

Service Lifecycle Management

Optimizing product design and service operations to maximize uptime and service revenue

White Paper

As profit margins in manufactured goods continue to come under pressure, product companies must seek additional sources of profitable revenue growth. One area of opportunity is product service, so it is no surprise that many firms are looking for the best way to increase service revenue or offer add-on services. This white paper describes methods and practices in service lifecycle management, and the role of product lifecycle management (PLM) software in achieving service excellence.

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Executive summary

As profit margins in many of the manufacturing sectors continue to be threatened by global competition, price deflation and rising commodity prices, product companies seek alternative sources of profitable revenue growth. Many brand owners are exploring revenue growth and profit protection strategies enabled by value-add service products.

However, delivering product service that is both effective and profitable is no small feat. Many service organizations may have reached a good level of performance given their current level of budget and human resources, and are seeking a new paradigm to reach a significantly higher level of service delivery. New service models based on technologies, such as the internet of things, are certainly promising, but unless they are put in the right business and technical context, these models may not deliver the promised benefits.

A different way of thinking is required to move service to the next performance level. This approach centers on incorporating service lifecycle management as an integral part of product lifecycle management in order to achieve significant improvement in service readiness.

First, this approach focuses on making complex products easier and less costly to maintain, and allowing for more effective allocation of human resources. The second key component is managing the complexity of information that will reduce the cost and time to create and deliver critical service documentation, while at the same time improving the quality and efficacy of this information.

Although portions of this approach might appear to increase operational and product costs when considering the long service life of engineered products, both customers and product companies should expect to recover these investments over the time the assets are in operation. Asset owners benefit from increased utilization and productivity due to faster and more reliable service. Brand owners are able to deliver higher quality service at lower cost, resulting in higher profits margins, enhanced brand image and greater customer loyalty.

Why service? Why now?

As profit margins in manufactured goods continue to be challenged due to increased global competition, price deflation and rising commodity costs, product companies must seek alternative sources of profitable revenue growth. One area of growth opportunity and profit protection is product service, and many companies are examining ways to increase service revenue or offer additional add-on services to supplement product revenues. There are several reasons why product companies are investigating service revenue opportunities:

Aftermarket service is highly profitable – Profits of well-executed aftermarket services vary dramatically by sector and company, but a reasonably good estimate is that across industries, aftermarket services represent approximately 25 percent of revenue, with some product companies, especially in production machinery, enjoying double that. As importantly, mature service operations typically contribute 40 to 80 percent of profit.

Service is countercyclical – When product sales slow down, for example, during an economic downturn, service activity tends to rise as customers hold on longer to older equipment. When product sales decrease, service revenues tend to increase and recover some of these losses.

Service for product life extension – As products approach end of life, effective service contracts and attractive pricing could help maintain brand loyalty until the customer is able to replace an aging piece of equipment with a new one.

Service drives customer loyalty – Customer-facing employees, such as call center agents and field technicians, are the face of the brand. They can understand customer needs and work diligently to delight them or, conversely, ruin the customer experience. Research has shown that asset owners that had a good customer service experience are more loyal than those who had never experienced any service interaction. Additionally, service representatives can become an excellent sales force add-on at no added cost.

Products as service platforms

The quest by manufacturing companies to improve the service experience parallels a shift in the way the markets view product ownership and lifetime costs. Mature organizations and sophisticated end users alike seek higher asset productivity and better return on their investment, whether they own the equipment outright, lease it, or contract a third party for a guaranteed level of productivity.

Traditional product-centric companies are supplementing product revenues and offer productivity-based agreements based on a contracted level of performance: uptime, produced units, etc. There are well publicized stories about performance-based service contracts such as Rolls-Royce's "Power by the Hour," its pioneering approach to engine maintenance management. The business benefits of this type of service agreements are relevant not only to complex, expensive mission-critical products such as jet engines, but also to smaller organizations and less complex equipment.

This new way of transacting service can be beneficial for both the asset owners and the product company. Asset owners enjoy lower capital investments and maintenance agreements that are tied directly to business outcomes. Brand owners use service revenues to compensate for troughs in product sales and enjoy a predictable and profitable revenue annuity.

Why now?

