ASSOCIATION OF
EQUIPMENT MANUFACTURERS

AEM Regulatory Compliance Steering Committee – Substances

Request-for-Information Committee Process:

Perspectives, Accomplishments and the Path to Full Material Disclosure

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Table of Contents

Background and Purpose……..3
Executive Summary……..4
Part One: The Evolving Business Landscape……...5
Part Two: The Data-Requirements Problem……9
Part Three: Data-Requirements Solutions……..14
Part Four: Evaluating Data-Exchange Platform Solutions……..…23
Part Five: Next Steps……..……27
Summary……28
References……...29

Appendix

Evolution of Data Requirements……30
Evolution of Environmental Regulations……..…31
Evolution of Supply Chains……37
Companies Invited to Participate in RFI Process……...38
Questions and Responses from Participating Companies……39
Usability Study……..40

BACKGROUND AND PURPOSE

Since May of 2014, AEM's Regulatory Compliance Steering Committee - Substances and its subcommittees ("the Committee") has worked diligently on defining technical and business criteria for an industry-wide data exchange platform and common data format.

The purpose of this AEM document is to provide a detailed summary of the Committee's work; to place it into an important context that has not been fully addressed; and, most importantly, to delineate a near-term and longer-term path to full material disclosure.

This confidential document is intended for internal use only by AEM's staff and Board; by the Committee's member companies; and by any others who may be designated by AEM.

EXECUTIVE SUMMARY

The evolution of environmental regulations, data requirements and supply chains has resulted in equipment-industry companies struggling to comply with REACH, Conflict Minerals, RoHS2 and similar regulations that target substances in products and that, in the future, will target greenhouse gasses, energy and other data sets.

Responding to the above situation, AEM established its Regulatory Compliance Steering Committee - Substances and its subcommittee the Request-for-Information (RFI) Committee (referred to as the Committee) comprised of representatives from nine OEM companies. Since being convened, the Committee has identified unique and challenging aspects of the off-road equipment industry, and it has also adopted a rigorous protocol of input, feedback and evaluation. Collectively, these activities have guided AEM in key areas that enable companies to collect, integrate and report substance data; in particular:

1. Developing a Regulatory Compliance Continuum to assist companies in gauging their compliance-readiness

2. Implementing the Market Access Pathway program, including:

    - High quality REACH and Conflict Minerals training programs for the equipment industry's supply chains that average 11 tiers deep

    - A monthly Regulated Substances Brief

Additionally, the Committee has spearheaded the introduction of a "clean-slate" infrastructure for collecting, verifying, tracing and updating data. In that regard, it has evaluated six data-exchange platforms in regard to extensive business and technical requirements. It is expected to shortly certify any platform that meets those requirements. And it is committed to certifying any other qualifying platforms on an every other year basis beginning in second quarter 2017.

The Committee has also launched a Data Format subcommittee for defining a cross-industry data format that will be integrated into any AEM-certified data-exchange platform.

It has committed to launching AEM's training programs within the members' companies and tier one suppliers after the first data-exchange platform is certified.

Finally, it has confirmed the need for a path towards obtaining full material disclosure in regard to substances incorporated into products and into manufacturing processes.

PART 1: THE EVOLVING BUSINESS LANDSCAPE

Economic, technological, market and other forces constantly alter the business landscape and force companies to adjust to it.

Three evolving aspects of the business landscape have been particularly important in AEM's 2012 decision to serve its members and their suppliers through the development of the Market Access Pathway program and related activities.

1. The Evolution of Regulatory Data Requirements (cf. Appendix A)

In the past, different kinds of data requirements have been imposed on companies. Initially, each of them created major collection, integration and reporting issues for those companies. Eventually, these other kinds of data became very low cost, routine business processes – and still continue to be.

The brief overview of past data-requirements provides a context for understanding why:

1) Virtually every company still struggles to meet its REACH, RoHS and Conflict Minerals substance data requirements

2) The Committee's work has the equipment industry on the brink of achieving a low-cost, workable data solution for its members and suppliers

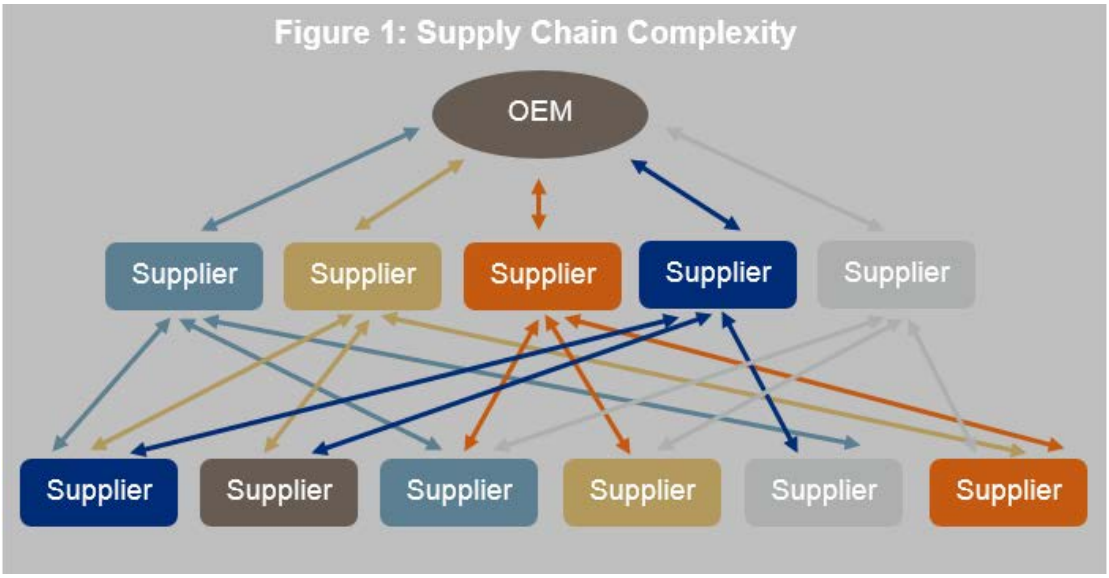
2. The Evolution of Modern Environmental Regulations (cf. Appendix B)

Understanding the evolution of environmental regulations, as well as their data requirements and financial risks, is also a major key to understanding the work of AEM's Committee.

The Steering Committee and its sub committees are driving forward a solution that will address today's regulations (REACH, RoHS and Conflict Minerals, others); enable compliance with future regulations and future data sets (energy, water, greenhouse gasses, other); and contain the costs of compliance both now and longer-term.

3. The Evolution of Supply Chains (cf. Appendix C)

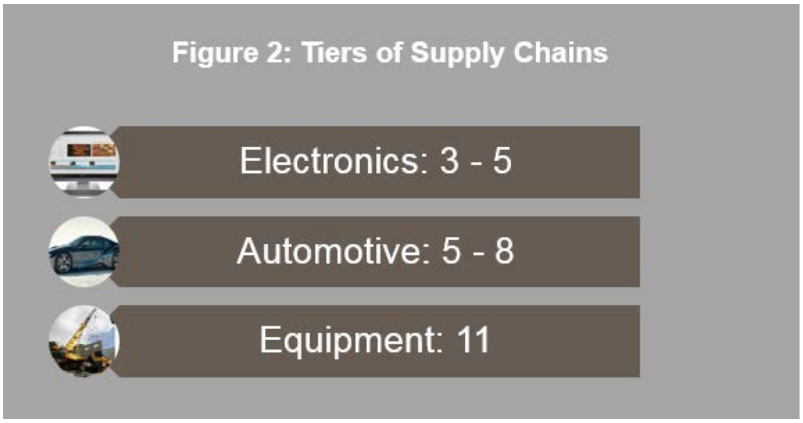
As supply chains have evolved, their complexity has increased dramatically.



