DASSAULT SYSTEMES

OPTIMIZE SOURCING & STANDARDIZATION OF CROSS-PROGRAM PARTS

White Paper

SECTION 1. THE CHALLENGE OF PRODUCT & PARTS PROLIFERATION

Back in the 1990s, IBM was facing multiple business challenges; it lost $8B in one year. A significant portion of this loss was attributed to the company's hardware business, which was struggling with runaway complexity. IBM had reached a point where it was:

- Carrying 5,000 different products, all managed in disparate information silos;
- Spending 25% of its development budget on products that never made it to market;
- Averaging 70 months in time-to-market for new products; and
- Reusing less than 2% of parts across products and product lines.

Parts reuse

< 2%

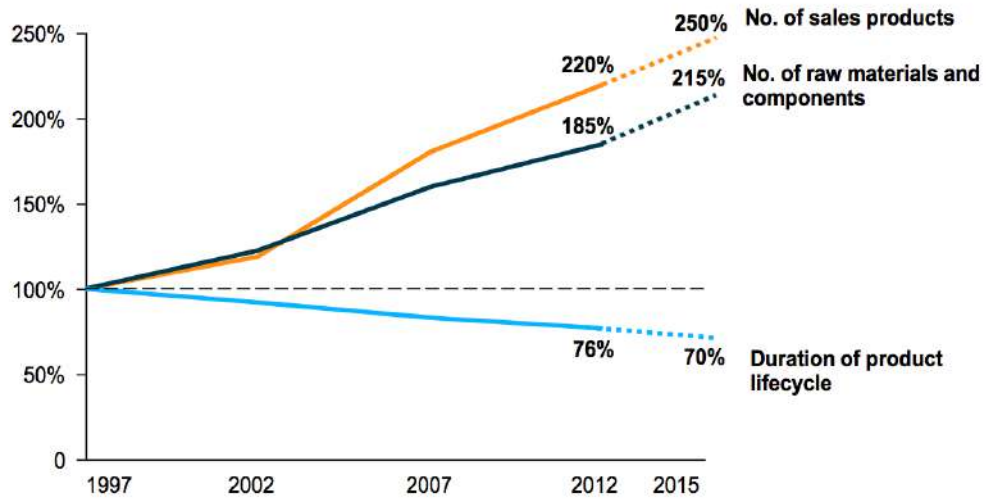
This product and part proliferation engendered significant costs and inefficiencies that rippled across the organization, affecting everything from engineering productivity to sourcing, manufacturing, inventory management, quality control, sales and after-market services.

In response, in 1993 IBM launched a major and largely successful seven-year transformation of its hardware business. However, the leading driver of the proliferation that impacted its bottom line remains a perennial challenge for IBM and all international manufacturers: namely, globalization.

The Pressure to Differentiate & Customize

Over the past few decades, globalization has opened new markets but also heightened competition. This has spurred manufacturers to use continuous product innovation and localization to attract and retain customers empowered by greater choice.

Increase of Product Variety Across All Industries[1)]



1) Automotive, chemicals, machinery, FMCG, pharmaceuticals

Roland Berger, "Mastering Product Complexity"

Over time, with the rise of the Internet and the market transparency it brings, customers have become even more powerful. It's a trend that's now being accentuated by the Internet of Things, or Industry 4.0, which is both enabling and fostering demand for "smart and connected" products that can be customized down to the level of the individual customer.

Accordingly, product complexity continues to rise and the pressure for product differentiation and customization is increasingly intense. This leaves manufacturers more vulnerable than ever to snowballing complexity and an accompanying proliferation of parts, products and components.

This proliferation has a significant impact on total product lifecycle cost and on company performance, as IBM discovered. While the impact is far-reaching, the direct costs alone associated with parts duplication are surprisingly high.

In an analysis for its report "Reduce Program Costs through Parts Management", the U.S. Department of Defense (DoD) found that introducing a single new part as trivial as a nut or bolt added $27,500 to a weapons system's lifecycle cost. They determined that if they could replace just 2.5% of new parts with common standard parts, they could save more than $6.8 million on a typical program that uses 10,000 parts.

THE HIGH COST OF A NEW PART

The U.S. DoD estimates the average lifecycle cost of a new part for a weapons system is $27,500.

