# EPC Value Model – Aerospace & Defense Value Model Manual

EPCglobal US
Eindhoven University of Technology
Stanford University


*Published 2006 Version 1.0*

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# Introduction

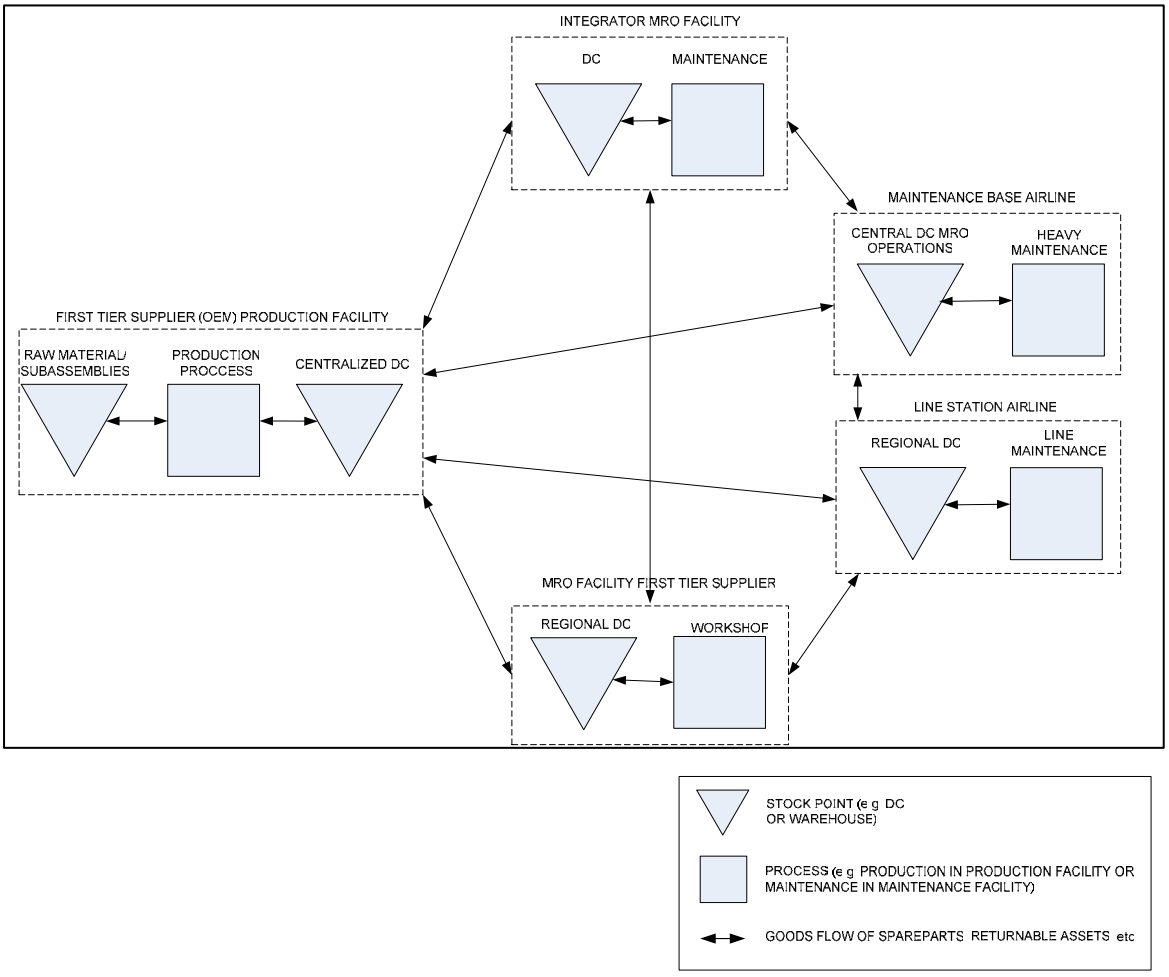
This EPC Value Model is designed to help *aerospace and defense (A&D) maintenance, repair, and overhaul (MRO) companies* assess their expected benefits from EPC/RFID global standards implementations within their internal organizations, their trading partner network and overall supply chain. This model is best suitable for the following types of businesses:

- MRO operations and/or production of 1st tier suppliers
- MRO operations of airlines
- MRO operations of integrators (airline manufacturers)

Built upon on inputs from leading A&D supply chain members who participated throughout 2006 in a study, this workbook was constructed jointly by the Stanford Global Supply Chain Management Forum and the Eindhoven University of Technology, and was sponsored by EPCglobal US. For comments or suggestions regarding the Model, please email rceleste@epcglobalus.org

**Supply Chain Structure**

An underlying assumption of the Model is that the supply chain under consideration has the following structures:



**Instructions Regarding the EPC/RFID Benefits Model**
This Model consists of 15 separate worksheets. Cells marked in *gray* require user inputs. Other data cells are calculations based on user input. Assumptions made in any sheet, if any, are mentioned in the respective worksheets.

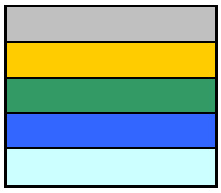
**Preliminary Information Sheet**
In this sheet users are asked to provide basic business information, including total annual revenues, profit margin, annual cost of capital, etc. In addition, the sheet provides a list of all the business drivers identified as those that can potentially be improved with the use of EPC/RFID. Users are asked to select those business drivers / business issues that are relevant for their organizations.

**Summary Sheet**
This sheet gives the overall summary of the Model, including the expected benefits, costs, as well as the net present value (NPV) of the EPC/RFID initiative over a 5-year planning horizon. The list of benefits includes business issues that EPC/RFID may help to mitigate as well as business drivers that EPC/RFID may help to enhance. Summarizing benefits in this way allows users to identify the contribution of EPC/RFID for each individual business issue / driver and might assist firms in prioritizing the areas to implement EPC/RFID. Two types of key benefits of EPC/RFID implementation are taken into consideration in this Model: added revenues and cost reduction. These benefits are calculated quantitatively in the Summary sheet. The Summary sheet also lists the annual costs associated with EPC/RFID implementation.

**Cost Sheet**
This sheet computes, based on user input, the total one-time and recurring costs for manufacturers for implementing RFID solutions in each of the five years in the Model's planning horizon. The sheet takes into account costs that are incurred at all the manufacturer's production facilities and warehouses.

**Business Issue / Driver Sheets**
Each of the remaining sheets calculates in detail the value of EPC/RFID for each of the business issues / business drivers. Each sheet includes default values for the expected impacts of EPC/RFID. Users should change these default values as needed, to fit to the characteristics of their own organizations. Out of the total worksheets available, the Model will present only those sheets that are relevant to the users, based on their selection in the Preliminary Information sheet. The information in the Summary sheet is based on the detailed calculations in the Business Issue / Driver sheets.

