DOCUMENT NO. 16021 | VERSION 1.0

Project Scheduling with Microsoft Project

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Prerequisite to Project Scheduling

- **Project scoping** → agreeing upon the **boundaries** and the **deliverable**(**s**) of the project ⇢ Project Roadmap ✓
- **Project planning** → identifying the **set of activities** to carry out to perform the project ⇢ Work Breakdown Structure (WBS) ✓
- **Project** *costing* → estimating and assigning **resources** to the project activities ⇢ Budget Document + RACI matrix ✓
- **Project scheduling** → sequencing the activities, calculating dates, floats and critical path(s), levelling/smoothing resources, baselining the result ⇢ **Coordination Schedule / Gantt Chart**

Typology

2 types of **project schedules**

Master Schedule
~ Summary Schedule
Masterplan
Calendrier directeur

Strategic level
The whole project
Intuitive approach

One page/slide
Can be in the **Project Roadmap**

Coordination Schedule
~ "~~PERT~~", Gantt chart
Activity network
Calendrier de coordination

Tactical level
One or a few phases
Analytical approach

Several pages
Can be in the **PMP**

Project **Planning** for Complex Systems Projects

1 Identifying the project activities

- 1.1 Describing the final deliverable(s) in a **PBS**
- 1.2 Deriving the **WBS top nodes** from the PBS
- 1.3 Preparing and populating the **WBS matrix**
- 1.4 Generating the **list of activities** from the WBS matrix

2 Estimating and assigning resources

- 2.1 Identifying the resources that are available in a **RBS**
- 2.2 Estimating the resources that are required (**workload**)
- 2.3 Assigning resources to activity in a **RACI matrix**

Project **Scheduling** for Complex Systems Projects

3 Sequencing and scheduling the activities

- **3.1** Estimating the **duration** for each activity
- **3.2** Deriving the **technical constraints** between activities
- **3.3** Perhaps, getting rid of **loops** → DSM (Design Structure Matrix)
- **3.4** If needed, defining **temporal constraints** and **calendars**
- **3.5** Calculating earliest/latest start/finish **dates**, **floats** and **critical path**(**s**) → PDM (Precedence Diagramming Method)
- **3.6** If needed, calculating (earliest) start/finish dates considering **resource constraints** → RCPS
- **3.7** Analysing the resulting schedule, inserting **buffers**, and freezing a **baseline** in view of following up progress

The CanNet Pilot Project

The project context (1)

- OrgaDairy is an industrial dairy that makes **yogurts**
- OrgaDairy factory houses **a lot of tanks** (homogenization, fermentation)
- The process shall be carefully monitored (**regular samplings**), the tanks shall also be carefully cleaned, rinced and controlled after each batch

the **initial situation**, i.e. problem (1)

- Until now, **this monitoring is carried out very manually**: many time-consuming rides between the factory lab and the many tanks
- To improve the monitoring process and to comply with evolving rules, OrgaDairy executive management decided to invest in an **enhanced sampling system** which shall be in operation in less than one year

the **project objectives** (2)

The CanNet Pilot Project

The project context (2)

some possible solutions (3)

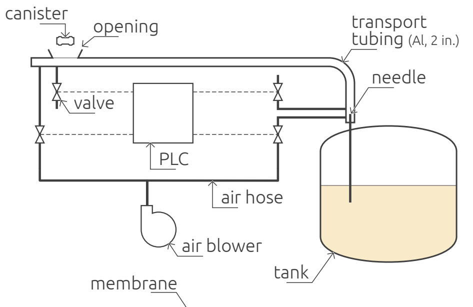
- A few possible solutions were considered during the **initialize phase**
- The one that was preferred consists of installing a **pneumatic tube transport system** (PTTS) to propel **canisters** between the factory lab and the many tanks

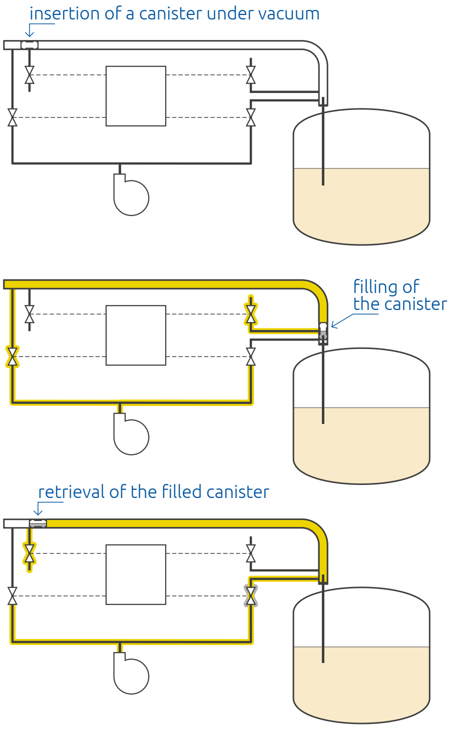
the preferred solution (4)

- Its feasibility was demonstrated during the **study phase** ← CDR
- The initiative is named **CanNet** (**can**ister **net**work) **Project** ← (4.2) and **Mr. Ayrton**, senior plant engineer, was appointed project manager
- The project is made of **three major phases**: ← (4.3)
  - A study phase (already completed)
  - A pilot project → PTTS between the factory lab and three tanks
  - A full deployment project throughout the entire factory