Admittedly, product service as a business practice, service revenue economics and the importance of service to customer loyalty are nothing new. The idea of customer-as-king, aggressive customer satisfaction metrics and running service as a profit and loss center has been around for many years. So why is it important now?

The economic slowdown and financial stress led asset owners to hold back expansion plans and delay replacing older equipment. Not only does this cause sales revenue to decline and greater dependency on parts and service revenues, but asset owners are paying greater attention to proper maintenance to keep the older equipment running and preserve its resell value.

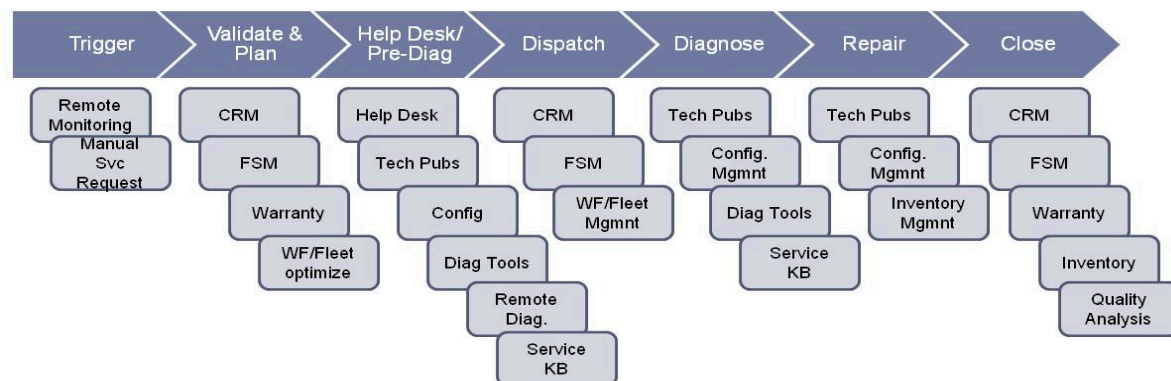
Over the years there has been a steady improvement in the reliability and durability of products. As assets last longer, so is the period during which routine maintenance and periodic – if less frequent – repairs are needed, and that means there are more opportunities to engage with customers.

Another driver for the renewed attention to service stems from the availability of relevant technologies that facilitate cost-effective and profitable service. Onboard sensors, data acquisition and process capabilities are getting increasingly smaller and less expensive. Coupled with ubiquitous and affordable communication, these technologies open the door for new business models and service offerings, such as remote monitoring and diagnostics, fleet management and remote software upgrades, all at reduced cost and requiring fewer human resources.

Service management

Responding to a service call and managing the service process from the equipment’s failure to restoring it to full operation is an intricate process, involving several sub processes and disciplines, different types of resources and engaging multiple parts of the organization. The figure below shows a detailed view of a reactive service process that incorporates numerous activities, resources and decision points. Depicted in this figure is an all-encompassing view of an event-driven, service-delivery process. In practice, rarely does an organization use the exact end-to-end process; different organizations adopt a process that reflects the type of equipment being maintained, customer expectations, contractual obligations and so forth.

Figure 1



Key operational metrics

The various functions and activities in service management are governed by a range of disciplines and associated metrics. The table below lists some common performance metrics used to manage a service organization. Just like the service delivery process flow is different from one organization to another, mature service organizations select metrics that are tuned to their business. It's important to note that not only do these metrics represent a broad set of types of information from different technical and business operation disciplines, but they are also managed by different enterprise software systems.

