GHENT
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Projectmanagement

Baseline schedule and risk analysis

Exhibition stand at BISbeurs

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Project introduction

Janssens NV, a cabinet maker specialized in the production and installation of fireplace cabinetry, wishes to be present at BISbeurs 2017 with an exhibition stand. To minimize construction and exploitation related costs and effort, Janssens NV plans to cooperate with a fireplace manufacturer and two other cabinet makers from another region (West-Flanders and Antwerp), to avoid rivalry. Prospects, encountered at the fair, will be assigned to a participating cabinet maker according to the location of the construction site of the prospect. Janssens NV will serve all prospects from East-Flanders, while the cabinet makers from West-Flanders and Antwerp will have to serve their regions. To manage and properly execute this idea, a project plan is essential.

The scope of this paper is to report our approach, findings and conclusions concerning the development and analysis of our project plan to the management of Janssens NV. A Management Summary is presented with our results and suggestions.

Illustration: a CAD draft of Janssens NV's exhibition stand at BISbeurs 2017.

Project definition

The first of August is the earliest date Janssens NV is willing to start working at the project. The BISbeurs takes place at Flanders Expo between 7 and 15 October 2017. This means that the construction of the exhibition stand has to be finished before the critical deadline of 6 October. The BISbeurs organization provides three days to set-up the exhibition stand, leaving Janssens NV with a limited time scheme to build the entire stand. Janssens NV and its cabinet maker colleagues only have 3 days to build the stand: 4, 5 and 6 October. Finishing within this tight time frame could be challenging without a proper project plan. Every day the project is late results in an estimated cost of 5.200,00 euro[1] per day for Janssens NV. The project is roughly divided into two phases: a preparation phase and a construction phase, which involves the construction of the exhibition stand at the BISbeurs. The division in two phases is established because these phases differ considerably in terms of goals, resource-usage, time dimension and deadline.

Phase 1: Preparation

Staff members of Janssens NV must still have sufficient time to fulfill their daily tasks. That's why staff members can't work for more than 50% per day on project tasks of the preparation phase. This phase involves the planning of the resources of Janssens NV.

Resources reckoned with:	7 resources
Goal	Cost minimization
Time dimension:	Days
Requested start date:	1 August
Deadline:	3 October

Phase 2: Construction

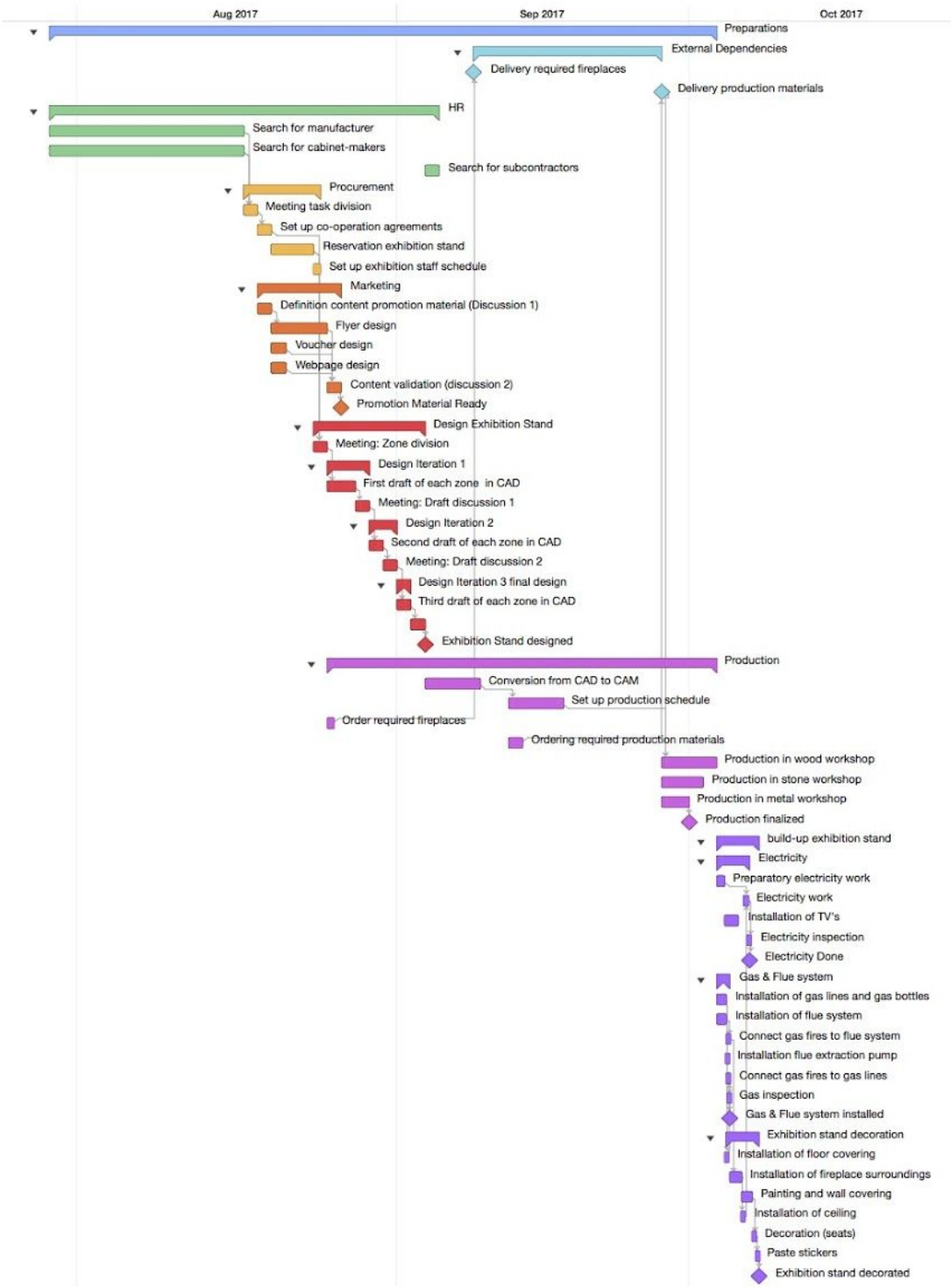
Involves planning of resources of Janssens NV, the cooperating firms and all subcontractors.

Resources reckoned with:	4 resources
Goal:	Time
Time dimension:	Hours
Requested start date:	4 October
Deadline:	6 October

[1] The details of the calculations of the opportunity cost are presented in Appendix A.

Management summary

Schedule results

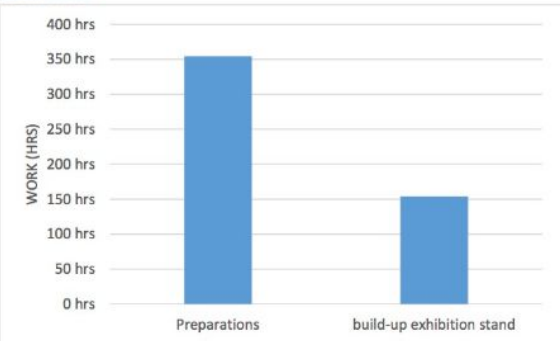


RESOURCE STATUS

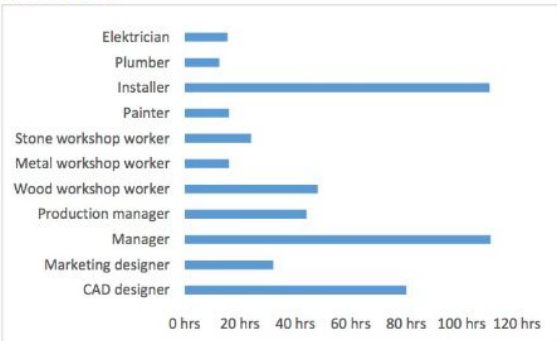
Remaing work for all work resources.

Name	Start	Finish	Remaining Work	Max Units
CAD designer	Tue 8/08/17	Tue 22/08/17	80 hrs	200%
Marketing designer	Tue 1/08/17	Wed 9/08/17	32 hrs	200%
Manager	Fri 28/07/17	Fri 18/08/17	110,4 hrs	200%
Production manager	Thu 17/08/17	Thu 31/08/17	44 hrs	100%
Wood workshop worker	Mon 11/09/17	Fri 15/09/17	48 hrs	300%
Metal workshop worker	Mon 11/09/17	Wed 13/09/17	16 hrs	200%
Stone workshop worker	Mon 11/09/17	Thu 14/09/17	24 hrs	200%
Painter	Thu 5/10/17	Fri 6/10/17	16 hrs	200%
Installer	Wed 4/10/17	Thu 5/10/17	110 hrs	1.400%
Plumber	Wed 4/10/17	Wed 4/10/17	12,5 hrs	200%
Elektrician	Wed 4/10/17	Fri 6/10/17	15,5 hrs	100%

WORK STATS



RESOURCE STATS



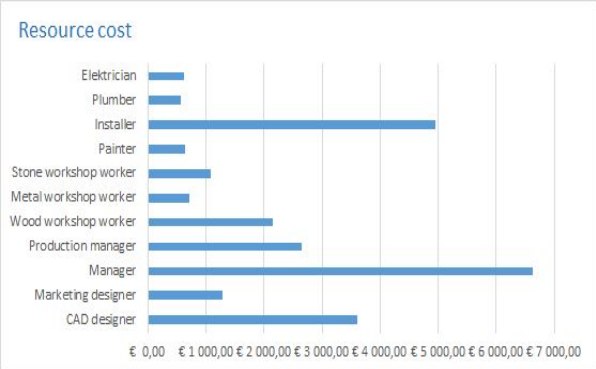
- ❏ In the proposed schedule, the maximum allocation for every resource is 50% during the preparation phase.
- ❏ The likelihood that the preparation phase will finish in 48 days, is below 15%.
- ❏ The likelihood that the preparation phase will finish in 53 days, is 85%.

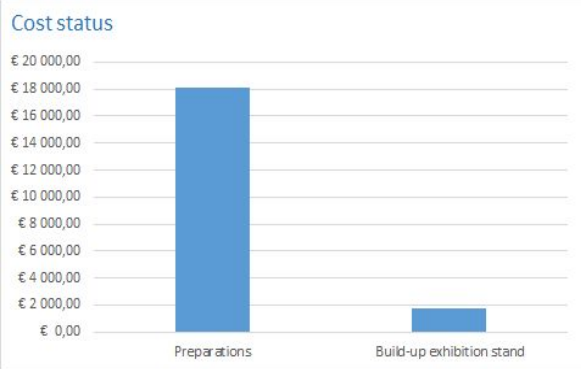
Based on the constructed schedule, Janssens NV can deduce the following information for each of the resource types:

- ❏ The expected period of time the resource type is scheduled to work on the project
- ❏ The expected number of resources that is needed
- ❏ The expected amount of work that needs to be done

Estimated cost of project

		Schedule cost	Cost with 85% certainty
Exploitation costs		€ 2.155,00	€ 2.155,00
Material costs		€ 4.725,00	€ 4.725,00
Labor costs		€ 19.797,00	€ 20.926,25
Opportunity costs		€ 9.000,00	€ 9.000,00
Deconstruction cost		€ 1.000,00	€ 1.000,00
	Total	**€36.677,00**	**€ 37.806,25**





- The total expected costs of the project for Janssens NV amount to € 36.677,00 if the project is executed according to the proposed schedule.
- With 85% certainty, the total cost will be € 37.806,25.
- The most important cost factor is labor cost, resulting from the relatively high labor costs incurred in the preparation phase.

Estimated profitability of project

The total expected profit for Janssens NV is estimated to be around € 9.000,00. It is worth mentioning that our estimation of revenues is a rough approximation. We highly recommend the company's commercial experts to make a better estimation of revenues to assess the potential profitability of this project.

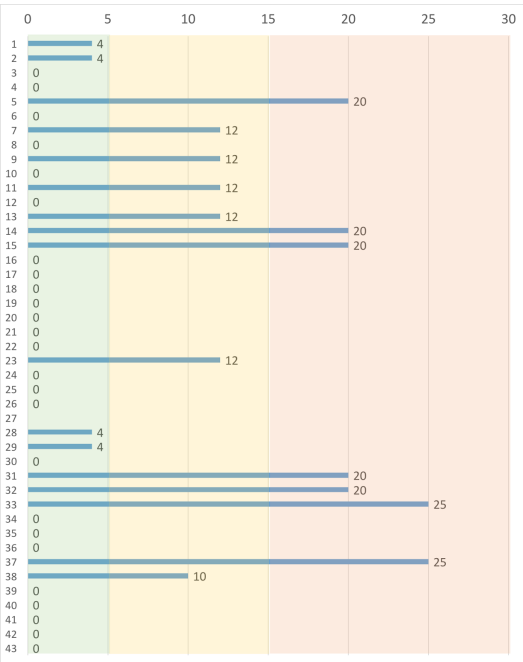
Total revenues[2]	€ 46.875,00
Total costs	€ 37.806,25
Profit/Loss	**€ 9.068,75**

Recommendations

Considering the low likelihood that the preparation phase of the project will finish on time, respecting the earliest start date (01/08/2017) and 50% allocation constraint, we suggest:

1. to start the preparation phase on 21/07/2017, which results in a more acceptable probability of 85% of finishing on time.
2. to let the resources work more than 50% of their time on the project during the preparation phase.

We suggest to execute the project, since the estimated profitability is worth the effort, however, only on the condition that Janssens NV is prepared to implement one of the suggestions listed above. Considering the estimated penalty cost of € 5.200,00 per day[3] the project is late, the probability that the profit would be nullified is otherwise very high.



