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OUT-OF-THE-BOX PLM

CXInsight for Electronics

e-Collaboration & PLM software for the electronics industry

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Software House
innovative software for electronics

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1. INTRODUCTION

The development and production of electronics is one of the most complex product realisation processes in the industrial world. Not only the endless design possibilities, but also the increasing subcontracting of (software) design, NPI and mass fabrication to third parties require very stringent data management in the supply chain. In addition, it is very important that in the earliest possible development phase, knowledge and experience of subcontractors and partners are utilized to develop a product right-first-time and to minimize development times. Both aspects - information management and intensive collaboration - are strongly linked to each other and require special functionality for the electronics industry, which has not been available until the introduction of CXInsight.

2. WHAT IS CXINSIGHT?

CXInsight is an "out-of-the-box" Engineering Collaboration and Product Data/Product Lifecycle Management solution, developed specifically for the electronics industry to aid management and control of all information streams and to guarantee global, controlled and safe collaboration over the Internet (e-Collaboration).

CXInsight provides unique data management for both design, engineering and production environments. The software provides project level integration for information, process and people throught the supply chain

PLM/PDM is a complex and comprehensive process, for which there are only two feasible options in the electronics industry:

- A dedicated solution - built for one constituent on the basis of one of the many commercially available general PLM/PDM systems in combination with extensive customisation.

- An out-of-the-box (off-the-shelf) solution - intended for broad operationality within the electronics industry and based on industry best practice.

3. THE DEDICATED PLM/PDM SOLUTION

The advantage of a dedicated solution speaks for itself. On the basis of a commercially available generic tool almost everything can be adapted and made in any desired form, functionality or complexity. The disadvantages however are also clear. In the majority of cases the industry expertise must come from the customer, which means that the specification phase of the PLM/PDM project is vital for the functionality.

For the customer, the specification phase is a time-consuming effort and carries a high risk. An erroneous specification results in the wrong solution, leading to costly and time-consuming rework which in turn slows down the operational phase. What's more, maintenance and extension/modification of a dedicated solution is costly and very supplier dependent. Another obstacle is that the contract manufacturers must interface with the different PLM/PDM systems of their customers. Lack of standardisation makes specifying a dedicated solution a dangerous and complicated operation.

4. THE "OUT-OF-THE-BOX" PLM/PDM SOLUTION

The advantages of "out-of-the-box" PLM/PDM are obvious. For a reasonable price, an industry specific solution is available, and maintenance costs are well-known in advance. The customer does not have to worry about drawing up specifications or going through a system analysis. The supplier has the obligation to make sure that the tool has adequate functionality, that the technical developments are followed and that the solution covers the advancing needs of the industry. This approach ensures that also small to medium sized companies can afford a solution in which industry expertise and best practice at the highest level are available for them. Another main advantage of the out-of-the-box solution is that a general adoption of the solution in the marketplace will be followed by a general and standardized working method within the electronics industry, thus enabling OEMs to work more efficiently with a number of suppliers.

There are, without doubt, disadvantages to an out-of-the-box approach. But they are mainly at the expense of the PLM/PDM solution provider. From a commercial point of view, the specialized functionality is tailored to a particular niche market; a major disadvantage unless that market is large enough. The electronics industry is a large and consistently growing market, and the disappearance of that market is, also in the longer term, improbable. In order to be successful the solution provider has the obligation to supply a complete solution before a first product version can even be brought into the market. Therefore, a first product version demands a large pre-investment in development of adequate functionality, otherwise it bears the risk of a low market acceptance.

From a technical point of view, in the first instance all industry expertise must come from the supplier. A large initial investment in market research is necessary in order to get a clear picture of industry best practice and to translate this into required functionality. After a successful market introduction of the first product version, user feedback and ideas, needs and insights will

start contributing to the improvement and extension of the solution. The disadvantages for customers are limited to situations where special requirements exist that haven't been covered by the out-of-the-box solution. In those cases, the solution must have the flexibility to allow serious customisation and/or integration with other applications.

e-Collaboration.

In order to bring products to market faster, more accurately and with a higher quality, it is necessary to optimize collaboration between OEMs, CEMs, design service bureaus and other suppliers of different disciplines.

The process of outsourcing the design, engineering or manufacturing of an electronics product is a complicated exercise that requires a large set of constraints to be balanced. As industries move towards the full outsourcing model, the need for close collaboration between different companies across the supply chain (web) is rapidly growing. At the same time, the audience involved in the decision making process within each supply chain partner grows as well.