The CanNet Pilot Project

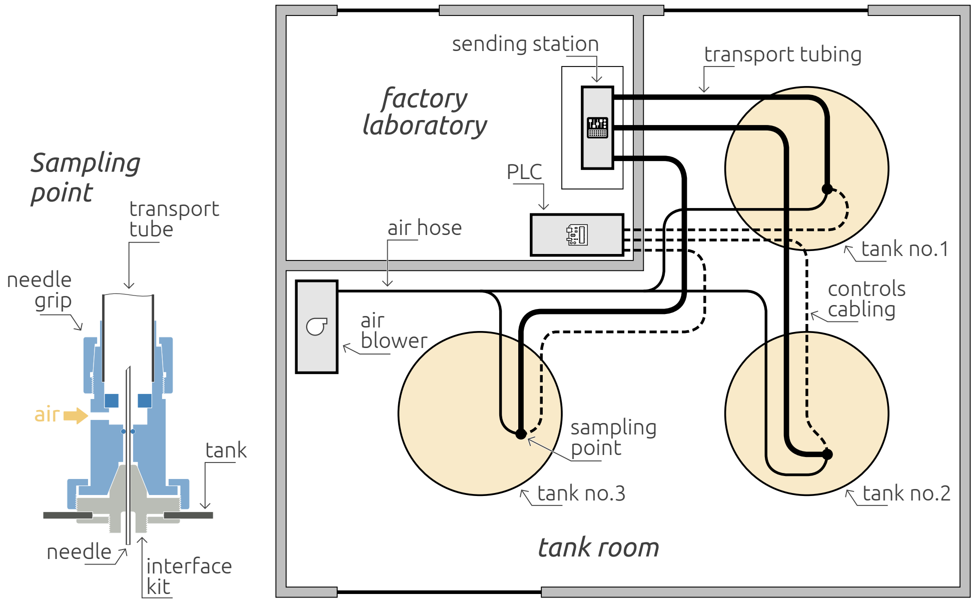
The process





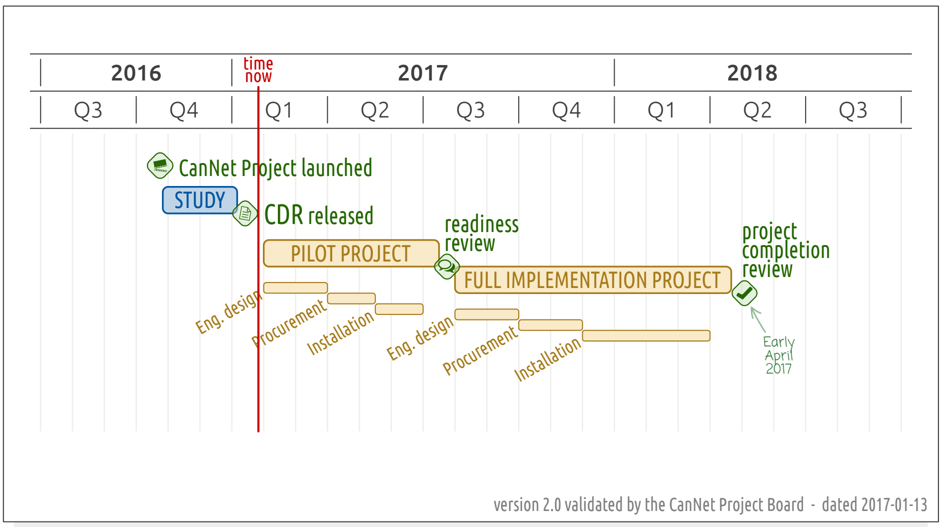
The CanNet Pilot Project

The layout



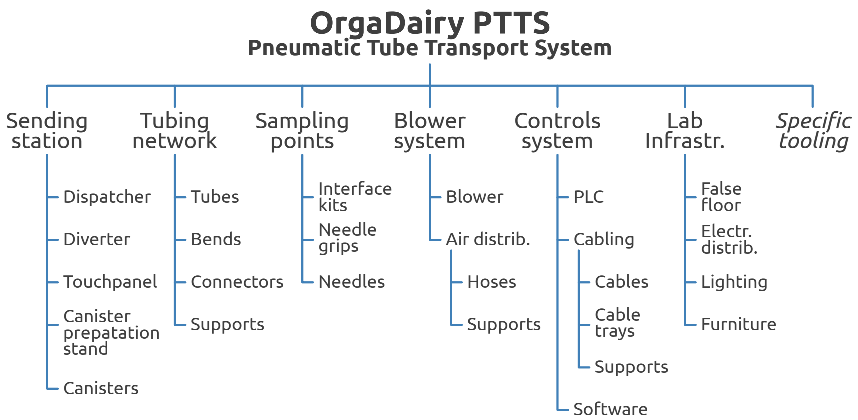
The CanNet Pilot Project

The project master schedule

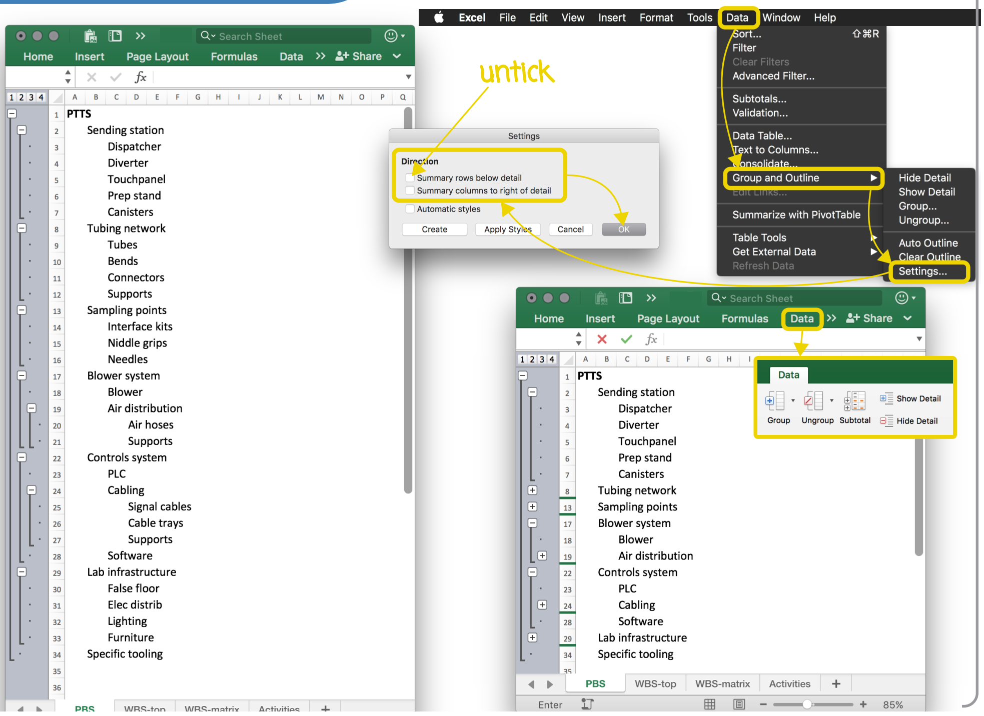


The CanNet Pilot Project 1.1 Not handled by Microsoft Project

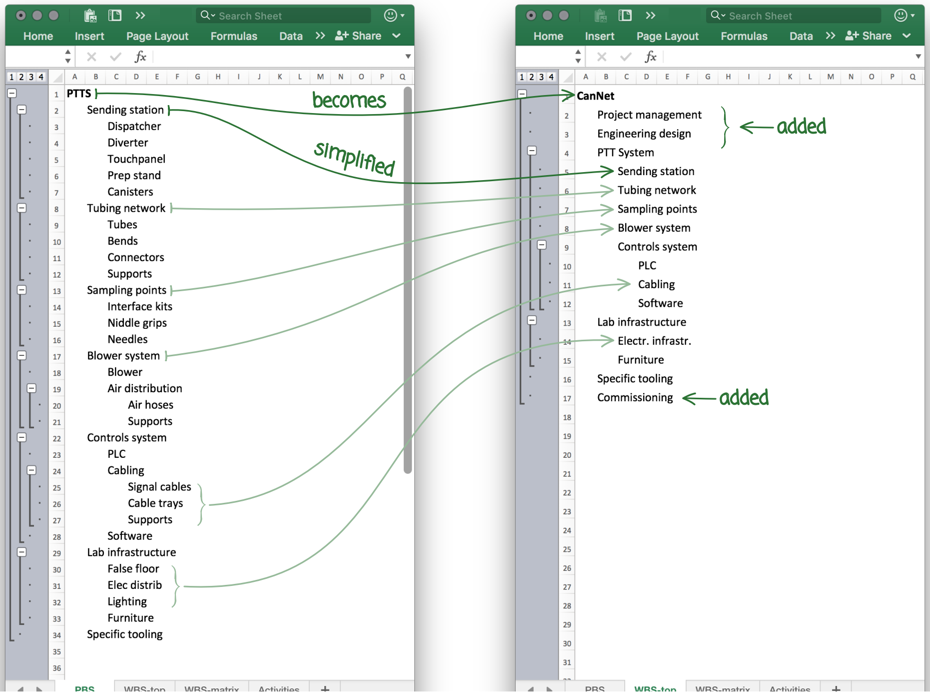
Product Breakdown Structure (PBS)



The CanNet Pilot Project 1.1 Not handled by Microsoft Project

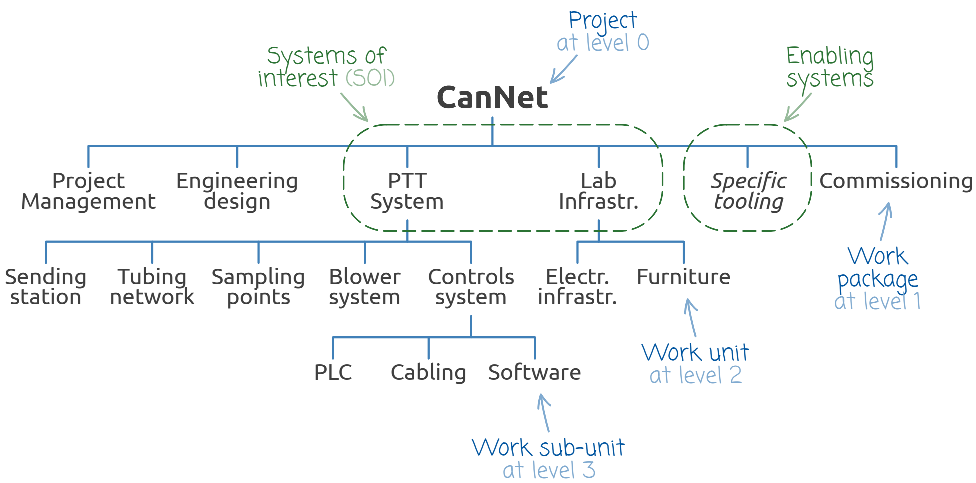


The CanNet Pilot Project 1.2 ⚠ Not handled by Microsoft Project



The CanNet Pilot Project 1.2 ⚠ Not handled by Microsoft Project

*Work Breakdown Structure (**WBS**)*



  Pierre Bonnal

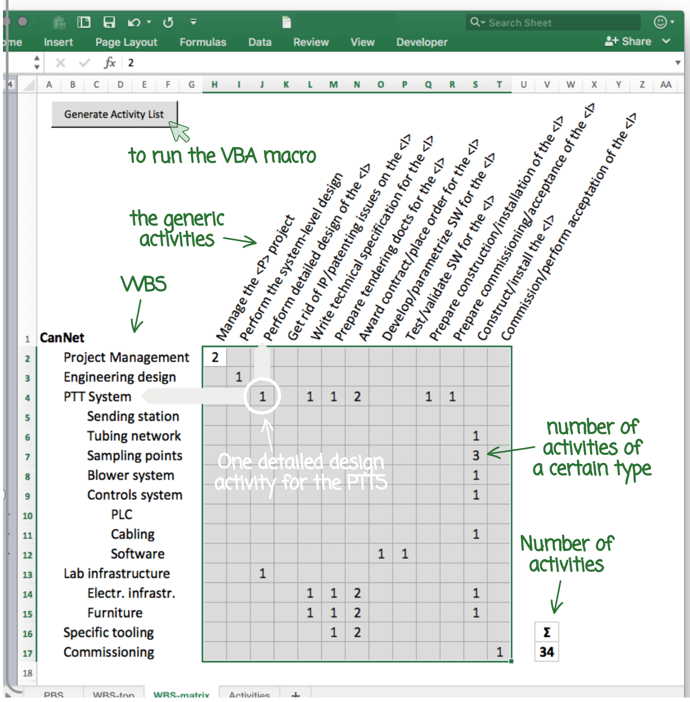
The CanNet Pilot Project

The generic activities

suited to OrgaDairy improvement projects

- Manage the project
- Perform the system-level design
- Perform detailed design
- Get rid of IP/patenting issues
- Write technical specification
- Prepare tendering docts
- Award contract/place order
- Develop/parametrize software
- Test/validate software
- Prepare construction/installation
- Prepare commissioning/acceptance
- Construct/install
- Commission/perform acceptation