Table 1: Typical key performance indicators

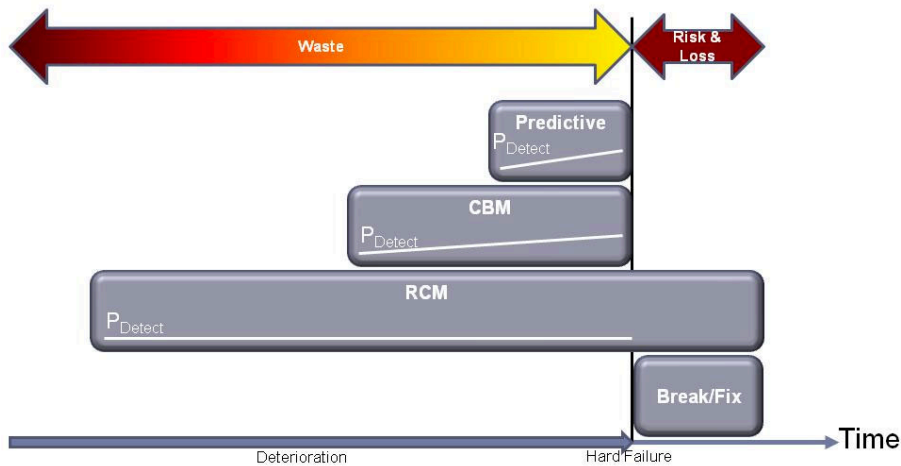
Service delivery	<ul style="list-style-type: none">• Mean time to repair (MTTR)• Response time• Parts used• First-time fix (FTF)• No fault found (NFF)• Repeat calls
Service operations	<ul style="list-style-type: none">• Adherence to service level agreement• Parts management related metrics• Workforce management metrics
Financial performance	<ul style="list-style-type: none">• Warranty-related metrics• Service profit and loss

Maintenance strategies

Different approaches to planning, scheduling and executing repair and maintenance activities have been honed over the last half century, with many of them originating in maintenance strategies developed by the military to maximize the availability and mission readiness of military hardware. Although some traditional methods are as relevant and effective as ever, the technology evolution in onboard computing and communication technologies opens the door for innovative approaches that can improve the efficiency and efficacy of service delivery.

The diagram below illustrates the four classes of maintenance strategies. The diagram illustrates the point in time, relative to the equipment failure, in which the service operation commences, and highlights the fact that different strategies have different attributes in terms of asset utilization, as discussed below.

Figure 2



Break/fix or “run to failure”

Break/fix repair strategy is the traditional and simplest approach to maintaining complex hardware. Simply put, the equipment runs continually until the asset owner or operator recognizes a failure and requests service. This approach has some clear and simple advantages.

First, this strategy requires very little in terms of planning and resource allocation, and is, therefore, very easy to implement. Similarly, the contractual agreement between the asset owner and the service provider can be straightforward, focusing on response time to a service call.

While an unscheduled service event is disadvantageous and disruptive, the strategy of letting a piece of equipment run for as long as possible maximizes asset utilization between failures.

However, the disadvantages and risks in this approach can be quite significant. Because the exact time and type of failure is unpredictable, any failure can cause a significant degradation or stoppage in operation, and results in unscheduled downtime. This is not only highly disruptive, but can also increase the cost and overall impact of the failure of a single low-cost component or subsystem, or can cause the failure or even destruction of a large and expensive piece of equipment. In certain instances, it can also pose risk to human life, such as the failure of a major aircraft system while in flight.

From an operational point of view, the break/fix approach also impacts the service organization that needs to scramble resources in order to adhere to the terms of the service contact, while maintaining the service levels agreements with other customers. This, in turn, can lead to suboptimal allocation of expertise, degrade service performance overall and hurt profitability.

It's worth noting that while certain types of machinery equipped with sensors and communication devices can alert the remote service organization of the failure, the impact of this event is nonetheless very disruptive, thereby improving response time and adherence to service level.

Reliability-centered maintenance

Despite the simplicity of the break/fix approach, its disruptive nature and inherent risks make it highly undesirable, except for instances in which downtime isn't critical and service levels are easy to manage.

Reliability-centered maintenance (RCM) aims to provide proactive rather than reactive service. Instead of reacting to a failure, preventative service is performed at regular intervals based on the asset's anticipated failure rate (MTBF). In this time-based strategy, repair is scheduled in advance so it is less

disruptive, maintenance resources can be preallocated, and multiple inspection and preventive maintenance activities take place to reduce the likelihood and impact of the inevitable hard failure.

Although effective in reducing the frequency of failures, any repair activity before it is actually required is wasteful because, by definition, a functioning component is replaced before it failed even if it could continue to operate reliably for a long time. RCM can be relatively effective and economical when the MTBF of the equipment is sufficiently accurate and the degradation rate is constant so that the service intervals can be continually adjusted to reflect the effect of the continued use of the equipment.

However, MTBF is often a misunderstood and poorly utilized metric. Even if an accurate MTBF can be calculated at design time, factors such as built-in variability, different configurations, asset operation patterns and maintenance practices influence MTBF across products and the lifecycles. Furthermore, the use of statistical models suggests that this approach works more effectively and economically in large fleets of similar equipment.

