Successful Material Compliance Reporting Strategies for the Electronics Industry

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Abstract

Growing material regulations compel electronics manufacturers to rethink product compliance. Can a company state with confidence every substance in the final product has been identified, and from where each item was sourced, by all direct and indirect suppliers? Consider the impact of the REACH, RoHS and Conflict Minerals regulations on the electronics industry.

REACH protects human health and the environment through early and accurate identification of intrinsic properties within chemical substances. Companies must report all potential hazards, and then implement risk management measures.

RoHS impacts all electronics manufactured or imported into the E.U., regardless of whether the manufacturer intended the item for sale in region.

Conflict Minerals requires companies to validate the sourcing of tin, tungsten, tantalum and gold (3TG) in products is not tied to vicious armed conflict in Africa. Electronics companies are challenged to verify the source materials came from conflict-free smelters.

Companies must explore the greater complexity that spans the entire supply chain, including direct and indirect suppliers. As an article producer, each company is ultimately responsible for everything contained in the product. Simultaneously, companies must respect intellectual property, data accuracy and public perception, all within the changing compliance landscape.

The End-of-Life Vehicle (ELV) legislation in the 1990s required the automotive industry to begin addressing the topic of material compliance reporting two decades before most other industries. The current solution employs data exchange standard, laboratory analysis, and supplier data communications to create a set of solutions that has proven effective.

The company has been a partner with Automotive in developing and sustaining the approach, and is actively working with companies in other global industries. Lessons learned are shared from the successes and failures of our predecessors and industry partners, to aid the industry as we proceed together in today's complex regulatory environment.

Introduction

Material compliance regulations have been in existence in the U.S. since the 1970s. However, over the past 20 years, the scope of material regulations has expanded dramatically. Initially, material regulations were issued by the Occupational Safety and Health Administration (OSHA), which held companies responsible to protect workers within the facilities from hazards. Examples include asbestos abatement requirements introduced in 1974 in manufacturing and office environments, and the requirement to provide safety data sheets (SDSs - previously known as Material Safety Data Sheets (MSDSs)) for chemicals used in the workplace, which started for carcinogens in 1976. In the 1990s, a new, broader generation of regulations was established. Originating from work of the European Chemical Agency (ECHA), these new rules are environmentally focused, and are designed to protect all people from the negative effects of certain substances present in everyday products; including people do not use these products. The European Commission (EC) End of Life Vehicle (ELV) directive 2000/53/EC was the first regulation of this kind.

The drivers behind these new types of regulations are simple and straightforward. In the 1970s, European, and especially German, citizens were experiencing improved living conditions and prosperity, which would normally indicate improved general population health. However, two key indicators of citizens' health were troubling: the failed attempts to conceive children and the dramatic increase in birth defects. Both categories were increasing at alarming rates, and the rates were accelerating. In the 1980s, multiple and thorough studies were commissioned to investigate probable causes. Study results indicated heavy metal poisoning from lead, mercury, hexavalent chromium, and cadmium, which were inadvertently introduced into the drinking water supply. The metals were present in high enough concentrations to affect reproductive health, although not yet at concentrations to cause other symptoms in the adult population. Heavy metal abatement efforts in the water were ineffective and extremely expensive. The levels indicated a clear and present danger to the European population, and immediate measures were deemed necessary to mitigate these risks.

The European governments jointly investigated the origin of the heavy metals. Primary sources were identified as improperly disposed vehicles, appliances, farm equipment and electronics. To begin addressing these concerns, the European Union

introduced the End of Life Vehicle (ELV) regulation. Under ELV, any company selling a passenger vehicle in the EU is required to conduct a three-stage remediation process:

- First, these companies must identify where the specified heavy metals are present in the vehicles.
- Second, they must eliminate these metals when an alternative can be engineered.
- Third, beginning in 2018, they are required to pay for reclaiming any heavy metals remaining at the products' end of life.

Once ELV was introduced, the automotive OEMs quickly realized that product substance knowledge was insufficient to comply with the regulation. Efforts to obtain the information from direct suppliers through supplier portals and engineering supplier reporting solutions proved ineffective, as the OEMs found that Tier 1 and Tier 2 suppliers did not possess the detailed product material composition necessary for compliance. Companies attempted to use spreadsheets and local company specific databases to gather the information by drilling down the supply chain to the lower level tiers where the product materials were formulated. Although somewhat effective, these efforts lacked data exchange standards and IP protection, and so were inefficient, costly and encountered resistance.

Suppliers became frustrated with the cost and effort of providing similar information to multiple clients in different formats. Although willing to provide the necessary regulatory information, suppliers became concerned about Intellectual Property (IP) violations and supply-chain data confidentiality issues. Some companies used IP collected in compliance campaigns to find alternate sourcing. In other incidents, reported compliance information permitted a customer to identify sub-supplier identities, which permitted them to circumvent the intermediate supplier to procure needed resources directly from the manufacturer. Sub-suppliers were also able identify the end-customer from the questions asked or templates used, and went directly to the end-clients, thus eliminating the intermediate supplier. After several of these incidents, suppliers began resisting efforts to provide the requested information and jeopardized the entire compliance information collection effort.

To address these issues, six large automakers doing business in Europe banded together to contract with an Information Technology (IT) solutions provider to create a global, cloud-based, internet-accessible international material data system. This data system collects heavy metals, all substances identified on the Global Automotive Declarable Substance List (GADSL), all REACH and most unregulated substances not considered proprietary or confidential by the material manufacturer. This system is now used by virtually all global automotive manufacturers, and more than 94 percent of all automotive suppliers.

The ELV legislation has proven effective in reducing the instances of heavy metal poisoning in Europe. However, it has not brought down the infertility and birth defect rates to those measured prior to when the contamination was detected. New regulations have been introduced to expand the efforts to eliminate heavy metals and other chemicals that have since been found to be harmful to humans and reproductive health. The automotive industry material reporting solution has grown to include many of these additional regulations, including:

- The Registration, Evaluation, Authorization, and Restriction of Chemicals regulation (REACH)
- The Restriction of Hazardous Substances (RoHS)
- EU Biocidal Directive
- Support for substance-based humanitarian concerns such as the U.S. Dodd-Frank Conflict Minerals Act

The electronics industry now faces a complex and ever-changing compliance regulation landscape, just as the automotive industry had in years past. Electronics has a broader product range and clientele, as well as more OEMs than automotive. As a result, some of the solutions may not meet all of our needs. However, it is clear that most of the challenges and opportunities that automotive encountered over the last 15 years will exist in electronics as well. While a detailed implementation plan for a successful compliance program for all electronics companies is unfeasible, four guiding principles would help electronics industry manufacturers with a process outline that supports understanding while addressing the challenges material compliance reporting requirements.

ELV's effectiveness has resulted in a dramatic increase in regulations being enacted. As these regulations increase, so does the rate at which new regulations are being introduced, along with the range of products and substances regulated. In addition, these regulations are being enacted independently in every region, instead of being focused in Europe, as shown in Figure 1 and Figure 2.

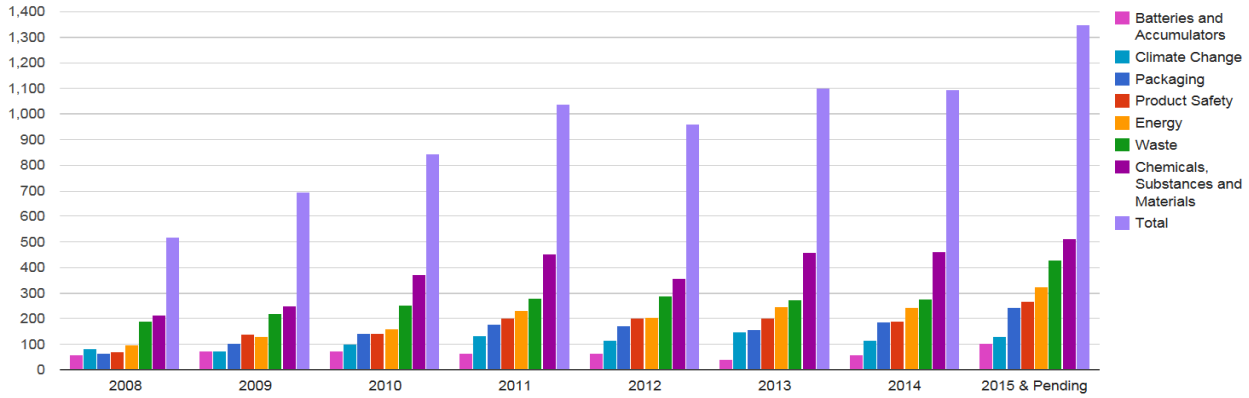


Figure 1: New Regulations - By Topic and Year

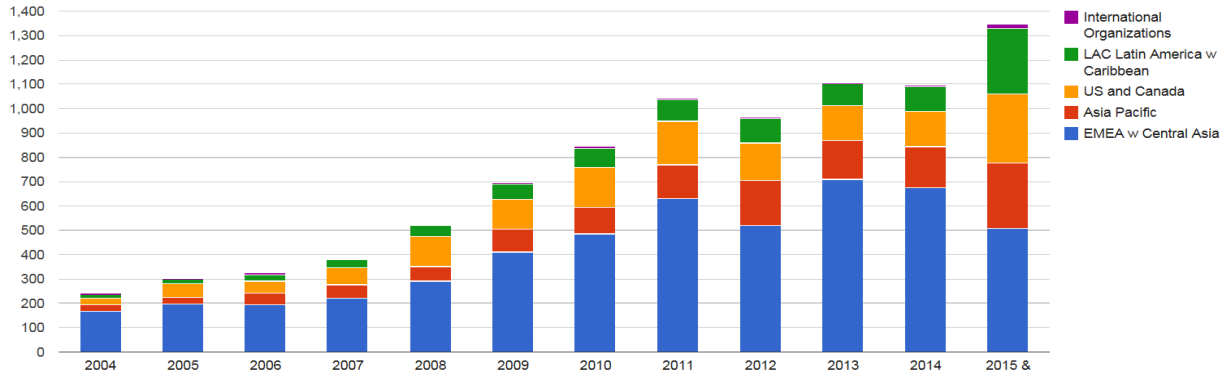


Figure 2: New Regulations -By Region and Year

Outputs from electronics industry manufacturing processes have a potential effect on the land, air, and water. These, in turn, affect the people who rely upon these resources for sustenance. Electronics regulatory requirements vary from one part of the world to another, with U.S. and Canadian regulatory requirements differing from European Union (EU) requirements, which differ from those of the Commonwealth of Independent States, as well as emerging regulations in Asia Pacific, Latin America and beyond.