We recommend to monitor only the most critical activities during project control. Potential setbacks can be countered by allocating more than 50% of the resources or overtime to the given activity.

Some of these most critical activities depend on other partners, for example: waiting on deliveries from suppliers. If a delivery doesn't arrive on time, it has a considerable impact on other activities, since they can't start. Please note that setbacks in these critical activities can't easily be resolved by assigning more resources.

[2] Deduced from appendix A: € 5.208,33/day x 9 days = € 46.875,00
[3] Appendix A

Technical report

Work Breakdown Structure

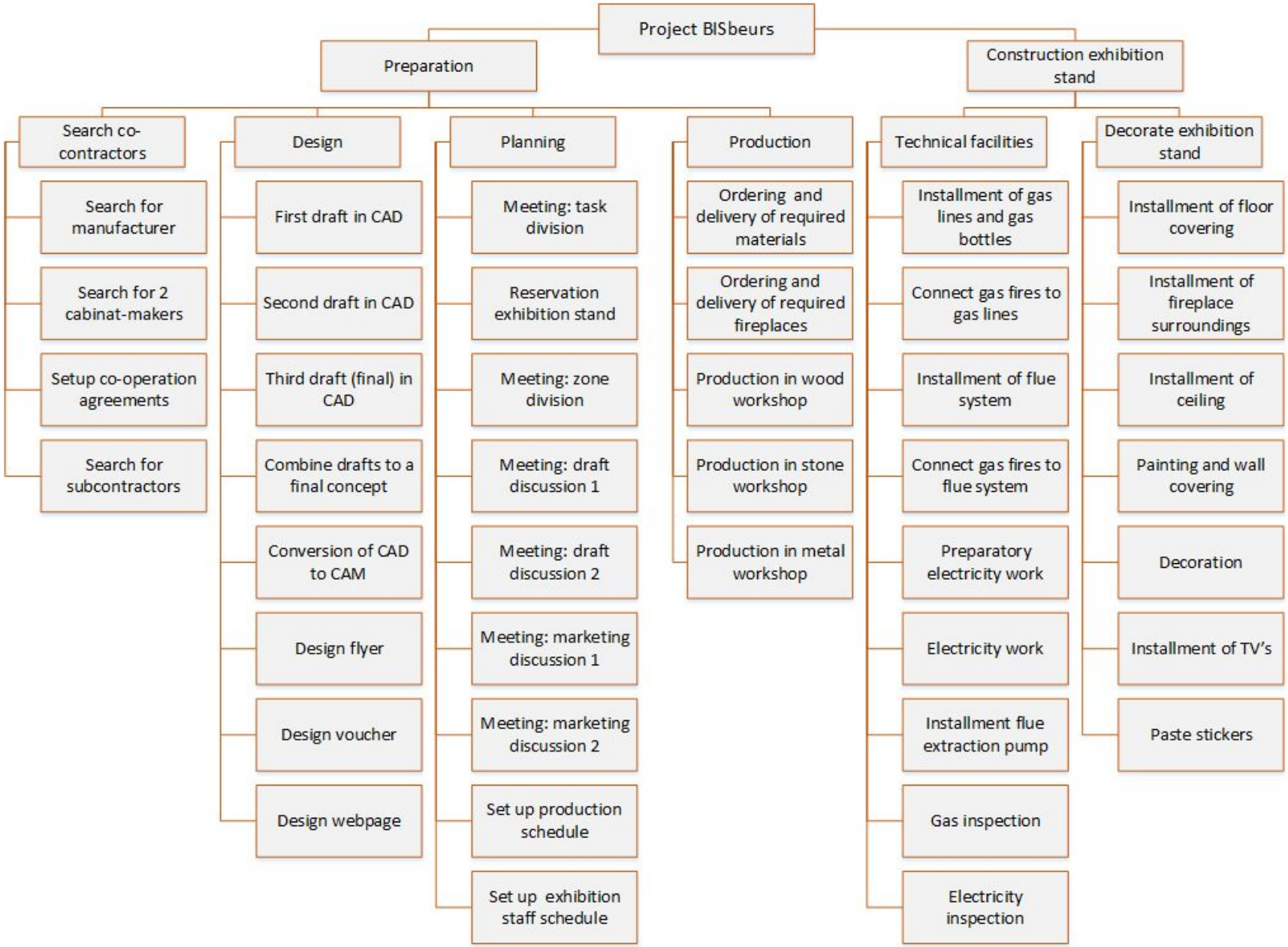
The following lists show an estimation of the various activities per phase of the project. In collaboration with the production manager of Janssens NV, three task length estimates were made (PERT). The task length for phase 1 is given in days, for phase 2 in hours.

Phase 1: Decomposition into activities

		Task length			
ID	**Task name**	*a*	*m*	*b*	**Dependencies**
1	Search for manufacturer	0,7	1,4	2,1	-
2	Search for two cabinet-makers firms	0,7	1,4	2,1	-
3	Meeting: Task division	1	1	1	-
4	Set up co-operation agreements	1	1	1	1,2,3
5	Reservation exhibition stand	1	3	7	1,2,3
6	Meeting: Zone division	1	1	1	4,5
7	First draft in CAD	1	2	3	6
8	Meeting: Draft discussion 1	1	1	1	7
9	Second draft in CAD	1	2	3	8
10	Meeting: Draft discussion 2	1	1	1	9
11	Third draft in CAD	1	1	2	10
12	Combine drafts to a final concept	1	1	1	11
13	Conversion of CAD to CAM	2	3	4	12
14	Ordering and delivery of required materials	7	14	21	13
15	Ordering and delivery of required fireplaces	7	14	21	6
16	Meeting: Marketing discussion 1	1	1	1	1,2,3
17	Flyer design	1	2	3	16
18	Voucher design	0,5	0,5	1	16
19	Webpage design	0,5	0,5	1	16
20	Meeting: Marketing discussion 2	1	1	1	17,18,19
21	Search for subcontractors	1	1	1	12
22	Set up production schedule	1	2	2	13
23	Production in wood workshop	5	6	7	22
24	Production in stone workshop	2	3	3	22
25	Production in metal workshop	2	2	3	22
26	Construction exhibition stand	3	3	3	21,23,24,25
27	Set up exhibition staff schedule	0,5	0,5	0,5	3

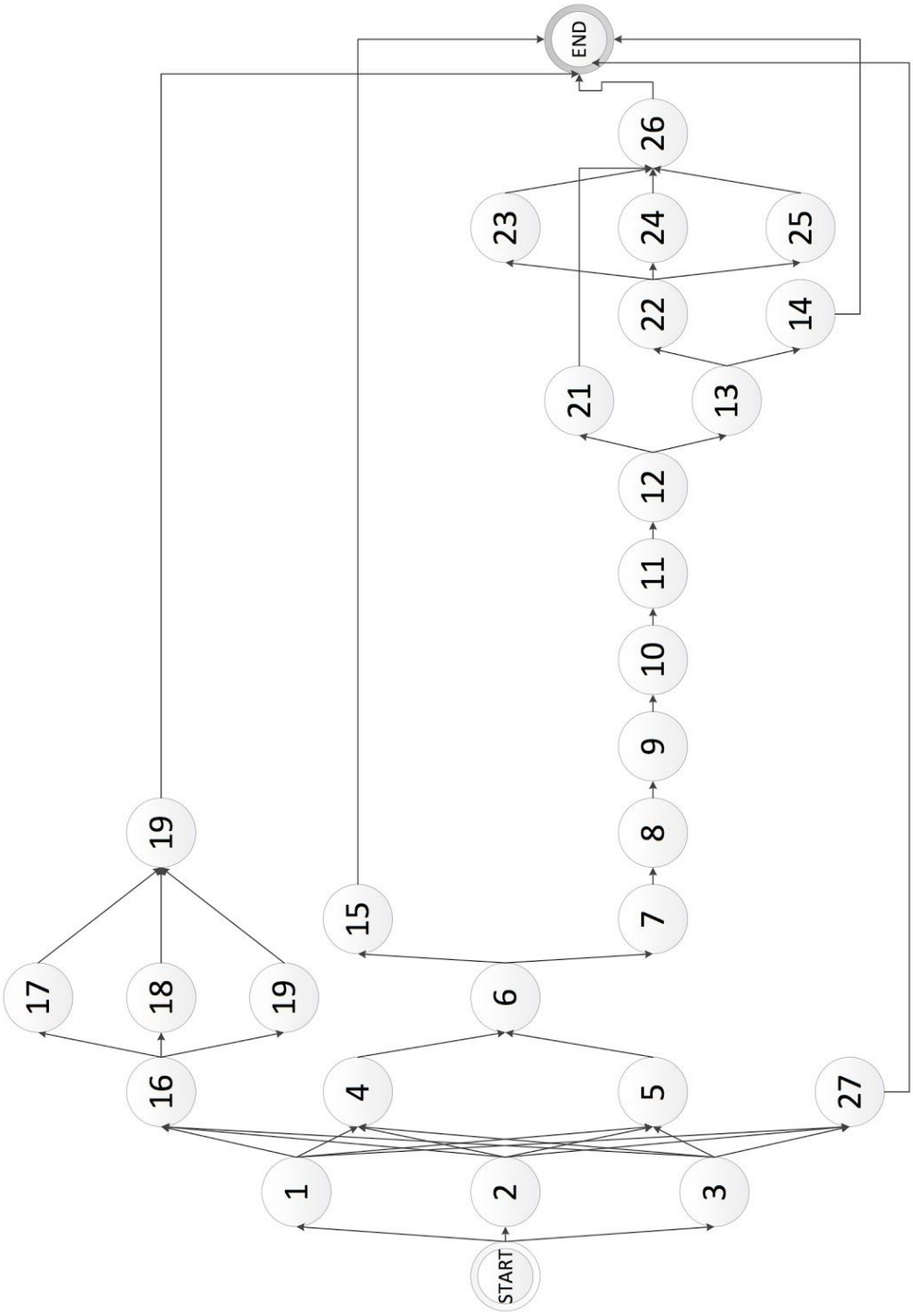
Phase 2: Decomposition into activities

ID	Task name	Task length			Dependencies
		a	*m*	*b*	
1	Installment of gas lines and gas bottles	4	5	6	
2	Installment of floor covering	4	5	6	1
3	Connect gas fires to gas lines	1	2	3	1,2
4	Installment of flue system	4	5	6	
5	Connect gas fires to flue system	1	2	3	4
6	Installment of fireplace surroundings	84	96	108	3,5
7	Installment of ceiling	4	5	6	6
8	Preparatory electrical work	4	4	5	
9	Electrical work	2	3	4	7,8
10	Painting and wall covering	10	12	14	6
11	Decoration	1,5	2	2,5	10
12	Installment of TV's	1,5	2	2,5	9
13	Paste stickers	2	2	2	10
14	Installment flue extraction pump	1	2	3	4
15	Gas inspection	0,5	0,5	0,5	3
16	Electrical inspection	0,5	0,5	0,5	9