Another shortcoming of RCM relative to more advanced methods is that despite the fact that as time advances and there is a greater chance of an impending failure, RCM is conducted in a regular cadence and the likelihood of detecting a problem in advance of a hard failure does not change, as denoted by the P_{Detect} line in figure 2.

Finally, being a statistical rather than an objective method, even the most precise RCM schedule does not prevent unexpected failures and the subsequent consequences. Consequently, organizations that maintain mission-critical equipment tend to increase the frequency of scheduled maintenance activities, leading to additional waste.

Condition-based maintenance

By definition, any maintenance activity performed before it is required is wasteful because it causes downtime, incurs costs and consumes resources before they are actually needed. Conversely, condition-based maintenance (CBM) is an approach that prescribes maintenance and repair activities on the basis of an objective evidence of need.

CBM uses any number of methods, including onboard sensors, measurement devices and manual inspections to assess the state of a component, subsystem, the entire system or production quality, and affects a repair action when and as needed.

Similar to break/fix, CBM maximizes utilization because the asset remains in operation for as long as possible. However, CBM reduces risk and waste because downtime can be scheduled in advance to maintain operation continuity and the repair itself covers only those components needing repair. As figure 2 denotes in the slope of the P_{Detect} line, the likelihood of detecting a problem in advance of a hard failure improves with time.

Although the methods discussed above focus on service planning and operation, they typically do not require any corresponding changes to the equipment. CBM relies on detailed and specific information about the state of the equipment and subsystems to assess the condition and target the components that need repair. This usually entails a broad set of diagnostic tools, such as onboard sensors, measurement devices and decision support systems. To further improve efficiency and optimize the allocation of human resources, asset owners may want data collection and transmission capabilities so that the equipment can be monitored remotely. These technologies, especially when not designed-in but rather conceived later and added as a field retrofit, can be prohibitive to the point that they negate the potential savings of CBM.

Predictive maintenance

One element common to some of the maintenance methods discussed above is that a service operation is triggered when a hard failure is imminent or has occurred, thereby increasing the likelihood of greater damage to the equipment and the cost of the repair, and making last minute resource scheduling more difficult.

Advanced failure prediction methods are designed to minimize the risk of unplanned failure while providing longer lead time for advance resource planning. Like CBM, they use early telltale signs of an impending failure to determine the urgency of the repair, but can also provide guidance on the time until the failure as well as the severity of the potential failure. Moreover, they offer guidance for the operators and maintainers as a measure to reduce the risk and extend the operation, for example, to reduce the load of the equipment to allow it to limp home.

Implementing a viable and reliable predictive maintenance system is difficult. It requires deep understanding of the normal operating parameters and failure modes of the equipment, and developing complex statistical models to analyze multiple sensor data streams and reliably predict trends and outcomes.

The main challenge facing the developers of predictive maintenance systems and, to a lesser degree, of CBM software, is that the behavior of complex engineering equipment – both during normal operation and when a subsystem fails – is not static: it continues to change due to normal wear and tear, modifications, operator interaction, maintenance practices and numerous other factors. Consequently, the predictive models have to be continually updated – either manually or programmatically – to respond to these changes. For that reason, predictive models are difficult to scale and re-use.

Service Lifecycle Management

Table 2

	Trigger	Pros	Cons
Break/fix	Hard failure	<ul style="list-style-type: none"> • Maximal utilization of asset up to the point of failure 	<ul style="list-style-type: none"> • Disruptive, unplanned maintenance/downtime • High, unpredictable use of maintenance resources • High level of subjective and incomplete decisions impact TTR, TTF, repeat calls, collateral damage, etc.
Reliability-centered maintenance	Regularly scheduled intervals	<ul style="list-style-type: none"> • Allows for proactive planning of other adjacent maintenance activities • Protects asset against permanent damage arising from failures 	<ul style="list-style-type: none"> • Maintenance before required wastes usable life of assets, prematurely uses resources
Condition-based maintenance	Upon objective evidence of need	<ul style="list-style-type: none"> • Utilize life of asset components almost to the point of failure, minimizing waste 	<ul style="list-style-type: none"> • Requires investment in instrumenting equipment: retrofit or upgrade, monitoring infrastructure, etc. • Quality can suffer at onset of asset performance degradation
Predictive maintenance	Advanced failure prediction	<ul style="list-style-type: none"> • Minimize risk of unplanned failure • Greater lead time for advance resource planning • Root cause analysis protects asset against permanent damage arising from failures 	<ul style="list-style-type: none"> • Requires significant investment in instrumenting equipment and analytics, failure modeling, etc. • Requires ongoing upkeep of predictive models; difficult to scale and reuse