However, not all supply chains are equally complex. In fact, they differ widely in their degree of complexity, both in terms of their depth and also their breadth.

Supply Chain Depth

As evidenced by the graphic below, industry supply chains differ widely in the number of tiers that comprise them.



As a result, for every additional supplier tier, there are hundreds, if not thousands, of additional suppliers from whom substance data must be collected.

Furthermore, in different industries, there is often a wide difference between the number of suppliers at any given tier. For example: it is estimated that automotive OEMs have an average

of 1,500 tier one suppliers, while at least several equipment-industry OEM's have approximately 15,000 tier one suppliers.

Supply Chain Breadth

Different industries manufacture a different breadth of product lines.

Example 1: Automotive Industry

A representative automotive company may manufacture cars, trucks and vans. Within any of those categories, e.g. "cars," it may manufacture compact cars, full-sized sedans, convertibles, hybrid vehicles and more.

Despite that diversity, the core product is similar. It has an engine, power transmission, wheels, windshield and so on. As a result, similar product lines from a given manufacturer may use the same parts or may use different parts from the same supplier, who adjusts its stamps, dies or other equipment to meet part specifications.

Furthermore, across the industry, there is minimal deviation from the core "cars, trucks and vans" product lines that are being manufactured.

Example 2: Off-Road Equipment Industry

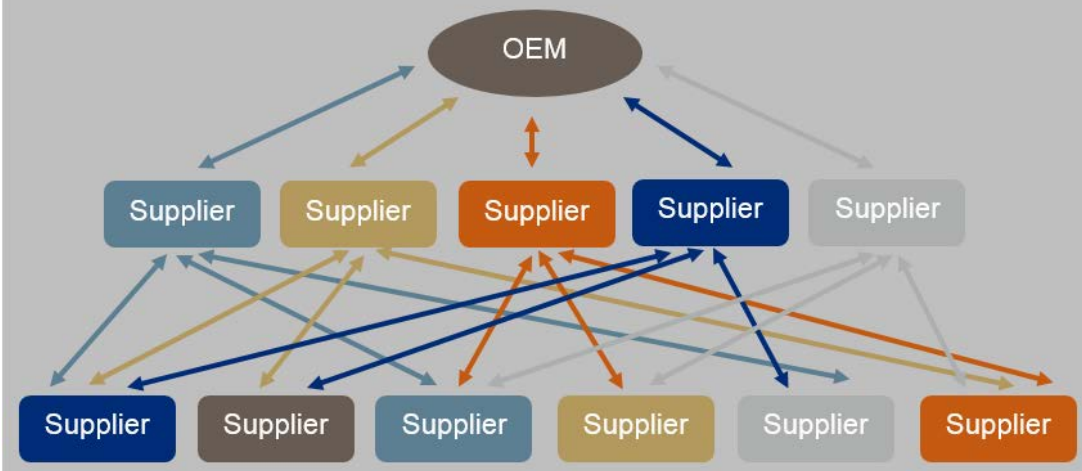
A representative off-road company may manufacture construction-industry products like excavators and cranes in addition to agricultural-industry products like tractors and harvesters. One equipment company also manufactures a line of toys.

As a result, the range of products requires a far wider range of materials and parts, which requires a broader base of suppliers and a deeper-tiered supply chain.

Given the above, the equipment industry is arguably one of the deepest, broadest and most complex durable-goods industries with the greatest number of small-to-medium sized vendors from whom data must be gathered.

In large part, this depth-and-breadth complexity explains why the ability to gather substance data from the equipment industry's extensive supply chain has, until recently, been a major bottleneck in developing a workable solution.

Figure 3: Equipment Industry's Supply Chain



Average Number of Supplier Tiers: 11

Deepest Known Supply Chain: 22 Tiers

Range of Tier One Suppliers in Two Polled Companies: 6,000-15,000

Number of Parts in One Polled OEM: > 1,000,000

PART 2: THE DATA-REQUIREMENTS PROBLEM

Given the three evolutionary trends mentioned above, as well as other factors, OEMs in the equipment and related industries must solve three historically complex data-related problems:

1. How do we cost-effectively collect data from multi-tiered supply chains?

2. How do we integrate the data into internal software tools and systems in order to:

    - Make better decisions today
    - Reduce the longer-term costs of compliance
    - Extract revenue value from the data

3. How do we efficiently and cost-effectively report the data to customers, customs officers, regulatory agencies and importers who typically have legal liability for placing our products on national markets?

Solving those problems is conceptually more straightforward than is often recognized.

First, whether requested by governments and/or increasingly by customers, data requirements are fundamentally requests for information.

Second, all of those requests for information can be met if we have answered 5 questions associated with REACH, RoHS and/or Conflict Minerals.

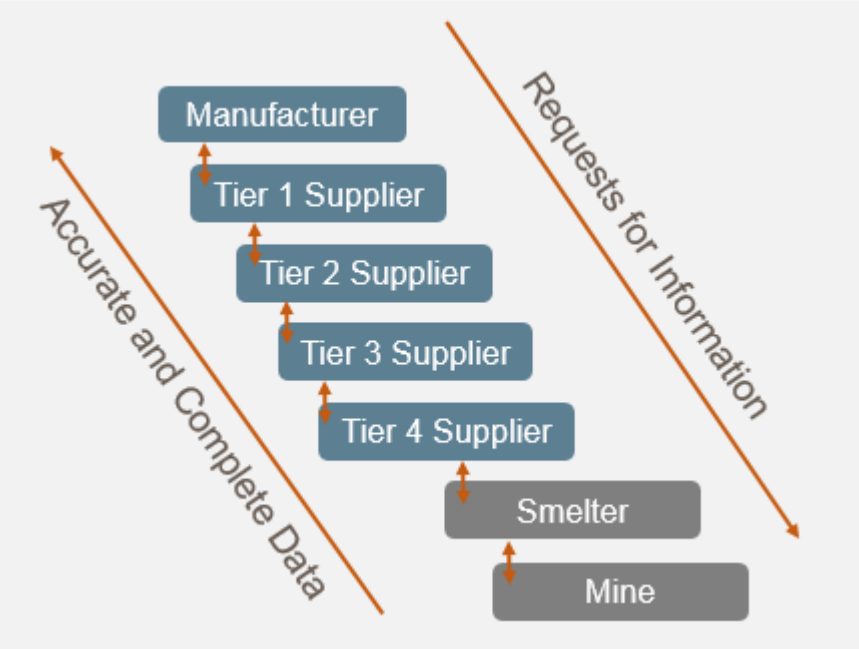
Figure 5: Five Questions for Substance Data

Questions for Requests for Information	REACH	RoHS	Conflict Minerals
What substances are in the product?	√	√	√
In what concentration?	√	√	
Where did the substance come from?			√
What process was used to make the substance?	√	√	
How is the substance used?	√	√	√

Third, we have identified the main sources for correctly and completely answering those five questions:

1. Internal data storage systems (PLM, ERP, LCA, BoMs, engineering drawings, others)
2. Multi-tiered suppliers
3. Smelters and mines that lie outside the traditional manufacturing supply chain

Figure 6: Information from the Supply Chain



While conceptually simple, implementing a solution has been anything but simple.

Two overlapping issues account for the lion's share of data collection, integration and reporting difficulties.

First, as outlined in Figure 7 below, there are numerous issues with the accuracy and completeness, i.e. quality, of data today.

