REPORT SAP: 15th of January 2018

Case study: GBI enters the Trolley Market in Brazil

LOGI0015-1: ERP Solutions for Supply Chain 2017 – 2018

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ERP Solutions for Supply Chains

Report: Implementation Case Study in SAP

1. Introduction

For the second part of this course we had to implement the obtained results in SAP. In this paper, we mainly want to emphasize the strategic decisions we made and provide the different created products, work center and routings. We always tried to make the decisions as realistic as possible. The most important calculations will be detailed, and the used values can be found in the attached excel file. For the different implementations, we followed the numerous instructions mentioned in the documents provided on Lol@.

First, the different created products are discussed. The reasoning behind the bill of materials will be followed by the created work center and routings. Finally, the created forecasting and MRP planning will be explained.

2. Material Management: created products

In this part of the project, we had to create raw materials, semi-finished products and the final product in SAP. First, we created all the different raw materials needed to manufacture a trolley. In total, nine raw materials were created:

- Parker screw: **PARKERSCREW806**
- M20 nut: **M20NUT806**
- M20 screw: **M20SCREW806**
- M10 screw: **M10SCREW806**
- Fixed castor: **FCASTOR806**
- Swivel castor: **SWIVELCST806**
- Rectangular steel tube: **RECTST802**
- Plywood plate: **PLYWOOD802**
- Round steel tube: **ROUNDST808**

In the ERP part of the case, we decided to only assemble the plywood back to the steel handle and the plywood tray to the steel frame to optimize the size and cost of the trolley box for transportation. Therefore, we decided to only create two semi-finished products, **PLYWOODFRAME808** and **PLYWOODHANDLE802**. The first one corresponds to the plywood tray attached to the steel frame. The second one includes mainly the plywood back and the steel handle**.** This simplified the further implementations in SAP, like the bill of materials and routings. So, we assumed that the worker takes the needed raw materials and follows the routing to produce the corresponding semi-finished product. Concretely, this implicated that for a semi-finished product, the raw materials are cut, bend, painted and assembled in one work centre.

Finally, we created one finished product that corresponds to the industrial trolley that we have to produce. We called it **TROLLEY806**.

2.1 Raw materials

As unit of measure for the plywood plate we decided to use cubic centimetre (CCM) as the measure of cubic meter was not available. Since the size of the needed parts are given, we can easily compute its volume. Furthermore, we only need a part of the raw material so we could not use the unit of measure 'each'. Next, the weight and volume of the plate were given and for the delivery time we used the lead time from the excel file. For the standard price of a plywood plate, we multiplied the cost per cubic meter with the volume of a plate and the exchange rate. In the excel file the same exchange rate is used for every calculation. This gives:

= (200/10^6) * 35721.6*0.85004

= **6.07 €/plate**

For the rectangular and round steel tubes, we used meter (M) as unit of measure since we again only use a part of the tube and it simplifies further calculations. The weight of a tube was easily computed by multiplying the given weight per meter by the length of a tube. The standard price of each tube is obtained by multiplying the cost per ton with the weight per tube and the same exchange rate.

Then, the different screws and nuts were encoded in a similar way. Since we use these raw materials entirely, we gave them all a unit of measure of 'each'. Next, the weight per unit was given for each of these items. The standard price was obtained by multiplying the unit cost with the exchange rate and needed to be rounded up to two decimals in SAP. For the M10 screws this gives:

(20 $ per 1000 units) / 1000 x exchange rate

= (20 / 1000) x 0.85004 = **0.017 €/ unit**

Finally, for the fixed and swivel castors, we also used 'each' as unit of measure. The weight per unit and standard price were given.

2.2 Semi-finished products

As unit of measure for the semi-finished products, we used 'each' since we also need the entire product. To clarify the further calculations, we will discuss the case of **PLYWOODFRAME808** but the **PLYWOODHANDLE802** was computed in the same way. The weight is found by adding the different elements:

Plywood tray + steel frame + 4 x M10 screw

(area tray / area plate) * weight per plate + (width part * weight/m * 2) + (length part *weight/m * 2) + (4*weight M10 screw)

= ((1.2*0.8)/ (2.44*1.22)) *26.8 +(0.8*3.2*2)+(1.07*3.2*2)+ (4*0.03)

= 8.6428 + 5.12 + 6.848 + 0.12 = **20.73 kg**/plywoodFrame

To determine the standard price, we needed to calculate the final value of the manufactured product. This was obtained by adding the cost of the materials (including waste) and the production cost. A table is provided below with the different operation times and costs.

Cost materials:

(plywood tray + steel frame + 4*M10 screw) * exchange rate

= (2.38 + 3.07 + 4.39 + 4*0.02) *0.85004 = **8.43 €** / plywoodFrame

Production cost:

= plywood tray + steel frame + welding + assembly + painting/varnishing

= (131.36* 23.4) +(467.43*23.4) + (388.8*28.8) + ((488 + 16) *23.4) +((960/2) *28.8)

= (131.36 +467.43 +488 +16) *23.4 + (388.8 +480) *28.8

= 50 826.73 / 3600 (hour to seconds) = **14.12 €**/ plywoodFrame

- ⇨ The final standard price: 14.12 + 8.43 = **22.55 €**/ plywoodFrame.