Companies now realize that the responsibility for accurate compliance rests upon them and their many suppliers. Whatever is produced upstream or downstream which ultimately becomes part of the product makes the manufacturer responsible. To add to this complexity, these regulations continue to grow and change. With new regulations introduced daily and existing regulations revised every few months, electronics manufacturers are continually compelled to rethink the actual substance content in their products.

Discussion of Methodology

Accurately addressing these compliance regulations while protecting intellectual property, data accuracy and public perception, requires a methodological, straightforward and flexible approach. These regulations affect virtually every aspect of business, including product engineering, procurement, manufacturing, shipping and distribution, warranty/repair, and customer service. Therefore, a broad, company-wide understanding of the basics of REACH, RoHS and Conflict Minerals regulations are essential to successful business continuity. Each company should begin by performing the following actions:

1. Understand the regulations and their impact upon the enterprise. Recognize the scope now includes direct suppliers and their suppliers, direct customers and their customers, the product at end-of-life and all the people it may affect.
2. Examine the company's products and operations to determine, and then understand how these specific regulations affect the organization
3. Establish a plan of action, along with the right tools, systems and services needed to support the plan
4. Revisit compliance reporting regularly to ensure the process/methodology is working, and adjust accordingly to ensure ongoing success.

Understanding the Regulations

Each electronics company must work independently to maintain a thorough understanding of each regulation and its impact upon their business, while also considering the importance of industry trade groups, standards organizations, and compliance tools and solutions. This results in a comprehensive regulatory understanding. Regulations often contain wording that may be unclear or open to interpretation. Valuable information can be obtained by understanding how other companies in similar or related industry segments handle compliance ambiguities. In some cases, collaborating with other companies will help maintain a cohesive understanding of regulatory scope or interpretation. Similarly, companies can benefit from understanding how different industries collect or maintain regulatory reporting information. This can help a company as they employ their own solution, often with little or no additional resource effort needed. These resources can introduce awareness of regulatory changes and additions through communication of updates or topics of current interest. Key regulations currently of high interest in the electronics industry are summarized here.

Understanding REACH

The Registration, Evaluation, Authorization, and Restriction of Chemicals regulation (REACH) looks into the production of chemical substances, the materials used, and their effect on human health and the health of the environment. This complex, 850-page piece of legislation went into effect on June 1, 2007, taking seven years to pass throughout the member states of the European Union. With its worldwide consequences, REACH is the strictest law to-date regarding the regulation of chemical substances. REACH seeks to reduce the damage done to both the people and environment by limiting the use of toxic substances. It focuses on open communication among manufacturers, importers, retailers, and customers.

Because of REACH, all companies manufacturing or importing into the European Union in quantities of one metric ton or more year per year must register those substances with the European Chemicals Agency (ECHA). REACH information is organized into Annexes, which identify both the assessment processes and reporting requirements. REACH Annex XVII contains restrictions on manufacturing and selling certain chemicals and articles containing those chemicals for categories of purposes. For example, Entry 23 restricts all use of cadmium, except in electrical contacts, aerospace, safely colorants, and a few other categories where no effective alternative has been identified. REACH Annex XIV contains authorizations for dangerous chemicals or articles containing those chemicals that are permitted only for a specific time. For example, Arsenic acid, used in electronic circuit board manufacture and other areas, is authorized until August 22, 2017. After that date, it will no longer be permitted.

REACH Annex XV describes the process by which a chemical becomes a REACH Substance of Very High Concern (SVHC). SVHCs are chemicals that may be hazardous, and are undergoing review to determine whether addition to the Annex XIV authorization list is appropriate, and what impact authorization would have on industry. SVHCs are not actively banned, so may appear in manufacturer's articles. However, they may soon become banned, so these substances must be identified and reported to clients, so that assessment of impact can be provided and a mitigation plan in the event of addition to the authorization list. The requirements become more restrictive and more companies become subjected to the regulation during the phase-in period. As an example, in 2010, only those manufacturing/importing 1,000 metric tons or more were required to register for REACH. By June 2018, the requirement applies to any company that imports or manufactures just one metric ton. To comply with REACH guidelines, manufacturers must provide information about substances in their products within 45 days of a receipt of consumer request. The lists of restricted, authorized, and SVHC substances continue to grow, as do the reporting requirements, so manufacturers must check carefully and consistently for changes to REACH on the European Chemicals Agency’s website.

A September 2015 ruling by the European Commission (EC) regarding the definition of an "article" subject to REACH compliance regulations dramatically increased the scope of REACH compliance. With this interpretation, the EC provided clarification stating that any item sold is an article subject to the REACH regulation. Further, once something is an article under REACH, it remains an article permanently. As an example, if a company sells a resistor, this makes it an article. Now, any more complex assembly containing one of these resistors is responsible for REACH reporting on that resistor. This interpretation, often called "Once an article, always an article", significantly impacts manufacturers of electronics, and to date has had a disproportionate impact upon the electrical wiring sub-industry, as many of the restricted and authorized substances were common in wiring harnesses and connectors. The once an article clarification has also removed the final barriers to REACH implementation; and companies in certain industry segments now experience REACH enforcement. Those manufacturers or suppliers that do not comply with REACH face penalties that range in severity from censure to unlimited fines or even prison time. Damage to a company’s reputation and globalization roadblocks are other possible consequences of non-compliance.

Understanding RoHS

The Restriction of Hazardous Substances (RoHS) came into effect in July 2006. The goal of RoHS is to reduce hazardous chemicals in electronics products, especially since many of the chemicals restricted by RoHS have been linked to serious ailments and conditions, including cancers. Originally, RoHS was a direct successor of ELV, which had a relatively narrow product scope focused on consumer electronics, and restricted only six dangerous chemicals - lead, mercury, cadmium, hexavalent chromium, and polybrominated biphenyl (PBB) and polybrominated-diphenyl-ether (PBDE) flame-retardants.

RoHS was reauthorized in 2011 as "RoHS 2", which implemented phased-in expanded product scope of the requirements to all electrical and electronic equipment (EEE), cables and spare parts with a view to full compliance by July 22, 2019. Only a few product categories were exempted. RoHS 2 also provided a methodology for the restriction of new substances, and in June 2015, four additional phthalates were added as "Declarable" RoHS substances, and become restricted on July 22, 2019 for all electronics except medical equipment and monitoring and control equipment, where the permitted use is for two additional years. These newly declarable phthalates are primarily used as plasticizers in plastics, particularly in soft PVC. Commonly found in wires and cables, they can also be found on some electronic components. These chemicals have also been added to the list of REACH SVHCs.

RoHS applies to those who export to EU member countries, and manufacturers, retailers, and entities who rebrand electrical and electronic equipment as their own. Retailers who distribute their own brands through direct sourcing are considered the manufacturer of the product and are responsible for ensuring compliance. Under RoHS, chemicals are assigned maximum concentration levels. Manufacturers, importers, and some exporters and retailers must ensure that their products stay below the following concentrations. The RoHS regulated products are tested for their presence, and are calculated by weight at raw homogeneous material levels:

- Lead (Pb) – Commonly used in termination coatings, solders, paints and pigment, PVC stabilizers, and batteries (no more than 0.1%)
- Cadmium (Cd) – Often found in semiconductors, contacts, PVC stabilizers, pigments, batteries, coatings, and solders (less than 0.01%)
- Mercury (Hg) – Often used in batteries, sensors, fluorescent lamps, and relays (100 parts per million (ppm)or less, and not intentionally added)
- Hexavalent chromium (Hex-Cr) – Used in anti-corrosive coatings and in some plastics (less than 0.01%)
- Polybrominated biphenyls (PBB) and Polybrominated diphenyl ethers (PBDE) – Both often used as flame-retardants (no more than 0.1%)

Regulations similar to RoHS exist in regions other than the EU. In Southeast Asia, Japan enacted a broad-scoped version of RoHS in April 2001, and China and South Korea began enforcement of RoHS type regulations with focus on the same substances as EU RoHS 2 but with a narrower product scope in March and April, 2007. In central Asia, India and the Russian Federation, Kazakhstan and Belarus have all introduced RoHS-like regulations, although enforcement has been inconsistent. In the U.S., there is no current national law, yet California has its own RoHS laws, As of January 1, 2007, the California Department of Toxic Substance Control (DTSC) adopted regulations prohibiting electronic devices containing EU RoHS heavy metals from being sold or offered for sale in California.

Understanding Conflict Minerals

As of August 2012, the Conflict Minerals Act, more properly known as section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act, requires publicly traded U.S. companies to file an annual report with the U.S. Securities and Exchange Commission (SEC). disclosing the origins of the Tin, Tungsten, Tantalum, and Gold (3TG) in their products. To obtain this information, these companies must solicit information and perform extensive due diligence on the origins of these metals from throughout their supply chains, down to the mines from which the ores used to produce these metals originated. This effectively involves the majority of global companies that produce product containing these materials. Because of a legal definition in the Conflict Minerals Act that creates confusion among many, "Conflict Minerals" are all derivatives of tin, tantalum, tungsten and gold (3TG) ores, regardless of the source.