**Color Coding Used in the Sheets**



-User Input (users are requested to enter data here)
-Higher and Sub-level Summary
-Result/Summary
-Title of the worksheet
-Part of the supply chain the calculations relate

# 1. Preliminary Information

The user will be prompted to fill-in general information about their company in the worksheet marked **"Preliminary Information".** This information will be used to calculate probable results.

| Please enter below the preliminary information about your company | | |
|---|---|---|
| GENERAL | | |
| | Current annual revenues | $100,000,000 |
| | % Margin (Profit) | 20% |
| | Expected annual business growth rate | 10% |
| | Annual cost of capital | 10% |
| | Average inventory as % of revenues | 15% |
| | % of total inventory dedicated as safety stock | 30% |

Then the user will be asked to check business areas that they would like to evaluate using the planning Models. The options to check are grouped into two categories – Business Issues, which are known problems for a large number of manufacturers and can potentially be reduced through EPC/RFID implementation. This area has six worksheets and is marked in red. The second category is Business Drivers, which includes those capabilities that manufacturers can potentially enhance through EPC/RFID implementation. This area has four worksheets and is marked in blue.

| | | |
|---|---|---|
| ✓ | OUT-OF-STOCK | **Business Issues** |
| ✓ | IMPROPER MONITORING PARTS' HISTORY | |
| ✓ | INEFFICIENT ASSET MANAGEMENT | |
| ✓ | UNAPPROVED PARTS | |
| ✓ | UNSCHEDULED MAINTENANCE TASKS | |
| ✓ | REWORK/SCRAP | |
| ✓ | ERRORS IN READING / WRITING PART CODES | |
| | | |
| ✓ | IMPROVE MONITORING OF PARTS' LOCATION | **Business Drivers** |
| ✓ | IMPROVE RETURNABLE ASSET MANAGEMENT | |
| ✓ | REDUCE MANUAL ADMINISTRATIVE PROCESSES | |
| ✓ | IMPROVE INBOUND / OUTBOUND | |

## 2. Summary

This worksheet is the RESULT of the calculations conducted in the individual worksheets based on inputs from the user. It is located at the front of the EPC Value Model so the user can reference inputs and the impact on the total picture. The worksheet is a total of the business issues and drivers worksheets that the user selected. The first part of the worksheet presents a summary of the expected added revenues, added profit, and reduced costs for Year 5 of the planning horizon, when it is assumed that EPC/RFID will already be fully implemented across the manufacturer's entire manufacturing and warehouse facilities. In addition, this part of the worksheet shows the expected one-time benefits in Year 1.

Double counting in overlap areas such as risk management, inventory management, and increasing transportation costs. Users can go to the individual cells and see the specific overlap areas for revenues and reduced cost.

**SUMMARY: EXPECTED BENEFITS AND COSTS OF EPC/RFID IMPLEMENTATION**

Year 5 (100% implementation) benefits:

| BENEFITS | Added Revenues | Added Profit | Reduced Cost |
|---|---|---|---|
| **ANNUALLY RECURRING BENEFITS** | | | |
| REDUCE OUT-OF-STOCK | $617,850 | $77,304 | $1,694,858 |
| IMPROPER MONITORING PARTS' HISTORY | $20,000 | $0 | $2,844,662 |
| INEFFICIENT ASSET MANAGEMENT | $0 | $0 | $2,836,403 |
| UNAPPROVED PARTS | $60,000 | $0 | $1,084,870 |
| UNSCHEDULED MAINTENANCE TASKS | $0 | $0 | $1,970,510 |
| REWORK/SCRAP | $40,000 | $0 | $2,159,933 |
| ERRORS IN READING / WRITING PART CODES | $0 | $0 | $1,862,664 |
| IMPROVE MONITORING OF PARTS' LOCATION | $120,000 | $0 | $2,935,380 |
| IMPROVE RETURNABLE ASSET MANAGEMENT | $0 | $0 | $2,156,535 |
| REDUCE MANUAL ADMINISTRATIVE PROCESSES | $0 | $0 | $2,283,996 |
| IMPROVE INBOUND / OUTBOUND | $0 | $0 | $2,320,843 |
| **TOTAL YEAR 5 BENEFITS (INCLUDING DOUBLE COUNTING)** | $857,850 | $77,304 | $24,150,653 |
| **ADJUSTMENT FOR DOUBLE COUNTING** | $0 | $0 | $8,539,132 |
| **TOTAL YEAR 5 BENEFITS** | $857,850 | $77,304 | $15,611,521 |

In the second part of the worksheet, Net Present Value (NPV) is calculated over a 5-year planning horizon based upon the expected additional annual revenue and profit from EPC/RFID the expected annual cost reductions, as well as the expected annual costs for EPC/RFID implementation. The Net Benefit is derived by summing the total benefits and subtracting the costs. The discounted benefit is calculated by factoring in the cost of capital against the net benefit. The Model calculates all of this for the user.

| NPV | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| Additional annual revenues due to EPC/RFID | $117,185 | $257,806 | $425,380 | $623,891 | $857,850 |
| Additional annual profit due to higher revenues (Margin*Add. Rev)/(1+ Margin) | $19,531 | $42,968 | $70,897 | $103,982 | $142,975 |
| Additional annual profits directly through EPC/RFID | $10,560 | $23,232 | $38,333 | $56,221 | $77,304 |
| Benefit due to reduction in costs | $2,132,576 | $4,691,667 | $7,741,250 | $11,353,834 | $15,611,521 |
| RFID/EPC related costs | $3,280,000 | $6,690,000 | $7,470,000 | $10,680,000 | $13,240,000 |
| Net Benefit using EPC/RFID | $1,000,149 | ($1,674,327) | $805,860 | $1,457,928 | $3,449,651 |
| Discounted benefit | ($1,000,149) | ($1,522,116) | $666,000 | $1,095,363 | $2,356,158 |
| **5-year discounted NPV** | **$1,595,256** | | | | |

## 3. Costs

This important source sheet is where the user will tailor the Model to both factory and warehouse implementation ramp over a 5-year period. The user may wish to refer to the example spreadsheet, which can provide a starting point.

Step 1: Users should enter the company's total number of factories and warehouses in the *gray* cells.

| | |
|---|---|
| Total Number of Production Facilities (Factories) | 8 |
| Total Number of Warehouses | 5 |

Step 2: Next, the user will input the percentage ramp expected for EPC/RFID adoption over the 5-year period. The Model assumes at the end of the 5th year, the factories are in full production at 100 percent with the EPC/RFID technology.