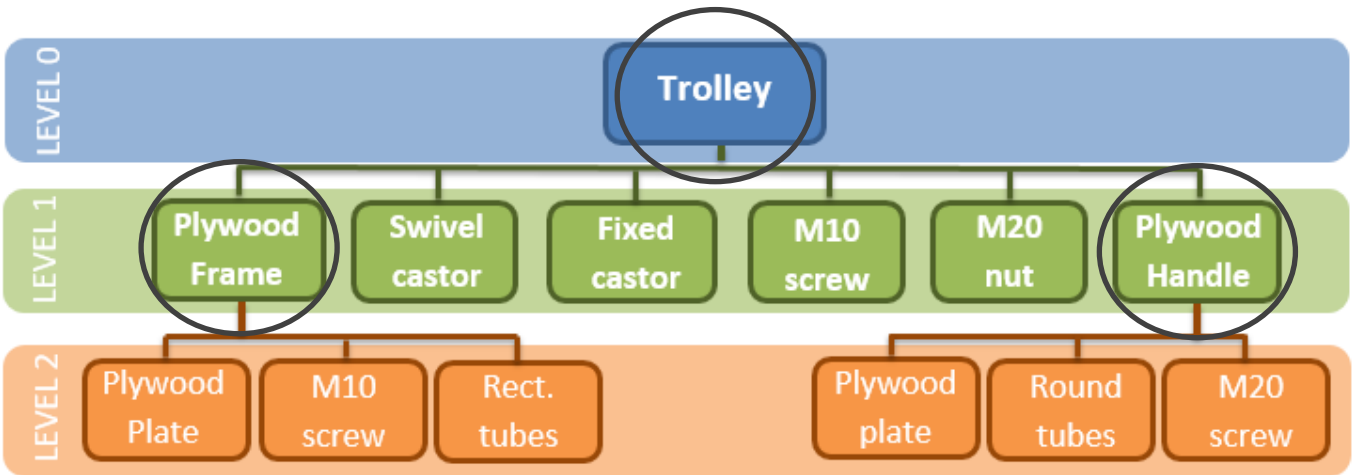
	Steel tubes	Plywood Plate	Welding	Assembly	Painting/varnishing	**Total**
Frame	467.43		388.8	488		1344.23
Handle	298.00		67.82	16		381.82
Plywood back		71.6		16		87.60
Plywood tray		131.36		16		147.36
Painting/varnishing					960	960
Assembly				64		
Total (s)	765.43	202.96	456.62	600.00	960.00	**2985.01**
Total(h)	0.21	0.06	0.13	0.17	0.27	0.83
Cost per hour	23.4	23.4	28.8	23.4	28.8	**€/hour**
Total cost	4.975285714	1.31924	3.652992	3.9	7.68	**21.53**

2.3 Finished product

The decision for the unit of measure and weight was made in the same way as for the semi-finished products. Next, we distinguished the price to distributor and the final selling price to the customer. In case of a fire in the warehouse, the money that would be lost is equal to the material costs added to production costs. Therefore, we encoded the standard price in the same way as for the semi-finished product, namely equal to the price to distributor. Nevertheless, we also encoded the final selling price within the sales organization conditions of the trolley. The corresponding values can be found in the excel file.

Finally, some general points should be mentioned. First, some rounding differences exists between our calculations and what we encoded in SAP. This was mostly due to a decimal constraint in SAP. Next, the gross weight was assumed to be equal to the net weight of each material.

The different materials and levels can be found in the illustration below. For each encircled material a bill of materials has been created. Level 0 corresponds to the finished product and level 1 displays the elements of the created bill of materials of the trolley. Level 2 represents the bill of materials of the two semi-finished products. This will be discussed further in the following section.



3. Production

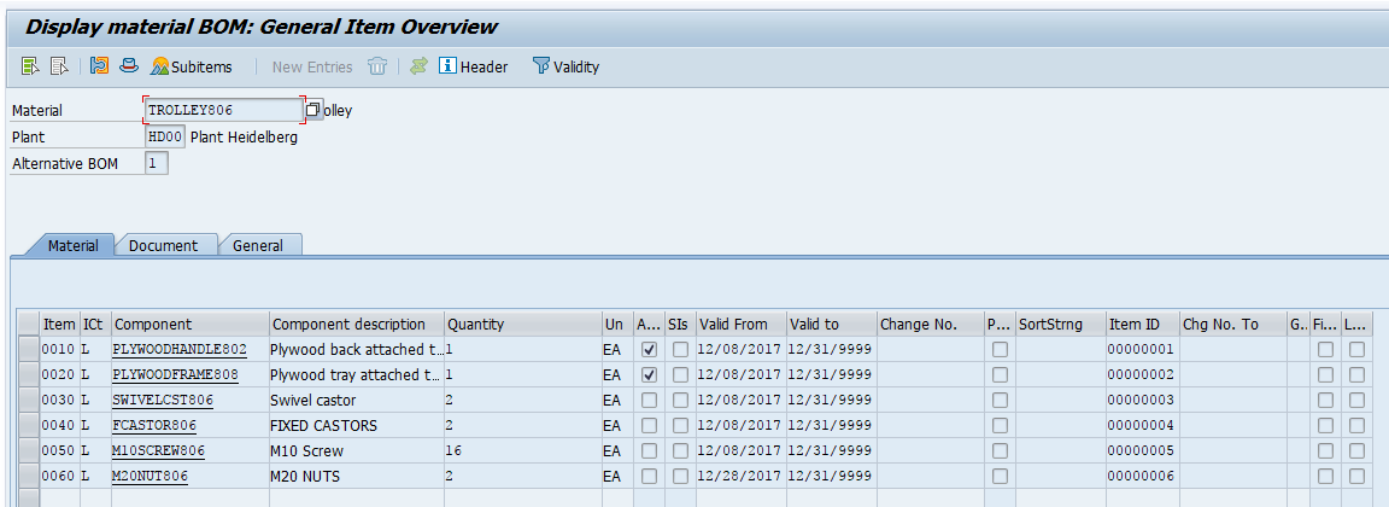
3.1 Bill of materials (BOM)

In this part, we created three different bills of materials, one for each semi-finished product and one for the finished product. In the illustration in the previous section, these different bill of materials can easily be distinguished.