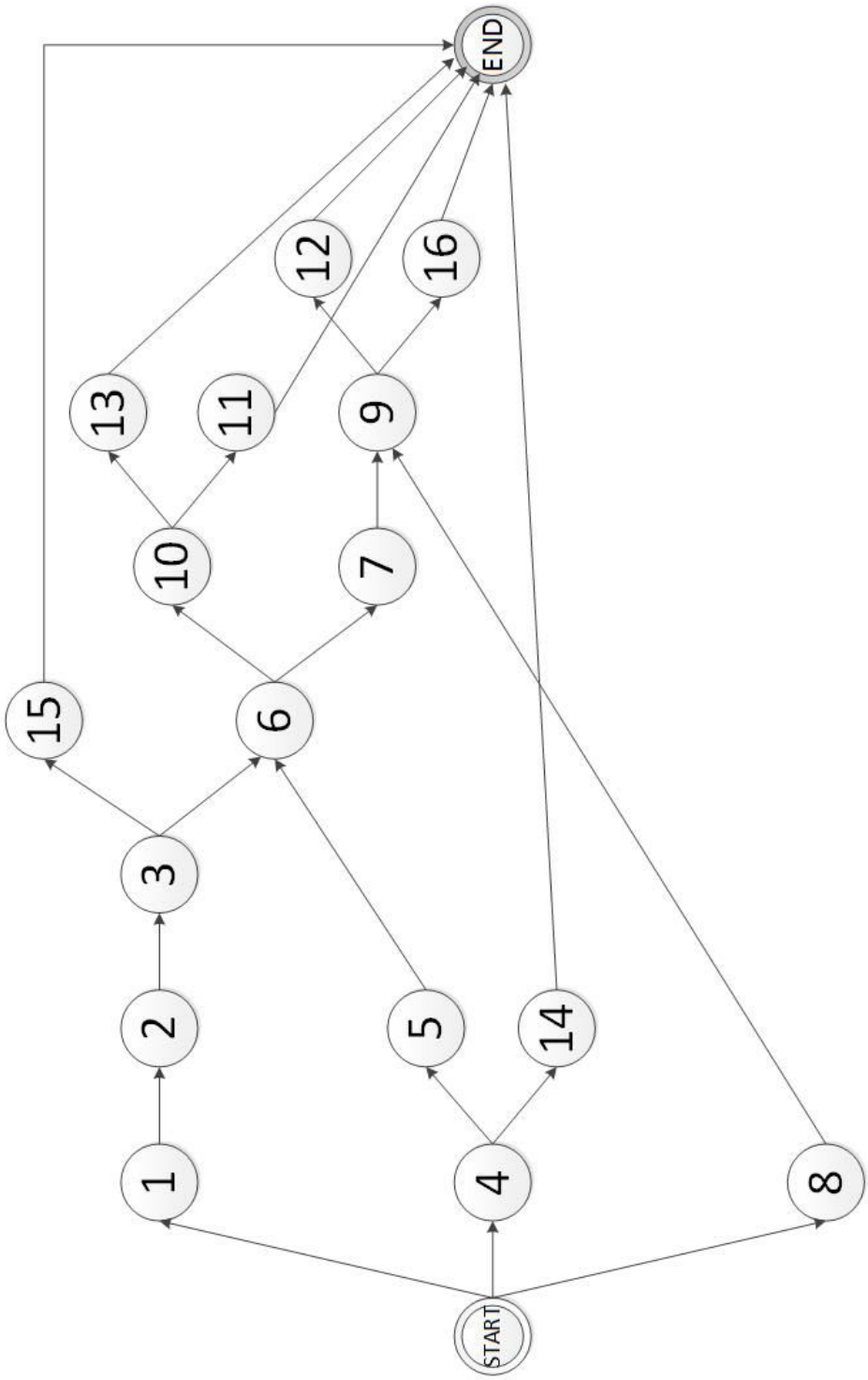

Project BISbeurs
Preparation
Construction exhibition stand
Search co-contractors
Search for manufacturer
Search for 2 cabinat-makers
Setup co-operation agreements
Search for subcontractors
Design
First draft in CAD
Second draft in CAD
Third draft (final) in CAD
Combine drafts to a final concept
Conversion of CAD to CAM
Design flyer
Design voucher
Design webpage
Planning
Meeting: task division
Reservation exhibition stand
Meeting: zone division
Meeting: draft discussion 1
Meeting: draft discussion 2
Meeting: marketing discussion 1
Meeting: marketing discussion 2
Set up production schedule
Set up exhibition staff schedule
Production
Ordering and delivery of required materials
Ordering and delivery of required fireplaces
Production in wood workshop
Production in stone workshop
Production in metal workshop
Technical facilities
Installment of gas lines and gas bottles
Connect gas fires to gas lines
Installment of flue system
Connect gas fires to flue system
Preparatory electricity work
Electricity work
Installment flue extraction pump
Gas inspection
Electricity inspection
Decorate exhibition stand
Installment of floor covering
Installment of fireplace surroundings
Installment of ceiling
Painting and wall covering
Decoration
Installment of TV's
Paste stickers

Network representation

Phase 1: Network diagram



Phase 2: Network diagram



Remark:
Node 26 in the first diagram corresponds with the second sub-project: construction of the exhibition stand. As a consequence, node 26 is the representation of the complete second diagram.

Resources

The only resources that are taken into consideration are human resources. The staff members have a full-time job, thus idle time between project activities is not considered as a problem: staff members won't be unemployed.

Staff members must still have sufficient time to fulfill their daily tasks. That's why a restriction on phase 1 was imposed: staff members can't work for more than 50% per day on project tasks. This restriction is not imposed during phase 2.

Phase 1: Resource availability

The resource availability of Janssens NV is represented in the table below. Resources of the other partners are not taken into account for phase 1.

	Availability	Standard rate €/h	Overtime rate €/h	Per use cost
CAD designer	2	45	54	0
Marketing designer	2	40	48	0
Manager	2	60	72	0
Production manager	1	60	72	0
Wood workshop worker	3	45	54	0
Metal workshop worker	2	45	54	0
Stone workshop worker	2	45	54	0

Phase 2: Resource availability

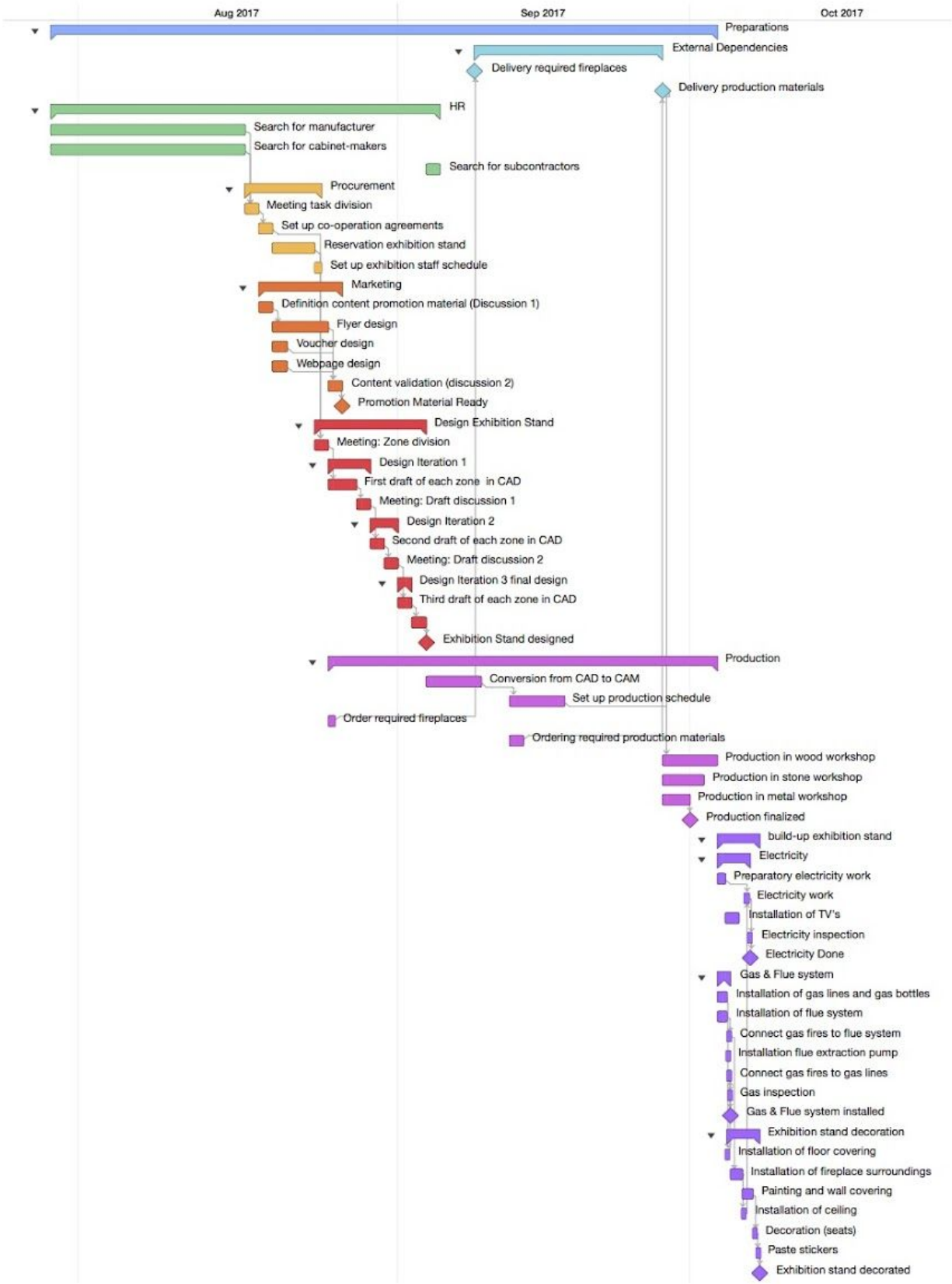
The combined resource availability for phase 2 of all partners is represented in the table below.

	Availability	Standard rate €/h	Overtime rate €/h	Per use cost
Painter	2	40	48	0
Installer	14	45	54	0
Plumber	2	45	54	0
Electrician	1	40	48	0

Baseline schedule

The total duration (phase 1 + phase 2) of the project is scheduled to take 51 days. According to the baseline schedule, the preparation phase has to start on 28/07/2017 and has a duration of 48 days, respecting the restriction of 50% worktime.

We added groups and milestones for important sets of activities. Although the baseline schedule was made in MS Project, we used OmniPlan to print the schedule due to convenience reasons. In the appendix, some screenshots can be found of the schedule in MS Project.

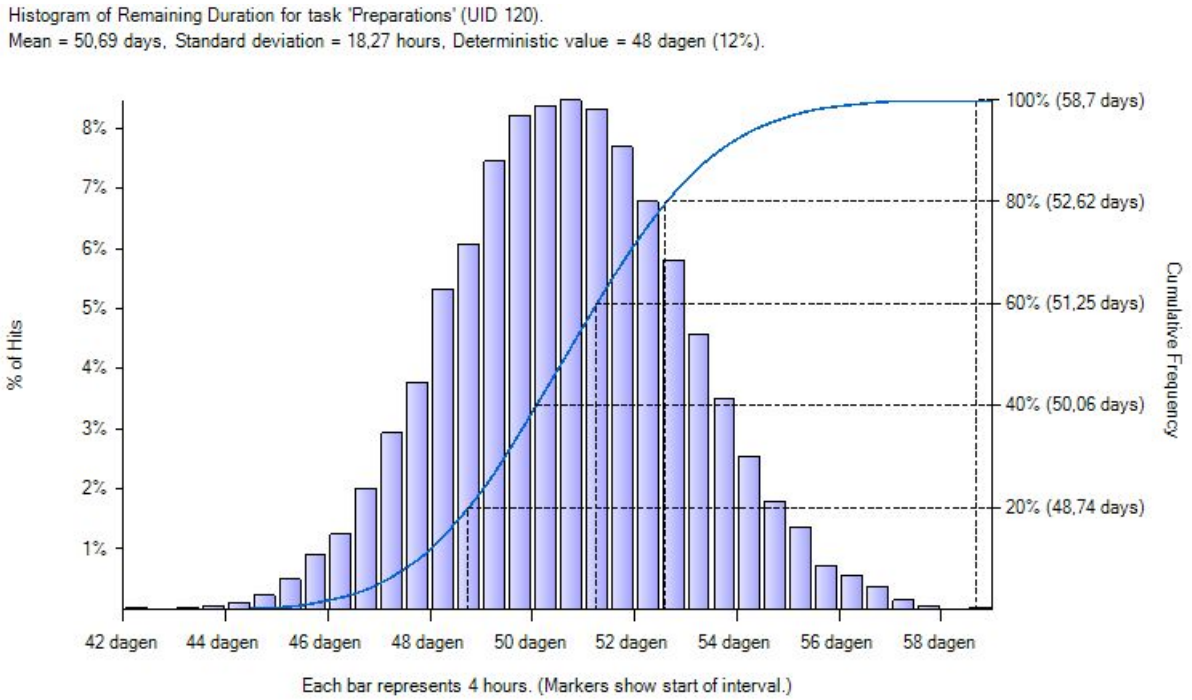

Aug 2017
Sep 2017
Oct 2017
Preparations
External Dependencies
Delivery required fireplaces
Delivery production materials
HR
Search for manufacturer
Search for cabinet-makers
Search for subcontractors
Procurement
Meeting task division
Set up co-operation agreements
Reservation exhibition stand
Set up exhibition staff schedule
Marketing
Definition content promotion material (Discussion 1)
Flyer design
Voucher design
Webpage design
Content validation (discussion 2)
Promotion Material Ready
Design Exhibition Stand
Meeting: Zone division
Design Iteration 1
First draft of each zone in CAD
Meeting: Draft discussion 1
Design Iteration 2
Second draft of each zone in CAD
Meeting: Draft discussion 2
Design Iteration 3 final design
Third draft of each zone in CAD
Exhibition Stand designed
Production
Conversion from CAD to CAM
Set up production schedule
Order required fireplaces
Ordering required production materials
Production in wood workshop
Production in stone workshop
Production in metal workshop
Production finalized
build-up exhibition stand
Electricity
Preparatory electricity work
Electricity work
Installation of TV's
Electricity inspection
Electricity Done
Gas & Flue system
Installation of gas lines and gas bottles
Installation of flue system
Connect gas fires to flue system
Installation flue extraction pump
Connect gas fires to gas lines
Gas inspection
Gas & Flue system installed
Exhibition stand decoration
Installation of floor covering
Installation of fireplace surroundings
Painting and wall covering
Installation of ceiling
Decoration (seats)
Paste stickers
Exhibition stand decorated

Risk analysis

Monte carlo simulation

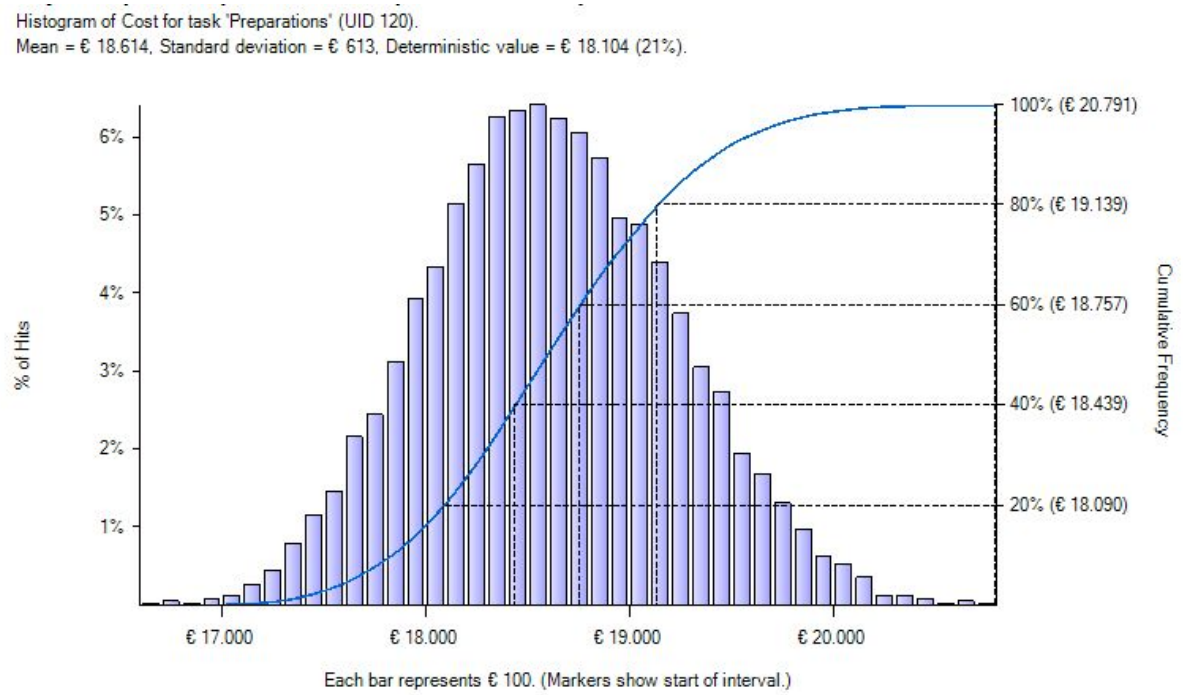
Monte carlo simulation is a technique in which a process is simulated several times. The result of this set of simulations is a distribution function that displays the area of possible outcomes. To do this, we used an add-in called ‘Full Monte’, which is compatible with Microsoft project. We did 15 000 iterations for running the simulation, using the optimistic and pessimistic PERT estimations of the activity durations.