ACTIVITY	COST	%TOTAL
Engineering & Design	$ 12,600	45%
Testing	$ 1,000	4%
Manufacturing	$ 2,400	9%
Purchasing	$ 5,200	19%
Inventory	$ 1,200	4%
Logistics Support	$ 5,100	19%
Total	**$27,500**	

Following the study, the DoD launched a program to boost the reuse of standard parts, tools, raw materials and processes. Many private sector manufacturers have done the same. They have also adopted modular, variant-oriented design to meet the need for competitive differentiation and customization while maximizing the reuse of common platforms, parts and assemblies.

These strategies are making a substantial difference for many manufacturers. But significant barriers to standardization and reuse remain, with many manufacturers never reaching their reuse targets.

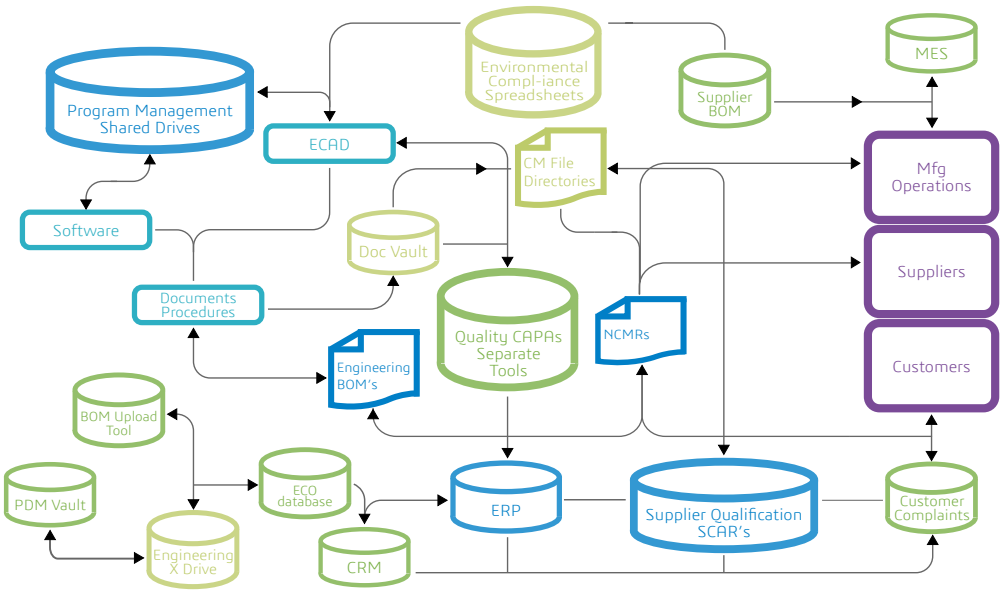
SECTION 2. BARRIERS TO PARTS STANDARDIZATION & REUSE

2.1. Multi-PDM & Multi-CAD Environments

One of the most significant barriers to identifying and reusing standard parts is the persistence of multi-PDM/PLM/CAD environments and the data silos they produce. The reasons for persistence include:

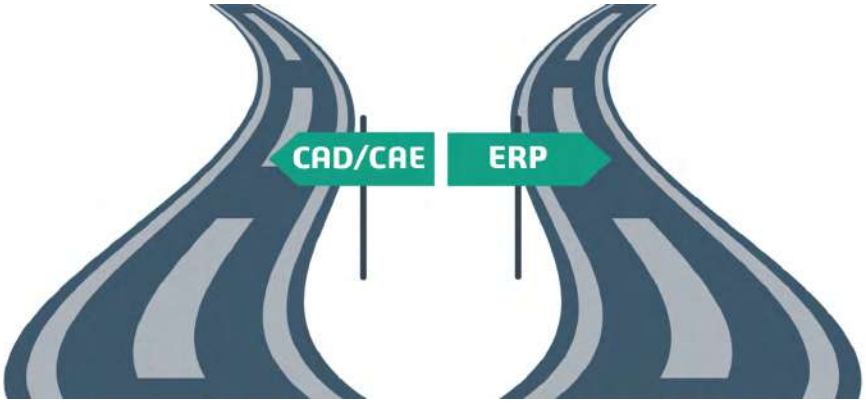
- **Cost & Continuity Concerns**
  Enterprise-wide rip-and-replace initiatives are sometimes simply deemed more costly and disruptive than the continued use of ad hoc legacy tools. This is especially true for global manufacturers using practices like concurrent engineering and multi-site manufacturing.
- **Engineer & Customer Resistance**
  Engineers frequently resist efforts to make them switch from applications they feel comfortable using. Externally, different customers and partners often demand that files be delivered in formats conforming to their own systems.
- **Mergers & Acquisitions**
  Mergers and acquisitions are common in manufacturing, and migrating each acquired or merged organization is a slow and difficult process that can lead to disparate systems persisting for, in some cases, years.