Unlike RoHS and REACH, Conflict Minerals is not an environmental regulation, but a social responsibility concern.

In the years immediately prior to 2012, large electronics manufacturers became aware that the purchase of 3TG from mining operations in the eastern Democratic Republic of Congo and surrounding countries was funding extreme violence and genocide. Armed militias were attacking the residents of small mining communities and stealing the output from their mines.

The stolen ores then passed through a variety of intermediaries before being refined into the 3TG metals, which then were purchased by multinational electronics companies and others, thus helping to fund the armed militias. While the African Great Lakes region where this violence was occurring is not a majority world producer of these minerals, the production in the region is significant. To address this humanitarian crisis, US-listed corporations, foreign companies and private companies which supply to publicly listed U.S. corporations must now disclose mineral use if "necessary to the functionality or production of a product" they manufacture. This annual US disclosure rule does not forbid corporations from using Conflict Minerals, and uncertainty exists regarding the sanctions that will apply for corporations that fail to comply.

Initially, the effectiveness of the Conflict Minerals Act in reducing violence in the DRC and surrounding countries was questionable at best. Confusion regarding the Act, its enforcement, and general lack of information regarding world smelters led to an embargo upon the region by many companies, unintentionally creating worse living conditions for many of the regions inhabitants than the conditions prior to the regulation. However, recent reports suggest that the legislation has begun to have beneficial effects. There is now a two-tier pricing structure for 3TG in the region: a reduced value for minerals without clearly legitimate sourcing that is reducing the capability of the armed militias to wage violence, and a premium value for minerals with valid traceability. The need for accurate records has also created a new recognition of the value of education in the region, which is an unexpected benefit being lauded by the region's leadership as potentially more beneficial than the immediate benefits. The most recent difficulties to the Conflict Minerals legislation relate to the funding of the agencies involved in documenting the traceability of legitimate minerals. The low-technology level of many of the artisanal mines in the region mandates labor-intensive methods of validating legitimate mineral distribution, and the organization that performs this validation is currently operating without a clear source of funding for continued operations.

The electronics industry is especially active in Conflict Minerals reporting. Gold is the best room-temperature electrical conductor, and so a small but significant amount of the world's annual gold production is used in electronics. Tin, tungsten, and tantalum are heavily used in electronics. Tin is used in virtually all solder, tantalum in most capacitors, high-power resistors, and low-corrosion alloys, and tungsten is essential in high-temperature electronic components. Many of the initial efforts to find ways to address the conflict minerals legislation were conducted by a joint effort of the Electronics Industry Citizenship Coalition (EICC) and Global e-Sustainability Initiative (GeSI). In 2008, this collaboration resulted in a new organization, the Conflict Free Smelter Initiative (CFSI), an organization with electronics companies at its core but permitting members from any company that uses or transacts in 3TG in any industry. The CFSI leads in developing the broadest range of tools and resources to support responsible mineral sourcing. Both the electronics and automotive industries have the most companies in good standing in reporting conflict minerals. The automotive industry's success is largely based upon their experience with ELV, and their "head start" in identifying the supply chains for conflict minerals.

China recently enacted a similar legislation, and the European Commission is currently conducting their third review on an initiative for responsible sourcing of minerals originating from conflict-affected and high-risk areas. The European legislative initiative will likely be more far-reaching than the US law, and recognizes that conflict minerals are also sourced from other areas than the DR Congo. For example, tungsten is mined illegally by the terrorist organization Fuerzas Armadas Revolucionarias de Colombia (FARC) and supplied to some of the world's leading multinationals. China has proposed similar legislation.

Understanding other regulatory requirements

While understanding these three regulations is essential, it is just the beginning. Other material regulations affecting electronics include those on batteries, biocides, the Waste Electrical and Electronic Equipment Directive (WEEE) and carbon emissions. When designing a compliance program, these efforts and the associated tools and programs must be capable of addressing multiple regulations. At a minimum, programs and tools must support efficient and open communication, to reduce inefficiencies related to the repetition of collecting similar information, and to permit "cross-checking" of related information from the same or different sources.

Examine The Company's Products and Operations

To understand the company's responsibility and involvement in material compliance reporting, one must realize that the product content goes well beyond the company. It extends deep into the supply chain, to every supplier that contributes to the creation of the end product(s). Manufacturers often discover that seemingly simple products are more complex than they realize, with the composition containing substances that were not previously identified or anticipated. Figure 3 displays an example of a relatively simple product assembly that contains only four subassemblies. When collapsed, it appears to have a simple supply chain, composition and structure. But this is not the case. Table 1 in the Data section shows that this seemingly simple item contains 60 chemicals in 30 different materials and assemblies, potentially produced by up to 4 tier one, 13 tier two, and 12 tier three suppliers.

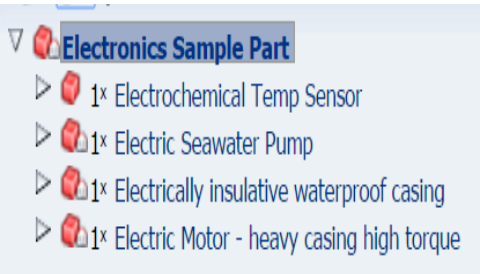


Figure 3: Sample Item, collapsed view

The unanticipated complexity of a product may or may not cause other challenges. The additional layers of complexity sometimes mask declarable or reportable substances of which suppliers are often unaware. Companies may initially rely upon declarations from suppliers that regulated substances are not present in their products. The IPC 1752A data exchange standard, maintained by the IPC 2-18B Committee, provides capabilities for exchanging this type of declaration - known as a "Class C" declaration. While this declaration can be a good starting point, Class C declarations often lack substance. Supplier companies often believe that their suppliers would proactively make them aware of regulated substances without being prompted. Suppliers often provide a declaration of compliance in good faith, believing that regulated substances are not present in a particular item. Sometimes there are people within the supplier organization who know a product's substance contents, but are not contacted to address a customer request for a supplier declaration of conformance (SDoC). This is especially true of medium-sized suppliers, which are often not large enough to have an IT infrastructure to make such information widely available, yet are big enough that the customer relationship personnel receiving the requests do not know how to locate the people who could respond properly.

Unless and until a supplier is compelled to report everything present in the product, they will often fail to learn the true content of the product from material engineers and/or sub-suppliers. An example of this type of expanded disclosure is provided in Figure 4, which is commonly called a Full Material Disclosure (FMD). In the electronics industry, it is also known as a 1752A Class D declaration, which is the data exchange type that supports this category of reporting. An FMD provides the added benefit of providing a measure of "future-proofing" against new or changed regulations by reporting all substances, not just those currently regulated. A sample of a product with the information necessary to outline an FMD is shown in Figure 4, on the next page. The item in Figure 4 deliberately makes use of an item that is not compliant with REACH or RoHS to illustrate how a FMD brings into a company's awareness of substances that could incur liability that can be masked in a Class C declaration. . In Figure 3, the lack of detailed composition information would provide the recipient no method to determine whether the supplier reported accurately. In Figure 4, the detailed composition information permits the recipient to identify that the "Electrically Insulative waterproof casing" is REACH reportable, and assuming this part is "In Scope" for RoHS, the use of lead chromate would be prohibited for both lead content and hexavalent chromium content unless this application is subject to an exemption.

From a lessons-learned perspective, the automotive industry discovered the unreliability of a declaration that consists only of what is not present in a product. This was especially true in the early days of ELV reporting, when suppliers could submit the equivalent of a Class C declaration. Data quality in the automotive industry in the early days of ELV reporting left great room for improvement, with many declarations containing unreported regulated substances, often through supplier ignorance as to what was included in their products by their suppliers. In the intervening years, strict adherence to requirements for FMD, improvements in data quality rules coupled with annual six-sigma quality improvement projects, mandatory recipient review and approval or rejection of supplier submissions, and client-driven refinements to the data quality validation rules have resulted in substantial improvement in automotive regulatory data quality. Efforts continue to improve automotive regulatory compliance data quality further, yet evidence indicates that increased detail in reporting, continuous improvement using six sigma methodologies, and refined data validation rules result in substantial data quality improvement.

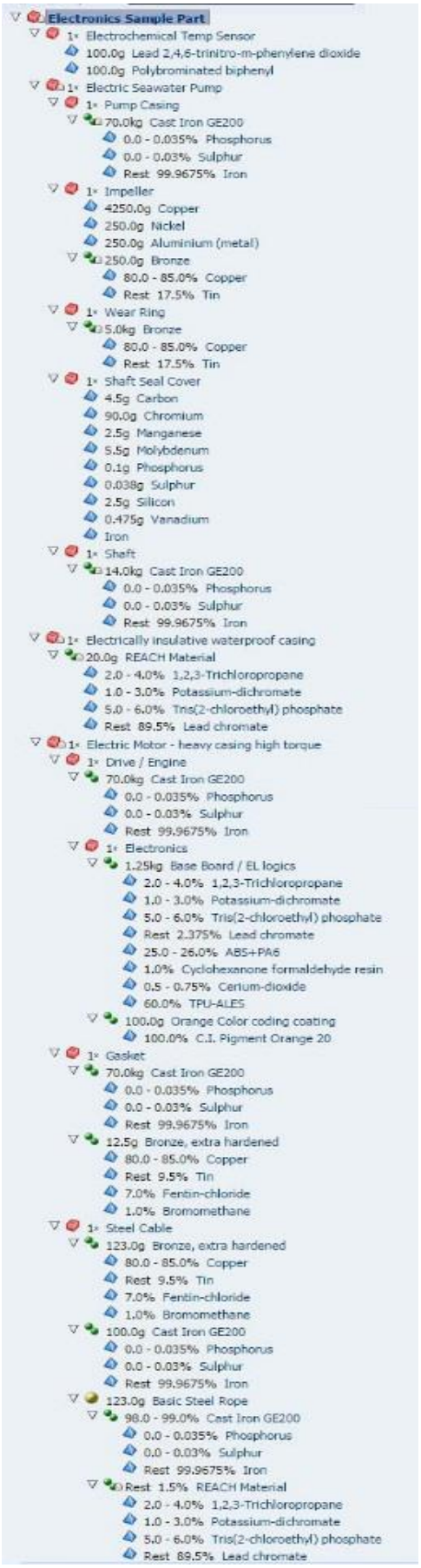


Figure 4: Sample Item, expanded view

Even when suppliers provide full material disclosures, they are often reluctant to disclose confidential or proprietary substances for fear of losing intellectual property. Clients typically allow for a small measure of unreported confidential substances. They only require that suppliers certify that the unreported substances are not regulated at the time of submission.