The Monte carlo simulation technique is used for analyzing the risk of the preparation phase. The blue S-curve is the most important part of the duration histogram. This is the cumulative distribution curve, which measures the probability of finishing by a certain date, as opposed to finishing on a certain date. The cumulative percentages can be found on the right hand axis. Concerning the baseline schedule, the preparation phase has a duration of 48 days. But, according to the simulation, there is only a probability of 12% that the preparation phase will be finished within this time frame. Considering this, we recommend to start the preparation phase 5 days earlier (duration of 53 days), in order to have a probability of 85% to finish on time. The build-up phase has to be finished in 3 days, since this is imposed by the management of Janssens NV.

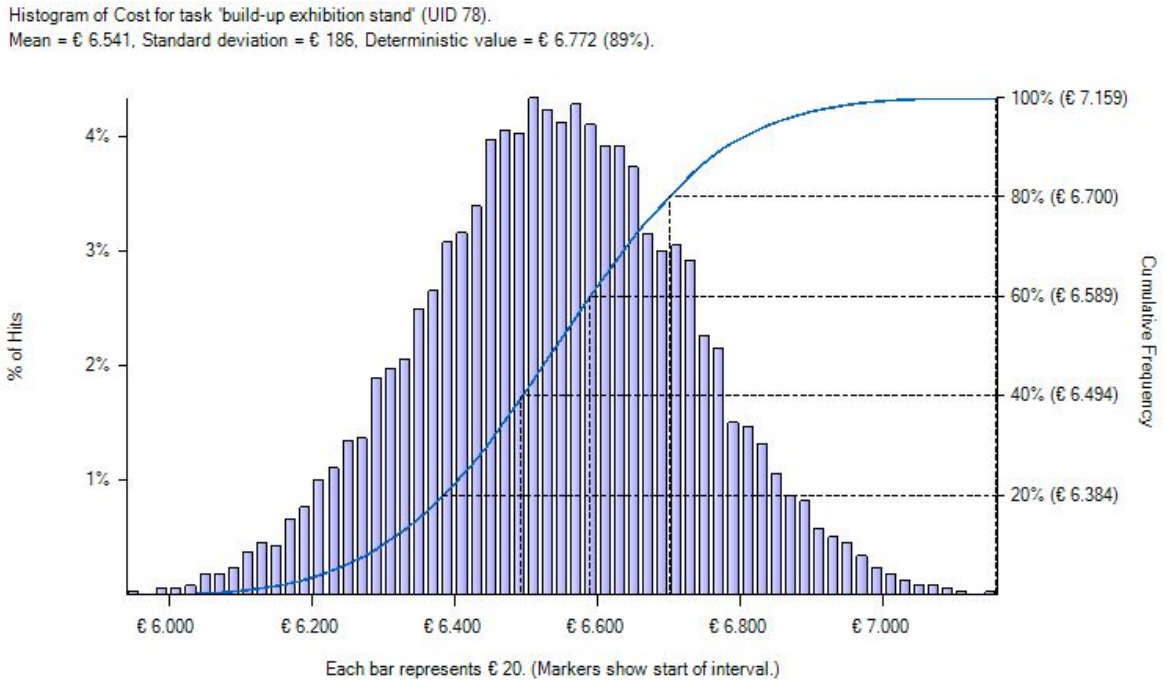


The Monte Carlo simulation technique can also be used to analyze the risk regarding the costs. The blue S-curve is the cumulative distribution curve, which measures the probability of the total labor cost. The labor costs of the preparation phase and build-up phase are analyzed both separately and together as the total project labor cost. We consider a probability of 85% as acceptable.

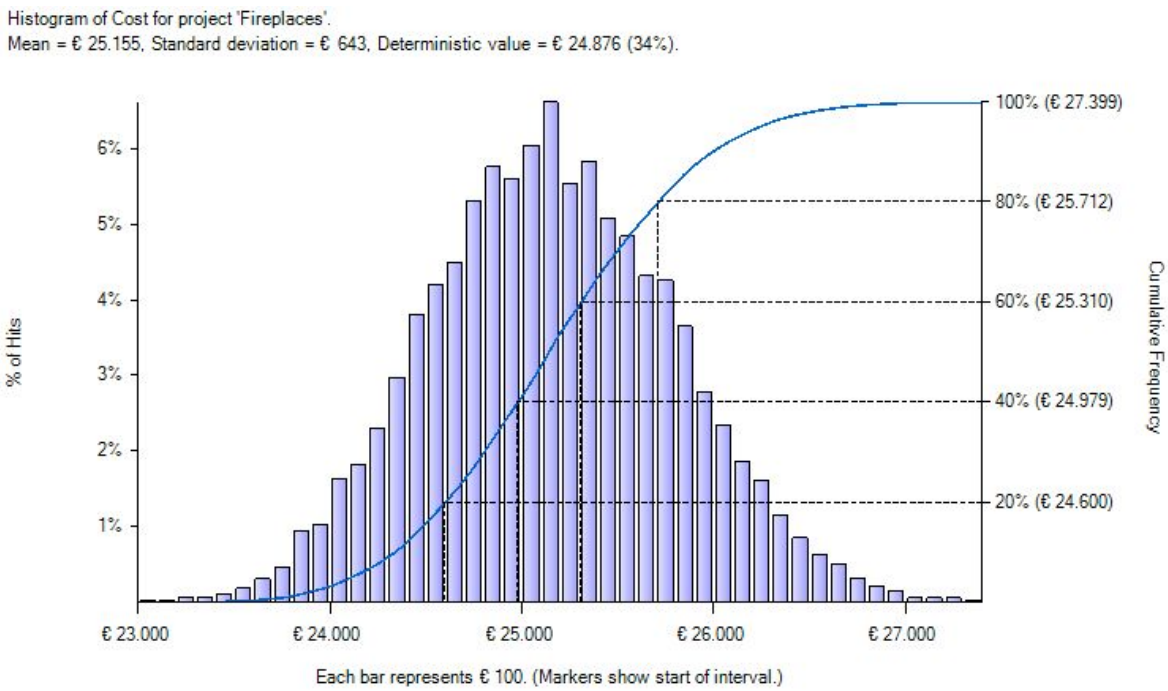
The calculated labor cost of the preparation phase, which is € 18.104, has a probability of only 21%. Considering a probability of 85%, the estimated cost of the preparation phase rises to € 19.245 according to the Monte Carlo simulations.



The calculated labor cost of the build-up phase, which is € 6.772, has a probability of 89%. The estimated cost at lower the probability of 85% is € 6.725.



The total calculated labor cost of € 24.876 has a probability of 34%, mainly because of the risk in the preparation phase. In order to have a probability of 85% the cost rises to € 25.815.



Risk evaluation

Only critical activities should be monitored closely for a thoughtful execution of the project. A 'criticality' percentage was found by running Monte Carlo simulations. This percentage was multiplied with a 'control multiplier' to calculate a 'criticality index'. The controller multiplier is arbitrarily chosen. The higher the controller multiplier, the higher the number of activities that have a high risk severity, which results in greater number of activities that have to be closely monitored. We chose 1,5 as control multiplier, since this results in a smart balance of activity control, according to our judgements. The final risk severity is calculated as the product of the impact index and the criticality index:

Risk severity = Impact index x Criticality index
Impact index = [(b - m) / (estimated duration of project / number of activities)] * 5
Criticality index = CI [%] given by Monte Carlo Simulations * control multiplier * 5

Both the impact index and the criticality index consists of number between 0 and 5. The risk severity index is a number between 0 and 25 and is used to evaluate the monitoring importance for each of the activities. We categorized the activities into three distinct groups according to their risk severity:

Risk severity	**Risk value**	**Color**
Low	1 - 5	Green
Medium	6 - 14	Yellow
High	15 - 25	Red

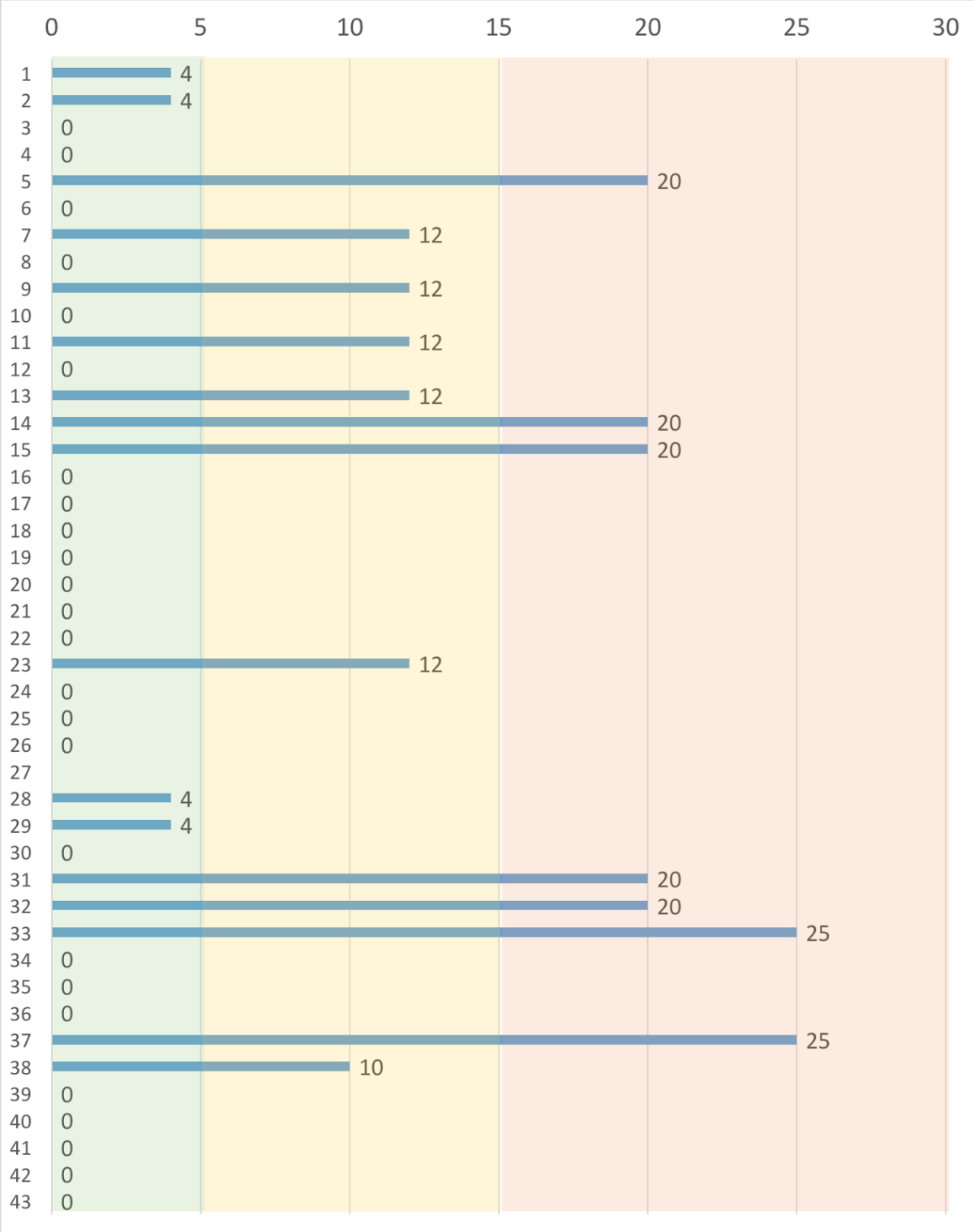
Calculating the risk severity for each activity results in the following table:

Task ID	**Name**	**Criticality Monte Carlo**	**Criticality index**	**Impact index**	**Risk severity[4]**
1	Search for manufacturer	22	2	2	4
2	Search for two cabinet-makers firms	22	2	2	4
3	Meeting: Task division	44	3	0	0
4	Set up co-operation agreements	44	3	0	0
5	Reservation exhibition stand	44	3	5	20
6	Meeting: Zone division	44	3	0	0
7	First draft in CAD	44	3	3	12
8	Meeting: Draft discussion 1	44	3	0	0

[4] Some of the activities have a risk severity of 0. This is because the pessimistic and the realistic estimates are the same, which results in an impact index of 0. On second thought, it would have been more thoughtful to have made different estimates for the realistic and pessimistic estimates.