Disconnected Silos



2.2. Disconnects Between Engineering & Business Systems

Another major challenge is the divide between engineering (CAD/PDM/PLM) and business (ERP/SRM/SC) systems. Procurement professionals may not be able, or know how, to access engineering systems to retrieve information that can help validate new part requests, select the best suppliers and secure the best prices.



Engineers often cannot easily consult essential sourcing information when making a decision as to whether they should reuse an existing part, design a new one, or request an existing commercially available part (a "make, reuse or buy" decision).

2.3. Security Roadblocks

As with siloed data, security can be a roadblock. Security is often applied at a program or project level, preventing access, and hence reuse, across multiple projects. Moreover, within and across projects, access to part-level details may be blocked for some users even if they can access higher-level designs.

2.4. Poor Data Quality

Poor data quality can also be a barrier to standardization and reuse. If data is incomplete or inconsistent, some designers may be unable to determine with certainty whether an existing part would truly fit their requirements, leading them to redesign or request a new part.

And even if data has been standardized and the quality is high, it may be organized in a manner that prevents them from successfully locating matches. For instance, some people prefer to access parts by a classification name (fastener/bolt) while others prefer to search by material, preferred supplier or other criteria. They may abandon searches that don't conform to their personal search habits and preferences.

2.5. Poor User Experience for Search Tools

A further barrier to parts reuse is poorly designed or restrictive part search tools. If the user interface is cumbersome or performance is slow, designers will be much more likely to simply create a new part in order to save time and frustration.

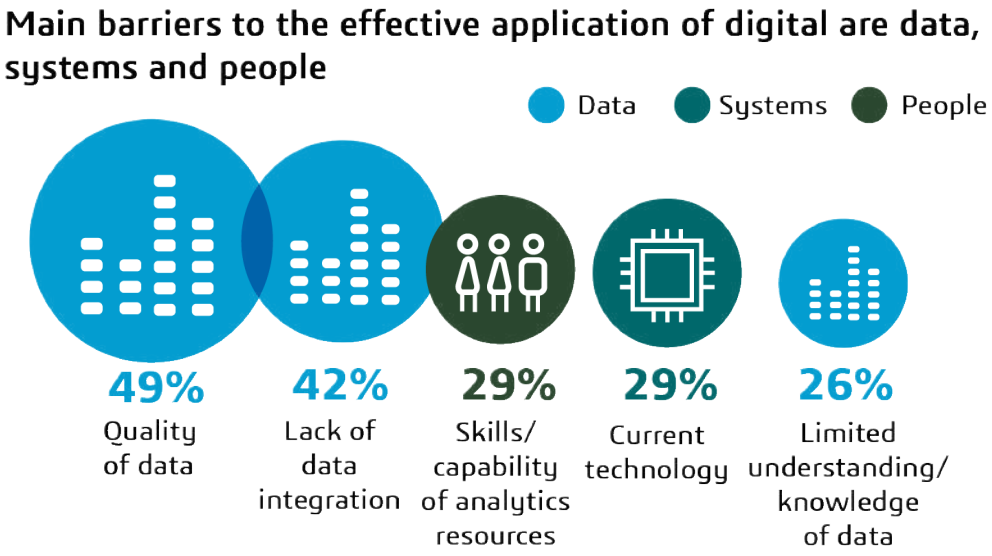
SECTION 3. BARRIERS TO OPTIMIZING PARTS SOURCING MANAGEMENT

While parts standardization and reuse are key drivers for limiting costs associated with new program development, they can also help decrease procurement costs and improve strategic sourcing partnerships. Of course in order to do so, the right people, notably the procurement department, must have access to the information required to guide their decision-making.

The primary challenges faced by Chief Procurement Officers include:

- Finding innovative performance and cost savings approaches
- Partnering with business stakeholders and breaking down business silos
- Taking advantage of analytics and Artificial Intelligence for an optimal experience
- Elevating the role of procurement to a trusted advisor for sustainable value creation
- Driving innovation while managing risks

Achieving all of the above starts with a detailed analysis of the total spend of the company, by categories, suppliers, countries, etc. Procure-to-Pay processes have been optimized by automating procurement and invoice payment systems. But Spend Analysis remains manual and tedious, whether when comparing the prices of parts and material ordered or identifying the main suppliers and their involvement in the total spend of the company.



