How IBM Transformed its Asset Reutilization by Applying IBM Smarter Analytics Solutions

See how IBM Business Analytics and Optimization products are used in the solution

Learn about the "three-in-a-box" method that is used in the project

Understand how this solution can apply to your business
Executive overview

Manufacturers have long benefitted from reusing returned products and parts. This beneficial approach can help contain costs and can help the manufacturer play a role in sustaining the environment. Reusing returned products and parts aids sustainability by reducing the use of raw materials, eliminating energy use to produce new parts, and minimizing waste materials. However, handling returns effectively and efficiently can be difficult if the processes and systems do not provide the visibility that is necessary to track, manage, and re-use the returns.

IBM® has been recognized for many years by leading analysts as having one of the top supply chains in the world. IBM established the Integrated Supply Chain (ISC) organization to transform the supply chain from a cost center into a competitive advantage. This organization encompasses various organizations such as manufacturing, procurement, customer fulfillment, and global logistics.

As part of continual improvement, IBM initiated a project to more effectively handle its returned hardware (products and parts), which is an effort known as asset reutilization. The Asset Reutilization Project applied business analytics to various aspects of asset reutilization, such as forecasting the return of material and enabling optimized reutilization. For example, IBM wanted to better manage returned IBM servers. IBM knew that these returns could be recycled into IBM hardware products that are being manufactured. By using analytics, the behavior of the historic IBM server market was analyzed to produce a forecast of returning products and parts. By using these forecasts, IBM could see where and how to use the returns. The ability to reuse and recycle returns created a demand-driven reverse supply chain, which is where a company finds ways to reduce costs by reusing returned products and parts.

This IBM Redguide™ publication explains how IBM transformed its process for handling returned products and parts and how it reshaped the asset reutilization processes. This guide identifies key issues with the original process and explains how IBM used the three-in-a-box concept in the project. This guide also describes how IBM used IBM Smarter Analytics to create the overall solution.
Original business environment

High-end electronics manufacturers, including IBM, have long benefited from reusing returned hardware products and parts. The IBM supply chain is one of the largest and most far-reaching in the world. Reutilization of returns is important because it has a significant positive impact on the company’s financial bottom line. For example, high value parts, such as processors and memory that are used in mainframe servers, can yield up to a 70 percent margin when recovered and reused.

Reutilization of returns is good for the environment. As a goal, IBM wanted to increase the reutilization of returned parts that are used to produce its servers. The higher the quantity is of equivalent-to-new (ETN) parts and certified service parts (CSP) that are recovered and reused, the better the result is for the environment. IBM set the following goals:

- Reduce the consumption of raw materials, and then minimize the energy used to manufacture new parts.
- Minimize the solid waste volume that is disposed of from scrapped parts.
- Reduce global procurement spending on new parts that are required to build IBM products.

The original process

The original materials returns process (based on the ETN parts process) ensured the proper handling of returns at a consolidation center. A return occurs for various reasons including machine upgrades, warranty returns, end of lease, and reseller returns. The original process had various pitfalls. For example, the process owners or the procurement materials planning team did not have any indication of when materials might be returned. This lack of information about returns inhibited the forecasting of future returns, directly affecting the parts planning process.

The ETN parts process: The ETN parts process takes back a part from customers and others. The parts go through a rigorous ETN parts process of qualification (including life span and past usage analysis), testing, and reconditioning according to the engineering specifications before reuse.

Because of the lack of future returns forecasts, the ETN team was forced to wait until the consolidation centers had the physical equipment to know which parts were available for reutilization. Not knowing when ETN parts might be available caused churn in parts orders, affecting both IBM manufacturing and its suppliers. Inventory levels of parts were also affected because parts were held in inventory that were not needed or could have been used elsewhere. This problem was amplified when it came to the recovery of high dollar or high demand products and parts that were returned.

The original process was inefficient at handling scrap reclamation for parts that could not be recovered. To comply with existing and potential new regulations, an upgraded reclamation process was needed. As part of this project, new cost-efficient scrap reclamation processes were developed and deployed at IBM manufacturing sites. These new processes ensure that environmental regulations are being met and material cost recovery is achieved. Business analytics provides insight into this decision making process by eliminating guesswork. The analytics solution creates a systematic way to balance economic and sustainability goals.
IBM originally processed its returns by using their existing manufacturing operations organization. This approach caused various process-related problems (shown in Figure 1).