The BOM in SAP of the finished product (**TROLLEY806**) includes the following:

- One **PLYWOODFRAME808** – Steel frame + plywood tray (semi-finished product)
- One **PLYWOODHANDLE802** – Steel frame + plywood back (semi-finished product)
- Two **FCASTOR806** – Fixed castor (raw material)
- Two **SWIVELCST806** – Swivel castor (raw material)
- Sixteen **M10SCREW806** – M10 screw (raw material) to fix both types of castor to the steel frame.
- Two **M20NUT806** – M20 nut (raw material)

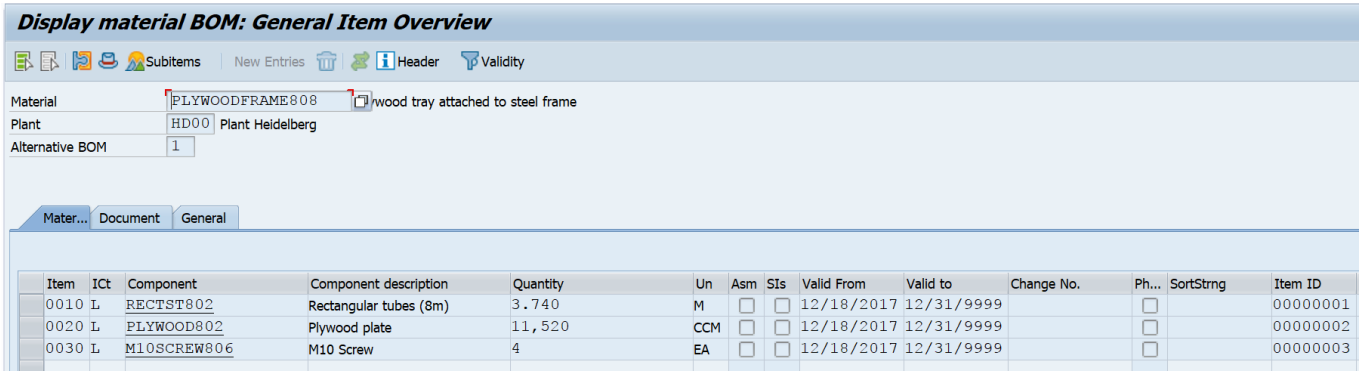
These parts correspond to the level 1 in the illustration and will thus be assembled to form the industrial trolley.



Item	ICt	Component	Component description	Quantity	Un	A...	SIs	Valid From	Valid to	Change No.	P...	SortStrng	Item ID	Chg No. To	G..	Fi...	L...
0010	L	PLYWOODHANDLE802	Plywood back attached t...	1	EA	☑	☐	12/08/2017	12/31/9999		☐		00000001			☐	☐
0020	L	PLYWOODFRAME808	Plywood tray attached t...	1	EA	☑	☐	12/08/2017	12/31/9999		☐		00000002			☐	☐
0030	L	SWIVELCST806	Swivel castor	2	EA	☐	☐	12/08/2017	12/31/9999		☐		00000003			☐	☐
0040	L	FCASTOR806	FIXED CASTORS	2	EA	☐	☐	12/08/2017	12/31/9999		☐		00000004			☐	☐
0050	L	M10SCREW806	M10 Screw	16	EA	☐	☐	12/08/2017	12/31/9999		☐		00000005			☐	☐
0060	L	M20NUT806	M20 NUTS	2	EA	☐	☐	12/28/2017	12/31/9999		☐		00000006			☐	☐

The two other bills of materials were created for the two semi-finished products. Let's start with the semi-finished product called **PLYWOODFRAME808** which is composed out of:

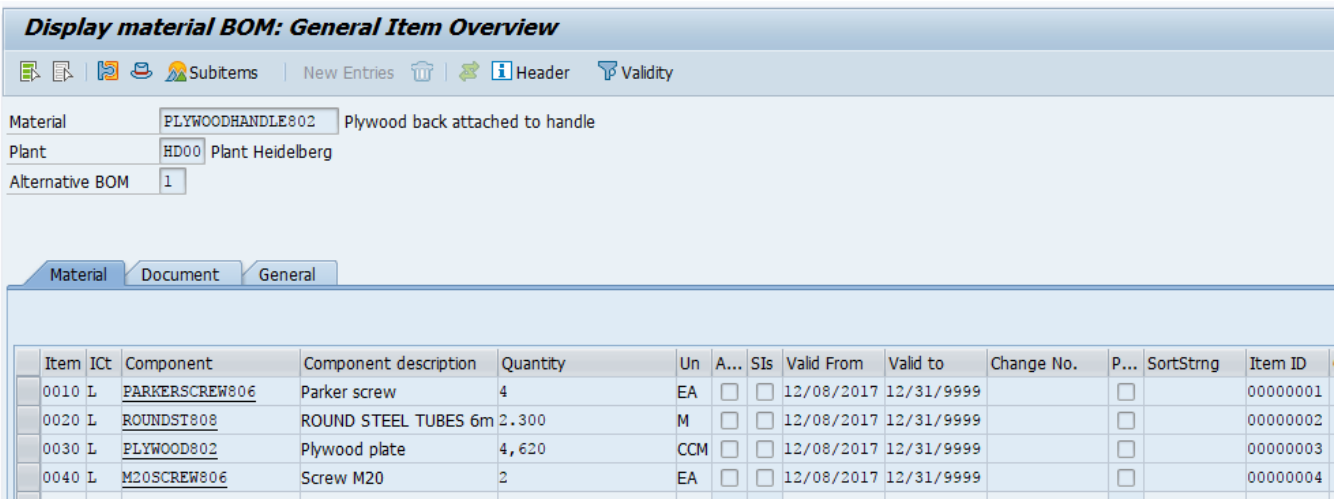
- One **RECTSTS802** – Rectangular steel tubes (raw material)
- One **PLYWOOD802** – Plywood plate (raw material)
- Four **M10SCREW806** – M10 screw (raw material) to fix the plywood tray to the steel frame.



The other semi-finished product (**PLYWOODHANDLE802)** is composed out of:

- **ROUNDST808** – Round steel tube (raw material)
- **PLYWOOD802** – Plywood plate (raw material)
- Four **PARKERSCREW806** – Parker screw (raw material) to fix the plywood bed to the steel handle.
- Two **M20SCREW806** – M20 screw (raw material)

The raw materials that were used in both the **PLYWOODFRAME808** and the **PLYWOODHANDLE802** correspond to the level 2 of the illustration.