CXInsight provides an effortless solution for collaboration via the internet, using the latest internet based collaboration technologies. CXInsight projects serve as a virtual meeting place for the project members within or outside the firewall. Additionally CXInsight offers communication benefits within an individual OEM. The most difficult challenge with this arena is the ability to effectively manage communication of all product information from conception to fruition. This includes project, task and content management as well as flexible product data management and management of unstructured data (e-mail, fax, notes, etc), which is becoming increasingly important in the product realization process and life cycle management. Management of such volatile data is difficult in less flexible formal PLM systems, in particular in the area of electronics design and NPI. CXInsight can add this high velocity, B2B engineering collaboration functionality to existing formal PLM systems.

CXInsight allows an OEM and its supply chain partners to collaborate in a secure and compartmentalized environment (project rooms or e-rooms). OEM members access content and files from within their network while supply chain partners do the same through the Internet. Partners interact with each of their customers separately, through the same username and password but with different authorization levels and access rights.

CXInsight is based on a highly secure and organized set of workspaces, or containers for a rich set of objects, including data files, e-mail communication, discussion notes, tasks, calendars, and more. CXInsight workspaces facilitate data distribution, collaborative problem solving, and change notification enabling supply chain integration, concurrent product development and such. Workspaces can be created to handle a specific product, from large assemblies down to the single PCB. A flexible notification mechanism provides the option to generate pre-emptive alerts to key project participants for a wide range of defined events. Such alerts are instrumental in avoiding wait time and expediting the design to manufacturing process. CXInsight also offers functionality to view, manipulate,

and communicate 2D and 3D geometrical data and the associated descriptive information, making product change and collaboration easily attainable.

Using the latest internet-based collaboration technologies, CXInsight delivers:

- Collaboration for data and change management, DFM communication and sophisticated content management. This secure, web based technology serves as a virtual meeting place for the supply chain partners, facilitating all collaboration operations.
- CXInsight also provides services for open data viewing in all different formats to review manufacturing issues during the electronic or mechanical design and NPI processes.
- The CXInsight collaboration network is the single data access point where all members access content and files that are stored on the central server. This arrangement allows all members, whether OEM or fabricator, to communicate and share information. Supply chain partners receive a federated view of their collaborative landscape, able to seamlessly move between customer collaborations.

WHAT IS THE INNOVATIVE AND ADDED VALUE OF CXINSIGHT?

For the Design environment

User of CXInsight in the design environment has a documented efficiency improvement of around 30%!

a. Design data management.

Within the design environment, several data management solutions are already available; most of these are related to the EDA-tools in use. This EDA-system centricity has the natural advantage of perfect integration; however, this is also its limitation, not only because of the specific functionality for a limited application field, but also as a result of the dedicated connection with the EDA vendor's products. CXInsight does not have that limitation. It is completely independent of any tool and guarantees full traceability on data management. CXInsight can handle the usual complex data structures of all (also EDA) tools; offers more and wider functionality and enables dynamic bi-directional communication with partners through the firewall. An important issue in electronics design is sharing and controlled updating of EDA libraries between partners, and in most cases, CXInsight solves this.

Another disadvantage of the data management tools connected to specific CAD systems becomes apparent when an operational EDA system needs to be replaced or extended. The changed requirements within an organisation, the rapid technological development and/or price erosion of competitive EDA systems can make it attractive to invest in a different solution. CXInsight doesn't have any tool dependency and can handle different EDA systems next to each other without any problems.

However, in most cases data management problems are solved by tools developed in-house or by standard file management functionality available in different Operating Systems (Microsoft; Linux, etc). The success of utlising these solutions is completely dependant on the dedication and discipline of the engineers, who need to use them structurally and consequently. And still, lack of the necessary automatic organisation, traceability and e-collaboration functionality are issues that arise all too often. The advantages of CXInsight in comparison to these basic solutions are numerous and evident.

b. Process flow management.

The complex character of electronics development resulting from differing development and design aspects of hard- and software, formal ECR/ECO procedures, requirements around global legislation (i.e. EMC and RoHS compliancy), locally differing requirements (i.e. 220 Volt in Europe; 110 Volt in the USA) as well as additional needs of partners and customers, demand a structured approach. Many companies do not have a formal and structured way of managing the product development cycle, and project managers are trying to keep control utilising their experience and point solutions, as well as the expertise and craftsmanship of colleagues and suppliers. The need for process flow management is growing rapidly, and CXInsight fits exactly into this widening gap.

CXInsight includes an integrated process flow management solution, based on a template structure that includes the generation of pre-defined tasks for the required process steps. Standard process flows can be incorporated in the project templates and automatically generated when a new project is generated. Gantt Charts are generated to give visibility of the planned (estimated) time frame per task and the dependencies between the tasks, giving a clear overview of the process flow and the progress of the project. Every task can be a process flow in itself, so that the task is executed in a structured way. This works for internal tasks as well as for tasks for and from the partners.

c. BOM (bill-of-materials) management.