Figure 7: Data-Related Issues in Information Sources

Information Sources	Issues
Customers Internal Systems (ERP, PLMs, BoMs, drawings, others)	• Few companies have substance data, because they didn't need to collect it in the past • Design teams have focused on performance and cost factors, not environmental factors • Clauses in supplier purchase orders requiring compliance with REACH and other regulations is very recent phenomenon
Supplier-provided data	• Suppliers seldom know what substances their suppliers incorporated • Customers have almost no transparency into their supply chains beyond their Tier Ones • Many suppliers consider their substances to be "secret sauce" confidential business information and won't document it
Smelters and Mines	• Companies never had to collect this data before • Mines ship ore to smelters in other parts of the world • Smelters may appear and disappear based on market conditions

Second: even if we had perfect data from all information sources, every industry, to date, lacked a platform that enables companies to:

1. Collect, verify, trace and update their data in a standardized, routinized and cost-effective manner

2. Address the rapidly changing number and complexity of the substances regulated, meaning that factors driving change in part numbers now include: fit, form, function, and formulation

3. Integrate their data into their ongoing business processes to make more informed decisions and to capitalize on incremental revenue opportunities

4. As needed, to make available their data to regulatory authorities, importers, customers, shareholders and other stakeholders

Historically, attempts at data-collection platforms have been made.

Electronics Industry

Spurred on by the EU's 2003 enactment of the RoHS directive, IPC (Association Connecting Electronics Industries), IEC (International Electrotechnical Commission) and iNEMI (International Electronics Manufacturing Initiative) and other industry associations, as well as private software vendors, have created a variety of forms, formats, tools and portals.

However, in reviewing those solutions over the last year, it has become clear to the Committee that the electronics industry is very different from the equipment industry, e.g. it:

1. Has a broad set of product lines, but has a much shallower supply chain (3 – 5 tiers) than the equipment industry

2. Uses design and contract manufacturing processes that are often tightly controlled by an OEM

3. Has very few mechanical parts compared to the equipment industry

Automotive Industry

Spurred on by the EU's 2000 End-of-Life Vehicle directive, the automotive industry has developed the most widely adopted platform (IMDS) to date with more than 100,000 users.

However, IMDS has shortfalls that have led AEM to pursue a different direction, e.g., it:

1. Is controlled by an OEM committee that tightly controls its rule sets and recommendations

2. Was designed to meet the requirements of a single directive that was enacted 15 years ago and is not flexibly architected to fully incorporate other regulatory reporting requirements, e.g. REACH, RoHS, Conflict Minerals, as well as future energy, water and greenhouse gas reporting requirements that are widely anticipated

3. Lacks a low-cost training platform for the entire supply chain that results in incomplete

and inaccurate supplier data and higher compliance costs associated with re-work

Fit, form, function and now formulation impact the fluid nature of the make-up of the products Coupled with the ever shifting nature of the number and complexity of the substances

PART 3: DATA-REQUIREMENTS SOLUTIONS

AEM represents more than 950 member companies. Mandated by its Board to develop a program that would assist these companies in complying with REACH and other regulations, AEM established a committee of industry OEMs to guide and assist the Association in implementing the wide range of solution activities discussed below.

Figure 8: AEM Regulatory Compliance Steering Committee - Substances

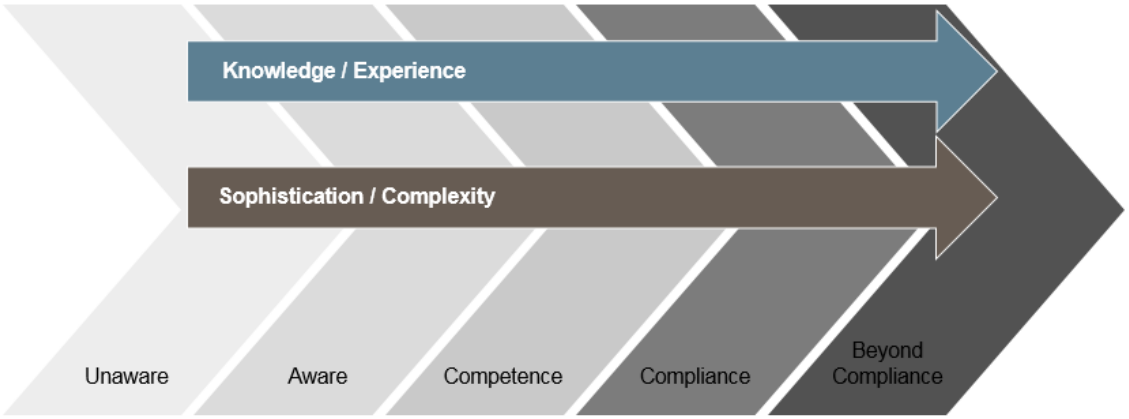
Caterpillar	**John Deere**	**CNH Industrial**
Doosan	**Volvo**	**Terex**
Navistar	**AGCO**	**Cummins**

Since May 2014, these nine companies have participated extensively on the Request-for-Information (RFI) sub-Committee. AEM is tremendously grateful for their efforts, perspectives, feedback and guidance in helping the Association to achieve a portfolio of activities related to the data-collection challenge.

Activity 1: Survey the State-of-the-Industry

Based on surveys and discussions with members and suppliers, AEM developed the Regulatory Compliance Continuum.

Figure 9: Regulatory Compliance Continuum



Moving from “Unaware” to “Beyond Compliant,” the continuum illustrates the greater accumulation of compliance knowledge and experience within companies. It also illustrates the increased sophistication and complexity of compliance solutions.

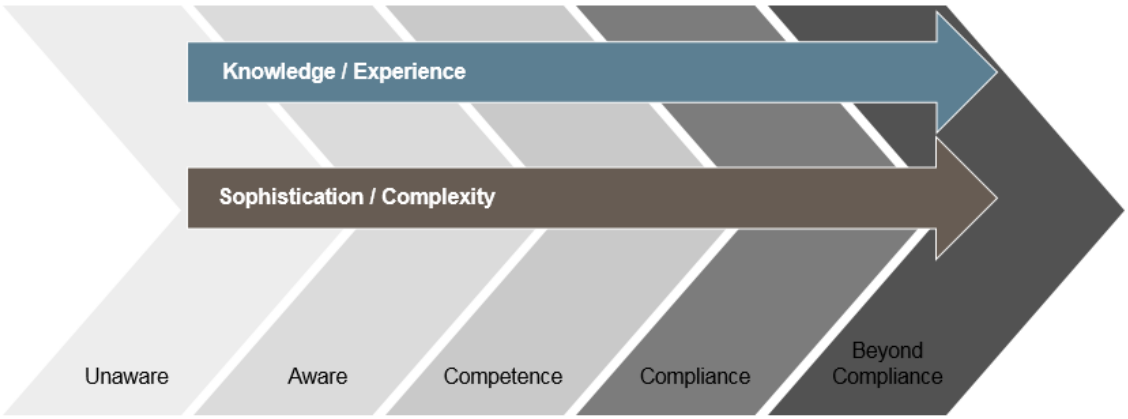
The table below defines the 5 continuum categories and highlights AEM's informal observations about the estimated number of companies in each category today.

Continuum Category	Observations
Unaware	**Definition:** Little or no awareness of the need to comply. **Number of companies:** Many, especially in the mid-layers of the supply chain.
Aware	**Definition:** Aware of needs for reporting, evaluating compliance options, and supply chain cooperation- looking for a place to start and a path forward. **Number of companies:** Many, especially those required to provide compliance information. As their supply chains beyond tier one are likely in the unaware portion of the continuum, bringing awareness to these suppliers is key to the successful collection of meaningful data.
Competent	**Definition:** Understanding the interconnected nature of regulatory compliance by collecting data, asking the right questions, involving tier one suppliers to help spread the knowledge down the supply chain, and understanding what is truly in their product. **Number of companies**: Very few, but growing.
Compliant	**Definition:** Regulatory Compliance Management Process in place, including a robust data-collection program that includes full-material disclosure. **Number of companies:** None fully implemented.

Beyond Compliant	**Definition:** Leveraging compliance activities to increase sales, marketing, sourcing and other revenue opportunities. **Number of companies:** Very few, those that are involved are expecting it will deliver bottom line results to their company.