9	Second draft in CAD	44	3	3	12
10	Meeting: Draft discussion 2	44	3	0	0
11	Third draft in CAD	44	3	3	12
12	Combine drafts to a final concept	44	3	0	0
13	Conversion of CAD to CAM	44	3	3	12
14	Ordering and delivery of required materials	44	3	5	20
15	Ordering and delivery of required fireplaces	44	3	5	20
16	Meeting: Marketing discussion 1	0	0	0	0
17	Flyer design	0	0	3	0
18	Voucher design	0	0	2	0
19	Webpage design	0	0	2	0
20	Meeting: Marketing discussion 2	0	0	0	0
21	Search for subcontractors	0	0	0	0
22	Set up production schedule	0	0	0	0
23	Production in wood workshop	44	3	3	12
24	Production in stone workshop	0	0	0	0
25	Production in metal workshop	0	0	3	0
27	Set up exhibition staff schedule	0	0	0	0
	Construction exhibition stand:				
28	Installment of gas lines and bottles	1	1	4	4
29	Installment of floor covering	1	1	4	4
30	Connect gas fires to gas lines	0	0	4	0
31	Installment of flue system	73	5	4	20
32	Connect gas fires to flue system	73	5	4	20
33	Installment of surroundings	73	5	5	25
34	Installment of ceiling	0	0	4	0
35	Preparatory electrical work	0	0	4	0
36	Electrical work	0	0	4	0
37	Painting and wall covering	73	5	5	25
38	Decoration	73	5	2	10
39	Installment of TV's	0	0	2	0
40	Paste stickers	73	5	0	0
41	Installment flue extraction pump	0	0	4	0
42	Gas inspection	0	0	0	0
43	Electrical inspection	0	0	0	0

Activities in the green region have a low risk, and don't need full-time attention. Yellow activities have a considerable risk and should be monitored more actively. Red activities should get full attention at all time.



Cost analysis

The BISbeurs runs for 9 days, from 07/10/17 until 15/10/17. Costs are divided under the assumption that every partner pays his fair proportion.

Partners:

1. Janssens NV (Fireplace cabinetry maker from East-Flanders)
2. Fireplace cabinetry maker from West-Flanders
3. Fireplace cabinetry maker from Antwerp
4. Fireplace manufacturer

Estimated exploitation costs

	Unit price	Amount	Unit	Total
Surface rent	€ 135,00	50	m^2	€ 6.750,00
Participation costs	€ 628,00	1		€ 628,00
Electrical usage	€ 0,0477	7000	W	€ 334,00
Gas usage	€ 1,2765	288	kg	€ 367,63
Catering	€ 60,00	9	days	€ 540,00
			Total	**€ 8.619,63**
			Share	**€ 2.155,00**

The total estimated exploitation costs can be equally divided among the 4 partners involved in the project, which results in a share of cost of € 2.155,00 for Janssens NV.

Estimated material costs

	Unit price	Amount	Unit	Total
Fireplaces	€ 800,00	6		€ 4.800,00
Lighting	€ 400,00	1		€ 400,00
Paint	€ 7,00	18	liter	€ 126,00
Fireplace cabinetry	€2.100	6		€ 12.600,00
Decoration	€ 200,00	1		€ 200,00
Floor and ceiling	€6,00	60	m^2	€ 360,00
Flyers	€ 0,0140	2500		€ 350,00
Stickers	€ 140,00	1		€ 140,00
Flue + gas system	€ 35,00	60	m	€ 2.100,00
			Total	**€ 21.076,00**
			Share	**€ 4.725,00**

The total estimated materials costs can be divided among the 4 parties involved in the project: the fireplace manufacturer bears the costs of fireplaces and flue + gas system while the other 3 partners equally divide the remaining costs. This results in a share of cost of € 4.725,00 for Janssens NV.

Estimated labor costs

	Unit price	Amount	Unit	Total
CAD designer	€ 45,00	80	h	€ 3.600,00
Marketing designer	€ 40,00	32	h	€ 1.280,00
Manager	€ 60,00	110,4	h	€ 6.624,00
Production manager	€ 60,00	44	h	€ 2.640,00
Wood workshop worker	€ 45,00	48	h	€ 2.160,00
Metal workshop worker	€ 45,00	16	h	€ 720,00
Stone workshop worker	€ 45,00	24	h	€ 1.080,00

	Unit price	Amount	Unit	Total
Painter	€ 40,00	16	h	€ 640,00
Installer	€ 45,00	110	h	€ 4.950,00
Plumber	€ 45,00	12,5	h	€ 562,50
Electrician	€ 40,00	15,5	h	€ 620,00

	Unit	Total	Prob. Risk	Total
Labor cost of preparations	h	€ 18.104,00	85%	€ 19.245,00
Labor cost of build-up stand	h	€ 6.772,50	85%	€ 6.725,00
	Total	**€ 24.876,50**	Total	**€ 25.970,00**
	Share	**€ 19.797,00**	Share	**€ 20.926,25**

The total estimated labor costs for Janssens NV add up to €19.797,00. Because of the risk, it will probably rise to € 20.926,25. The labor cost of preparations is entirely paid by Janssens NV and the labor cost of build-up stand is divided by the 4 partners.

Estimated opportunity costs

Janssens NV expects an annual turnover of € 4.000.000,00 this year, while the total amount of hours worked is estimated to be approximately 33.000 hours.

$$\frac{€\ 4.000.000{,}00}{33.000\ hours} = €\ 121{,}21\ per\ hour$$

This results is an estimated turnover of € 121,00 per hour worked. According to our schedule, the total amount of hours worked on the project is around 500 hours.

$$€\ 121\ per\ hour \times 500\ hours = €\ 60500$$

Due to the hours worked on the project, € 60.500,00 turnover, that would have resulted from the normal operations, is missed.
The average profit margin amounts to 15%. Based on these rough calculations, the expected opportunity cost of the project is € 9.000,00 (= 0,15 x 60.500,00).

Estimated deconstruction costs

After the finish of the BISbeurs, Janssens NV will incur an extra cost for deconstruction of € 1.000,00.

Total expected costs

The total expected cost for Janssens NV is estimated to be € 35.677,00. When we take the risk in consideration, the estimated total cost is € 36.806,25.

	Cost	Cost with risk
Exploitation costs	€ 2.155,00	€ 2.155,00
Material costs	€ 4.725,00	€ 4.725,00
Labor costs	€ 19.797,00	€ 20.926,25
Opportunity costs	€ 9.000,00	€ 9.000,00
Deconstruction costs	€ 1.000,00	€ 1.000,00
	Total **€36.677,00**	**€ 37.806,25**

Appendix

A. Calculation of cost for each day over-time

$$\frac{number\ of\ fair\ visitors \times average\ stand\text{-}visits\ per\ fair\ visitor}{number\ of\ stands}$$
$$\times\ percentage\ of\ prospects\ among\ stand\ visitors$$
$$\times\ percentage\ of\ prospects\ located\ in\ East\text{-}Flanders$$
$$\times\ percentage\ of\ customers\ among\ prospects$$
$$\div\ fair\ days$$
$$\times\ profit\ per\ customer$$
$$= \frac{75000 \times 10}{480} \times 0{,}25 \times 0{,}40 \times 0{,}20 \times \frac{1}{9} \times 1500$$
$$= 5208{,}33$$

B. Detailed description of activities

1: Search for manufacturer

Search for a manufacturer of gasfires who wants to cooperate on the exhibition stand for the BISbeurs. (e.g. financing the gasfires used on the stand, providing a salesman, etc.). This task includes the time it takes to find a willing manufacturer and to negotiate some raw conditions and agreements.

2: Search for two cabinet-makers firms

Two 2 other fireplace cabinetry firms (one located in West Flanders and one located in Antwerp) who wish to participate in building the exhibition stand has to be found, since the project is too big and expensive to perform alone. By finding participators, both work and cost price can be split in 3. This task includes the time it takes to find willing firms and the time it takes to negotiate some raw conditions and agreements.

3: Meeting: Task division

During this meeting, several general questions and topics must be discussed. Focus is on the division of tasks among the three carpenters. This includes: How to work together? How to distribute the prospects among the carpenters? What needs to be done? What are the budgets? How many gas fires to exposure? Location of the stand (which hall at Flanders Expo)? Size of the stand? etc.

4: Set up co-operation agreements
Preparing contracts in which the cooperation is determined.

5: Reservation exhibition stand
This requires negotiations with Flanders Expo and BISbeurs concerning the places that can be used for the stand. Since gas fires are exposed, there is a flue outlet required to remove the smoke. This means that not every place will be suitable. Experts have to come on site in Flanders Expo to see what is technically possible.

6: Meeting: Zone division
When the location at the fair of the exhibition stand is determined, the stand can be divided into several zones. The manufacturer of the fireplaces can propose different types of gas fires he wants to place at the stand to promote to the public.

Decision have to be made concerning:
- the division of the stand into 3 zones
- the interior style and design (each carpenter is responsible for his zone).

A rough top view of the stand will be designed in consultation. In this manner, every carpenter knows the possibilities to design his zone. The cooperation contracts will be signed during this meeting.

7: First draft in CAD
Design area for which Janssens NV is responsible. Level of the design: design of fireplace walls.

8: Meeting: Draft discussion 1
Every carpenter has made a first design of his zone. The designs will be discussed at the meeting to see whether the suggested concepts are technically feasible.

9: Second draft in CAD
Based on the discussion in the previous meeting, the zone designs will be adapted. After that, the materials that will be used for the fireplace walls will be selected.

10: Meeting: Draft discussion 2
The zone designs of all carpenters will be pooled and discussed to see whether the materials and styles fit together.

11: Third draft in CAD
Based on the discussion in the previous meeting (activity 10), the zone designs will be adapted and completed. This third zone design is final.

12: Combine drafts to a final concept
All previously designed CAD drafts of the different stad zones has to be combined to one final CAD plan.

13: Conversion of CAD to CAM
The final CAD plan has the be converted to multiple CAM construction plans. These CAM plans are needed to control the CNC (and other) machines in de wood workshop. The construction plans will be used by operators and workshop staff to produce the necessary components of the exhibition stand.

14: Ordering and delivery of required materials
Wood, natural stone, metal, etc. has to be ordered at suppliers. This task involves ordering all materials and waiting for them upon their delivery.

15: Ordering and delivery of required fireplaces
All fireplaces has to be ordered at the manufacturer. This task involves ordering all fireplaces and waiting for them upon their delivery.

16: Meeting: Marketing discussion 1
Specific promotional material has to be designed, such as a flyer and a voucher. In this meeting, the details of those promotional material are discussed: what information has to be in the flyer? How much of a discount will we give with the voucher? etc.

17: Flyer design
Designing a flyer to give to the exhibition stand visitors to promote the product and companies.

18: Voucher design
Designing a voucher with a discount code for the exhibition stand visitors.

19: Webpage design
Designing a webpage for the website to promote the presence at the fair.

20: Meeting: Marketing discussion 2
Discuss the designed flyer, voucher and webpage with the other carpenter firms.

21: Search for subcontractors
Search and contact subcontractors, such as a cleaning firm, a gas inspector, etc.

22: Set up production schedule
Schedule workshop staff and machines.

23: Production in wood workshop
The production of cabinets and other components.

24: Production in stone workshop
The production of stone tablets and other components.

25: Production in metal workshop
The production of metal components.

26: Construction of exhibition stand
This activity node represents phase 2 of this project. See the network diagram of this phase for the involved activities.

27: Set up exhibition staff schedule
The exhibition stand should be at all time manned with salesmen to assist visitors and prospect. A schedule of staff presence has to be made.

C. Retrospective evaluation

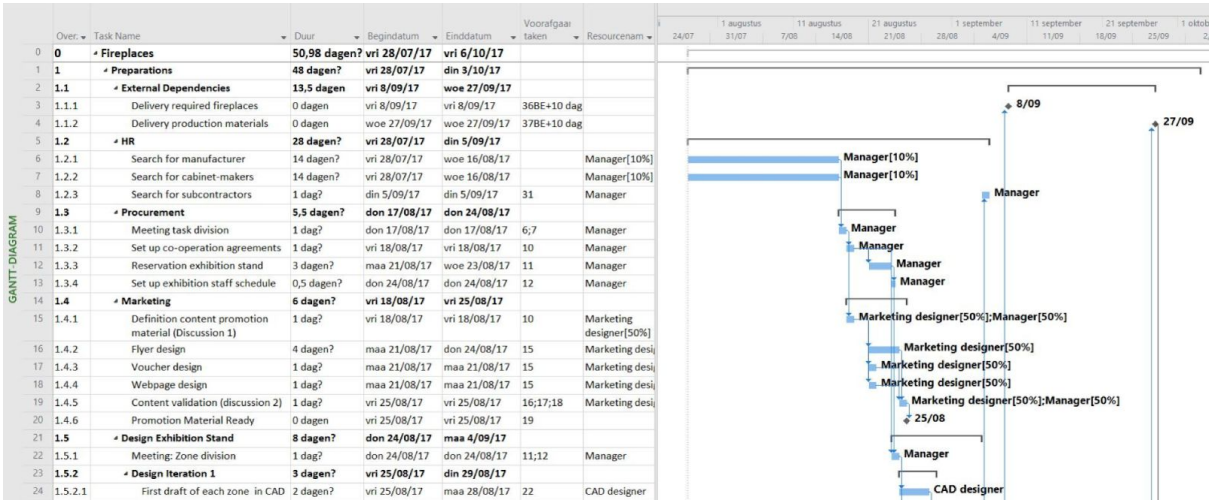
During the course of the development of the project schedule, we quickly came to the understanding that a good preparation is essential. An insufficient WBS results in a lot of double work and unnecessary adjustments. That's why we invested lots of time in a thorough preparation before we even started using any software to make the baseline schedule. Although we had spent a great deal of time and effort in our preparation, we still encountered some difficulties during the scheduling that could have been foreseen.