Deloitte: The Global Chief Procurement Officer Survey
https://www2.deloitte.com/uk/en/pages/operations/articles/cpo-survey.html

Not surprisingly, the inhibitors to automatization are the same as those for engineering to optimize standardization and reuse. In particular:

- poor data quality, such as inaccurate or incomplete descriptions of a part or its supplier;
- multiple references of the same part found in different sources;
- lack of expertise on standard parts requiring the intervention of more experienced personnel; or
- disconnection with engineering, all contribute to the need for skilled persons in the procurement and sourcing department.

While analytics tools can help, they are based mainly on a semantic approach and are therefore limited by the level of data quality.

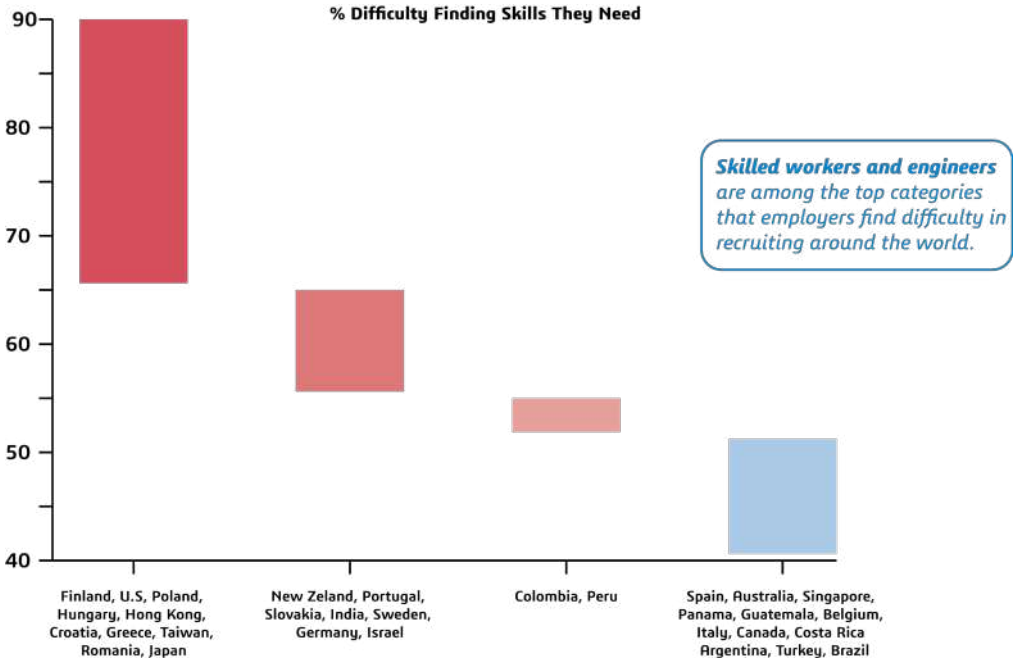
SECTION 4. THE BENEFITS OF PARTS REUSE

If organizations can overcome these barriers and achieve their reuse goals, the direct and indirect savings can be significant. IBM demonstrated this through its seven-year transformation project. The company succeeded in **boosting part reuse from 2% to 59%** and:

- Dropped abandoned project expense from 25% to 1%;
- Cut average time-to-market from 70 to 18 months; and
- Turned an $8B loss into an $8.4B profit.

One of the most significant contributors to this positive performance was the sharp increase in designer and engineering productivity thanks to greater parts reuse.

Percentage of Employers Facing Difficulties in Filling Jobs



With talent in short supply, maximizing productivity is essential
Talent Shortage 2020, ManpowerGroup

4.1. Direct Savings

The Aberdeen Group estimates that engineers spend up to 45% of their time searching for or recreating parts that already exist. The loss of valuable engineering time can be significant in sectors whose products include high volumes of simple parts, like industrial equipment, big-ticket consumer goods, aerospace and defense, and transportation.

Consider, for example, a typical automotive engine. Simple fasteners make up more than 40% of the engine's components. If simple parts like this can be standardized and easily reused, the number of valuable engineering hours that can recouped for higher value tasks is very high.

45%

Time spent searching for and recreating existing parts

Engine Type	Number of Components	Number of Fasteners	Percent Fasteners
B Series, 6 Cyl 5.9L	1,086	436	40%
B Series, 4 Cyl 3.9L	718	331	46%
C Series, 8.3L	1,111	486	44%

Data from Munroe & Associates

Significant savings can also be realized from the reduction in Engineering Change Orders (ECOs) enabled by greater reuse of existing, fully-vetted inventory parts or designs. Engineering change management is a complex, time-consuming and expensive process. Overall, change management:

- Constitutes 10% to 20% of design costs;
- Consumes 30% to 50% of engineering capacity; and
- Represents 20% to 40% of retooling costs.