As evident from the table above, the equipment industry – and most AEM members companies within it – are primarily in the "Aware" stage.

Figure 10: Regulatory Compliance Continuum



Regardless of where your company is today, there is a starting point and a path forward

Similarly, AEM believes that most Tier One suppliers are distributed along the continuum in a similar proportion to OEMs. Below Tier Ones, AEM assumes that most suppliers are only at the "Unaware" or "Aware" stages.

Given this state of the industry, AEM determined that it needed to develop a compliance program that would assist all its members and suppliers -regardless of where they fall on the continuum.

Activity 2: Training

A key aspect of AEM's overall program is the belief that, along with quality products, companies must provide quality substance data.

Given that there has never been a training program that was low-cost and engaging enough to permeate the tens of thousands of companies that comprise the equipment industry's supply chain, AEM has developed a training platform consisting of:

1. The Market Access Pathway program that provides companies with a path forward

2. Currently, low-cost online trainings in REACH and Conflict Minerals that are hosted within a Learning Management System, whereby customers can:

    - Directly track their tier ones who complete the training
    - Anonymously gauge the number of suppliers below tier one who have taken the training
    - Gain confidence in the quality of data they receive because of the higher training levels

3. A monthly Regulated Substances Brief that provides technical and business perspectives in regard to REACH, RoHS2 and Conflict Minerals, as well as updates to the regulations themselves

Figure 11: Regulatory Compliance Training

As the trainings were being developed, AEM received very important feedback from industry companies:

1. The content, animations and graphics of the Executive and Managerial Awareness trainings were very good

2. Before companies could roll out the training to their internal staff and tier one suppliers, they wanted AEM to complete the Operational Training that would demonstrate the mechanics of collecting, verifying, tracing and updating substance data in a data-exchange platform

3. Since the industry was entering unchartered territory in terms of collecting substance data, AEM should evaluate different tools and make recommendations in regard to a

common data exchange platform that could meet the technical and business requirements of companies across the industry

Figure 12: Regulatory Compliance Tools

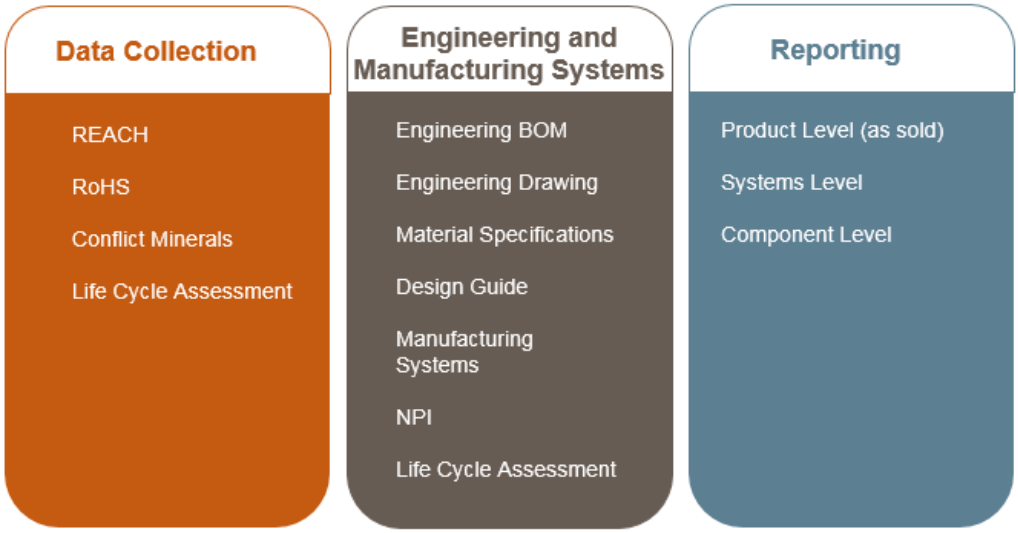
Activity 3: Tools

Based on the above feedback, AEM and the Committee set in motion a process to evaluate a common data format and, in particular, data-exchange platforms that would serve the equipment industry's need for a cost-effective way to collect, verify, exchange, trace and update data along its very complex supply chain.

In preparation for that effort, the Committee accomplished a number of tasks.

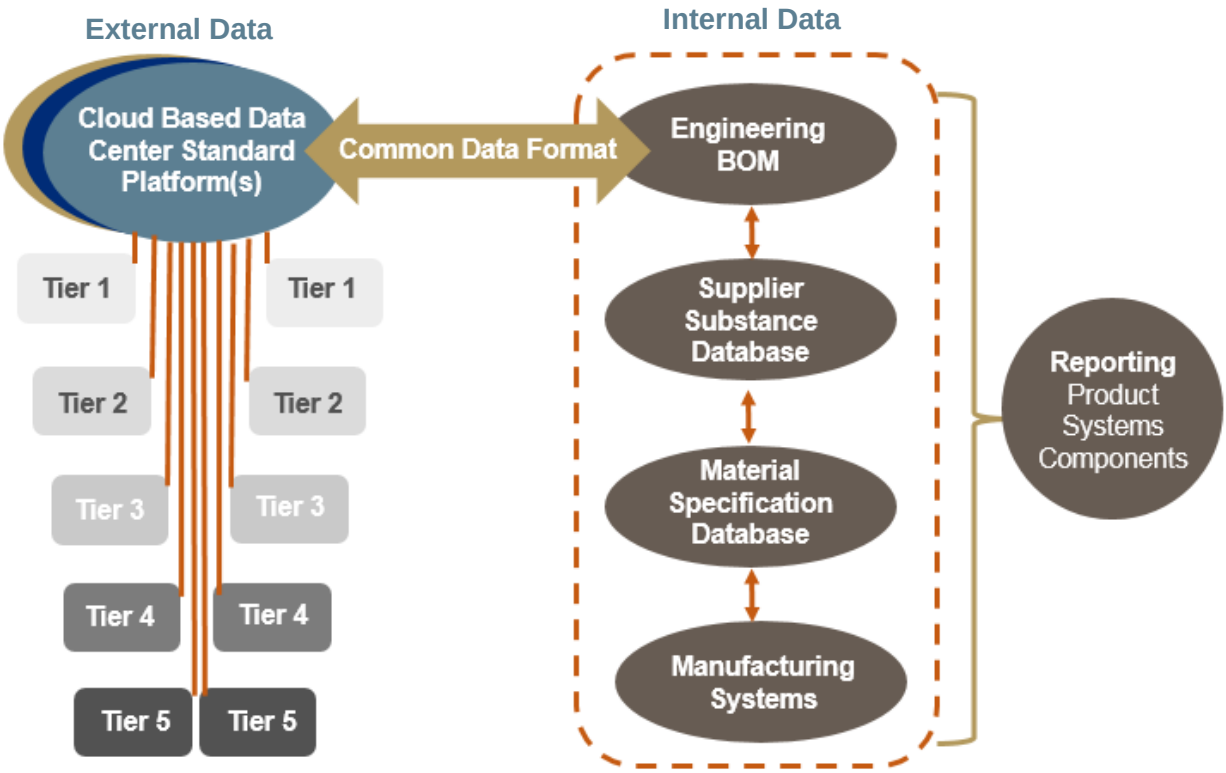
For instance, the Committee defined the data-related challenges.

Figure 13: Data Collection, Integration and Reporting Challenges



It investigated the various data flows that a data-exchange platform must facilitate and developed the schematic below.