As with Class C declarations, Class D declarations must be updated when the material composition is changed. This makes version control and revision date tracking essential for a successful compliance program. This can cause problems as a part number change or revision has classically been assigned when the product changes in form, fit, or function, and a chemistry change may not generate these changes.

Some companies find the most effective way to address this problem is to modify their definition of a part number change or revision to include changes in form, fit, function or formulation. However, since this is not a universal change, it is often difficult for the company to explain to its supply chain that is not comprehensively aware of the needs of modern material compliance reporting. As with many such activities, active education, training, and communication are essential to effective management of this issue.

The Need to Establish a Plan of Action

To gain a solid understanding of the material compliance landscape, a layered, ongoing process approach is essential. Electronics companies are subject to a heavier burden in regards to material compliance regulations than most industries. An enterprise view is essential. It should include not only the entire supply chain, and the customers, but also those potentially impacted by the products during usage and after the product end-of-life. Gather in-depth knowledge of what is in the product, all the way down to the substance level. New regulations, and the changes to existing ones, further complicate corporate responsibility obligations. These rapid revisions also make constant change tracking essential. These broad and far-reaching changes may require a paradigm shift, as companies should expect a continuous improvement process of ever-evolving compliance, rather than a one-time project to fulfill regulatory compliance.

In many ways, the exercise to adopt to these new regulations is similar to the changes that occurred with the advent of enterprise resource planning (ERP) over the last few decades. ERP challenged companies to start thinking of their business departments and immediate suppliers as the greater whole, instead of separate operations. Similarly, regulatory material compliance challenges companies to think of the "Enterprise" as one that encompasses the entire product lifecycle, both upstream and downstream. As with ERP implementation, the transition to regulatory compliance reporting requires companies tackle integration efforts incrementally. The shift to ERP required new tools to manage information on a much broader scale; regulatory material compliance requires the same. Many of today's ERP and product lifecycle management (PLM) tools have added new capabilities to support compliance requirements. While these tools are helpful and in some cases can address the needs of regulatory compliance, they lack maturity, and do not address the intellectual property protections and supply chain identity disclosures of which suppliers remain wary. This protection is difficult to guarantee when reporting to client-owned, in-house systems. Companies, especially large ones, benefit from integration with in-house systems to provide a common repository for product data and in-depth analysis capabilities. However, this is secondary to establishing the necessary and effective supply chain communication to collect the required product material information.

When selecting a reporting platform, tool or service, recognize that material compliance rules change quickly, and require information beyond what is typically available to immediate suppliers. Growing supply chain complexity, as well as an increasing number of legal requirements, necessitates the need for a standardized approach to material data collection and analysis. Regulatory compliance is not an ideal environment for developing a custom, in-house IT solution, as the rapid flux in requirements necessitates constant enhancements and maintenance, generally making a self-developed, maintained and operated solution prohibitively expensive for large companies.

In some instances, a self-developed solution may be suitable. In companies with products that are known to contain few regulated substances, or relatively narrow product variety, or limited regional product distribution and shallow or local supply chains, a self-developed solution can be appropriate. Another occasion when a self-developed solution may be appropriate is when an organizations needs are unique, and cannot be addressed by a Commercial-off-the-shelf (Cots) solution. A self-developed solution can and in most cases must be dynamic to accommodate the rapidly changing regulatory landscape. The organization must be staffed or make use of reliable resources to remain current with applicable regulations. This will prevent the organization from having full control of the development timeline, as the solution must be capable of reporting on regulatory changes according to regulatory due dates, which can adversely impact development costs. Perhaps most importantly, even though the solution must be dynamic, adherence to industry standards such as the IPC-1752A for data reporting is critical, as the enterprise does not consist only of the company, but of the suppliers and customers as well. If data exchange standards are not consistent, external partners will be unable to satisfy disparate data requests from their multiple partners, and the solution will not be effective.

If an assessment determines that a self-developed solution is not appropriate for the organization, there are a rapidly growing number of commercial regulatory compliance solutions available. Cots solutions are typically less aligned with existing company procedures than custom solutions, yet this drawback is sometimes offset by obtaining optimized solutions without a costly learning curve. Many Cots and Software-as-a-Service (SaaS) solutions permit configuration to more closely meet the requirements of a specific client, yet true customization can be prohibitively expensive, time consuming, and in some cases can render the customized solution unable to accept new revisions or regulations without further customization.

The rapid change in solution scope, the capability for adding new regulatory topics dynamically, and the broad reach needed to include the supply chain makes regulatory compliance an ideal environment for cloud-based software-as-a-service solutions. If possible, ensure the tools selected are adequately mature, provided by reputable suppliers, and include appropriate safeguards to protect the product and supply chain information. Electronics companies must be able to collect and analyze material and substance data from suppliers at various supply chain depths. The chosen solution should gather information securely and accurately from the actual material manufacturers used, which should be propagated up the supply chain. In addition, it is important to understand the options and capabilities to retain access to your data and migrate the data when changing solutions before selecting a solution. This is much easier to address during tool selection than afterwards, and is a critical factor should it become necessary to change providers.

Regulatory material compliance requires excellent lines of communication with suppliers and customers. Collaborate with others in the same or similar industries can provide valuable information on how others are addressing the same topics. Active participation in standards groups such as IPC offer essential resources to more effective solutions. Other standards organizations, industry groups and/or advocacy organizations, such as the Electronics Industry Citizenship Coalition (EICC), and the Conflict-Free Sourcing Initiative (CFSI) include members that are well educated and often eager to provide lessons learned. These groups provide many different tools: EICC offers regulatory compliance audits that rapidly identify areas of concern, and the CFSI offers the Conflict-Free Smelter Program, the Conflict Minerals Reporting Template, Reasonable Country of Origin Inquiry data and a range of guidance documents on conflict minerals sourcing. The CFSI also hosts regular workshops on conflict minerals issues, contributes to policy development, and participates in leading civil society organizations and governments. For Conflict Minerals, existing global guidelines from the OECD and the United Nations provide practical guidance on how to identify the source of conflict minerals in the supply chains.

Other resources include laboratories that offer RoHS compliance testing. The laboratory services can test products and packaging for trace amounts of restricted chemicals and can even provide details on the exact concentration of each chemical present. Laboratories offering these services use a number of RoHS-compatible test methods. Portable RoHS analyzers, also known as XRF metal analyzers, can be used as field testers to uncover trace amounts of some of the restricted chemicals. Once a manufacturer or importer has their product and packaging analyzed by a laboratory service, they can prove that a specific batch of products is RoHS compliant. While this is not generally the best approach for all compliance activities, it is a valuable validation tool when used in conjunction with supplier reporting.

Revisit Compliance Reporting Effectiveness Regularly

Regulatory material compliance reporting is an ideal environment for continuous improvement using a methodology such as six sigma. The compliance regulations are not static, but continue to evolve. When first established the reporting process may be perfectly suited to the requirements at that time. However, as the regulations change, so must the process, and incremental improvement via regular, periodic course corrections and refinement are more effective and more easily adjusted than larger, less frequent revision. Table 2 in the Data section shows regulatory material compliance activities during just one representative week, March 24-31, 2014 when 80 actions regarding regulatory material compliance were taken in various jurisdictions. The week shows a typical example week that was not abnormally active or slow. It simply illustrates the fluid nature of this topic.

Data

Table 1: Supplier Count for Sample Electronics Component in Figure 2, Figure 3

Sub-assembly or Material	Chemical	Tier 1	Tier 2	Tier 3	Total
Electrochemical Temp Sensor		1			0
	1				1
	1				0
Electric Seawater Pump		1			0
Pump Casing			1		1
Cast Iron GE200			1		1
	1				1
	1				0
	1				0
Impeller			1		0
	1				1
	1				0
	1				0
Bronze	1			1	0
	1				1
	1				0
Wear Ring			1		0
Bronze				1	1
	1				1
	1				0
Shaft Seal Cover			1		0
	1				1
	1				0
	1				0
	1				0
	1				0
	1				0
	1				0
	1				0
Shaft			1		0
Cast Iron GE200				1	1
	1				1
	1				0
	1				0
Electrically insulative waterproof casing		1			0
REACH Material			1		1
	1				1
	1				0
	1				0
	1				0
Electric Motor		1			0
Drive / Engine			1		1
Cast Iron GE200				1	1
	1				1
	1				0
	1				0
Electronics			1		0
Base Board / EL logics				1	1
	1				1
	1				0
	1				0