50%

of engineering capacity ECOs can consume

Beyond engineering and ECO-related costs, reuse can reduce costs associated with other new part introduction activities, including:

- Design compliance verification
- Administrative time to create SKUs and update parts database
- Part and/or raw materials selection and purchase
- Equipment tooling
- Production labor and overhead
- Quality control testing
- Regulatory compliance certification
- Documentation
- Shipping and handling through production, supply and storage
- Inventory carrying costs (covering insurance, taxes, interest, storage, shrinkage, damage, etc.)
- Disposition of obsolete inventory

Average annual inventory carrying cost

20%

of inventory value

4.2. Indirect Savings

Beyond these direct savings opportunities, indirect gains from standardization and reuse can have an enormous impact on competitiveness, even if they are difficult to quantify. These include:

- Greater negotiation leverage for bulk purchases of standard parts
- More design and engineering time available for innovation
- More capital available for technology investments
- Reduced schedule slippage and faster time-to-market
- Increased customer satisfaction from higher, more consistent product quality

In order to help companies realize these competitive advantages, EXALEAD developed a solution uniquely designed to eliminate the barriers that have to date impeded effective standardization, reuse and sourcing to facilitate make, reuse or buy decisions company-wide.

SECTION 5. EXALEAD SOURCING & STANDARDIZATION INTELLIGENCE

EXALEAD has designed Sourcing & Standardization Intelligence applications to reveal and classify hidden legacy assets for optimized reuse that is easy, non-intrusive and affordable. With a view toward reducing costs, boosting productivity, facilitating collaboration and accelerating time-to-market, the solution uses advanced analytics and information retrieval technologies to:

- Automate and improve parts **classification** (OnePart Reduce)
- Enable more informed **sourcing** decisions (PartSupply on the **3D**EXPERIENCE Marketplace)
- Increase parts **reuse** by designers and engineers (OnePart Reuse)

5.1. Classification & Standardization

The foundation of successful parts reuse is a clean, standardized catalog of preferred designs and parts. Laying this foundation entails four essential steps:

i. Collecting parts data enterprise-wide

ii. Categorizing parts

iii. Designating preferred parts and vendors

iv. Monitoring and controlling reuse

i. Collecting Parts Data: Universal Connectivity

The first step in identifying duplicates and developing a catalog of standard, preferred parts is to access all parts from all engineering systems and projects.

Because it was designed for heterogeneous engineering environments, Sourcing & Standardization Intelligence leverages indexing technology which can crawl information systems silos to create a comprehensive data set focused on the primary element, the part.

It includes aggregating data from ERP and SCM systems with data from engineering systems to break down one of the most important barriers to reuse and smart sourcing, bringing together business and data information at the same place.

Once it accesses CAD models, the Sourcing & Standardization Intelligence index extracts any relevant information, from the size or the technical characteristics, up to the geometrical features. It is even capable of computing a unique digital signature leveraged for similarity search.

This does not require investments in changing the current infrastructure, as index crawling technology does not require changing authoring systems.

Benefits

- Break silos across applications and projects without impacting source systems
- Enable discovery of duplicates enterprise-wide

ii. Categorizing: Machine Learning Automation Leveraging 3D Shape Similarity

Once ecosystem data has been indexed, the **OnePart Reduce** application uses advanced machine learning to enable parts to be organized and duplicates identified at scale.

An algorithm is first used to cluster parts based on 3D shape similarity, geometrical features, and semantic criteria (name, weight, material, etc.).

All the clusters are displayed by highlighting the ones with the most duplicates or, when price has been associated with the part, those with the highest potential cost savings benefits.

Benefits

- Identify and reduce duplicates at scale
- Automate catalog cleansing and enrichment

iii. Designating Preferred Parts & Vendors

Among the parts classified in the same cluster, duplicates and near-duplicates can then be easily reviewed. Based on all complementary associated part information (vendor, price, technical information, etc.), the decision to designate a master part for the family can be made

Thus, product data managers and/or sourcing professionals can then use **OnePart Reduce** to identify and tag preferred parts and associated vendors.

Last but not least, these decisions are pushed to the **OnePart Reuse** application, which will guide the designer to promote reuse according to the company standardization policy.

