

# Concept of a modern data-management system for legally compliant and sustainable product design

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**Abstract** The quality requirements for modern products on the global market are ever growing. In addition to the increase in user expectations, the manufactures face the increasing volumes of legal requirements as well. In particular environmental protection and further aspects of sustainability gain in importance on both sides (consumer and legislative). To fulfill all of these requirements a immense amount of data (as well as other terms) must be managed. For example, the European regulation about regarding restrictions of substances and materials, demands a complex information exchange through the supply chain. Some big companies have developed, with high costs to themselves, their own in-house system. Other companies use existing on online systems. This central collection of data however usually means manual or semi-manual interfacing with the internal PDM/PLM systems, raising the likelihood of uncertainties concerning data security for the customer and questions of the protection of the intellectual property for the producer. Additionally, this means the dependence on externally controlled systems outside their own sphere of influence. A key problem with companies' internal systems and the existing online systems are the compatibility or lack thereof between them. Currently, no data exchange between the systems has been realized which makes an automate process for data inquiry through the entire supply chain and vertical data integrations practically impossible. The paper provides a solution that will effectively support all requirements for the modern product design process.

## 1 Existing situation

Production companies normally operate on a global market, bringing the need to meet different requirements throughout the different economic and geographic regions of the world (e.g. in Europe with Registration, Evaluation, Authorization and Restriction of Chemical substances - REACH and Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment - ROHS, in

Asia, China and Japan RoHS or the Asian REACH adaptations, or the Toxic Substances Control Act from USA or California's ROHS). This requires an enormous effort through the introduction of the essential and highly specific legal knowledge (such as the interpretation and fulfillment of the requirements for the target markets) and a massive data flow (such as the material data exchange in the complex supply chains). The legislative sector increased the requirements permanently, consequently meaning more aspects have to be considered from the development stage to the product design. At the same time the need to rapidly and cost-effectively launch products on the world market is not abated and is in fact even more difficult due to permanently shorten the time-to-market margins while keeping prices lower. The balance between, the very complex (and increasing), legal requirements and the market pressure, increases the risk that compliance with the law will not be secure enough for some products. This pressure comes from the complexity of the legal requirements around the world and is connected to the amount of data which has to be managed. This is combined with a permanent reduction of time for analysis of different requirements and relevant data.

This situation can be very critical for the company. The risk of regulatory non-compliance increases with time, as the regulations do not stay static and are continuously expanded and adapted (e.g. regularly extension of the SVHC-list of REACH). For these reasons, manual processing compliance issues is, in everyday operation, not feasible.

The first software tools considering the issue of legal compliance, for products, are already available on the market, are trying to solve this problem with varying levels of success.

## **2 State of the art for software solutions of material data management and legal compliance**

Varying methods are used to approach supply chain communication and legal compliance, just as coping with sustainability and CSR are done differently throughout the industry leading to know one solution on the market.

Outsourcing to a third party is the easiest way to review the legal compliance of a product, taking into account the supplier of parts, components and auxiliary materials. In the present transition period (launching of new legal regulations such as REACH) outsourcing is a common way and can be a practicable solution at this stage. As a durable/long term solution for a production company it is not feasible,

simply due to transaction costs alone. An automated data management system is not possible, in this model.

Some big companies have therefore, developed they own company-centric (In-House) solutions connected to existing PDM (Product Data Management) and PLM (Product Lifecycle Management) systems. An In-House solution has limitless flexibility, automation and technical options but this comes with a hefty fee, something that smaller companies are unable to absorb.

The other options are a number of existing online platforms offering standardized functions with centrally held databases containing component/material information. Some of which include legal compliance information in regards to specific legal standards. A big downside is the use of these systems normally means the outsourcing of critical know-how. Another is these systems have generally no concept/capacity for handling incomplete data (it is implausible that every supplier worldwide would upload their data on time or at all). A further important disadvantage of these systems is the lack of flexibility to individual requirements.

Big global PDM system providers have started to launch solutions for data management with legal compliance support, but none of them can currently provide an effective industry “ready to go” solution.

Table 1 summarizes the advantages and disadvantages of the above described different systems and services (with some examples of sources).