The first version of our work breakdown structure contained an estimated duration for every activity. When constructing the baseline schedule with resources, we realized that we shouldn't have estimated the duration of each activity, but rather the estimated effort needed to complete each activity. Estimated duration is not the same as the estimated effort. In hindsight, we should have known this and it would have saved us some adjustments and time.

We assumed that, once the preparation was finished, the construction of the baseline schedule and risk analysis would be easy since we thought software could do that in a mouse click. It became clear that even expensive software as MS Project and OmniPlan doesn't have an easy-to-use button to solve all problems. For example, due to time constraints in our project, some resource over-allocations occurred. We assigned an initial number of resources to the activities, assuming that the software could optimize the resource availability in order to finish within the given deadlines. However, we had to manually increase the resource availability to solve these over-allocations.

We used PERT to make reliable estimates. During the risk analysis, we came to the understanding that we should've been more careful when making estimates. A considerable amount of our pessimistic estimates are equal to our realistic estimates, which results in 'zero risk' within our risk analysis method. We imposed ourself to a time dimension of days for the preparation phase, but it could have been smarter to use hours instead. This would have resulted in more accurate estimates.

D. Screenshots of baseline schedule in MS Project



	Over.	Task Name	Duur	Begindatum	Einddatum	Voorafgaa taken	Resourcenam
0	**0**	**Fireplaces**	**50,98 dagen?**	**vri 28/07/17**	**vri 6/10/17**		
1	**1**	**Preparations**	**48 dagen?**	**vri 28/07/17**	**din 3/10/17**		
2	**1.1**	**External Dependencies**	**13,5 dagen**	**vri 8/09/17**	**woe 27/09/17**		
3	1.1.1	Delivery required fireplaces	0 dagen	vri 8/09/17	vri 8/09/17	36BE+10 dag	
4	1.1.2	Delivery production materials	0 dagen	woe 27/09/17	woe 27/09/17	37BE+10 dag	
5	**1.2**	**HR**	**28 dagen?**	**vri 28/07/17**	**din 5/09/17**		
6	1.2.1	Search for manufacturer	14 dagen?	vri 28/07/17	woe 16/08/17		Manager[10%]
7	1.2.2	Search for cabinet-makers	14 dagen?	vri 28/07/17	woe 16/08/17		Manager[10%]
8	1.2.3	Search for subcontractors	1 dag?	din 5/09/17	din 5/09/17	31	Manager
9	**1.3**	**Procurement**	**5,5 dagen?**	**don 17/08/17**	**don 24/08/17**		
10	1.3.1	Meeting task division	1 dag?	don 17/08/17	don 17/08/17	6;7	Manager
11	1.3.2	Set up co-operation agreements	1 dag?	vri 18/08/17	vri 18/08/17	10	Manager
12	1.3.3	Reservation exhibition stand	3 dagen?	maa 21/08/17	woe 23/08/17	11	Manager
13	1.3.4	Set up exhibition staff schedule	0,5 dagen?	don 24/08/17	don 24/08/17	12	Manager
14	**1.4**	**Marketing**	**6 dagen?**	**vri 18/08/17**	**vri 25/08/17**		
15	1.4.1	Definition content promotion material (Discussion 1)	1 dag?	vri 18/08/17	vri 18/08/17	10	Marketing designer[50%]
16	1.4.2	Flyer design	4 dagen?	maa 21/08/17	don 24/08/17	15	Marketing desi
17	1.4.3	Voucher design	1 dag?	maa 21/08/17	maa 21/08/17	15	Marketing desi
18	1.4.4	Webpage design	1 dag?	maa 21/08/17	maa 21/08/17	15	Marketing desi
19	1.4.5	Content validation (discussion 2)	1 dag?	vri 25/08/17	vri 25/08/17	16;17;18	Marketing desi
20	1.4.6	Promotion Material Ready	0 dagen	vri 25/08/17	vri 25/08/17	19	
21	**1.5**	**Design Exhibition Stand**	**8 dagen?**	**don 24/08/17**	**maa 4/09/17**		
22	1.5.1	Meeting: Zone division	1 dag?	don 24/08/17	don 24/08/17	11;12	Manager
23	**1.5.2**	**Design Iteration 1**	**3 dagen?**	**vri 25/08/17**	**din 29/08/17**		
24	1.5.2.1	First draft of each zone in CAD	2 dagen?	vri 25/08/17	maa 28/08/17	22	CAD designer

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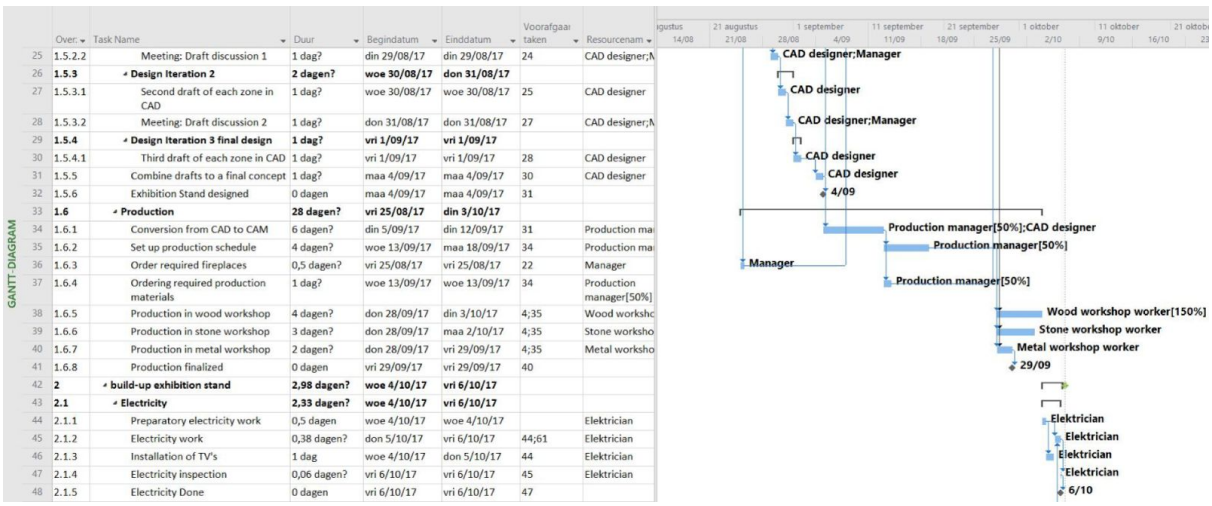

	Over.	Task Name	Duur	Begindatum	Einddatum	Voorafgaa taken	Resourcenam
25	1.5.2.2	Meeting: Draft discussion 1	1 dag?	din 29/08/17	din 29/08/17	24	CAD designer;M
26	**1.5.3**	**Design Iteration 2**	**2 dagen?**	**woe 30/08/17**	**don 31/08/17**		
27	1.5.3.1	Second draft of each zone in CAD	1 dag?	woe 30/08/17	woe 30/08/17	25	CAD designer
28	1.5.3.2	Meeting: Draft discussion 2	1 dag?	don 31/08/17	don 31/08/17	27	CAD designer;M
29	**1.5.4**	**Design Iteration 3 final design**	**1 dag?**	**vri 1/09/17**	**vri 1/09/17**		
30	1.5.4.1	Third draft of each zone in CAD	1 dag?	vri 1/09/17	vri 1/09/17	28	CAD designer
31	1.5.5	Combine drafts to a final concept	1 dag?	maa 4/09/17	maa 4/09/17	30	CAD designer
32	1.5.6	Exhibition Stand designed	0 dagen	maa 4/09/17	maa 4/09/17	31	
33	**1.6**	**Production**	**28 dagen?**	**vri 25/08/17**	**din 3/10/17**		
34	1.6.1	Conversion from CAD to CAM	6 dagen?	din 5/09/17	din 12/09/17	31	Production ma
35	1.6.2	Set up production schedule	4 dagen?	woe 13/09/17	maa 18/09/17	34	Production ma
36	1.6.3	Order required fireplaces	0,5 dagen?	vri 25/08/17	vri 25/08/17	22	Manager
37	1.6.4	Ordering required production materials	1 dag?	woe 13/09/17	woe 13/09/17	34	Production manager[50%]
38	1.6.5	Production in wood workshop	4 dagen?	don 28/09/17	din 3/10/17	4;35	Wood worksho
39	1.6.6	Production in stone workshop	3 dagen?	don 28/09/17	maa 2/10/17	4;35	Stone worksho
40	1.6.7	Production in metal workshop	2 dagen?	don 28/09/17	vri 29/09/17	4;35	Metal worksho
41	1.6.8	Production finalized	0 dagen	vri 29/09/17	vri 29/09/17	40	
42	**2**	**build-up exhibition stand**	**2,98 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
43	**2.1**	**Electricity**	**2,33 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
44	2.1.1	Preparatory electricity work	0,5 dagen	woe 4/10/17	woe 4/10/17		Elektrician
45	2.1.2	Electricity work	0,38 dagen?	don 5/10/17	vri 6/10/17	44;61	Elektrician
46	2.1.3	Installation of TV's	1 dag	woe 4/10/17	don 5/10/17	44	Elektrician
47	2.1.4	Electricity inspection	0,06 dagen?	vri 6/10/17	vri 6/10/17	45	Elektrician
48	2.1.5	Electricity Done	0 dagen	vri 6/10/17	vri 6/10/17	47	

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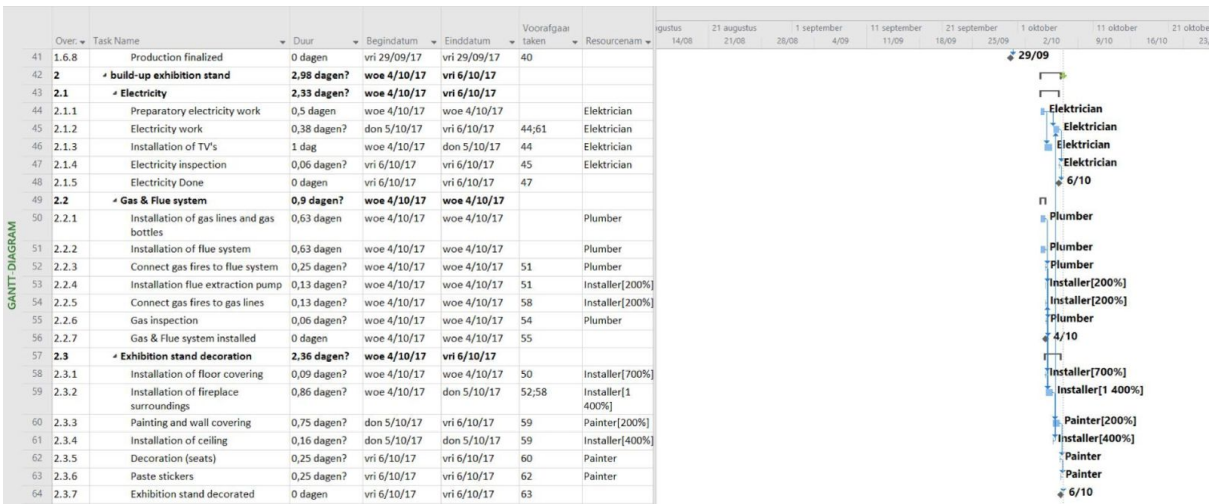

	Over.	Task Name	Duur	Begindatum	Einddatum	Voorafgaa taken	Resourcenam
41	1.6.8	Production finalized	0 dagen	vri 29/09/17	vri 29/09/17	40	
42	**2**	**build-up exhibition stand**	**2,98 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
43	**2.1**	**Electricity**	**2,33 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
44	2.1.1	Preparatory electricity work	0,5 dagen	woe 4/10/17	woe 4/10/17		Elektrician
45	2.1.2	Electricity work	0,38 dagen?	don 5/10/17	vri 6/10/17	44;61	Elektrician
46	2.1.3	Installation of TV's	1 dag	woe 4/10/17	don 5/10/17	44	Elektrician
47	2.1.4	Electricity inspection	0,06 dagen?	vri 6/10/17	vri 6/10/17	45	Elektrician
48	2.1.5	Electricity Done	0 dagen	vri 6/10/17	vri 6/10/17	47	
49	**2.2**	**Gas & Flue system**	**0,9 dagen?**	**woe 4/10/17**	**woe 4/10/17**		
50	2.2.1	Installation of gas lines and gas bottles	0,63 dagen	woe 4/10/17	woe 4/10/17		Plumber
51	2.2.2	Installation of flue system	0,63 dagen	woe 4/10/17	woe 4/10/17		Plumber
52	2.2.3	Connect gas fires to flue system	0,25 dagen?	woe 4/10/17	woe 4/10/17	51	Plumber
53	2.2.4	Installation flue extraction pump	0,13 dagen?	woe 4/10/17	woe 4/10/17	51	Installer[200%]
54	2.2.5	Connect gas fires to gas lines	0,13 dagen?	woe 4/10/17	woe 4/10/17	58	Installer[200%]
55	2.2.6	Gas inspection	0,06 dagen?	woe 4/10/17	woe 4/10/17	54	Plumber
56	2.2.7	Gas & Flue system installed	0 dagen	woe 4/10/17	woe 4/10/17	55	
57	**2.3**	**Exhibition stand decoration**	**2,36 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
58	2.3.1	Installation of floor covering	0,09 dagen?	woe 4/10/17	woe 4/10/17	50	Installer[700%]
59	2.3.2	Installation of fireplace surroundings	0,86 dagen?	woe 4/10/17	don 5/10/17	52;58	Installer[1 400%]
60	2.3.3	Painting and wall covering	0,75 dagen?	don 5/10/17	vri 6/10/17	59	Painter[200%]
61	2.3.4	Installation of ceiling	0,16 dagen?	don 5/10/17	don 5/10/17	59	Installer[400%]
62	2.3.5	Decoration (seats)	0,25 dagen?	vri 6/10/17	vri 6/10/17	60	Painter
63	2.3.6	Paste stickers	0,25 dagen?	vri 6/10/17	vri 6/10/17	62	Painter
64	2.3.7	Exhibition stand decorated	0 dagen	vri 6/10/17	vri 6/10/17	63	

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Janssens NV

Building an exhibition stand at BISbeurs 2017

Group 31:
Dejonckheere Gauthier - Devlieghere Bram - Pitteman Maxim - Vanacker Laura - Van Raemdonck Olivier

Project definition

- Janssens NV = Fireplace cabinet maker
- Project goal = Building an exhibition stand
- Project divided in 2 phases:
  - Preparation
    Deadline 03/10
  - Construction
    Limited to 3 days: 04/10 – 06/10
- Other subcontractors / partners involved
- Resource allocation constraint
  Resources aren't allowed to work more than 50% of their time on project tasks.
- Earliest start date constraint
  Management doesn't want to start working on the project before 01/08

Phase 1: Preparation

Involves planning of resources of Janssens NV.