Benefits

- Flag preferred parts and vendors to guide engineering
- Auto-push preferences to teams

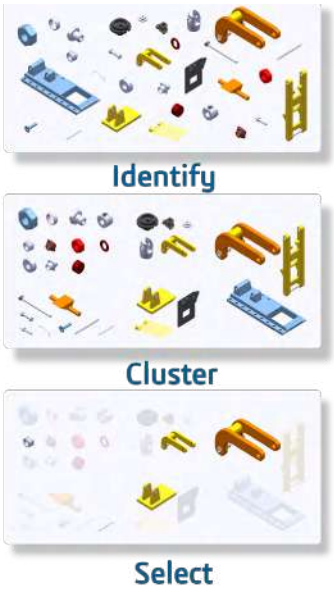
iv. Monitoring & Control: Built-in Analytics

To ensure the catalog stays clean and to prevent future duplication, **OnePart Reduce** can be run regularly to identify newly created parts belonging to a named classified cluster, and therefore alert for possible deviation from the standardization process.

Benefit

- Maintain control of duplicates and quality

Standardization Process



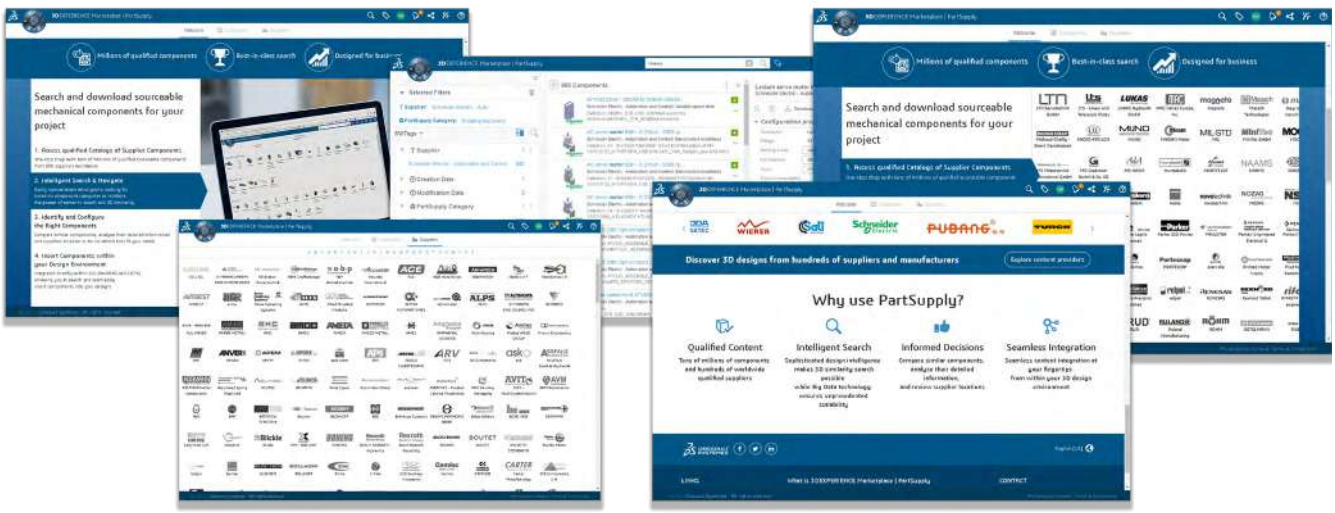
5.2. Sourcing

Sourcing and procurement teams don't need to master CAD software in order to benefit from using Sourcing & Standardization Intelligence applications to associate business information (extracting from purchase orders part provider names, location, price, quantity) with engineering information (shape signature, feature recognition, technological properties) to make smarter, more advantageous buying decisions:

- Sourcing can identify similar parts the company has allocated its budget to, and determine whether its supplier strategy is optimized and the pricing policy uniform by geography, and take corrective actions, if any (**OnePart Reduce**).
- Purchasing can use the machine-learning-based clustering feature to quickly and easily group similar parts on shape or on material or manufacturing location to negotiate favorable bulk pricing (**OnePart Reduce**).
- Click-and-go shape search can help rapidly retrieve matching parts from past or parallel ongoing projects and make fast and fully informed make, reuse or buy decisions (**OnePart Reuse**).
- Comparative data on tens of millions of catalogued parts from hundreds of suppliers can also be searched to evaluate technical characteristics, performance and quality, and quickly secure vendors able to deliver (**PartSupply on the 3D**EXPERIENCE **Marketplace**).
- If the requested part cannot be found, sourcing and procurement managers can find a manufacturing service provider. Thus, they can manage in one user-friendly place all the transactions exchanges needed to fill simply and efficiently their manufacturing part orders (**Marketplace Make**).