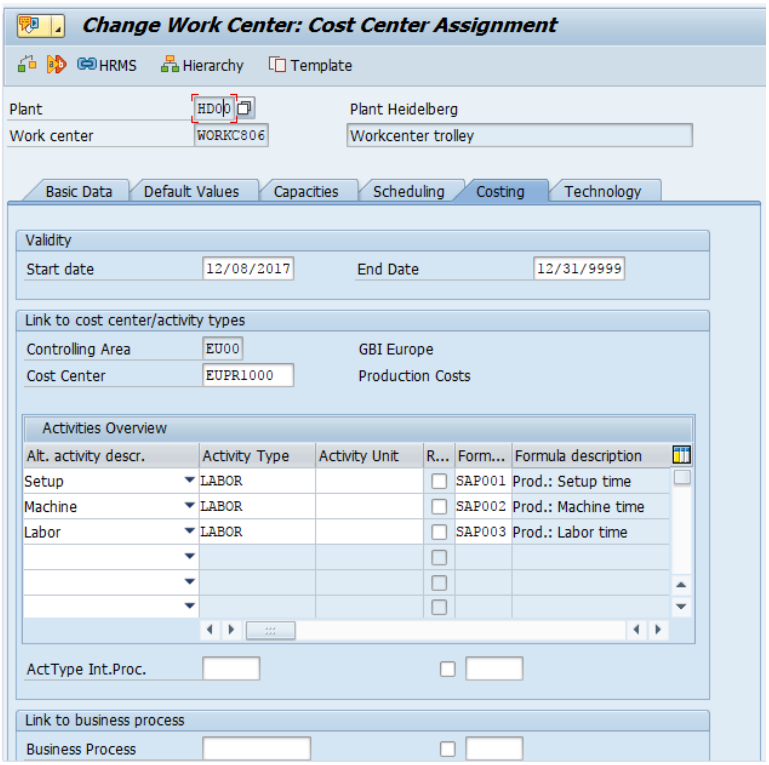


As can be seen from the last two bills of materials, we did not explicitly create the plywood back, the plywood tray, the steel frame and the steel handle. Indeed, as said before, we assumed that we take the raw materials and perform all the operations in one work center to finally obtain the **PLYWOODFRAME808** and the **PLYWOODHANDLE802**. More detailed information about these routings is given in another part of the report.

3.2 Work center

In this part of the case, we decided to only create one work center and assumed that it would contain all the necessary machines to manufacture a trolley. Furthermore, we set the default value of units of measurement to minutes. This seemed to be the most realistic value of measurement for the production time per trolley. Next, we distinguished three types of activities to enhance our precision: setup, machine and labor activity. The setup activity is required for certain operations for which the

corresponding setup time was given. The labor activity corresponds to operations that do not need a machine, like we assumed assembling would be. The machine activity does need a machine and for these types of operations a machine time was given.

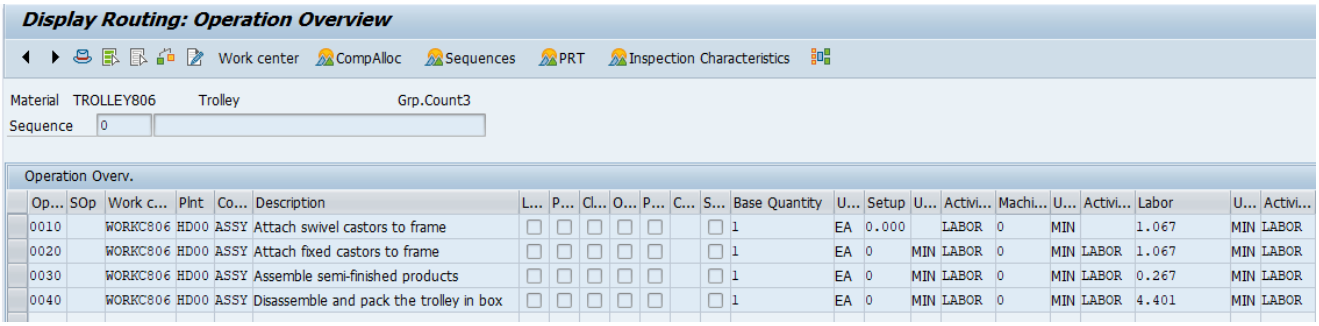


3.3 Routings

We created a routing for every semi- finished and finished product. Within a routing we decided to group together some operations.

The routing of the finished product contains the attachment of the different wheels to the steel frame, the assembling of the semi-finished products and the disassembling and packaging of the trolley in a box. We wanted to be consistent with the ERP part of the case where we decided to not assemble the trolley for transportation. Therefore, we assumed that the company would assemble the parts to verify their coherence and later disassemble them to fit optimally in a box.

These were assumed to be labor activities. The corresponding labor time was calculated by multiplying the required number of screws with the given speed of a screwing tool. Respectively sixteen M10 screws and two M20 nuts are needed, as can be deduced from the BOM of the trolley. For the packaging, we assumed that this would take around 2 minutes. This was added to the disassembly time, which we assumed to be equal to the assembling time. Moreover, the link was made between the routing and its corresponding BOM. Since no distinction was made between the M10 screws needed for swivel and fixed castors we could only assign the screws to one of them. Except from the packaging, all the materials of the corresponding BOM could always be assigned to one of these operations.