Sub-assembly or Material	Chemical	Tier 1	Tier 2	Tier 3	Total
	1				0
	1				0
	1				0
	1				0
Orange color coding coating	1			1	0
					1
			1		0
Gasket				1	1
Cast Iron	1				1
	1			1	0
	1				1
Bronze, Extra hardened			1		0
	1				1
	1				0
	1				0
	1				0
Steel Cable			1		0
Bronze				1	1
	1				1
	1				0
	1				0
	1				0
Cast Iron GE200				1	0
	1				1
	1				0
	1				0
Basic Steel Rope			1		0
Cast Iron GE200				1	1
	1				1
	1				0
	1				0
REACH Material				1	0
	1				1
	1				0
	1				0
	1				0
Subtotal Supplied by tier	60	4	13	12	0
Total Supplied Overall					29

Table 2: Regulatory material compliance actions during week of 2014 March 24-31

Date	Action	Region: Name	Focus Area
24-Mar-14	Approved	USA: Mandatory Safety Standards for Infant Seats, Cribs, etc.	Materials
26-Mar-14	Proposed	Montenegro: Chemicals Law, March 2012	Materials
26-Mar-14	Supporting	EU: Safety of the Use of Bisphenol A in Medical Devices	Materials
26-Mar-14	Proposed	Cameroon: Waste Collection, Recycling, Reuse, Storage, Transport & Treatment	Waste/WEEE
28-Mar-14	Proposed	Switzerland: Reducing Carbon Emissions	Air Quality
29-Mar-14	Proposed	Mexico: Safety Specifications for Electrical Products, Standard	Materials
30-Mar-14	Approved	UAE: Technical Regulation Scheme for Drinking Water	Waste/WEEE
30-Mar-14	Proposed	Latvia: Electrical and Electronic Equipment Waste Management	Waste/WEEE
30-Mar-14	Proposed	Turkey: Environmentally Sound Management of Hazardous Waste	Waste/WEEE
31-Mar-14	Proposed	Croatia: Air Protection Act	Air Quality
31-Mar-14	Supporting	Hawaii: Covered Electronic Device (CED)	Materials
31-Mar-14	Proposed	Germany: Authorization for Graphite	Materials

Date	Action	Region: Name	Focus Area
31-Mar-14	Proposed	Germany: Authorization for Computers and Related Equipment	Materials
31-Mar-14	Supporting	EU: Call for Information on In-situ Generated Biocidal Active Substances	Materials
31-Mar-14	Proposed	South Korea: Registration & Assessment of Chemical Substances Enforcement	Materials
31-Mar-14	Approved	South Korea: Registration & Assessment of Chemical Substances Rules	Materials
31-Mar-14	Proposed	Germany: Management of Waste Electrical and Electronic Equipment (WEEE)	Waste/WEEE
31-Mar-14	Approved	Hawaii: Electronic Waste Recycling Act	Waste/WEEE
31-Mar-14	Proposed	Sweden: Producer Responsibility for Batteries Ordinance	Materials
31-Mar-14	Proposed	Switzerland: Reduction of Risks Linked to Use of Dangerous Substances	Materials
31-Mar-14	Proposed	USA: Mandatory Greenhouse Gas Reporting	Air Quality
31-Mar-14	Proposed	Spain: Hazardous Waste Regulation	Waste/WEEE
31-Mar-14	Proposed	Colombia: Collection and Management of Waste Batteries and Accumulators	Waste/WEEE
31-Mar-14	Proposed	Denmark: Batteries and Accumulators and Waste Batteries and Accumulators	Waste/WEEE
31-Mar-14	Proposed	Denmark: Batteries and Accumulators and Waste Batteries and Accumulators	Waste/WEEE
31-Mar-14	Proposed	Nova Scotia (Ca): Greenhouse Gas Emissions Regulations	Air Quality
31-Mar-14	Proposed	Macedonia: Management of Batteries and Accumulators Law	Materials
31-Mar-14	Proposed	Colombia: Establishing a System for Collection & Management of Waste Lamps	Waste/WEEE
31-Mar-14	Proposed	Czech Republic: Details on Waste Management	Waste/WEEE
31-Mar-14	Proposed	Macedonia: Waste Management Law	Waste/WEEE
31-Mar-14	Proposed	Nigeria: National Environmental (Electrical and Electronic Sector)	Materials
31-Mar-14	Proposed	Nigeria: National Environmental (Metals Manufacturing/Recycling Industry)	Materials
31-Mar-14	Proposed	British Columbia: Greenhouse Gas Reporting Regulation	Air Quality
31-Mar-14	Proposed	Serbia: Fees and Reporting Requirements for Products Generating Special Waste	Waste/WEEE
31-Mar-14	Proposed	Bosnia/Herzegovina: Conditions of Licenses for Waste Management	Waste/WEEE
31-Mar-14	Proposed	Luxembourg: Management of End of Life Vehicles	Materials
31-Mar-14	Proposed	Italy: Greenhouse Gas Emission Allowance Trading	Air Quality
31-Mar-14	Proposed	Czech Republic: Ozone Depleting Substances and Fluorinated Greenhouse Gases	Air Quality
31-Mar-14	Proposed	Shanghai: Regulations on Prevention of Pollution from Medical Waste	Waste/WEEE
31-Mar-14	Proposed	Italy: Implementation of Batteries Recycle/Reuse	Waste/WEEE
31-Mar-14	Proposed	Slovakia: WEEE Management and RoHS Exemptions	Waste/WEEE
31-Mar-14	Proposed	Finland: Greenhouse Gas Emissions Trading	Air Quality
31-Mar-14	Proposed	Germany: Greenhouse Gas Emissions Allowance Trading Act	Air Quality
31-Mar-14	Proposed	Macedonia: Chemicals Law	Materials
31-Mar-14	Proposed	France: Stationary Fire Protection Systems Fluorinated Greenhouse Gases	Materials
31-Mar-14	Proposed	France: Recovering Fluorinated Greenhouse Gas-Based Solvents	Materials
31-Mar-14	Proposed	France: Recovering Certain Fluorinated Gases from High Voltage Switchgear	Materials
31-Mar-14	Proposed	Ireland: Greenhouse Gas Emissions Trading Aviation	Air Quality
31-Mar-14	Proposed	Andorra: Approving Regulation on Hazardous Waste Management, Decree	Waste/WEEE
31-Mar-14	Proposed	France: Certified Organizations & Personnel re: Fluorinated Greenhouse Gases	Materials
31-Mar-14	Proposed	EU/EEA: Monitoring and Reporting of Greenhouse Gas Emissions	Air Quality
31-Mar-14	Proposed	Kosovo: Waste Law	Waste/WEEE
31-Mar-14	Proposed	Luxembourg: Waste Management Law	Waste/WEEE
31-Mar-14	Proposed	Montenegro: Chemicals Law	Materials
31-Mar-14	Proposed	UK: Greenhouse Gas Emissions Trading Scheme Regulations	Air Quality
31-Mar-14	Proposed	Slovenia: Waste Decree	Waste/WEEE
31-Mar-14	Proposed	Switzerland: Reducing Carbon Emissions	Air Quality
31-Mar-14	Proposed	Wallonia: Hazardous Waste Management	Waste/WEEE
31-Mar-14	Proposed	Liechtenstein: Emissions Trading	Air Quality
31-Mar-14	Proposed	Denmark: CO2 Allowances	Air Quality
31-Mar-14	Proposed	EU/EEA: Quality of Petrol and Diesel Fuels / biofuels	Materials
31-Mar-14	Proposed	Croatia: Air Protection Act	Air Quality
31-Mar-14	Proposed	EU/EEA: Fluorinated Greenhouse Gases	Air Quality
31-Mar-14	Proposed	Liechtenstein: Emissions Trading Act	Air Quality
31-Mar-14	Proposed	EU/EEA: Establishing a Registry of Greenhouse Gas Emissions	Air Quality
31-Mar-14	Proposed	Hawaii: Electronic Waste Recycling	Waste/WEEE

Date	Action	Region: Name	Focus Area
31-Mar-14	Proposed	China (Mainland): Provisions on Import and Export of Precursor Chemicals	Materials
31-Mar-14	Proposed	Bulgaria: Ordinance on Waste Batteries and Accumulators	Waste/WEEE
31-Mar-14	Proposed	Montenegro: Management of Waste Batteries and Accumulators	Waste/WEEE
31-Mar-14	Proposed	Slovakia: Greenhouse Gas Emission Allowance Trading	Air Quality
31-Mar-14	Proposed	Belgium: Market Placement of Substances Manufactured at the Nanoscale	Nanomat'ls
31-Mar-14	Proposed	Canada: Precursor Materials Control Regulations	Materials
31-Mar-14	Proposed	Canada: Perfluorooctane Sulfonate and its Salts and Certain Other Compounds	Materials
31-Mar-14	Proposed	Iceland: Monitoring and Reporting of Greenhouse Gas Emissions	Air Quality
31-Mar-14	Proposed	Ireland: Pollutant Release and Transfer Register Regulations	Air Quality
31-Mar-14	Proposed	Malaysia: Hazardous Chemical Classification, Labelling & Safety Data Sheets	Materials
31-Mar-14	Proposed	Hungary: Greenhouse Gas Emission Trading Scheme	Air Quality
31-Mar-14	Proposed	Norway: Product Regulation on sustainability for biofuels and bioliquids	Materials
31-Mar-14	Proposed	Malta: Greenhouse Gas Emissions Trading Scheme for Stationary Installations	Air Quality
31-Mar-14	Proposed	Denmark: Waste Electrical and Electronic Equipment (WEEE)	Waste/WEEE

Results

As with any new, complex endeavor within an organization, it takes time to determine the success of the regulatory material compliance program. Expected key performance measurements include meeting required reporting deadlines and content with accurate submissions and expected levels of supply chain involvement. However, other key metrics may not be as obvious, yet can be equally critical. Examples include having the company's employees well educated and comfortable with the reporting process, establishing lines of communication with the supply chain, and understanding the end-of-life considerations for the company products. It is important that regulatory material compliance be viewed as an activity that provides benefits to the company. Definite advantages exist to identify the materials that comprise the company products, such as more opportunity to create products that are smaller, less expensive and/or provide better performance.