Figure 14: Facilitating the Process

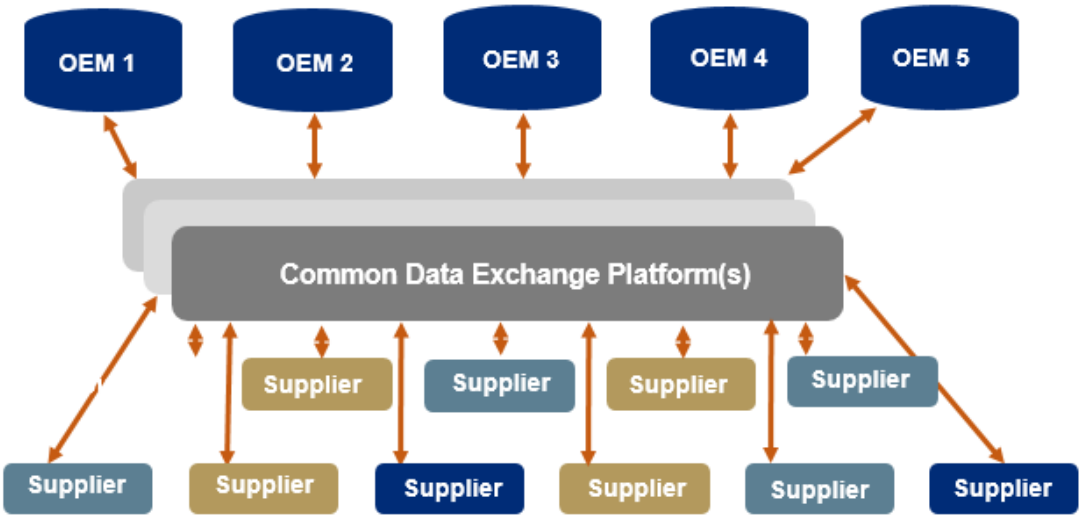


As illustrated below, it also evaluated the ability of each data-exchange platform to accommodate any company along any point on the Regulatory Compliance Continuum – regardless of whether they were collecting Supplier Declarations of Conformity, Materials Data Sheets and/or Full Material Disclosure.

Figure 15: Regulatory Compliance Continuum

It took into account the need for a data-exchange platform for allowing suppliers to provide data to multiple OEMs in the equipment industry and in other industries as well.

Figure 16: Common Data Exchange Platform(s)



This multiple-customer functionality is critical because:

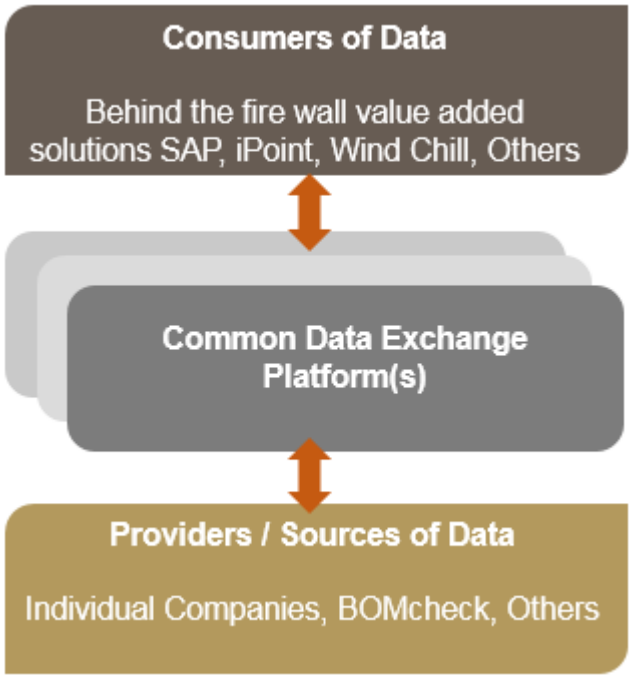
1. It minimizes duplicative work for suppliers

2. It reduces the longer-term costs of using any particular data-exchange, as more companies utilize it and as it becomes cross-industry in scope

Additionally, the Committee developed a very deep understanding of how any data-exchange platform that meets the data collection/integration/reporting challenge must work.

Specifically, the platform – or platforms – must allow companies to gather, store and retrieve the substance data needed for regulatory compliance.

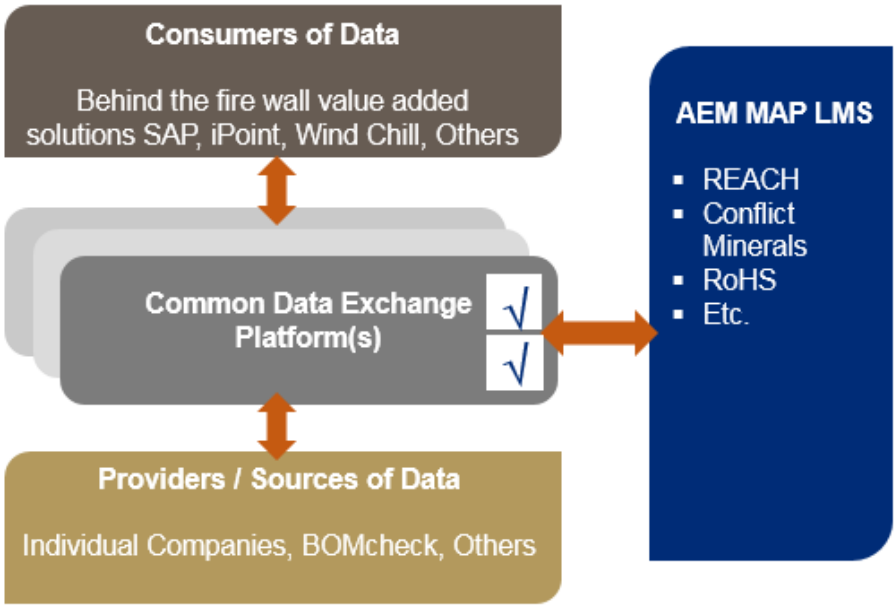
Figure 17: How it Works (part 1)



Furthermore, the data-exchange platforms must be connected to a Learning Management System (LMS) that houses training programs that address) different regulation and 2) different staff levels within a company.

Once in place, the LMS allows companies to track the training participation of both their supplier companies and also of the individuals who inputted the data from their supplier companies.

Figure 18: How it Works (part 2)



As part of its foundational work, the Committee also identified the following benefits that any data-exchange platform that might be implemented within our industry must deliver.

Deliverable Benefits of Data-Exchange Platform(s)

1. Continued market access

2. One consistent business process
   - Internal to your business
   - Throughout the supply chain
   - Throughout the industry

3. Suppliers have reduced complexity

4. Provide data to:
   - Proactively manage issues such as Critical Mineral
   - Proactively address compliance issues in design cycle
   - Differentiate your company in the market place

Plus, one other critically important benefit:

5. Any and all data-exchange platforms adopted by our industry must reduce today's costs of compliance and, as we move forward, keep those costs to a minimum

PART 4: EVALUATING DATA-EXCHANGE PLATFORM SOLUTIONS

Building on the above foundational work, AEM moved forward in evaluating potential data-exchange platforms.

Initially, the RFI Committee held extensive conversations about the requirements to comply with REACH, RoHS, Conflict Minerals and future anticipated regulations and data sets. The Committee then adopted a detailed set of business and technical criteria against which all candidate data-exchange platforms would be evaluated.