**Figure 1 Existing IBM returns handling processes**

The existing environment included the following problems:

- A lack of one integrated end-to-end process and the focus to drive improvements
- No metrics or misaligned metrics
- Poor visibility of parts and no mechanism to forecast or optimize the use of returns
- No end-to-end reverse supply chain visibility, and a lack of analytic tools to forecast and optimize returns and material reuse
Overcoming the challenges

For the project, IBM employed a management system concept called *three-in-a-box*. This method (shown in Figure 2) consisted of three key components:

- Governance through project and process ownership
- Process and IT transformation
- Analytics technology

By employing analytics with governance and process transformation, IBM achieved breakthrough business results. The three-in-a-box concept enabled IBM to achieve the following objectives:

- Develop an aligned end-to-end business process.
- Identify the critical success factor for the project.
- Create aligned business goals for each key process step.
- Make decisions that provided the best benefit for IBM.
- Secure the funding and resources needed to drive the project to completion.

Use of this method enabled significant cost savings and created an environmentally friendly solution. By employing analytics with governance and process transformation, IBM achieved breakthrough business results. Governance and process transformation also ensured end-to-end process ownership and alignment across the different functions of the reverse supply chain.

**Governance**

A critical success factor for the project was having strong process owners. These process owners represent the business organizations that benefit from the solution. They represented the user, owned the solution, and continue to maintain the solution over time. They were involved throughout the complete development and implementation cycle.
The cycle included the following activities:

- Business case development
- Conceptualization of the solution
- Solution development and piloting
- Deployment of the solution to the business environment
- Metric monitoring over the long term

Collaboration with other functions in the supply chain, such as product design, procurement, engineering, and reutilization operations, made governance a critical focal element of the project.

The process owners were responsible for communicating with the steering committee. Even more critical, they interacted with the business users to encourage input to and acceptance of the solution, gain trust, and obtain feedback, so that the solution can deliver benefits now and in the future.

Process and IT transformation

IBM found that its manufacturing team could not effectively support the used part reclamation process. A new team was created to focus on the activity, and processes were revised and created where necessary. Situations were identified where data was lacking and where applications did not adequately support the processing of returned parts. Incorporating analytics at strategic points in the processes enabled better interaction between key applications. Incorporating analytics was critical to the success of the project. Smarter Analytics (commonly known as Business Analytics and Optimization (BAO)) was used to help enhance and streamline key processes, making them more efficient and effective.

For example, BAO was used to pull together vast amounts of data from various sources. The different data sources include product sales, upgrades information, parts procurement, returns, product information, bills of materials, engineering changes, and product announcement information. This data was used to model and ultimately forecast part returns. Business rules that were implemented with the solution identified which alternative part numbers to use and when to use them. They also identified acceptable cycle times, rework costs, and interplant (between manufacturing plant) transfer costs.

These rules and the associated data were entered as input into the BAO solution for processing returns. The resulting insights enable stakeholders to make meaningful decisions on reuse and on handling returns and their parts.

Analytics and optimization

The growing volume and range of information encountered in the reverse supply chain drove complexity and created a need for BAO. Analytics and optimization capabilities were used to tackle problems in the original reverse supply chain such as the following examples:

- Descriptive analytics was used to enable visibility.
- Predictive analytics helped to forecast returns.
- Prescriptive analytics helped to maximize the benefits of reutilization by optimizing decision making.
**Effects of the three-in-a-box method**

The three-in-a-box method continues to enable the team to work on key challenges and factors that influence long-term project success. Governance helps achieve timely economic-based decisions and enables a global used parts business by aligning the organizations in the supply chain. This alignment creates an end-to-end process with a process owner. Furthermore, it tracks the business case, comparing the solution development budget to the improved business benefits. The process transformation and use of data (gathered from different sources) enables parts visibility within the global supply chain. The analytics team employed BAO to create a truly smarter supply chain.