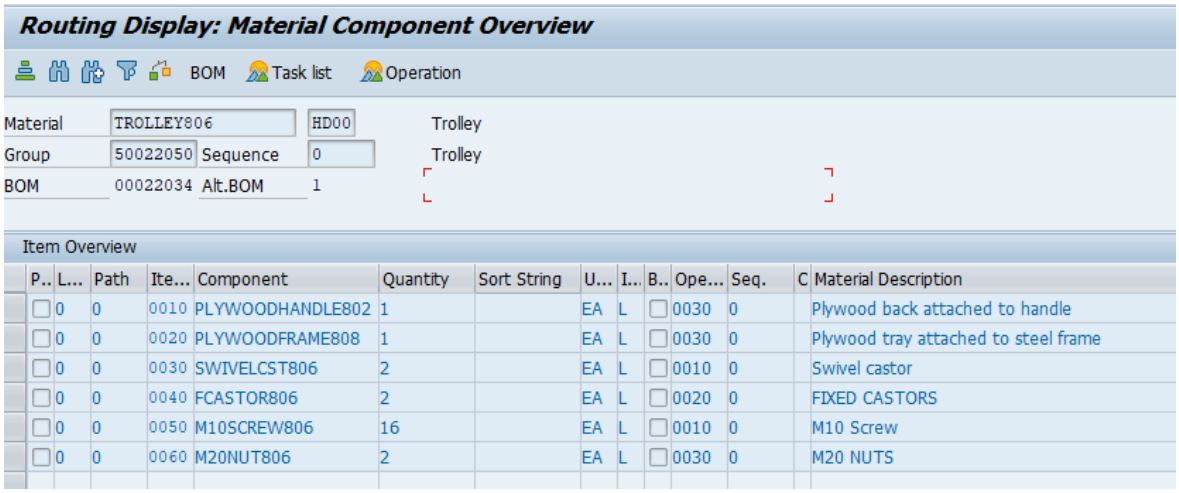
Display Routing: Operation Overview

Work center | CompAlloc | Sequences | PRT | Inspection Characteristics

Material TROLLEY806 Trolley Grp.Count3
Sequence 0

Operation Overv.

Op...	SOp	Work c...	Plnt	Co...	Description	L...	P...	Cl...	O...	P...	C...	S...	Base Quantity	U...	Setup	U...	Activi...	Machi...	U...	Activi...	Labor	U...	Activi...
0010		WORKC806	HD00	ASSY	Attach swivel castors to frame								1	EA	0.000		LABOR	0	MIN		1.067	MIN	LABOR
0020		WORKC806	HD00	ASSY	Attach fixed castors to frame								1	EA	0	MIN	LABOR	0	MIN	LABOR	1.067	MIN	LABOR
0030		WORKC806	HD00	ASSY	Assemble semi-finished products								1	EA	0	MIN	LABOR	0	MIN	LABOR	0.267	MIN	LABOR
0040		WORKC806	HD00	ASSY	Disassemble and pack the trolley in box								1	EA	0	MIN	LABOR	0	MIN	LABOR	4.401	MIN	LABOR



Routing Display: Material Component Overview

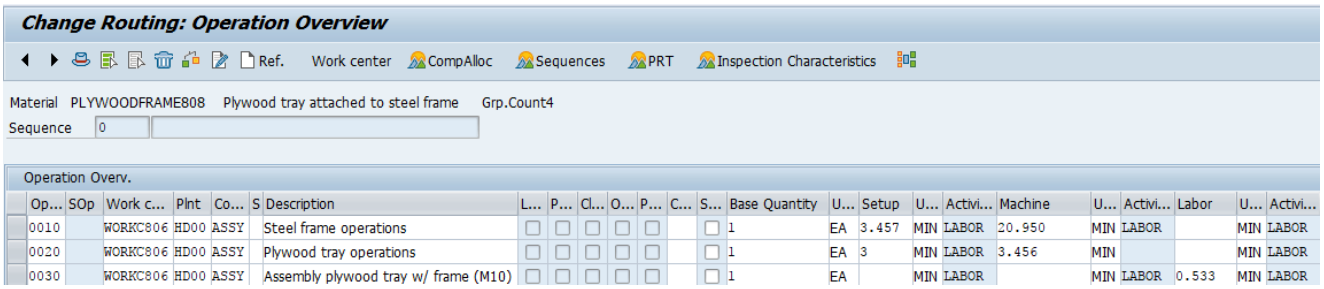
BOM | Task list | Operation

Material TROLLEY806 HD00 Trolley
Group 50022050 Sequence 0 Trolley
BOM 00022034 Alt.BOM 1

Item Overview

P..	L...	Path	Ite...	Component	Quantity	Sort String	U...	I...	B..	Ope...	Seq.	C	Material Description
	0	0	0010	PLYWOODHANDLE802	1		EA	L		0030	0		Plywood back attached to handle
	0	0	0020	PLYWOODFRAME808	1		EA	L		0030	0		Plywood tray attached to steel frame
	0	0	0030	SWIVELCST806	2		EA	L		0010	0		Swivel castor
	0	0	0040	FCASTOR806	2		EA	L		0020	0		FIXED CASTORS
	0	0	0050	M10SCREW806	16		EA	L		0010	0		M10 Screw
	0	0	0060	M20NUT806	2		EA	L		0030	0		M20 NUTS

Then, we decided to create three operations for the routing of each semi-finished product. Since the different values were obtained in a similar way for both semi-finished product, we are only going to discuss the **PLYWOODFRAME808**.



Change Routing: Operation Overview

Ref. | Work center | CompAlloc | Sequences | PRT | Inspection Characteristics

Material PLYWOODFRAME808 Plywood tray attached to steel frame Grp.Count4
Sequence 0

Operation Overv.

Op...	SOp	Work c...	Plnt	Co...	S	Description	L...	P...	Cl...	O...	P...	C...	S...	Base Quantity	U...	Setup	U...	Activi...	Machine	U...	Activi...	Labor	U...	Activi...
0010		WORKC806	HD00	ASSY		Steel frame operations								1	EA	3.457	MIN	LABOR	20.950	MIN	LABOR		MIN	LABOR
0020		WORKC806	HD00	ASSY		Plywood tray operations								1	EA	3	MIN	LABOR	3.456	MIN			MIN	LABOR
0030		WORKC806	HD00	ASSY		Assembly plywood tray w/ frame (M10)								1	EA		MIN	LABOR		MIN	LABOR	0.533	MIN	LABOR

As can be seen in the image above, the manufacturing of this semi-finished product can be separated in steel frame operations, plywood tray operations and the assembly of the tray to the frame. We always used the unit of measure 'each' since we want to obtain the total activity time of each step for one trolley. So, for the setup and operation time we added the activity time of the different steps of an operation. The calculations are given below.