**Tab.1: Overview of systems for material data management and legal compliance**

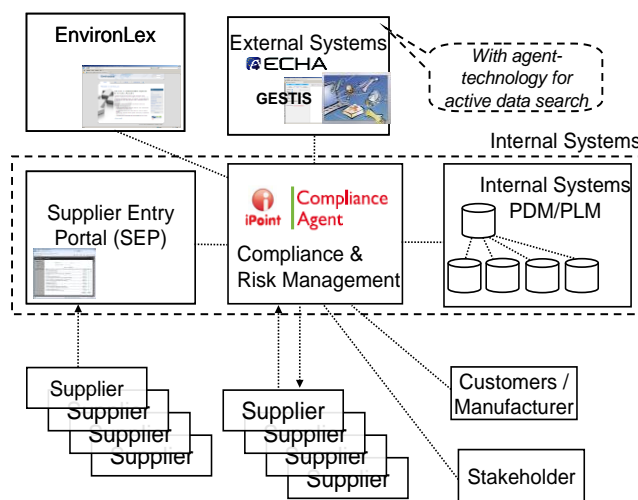
Type of Solution	Advantage	Disadvantages
Outsourcing to a third party service provider	Flexible, fast, low investment cost	High transaction costs, no data integration into internal or external systems, no automation of recurring processes, no economies of scale, outsourcing of critical know-how and confidential information, no sustainability or CSR function
Self-developed, proprietary company-centric systems	Tailored to individual requirements, connection to an existing PDM, flexibility,	Very high implementation costs, very high legal knowledge, limited possibility to re-use existing data on the supplier side,
Online Platforms	Simple to use, Re-Use of existing data	Outsourcing of critical know how, lack of concept for incomplete data; missing strategy for data maintenance, no support for

		supplier communication, no flexibility to individual requirements
In-house Database	good position for integration to their own respective PDM system	Lack of integration into all other systems, and missing functionality (user and task support)

### 3 Practical solution for the industry

In the electronics industry, the communication, exchanging of material data and compliance checks through the supply chain are carried out by a number of parallel systems, which is to be expected due to the number of suppliers in this field. The number is almost unlimited and a joint system for all of these functions could not be achieved until yet therefore it is not realistic to expect a united branch solution. Most production companies prefer to develop their own or to join different systems (see chapter 2). This means an information exchange system is needed and that it must be flexible to enable it to be adaptable to new and changing legislation. The exchange of information shall take place between the commercial software solutions such as IMDS and BOMcheck; the existing in-house IT environments and between various public data systems, such as the European Chemicals Agency (ECHA) or the German hazardous materials information system (GESTIS). The software integration tool, iPoint Compliance Agent (iPCA), implements this approach. The system accesses the existing component, material and substance data throughout the value chain. Additionally, for the communication outside of existing systems, the iPCA offers a module for data delivery/import e.g. the Supplier Entry Portal (see Figure 1). Figure 1 shows the core modules of the iPCA with an expanded material and supplier management functionality, including the ability to connect and communicate with the in-house PDM/PLM systems. The Supplier Entry Portal (data communication with supplier) makes connection with supplier's own systems is possible. Special interfaces allow for data to be uploaded from the supplier's own system or through manual data input. Other interfaces also connect the system with other third party systems (such as "EnvironLex", the European Chemicals Agency ECHA or the German hazardous materials information system GESTIS). Additionally, an agent technology searches the available data online which is provided by the supplier.

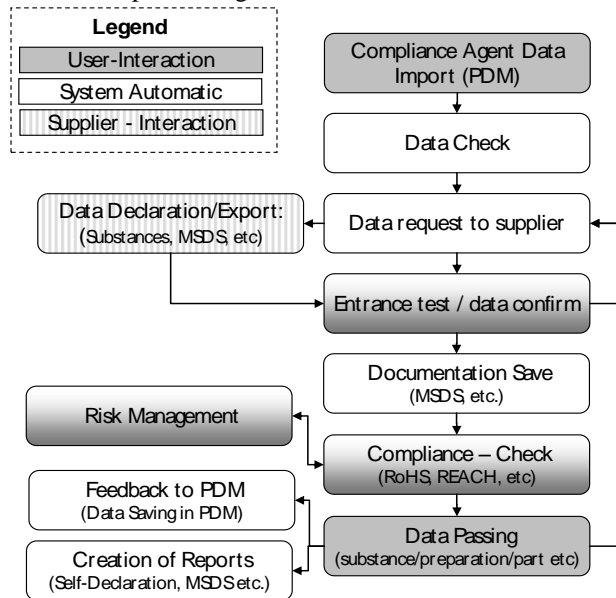
The iPCA allows an open communication between different systems to be implemented. Therefore, a corresponding user administration, with clearly defined rights has been developed. This ensures high data security (intellectual property), while providing filtered and task-oriented access to the required data. In order to effectively secure the intellectual property of the manufacturers, the iPCA application runs locally on the in-house system. Thus, all product-specific data (bill of material, specifications, compliance documents, etc.) are saved and managed exclusively on the in-house PDM systems and thus not accessible to competitors.