The CanNet Pilot Project 1.3 ⚠ Not handled by Microsoft Project



To run the macro:

1. Put a '>' in col. A (e.g. cell A20)
2. Select cells for which activities will be generated (e.g. H2:T17)
3. Click the button

Activity ≈ Work Unit ≈ Work Package

An activity is an elementary action that:

- consumes **time**
- consumes **resources**
- has a **start** and a **finish** dates
- is assignable to **one person**
- produces **deliverable**(**s**)
- is **measurable** (to assess its progress)

Activity ≠ Deliverable

To avoid confusion, clever professional practices and several textbooks suggest to label activities as follow:

Action verb (infinitive tense) + Substantive

How many activities on a schedule?

What should be the size of a project's **Activity Portfolio**?

- No definitive answer!
- That depends of the size and complexity of the project
- But more than **300 or 400 activities*** is known to be difficult to handle
- **100 activities*** sounds reasonable for a project spanning over one year

* Activities + remaining planned activities

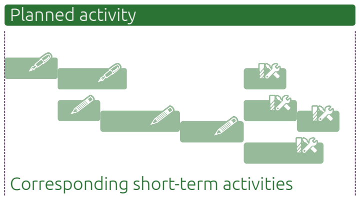
Activity vs. **Planned Activity**

The ANSI **#748** project management standard for reporting distinguishes two types of activities:

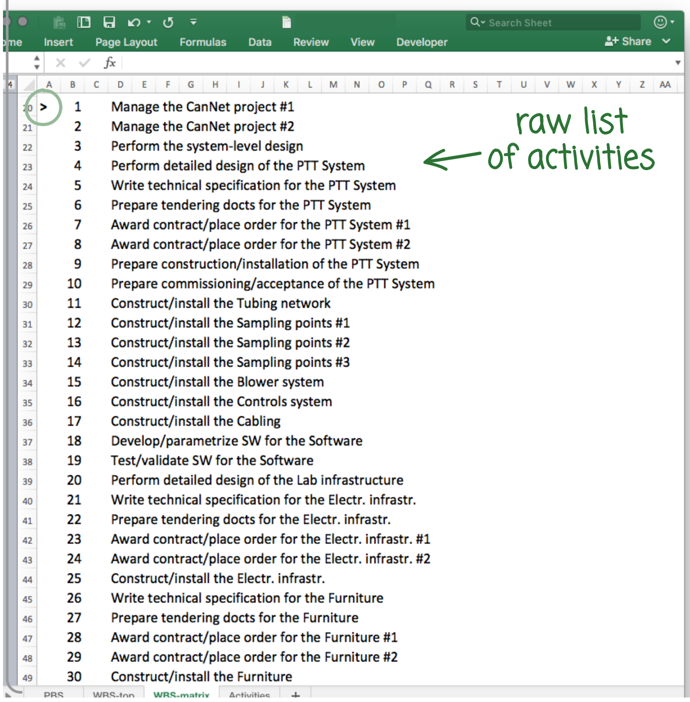
- **Activities** (work units) ⇢ short/medium term
- **Planned activities** (planned units) ⇢ longer term

Planned activities are defined more roughly that short/medium term activities

As the project progresses, planned activities arrive on a shorter term and are split up in short/medium term activities



The CanNet Pilot Project 1.4 ⚠ Not handled by Microsoft Project



To run the macro:

1. Put a '>' in col. A (e.g. cell A20)
2. Select cells for which activities will be generated (e.g. H2:T17)
3. Click the button

Activities listed as from row marked '>' downward

4. Adjust the labels*
5. Copy-paste the list into the project scheduling software

The CanNet Pilot Project | 1.4 | Microsoft Project

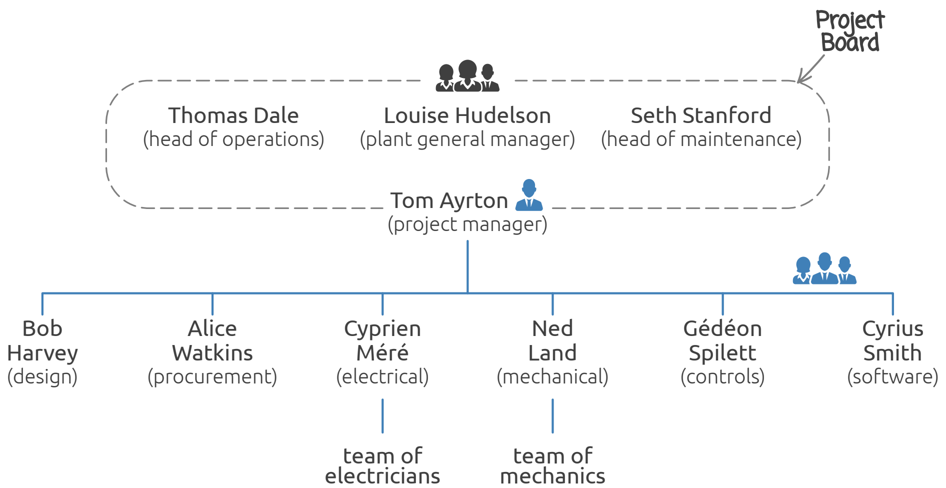
*List of activities (**LoA**) with ajusted labels*

Manage the CanNet project
Set the project management framework
Perform detailed design of the PTT system
Write technical specification for the PTT system
Prepare tendering docts for the PTT system
Send invitations to tender for the PTT system
Open tenders and place order for the PTT system
Perform the installation design
Prepare installation of the PTT system
Prepare commissioning of the PTT system
Install the tank #1 sampling point assembly
Install the tank #2 sampling point assembly
Install the tank #3 sampling point assembly
Lay down the tubing network
Install the blower and lay down the air hoses
Pull and connect controls cabling
Install the PLC and sending station in the lab

Parametrize software for the PTT system
Test and validate software for the PTT system
Perform detailed design of the lab arrangement
Write technical specification for the electr. infrastr.
Prepare tendering docts for the electr. infrastr.
Send invitations to tender for the electr. infrastr.
Open tenders and place order for the electr. infrastr.
Install the electr. infrastr. In the lab
Write technical specification for the lab's furniture
Prepare tendering docts for the lab's furniture
Send invitations to tender for the lab's furniture
Open tenders and place order for the lab's furniture
Arrange the furniture in the lab
Prepare tendering docts for the specific tooling
Send invitations to tender for the specific tooling
Open tenders and place order for the specific tooling
Debug and commission the pilot PTT system

The CanNet Pilot Project | 2.1 | Not handled by Microsoft Project

*Organisational Breakdown Structure (**OBS**)*



The CanNet Pilot Project | 2.1 | Microsoft Project

*Resource Breakdown Structure (**RBS**)*

CanNet

Manpower

- Tom Ayrton Senior Plant Engineer
- Bob Harvey Senior Plant Designer
- Alice Watkins Procurement Officer
- Cyprien Méré Electr. Engineer
- Herbert Brown Electrician
- Michel Zorn Electrician
- Ned Land Mech. Engineer
- John Proth Mechanic
- Mathieu Strux Mechanic
- Gédéon Spilett Controls Engineer
- Cyrus Smith Software Engineer