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| Percentage of Business using EPC/RFID | 20.00% | 40.00% | 60.00% | 80.00% | 100.00% |

Step 3: Next, the user is asked to provide information separately for the expected implementation costs at the manufacturer's production facilities. In the **"Factories"** part of the worksheet, the user should first input the total number of production facilities that are expected to have EPC/RFID technology implemented in them in each of the 5 years. The Model will calculate the percentage of factories with EPC/RFID based upon the **"Percentage of factories with EPC/RFID"** and **"Number of MRO/production facilities".**

The factories' costs are based upon one-time start-up costs, and recurring costs. The one-time cost includes hardware, software, consulting, infrastructure charges, and internal project teams. These costs add up to a fixed cost for each production facility. Variable costs include tags, which may change overtime due to price reductions, annual maintenance, labor, and additional costing for readers, as well as training costs.

The user should enter the expected costs per production facility in the "Year" columns and associated **"One-time average cost per MRO/production facility**" and **"Variable cost per MRO/production facility"** rows.

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| **Number of MRO/production facilities** | 1 | 3 | 4 | 6 | 8 |
| Percentage of factories with EPC/RFID | 12.50% | 37.50% | 50.00% | 75.00% | 100.00% |
| **One-time average cost per MRO/production facility:** | | | | | |
| Hardware expense (Including readers) | $200,000 | $200,000 | $200,000 | $200,000 | $200,000 |
| Software expense | $200,000 | $200,000 | $200,000 | $200,000 | $200,000 |
| Consulting and systems Integration | $200,000 | $200,000 | $150,000 | $100,000 | $100,000 |
| Other infrastructure change expense (for readability of tags etc) | $100,000 | $100,000 | $100,000 | $100,000 | $100,000 |
| Internal project teams | $150,000 | $150,000 | $150,000 | $150,000 | $150,000 |
| Fixed cost of EPC/RFID for manufacturer's MRO/production facilities | $850,000 | $1,700,000 | $800,000 | $1,500,000 | $1,500,000 |
| | | | | | |
| **Variable cost per MRO/production facility:** | | | | | |
| Total annual cost of tags used for production tracking | $500,000 | $500,000 | $500,000 | $500,000 | $500,000 |
| Total annual maintenance costs | $50,000 | $50,000 | $50,000 | $50,000 | $50,000 |
| Additional mfg. floor labor (Number * annual pay) | $180,000 | $180,000 | $180,000 | $180,000 | $180,000 |
| Annual cost of readers | $50,000 | $50,000 | $50,000 | $50,000 | $50,000 |
| Training and other costs | $50,000 | $50,000 | $50,000 | $50,000 | $50,000 |
| Per facility annual variable cost of EPC/RFID (sum of the above) | $830,000 | $830,000 | $830,000 | $830,000 | $830,000 |
| Total variable cost of EPC/RFID for manufacturer's MRO/production facilities | $830,000 | $2,490,000 | $3,320,000 | $4,980,000 | $6,640,000 |

Step 4: Next, Next, the user is asked to provide information separately for the expected implementation costs at the manufacturer's production facilities. In the **"Warehouses"** part of the worksheet, the user should first input the total number of warehouse facilities that are expected to have EPC/RFID technology implemented in them in each of the 5 years. The Model will calculate the percentage of factories with EPC/RFID based upon the **"Percentage of warehouses with EPC/RFID"** and **"Number of warehouses".**

The warehouses' costs are based upon one-time start-up costs, and recurring costs. The one-time cost includes hardware, software, consulting, infrastructure charges, and internal project teams. These costs add up to a fixed cost for each production facility. Variable costs include tags, which may change overtime due to price reductions, annual maintenance, labor, and additional costing for readers, as well as training costs.

The user should enter the expected costs per production facility in the "Year" columns and associated **"One-time average cost per warehouse**" and **"Recurring average cost per warehouse"** rows.

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| **Number of warehouses** | 1 | 2 | 3 | 4 | 5 |
| Percentage of warehouses with RFID/EPC | 20.00% | 40.00% | 60.00% | 80.00% | 100.00% |
| **One-time average cost per warehouse:** | | | | | |
| Hardware expense (Including readers) | $200,000 | $200,000 | $200,000 | $200,000 | $200,000 |
| Software expense | $100,000 | $100,000 | $100,000 | $100,000 | $100,000 |
| Consulting and Systems Integration | $200,000 | $200,000 | $150,000 | $100,000 | $100,000 |
| Other infrastructure change expense (for readability of tags etc) | $50,000 | $50,000 | $50,000 | $50,000 | $50,000 |
| Internal project teams | $150,000 | $150,000 | $150,000 | $150,000 | $150,000 |
| Total Fixed cost of RFID for manufacturer's warehouses | $700,000 | $700,000 | $650,000 | $600,000 | $600,000 |
| | | | | | |
| **Recurring average cost per warehouse:** | | | | | |
| Total annual cost of tags | $500,000 | $500,000 | $500,000 | $500,000 | $500,000 |
| Maintenance costs per year | $50,000 | $50,000 | $50,000 | $50,000 | $50,000 |
| Additional warehouse labor (Number * annual pay) | $250,000 | $250,000 | $250,000 | $250,000 | $250,000 |
| Annual cost of readers | $50,000 | $50,000 | $50,000 | $50,000 | $50,000 |
| Training and other costs | $50,000 | $50,000 | $50,000 | $50,000 | $50,000 |
| Per facility annual variable cost of RFID/EPC | $900,000 | $900,000 | $900,000 | $900,000 | $900,000 |
| Total Variable cost of RFID/EPC for manufacturer's warehouses | $900,000 | $1,800,000 | $2,700,000 | $3,600,000 | $4,500,000 |

Results: The Model will then multiply the cost per facility by the number of facilities with EPC/RFID implementation to determine total expected fixed and variable costs for each year and provides a summary of costs.

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| TOTAL COST | $3,280,000 | $6,690,000 | $7,470,000 | $10,680,000 | $13,240,000 |

Spreadsheet Notes:

1. It is assumed that the company gradually adopts the EPC/RFID technology across the different facilities, each time fully implement the technology within an entire facility and then expanding the adoption to additional facilities.
2. The **"Percentage of MRO/production with EPC/RFID**" information is used by the Model in the Summary worksheet, to determine what portion of the potential benefits across the entire business will be realized each year. The **"Number of MRO/production facilities"** is used to determine total costs per year. Therefore it is important that users enter both these pieces of data.