**Fig.2: Communication between given systems supported by iPCA.**

Figure 2 shows the complete process of conformity assessment by the iPCA. A user (legal/quality manager) starts a compliance check of a product by automatically importing the bill of material (BOM) from the in-house PDM system. Automatically the input data will be imported and verified by iPCA. The data is checked for both the accuracy of the individual items in the bill of material (meaning questions such as completeness of parts, naming of used units, correctness of part numbers etc.) and, for all the components, allowing a part number search to be conducted in the system database. If the component is already saved in the system and contains sufficient supplier information it will be identified and used for the current and future bill of material analyses and compliance checks. For new entered/unknown components or components with insufficient information, the appropriate suppliers will be requested to deliver the relevant information via the Supplier Entry Portal (SEP). This allows the system to constantly monitor information already entered in the system or information that is available on publicly held sources. The input information (material

declaration, conformity certificate, negative declaration, etc.) will be checked for plausibility and completeness by the user and also against positive results saved in the system (that means questions like naming of substances, used units, form and contents of specification related to a given regulation etc.). When something is missing or is incomplete a further query will be sent to the supplier. The information collection is an automated process and the user interaction is reduced to a necessary minimum (input data control). In the subsequent step the complete bill of materials is checked for compliance with pre-defined legal requirements (e.g. ROHS, REACH, ELV etc.). This means, for example, that the legal requirements (e.g. restrictions of use of specific substances according to REACH) will be identified, calculated and compared to the current limits as stated in the regulation. If a substance included in a sub-part exceeds the acceptable concentration (as defined by regulation) a warning and a report will be create by the system. Changes in the legislation are supported by experts/system managers and periodically updated. A completed compliance check must be approved by the user before saving the information in the in-house PDM system. Based on the BOM provided and the generated information, the pertinent reports will be composed automatically by the system (e.g. MSDS, reports for public regulators, declaration letters etc.). The information collection, integration into the in-house systems, analysis and reporting is organized and managed entirely through the iPoint Compliance Agent.



**Fig3: Compliance checks by iPCA**

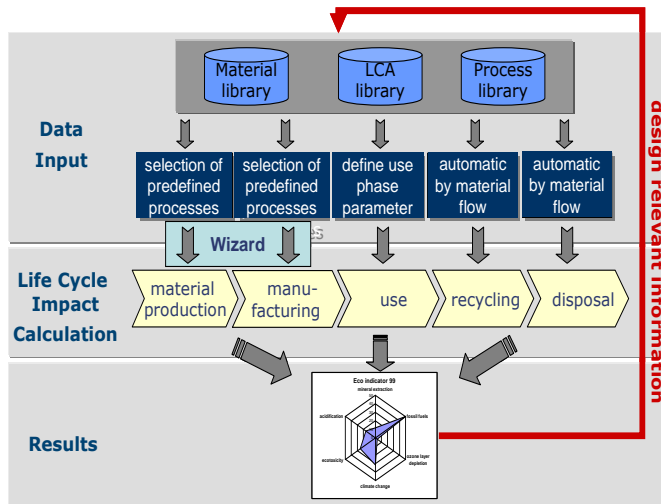
The information collected in the system, not only is a compliance check, it also gives a good basis to provide the necessary sustainability strategies in the development of a product. For example the material specification builds appropriate basic information for a Life Cycle Assessment of products. This information includes the type and amount of auxiliary materials used e.g. in production which can be later used for the optimization of the environmental performance of production processes. Additionally, the information gained about the origin of the components could be used for further optimization in regards to sustainability.