Conclusions

Electronics manufacturers are responding to new and growing material compliance regulations. The scope is beyond the company itself, and includes their supply chains, and their customers. Environmental considerations make it possible that virtually everyone can be a potential stakeholder. Supply chains are now, more than ever, a key part of successful compliance reporting. A broader view of the enterprise is critical to understanding product content and sources. In working with industry groups, often competitors may become key allies in successfully navigating these challenges.

Regulatory compliance reporting expectations are high, and the breadth and depth of tasks involved are significant, especially in electronics. An incremental, methodology-based approach is the optimum strategy. Metrics for compliance success are established, and there is no benefit to delay in implementation. Continuous improvement is essential to achieving future reporting that is more accurate and timely. REACH, RoHS and Conflict Minerals require current action, as do other regulation requirements to which the entity is subjected. Products and operations should be examined to understand how specific regulations will affect the business. An appropriate methodology to identify the right tools, services and associations is recommended. Finally, compliance reporting methodologies and tools must be reviewed periodically to ensure the process remains optimized, and should be adjusted accordingly to ensure ongoing success.

Successful Material Compliance Reporting Strategies for the Electronics Industry

Chuck LePard

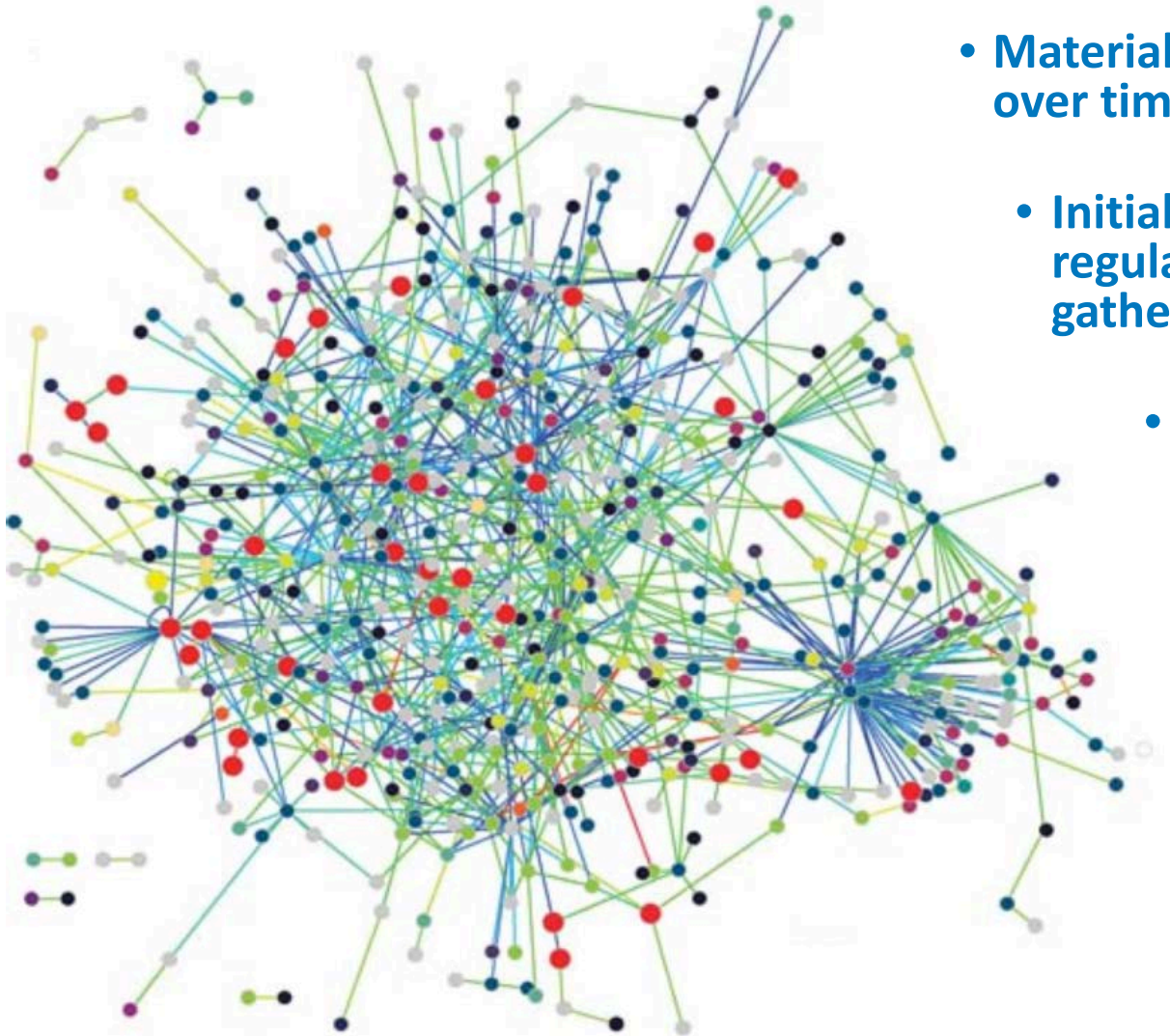
Hewlett Packard Enterprise

Abstract

“Growing material compliance regulations compel electronics manufacturers to rethink product compliance. Can a company state with confidence every substance in the final product has been identified, and from where each item was sourced, by all direct and indirect suppliers? Consider the impact of the REACH, RoHS and Conflict Minerals regulations on the electronics industry.

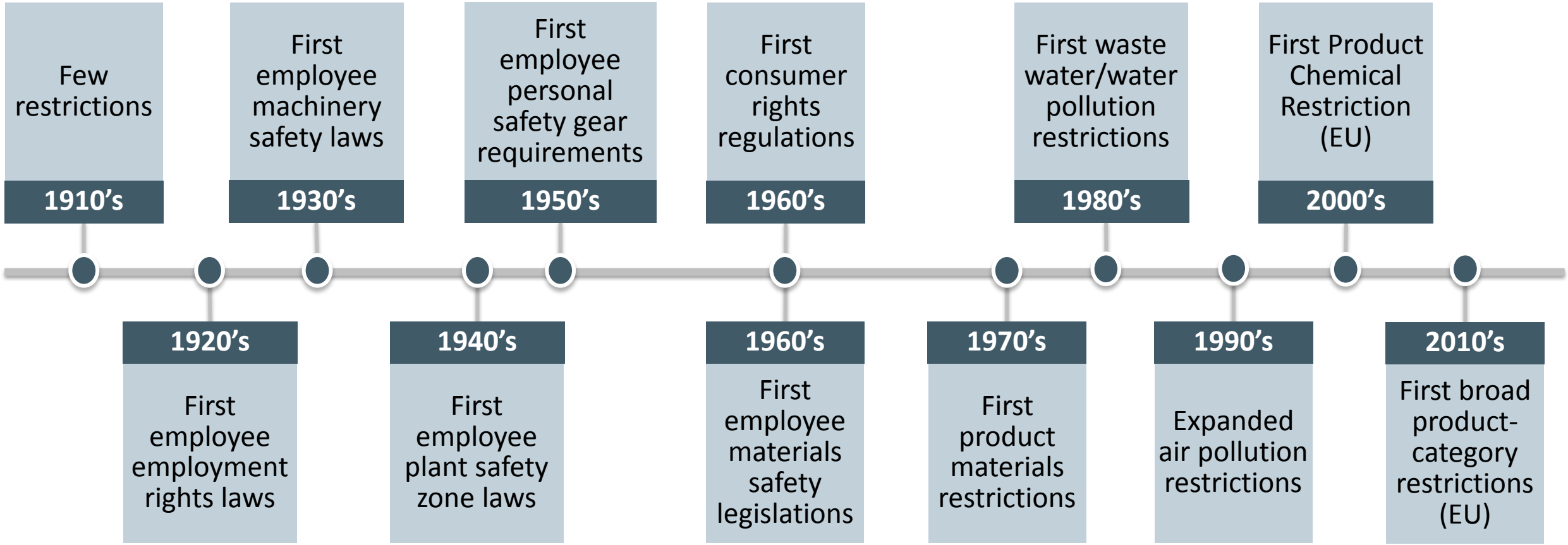
Companies must explore the greater complexity that spans the entire supply chain, including direct and indirect suppliers. As an article producer, each company is ultimately responsible for everything contained in the product. Simultaneously, companies must respect intellectual property, data accuracy and public perception, all within the changing compliance landscape.”