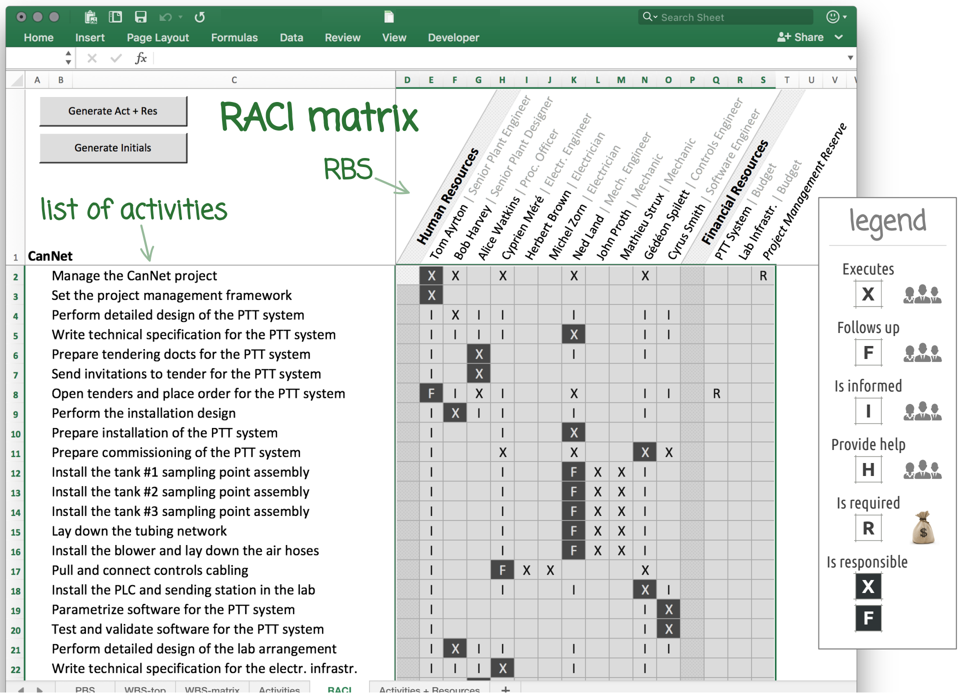
Financial

Budgets

- PTT System & Tooling
- Lab Infrastructure
- **PMR**

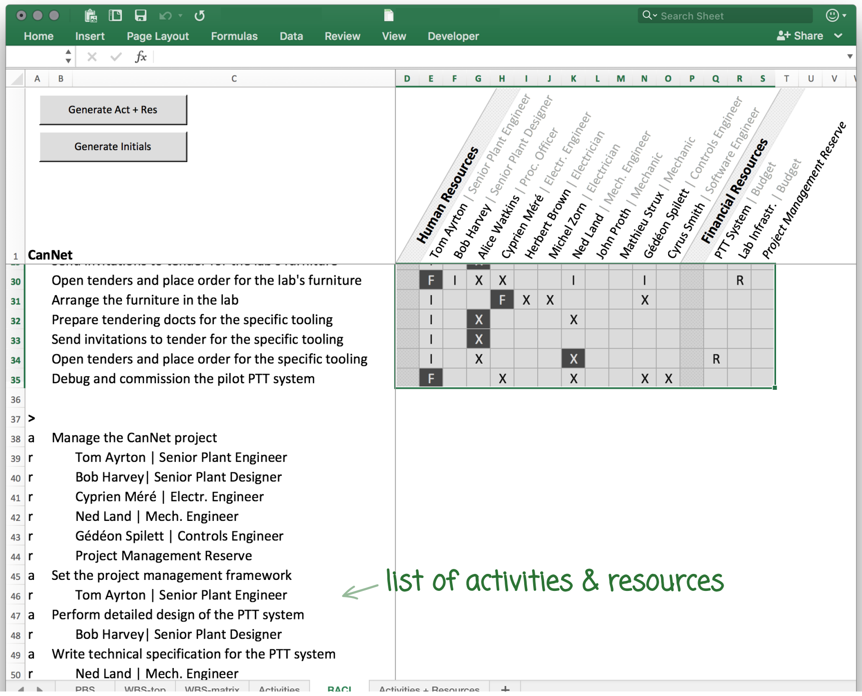
Project Management Reserve

The CanNet Pilot Project | 2.3 | Not handled by Microsoft Project



	CanNet	Human Resources	Tom Ayrton | Senior Plant Engineer	Bob Harvey | Senior Plant Designer	Alice Watkins | Proc. Officer	Cyprien Méré | Electr. Engineer	Herbert Brown | Electrician	Michel Zorn | Electrician	Ned Land | Mech. Engineer	John Proth | Mechanic	Mathieu Strux | Mechanic	Gédéon Spilett | Controls Engineer	Cyrus Smith | Software Engineer	Financial Resources	PTT System | Budget	Lab Infrastr. | Budget	Project Management Reserve
2	Manage the CanNet project		**X**	X		X			X			X					R
3	Set the project management framework		**X**														
4	Perform detailed design of the PTT system		I	X	I	I			I			I	I				
5	Write technical specification for the PTT system		I	I	I	I			**X**			I	I				
6	Prepare tendering docts for the PTT system		I		**X**				I			I					
7	Send invitations to tender for the PTT system		I		**X**												
8	Open tenders and place order for the PTT system		**F**	I	X	I			X			I	I		R		
9	Perform the installation design		I	**X**	I	I			I			I					
10	Prepare installation of the PTT system		I			I			**X**								
11	Prepare commissioning of the PTT system		I			X			X			**X**	X				
12	Install the tank #1 sampling point assembly		I			I			**F**	X	X	I					
13	Install the tank #2 sampling point assembly		I			I			**F**	X	X	I					
14	Install the tank #3 sampling point assembly		I			I			**F**	X	X	I					
15	Lay down the tubing network		I			I			**F**	X	X	I					
16	Install the blower and lay down the air hoses		I			I			**F**	X	X	I					
17	Pull and connect controls cabling		I			**F**	X	X				X					
18	Install the PLC and sending station in the lab		I			I			I			**X**	I				
19	Parametrize software for the PTT system		I									I	**X**				
20	Test and validate software for the PTT system		I									I	**X**				
21	Perform detailed design of the lab arrangement		I	**X**	I	I			I			I	I				
22	Write technical specification for the electr. infrastr.		I	I	I	**X**			I			I					

The CanNet Pilot Project 2.3 ⚠ Not handled by Microsoft Project



← list of activities & resources

Activity

An activity is an elementary action that:

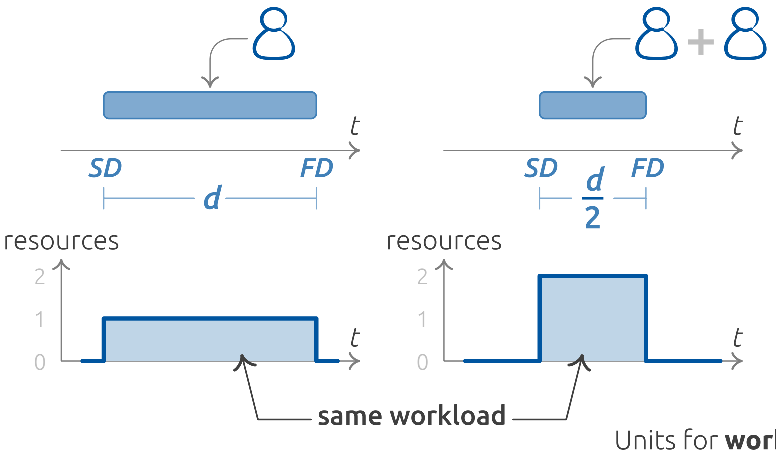
- consumes **time** *yes, but within certain limits!*

What is then the maximum duration for an activity?

- No definitive answer!
- No more than **5%** to **10%** of the project duration
- No more than **13 weeks** (long lead projects)
- Some so-called **Level-of-Effort** activities are allowed **one** such or up to **1%** of the activities ANSI **#748**

Estimating Activity Duration

Workload Histogram



Units for **duration**:
- hour [hr]
- day [d]
- week [wk]
- month [m]

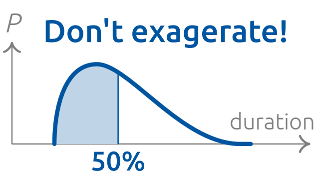
Units for **workload**:
- person·day [p·d]
- person·week [p·wk]
- person·month [p·m]
- person·year [p·yr]
- working hours [whr]

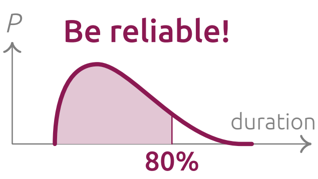
Estimating Activity Duration

Sources of Estimates

global knowledge
- prefessional knowledge database
- knowledge database of the company

knowledge of project members
- Project Manager
- Project Participant



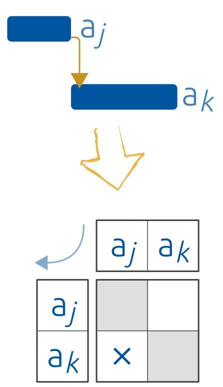


*List of activities (**LoA**) + duration estimates* [weeks]