Benefits

- Make better informed decisions
- Leverage bulk purchases for price negotiations



5.3. Reuse

To increase the use of standard, preferred parts at design time, **OnePart Reuse** provides a search experience for engineers that makes reusing or adapting such parts consistently faster and easier than creating new ones.

OnePart Reuse provides intuitive user navigation, ultra-fast query processing, and a unique combination of text and shape search features.

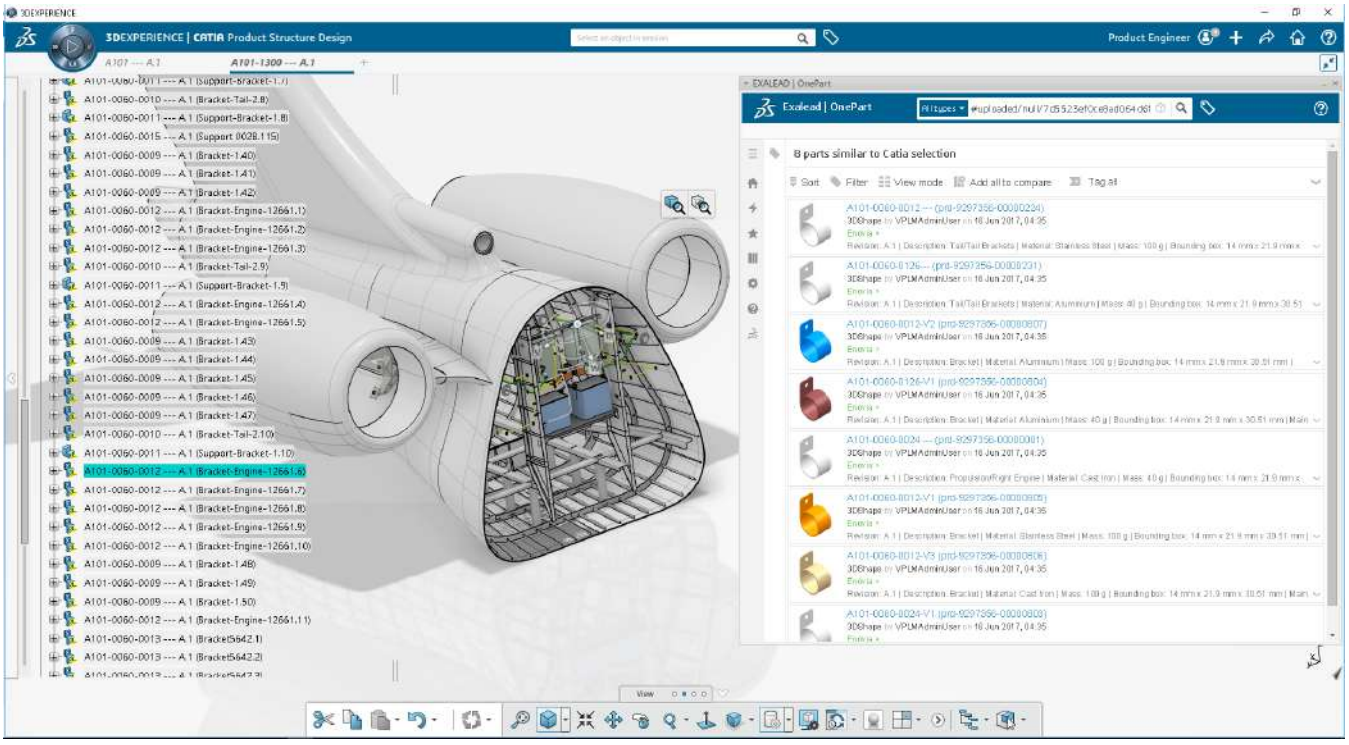
- **Semantic (Text) Search**
  The full-text search engine in **OnePart Reuse** enables engineers to conduct natural language search for parts and related documents, complete with auto-correction and auto-suggest features. The application also automatically generates search refinement menus with each result set to help engineers quickly hone in on parts of interest.
- **Shape Search**
  Users can alternately launch a search by drawing or clicking on an existing 3D shape. The engine will automatically return all designs of a similar shape, making it easy to scan results and rapidly identify potentially reusable parts and designs.
- **Combined Semantic & Shape Results**
  To make a final determination of whether a given part is suitable for reuse, each result set combines semantic data and 2D/3D data, regardless of whether text or shape search was used to launch the query. This combined data is essential for distinguishing between seemingly identical parts, and determining if a given part truly meets all engineering requirements. Furthermore, the designer's decision to reuse is driven by product data managers and/or sourcing professionals who define the company's master parts.