# 4. Business Issue: Out of Stock

Definition: An out of stock (OOS) occurs when there is no stock available on the shelf to fulfill customer demand (only applicable to parts held on stock). The term 'Stock' here is only mentioning the finished products that are produced in advance and can be set aside for the use of MRO purposes. In the manufacturer (OEM) point of view, they are products that can be shipped directly to the customers without delay. The lead time here is only the order processing time and the shipping time, which is considered under normal conditions instead of expedition. For MRO service providers, the stock is typically referring to the products that are stored in their warehouse for routine use. EPC/RFID implementation may lead to higher revenues and added profits since it might reduce the amount of lost sales.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to OOS situations (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to OOS situations (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to OOS situations (as % of revenues) | 4.00% | $5,856,400 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of out of stock situations".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| Causes of out of stock situations | Percentage | | Max. % reduction through EPC/RFID |
|---|---|---|---|
| Unpredictable environment | % | 10.00% | |
| High number of unscheduled maintenance events | 50.00% | | 0.00% |
| Unreliable (internal) suppliers | 50.00% | | 0.00% |
| Improper planning | % | 20.00% | |
| Improper scheduling of maintenance | 10.00% | | 10.00% |
| Inaccurate Spare parts demand forecasting | 60.00% | | 10.00% |
| Improper production planning | 30.00% | | 10.00% |
| Inaccuracies in inventory management system | % | 15.00% | |
| Theft | 20.00% | | 70.00% |
| Inaccurate physical counting of inventory | 70.00% | | 80.00% |
| Quality issues | 10.00% | | 10.00% |
| Product reached the end of its usable life cycle | % | 5.00% | 90.00% |
| Others | % | 50.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Out of stock situations due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to OOS situations (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Out of stock situations due to this cause".**

**"Expected out of stock situations after EPC/RFID"** is calculated by the Model by multiplying **"Out of stock situations due to this cause"** times 1 minus "**Max % reduction expected through EPC/RFID".**

**"Added Revenue"** is arrived at by the Model through the subtracting **"Expected out of stock situations after EPC/RFID"** from **"Out of stock situations due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)".**

**"Added Profit"** is calculated by the Model by subtracting **"Expected out of stock situations after EPC/RFID** from**" "Out of stock situations due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)"** times the profit margin, which is sourced from the **"Preliminary Information"** worksheet.

**"Reduced Costs"** is derived by the Model through subtracting **"Expected out of stock situations after EPC/RFID"** from **"Out of stock situations due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)"** times 1 minus the profit margin, which is sourced from the **"Preliminary Information"** worksheet.

| Causes of out of stock situations | Out of stock situations due to this cause | | Expected out of stock situations after RFID/EPC | | Added Revenues | Added Profit | Reduced Costs |
|---|---|---|---|---|---|---|---|
| Unpredictable environment | | 0.40% | | 0.40% | $0 | | |
| High number of unscheduled maintenance events | 0.20% | | 0.20% | | $0 | | |
| Unreliable (internal) suppliers | 0.20% | | 0.20% | | $0 | | |
| Improper planning | | 0.80% | | 0.72% | $117,128 | | |
| Improper scheduling of maintenance | 0.08% | | 0.07% | | $11,713 | | |
| Inaccurate Spare parts demand forecasting | 0.48% | | 0.43% | | $70,277 | | |
| Improper production planning | 0.24% | | 0.22% | | $35,138 | | |
| Inaccuracies in inventory management system | | 0.60% | | 0.17% | $500,722 | $24,597 | $98,388 |
| Theft | 0.12% | | 0.04% | | | $24,597 | $98,388 |
| Inaccurate physical counting of inventory | 0.42% | | 0.08% | | $491,938 | | |
| Quality issues | 0.06% | | 0.05% | | $8,785 | | |
| Product reached the end of its usable life cycle | 0.20% | 0.20% | 0.02% | 0.02% | | $52,708 | $210,830 |
| Others | 2.00% | 2.00% | 1.60% | 1.60% | | | $585,640 |
| **Total** | | | | | **$617,850** | **$77,304** | **$894,858** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Reduced Costs |
|---|---|---|---|
| Reduce costs of expediting from central DC | $200,000 | 60.00% | $120,000 |
| Reduce costs of delayed MRO processes | $1,200,000 | 30.00% | $360,000 |
| Reduce costs of purchasing or leasing parts from 3rd parties | $100,000 | 60.00% | $60,000 |
| Reduce costs of penalties by customers | $300,000 | 60.00% | $180,000 |
| Reduce costs of less efficient operations | $400,000 | 20.00% | $80,000 |
| **Total** | **$2,200,000** | | **$800,000** |

## 5. Business Issue: Traceability

Definition: Airplanes are subject to extreme conditions, that is why strict safety requirements are imposed on MRO organizations. To comply with the regulations, all repairs and modifications are supposed to be properly recorded and documented. This recording and monitoring of parts' history is traceability. By improving parts traceability, MRO organizations are likely to invest less time in maintenance operations, thus reducing operational costs and costs incurred by long down time of aircrafts.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to inefficient traceability (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to inefficient traceability (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to inefficient traceability (as % of revenues) | 7.00% | $10,248,700 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of improper traceability (monitoring parts' history)".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of improper traceability (monitoring parts' history)** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| Internal/operational causes | % | 20.00% | |
| Improper recording of ingoing outgoing parts | 40.00% | | 30.00% |
| Improper recording of operations performed | 60.00% | | 30.00% |
| External causes | % | 20.00% | |
| Lack of consistent standards for registration of parts | 50.00% | | 30.00% |
| Incompatibility of IT systems | 50.00% | | 30.00% |
| Improper monitoring capabilities, current ID method | % | 20.00% | |
| Difficulties with current (automatic) Identification solution | 70.00% | | 30.00% |
| Improper recording of environmental conditions | 30.00% | | 30.00% |
| Others | % | 40.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Improper traceability due to this cause"** (before EPC/RFID by multiplying **"Percentage"** times **"Total costs due inefficient traceability (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Causes of improper traceability (monitoring parts' history)".**

**"Expected improper traceability after EPC/RFID"** is calculated by the Model by multiplying **"Percentage"** times 1 minus **"Max % reduction expected through EPC/RFID".**

**“Reduced Costs”** is derived by the Model through subtracting **“Expected improper traceability after EPC/RFID”** from **“Improper traceability due to this cause”** and then the result is multiplied by **“Extrapolated year 5 revenues (100% EPC/RFID)”.**

| Causes of improper traceability (monitoring parts' history) | Improper traceability due to this cause | | Expected improper traceability after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Internal/operational causes | | 1.40% | | 0.98% | $614,922 |
| Improper recording of ingoing outgoing parts | 0.56% | | 0.39% | | $245,969 |
| Improper recording of operations performed | 0.84% | | 0.59% | | $368,953 |
| External causes | | 1.40% | | 0.98% | $614,922 |
| Lack of consistent standards for registration of parts | 0.70% | | 0.49% | | $307,461 |
| Incompatibility of IT systems | 0.70% | | 0.49% | | $307,461 |
| Improper monitoring capabilities, current ID method | | 1.40% | | 0.98% | $614,922 |
| Difficulties with current (automatic) Identification solution | 0.98% | | 0.69% | | $430,445 |
| Improper recording of environmental conditions | 0.42% | | 0.29% | | $184,477 |
| Others | 2.80% | 2.80% | 2.24% | 2.24% | $819,896 |
| **Total** | | | | | **$2,664,662** |

