offer. As observed in chapter 5, they describe the product, they structure the interaction with the customer, they do not overwhelm him with options and they make the customer appreciate the value of available alternatives. Moreover, the configurators, being highly interactive, foster the customer's learning process.

When the salesman, on the other hand, contacts for the first time a customer, he does not have any precise idea of his needs. Contact after contact, he collects more and more information about the customer's needs and preferences. By collecting this information on simple sheets of papers, double-entry tables, pre-printed forms, etc, exposes the company to the risk of collecting incorrect information, losing useful information or forgetting to get the necessary information. No doubt, this is not the best way to start a relationship. The sales dialogue of a configurator, instead, offers a way out of all these problems. The information collected is correct, as questions should be made unambiguously, and replies should comply with appropriate constraints. Useful information, such as intermediate configurations that did not fully meet customer needs can be stored and retrieved in case the customer goes back on his previous choices. Finally, all the necessary information should be collected, as the configurator does not release any configuration until all the required attributes have not been specified.

That's why the configurator may support CRM in the acquisition of new customers. Its utility, however, is limited to the aspect "product", because the configurator does not take into account some elements, such as how far the customer is from placing an order (indifferent, awaiting, motivated, ready to decide).

3.2 Streamlining existing customer relationships

Faithful customers are an asset for a company. They place orders absorbing minimal commercial resources, because they are familiar with the company and its products. In addition, they tend to place orders when economy is bad, thus providing an ensured income. For these reasons, faithful customers constitute a stock of assets, the company has a strong incentive to expand and maintain. CRM, accordingly, aims at making life easier to its faithful customers, thus discouraging them to switch to a competitor.

The mechanisms through which CRM streamlines the relation with customers are multiple. For example, when a customer calls to know its orders status, the salesman should have updated feedback from factory control, to understand whether manufacturing is on time or not. Were the salesman to notice a delay, he should be able to track down the reason for the

delay. It may need an accounting profile of the customer, to understand if his order has been frozen because of bad credit. Alternatively, he may need to find out who picked the order and committed to that delivery date. Finally, he may have to check whether delay was due to the backlog of paper going to and fro the customer's and the supplier's technical offices.

Customized products increase the amount of information needed when the company interacts with its customers. More precisely, customization poses to CRM stringent product information management requirements. Prerequisite to manage information on customized products is to accurately store all product specifications concerning past and current product configurations offered to each specific customer. Needless to say, a product configurator provides this capability.

A possible use of past product configurations is in the after-sales service. When a customer needs a spare part for a customized product, the key issue is to identify the very spare part compatible with the specific product configuration in question. For example, if a bathtub manufacturer field service receives a call to replace the pump of a custom shower-tub five years old, it is necessary to understand what kind of pump was installed in that product. This may be problematic in the case the invoice does not indicate bathtub components. If a product configurator was used when selling the tub, by recalling the product code (indicated in the invoice) it would be easy to trace back to the specific pump installed. In case of late or erroneous replacement of the pump, the customer will likely write off the company. As everyday life teaches, it takes a lot to build a relationship and a mere nothing to wipe it out.

Past product configuration data can be also used to speed up configuration activities of faithful customers. Most often, in fact, every customer tends to have his own "standards", i.e. his configurations tend to share some common requirements. In this case, he expects the company to remember his usual requirements, making life easier for him when placing an order. Product configurators may favor the creation of a customer profile and in this way, the company is able to offer the customer, as defaults, his favored or typical options. For example, let us consider a manufacturer of gas pressure regulators. If a customer's installations are located in Germany, where the DVGW standard is used, it is possible to create a default that, given the name of the customer, offers him only those solutions complying with DVGW standard. In this way, by automatically screening for those options that apply to his context, he is not required to specify product standard each time.

In conclusion, product configurators support CRM because it systematically remembers and precisely retrieves information on product configurations. Whenever a configurator is missing, there will be a serious risk of mismanaging such information, with negative implications on the customer-supplier interaction.

3.3 Studying and redefining existing customer relationships

CRM does not only help to acquire new customers and streamline the relationship with active customers. It also helps marketing to set the company's product, price, promotion and placement strategies by providing detailed and structured data on what customers have been asking for, buying, complaining, etc. In short, it supports marketing planning by means of the most accurate data on customer relationships. How marketing actually uses such data is constrained only by imagination: to screen market trends, to track and improve customer relationships, to assess changes in customers' logistical requirements, etc. For example, a

company that manufactures boilers groups its customers according to their profitability, and based on this value the company offers a series of added services, such as training courses, smoke analysis devices, financial aid to purchase vans, etc. The more profitable a customer, the wider the range of services he can obtain from the company.

Also in this case product customization adds to the bulk of information CRM has to manage and it increases the complexity of possible analyses as well. To give an idea of possible difficulties, just think of a segment of customers that stopped making orders last year. Let's say they are unsatisfied with the product. What's wrong with the product? What attribute? Or what set of attributes? etc. Answering these questions implies having accurate descriptions of those features of products sold in the past to each customer. Product configurators make this information easily available.

A fundamental use of data on customer relations is to calculate how much each relationship is profitable. Calculating profitability per relation, when products are customized, cannot be done without precise data on past product configurations. For example, sales data on past product configurations allows computing accurate product variable costs, as well as other product costs, e.g. the cost of customer-specific product certifications. Calculating profitability per relationship requires also other non-product related data, outlining the cost of the customer-supplier relationship. Not all relationships, in fact, have the same cost. For example, some customers may take a long time to make up their minds about exact product specifications, so that they adsorb a lot of the supplier's sales resources. On the contrary, other customers may know the product as well as their needs precisely and, consequently, their decision making process absorbs very little of the supplier's sales resources. Supported by configuration data, therefore, CRM can help the company to screen customers, supplying information on what relationships have to be fostered or trimmed.

Besides supporting the management of "customer relationships", CRM systems often include business intelligence tools. Such tools are intended to analyze raw data on customer relationships providing synthetic figures needed by high-level managers. For example, they may supply information on sales by customer segment, by region, etc. When custom products are sold, data on past product configurations are very important to perform such analyses. For instance, by analyzing the requests for "special orders", it may be possible to understand what additional features should be incorporated in the sales dialogue. On the contrary, it may be useful to assess what features are seldom required by customers, so that it may be appropriate to drop them from the sales dialogue. When custom products are offered, therefore, to get the most from the business intelligence tools included within CRM systems, accurate sales data on past product configurations are needed.

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