The maintenance strategy or combination of strategies utilized for service operations depends on a multitude of considerations, such as equipment type and mission criticality, business objectives and where the investment will be made.

Service Lifecycle Management

As we described earlier, fulfillment of service requests is a complex process that requires interactions among numerous activities, resources and decision points, such as the contact center, remote monitoring, field service, spare parts planning, repair depot, warranty management and service knowledge management.

The challenge facing service organizations, whether it is an original equipment manufacturer (OEM) or a third party, and asset owners and operators, is to deliver service that is both effective and profitable. Most service organizations believe they have already reached a good level of performance under the present level of budget and human resources, and other than small incremental improvements and cost-cutting measures, there isn't much more they can do.

A different way of thinking is required to move service operations to the next level of performance. Service lifecycle management (SLM) is a strategic way to look at service planning and delivery as an integral part of the overall equipment lifecycle management. SLM enables the service organization to manage all the service aspects of a product from design phases until it is no longer in service. A complete SLM process drives up the efficiency and efficacy of all aspects of service operations:

- Built-in serviceability characteristics
- Service planning
- Service delivery
- Quality and performance management

Design for service

As discussed earlier, providing information about as-designed, as-installed and as-maintained equipment helps service technicians deliver effective and efficient service. However, when considering the multitude of information and design and attributes that influence, assist or hinder service, we realize that most of them are designed-in and, therefore, have a permanent – positive or negative – impact on service execution.

Design for service (DFS) is a product lifecycle strategy that addresses the *serviceability attributes* to determine the cost and efficacy of servicing the product. Some key serviceability attributes are:

Reliability planning – Product reliability is the primary driver of service and warranty costs. However, achieving high reliability can delay the release of the product to manufacturing, add cost to the final product, or add complexity to the supply chain. Therefore, the goal of DFS is not to maximize reliability, but rather optimize it relative to competitive products, warranty period, the type of maintained strategy to be employed and the type of service level agreement.

Architecture – The physical architecture of an asset has significant influence on service and repair activities. The physical architecture, parts modularity and the designation of field replaceable units (FRU) dictate which parts have to be inventoried, carried to the point of service and replaced, and subsequently sent back for depot repair, testing and recertification. From a troubleshooting and replacement point of view, FRU level influences time and accuracy of diagnosis and repair: higher level FRUs have a clear advantage since a single repair action can cover numerous functions and potential failure modes. On the other hand, these FRUs are more expensive to inventory, ship and repair, and can be more difficult to handle by a single service technician.

Ergonomics – Performing routine maintenance and repairing highly engineered assets, such as heavy equipment, automotive and industrial machinery, can be difficult and potentially hazardous, ranging from heavy lifting and working around hot surfaces, to proper handling of hazardous materials. When considered early enough in the lifecycle, design engineering and service planners can consider modifying the physical architecture, design special tools and devise appropriate techniques to ensure fast as well as safe service. These techniques can be proven by employing the same simulation tools that are used in manufacturability assessments.

DFS offers a structured framework to help the product organization determine the appropriate level of product reliability and serviceability. From an external, market perspective, DFS considers customer expectations and competitive products. From an internal service operations perspective, DFS focuses on the ability to deliver the highest desired level of service performance under given resource and cost constraints.

Understanding the serviceability characteristics of a new piece of equipment helps the service organization achieve a higher level of service readiness before the launch of a new product. As importantly, when a DFS strategy is in place, the interaction between engineering and service should lead to better design decisions. For example, analysis of lifetime service cost should help determine the economic value, if any, of improving onboard diagnostics.