PM	Manage the CanNet project	LoE
PMF	Set the project management framework	1
DDP	Perform detailed design of the PTT system	5
TSP	Write technical specification for the PTT system	2
TDP	Prepare tendering docts for the PTT system	1
ITP	Send invitations to tender for the PTT system	0+ε*
POP	Open tenders and place order for the PTT system	1
IDP	Perform the installation design	1.5
IPP	Prepare installation of the PTT system	2
CPP	Prepare commissioning of the PTT system	2
Tk1	Install the tank #1 sampling point assembly	0.5
Tk2	Install the tank #2 sampling point assembly	0.5
Tk3	Install the tank #3 sampling point assembly	0.5
Tub	Lay down the tubing network	2
Blw	Install the blower and lay down the air hoses	1
Ctrl	Pull and connect controls cabling	1
Lab	Install the PLC and sending station in the lab	2
PSW	Parametrize software for the PTT system	4
TSW	Test and validate software for the PTT system	2
DDL	Perform detailed design of the lab arrangement	2
TSE	Write technical specification for the electr. infrastr.	1
TDE	Prepare tendering docts for the electr. infrastr.	1
ITE	Send invitations to tender for the electr. infrastr.	0+ε*
POE	Open tenders and place order for the electr. infrastr.	0.5
Elec	Install the electr. infrastr. In the lab	2
TSF	Write technical specification for the lab's furniture	0.5
TDF	Prepare tendering docts for the lab's furniture	0.5
ITF	Send invitations to tender for the lab's furniture	0+ε*
POF	Open tenders and place order for the lab's furniture	0.5
Furn	Arrange the furniture in the lab	1
TDT	Prepare tendering docts for the specific tooling	0.5
ITT	Send invitations to tender for the specific tooling	0+ε*
POT	Open tenders and place order for the specific tooling	0.5
Com	Debug and commission the pilot PTT system	1

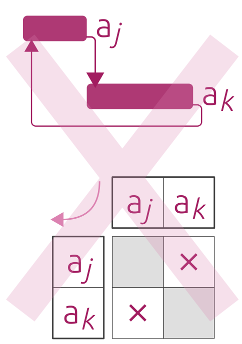
* ca. one hour, but once converted in weeks, dur = 0+ε = 0 wk

Technical Constraints

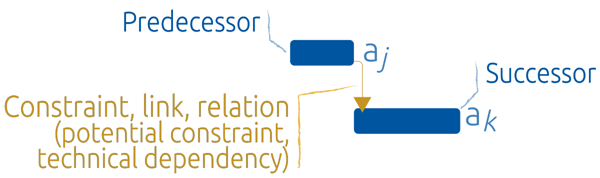


Precedence Matrix

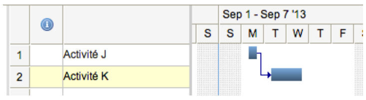
ATTENTION
The activity net shall be free of loops!



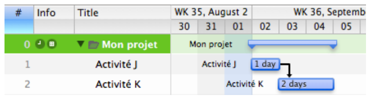
Technical Constraints → Finish–Start



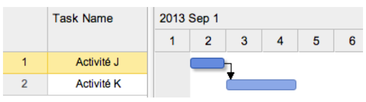
Finish–start constraint in **Gantter.com**



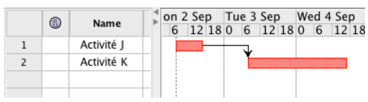
Finish–start constraint in **Merlin**



Finish–start constraint in **Gantic.com**

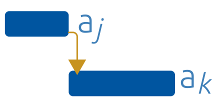


Finish–start constraint in **OpenProj**



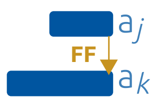
Technical Constraints

finish-start

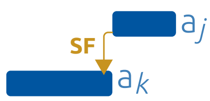


start-start

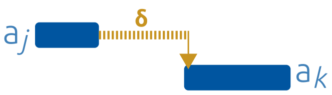
finish–finish



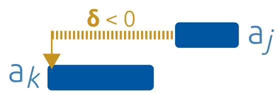
start–finish



positive lag



negative lag



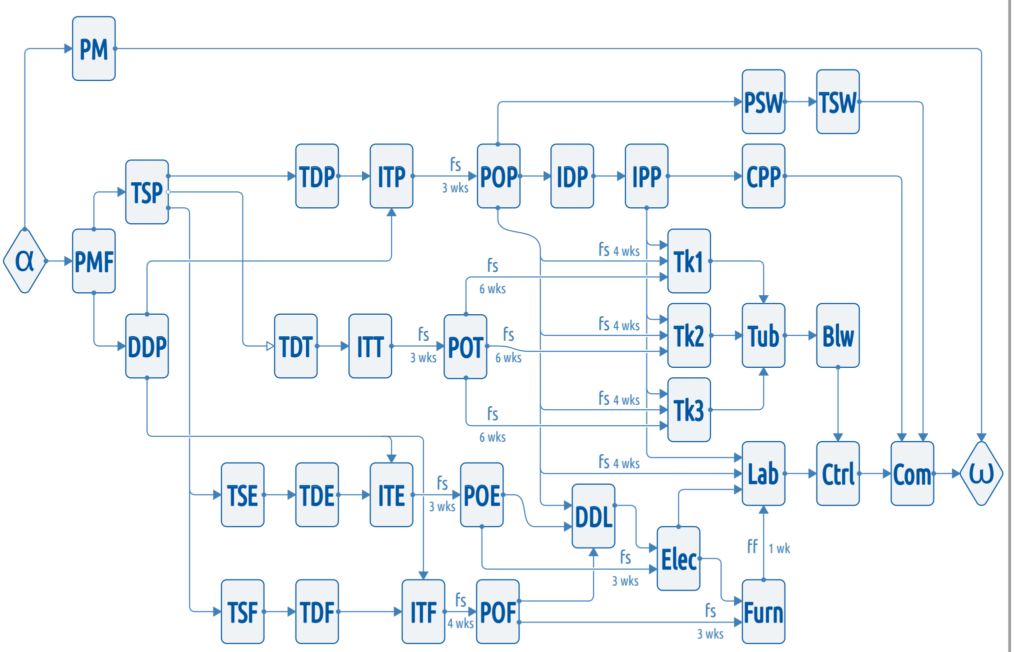
The CanNet Pilot Project 3.2 Microsoft Project

*List of activities (**LoA**) + duration estimates* [weeks] *+ predecessors*

Activity	Predecessors	Duration
α	project start node	
PM	α	LoE
PMF	α	1
DDP	sPMF	5
TSP	PMF	2
TDP	TSP	1
ITP	DDP, TDP	0
POP	ITP fs+3 wks	1
IDP	POP	1.5
IPP	IDP	2
CPP	IPP	2
Tk1	POP fs+4 wks, IPP, POT fs+6 wks	0.5
Tk2	POP fs+4 wks, IPP, POT fs+6 wks	0.5
Tk3	POP fs+4 wks, IPP, POT fs+6 wks	0.5
Tub	Tk1, Tk2, Tk3	2
Blw	Tub	1
Ctrl	Blw, Lab	1
Lab	POP fs+4 wks, IPP, Elec, Furn ff+1 wk	2
PSW	POP	4
TSW	PSW	2
DDL	POP, POE, POF	2
TSE	TSP	1
TDE	TSE	1
ITE	DDP, TDE	0
POE	ITE fs+3 wks	0.5
Elec	DDL, POE fs+3 wks	2
TSF	TSP	0.5
TDF	TSF	0.5
ITF	DDP, TDF	0
POF	ITF fs+4 wks	0.5
Furn	Elec, POF fs+3 wks	1
TDT	TSP	0.5
ITT	TDP	0
POT	ITT fs+3 wks	0.5
Com	Ctrl, TSW, CPP	1
ω	PM, Com	