Amongst the Committee's criteria was the requirement that any platform must:

1. Already be up-and-running

2. Minimize, if not eliminate, costly re-work

3. Include process chemicals and alternative sources of parts

4. Incorporate rule sets and recommendations agreed upon by the industry

5. Enable companies to use the platform regardless of:
    - Where they were on AEM's continuum
    - Whether they were utilizing Certificates of Compliance, Material Data Sheets and/or Full Material Disclosure

6. Answer the five questions discussed earlier

7. Serve as a core infrastructure for a broader Regulatory Compliance Management Process (RCMP) that would:
    - Reduce the long-term costs of compliance
    - Turn "compliance" into a routine business process
    - Allow companies to extract value from their compliance activities

8. Additionally, the platforms must allow:

9. Customers to:
    - Plausibly verify supplier data
    - Trace substance data back to the materials manufacturers who initially incorporated the substances

10. Suppliers to:
    - Cost-effectively input data and send it to their customers
    - Send data to customers in different industries

11. Material manufacturers to:
    - Protect the identity of their suppliers and their formulations
    - Update their formulations when new substances became reportable

DATA-EXCHANGE PLATFORM EVALUATION PROCESS

With the business and technical criteria in place, the Committee set in motion a process for:

1. Identifying companies who might potentially satisfy the business and technical requirements
2. Understanding in depth their platform offerings
3. Viewing, via a live demonstration, the platform's capabilities

Determining Key Questions

In accomplishing the above, the Committee created a list of 46 key questions that were employed in the evaluations. For example:

Question #	Capability description	Yes/no/ planned	Comments and discussion on how it works today	Comments on future capabilities
	Data Exchange Questions:			
3	Support for direct manual data entry to online system?			
19	Support for multiple suppliers for a part in BOM structure?			
36	Please describe ability for integration of training certifications of person entering the data from a third party secure training system into the data submittals.			

Invitation to Participate

The Committee identified a wide universe of potential candidates for the database exchange platform. Over time, it selected a sub-set of seven companies that comprised:

1. Available database types

2. Best of class options

On June 17, 2014, AEM sent a formal Request-for-Information document to these seven companies (cf. Appendix D). It invited them to participate, and it outlined the evaluation process, timetable and criteria. In response, one company declined, because it lacked an up-and-running data-exchange platform. The other six companies agreed to participate in the three-phase evaluation process.

Phase 1: Providing Detailed Database Information

Each of the six companies responded to the 46 questions mentioned above (cf. Appendix E). Their answers were inserted into a spreadsheet, so that the answer to each question by all six companies could be compared and evaluated line by line.

At the end of this phase, two companies were disqualified because their responses did not adequately address the business and technical criteria.
Four companies were invited to participate in Phase 2.

Phase 2: 4-Hour Live Demonstration of an Up-and-Running Data-Exchange Platform

Each of the four companies presented an extensive demonstration of their system's functionality and responded to an additional round of business and technical questions from the Committee.

Based on the live demonstrations and responses to questions, two companies were disqualified. The other two companies were then considered further.

Phase 3: Final Consideration

In great detail, the Committee discussed the strengths and weaknesses of the two finalists.

Worth noting: one of the areas discussed was the ability of each platform to serve the needs of any company – regardless of where it fell along the Awareness Continuum described above, i.e. whether the company was collecting Certificates of Compliance, achieving Full Material Disclosure or anywhere in between.

Also worth noting: the Committee arranged for a regulatory compliance data-input expert to perform a usability study of both finalists (cf. Appendix F). This test demonstrated that one of the two systems was significantly easier to use than the other.

Based on the Committee's final discussions and the results of the usability test, one company was disqualified. The other company was certified as meeting the technical and business requirements and as having a solution that could be utilized by any company at any point along the Awareness Continuum. The certification of this platform will be publicly announced in the near future.

PART 5: NEXT STEPS

Based on the learning achieved in the above evaluation process, the Committee has evolved its thinking: specifically, whereas earlier discussions centered around a single data-exchange platform for the industry, current thinking recognizes the reality that, over time, multiple data-exchange platforms might very well serve our industry.

Within this evolved framework, it is understood that:

1. The Committee's role is – and will be – to certify any data-exchange platform that meets the Committee's technical and business criteria

2. Any certified platform must integrate with previously-certified platforms

3. A platform may be certified because it provides sufficient functionality to allow other industries (e.g. electronics, automotive, defense) to migrate their data; to incorporate their industry-specific data requirements; and /or to achieve the cost benefits of being part of a cross-industry infrastructure.

In that regard, starting in 2017, AEM will re-convene a similar industry-representative Committee every two years. The Committee will evaluate any previous or new candidate companies who believe they have an up-and-running data-exchange platform that will meet our industry's business and technical criteria and serve any company at any point along the Awareness Continuum.

In the meantime, the current Committee will move forward in defining a data-format that will be a requirement for any certified data-exchange platform to integrate.

Additionally, the Committee will also provide input on AEM trainings in regard to the certified data-exchange platform, as well as additional regulatory trainings.

As AEM completes its Operational trainings, the Committee members and other AEM members will:

1. Utilize the package of Executive, Managerial and Operational trainings for its in-house staff

2. Invite a sub-set of its Tier One suppliers to participate in the training

3. Encourage their Tier One suppliers to invite their Tier One suppliers to participate in the training

SUMMARY

The global web of environmental laws targeting products has provided one of the most complex regulatory challenges the equipment industry has faced; in particular, the need to collect substance data from tens of thousands of globally dispersed suppliers while honoring the proprietary nature of the supply chain identity

Previous data-collection infrastructure implementations from the automotive and electronics industries are not directly transferrable to the equipment industry.

Given the above, AEM assembled AEM's Regulatory Compliance Steering Committee - Substances and its subcommittees ("the Committee") made up of nine industry-representative OEMs that subsequently became known as the Committee.

Since May 2014, the Committee has assisted AEM in developing the Compliance Continuum, REACH trainings and other aspects of compliance with REACH, RoHS, Conflict Minerals and future regulations that target our products and that will include other data sets in the future.

Most significantly, the RFI Committee has established the business and technical criteria for evaluating data-exchange platforms. Based on this initiative, the Committee extended invitations to seven different software firms; evaluated several of the strongest candidates in great detail; and finally identified one data-exchange platform that was up-and-running and that meets the business and technical criteria that we can recommend to our members and their supply chains.

Presently, the Committee is working with AEM in developing a data-format for the data-exchange platform and in related efforts. Every two years, it will evaluate any data-exchange platforms from companies that would like their software infrastructure to be certified by AEM.

REFERENCES

RSJ Technical Consulting

RSJ Technical consulting specializes in “Do It Once. Do It Right” compliance with product-oriented regulations. For more than a decade, it has provided consulting, training, and managed substance-data service for automotive and heavy equipment OEMs and their suppliers. The firm is also a consultant to AEM’s Market Access Pathway program.

AEM

AEM is a trade association that provides services on a global basis for companies that manufacture equipment, products and services used worldwide in the following industries: Agriculture, Construction, Forestry, Mining and Utility. AEM’s membership is more than 850 companies and represents 200+ product lines.

Appendix A: Evolution of Data Requirements

In today's business landscape, virtually every manufacturer in every industry is under pressure to provide more and more data to regulators and to customers. Seen from an historical perspective, these data requirements come in waves and, once here, become an accepted set of requirements.

Three waves are worth noting.

1. Financial Data

Following the stock market crash in 1929, the US established the Security and Exchange Commission and enacted numerous laws to prevent a similar economic collapse. Collectively, these actions in the US and other nations demanded more granular, audited levels of financial data from companies in every industry.

Today, tools and processes for collecting, integrating and reporting this data are both a critical and a routine part of equipment manufacturers' business operations.

2. EH&S Data

In 1971, the establishment of the US' Occupational Safety and Health Administration (OSHA) signaled an aggressive governmental campaign to reduce workplace illnesses, accidents and deaths.

From the first establishment of OSHA standards in 1971-72 to more recent activities like the 2010 Cranes and Derricks Standard, manufacturing firms in every sector have been required to collect, integrate and report safety and health data – activities that are also routine in today's business landscape.

3. Substance Data in Product Materials and Parts

Spurred on by the enactment of Extended Producer Responsibility laws ever since the 1990s, manufacturing firms have been required by governments – and increasingly by customers – to provide very detailed substance content data.

Discussed in greater detail later in this report, the tools, methods and successes in collecting, integrating and reporting this data has also evolved tremendously from Certificates of Compliance to Material Data Sheets to Full Material Disclosure.