Step 4: In the **“Other benefits”** area, the user should input dollar values for **“Current annual value”** and percentage values for **% of improvement through EPC/RFID”. “Added Revenues”** and **“Reduced Costs”** are calculated by the Model by multiplying **“Current annual value”** times **“% of improvement through EPC/RFID”.**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Added Revenues | Reduced Costs |
|---|---|---|---|---|
| Reduce costs of rework and scrap | $300,000 | 40.00% | | $120,000 |
| Added revenues due to improvement of incorrect identification of part classification | $400,000 | 5.00% | $20,000 | |
| Reduce costs of improper production and planning control | $300,000 | 20.00% | | $60,000 |
| **Total** | **$1,000,000** | | **$20,000** | **$180,000** |

## 6. Business Issue: Asset Management

Definition: Especially in the A&D industry, assets, such as tools and MRO equipment, are expensive and also critical to performing specific operations on time. However, due to the size and complexity of a typical MRO operation site, MRO organizations are suffering from loss of tools, equipment, and other assets in their operations site. EPC/RFID implementation may result in better utilization of resources, both tools and labor, and thereby decrease the overall costs of operations.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to inefficient asset management (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to inefficient asset management (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to inefficient asset management (as % of revenues) | 7.00% | $10,248,700 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of inefficient asset management".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of inefficient asset management** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| Inefficient use of asset tracking procedures | % | 20.00% | |
| Lack of asset tracking procedure | 20.00% | | 0.00% |
| No fulfillment of asset tracking procedure | 80.00% | | 30.00% |
| Disorganized processes | % | 20.00% | |
| Unpredictable workload/unscheduled maintenance | 50.00% | | 30.00% |
| Unstructured work | 50.00% | | 40.00% |
| Lack of communication | % | 10.00% | |
| Internal communication problems | 40.00% | | 40.00% |
| External communication problems | 60.00% | | 30.00% |
| Less visibility in large facilities | % | 15.00% | 30.00% |
| Others | % | 35.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Inefficient asset management due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to inefficient asset management (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Inefficient asset management due to this cause".**

**"Expected inefficient asset management after EPC/RFID"** is calculated by the Model by multiplying **"Inefficient asset management due to this cause"** times 1 minus **"Max % reduction expected through EPC/RFID".**

**"Reduced Costs"** is derived by the Model through subtracting **"Expected inefficient asset management after EPC/RFID"** from **"Inefficient asset management due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| Causes of inefficient asset management | Inefficient asset management due to this cause | | Expected inefficient asset management after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Inefficient use of asset tracking procedures | | 1.40% | | 1.06% | $491,938 |
| Lack of asset tracking procedure | 0.28% | | 0.28% | | $0 |
| No fulfillment of asset tracking procedure | 1.12% | | 0.78% | | $491,938 |
| Disorganized processes | | 1.40% | | 0.91% | $717,409 |
| Unpredictable workload/unscheduled maintenance | 0.70% | | 0.49% | | $307,461 |
| Unstructured work | 0.70% | | 0.42% | | $409,948 |
| Lack of communication | | 0.70% | | 0.46% | $348,456 |
| Internal communication problems | 0.28% | | 0.17% | | $163,979 |
| External communication problems | 0.42% | | 0.29% | | $184,477 |
| Less visibility in large facilities | 1.05% | 1.05% | 0.74% | 0.74% | $461,192 |
| Others | 2.45% | 2.45% | 1.96% | 1.96% | $717,409 |
| **Total** | | | | | **$2,736,403** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Reduced Costs |
|---|---|---|---|
| Reduce costs due to decrease in throughput time | $500,000 | 20.00% | $100,000 |
| **Total** | **$500,000** | | **$100,000** |

## 7. Business Issue: Unapproved parts

Definition: Unapproved parts such as rogue parts or salvaged parts are sometimes used and installed in the plane. These parts may cause flight accidents and threaten the flight safety. EPC/RFID technology may help to identify unapproved parts in an early stage. This will overcome usage of unsuitable components for aircraft maintenance, and thereby reduce costs of associated additional required processes. Furthermore, new parts have to be purchased.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **Total costs due to unapproved parts (as % of revenues**)", which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to unapproved parts (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to unapproved parts (as % of revenues) | 2.00% | $2,928,200 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of unapproved parts".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of unapproved parts** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| Distribution of unapproved parts | % | 20.00% | |
| Distribution of outdated products | 20.00% | | 50.00% |
| Distribution of rouge parts | 40.00% | | 50.00% |
| Distribution of salvaged parts | 40.00% | | 50.00% |
| Human caused errors | % | 10.00% | 50.00% |
| Improper monitoring of parts history | % | 20.00% | 50.00% |
| Others | % | 50.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Unapproved parts due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to unapproved parts (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Causes of unapproved parts".**

**“Expected unproved parts after EPC/RFID”** is calculated by the Model by multiplying **“Unproved parts due to this cause”** times 1 minus **“Max % reduction expected through EPC/RFID”.**

**“Reduced Costs”** is derived by the Model through subtracting **“Expected unproved parts after EPC/RFID”** from **“Unproved parts due to this cause”** and then the result is multiplied by **“Extrapolated year 5 revenues (100% EPC/RFID)”**.

| Causes of unapproved parts | Unapproved parts due to this cause | | Expected unapproved parts after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Distribution of unapproved parts | | 0.40% | | 0.20% | $292,820 |
| Distribution of outdated products | 0.08% | | 0.04% | | $58,564 |
| Distribution of rouge parts | 0.16% | | 0.08% | | $117,128 |
| Distribution of salvaged parts | 0.16% | | 0.08% | | $117,128 |
| Human caused errors | 0.20% | 0.20% | 0.10% | 0.10% | $146,410 |
| Improper monitoring of parts history | 0.40% | 0.40% | 0.20% | 0.20% | $292,820 |
| Others | 1.00% | 1.00% | 0.80% | 0.80% | $292,820 |
| **Total** | | | | | **$1,024,870** |

Step 4: In the **“Other benefits”** area, the user should input dollar values for **“Current annual value”** and percentage values for **“% of improvement through EPC/RFID”.** The Model will calculate **“Added Revenues”** and **“Reduced Costs”** by multiplying **“Current annual value”** times **“% of improvement through EPC/RFID”.**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Added Revenues | Reduced Costs |
|---|---|---|---|---|
| Added revenues due to improved customer service (lower level of lost sales) | $300,000 | 20.00% | $60,000 | |
| Reduce costs of penalties by customers | $200,000 | 30.00% | | $60,000 |
| **Total** | **$500,000** | | **$60,000** | **$60,000** |