Introduction



- Material regulation scopes have expanded significantly over time, especially in the last decade
  - Initially, the drivers behind material compliance regulations were simple and straightforward, yet gathering product compliance information is not
    - Suppliers become frustrated providing similar data to multiple clients in different formats
      - Globally, the automotive industry banded together to standardize material reporting
        - Now the electronics industry faces similar challenges, especially in data exchange

U.S. Regulatory Compliance Timeline



Material regulation scopes have expanded significantly over time, especially in the last decade

Gathering Compliance Product Knowledge is a Complex Task

- Traditional methods of gathering product data from Tier-1 & Tier-2 suppliers do not yield regulatory material compliance results
- Tier 1 and Tier 2 suppliers must drill down to lower tiers to obtain the required product material composition information
- Spreadsheets and local company data bases required repeated efforts for each client
- Lack of data exchange standards resulted in inconsistent information that was not reusable

Suppliers Felt Pressure and Frustration

- They were receiving the same requests from numerous companies
- The format for these requests were often disjointed and dissimilar
- Suppliers received multiple data requests simultaneously for similar data, creating unleveled resource peak loads
- Request communication was often incomplete, creating uncertainty about what data was needed

Automotive Industry Banded Together to Address Material Reporting

- Six automotive companies realized they were all being asked to provide similar information
- They contracted with an IT solutions provider to create a system to solve their reporting issues
- The result was a successful, cloud-based international material data system
- Data quality has improved through annual continuous improvement
- Now used by over 90% of suppliers
- More than 250,000 suppliers have provided over 50 million declarations over fifteen years of operation
- China is implementing separate operations, creating challenges for global suppliers

Now the Electronics Industry Faces Similar Challenges

- New and rapidly changing existing regulations
- Reporting requirements differ based on region
- Requirement for supply chain reporting
- Inconsistent data request mechanisms
- High level of manual effort with peak loads
- Competing, parallel reporting standards
- Inconsistent data collection implementations
- Realization that electronics industry output has potential environment product end-of-life impact

Discussion of Methodology

A methodological, straightforward and flexible approach will help the electronics industry accurately address material compliance reporting

1. Understand REACH, RoHS, Conflict Minerals, and other rules and the impact on your enterprise
2. Examine and understand your company's products and operations
3. Establish a plan of action, with right tools, systems and services
4. Revisit compliance reporting regularly to continuously improve

Understanding REACH

Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

- Described as “the most complex legislation in EU history”, this 849 page regulation took 7 years to pass.
- Phased implementation based on tons of chemical manufactured or imported. ‘10: 1000 ton. ‘13: 100 ton. ‘18: 1 ton.
- New “Substances of Very High Concern” (SVHCs) added every 1-2 years, with global impact and 168 SVHCs as of July 2015
- A September 2015 ruling on REACH “articles” triggered active enforcement

Understanding RoHS

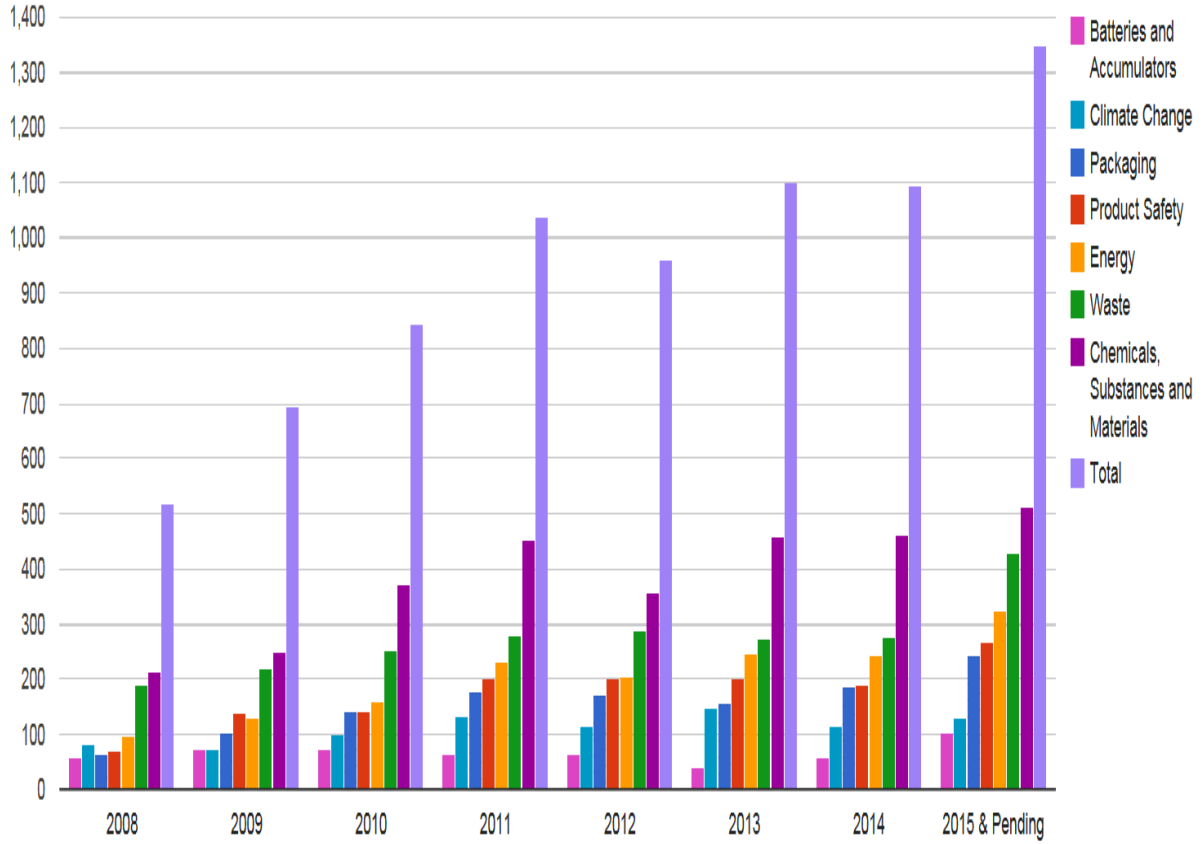
The Restriction of Hazardous Substances (RoHS)

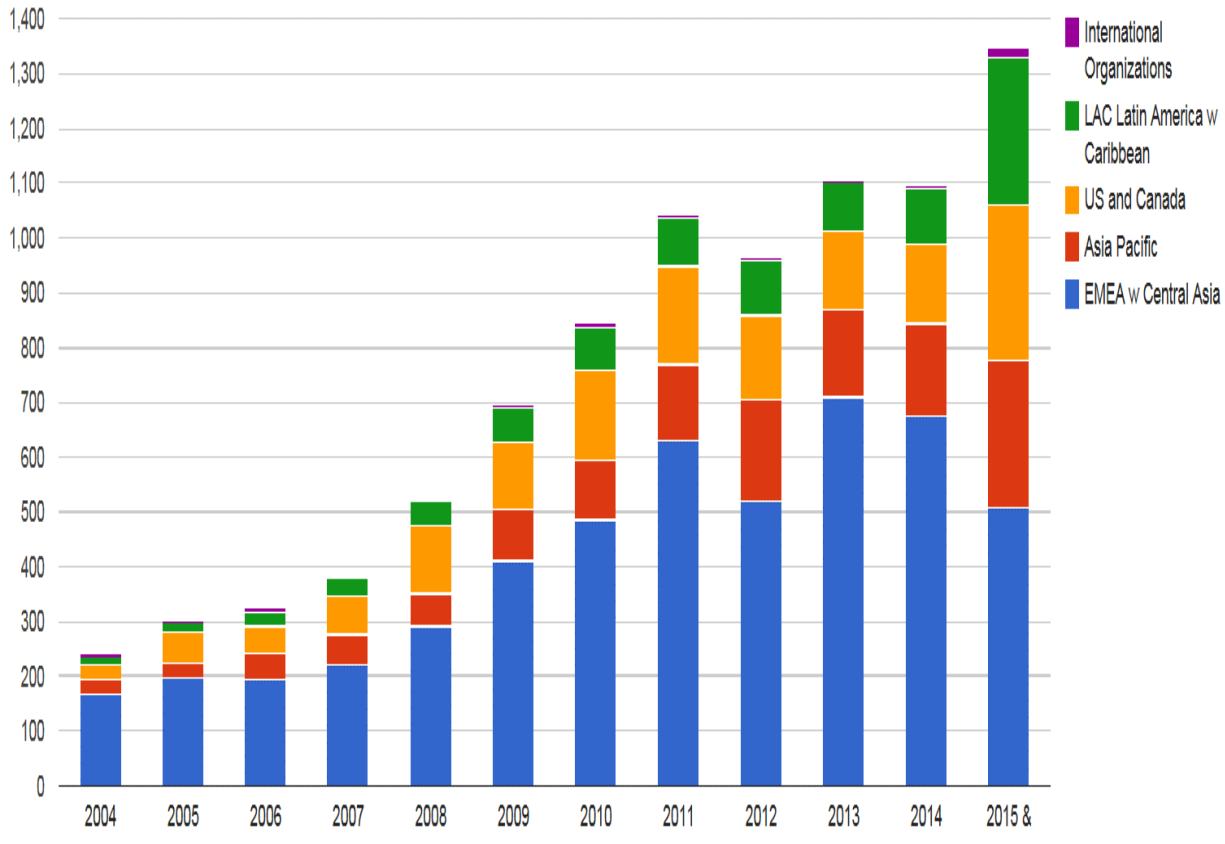
Pb Lead	Hg Mercury	Cd Cadmium	DEHP Phthalate	BBP Phthalate
Cr^{VI} Hexavalent Chromium	PBB Polybrominated Biphenyls	PBDE Polybrominated Diphenyl Ethers	DBP Phthalate	DIBP Phthalate

Understanding Conflict Minerals

- Companies must disclose use of “conflict minerals”; Tin, Tantalum, Tungsten (“T3G”) and Gold from any source, and determine if origin is from militias centered in the Democratic Republic of Congo (DRC)
- Applies to companies and their supply chain that use 3TG in product production or functionality
- Must report smelter or refiner (SoR) identities, country of origin and describe due diligence efforts per OECD.
- Most heavily impacts electronics, but applies to all
- “Social change” legislation; not environmental
- U.S. originated; other global versions in preparation

Growth of New Regulations – by Topic/Year and Region/Year





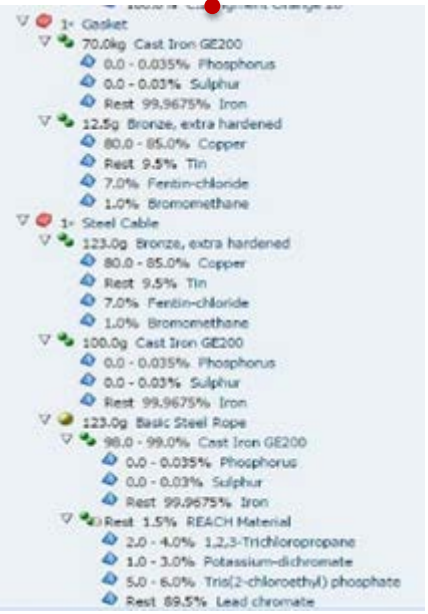
Source: Compliance & Risks

Examine Your Company's Products and Operations

- Your product content goes well beyond your company, extending deep into your supply chain
  - Product complexity brings its own challenges
    - Full material disclosures may be missing information that suppliers deem confidential or proprietary
      - Supplier education, training and communication is essential