Steel frame operations

- Setup time :
  WIDTH + LENGTH + PAINTING
  = ((180/10)*2) + ((180/7)*2) + 120
  = 207.43sec
  = **3.457min**

- Machine time:
  CUTTING W + CUTTING L + WELDING + DRILLING M20 + DRILLING M10 + TAPPING
  = ((1080-180)/10)*2 + ((880-180)/7)*2 + 388.8 + 8 +80 + 400
  = 1256.8 sec
  = **20.95 min**

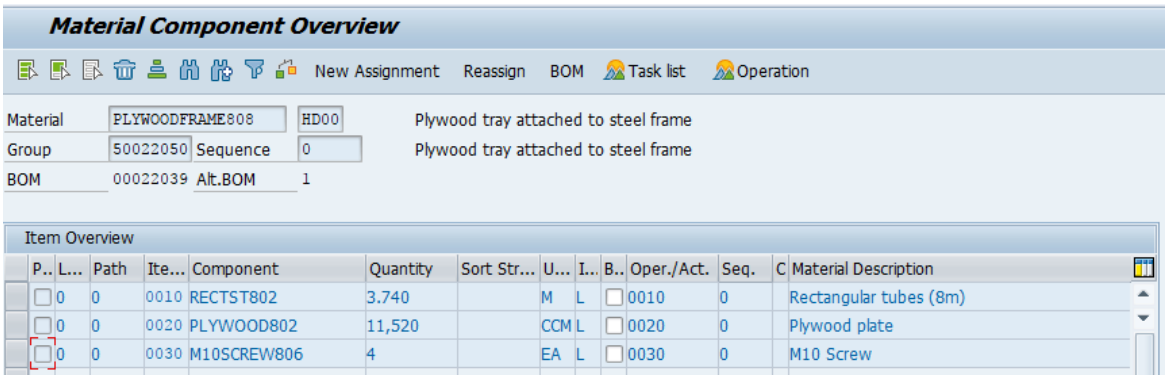
Plywood tray operations

- Setup time = **3 min** (given in the case)
- Machine time:
  CUTTING + DRILLING + VARNISHING
  = ((394.08-180)/3) + 16 +120
  = 207.36 sec
  = **3.456 min**

Assembly plywood tray with frame

- Setup time = 0
- Machine time: M10 screws
  = 4*8 = 32 sec
  = **0.533 min**

In this case we assigned the **RECTST802**, **PLYWOOD802** and the **M10SCREW806**, respectively to the steel frame operations, plywood tray operations and assembly.



4. MRP: forecasting

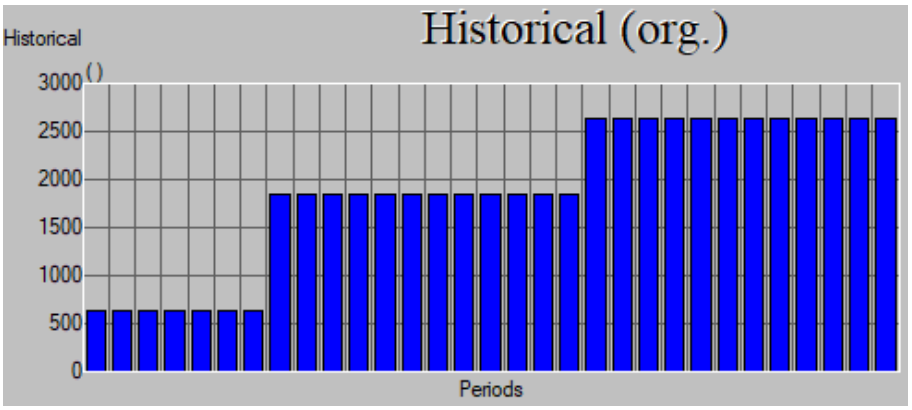
4.1. Historical/Consumption values

First, we had to enter historical values for our product **TROLLEY806** to allow SAP to forecast values for the coming year. The historical values for the first three years were obtained from the ERP part of the case. Therefore, historical values concern 36 periods whilst the forecast 12. Furthermore, there are 12 periods per season (months/ year). The alpha, beta, gamma and delta factors were provided in the case study. Concretely, we divided the value of our forecasted annual demand for the next 3 years by 12 to have a monthly demand as follows:

Year	Forecasted annual demand	Forecasted monthly demand
2018	7620	7620 / 12 = 635
2019	22168	22168 / 12 = 1847,33
2020	31640	31640 / 12 = 2636,67

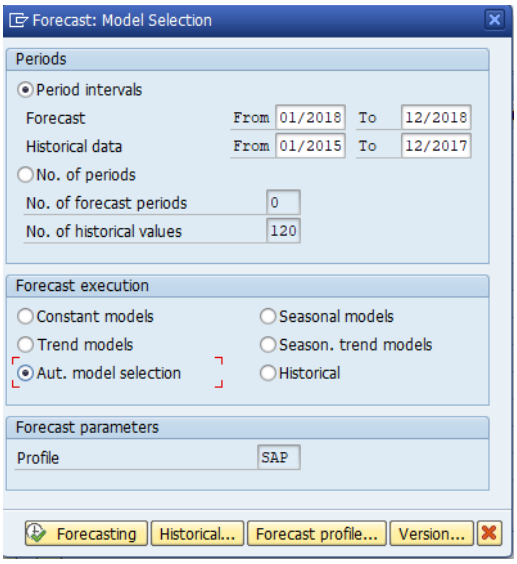
In the ERP part of this case, we estimated the demand for 2018, 2019 and 2020 since we assumed to start producing in January 2018. These values are represented in the table above. But in SAP we could not insert these values as historical data. Therefore, we entered these values as "Total consumption" for the years 2015, 2016 and 2017, as can be seen in the table below. The graph also represents the historical values and clearly shows an increasing trend over the years.