**The IBM solution**

Figure 3 illustrates the material flow of the reverse supply chain that is supported by the asset reutilization solution. The high-level flow shows that returns are collected at consolidation centers, processed at the centers, and then dispersed to locations around the world where they are needed. During the asset recovery process, returned products and parts are recovered, and any required repair, retesting, or relabeling is performed. After these activities are completed, the reusable products and parts are made available to the appropriate manufacturing and supplier locations and then ultimately are available to the sales channel. The returned products and parts that cannot be recovered are sent to scrap vendors.
The processes that are used for harvesting and reselling parts and machines have an ever expanding mix of returns and increasing complexity. The asset reutilization solution supports the smarter supply chain objective by supporting the following activities:

- Increasing global supply chain visibility
- Enabling timely economic-based reutilization optimization
- Creating a global parts business to generate additional profit
- Enhancing sustainability by reducing parts scrap

To increase reutilization, IBM applied various analytic capabilities, including business intelligence, forecasting, and optimization. Analytics helped IBM to answer many questions such as the following examples:

- What is the best match between demand and supply (based on key business rules)?
- What is the forecast quantity of parts returning in the next 12 months?
- What is the parts supply that is available, and where are the parts?
- How much demand do we have for each specific used part?

BAO consists of the following analytic technology categories:

- **Descriptive analytics** provides information about the past state or performance of the business and its environment.
- **Predictive analytics** helps predict (based on data and statistical techniques) with confidence what will happen next so that you can make well-informed decisions and improve business outcomes.
- **Prescriptive analytics** recommends high-value alternative actions or decisions given a complex set of targets, limits, and choices. Specifically, optimization is used to examine how you can achieve the best outcome for a particular situation.

Analytics technologies provided the IBM Integrated Supply Chain with the ability to use the massive amounts of data that is available to make competitive decisions, moving beyond intuition to “fact check”.

Currently, IBM uses analytics technologies to support the following key areas:

- **Auto-bin supply netting by using descriptive analytics**
  Auto-bin supply netting identifies the reusable parts supply that is available. Descriptive analytics provided visibility to parts (by part number) and their supply quantity that is available at each inventory location around the world. This visibility is crucial to determining the need for parts and overall inventory levels. IBM used business intelligence to collect and analyze existing and past part-related data. As a result of this analytics solution, decision makers can make decisions about the number of parts to refurbish and reuse.

- **Forecasting returns by using predictive analytics**
  The process of forecasting returns identifies the quantity of parts that will be returned in the next 12 months. Predictive analytics provides the capability to find trends and extrapolate into the future. This analytics solution helped to predict the future value of returns. The forecast enables collaboration with demand owners, such as the procurement team who buys parts for manufacturing or service.

- **Returns value optimization by using prescriptive analytics**
  Returns value optimization is about taking a conventional supply chain approach to meet demand and supply and determining the highest value from reusing machines and parts. This prescriptive analytics solution analyzes various factors such as the current supply and current and future demands, costs, and market value. Optimization is used to propose the best course of action, given the predicted data, goals of the enterprise, current state,
How IBM Transformed its Asset Reutilization by Applying IBM Smarter Analytics Solutions and capabilities. Optimization finds the course of action that optimizes the expected performance of the organization.

Auto-bin supply netting

Auto-bin supply netting identifies the reusable or ETN parts and CSP supply that is available at multiple return centers around the world. This process is intended to increase reutilization by avoiding the cost of purchasing or manufacturing new parts.

The process provides reusable parts supply input into the materials requirements planning (MRP) process. The reusable parts supply data includes on-site current usable stock, available to supply (confirmed supply from vendor), and reusable stock (used or ETN parts supply). Analytics technology is used to enable visibility to the reusable parts supply.

Auto-bin supply netting reduces or eliminates steps in the manual demand supply planning process. It also improves the ability to support ETN reutilization with less subject matter expertise skills. With the new process in place, the bin quantities of the reusable stock inventory are added to the MRP processing based on user-controlled business rules. This solution offers visibility of reusable stock to the MRP process. It allows manual override, where authorized users can choose whether to use the reusable stock.