Service planning

Effective service planning, especially for performance-based service contracts, requires that the service organization has a good advance understating of the factors that drive service events and the resource requirements to deliver efficient and effective service. Considering these factors based on information obtained from engineering data early in the product design elevates the level of service readiness so that the service organization is better prepared for the launch of a new product.

Reliability – Asset reliability is the primary influencer of service and warranty costs. Service planners should use reliability assessments that have been obtained during early product lifecycle phases: design, simulation and volume production ramp-up to staff and prepare the service organization. Organizations that do not have access to such structured information and do not take advantage of it well in advance of a product launch tend to struggle to keep up with evolving service needs. The service planner will define service requirements, service cycles, utilization characteristics and service procedures based on product design and reliability.

Spare-part planning – After labor costs, spare parts are typically the second highest cost element in service delivery. While there is an impetus to reduce spare-part inventories and the number of inventory locations, over-leaning can have a negative impact on the ability to meet service level requirements and increase logistics costs.

Human resources – Good knowledge of the time, skills and resources each service operation requires helps service planners recruit and train talent, and optimize allocation and scheduling of these resources.

Service delivery

Configuration management

Many asset types, such as aerospace, marine, automotive, heavy equipment and industrial machinery, are available in many configurations and customer options. Furthermore, such long-life assets may undergo many changes throughout their service life, such as hardware or software upgrades, modifications to correct design flaws, or adding or removing options. So a single type of equipment may appear in the field in any one of many variants.

Effective maintenance and repair activity consists of not only considering the general class of equipment – the as-designed or as-sold version – but also the as-installed and as-maintained version of the same. The details of each instance's configuration are critical so that service personnel can access accurate and up-to-date spare parts information and repair instructions. Asset configuration management and associated knowledge drive all aspects of service work definition and execution.

Service information

Maintaining, troubleshooting and repairing complex equipment requires knowledge and experience. As most products are becoming increasingly complex, and, conversely, availability of knowledgeable and experienced maintenance and service staff decreases, service organizations are challenged to deliver effective, efficient and safe service. Another interesting observation is that the improved reliability of many types of complex assets results in less experienced personnel that only rarely gets to work on a certain system, unique configuration, or a type of failure.

Therefore, it is critical to provide service technician training, and it is even more important to make available top-notch service information, such as theory of practice, diagnostics and troubleshooting, work instructions and illustrations, safety and compliance guidelines and part catalogs.

But since the configuration of each deployed piece of equipment can be different enough to impact the accuracy of the troubleshooting and repair activity, effective service information should be configurable, comprising only information pertinent to the specific configuration of the equipment under service.

Traditional approaches to authoring service documentation, such as troubleshooting procedures and repair instructions, are very labor intensive. They are very information rich, covering issues from theory of operation to safety and disposal instructions, resulting in monolithic document sets that are hard to manage and update, and users often find them difficult to navigate and use effectively at the point of service. These challenges are amplified when repair manuals have to be translated into one of many languages used in international markets.

Although content authoring and delivery tools have improved over the years and, quite ironically, cost limitations have led some manufacturers to reduce the volume of service information they produce, by and large, service information often lags behind, as service information authors are unable to keep up with the rate of new product configurations, design improvements and latest service knowledge..

To overcome the sluggish authoring and delivery system, manufacturing companies – most notably in the automotive industry – have resorted to issuing brief periodic updates, commonly referred to as technical service bulletins (TSBs). Technical bulletins address the publishing bottleneck, but they generate another problem by producing a separate stream of knowledge that is managed separately and is rarely incorporated into the main corpus of service information.

In the SLM environment, service content is linked to product and asset configuration at a re-usable level that enables rapid update of just the effected elements and assembly of service documentation based

on that asset configuration. This strategy ensures that the information delivered to the technician at the point of service is complete, up-to-date, accurate and specific to the equipment and task.

Closing the quality loop

Once a product design is essentially frozen and the product enters volume production, the service organization and the warranty department serve as the only source of critical information about product operation, durability, reliability, customer experience, etc. This is a critical fact many product organizations fail to recognize and leverage.

SLM enables an ongoing feedback mechanism between design and engineering and service. During the service planning stage, this information is improving service readiness. Once the equipment is in the field, information from service operations and warranty claims is used to refine service planning: improve service information, update training, modify inventory strategy and so forth. The same Information flows to product marketing and engineering to facilitate long term processes such as product enhancements.