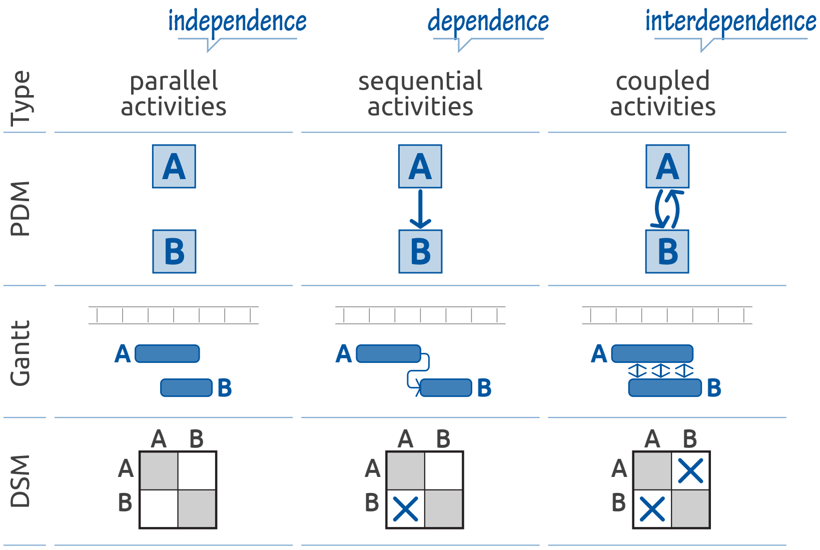
ω ← project finish node

The CanNet Pilot Project 3.2 Microsoft Project



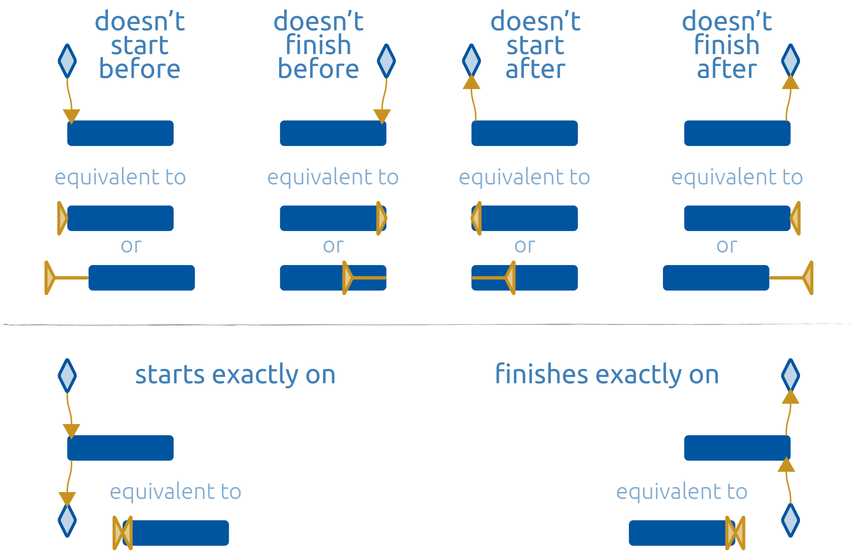
  Pierre Bonnal

Design Structure Matrix



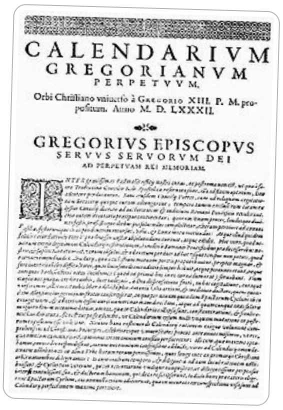
PDM Scheduling

Six possible temporal constraints



Calendars

The Gregorian Calendar
and the calendar handling issue


CALENDARIVM
GREGORIANVM
PERPETVVM.
Orbi Christiano vniuerso à GREGORIO XIII. P. M. propositum. Anno M. D. LXXXII.
GREGORIVS EPISCOPVS
SERVVS SERVORVM DEI
AD PERPETVAM REI MEMORIAM.

- one year = 12 months, 365 or 366 days, ca. 52 weeks (every 4.09 years in average)
- one month = from 28 to 31 days, slightly more than four weeks
- one week = seven days, but five working days
- one day = 24 hours, but 7 or 8 working hours
- one hour = 60 minutes and one minute = 60 seconds

⚠ ISO 8601:2004 *Representation of dates and times* → `YYYY-MM-DDTHH:MM:SS`

PDM Scheduling

- A given **set of activities**: A = { a_1, a_2, …, a_n }
- For each activity, a **duration** is estimated: $a_i \rightarrow DUR_i$
- Some activities are interdependent by means of **technical constraints**
- **Earliest start** (ES_i) and **earliest finish** (EF_i) dates
- **Latest start** (LS_i) and **latest finish** (LF_i) dates
- **Total float** (TF_i), **free floats** (FF_i) and **critical path**(**s**)
- While minimizing the project duration

PDM Scheduling

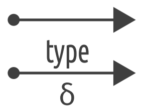
"a PDM convention"

ID	DUR
ES	LS
EF	LF
FF	TT

ID	Activity ID
DUR_{ID}	Estimated duration
ES_{ID}	Earliest start date
EF_{ID}	Earliest finish date
LS_{ID}	Latest start date
LF_{ID}	Latest finish date
FF_{ID}	Free float (slack)
TT_{ID}	Total float (slack)

α	ω
E_α	E_ω

α, ω	Project start and finish nodes
E_α	Project fixed start date ← given!
E_ω (L_ω)	Project earliest finish date



Technical constraint: default type = finish–start

Technical constraint: type (fs, ff, ss, sf) and lag δ

PDM Scheduling

Calculations in three steps

The CPM algorithm

1. Calculation of the **earliest dates** by propagation (**forward pass**) from left to right

$\mathbf{E}_\alpha \leftarrow$ Project start date

Order $\{ \mathbf{a}_j \}$ so that $\mathbf{a}_i \prec \mathbf{a}_k \ \forall\ \mathbf{i} < \mathbf{k}$

For $\mathbf{j} = 1$ to $|\{ \mathbf{a}_j \}|$ repeat:

$$\mathbf{ES}_j \leftarrow \begin{cases} \mathbf{E}_\alpha \text{ if } \Gamma_j^{-1} = \emptyset \\ \max_{k \in \Gamma_j^{-1}} \{ \mathbf{ES}_k + \mathbf{DUR}_k \} \text{ otherwise} \end{cases}$$

2. Calculation of the **latest dates** by propagation (**backward pass**) from right to left

$\mathbf{L}_\omega \leftarrow \mathbf{E}_\omega$

For $\mathbf{j} = |\{ \mathbf{a}_j \}|$ to 1 repeat:

$$\mathbf{LF}_j \leftarrow \begin{cases} \mathbf{L}_\omega \text{ if } \Gamma_j = \emptyset \\ \min_{k \in \Gamma_j} \{ \mathbf{LF}_k - \mathbf{DUR}_k \} \text{ otherwise} \end{cases}$$

3. Calculation of the **total floats** and **free floats**

$\mathbf{TF}_j \leftarrow \mathbf{LF}_j - \mathbf{EF}_j$

$\mathbf{FF}_j \leftarrow \min_{k \in \Gamma_j} \{ \mathbf{ES}_k \} - \mathbf{EF}_j$

PDM Scheduling

The real PDM algorithm!

$\mathbf{E}_\alpha \leftarrow$ Project start date

Order $\{ a_j \}$ so that $a_i \prec a_k \; \forall \; i<k$

For $j=1$ to $|\{ a_j \}|$ repeat:

$$\mathbf{ES}_j \leftarrow \begin{cases} \mathbf{E}_\alpha \text{ if } \Gamma_j^{-1}=\emptyset \\ \max_{k\in\Gamma_j^{-1}} \{ \ast \} \text{ otherwise} \end{cases}$$

where $\ast$ is:

- $\mathbf{ES}_k+\mathbf{DUR}_k+\mathbf{LAG}_{kj}$ if $\sigma_{kj}=$"FS"
- $\mathbf{ES}_k+\mathbf{LAG}_{kj}$ if $\sigma_{kj}=$"SS"
- $\mathbf{ES}_k-\mathbf{DUR}_j+\mathbf{LAG}_{kj}$ if $\sigma_{kj}=$"SF"
- $\mathbf{ES}_k+\mathbf{DUR}_k-\mathbf{DUR}_j+\mathbf{LAG}_{kj}$ if $\sigma_{kj}=$"FF"

$\mathbf{L}_\omega \leftarrow \mathbf{E}_\omega$

For $j=|\{ a_j \}|$ to 1 repeat:

$$\mathbf{LF}_j \leftarrow \begin{cases} \mathbf{L}_\omega \text{ if } \Gamma_j=\emptyset \\ \min_{k\in\Gamma_j} \{ \ast \} \text{ otherwise} \end{cases}$$

where $\ast$ is:

- $\mathbf{LF}_k-\mathbf{DUR}_k-\mathbf{LAG}_{kj}$ if $\sigma_{jk}=$"FS"
- $\mathbf{LF}_k-\mathbf{DUR}_k+\mathbf{DUR}_j-\mathbf{LAG}_{kj}$ if $\sigma_{jk}=$"SS"
- $\mathbf{LF}_k+\mathbf{DUR}_j-\mathbf{LAG}_{kj}$ if $\sigma_{jk}=$"SF"
- $\mathbf{LF}_k-\mathbf{LAG}_{kj}$ if $\sigma_{jk}=$"FF"