  To encourage reuse and maximize engineering productivity, the **OnePart Reuse** application is accessible on the Web via an Internet browser, or embedded in Dassault Systèmes' popular CATIA software.

  Let's look now at some specific case studies of how engineering, procurement and data management professionals are using EXALEAD's Sourcing & Standardization Intelligence applications to achieve their standardization and reuse goals.

Benefits

- Make reuse faster and easier than creating a new part
- Free engineering capacity for innovation



SECTION 6. CASE STUDIES

6.1. Dramatic Reduction of Duplicates: High-Tech Industry

The Challenge

Bird Technologies (Bird) is one of the world's leading providers of radio frequency products and services. The company designs and manufactures a large variety of components for its RF equipment at multiple sites in Ohio, New York, Virginia and Sweden.

John Winter, Bird's mechanical engineering manager, knew that the company had many 3D models that, if reused in new designs, would considerably cut costs and market delivery time.

75%

Reduction in duplicates

Results with OnePart

Using EXALEAD's Sourcing & Standardization Intelligence solution, Bird was able to identify over 3,000 duplicate parts. They used the application to reduce that number by 75%, a figure Winter expects to rise as its usage increases. In addition, he notes the application was very easy to install: "Once the system was installed, it took under six hours to get it up and running."

6.2. Cost Savings from New Part Introduction: Automotive Industry

The Challenge

Volvo Bus conducted an internal analysis to calculate the total cost of new parts introduction (NPI) for a typical project involving three years in development, plus five years in production, and carried out 15 years in the after-market (with a 12% discount rate). The costs analyzed included Product Development, Purchasing, Manufacturing and After-Sales Maintenance. The results showed that reducing NPI volume could significantly improve Volvo's bottom line.

€3K-€75K

Total cost of NPI

Part Category	Simple	Normal	Complex
New Part	€3,300	€16,000	€75,000

Estimated Cost of New Part Introduction

Results with OnePart

The company deployed EXALEAD's Sourcing & Standardization Intelligence solution after a second study determined it to be an effective tool for increasing reuse, and one for which they could achieve a 100% return on investment in just six months with as little as a 1% reduction in NPI.

6.3. Small Costs Really Add Up: Industrial Equipment Industry

The Challenge

Following a series of acquisitions, Wittur, a top manufacturer of elevator components, modules and systems, faced a significant challenge in using the massive amount of diverse data across its globally-located plants to support part reuse.

20 Hours
€184,000

Engineering hrs saved per day and corresponding annual savings

Results with OnePart

The company adopted EXALEAD's Sourcing & Standardization Intelligence solution to break through data silos and provide global access to parts data stored in distributed sources including SOLIDWORKS PDM Professional and legacy SQL databases. This reduced the time engineers spent looking for information by more than 20 hours per day, freeing up €184,000 worth of engineering time per year for higher value tasks while reducing parts proliferation.

SECTION 7. CONCLUSION

Manufacturing always has been and will remain a highly dynamic sector. Forces such as globalization, digitization, consumer and industrial IoT, and mergers and acquisitions will continue to fuel this dynamism. And with them will come continued pressure for product differentiation and customization.

But the costly proliferation of parts and components that often accompanies this pressure can be controlled through multiple strategies. One of the easiest and most effective of these is to deploy EXALEAD Sourcing & Standardization Intelligence.

Combining information sources complemented by semantic information and the **universal language of 3D shape signature** enables Sourcing & Standardization Intelligence applications to go beyond the limits of conventional analytics solutions and deliver **simple user experiences** for decision makers.

This easy solution wasn't available to IBM when it went through its lengthy transformation, but that transformation, and the EXALEAD deployments by customers like Bird, Volvo Bus, and Wittur, show that boosting the reuse of standardized, preferred parts, especially simple, high-volume ones, can significantly:

- **Improve parts standardization between programs and sites**
    - Maximize cost reductions across departments
    - Minimize the number of references
- **Reduce the number of suppliers, but strengthen the strategic relationship**
    - Capitalize on past orders
    - Reduce the pricing differential

The non-intrusive EXALEAD Sourcing & Standardization Intelligence solution makes it easy to achieve these goals. Advanced machine learning technology automates previously time-consuming tasks, such as:

- Identifying and reducing duplicates enterprise-wide,
- Enriching and standardizing catalogs, and
- Locating existing preferred parts in seconds.

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