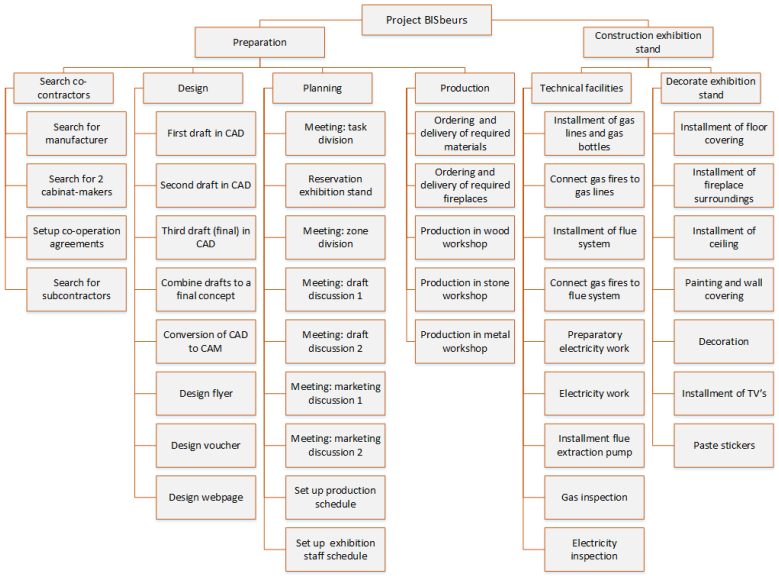
Resources reckoned with:	7 resources
Goal	Cost minimization
Time dimension:	Days
Earliest start date:	1 August
Deadline:	3 October

Phase 2: Construction

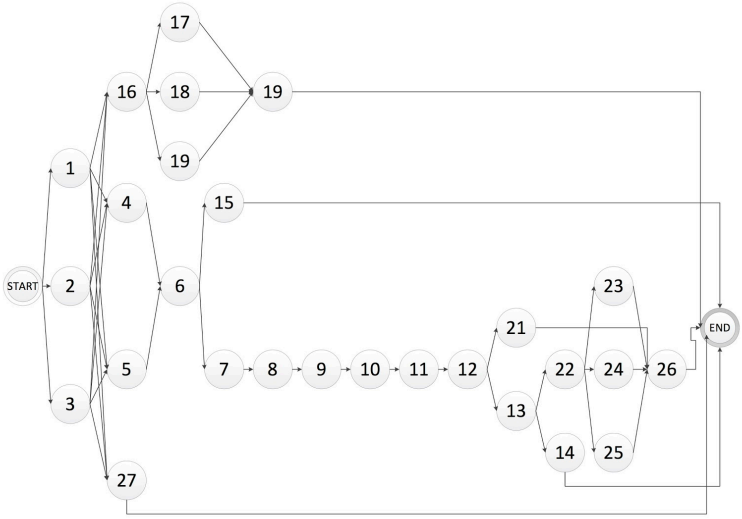
Involves planning of resources of Janssens NV, the cooperating firms and all subcontractors.

Resources reckoned with:	4 resources
Goal:	Time
Time dimension:	Hours
Earliest start date:	4 October
Deadline:	6 October

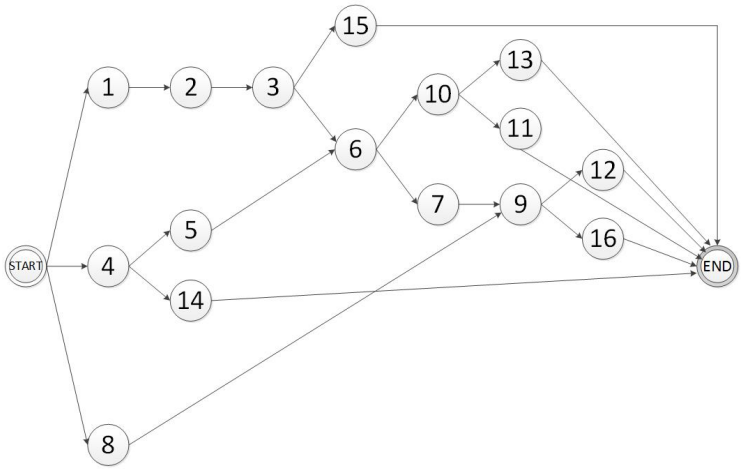
Work breakdown structure



Phase 1: Preparation



Phase 2: Construction



Resource availability

Phase 1: Preparation

	Availability	Standard rate €/h	Overtime rate €/h	Per use cost
CAD designer	2	45	54	0
Marketing designer	2	40	48	0
Manager	2	60	72	0
Production manager	1	60	72	0
Wood workshop worker	3	45	54	0
Metal workshop worker	2	45	54	0
Stone workshop worker	2	45	54	0

Phase 2: Construction

	Availability	Standard rate €/h	Overtime rate €/h	Per use cost
Painter	2	40	48	0
Installer	14	45	54	0
Plumber	2	45	54	0
Electrician	1	40	48	0

Microsoft Project

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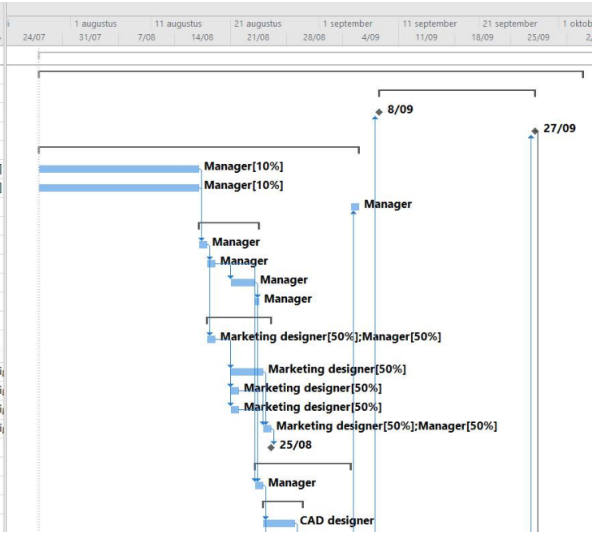
	Over.	Task Name	Duur	Begindatum	Einddatum	Voorafgaa taken	Resourcenam
0	**0**	**Fireplaces**	**50,98 dagen?**	**vri 28/07/17**	**vri 6/10/17**		
1	**1**	**Preparations**	**48 dagen?**	**vri 28/07/17**	**din 3/10/17**		
2	**1.1**	**External Dependencies**	**13,5 dagen**	**vri 8/09/17**	**woe 27/09/17**		
3	1.1.1	Delivery required fireplaces	0 dagen	vri 8/09/17	vri 8/09/17	36BE+10 dag	
4	1.1.2	Delivery production materials	0 dagen	woe 27/09/17	woe 27/09/17	37BE+10 dag	
5	**1.2**	**HR**	**28 dagen?**	**vri 28/07/17**	**din 5/09/17**		
6	1.2.1	Search for manufacturer	14 dagen?	vri 28/07/17	woe 16/08/17		Manager[10%]
7	1.2.2	Search for cabinet-makers	14 dagen?	vri 28/07/17	woe 16/08/17		Manager[10%]
8	1.2.3	Search for subcontractors	1 dag?	din 5/09/17	din 5/09/17	31	Manager
9	**1.3**	**Procurement**	**5,5 dagen?**	**don 17/08/17**	**don 24/08/17**		
10	1.3.1	Meeting task division	1 dag?	don 17/08/17	don 17/08/17	6;7	Manager
11	1.3.2	Set up co-operation agreements	1 dag?	vri 18/08/17	vri 18/08/17	10	Manager
12	1.3.3	Reservation exhibition stand	3 dagen?	maa 21/08/17	woe 23/08/17	11	Manager
13	1.3.4	Set up exhibition staff schedule	0,5 dagen?	don 24/08/17	don 24/08/17	12	Manager
14	**1.4**	**Marketing**	**6 dagen?**	**vri 18/08/17**	**vri 25/08/17**		
15	1.4.1	Definition content promotion material (Discussion 1)	1 dag?	vri 18/08/17	vri 18/08/17	10	Marketing designer[50%]
16	1.4.2	Flyer design	4 dagen?	maa 21/08/17	don 24/08/17	15	Marketing desi
17	1.4.3	Voucher design	1 dag?	maa 21/08/17	maa 21/08/17	15	Marketing desi
18	1.4.4	Webpage design	1 dag?	maa 21/08/17	maa 21/08/17	15	Marketing desi
19	1.4.5	Content validation (discussion 2)	1 dag?	vri 25/08/17	vri 25/08/17	16;17;18	Marketing desi
20	1.4.6	Promotion Material Ready	0 dagen	vri 25/08/17	vri 25/08/17	19	
21	**1.5**	**Design Exhibition Stand**	**8 dagen?**	**don 24/08/17**	**maa 4/09/17**		
22	1.5.1	Meeting: Zone division	1 dag?	don 24/08/17	don 24/08/17	11;12	Manager
23	**1.5.2**	**Design Iteration 1**	**3 dagen?**	**vri 25/08/17**	**din 29/08/17**		
24	1.5.2.1	First draft of each zone in CAD	2 dagen?	vri 25/08/17	maa 28/08/17	22	CAD designer



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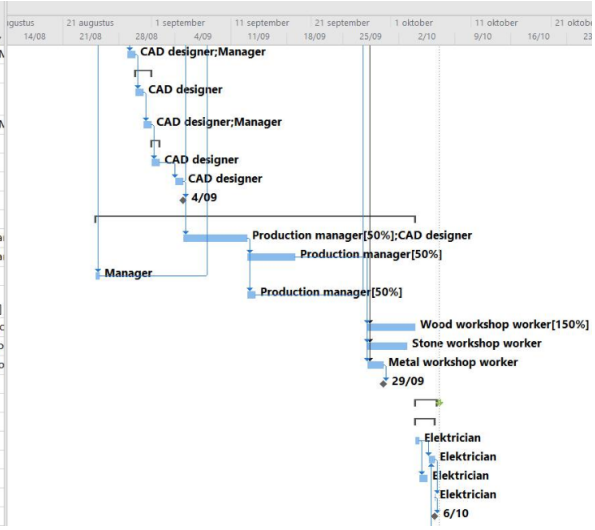
GANTT DIAGRAM