Forecasting returns

The ability to forecast returns sufficiently in advance prevents procurement from incurring inventory liability when ordering new parts. Procurement purchases parts before they are needed for their use in the assembly of components, finished products, or spare parts. Parts with a longer lead time to build must be ordered much further in advance of being needed. Inventory liability increases when parts can be purchased or manufactured, or obtained from an ETN source. Without a good visibility to ETN parts, unexpected inventory increases can occur because parts supply comes from ETN sources and new purchase orders.

This situation causes planning churn for related parts orders. Without a reliable and accurate ETN supply forecast, working capital continues to be tied up in purchase orders. This situation also results in carrying costs, risk of obsolescence, and general inefficiencies in the overall supply chain.

The forecasting solution incorporated IBM SPSS® Modeler, which is a statistical tool. SPSS Modeler helped to forecast the continuity of returns supply in a relatively short amount of time. Returns do not necessarily follow sales patterns or revenue projections that are commonly used in a forecasting process. Also, returns cannot be easily forecasted as salable items or marketing units can, by using more conventional demand forecasting techniques. By having predictive analytics as part of the overall solution, IBM can better forecast returns. By knowing what will be returning (in advance), IBM can now reduce the expense of new parts purchases by using the forecasted returns as a trusted source of supply.
Figure 4 illustrates a simplified representation of the model.

Figure 4 highlights the three major steps in the forecasting process:

1. Learn from the sales and returns relationship by using previous history.
2. Extrapolate returns behavior from the historical information of each target part. Relate the returns behavior of the part to previous forecasts of returns for each target part.
3. Generate forecast for returns of the target part by using the predictive analytics that SPSS Modeler provides.

In addition to predicting the number of returns over time, the solution provides an upper and lower confidence interval of volume returns that are influenced by other business factors. A key benefit to this solution is the ability to predict a long-range returns pattern. From this result, IBM can minimize supplier liability for high-cost parts with a longer manufacturing lead time. In addition, IBM can create a new a source of supply by accounting for the availability of forecasted returns.

The availability of forecasted returns, enables IBM to take the following actions:

- Authorize the recovery of the returning parts.
- Release the parts to the recovery processes.
- Reduce the total cost of bill of materials (BOM) that is needed to build new refurbished servers or service parts.

Demand supply optimization

The demand supply optimization process is a way to cost-effectively analyze a global view of a nontraditional supply of forecast and available returned products and parts. This solution incorporated a way to use this forecast supply to satisfy some of the new material or parts purchases that are generated by MRP.

An IBM supply chain optimization tool, called Watson Implosion Technology (WIT), which incorporates IBM ILOG® CPLEX® Optimizer that is modeled the demand supply optimization process. WIT takes into account demand, used supply, inventory parameters, economic
attributes, and business process rules to optimize asset reutilization and make recommendations and solution savings.

**WIT for implosion problems**: The WIT tool, developed by IBM Research, solves a class of resource-constrained production planning problems called *implosion problems*. WIT provides two alternative approaches to solving implosion problems: one based on a linear programming formulation and one based on a specialized heuristic. For more information about WIT, see *Visualizing Supply Chains: A Design Study* at:


Figure 5 shows the high-level architecture of the demand supply optimization solution.

The returning parts management process ensures that returns are received and accounted for. The model (identified as WIT in Figure 5) reviews the recorded returns and compares them to the forecasted values. This analytics-based demand-supply optimization solution looks at returned machines or parts availability value to meet the demand. The model identifies when to refurbish machines (to sell as machines) or to create ETN parts based on when there are benefits to doing either activity. For example, a machine or part is processed based on the optimal profit under specific economics situations.

An interlock process was implemented to enable communication of the results from the forecasting analytics solution to managers before the running MRP. With this interlock, managers can see the timing and quantity of forecasted returns that are available. This insight is used to help determine if a new parts order needs to be placed and the order quality.
The optimization solution resulted in an increased bottom line, and at the same time, reduced environmental impacts:

- Increased revenue from reselling machines or parts
- Increased used material supply to satisfy overall new buy demands
- Reduced new buy expense for last-time-buy (end of life) service parts
- Reduced new buy expense for regular field service parts
- Reduced amount of scrapped materials going to landfills

Tracking the benefits

As part of deploying the solution in the production environment, the focus moved from development (three-in-a-box method to an end-to-end business process with operational ownership. Operational business owners take responsibility for executing and improving the solution over time and tracking the solutions benefits.