Periods (Months)	2017	2016	2015
12	2636,67	1847,33	635
11	2636,67	1847,33	635
10	2636,67	1847,33	635
9	2636,67	1847,33	635
8	2636,67	1847,33	635
7	2636,67	1847,33	635
6	2636,67	1847,33	635
5	2636,67	1847,33	635
4	2636,67	1847,33	635
3	2636,67	1847,33	635
2	2636,67	1847,33	635
1	2636,67	1847,33	635

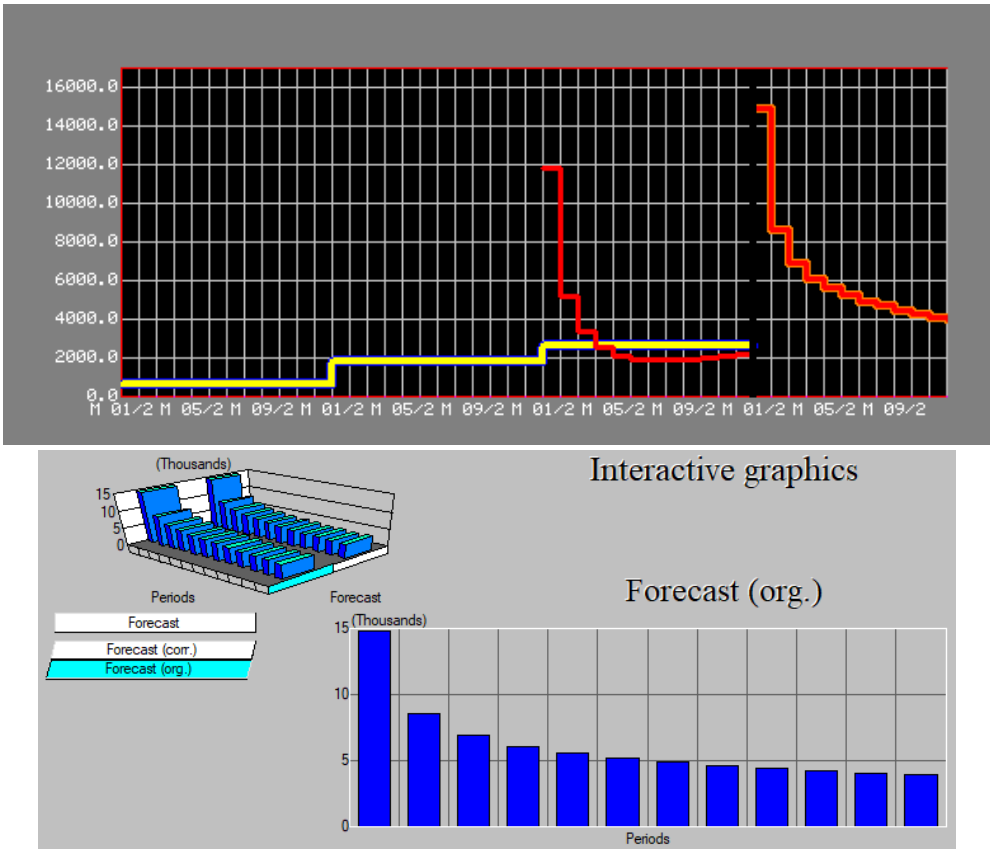


4.2. Sales and Operations Plan (SOP)

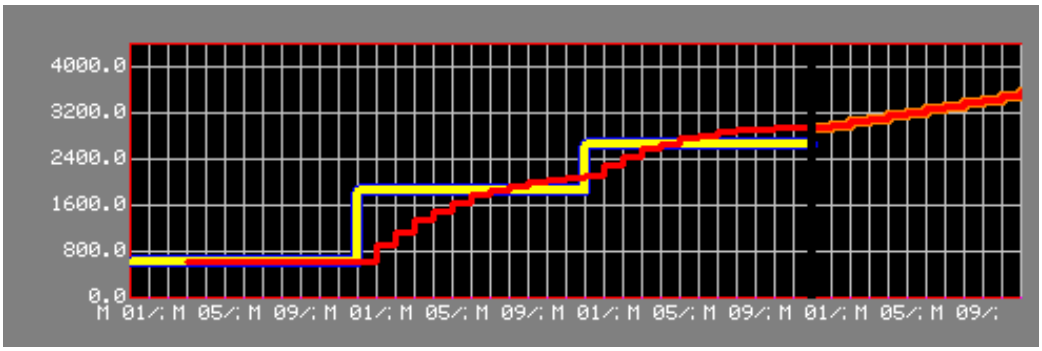
In this part, we first had to create a product group: **TROLLEY808.** Since we only had one type of trolley in this case study, the proportion of the finished product **TROLLEY806** within this group is 100%. Then we used the SAP's forecasting module "For Product Group" to create the sales plan for 2018 based on historical values from January 2015 to December 2017.