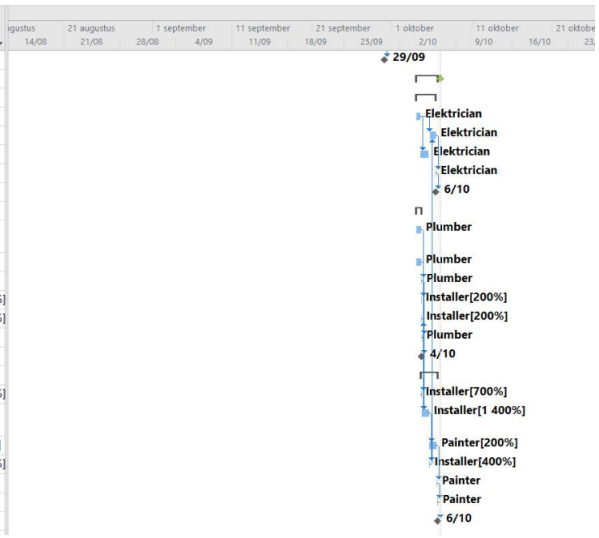
	Over.	Task Name	Duur	Begindatum	Einddatum	Voorafgaa taken	Resourcenam
25	1.5.2.2	Meeting: Draft discussion 1	1 dag?	din 29/08/17	din 29/08/17	24	CAD designer;M
26	**1.5.3**	**Design Iteration 2**	**2 dagen?**	**woe 30/08/17**	**don 31/08/17**		
27	1.5.3.1	Second draft of each zone in CAD	1 dag?	woe 30/08/17	woe 30/08/17	25	CAD designer
28	1.5.3.2	Meeting: Draft discussion 2	1 dag?	don 31/08/17	don 31/08/17	27	CAD designer;M
29	**1.5.4**	**Design Iteration 3 final design**	**1 dag?**	**vri 1/09/17**	**vri 1/09/17**		
30	1.5.4.1	Third draft of each zone in CAD	1 dag?	vri 1/09/17	vri 1/09/17	28	CAD designer
31	1.5.5	Combine drafts to a final concept	1 dag?	maa 4/09/17	maa 4/09/17	30	CAD designer
32	1.5.6	Exhibition Stand designed	0 dagen	maa 4/09/17	maa 4/09/17	31	
33	**1.6**	**Production**	**28 dagen?**	**vri 25/08/17**	**din 3/10/17**		
34	1.6.1	Conversion from CAD to CAM	6 dagen?	din 5/09/17	din 12/09/17	31	Production ma
35	1.6.2	Set up production schedule	4 dagen?	woe 13/09/17	maa 18/09/17	34	Production ma
36	1.6.3	Order required fireplaces	0,5 dagen?	vri 25/08/17	vri 25/08/17	22	Manager
37	1.6.4	Ordering required production materials	1 dag?	woe 13/09/17	woe 13/09/17	34	Production manager[50%]
38	1.6.5	Production in wood workshop	4 dagen?	don 28/09/17	din 3/10/17	4;35	Wood worksho
39	1.6.6	Production in stone workshop	3 dagen?	don 28/09/17	maa 2/10/17	4;35	Stone worksho
40	1.6.7	Production in metal workshop	2 dagen?	don 28/09/17	vri 29/09/17	4;35	Metal worksho
41	1.6.8	Production finalized	0 dagen	vri 29/09/17	vri 29/09/17	40	
42	**2**	**build-up exhibition stand**	**2,98 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
43	**2.1**	**Electricity**	**2,33 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
44	2.1.1	Preparatory electricity work	0,5 dagen	woe 4/10/17	woe 4/10/17		Elektrician
45	2.1.2	Electricity work	0,38 dagen?	don 5/10/17	vri 6/10/17	44;61	Elektrician
46	2.1.3	Installation of TV's	1 dag	woe 4/10/17	don 5/10/17	44	Elektrician
47	2.1.4	Electricity inspection	0,06 dagen?	vri 6/10/17	vri 6/10/17	45	Elektrician
48	2.1.5	Electricity Done	0 dagen	vri 6/10/17	vri 6/10/17	47	



Microsoft Project

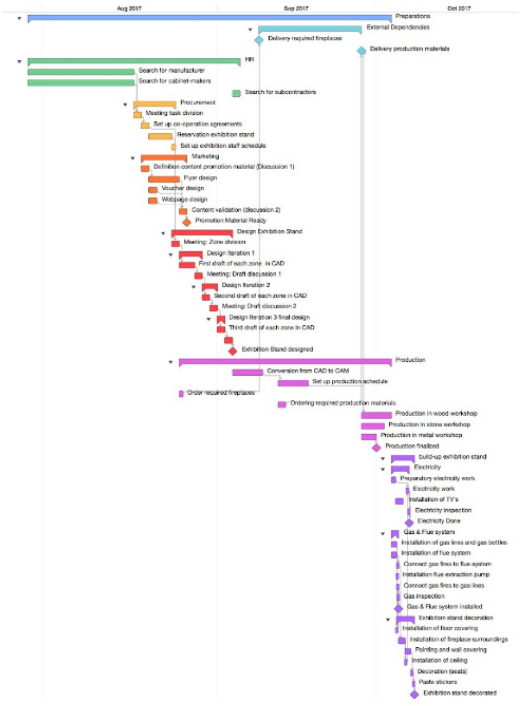
GANTT DIAGRAM

	Over.	Task Name	Duur	Begindatum	Einddatum	Voorafgaa taken	Resourcenam
41	1.6.8	Production finalized	0 dagen	vri 29/09/17	vri 29/09/17	40	
42	**2**	**build-up exhibition stand**	**2,98 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
43	**2.1**	**Electricity**	**2,33 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
44	2.1.1	Preparatory electricity work	0,5 dagen	woe 4/10/17	woe 4/10/17		Elektrician
45	2.1.2	Electricity work	0,38 dagen?	don 5/10/17	vri 6/10/17	44;61	Elektrician
46	2.1.3	Installation of TV's	1 dag	woe 4/10/17	don 5/10/17	44	Elektrician
47	2.1.4	Electricity inspection	0,06 dagen?	vri 6/10/17	vri 6/10/17	45	Elektrician
48	2.1.5	Electricity Done	0 dagen	vri 6/10/17	vri 6/10/17	47	
49	**2.2**	**Gas & Flue system**	**0,9 dagen?**	**woe 4/10/17**	**woe 4/10/17**		
50	2.2.1	Installation of gas lines and gas bottles	0,63 dagen	woe 4/10/17	woe 4/10/17		Plumber
51	2.2.2	Installation of flue system	0,63 dagen	woe 4/10/17	woe 4/10/17		Plumber
52	2.2.3	Connect gas fires to flue system	0,25 dagen?	woe 4/10/17	woe 4/10/17	51	Plumber
53	2.2.4	Installation flue extraction pump	0,13 dagen?	woe 4/10/17	woe 4/10/17	51	Installer[200%]
54	2.2.5	Connect gas fires to gas lines	0,13 dagen?	woe 4/10/17	woe 4/10/17	58	Installer[200%]
55	2.2.6	Gas inspection	0,06 dagen?	woe 4/10/17	woe 4/10/17	54	Plumber
56	2.2.7	Gas & Flue system installed	0 dagen	woe 4/10/17	woe 4/10/17	55	
57	**2.3**	**Exhibition stand decoration**	**2,36 dagen?**	**woe 4/10/17**	**vri 6/10/17**		
58	2.3.1	Installation of floor covering	0,09 dagen?	woe 4/10/17	woe 4/10/17	50	Installer[700%]
59	2.3.2	Installation of fireplace surroundings	0,86 dagen?	woe 4/10/17	don 5/10/17	52;58	Installer[1 400%]
60	2.3.3	Painting and wall covering	0,75 dagen?	don 5/10/17	vri 6/10/17	59	Painter[200%]
61	2.3.4	Installation of ceiling	0,16 dagen?	don 5/10/17	don 5/10/17	59	Installer[400%]
62	2.3.5	Decoration (seats)	0,25 dagen?	vri 6/10/17	vri 6/10/17	60	Painter
63	2.3.6	Paste stickers	0,25 dagen?	vri 6/10/17	vri 6/10/17	62	Painter
64	2.3.7	Exhibition stand decorated	0 dagen	vri 6/10/17	vri 6/10/17	63	



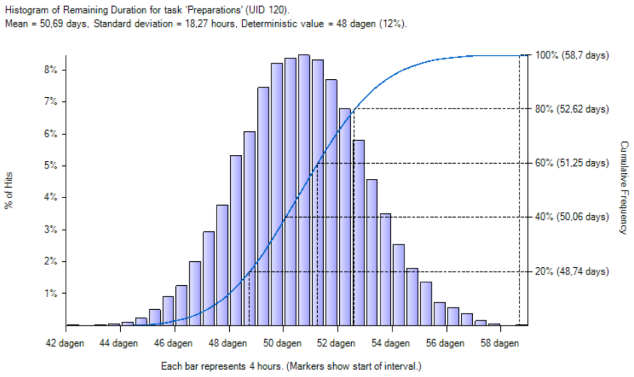
Baseline schedule with resources

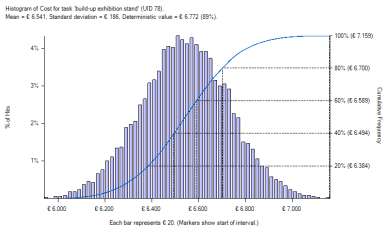
- Phase 1 takes 48 days
  Has to start on 28/07 to respect 50% resource allocation and availability
- Phase 2 takes 3 days
- 50% resource allocation constraint
- Resource availability constraint
- Project has to start on 28/07 to respect 50% resource allocation and availability
  => Earliest start date constraint of 01/08 violated.

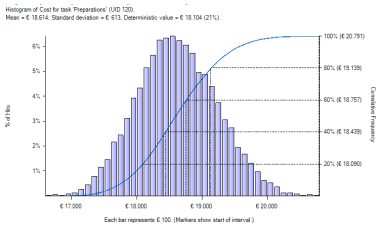


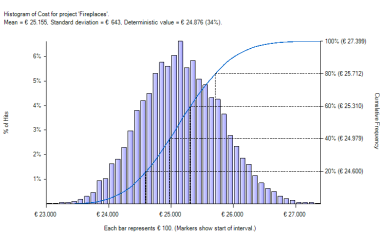
Monte Carlo Simulations

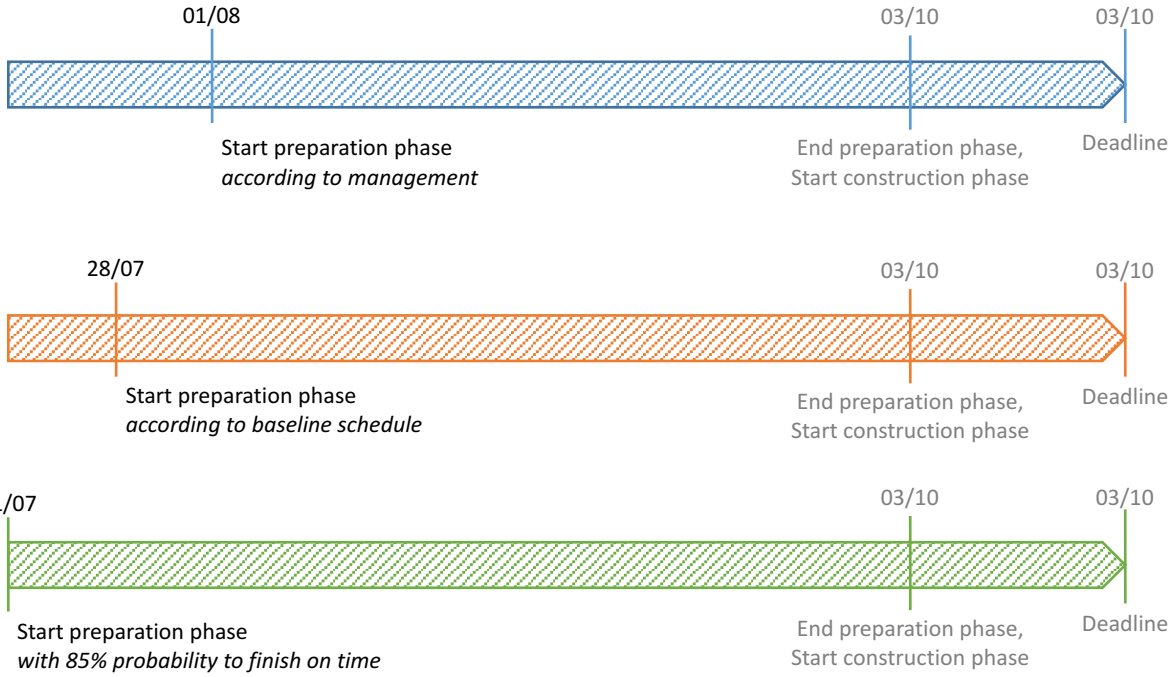
- Duration probabilities
  scheduled preparation phase ≤ 48 days => 12%
- Cost probabilities
  scheduled labour cost ≤ € 24.876 => 34%
- 85% probability as a rule of thumb
  preparation phase could take ≤ 53days
  labour cost ≤ € 25.815











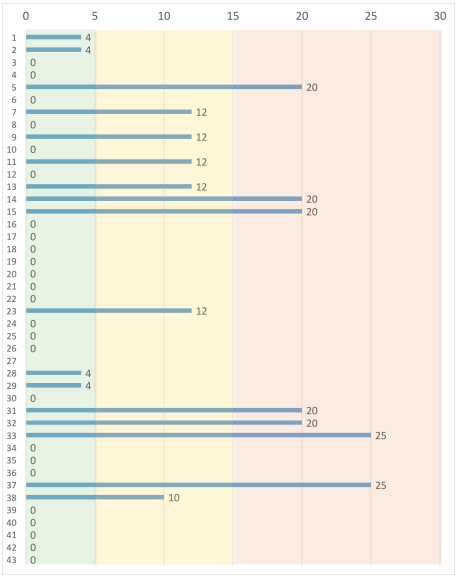
Risk evaluation

- Risk severity
  = Impact index x Criticality index
- Impact index
  = [(b - m) / (estimated duration of project / number of activities)] * 5
- Criticality index
  = CI (%) given by Monte Carlo Simulations * control multiplier * 5

- Control multiplier lets management decide degree of control

- 7 activities with high risk severity
- 6 activities with medium risk severity
- 30 activities with low risk severity

} 30% project control



Cost analysis

- Labour cost is major cost component
- See report for detailed cost breakdown
- Should be compared with short-term revenues, estimated by commercial department to assess the potential profitability of this project

	Scheduled cost	Cost with 85% probability
Exploitation costs	€ 2.155,00	€ 2.155,00
Material costs	€ 4.725,00	€ 4.725,00
Labour costs	€ 19.797,00	€ 20.926,00
Missed opportunity costs	€ 9.000,00	€ 9.000,00
Deconstruction cost	€ 1.000,00	€ 1.000,00
Total	**€ 36.677,00**	**€ 37.806,25**

Recommendations

- Low likelihood of finishing project on time under imposed constraints:
  - Requested earliest start date: 01/08
  - Requested maximum resource allocation: 50%

Solutions

1. Start the preparation phase on 21/07/2017 => acceptable probability of 85% of finishing
2. Allocate ≥ 50% of resources' time on project during the preparation phase.
3. Mix of both.

- Control activities classified as 'Medium' and 'High' during project execution.