Service Lifecycle Management and product lifecycle management

The service and support delivery process in many organizations tends to be fractured since it incorporates roles and responsibilities from various groups that have divergent goals and measures. In a typical product company, many of the decision points and much of the data required to execute effective service are managed by different enterprise software systems, including PLM and enterprise resource planning (ERP), and, quite often, a myriad of local databases and spreadsheets, to circumvent the lack of a single governing process and tool, further fragmenting information and knowledge processes.

Conversely, a strategic view of the SLM process dovetails and intersects with the extended PLM process: design information is used to bootstrap and enhance service planning, and product changes and updates are directed to modify service work instructions, and field experience provides up-to-date insight into product quality.

Furthermore, the bulk of the information that service technicians need, such as illustrations, schematics and work instructions, already exist within the engineering organization and can be repurposed with a relatively modest effort. For example, 3D computer-aided design (CAD) models can be used to create everything from exploded wireframe views to photo realistic rendering, and to remove and replace animations that help in service execution. Or, manufacturability and ergonomic simulations can be used to improve the safety and efficiency of repair procedures.

The enterprise PLM framework should be expanded to govern the service lifecycle management as a dynamic process that continues throughout the useful life of the asset.

The enterprise PLM system should provide a centralized repository of the in-service bill-of-materials (BOM) so that service items, which are mostly design and manufacturing items repurposed for service, can be synchronized to reflect the most up-to-date state of information. This synchronization is possible when SLM is part of PLM and shares the same configuration and change management processes.

Essential guidance

Becoming a customer-centric or service-centric organization takes more than just best intentions and requires mastering of new process skills, organizational principles and technologies. Manufacturing organizations and, specifically, the engineering and service departments, should adopt a new comprehensive view of the product lifecycle to move service to the next performance level. This approach centers on incorporating service lifecycle management as an integral part of the product lifecycle management in order to achieve significant improvement in service readiness. Furthermore, this structured approach is needed in order to assess investments in serviceability technologies, including technologies such as machine-to-machine communication and the internet of things.

Serviceability should be designed-in

- Implement a design for service center of excellence and incorporate SLM practices and metrics in product design
- Involve design for service and service planning early in the product lifecycle
- Institute a service BOM that incorporates all types and aspects of service-related information, and is linked to the master BOM and is configuration-driven. Items in the service BOM represent a broad range of item types and are sources from multiple enterprise systems, including PLM, product data management (PDM) and ERP, and many could be provided by suppliers and partners

Closed-loop processes and knowledge re-use

- Minimize the creation of new service related content, whether for training, service delivery or root-cause analysis
- Institute enterprise-wide information re-use practices. The purpose is not only to reduce cost and time-to-market of information, but also to facilitate feedback from manufacturing, service and warranty to improve the quality of information in the PLM system, which can then be leveraged to rebuild and update all users of that information across products and lifecycle phases
- Incorporate information from downstream processes, especially service incidents and warranty claims, to influence upstream activities in various phases of the product lifecycle. Equipment uptime, failure rate, repair efficiency and similar metrics are very helpful in forecasting warranty claims and accruals. They are also used to guide the development of enhanced service information and technician training as well as to drive product improvements

PLM

Essentially, the enterprise PLM systems should become the digital backbone of the entire product lifecycle, including SLM, to reduce process fragmentation and to provide rich end-to-end context for better and more profitable service.

Conclusion

Incorporating design considerations and features to support service operations increases engineering time and manufacturing costs, which in turn could drive up product cost. However, considering the long service life of certain types of production-related assets, both customers and product companies should expect to recover these investments over the time the assets are in operation:

- Asset owners will benefit from increased utilization and productivity due to faster and more reliable service as well as long asset life
- Product companies and service organizations will be able to design products that are easier to service, and deliver higher quality service at lower cost, resulting in higher profits margins, enhanced brand image and greater customer loyalty
- Detailed visibility into product uptime and serviceability, and greater awareness of overall service will result in enhancements to current and future product and service packaging, further increasing the value and return on investment in SLM

For more information on service lifecycle management, please visit the [Siemens PLM Software](#) website. This white paper was underwritten by Siemens PLM Software. All concepts and ideas were developed independently. © 2014 Joe Barkai.