Understand Product Complexity at the Chemical Level

- **Electronics Sample Part**
  - 1x Electrochemical Temp Sensor
  - 1x Electric Seawater Pump
  - 1x Electrically insulative waterproof casing
  - 1x Electric Motor - heavy casing high torque



Lessons Learned from Automotive Industry

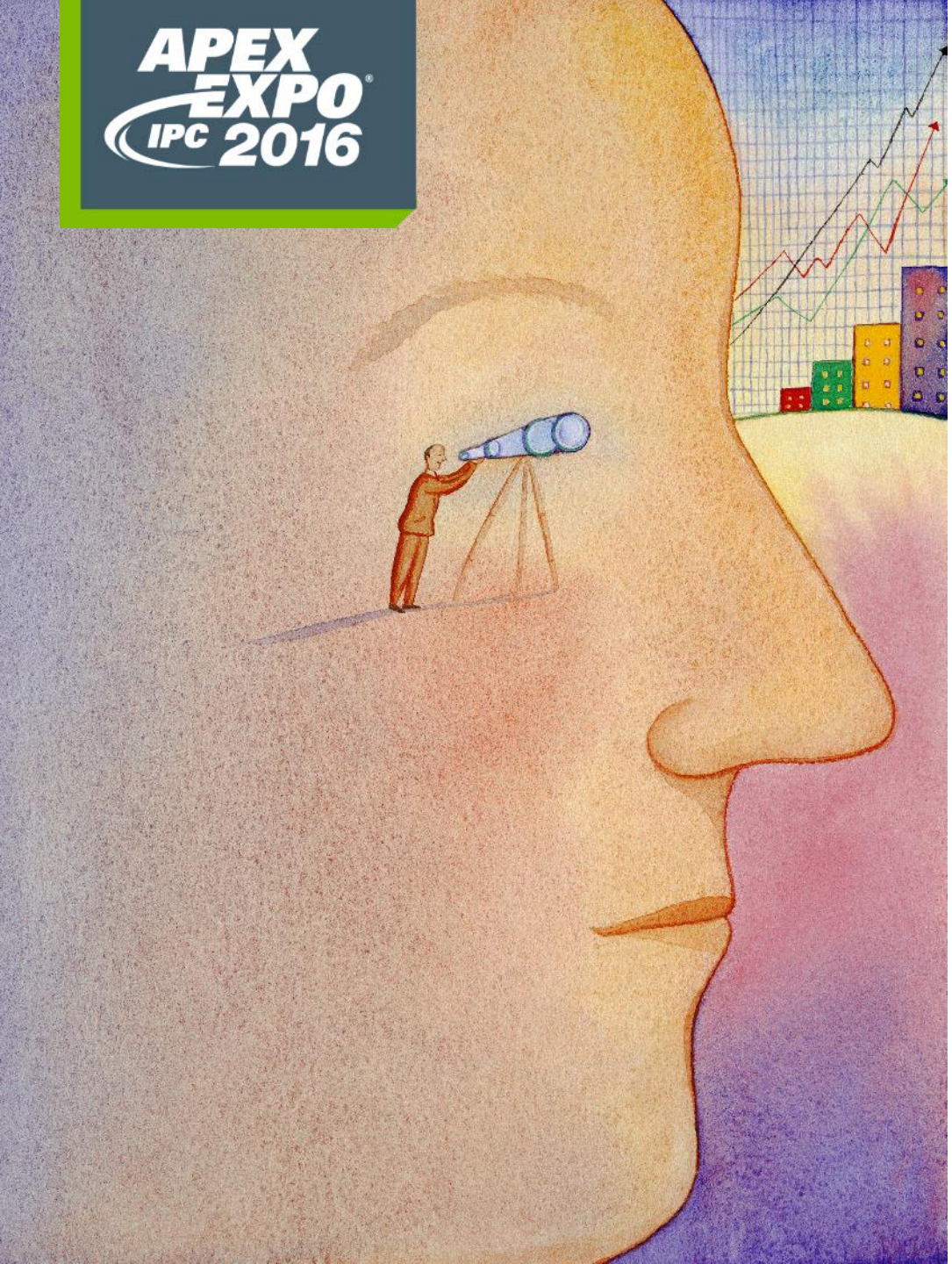
- **Challenges stem from insufficient and inaccurate information sources, such as:**
  - **Supplier compliance declarations**
  - **Partial material disclosure reporting of only non-compliance substances**
- **Full Material Disclosure is often the only way to find out the extent of supplier content**
- **Care must be taken to protect Intellectual Property (IP) and supply chain company identities**
- **Laboratory analysis can be a useful tool to validate content**

Consider Similarity to Enterprise Resource Planning (ERP)

- Allows an organization to use a system of integrated applications to manage the business and automate many back-office functions related to technology, services and human resources.
- Integrates all facets of an operation, including product planning, development, manufacturing, sales and marketing.
- Designed to be used by larger businesses and often requires dedicated teams to customize and analyze the data and to handle upgrades and deployment.

Establish a Plan of Action

- Layered, ongoing approach is essential
- Choose a cloud-based reporting platform that provides a flexible, standardized approach for material data collection and analysis
- Remember that transparent communication with your suppliers is important to provide ease of collaboration
- Tap into the many available industry resources

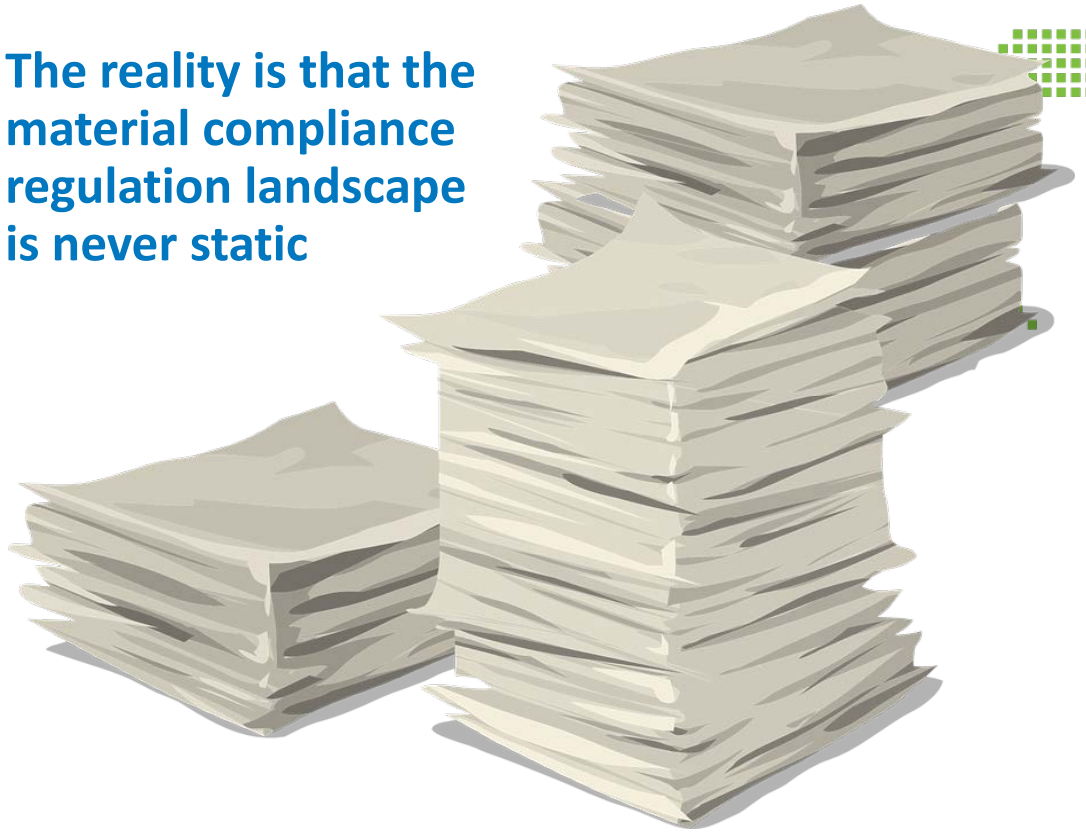


Continuous Improvement is a Journey

- **Establish efficient reporting process**
- **Remain flexible as regulatory environment changes and grows**
- **Adapt process refinements as necessary**
- **Revisit process on a predetermined basis**

Data

The reality is that the material compliance regulation landscape is never static



Many different types of regulations continue to be introduced across industries and geographies

Compliance Program Success KPMs

Key Performance Measurements (KPMs) include:

- **Meeting required reporting deadlines and content with accurate submissions**
- **Expected levels of supply chain involvement.**
- **Well educated employees who understand the reporting process**
- **Open lines of communication with supply chains**
- **Understanding product end-of-life considerations**
- **Regulatory compliance seen as beneficial.**

Conclusions

- New and growing material compliance regulations
- Scope includes supply chains, customers, all environmentally impacted at end-of-life
- Industry groups can make competitors into key allies
- Regulatory compliance reporting expectations are high
- An incremental, methodology-based approach is the optimum strategy
- Metrics for compliance success are established
- Continuous improvement is essential to achieving more accurate & timely reporting
- REACH, RoHS and Conflict Minerals require current action
- Examine products, operations and regulations determine affect on business
- Use a methodology to identify tools, services and associations
- Methodologies and tools must be reviewed periodically for success