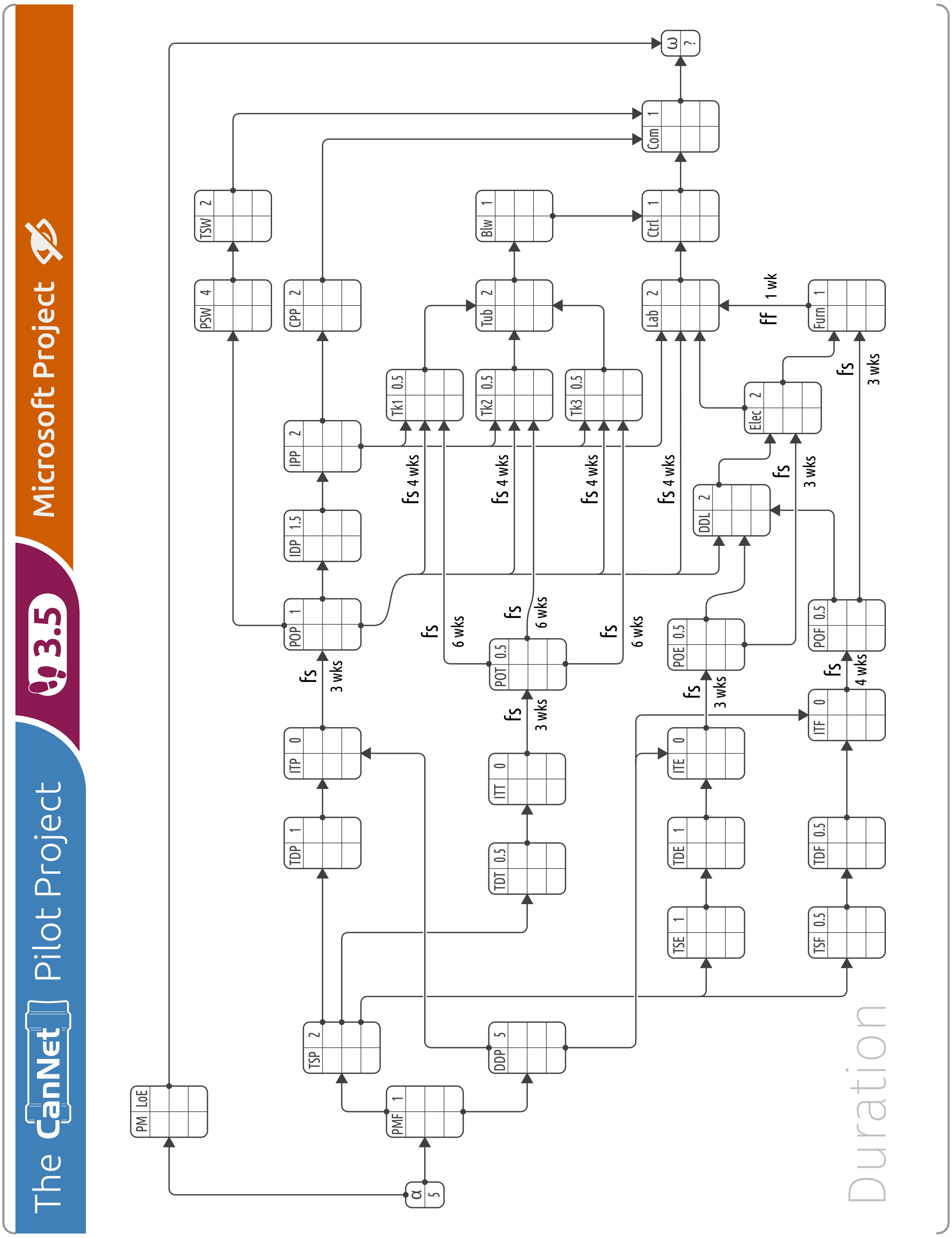
$\mathbf{TF}_j \leftarrow \mathbf{LF}_j - \mathbf{EF}_j$

$\mathbf{FF}_j \leftarrow \min_{k\in\Gamma_j} \{ \mathbf{ES}_k \} - \mathbf{EF}_j$

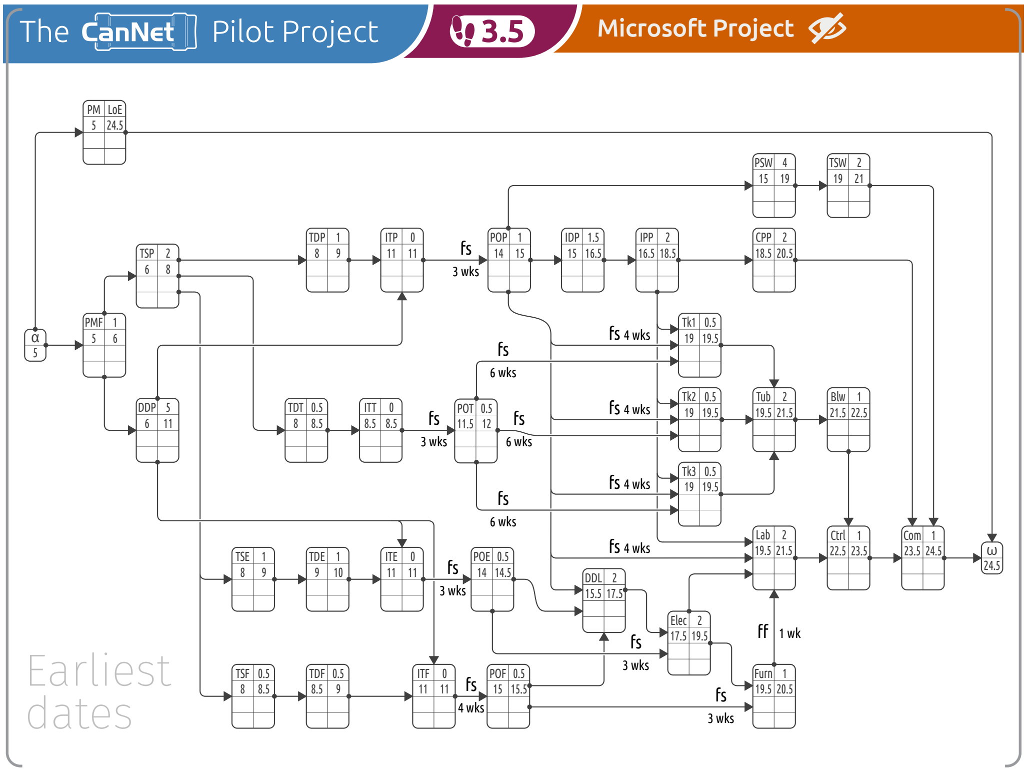
PDM Scheduling

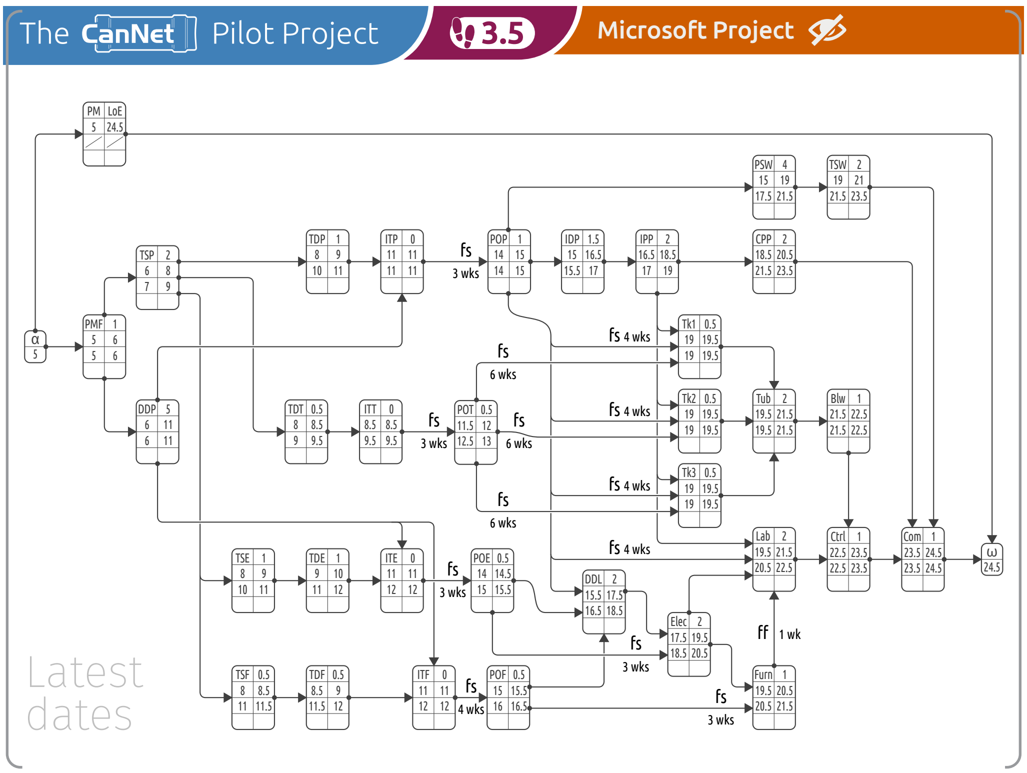
Floats and Critical Path(s)