## 8. Business Issue: Unscheduled Maintenance

Definition: Unscheduled maintenance is irregular maintenance performed to restore an item to a satisfactory condition by providing correction of a known or suspected malfunction and/or defect. Irregularities occurring during maintenance have been generally known to consist of failures and malfunctions, including findings from scheduled maintenance and inspections, normal flight operations, or special inspections. EPC/RFID technology may lead to reduced costs by reducing the number of unscheduled maintenance events. Since unscheduled maintenance events cause large disruptions within normal operations and therefore lead to lower efficiencies in these operations.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to unscheduled maintenance (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to unscheduled maintenance (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to unscheduled maintenance (as % of revenues) | 4.00% | $5,856,400 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of unscheduled maintenance".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| Causes of unscheduled maintenance | Percentage | | Max. % reduction through EPC/RFID |
|---|---|---|---|
| Inappropriate parts/Insufficient information about parts | % | 20.00% | |
| Unapproved parts | 20.00% | | 30.00% |
| Inappropriate monitoring of parts environment | 60.00% | | 50.00% |
| Function failure (part does not perform after assembly into aircraft system) | 20.00% | | 0.00% |
| Lack of communication | % | 20.00% | |
| Internal communication problems | 40.00% | | 40.00% |
| External communication problems | 60.00% | | 30.00% |
| Inappropriate routine / preventive maintenance | % | 10.00% | 5.00% |
| Human caused errors | % | 10.00% | 50.00% |
| Others | % | 40.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Unscheduled maintenance due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to unscheduled maintenance (as % of revenues)".** Each sub-row is calculated by the Model and

represents its respective **"Percentage"** of the master row's **"Unscheduled maintenance due to this cause".**

**"Expected unscheduled maintenance after EPC/RFID"** is calculated by the Model by multiplying **"Unscheduled maintenance due to this cause"** times 1 minus **"Max % reduction expected through EPC/RFID".**

**"Reduced Costs"** is derived by the Model through subtracting **"Expected unscheduled maintenance after EPC/RFID"** from **"Unscheduled maintenance due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| Causes of unscheduled maintenance | Unscheduled maintenance due to this cause | | Expected unscheduled maintenance after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Inappropriate parts/Insufficient information about parts | | 0.80% | | 0.51% | $421,661 |
| Unapproved parts | 0.16% | | 0.11% | | $70,277 |
| Inappropriate monitoring of parts environment | 0.48% | | 0.24% | | $351,384 |
| Function failure (part does not perform after assembly into aircraft system) | 0.16% | | 0.16% | | $0 |
| Lack of communication | | 0.80% | | 0.53% | $398,235 |
| Internal communication problems | 0.32% | | 0.19% | | $187,405 |
| External communication problems | 0.48% | | 0.34% | | $210,830 |
| Inappropriate routine / preventive maintenance | 0.40% | 0.40% | 0.38% | 0.38% | $29,282 |
| Human caused errors | 0.40% | 0.40% | 0.20% | 0.20% | $292,820 |
| Others | 1.60% | 1.60% | 1.28% | 1.28% | $468,512 |
| **Total** | | | | | **$1,610,510** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Reduced Costs |
|---|---|---|---|
| Reduce costs of delayed MRO processes | $1,200,000 | 30.00% | $360,000 |
| Reduce cots of higher down time | $500,000 | 20.00% | $100,000 |
| **Total** | **$1,700,000** | | **$360,000** |

## 9. Business Issue: Rework & Scrap

Definition: Rework & scrap is caused by using inappropriate parts or improper assembly. In providing MRO services or parts, MRO-related companies are facing unnecessary squandering of their resources. EPC/RID technology may lead to a lower amount of rework occasions, which directly results in lower operational costs. Furthermore, reducing the amount of parts scrapped may also result in lower costs.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to rework/scrap (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to rework/scrap (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to rework/scrap (as % of revenues) | 5.00% | $7,320,500 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of rework/scrap".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of rework/scrap** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| External causes | % | 30.00% | |
| Lack of communication between airlines and MRO providers | 50.00% | | 20.00% |
| Unapproved parts | 50.00% | | 30.00% |
| Internal/operational causes | % | 20.00% | |
| Inappropriate monitoring of parts environment | 40.00% | | 50.00% |
| Incorrect configuration management | 50.00% | | 50.00% |
| Inappropriate handling / usage of parts | 10.00% | | 0.00% |
| Others | % | 50.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Rework/scrap due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to rework/scrap (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Rework/scrap due to this cause".**

**"Expected rework/scrap after EPC/RFID"** is calculated by the Model by multiplying **"Rework/scrap due to this cause"** times 1 minus **Max % reduction expected through EPC/RFID".**

**"Reduced Costs"** is derived by the Model through subtracting **"Expected rework/scrap after EPC/RFID"** from **"Rework/scrap due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)"**.

| Causes of rework/scrap | Rework/scrap due to this cause | | Expected rework/scrap after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| External causes | | 1.50% | | 1.13% | $549,038 |
| Lack of communication between airlines and MRO providers | 0.75% | | 0.60% | | $219,615 |
| Unapproved parts | 0.75% | | 0.53% | | $329,423 |
| Internal/operational causes | | 1.00% | | 0.55% | $658,845 |
| Inappropriate monitoring of parts environment | 0.40% | | 0.20% | | $292,820 |
| Incorrect configuration management | 0.50% | | 0.25% | | $366,025 |
| Inappropriate handling / usage of parts | 0.10% | | 0.10% | | $0 |
| Others | 2.50% | 2.50% | 2.00% | 2.00% | $732,050 |
| **Total** | | | | | **$1,939,933** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Added Revenues"** and **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Added Revenues | Reduced Costs |
|---|---|---|---|---|
| Reduce costs due to decrease in throughput time | $200,000 | 20.00% | $40,000 | |
| Reduce costs of low utilization of assets | $300,000 | 20.00% | | $60,000 |
| Reduce costs of low utilization of labor | $200,000 | 20.00% | | $40,000 |
| Reduce costs of OOS | $400,000 | 30.00% | | $120,000 |
| **Total** | **$1,100,000** | | **$40,000** | **$220,000** |

## 10. Business Issue: Errors Reading/Writing Part Codes Data

Definition: Part codes are defined as part / serial number assigned by a supplier and part / serial number used within own operations. EPC/RFID implementation may decrease the amount of extra work required to correct errors in reading/writing parts' codes, and thereby, directly reduce costs.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to reading/writing part codes (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to errors in reading/writing part codes (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to errors in reading/writing part codes (as % of revenues) | 4.00% | $5,856,400 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of errors in reading/writing part codes".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of errors in reading/writing part codes** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| Difficulties with current identification method | % | 20.00% | |
| Used / torn identification plates | 50.00% | | 10.00% |
| No / difficult line of sight | 30.00% | | 50.00% |
| Missing identification plates | 20.00% | | 0.00% |
| Human caused errors in reading / writing | % | 20.00% | 50.00% |
| Others | % | 60.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Errors in reading/writing part codes due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to OOS situations (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Errors in reading/writing part codes due to this cause".**