An incorrect BOM (Bill of Materials) leads to a product that won't work. This statement is very simple but the problems around BOM and BOM management are very complex. The materials in the BOM define the complexity, the functionality, the reliability, the life time, the price, the delivery time and the profitability of a product.

Deleted:

The BOM is the key element in the product realisation process and requires not only a lot of company internal attention, but also a lot of commitment from partners in the supply chain (i.e. contract assemblers). The designers have theoretically free choice from more than 80 million commercially available components supplied by hundreds of component manufacturers. Many of these components look the same but are different, or are the same but look different. It is clear that no contract manufacturer will have them all in stock (not even a fraction of it). It is also a fact that no company can afford

to let their design engineers make an unlimited free choice from these 80 million+ commercially available parts. Both the OEM and the EMS have a similar interest in standardisation as well as limited choice in the part selection, and they have to communicate about the chosen parts in order to guarantee a functioning end product.

This issue becomes even more complex when multiple EMS companies are involved in the production. The needs of the OEMs and the recommendations of the different EMS companies will have to be balanced to create the final BOM. This process involves a lot of communication beginning in the early stages of design, when the preliminary BOM is generated from a rough component choice or a schematic, through the different phases of development, engineering and new product introduction (NPI) (different versions and different revisions), culminating in the right product BOM(s) for mass production. This BOM specification and finetuning process is a continuous source of problems, labour and frustration for all partners in the supply chain.

To alleviate these issues, we have developed a unique BOM management solution within CXInsight, for both the design and manufacturing environment. The CXInsight BOM Manager handles unlimited hierarchical BOMs of different nature (electrical, mechanical, other materials, associated parts and Phantom BOMs). ItI also features highly automated functionalities including import BOM, enrich BOM, synchronise BOM, compare BOM, match ERP, and fuzzy part search on the Internet. This functionality alone returns the entire investment in CXInsight.

d. Change management (ECR/ECO management)

It is a well-known fact that more than 60% of the development and design time of an electronic product is taken up by modifications – resulting in a major dent in the development budget and critical delays in time-to-market as well as loss in revenue of a product launch. A small change in an electronics design can have serious repercussions in the realisation of both hardware and software and therefore in production. In particular during the NPI and pre-series production stages, the change dynamics are at a peak. A PLM system for electronics companies needs special functionality to be able to handle this myriad of modifications and changes in a dynamic way over the entire supply chain, avoiding the frustration of developers, designers and engineers. CXInsight is specially designed to handle these dynamics, with change management being a core capability. The solution includes all the functionality needed, such as automatic revision control, full traceability, task management and process flow management, but also configuration and build management, covering the entire supply chain.

e. Configuration and build management

An EMS company will have to know exactly what has to be built in both NPI and mass production. One wrong line item in the BOM or a mistake in a document revision can create a very costly and disastrous situation. The OEM

will have to create a "product configuration" or "product build" as the basis for physical production. Even for relatively simple products, the task of collecting all the correct information for a product configuration and build, and making it available for production in a structured way can be quite complex.

CXInsight provides professional configuration and build management functionality for design and engineering as well as for the production side. A configurable wizard manages the right process flow, consistency and structure, the checks and controls on tasks and file revisions, as well as the configured authorisations and sign-off procedures. Combined with the formal CXInsight "release-to-production" (RTP) and "delivery" functionality, it makes it impossible to make configuration mistakes in either the design or the production environment. The full traceability log keeps track of the configuration as well as the ordering history.

f. Document management

CXInsight is a fully functional document management system that complies with the FDA Part 11 standards (not yet formally certified). Having all development and design specifications, related documentation and requirements available for all involved engineers in a structured way, offers an important efficiency improvement and makes it very simple to keep all documents up-to-date. ISO 90XXX audits are highly simplified.

For the production environment

a. Customer Data Intake

Electronics Contract Manufacturers (CEMs or EMS companies) can be located all over the globe and can have complex global organisational structures. The revenues of these companies can vary from a few million to a few billion Euros per annum. Some of the large EMS companies have different sites that specialise in specific markets in the electronics industry (i.e. Mobile & Consumer; Computers; Medical equipment; Aerospace & Defence; etc), or functionality.

What they have in common though is that they receive data sets from their customers to build products. There is a level of standardisation in those data sets and the way they are delivered, but despite the efforts of standardisation institutes like IPC, most of the OEMs don't comply and are sending information in whatever format is available.

CXInsight has the full data management and e-collaboration capability required to handle different data sets and formats in a professional way. It offers functionality to communicate mistakes and change requests, as well as design changes and other modifications between the OEM and EMS companies.