A set of metrics was defined and is updated after the execution of each planning cycle. These metrics enable the Integrated Supply Chain management team to adjust the process and optimize the level of parts reutilization. Metrics are used in the following ways:

- Assess the accuracy of the monthly returns forecast.
- Measure the level of reused materials that are available for the Operational Commodity Manager to use.
- Monitor the percentage of forecasted returns that are used by the Operational Commodity Manager.
- Determine the risk level incurred in the total supply solution.

To truly understand the value of the overall solution and the benefits of using analytics, the team deployed four key reutilization metrics:

- Forecasted returns accuracy (early warning to the Operational Commodity Manager)
  This metric provides a monthly comparison of previous forecasted returns versus current forecasted returns. The metric gives a delta (percentage) that reflects an increase or decrease in forecast returns that are produced as part of the post-processing step. The post-processing step happens after the forecast output is available and before it is applied to the MRP process. The users of the output have a clear picture (represented by a percentage) of a month-to-month change in the forecast. Based on that clear picture, they approve and can apply the forecasted returns to MRP. If any significant change in the forecast occurs, the business reason behind that change must be identified. That reason is reflected in the input data and documented to help in the ongoing effort to improve the model.

- Forecasted versus actual returns to choose the best method indicator
  This metric provides retroactive comparison between the actual return and the forecasted returns for the past 6 months. This metric is produced as a post-processing step. This metric shows which model is the most reliable based on a historical data forecast compared to actual data.

- Forecasted versus Operational Commodity Manager actual input and actual returns
  This metric provides a monthly comparison of the forecast versus actual inputs and actual returns. The metric output helps to create a business benefit statement for actual returns. It helps the Operational Commodity Managers to evaluate the reliability of their decision-making in the approval process. The metric also provides directions for improvement in taking more or less risk when applying the forecasted quantities to the MRP cycle.
Supply solution to risk assessment

This metric provides a 16-week risk analysis of a supply solution based on a formula where risk equals the percent of forecast returns that are being used for coverage of the total supply.

Risk is associated for the first 8 weeks after a frozen zone. The frozen zone is the procurement lead time within which order canceling might cause liability. Business risk is calculated as a percentage of the total supply that is covered by the ETN forecast, which helps the Operational Commodity Manager avoid supply constraint. The metric helps the Operational Commodity Manager see the risk that they are taking by applying the ETN forecast numbers into the MRP.

Summary

This guide introduced the business needs for asset reutilization, the problems IBM tried to solve, and the techniques and technology that IBM adopted. IBM used the three-in-a-box method to help ensure that the project was successful. This method consists of governance, business transformation, and analytics. IBM found that having business process owners was key to project success now and in the future.

IBM used BAO solutions to evaluate the expanding mix of returns and the increasing complexity of the process that is used to harvest and resell parts and machines. The analysis results were used to optimize the entire reverse supply chain process, so that it can capitalize on the opportunity for recovery and reuse. This approach supports the supply chain objective in the following ways:

- Increasing global supply chain visibility
- Enabling timely economic-based dismantling decisions
- Establishing a global parts business
- Generating additional profit

With the help of this asset reutilization solution, IBM has expanded its addressable market into lower price point, certified, pre-owned segments. The solution proved that there is cost avoidance when a recovered part is used in IBM manufacturing or as a service part. In addition, there is value recovery from used parts sold into secondary markets. Concerning sustainability, IBM achieved waste reduction for improved environmental performance and associated cost savings sufficient to justify the investment in this asset reutilization solution.

Other resources for more information

For additional information about Business Analytics and Optimization, see Smarter Analytics: Making Better Decisions Faster with IBM Business Analytics and Optimization Solutions, REDP-4886. In addition, consult the following resources:

- IBM Smarter Analytics
- IBM SPSS Modeler
  http://www.ibm.com/software/analytics/spss/products/modeler/
- IBM ILOG CPLEX Optimizer
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Now you can become a published author, too!

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