**"Expected errors in reading/writing part codes after EPC/RFID"** is calculated by the Model by multiplying **"Errors in reading/writing part codes due to this cause"** times 1 minus **"Max % reduction expected through EPC/RFID".**

**"Reduced Costs"** is derived by the Model through subtracting **"Expected errors in reading/writing part codes after EPC/RFID"** from **"Errors in reading/writing part codes due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)"** times.

| Causes of errors in reading/writing part codes | Errors in reading/writing due to this cause | | Expected errors in reading/writing part codes after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Difficulties with current identification method | | 0.80% | | 0.64% | $234,256 |
| Used / torn identification plates | 0.40% | | 0.36% | | $58,564 |
| No / difficult line of sight | 0.24% | | 0.12% | | $175,692 |
| Missing identification plates | 0.16% | | 0.16% | | $0 |
| Human caused errors in reading / writing | 0.80% | 0.80% | 0.40% | 0.40% | $585,640 |
| Others | 2.40% | 2.40% | 1.92% | 1.92% | $702,768 |
| **Total** | | | | | **$1,522,664** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Reduced Costs |
|---|---|---|---|
| Reduce costs of more frequent unscheduled maintenance | $400,000 | 10.00% | $40,000 |
| Reduce costs of erroneous shipment to MRO site or station | $200,000 | 30.00% | $60,000 |
| Reduce costs of inaccurate configuration management | $300,000 | 40.00% | $120,000 |
| Reduce costs of OOS | $400,000 | 30.00% | $120,000 |
| **Total** | **$1,300,000** | | **$340,000** |

## 11. Business Driver: Trackability

Definition: The knowledge regarding parts' position within the supply chain. EPC/RFID implementation may lead to lower amount of lost parts and associated costs. Furthermore improved trackability may decrease logistics costs.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to inefficient trackability (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to inefficient trackability (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to inefficient trackability (as % of revenues) | 8.00% | $11,712,800 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of not optimal trackability (monitoring of parts location".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of not optimal trackability (monitoring of parts location)** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| Internal/operational causes | % | 30.00% | |
| Discrepancies in asset inventory management system | 80.00% | | 30.00% |
| Improper registration of incoming and outgoing parts | 20.00% | | 30.00% |
| External causes | % | 20.00% | |
| Lack of consistent standards for registration of parts | 25.00% | | 30.00% |
| Incompatibility of IT systems | 60.00% | | 30.00% |
| Lack of communication between parties | 15.00% | | 30.00% |
| Others | % | 50.00% | 15.00% |
| **Total** | | **100%** | |

Step 3:The Model will derive **"Not optimal trackability due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to not optimal trackability (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Not optimal trackability due to this cause".**

**"Expected not optimal trackability after EPC/RFID"** is calculated by the Model by multiplying **"Not optimal trackability due to this cause"** times 1 minus **Max % reduction expected through EPC/RFID".**

**"Reduced Costs"** is derived by the Model through subtracting **"Expected not optimal trackability after EPC/RFID"** from **"Not optimal trackability due to this cause" a**nd then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)"**.

| Causes of not optimal trackability (monitoring of parts location) | Not optimal trackability due to this cause | | Expected not optimal trackability after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Internal/operational causes | | 2.40% | | 1.68% | $1,054,152 |
| Discrepancies in asset inventory management system | 1.92% | | 1.34% | | $843,322 |
| Improper registration of incoming and outgoing parts | 0.48% | | 0.34% | | $210,830 |
| External causes | | 1.60% | | 1.12% | $702,768 |
| Lack of consistent standards for registration of parts | 0.40% | | 0.28% | | $175,692 |
| Incompatibility of IT systems | 0.96% | | 0.67% | | $421,661 |
| Lack of communication between parties | 0.24% | | 0.17% | | $105,415 |
| Others | 4.00% | 4.00% | 3.40% | 3.40% | $878,460 |
| **Total** | | | | | **$2,635,380** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Added Revenues"** and **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Added Revenues | Reduced Costs |
|---|---|---|---|---|
| Reduce costs of low utilization of assets | $600,000 | 50.00% | | $300,000 |
| Added revenues due to improved customer service level | $800,000 | 15.00% | $120,000 | |
| **Total** | **$1,400,000** | | **$120,000** | **$300,000** |

## 12. Business Driver: Returnable Assets

Definition: Returnable asset management (through the supply chain tracking and locating of returnable assets - containers, totes, bins, etc.). EPC/RFID implementation may result in lower amount of lost returnable assets (e.g. theft) and thereby directly decrease the costs.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to improper returnable assets management (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to improper returnable assets management (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to improper returnable assets management (as % of revenues) | 5.00% | $7,320,500 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of not optimal returnable asset management".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of not optimal returnable asset management** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| Internal/operational causes | % | 20.00% | |
| Discrepancies in asset inventory management system | 30.00% | | 50.00% |
| Improper registration of incoming and outgoing assets | 70.00% | | 50.00% |
| External causes - Lack of communication between parties | | 10.00% | 30.00% |
| Others | % | 70.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Not optimal returnable asset management due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to not optimal returnable asset management (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Not optimal returnable asset management due to this cause".**

**"Expected not optimal returnable asset management after EPC/RFID"** is calculated by the Model by multiplying **"Not optimal returnable asset management due to this cause"** times 1 minus **"Max % reduction expected through EPC/RFID".**

**"Reduced Costs"** is derived by the Model through subtracting **"Expected not optimal returnable asset management after EPC/RFID"** from **"Not optimal returnable asset**

**management due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)"**.

| Causes of not optimal returnable asset management | Not optimal returnable asset management due to this cause | | Expected not optimal returnable asset management after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Internal/operational causes | | 1.00% | | 0.50% | $732,050 |
| Discrepancies in asset inventory management system | 0.30% | | 0.15% | | $219,615 |
| Improper registration of incoming and outgoing assets | 0.70% | | 0.35% | | $512,435 |
| External causes - Lack of communication between parties | 0.50% | 0.50% | 0.35% | 0.35% | $219,615 |
| Others | 3.50% | 3.50% | 2.80% | 2.80% | $1,024,870 |
| **Total** | | | | | **$1,976,535** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Reduced Costs |
|---|---|---|---|
| Reduce costs of low utilization of assets | $900,000 | 20.00% | $180,000 |
| **Total** | **$900,000** | | **$180,000** |