#### **4 Sustainability assessment of products using existing data**

The developers must consider the product's environmental characteristics throughout the whole life cycle, as environmental considerations are becoming increasingly significant in the product development process.

a user-friendly tool is provided by the iPoint LCA Module, which enables the user to swiftly generate a detailed and accurate product image of its entire life cycle (see Figure 3). This enables the user to calculate the environmental impact caused by the product and take action where necessary in accordance with ISO 14040.

For a comprehensive analysis of products, an immensely detailed set of environmental data is needed. The iPoint LCA Module negates the need for tedious research. The iPoint LCA Module connects to an existing database and integrates the data into the structural product model. According to Figure 3 the database offers prepared recycling and disposal process data. In this case, data input from the user is not necessary. The recycling performance of the defined product will be automatically calculated using the available product material data and by using the process data stored in the database (see "automatic by material flow" in the Figure 3). The built-in wizard mode helps to minimize the time needed for user inputs and makes the user experience of the iPoint LCA Module effortless. The wizard helps to locate the relevant processes for the material production and manufacturing stages (see "selection of predefined processes" in the Figure 3) and to define the parameter of the use stage (like energy consumption, maintenance material, etc. in an easy way – see "define user parameter" in the Figure 3). The degree of the assessment of the product can be set independently to the product or individual assemblies and components. Naturally, it is possible to add fast and easy, unique and individual LCA processes.



**Fig.4: Work flow for LCA with the iPCA**

As result of the analysis an eco-profile is accessible. Different indicators such as Global Warming Potential (GWP) or Cumulative Energy Demand (CED) can be calculated from the derived data. These results are available for customers and public authorities via an export function.

The means to evaluate precisely these issues are provided for as part of the iPoint Compliance Agent materials management system, the RRR module (Reduce, Reuse, Recycle). The developer is supplied with information on end-of-life product characteristics, which can otherwise only be compiled through the expensive process of physically disassembling a prototype. Due to the product's structured presentation and its pre-loaded recycling profiles, the occasional user will find it simple and efficient to use. An expert user can exploit the full range of RRR calculation opportunities through using the tool for complete material flow simulation. The recycling profiles used in the calculations contain essential end-of-life technical and financial data on recycling and disposal processes. This makes it possible to conduct an assessment of end-of-life properties for various markets and technologies without additional modelling costs.

## 5 Conclusion

A modern data management tool in business should rapidly and efficiently collect and evaluate the necessary data and also be able to use the full potential of the



given information portfolio. This allows for the protection of the sustainable existence of the company and its products. Additionally, this system should be at the forefront of innovation, therefore allowing the user to obtain a competitive advantage in the market.

With the foundation of legal accomplishment being effectively covered, the Compliance Agent takes the next step into the modern sustainability of products and production organization. This step will be done with a minimum of additional effort because of a very efficient management of the given information (e.g. information in the house internal PDM system and different external sources such as the “EnvironLex” as mentioned previously in chapter 2) and accessible data (e.g. the required supplier information) (see Figure 4). In accordance with a recent analysis of global active companies; sustainable oriented organizations clearly have a higher longevity and increased development opportunities in the global market. Figure 4 lists the system requirements and its implementation by iPoint Compliance Agent.

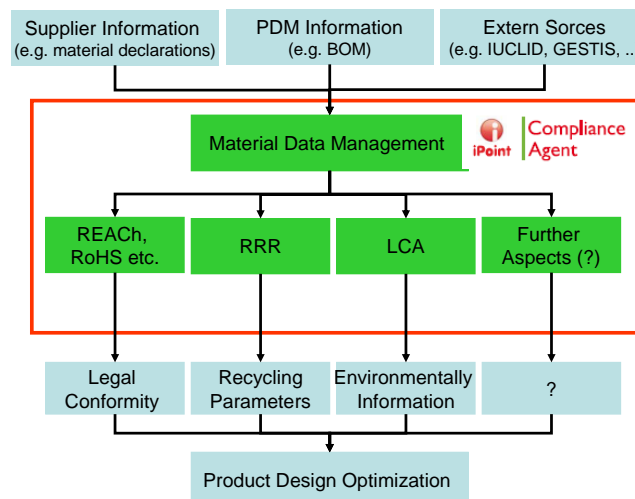


Fig.5: iPCA overview about Data and functions

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