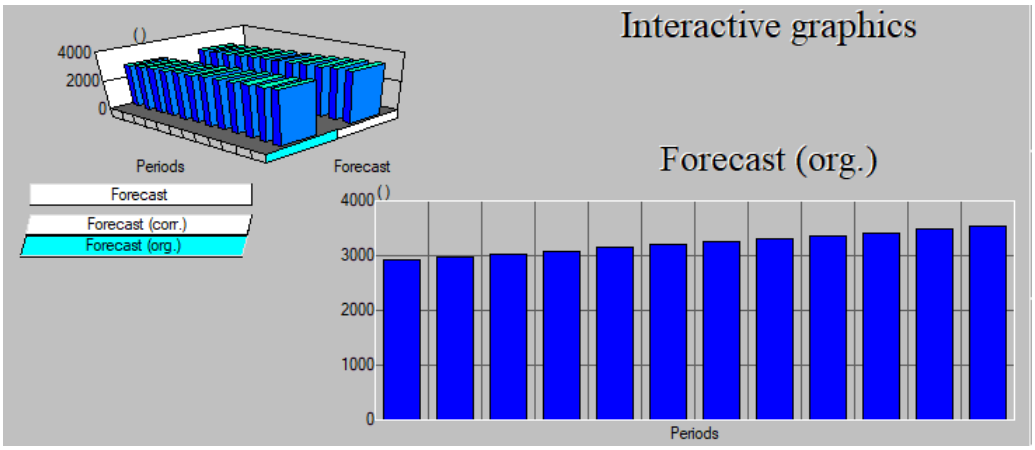


For the forecast model selection, we started by selecting the 'automatic model selection'. SAP then proposed the 'seasonal and trend model', which gave the following result:



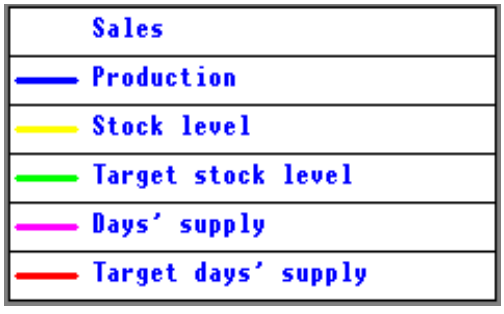
Although in reality the yearly demand is not constant every month, as we assumed for the historical values, the decreasing trend does not seem optimal either. Therefore, we wanted to test the trend model as well considering that we can neither deduce a seasonality nor decreasing trend from the given historical data. We set the values of the alpha and beta factor equal to the ones provided in the case study and obtained this result:

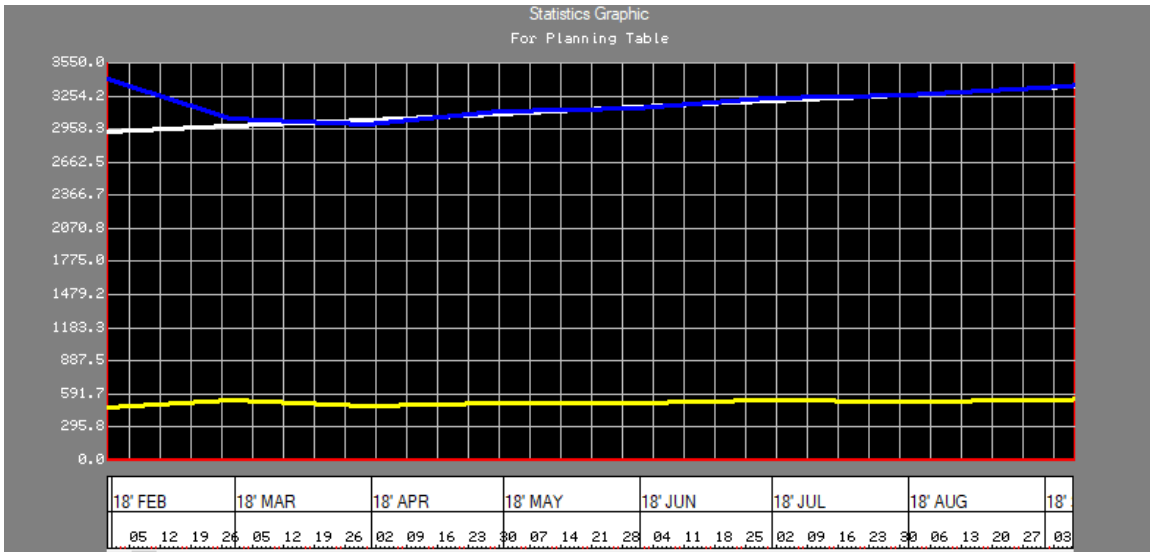




In this forecast, we can observe an increasing trend. According to us and based on our previous assumptions, this result seems more fitting than the forecast with the seasonal model. The growth in the first graph above seems to be the continuity of the growth that we can see in the historical values.

Next, we assumed that a stock quantity should be available for up to 5 work days. Therefore, for each forecasted period we entered '5' as "Target day's supply". Then we created a production plan "Synchronous to sales" and "Target day's supply". As a result, we obtained a production plan that matches the sales forecast whilst meeting the target days of supply. This is illustrated on the next graph.





In the following step, we transferred the SOP to the demand management and obtained 'Planned Independent Requirements' for the trolley. We checked that this was also transferred to the stock/requirements list. Finally, we ran the MRP for the trolley and got the following result:

Single-Item, Multi-Level

Statistics	
Materials planned	1
Materials with New Exceptions	1
Materials with Termination MRP List	

Parameters	
Plnt	HD00
Processing Key	NETCH
Create Purchase Requisition	3
SA Schedule Line	3
Create MRP List	1
Planning Mode	1
Scheduling	1

Database Statistics	
Planned orders changed	1

Runtime Statistics	
Start of Planning Run	18:22:39
End of Planning Run	18:22:39

Ranking List of Materials with Highest CPU Times (in ms)

Material	Plnt				
Runtime	Read	Net Calc.	BOM	LdTmeSched	Update
TROLLEY806	HD00				
23	7	2	6	0	8

5. Conclusion

The main strategic decisions that were made in this project concerned the creation of different materials, the BOM, the routings and the sales planning. In total, we created nine raw materials, two semi-finished products and one finished product. We also created three bills of materials and three different routings consisting out of several operations to obtain either one of the two semi-finished products or the finished product. Finally, we forecasted the sales planning for the coming year based on three years of historical values and ran the MRP for the trolley.

Thanks to the lectures and different provided instruction files we could realize this project starting with almost no knowledge of SAP. This project was different from previous projects we had, which was enlightening. We also found it interesting to get insights in one of the leading providers of business software.