## 13. Business Driver: Manual Administrative Processes

Definition: In the aerospace industry often transformation (production, assembly and MRO) or transportation (inbound and outbound) of parts requires manual administrative processes. These processes are needed to (uniquely) identify the part and its current position and to register additional information of the parts, such as maintenance history, repair procedure performed and information about the production batch it belonged to. EPC/RFID implementation may lead to more efficient use of machine and labor resources and thereby reduce costs.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to manual administrative processes (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to manual administrative processes (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to manual administrative processes (as % of revenues) | 6.00% | $8,784,600 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of extensive manual administrative processes".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of extensive manual administrative processes** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| Inability of current ID method to automate data gathering | % | 20.00% | |
| Human readable plate | 50.00% | | 50.00% |
| 1D Bar code | 30.00% | | 50.00% |
| 2D Bar code | 15.00% | | 50.00% |
| Memory buttons | 5.00% | | 50.00% |
| Others | % | 80.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Extensive manual administrative processes due to this cause"** (before EPC/RFID (as % of yr 5 revenues) by multiplying **"Percentage"** times **"Total costs due to extensive manual administrative processes (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective

**"Percentage"** of the master row's **"Extensive manual administrative processes due to this cause".**

**"Expected extensive manual administrative processes after EPC/RFID"** is calculated by the Model by multiplying **"Extensive manual administrative processes due to this cause"** times 1 minus **"Max % reduction expected through EPC/RFID".**

**"Reduced Costs"** is derived by the Model through subtracting **"Expected extensive manual administrative processes after EPC/RFID"** from **"Extensive manual administrative processes due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)"**.

| Causes of extensive manual administrative processes | Extensive manual administrative processes due to this cause | | Expected extensive manual administrative processes after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Inability of current ID method to automate data gathering | | 1.20% | | 0.60% | $878,460 |
| Human readable plate | 0.60% | | 0.30% | | $439,230 |
| 1D Bar code | 0.36% | | 0.18% | | $263,538 |
| 2D Bar code | 0.18% | | 0.09% | | $131,769 |
| Memory buttons | 0.06% | | 0.03% | | $43,923 |
| Others | 4.80% | 4.80% | 3.84% | 3.84% | $1,405,536 |
| **Total** | | | | | **$2,283,996** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Added Revenues"** and **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Added Revenues | Reduced Costs |
|---|---|---|---|---|
| Reduce costs of down time of an aircraft due to decreased throughput time of MRO processes | $700,000 | 30.00% | | $210,000 |
| Added revenues due to higher customer service (shorter lead times) | $200,000 | 30.00% | $60,000 | |
| **Total** | **$900,000** | | **$60,000** | **$0** |

## 14. Business Driver: Inbound - Outbound

Definition: Inbound processes are those activities performed when receiving goods at the entrance of a facility (e.g. factory, distribution centre, maintenance shop). These activities might consist of; reading pallet, box and/or parts' codes, de-stacking and unpacking if necessary, checking quality of incoming goods, checking parts' documentation and entering the incoming goods, with if necessary additional information, into the information system. EPC/RFID technology might prevent errors in inbound/outbound operations and/or make them more efficient. This will ultimately lead to lower cots.

Step 1: **"Current annual revenue"** is sourced from the **"Preliminary Information"** worksheet. The Model takes **"Current annual revenue"** from the **"Preliminary Information"** worksheet and calculates **"Extrapolated year 5 revenues (100% EPC/RFID)**" by using the **"Expected annual business growth rate".**

The user inputs **"Total costs due to inefficient inbound-outbound processes (as % of revenues)"**, which is used by the Model to calculate the dollar amount. The Model multiplies the percentage value of **"Total costs due to inefficient inbound-outbound processes (as % of revenues)"** times **"Extrapolated year 5 revenues (100% EPC/RFID)".**

| **Company** | | |
|---|---|---|
| Current annual revenue | | $100,000,000 |
| Extrapolated year 5 revenues (100% EPC/RFID) | | $146,410,000 |
| Total costs due to inefficient inbound-outbound processes (as % of revenues) | 6.00% | $8,784,600 |

Step 2: The user inputs percentage values in all *gray* **"Percentage"** cells. Note: Where cells are marked in *white*, the Model will calculate the balance of each of the areas in **"Causes of not optimal inbound/outbound processes".** For percentage values located in **"Max. % reduction through EPC/RFID",** the user should input the expected maximum percentage that can be reduced by implementing EPC/RFID. Each of the row's values can be from 0% to 100%.

| **Causes of not optimal inbound/outbound processes** | **Percentage** | | **Max. % reduction through EPC/RFID** |
|---|---|---|---|
| Improper monitoring of parts location (trackability) | % | 30.00% | 50.00% |
| Unstructured work | % | 5.00% | 30.00% |
| Difficulties with current identification method | % | 20.00% | |
| Difficulties with current automatic ID solution | 30.00% | | 50.00% |
| Human caused errors | 70.00% | | 50.00% |
| Others | % | 45.00% | 20.00% |
| **Total** | | **100%** | |

Step 3: The Model will derive **"Not optimal inbound/outbound processes due to this cause"** (before EPC/RFID) by multiplying **"Percentage"** times **"Total costs due to not optimal inbound/outbound processes (as % of revenues)".** Each sub-row is calculated by the Model and represents its respective **"Percentage"** of the master row's **"Not optimal inbound/outbound processes due to this cause".**

**"Expected not optimal inbound/outbound processes after EPC/RFID"** is calculated by the Model by multiplying **"Not optimal inbound/outbound processes due to this cause"** times 1 minus **Max % reduction expected through EPC/RFID".**

**"Reduced Costs"** is derived by the Model through subtracting **"Expected not optimal inbound/outbound processes after EPC/RFID"** from **"Not optimal inbound/outbound processes due to this cause"** and then the result is multiplied by **"Extrapolated year 5 revenues (100% EPC/RFID)"**.

| Causes of not optimal inbound/outbound processes | Not optimal inbound/outbound processes due to this cause | | Expected not optimal inbound/outbound processes after EPC/RFID | | Reduced Costs |
|---|---|---|---|---|---|
| Improper monitoring of parts location (trackability) | 1.80% | 1.80% | 0.90% | 0.90% | $1,317,690 |
| Unstructured work | 0.30% | 0.30% | 0.21% | 0.21% | $131,769 |
| Difficulties with current identification method | | 1.20% | | 0.60% | $878,460 |
| Difficulties with current automatic ID solution | 0.36% | | 0.18% | | $263,538 |
| Human caused errors | 0.84% | | 0.42% | | $614,922 |
| Others | 2.70% | 2.70% | 2.16% | 2.16% | $790,614 |
| **Total** | | | | | **$1,800,843** |

Step 4: In the **"Other benefits"** area, the user should input dollar values for **"Current annual value"** and percentage values for **"% of improvement through EPC/RFID".** The Model will calculate **"Reduced Costs"** by multiplying **"Current annual value"** times **"% of improvement through EPC/RFID".**

| Other benefits | Current annual value | % of improvement through EPC/RFID | Reduced Costs |
|---|---|---|---|
| Reduce costs of delayed MRO processes | $1,200,000 | 30.00% | $360,000 |
| Reduce costs of discrepancies in inventory management system | $400,000 | 40.00% | $160,000 |
| **Total** | **$1,600,000** | | **$520,000** |