One of the biggest problems in electronics product development is the chaos around part numbering. On top of the part numbers of the manufacturers

(MPN's), both OEMs and EMS companies have their own part numbering for electronic components in their respective ERP systems. This in addition to the different library definitions possible in the commercially available 20+ E-CAD systems means that every new data set is in fact unique. Data interpretation and validation of a new data set is therefore complex, involving time consuming manual processes, before the EMS company can have certainty about the completeness and correctness of the data set and the readiness of the data set for quotation or production. The high frequency of changes or modifications during the data interpretation session makes it prone to errors and miscalculations.

The CXInsight data intake module includes special functionality to read, interpret and check new data sets for errors and completeness. Core information and numeric information about the product such as PCB technology, components, component types and amounts, alternatives (AVL information), production and test processes, as well as information about number of solder joints and defect chances are automatically distilled from the data set. All customer related peculiarities (AVL, library symbol rotations, BOM syntax, etc) are stored per "design centre" in a self learning operation. Frequent synchronisation with the ERP system updates this information. The data actively supports the quotation process, and in case of an order the delivered data set can quickly be compared with the original data set on which the quotation was based.

b. BOM management.

The BOM (Bill of Materials) defines which product is built. One modification in the BOM can define a completely new build and can change the entire manufacturing process. The BOM can define an entire system with consequential hierarchical structure. On the lowest BOM level (the PCA or printed circuit assembly level), the BOM contains not only electronic components, but also mechanical parts (screws, bolts, nuts, frames, heat sinks etc) as well as other items such as embedded software and supporting material for the assembly operation (wires, glue, and bar code stickers). It is most important for both the OEM and the manufacturer to have the latest information about the materials on the BOM. Information about parts such as obsolescence, high price, long delivery times, production or quality problems are very valuable. A dynamic, structured feed-back of this information to the OEM can avoid a multitude of problems.

CXInsight's BOM Management covers all this, including full traceability registration, component code number conversions and customer dedicated part alternatives. The direct link between CXInsight and the ERP system secures up-to-date information for the customer about price, availability, delivery time and other relevant aspects. CXInsight BOM management also handles mechanical parts lists, associated parts as well as phantom BOMs of sub-assemblies.

c. Customer feed-back.

EMS companies have invested heavily in production and test equipment. Component stock locks a substantial amount of capital, and competition has eroded margins drastically. The only way for EMS companies to be profitable is to have a seamless production process. Therefore, before any product is taken into production, manufacturability as well as a testability tests of the build in question are done. An early involvement of the EMS company in the customer's design process can already alleviate the most serious problems, but a final automatic DFx *(Design for Manufacturability)* and DFt *(Design for Testability&Test strategy)* analysis should be executed in order to guarantee the quality of the data set before production. In practice, a lot of issues (serious or less serious) are found, which must be communicated with the customer. In many cases these issues lead to modifications in the actual or a new design data set. In a professional environment the changes are subject to a formal ECR/ECO process. The informal execution of changes by telephone or e-mail correspondence is an undesired way of working and can lead to misunderstandings, temporary solutions and eventually serious problems in production or product.

CXInsight's project feed-back functionality and procedures offer a professional solution for this problem. In many cases CXInsight can automatically generate tasks for the customer, so that the project manager can either distribute the change tasks or just note them. Nothing will be overlooked and there is full traceability of the entire change process.

d. Data management and revision control.

Every modification in a product data set has to be managed very carefully during the design process. Not only the occurrence of the modification has to be monitored, but also the history of the decision process that has lead to the modification. Ultimately, the product will be manufactured and multiplied into many physical products. An error in the product build data set can have very serious consequences. However, under the pressure of time-to-market and the limited window of opportunity for product sales, changes will have to be incorporated in the manufacturing process, and the cooperation between design and manufacturing should allow this. In an ideal world, the manufacturer is able to react immediately to changes, even if the product is in full production. .

CXInsight's revision control mechanism allows both the design department and the manufacturer to manage all changes in a professional way. CXInsight enables the manufacturer to automatically analyse the changes and to define the consequences for material as well as production and test data, and it manages the feed-back to the customer in case of any issues.

Production generates large amounts of data; in many cases linked to every individual serial number of the product. Quality, process, component traceability, test and calibration data as well as repair data from production and field return services have to be stored in a structured way. It has to be

available for analysis by the producer as well as the owner of the design in order to be useful and contributing to the product lifecycle management.

CXInsight offers professional data management and revision control functionality, which manages the data on both the design as well as the manufacturing side in one operation. CXInsight enables full functional PLM by collecting not only the data on the design side, but also all relevant information from the supply chain partners during any stage of the product realization process.

e. For Change (ERCR/ECO) management, Build management and Document management, see above under Design.

Jan Keijzer