Appendix B: Evolution of Environmental Regulations

In the Past

Arguably, the modern era of environmental regulations began in the 1970s when, in the US, laws like the Clean Air Act and Clean Water Act were enacted and the EPA was established.

Typically, "modern" environmental laws were "end-of-pipe" laws that targeted facilities and restricted companies from polluting. Compliance required Company X – on its own - to install scrubbers or similar solutions. Compliance did not require Company X to gather any data from any of its suppliers – never mind all of its suppliers.

In 2000, the European Union (EU) elevated the Precautionary Principle to the status of law. This "better safe than sorry" principle squarely shifted the burden of proof for product safety to the manufacturing firms and importers who place the products on the market.

It also unleashed a new wave of environmental laws: Extended Producer Responsibility directives that targeted products rather than facilities. Collectively, they represent the EU's evolving attempt to:

1. Protect its citizens and natural environment
2. Reduce its spiraling health care and environmental remediation costs
3. Provide a competitive advantage to its domestic businesses

Most relevant to the work of the RFI Committee, several EPR laws addressed toxicity in specific product categories, as described below. Furthermore, compliance with these laws was made geometrically more complex. For the very first time, customers had to collect substance data from their multi-tiered and globally dispersed supply chains.

ELV

In 2000, the End-of-Life Vehicle (ELV) directive restricted the application of four heavy metals in two classes of on-road automotive products.

RoHS

In 2003, the Restrictions on Hazardous Substances directive (RoHS) directive addressed the same 4 heavy metals as the ELV directive + two polybrominated flame-retardants.

Just 8 years, later, in 2011, the EU recast RoHS. Among the changes, the scope of RoHS2 now included a sub-set of non-road mobile machines manufactured by our industry.

RoHS2 also paved the way for additional substances to be restricted. Recently, four new phthalate substances found in integrated circuit packages, capacitors, resistors, moulded plastic, adhesives, paints, resins and other materials and parts incorporated into our industry's equipment were added to RoHS's scope.

Additionally, RoHS2 adopted an aggressive policy in regard to deadlines for substance application exemptions. Several current exemptions utilized by equipment manufacturers (e.g. glass in sensors, lead in bearings) are up for extension, amendment or deletion. Narrowing or deleting those exemptions could result in major R&D, testing and re-qualification costs for AEM members and their suppliers.

REACH

Enacted in 2006, the Registration, Evaluation and Authorization of Chemicals (REACH) regulation is the most comprehensive environmental regulation targeting products.

As seen below, REACH is also the most dynamically changing EPR regulation in regard to three separate substance lists – each of which demands ongoing attention and documentation from AEM members and their suppliers.

Substances of Very Concern (SVHCs) List

Under REACH, chemical manufacturers and importers:

1. Register substances that they place on the EU market and that exceed annual threshold volumes

2. As part of the registration process, they submit dossiers that contain detailed technical, safety and other information on each registered substance

Utilizing those dossiers, the European Chemicals Agency evaluates the registered substances for their levels of carcinogenic, endocrine disrupting, bio-accumulative and other risks. Based on those evaluations, ECHA identifies SVHCs and adds them to the SVHC Candidate List for Authorization.

http://echa.europa.eu/candidate-list-table

By law, ECHA adds to this list at least twice a year. Table X below indicates the dynamic nature of this list.

Non-EU companies in the equipment and other industries may continue to incorporate Annex XIV substances into their products. However, their EU importers, distributors and/or end-user customers must notify the European Chemicals Agency (ECHA) if the concentration of the substance within the product exceeds 0.1% w/w and if other criteria are also met.

Furthermore, REACH Article 33 requires EU manufacturers and importers to immediately notify downstream users in the EU about, at a minimum, the presence of any SVHC and any related safety information. Thus, if ECHA adds substance "A" to the SVHC list today, companies using substance "A" in their products would need to notify their EU importers, distributors and/or end-customers tomorrow. While, as discussed below, the ability to provide immediate notice is forthcoming through the work of the RFI Committee, the notification of an SVHC is a public record and may entail a legal liability in the manufacturer's home country.

Figure 19: Rising Number of REACH-Identified SVCHs

YEAR	NUMBER OF SUBSTANCES
2008	13
2015	161
2015-2017	168 new substances to be evaluated by ECHA
2020	450 SVHCs expected
20XX	>1000 SVHCs expected

Annex XIV: Authorization List

After further evaluation, ECHA places a sub-set of SVHCs into REACH Annex XIV. It also publishes a "sunset date," i.e. the date beyond which EU manufacturers may not use the Annex XIV substance in its manufacturing processes or its finished products placed on the EU market without applying for – and receiving – an authorization to use the substance in a very narrowly-defined application.

> http://www.echa.europa.eu/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list

Currently, Annex XIV contains 33 substances that require an application-specific authorization to use them. These 33 substances represent more than 20% of the 161 currently identified SVHCs.

As with SVHCs, the list of Annex XIV substances is regularly increased. As an example: in August 2014, ECHA added 9 substances to Annex XIV. Four of these 9 substances are chromates that may be used by equipment manufacturers for corrosion resistance and other uses. The sunset date for these new chromates is January 22, 2019 – less than four years from now. In total, Annex XIV now contains a total of 11 chromates – plus epoxy hardeners and solvents that may also be used today in our industry's equipment.

Also worth noting: in September 2014, ECHA published the names of 21 SVHCs that it is recommending for inclusion in Annex XIV. A sub-set of the 21 SVHCs will very likely be added

to Annex XIV and will then require an application-specific authorization beyond the substances' TBD sunset dates. Seven of these recommended substances are phthalates that are used in PVC, rubbers, adhesives and other equipment-industry applications.

Restrictions List

REACH Annex XVII includes SVHCs that are restricted from use in EU manufacturing processes and in finished products. Currently, there are 63 categories of substances that comprise 105 substances and more than 1,000 substance compounds.

http://echa.Europa.eu/addressing-chemicals-of-concern/restrictions/list-of-restrictions

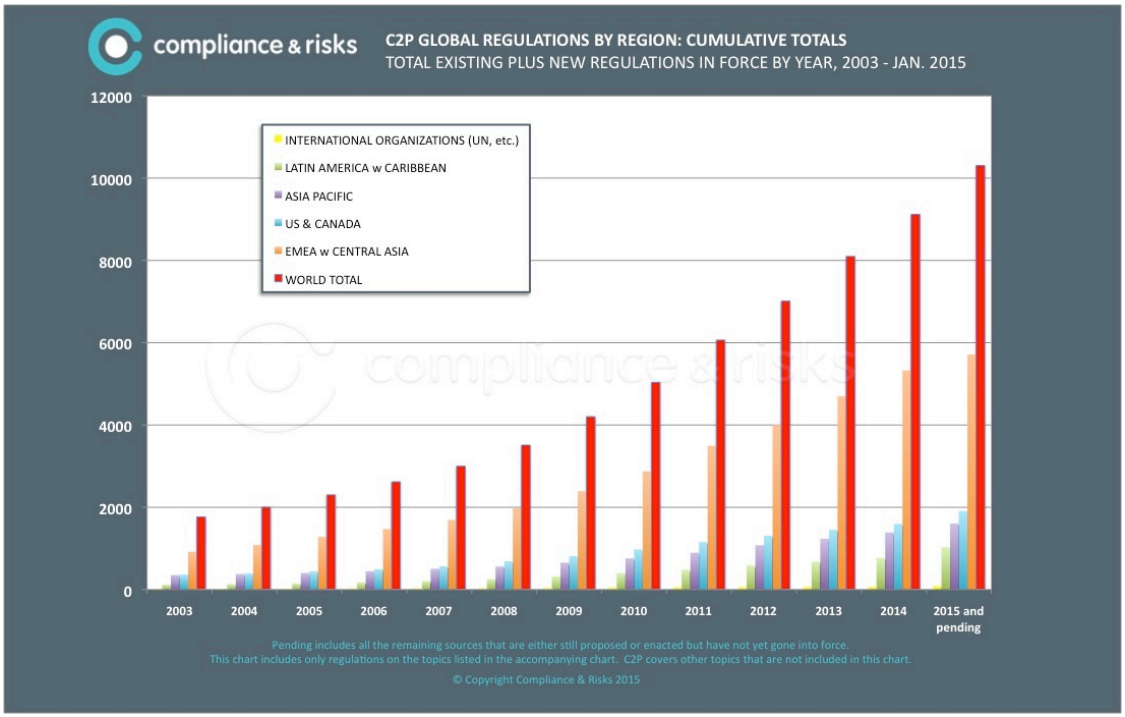
Here, too, additional substances will periodically be added to Annex XVII. Currently, 5 new ones are under review.

Non-EU equipment manufacturers need to pay attention to Annex XVII substances because, unlike substances on the Authorization List, they cannot legally be included in products that are exported to the EU and placed on the EU market.

Today

As indicated by the sharp upswing in Figure 20, environmental regulations are here to stay.

Figure 20: Global Regulations by Region: 2003-2015



Furthermore, “copycat” regulations are spreading to major markets globally. As the latest example: on January 1, 2015, South Korea, Taiwan and Turkey all adopted or amended a variation on the EU’s REACH regulation.

Most relevant to the work of the RFI Committee: until recently, equipment industry OEMs and suppliers had understandably little concern about global toxicity regulations. After all, our industry was excluded from the scope of ELV and the original RoHS. The RoHS recast only included a small sub-set of non-road mobile machinery within its scope. And while heavy equipment clearly fell within the scope of REACH, compliance was not a priority because the basis for compliance was the entire article – or finished product. These products were very heavy. Most of the weight was metal. The likelihood of reportable concentrations of SVHCs in the metal or the non-metallic parts was very small.

But, today…as we approach the mid-point of 2015…the situation for the equipment industry has evolved into something very different than a year or two ago. For example:

1. The US’ Conflict Minerals law does not address toxicity in products. But compliance with the law for US public companies requires substance data information from their entire supply chain.

2. EU equipment manufacturers and importers will likely face a Conflict Minerals law that is broader in scope than the US law

3. Most importantly: in March 2015, the EU’s Advocate General issued a complex opinion on the proper basis for REACH compliance. The opinion was requested by the EU Court of Justice, because seven of the most economically developed EU nations, including Germany and the Netherlands, have aggressively advocated that the basis for REACH compliance should be at the homogenous material or component level (cf Figure 21)

4. In effect, the Advocate General agreed with those seven nations. If the EU Court of Justice also agrees, equipment industry firms will no longer be able to use the “massive metal” argument to postpone REACH compliance.

Figure 21: Basis for Compliance with ELV, RoHS and REACH Regulations

LEGISLATION	BASIS FOR COMPLIANCE
• End-of-Life Vehicle	• Homogenous Material
• RoHS	• Homogenous Material
• REACH	• Article*
*Spare parts placed on EU market are articles	

The Future

In the next few years, AEM anticipates that more markets will localize ELV, RoHS, REACH and Conflict Minerals laws.

Equipment industry OEMs will receive a growing number of requests for substance information.

There is at least a moderate likelihood that – just as the EU recast the RoHS directive (and the WEEE directive) – the EU will also recast the REACH directive. And, if the EU Court of Opinion rules in favor of "Once An Article, Always An Article," the REACH recast will adopt that ruling.

Furthermore, past REACH enforcement focused on:

1. Chemical manufacturers and importers

2. Consumer products

But, moving forward, the scope of products will likely expand to include business and professional products.

Additionally, the REACH enforcement forum has indicated that, in 2016, enforcement will focus on Annex XVII restricted substances and that there will be greater involvement from national customs officials. These customs officials will presumably apply greater scrutiny to REACH-related documentation for products being placed on their markets.

Appendix C: Evolution of Supply Chains

Ever since the 1970s, technological advances in computing, transportation and other areas have transformed local, national and regional markets into a global market.

Not surprisingly, many supply chains have also become far more global and far more complex. Table Z approximates today's varying level of supply-chain tiers – and associated complexities - in different industries.

INDUSTRY	AVERAGE NUMBER OF SUPPLY-CHAIN TIERS
Electronics	4 – 6
Automotive	6 – 8
Equipment	11

Appendix D: Companies Invited to Participate in RFI Process

1. BOMcheck
2. HP-CDX
3. HP-IMDS
4. iPoint
5. PTC
6. SAP
7. Source Intelligence

Appendix E: Questions and Responses from Participating Companies

The questions and responses to the 46 references questions from the six participating companies are housed in a comprehensive spreadsheet that is an attachment to this document. If you wish to view this spreadsheet and receive this document without this attachment included, please email John Wager, jwagner@aem.org, with your request.

Appendix F: Usability Study

BOMcheck / CDX Use Comparison-Contrasting (prepared by Kees deWit, Navistar, 12/15/2014)

	BOMCheck	CDX	Favored
1	Designed for materials, components secondary	Designed for materials and components (and semi-components) and easy roll-up of components	CDX
2	Not designed for combining of materials	Designed for combining materials in the supply chain (e.g. coatings, polymer materials)	CDX
3	Not designed for items that require further processing in the supply chain (e.g. raw castings, masticated rubber on a roll)	Designed for items that require further processing (i.e. semi-components)	CDX
4	Designed for many parts with same chemistry (uploading of part number file)	Designed for parts with different chemistry. Each declaration (MDS) has its own part number	BOMCheck Electronics (CDX all mechanical and overall product)
5	Designed for single level of Bill of Material (each level requires new XLS file to upload)	Designed for complex Bill of Materials with many levels (e.g. engine, transmission, turbocharger)	CDX
6	Not designed for BOM with many levels (with several hundreds of suppliers and thousands of components and sub-components)	Designed for complex products with hundreds of suppliers and thousands of components and sub-components	CDX (BOMCheck only for electronic subassemblies) (Loaded PCBs)
7	Designed for materials controlled by the manufacturer (e.g. semi-conductor industry)	Designed for both materials controlled by manufacturer (i.e. polymers) and standard materials selected by OEM / design responsible supplier	CDX (BOMCheck only for electronic components(
8	Summary information only for substance level	Substance traceability down to the component and the material level	CDX
9	Version control only through date of publication of declaration	Easy version control	CDX

10	Supplier publishes declarations	Receiver decides to accept / reject of declaration after review. Reject required supplier to make corrections	CDX (Ease of rejecting and getting data corrected. May be a major time issue)
11	Every material has to be created by the user in their account	Free use of standard material (i.e. steel alloys and platings)	CDX (BOMCheck plan to add, but needs someone to define and guide process)
12	Real search function does not exist	Easy search for existing and published information	CDX (BOMCheck does not have enough standardization of naming or data structure. May be IPC/IEC issue.)
13	Does not have a “where-used” analysis	Where used analysis for classification, material and other criteria. (e.g. search for presence of SVHC substances)	CDX
14	No settings for confidential substances (marking confidential, but still be identified as on a restricted list). Allows 5% of a material to be “not declared”. No method to determine if the “not declared” are on a restricted list by the customer.	Designed for handling confidential substances for both within own account and customer (showing the restricted status, and not the actual substance to protect intellectual property)	CDX (Both cover highly confidential, issue is auto updating from polymer companies.)
15	A complex part would have many external controlled CSV files with different CSV layouts. Naming and version control is very difficult and depends on the user.	No use of external files with different formats.	CDX (BOMCheck requires new set of capabilities for version controlling)
16	Not designed for large OEMs with multiple reviewers who could be overseas.	Designed for multiple users with different access levels.	CDX (Security issues and individual traceability of actions in the system.)