- So called **total floats**, **free floats** and **critical paths** are obtained from PDM calculations
- **Free float** (Free slack in Microsoft Project) = the amount of time that an activity can be delayed from its earliest start date without causing a delay to the earliest dates of subsequent activities
- **Total float** (Total slack in Microsoft Project) = the amount of time that an activity can be delayed from its early start date without causing a delay to the project finish date
- If $TF_{ID} = 0$ then necessarily $FF_{ID} = 0$!
- **Critical path** = the sequence of activities which add up to the longest overall duration, i.e. which makes the project duration
- **Critical activity** = an activity that belongs to a critical path ($TF_{ID} = 0$)



The CanNet Pilot Project
3.5
Microsoft Project
Duration


The CanNet Pilot Project
3.5
Microsoft Project
PM LoE
PSW
TSW
TSP
TDP
ITP
POP
IDP
IPP
CPP
PMF
α
DDP
Tk1
Tub
Blw
TDT
ITT
POT
Tk2
Tk3
Lab
Ctrl
Com
ω
TSE
TDE
ITE
POE
DDL
Elec
TSF
TDF
ITF
POF
Furn
fs
3 wks
4 wks
6 wks
ff
1 wk
Earliest dates


The CanNet Pilot Project
3.5
Microsoft Project
PM LoE
PSW
TSW
TSP
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POE
DDL
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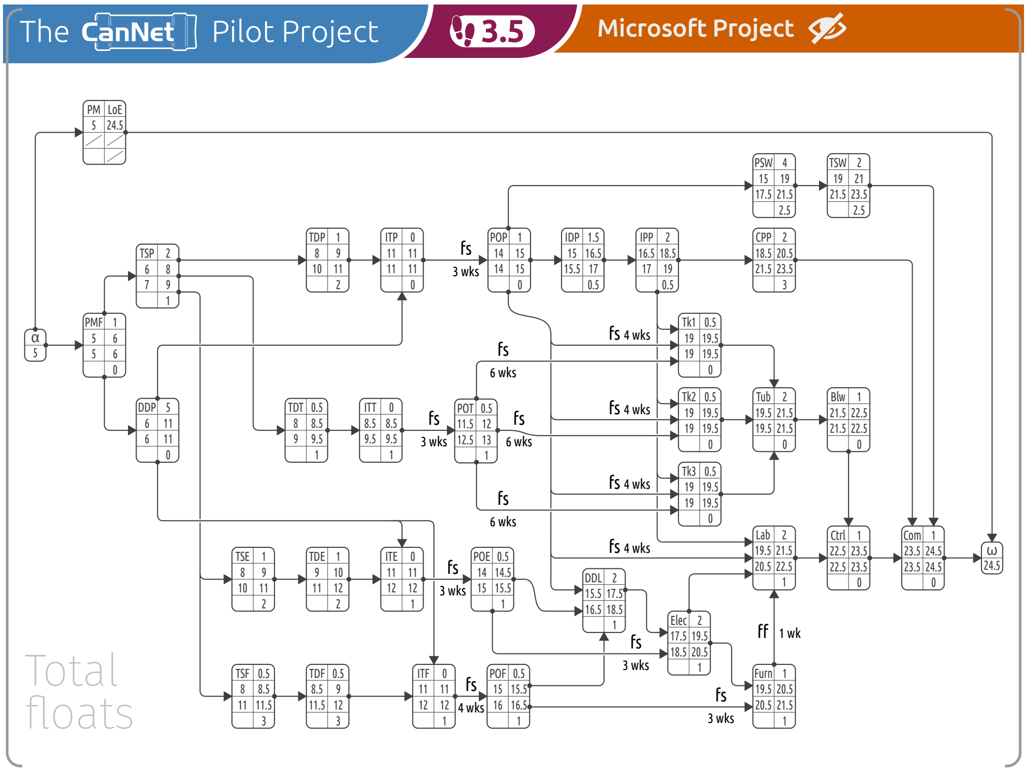
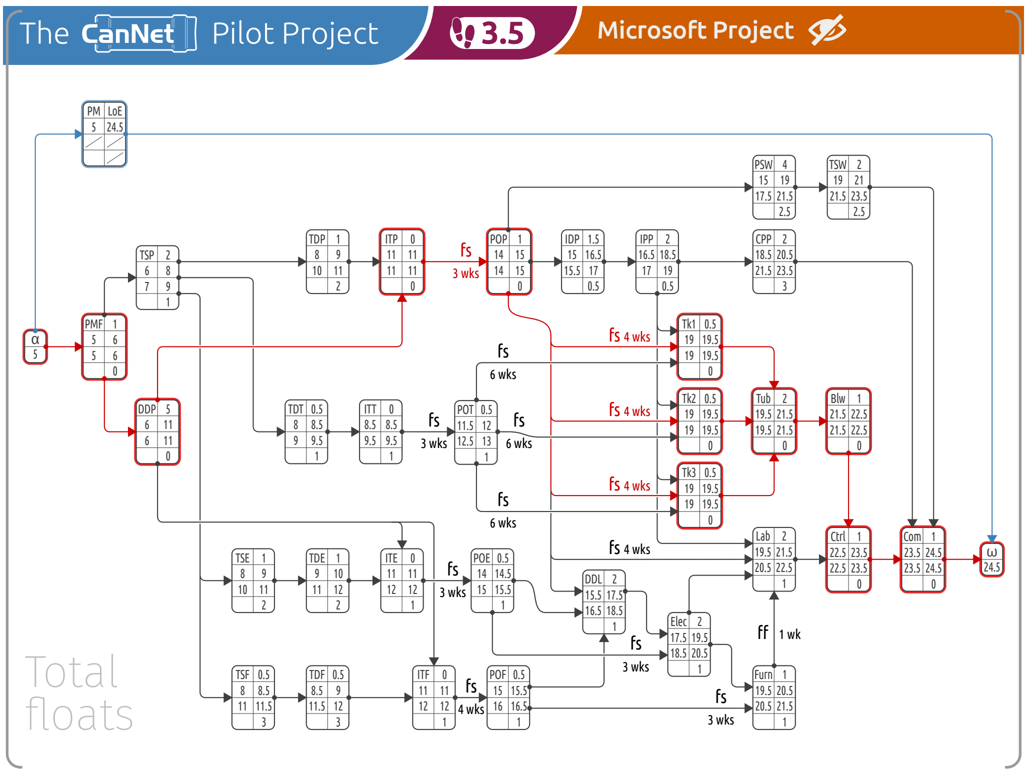
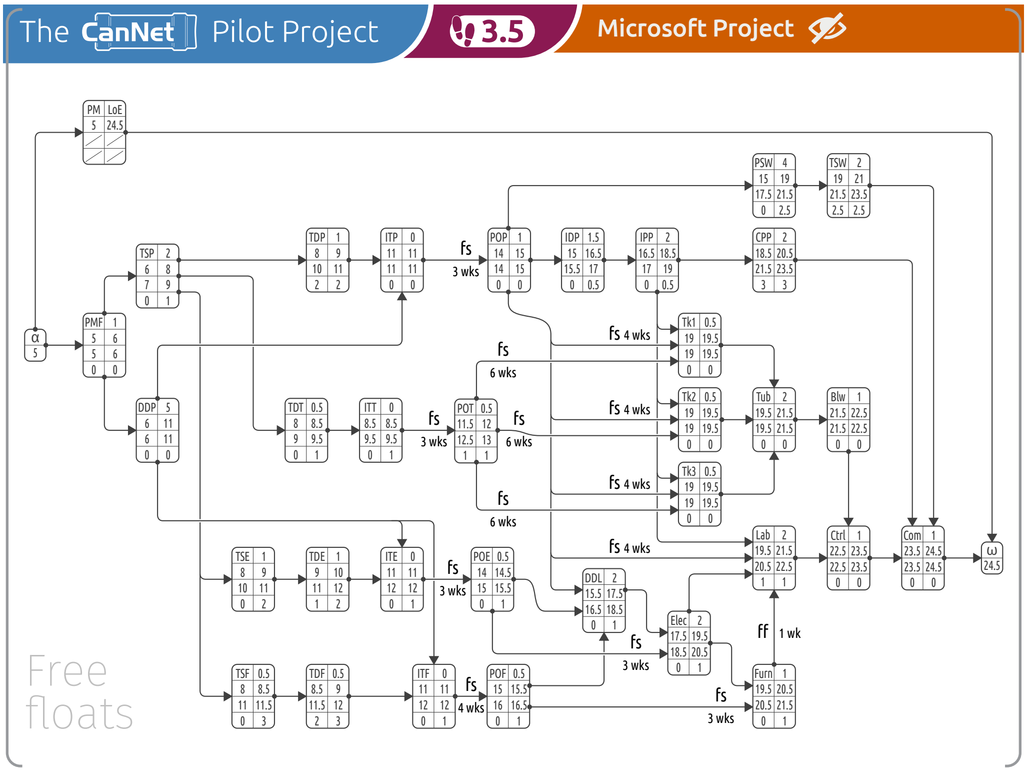
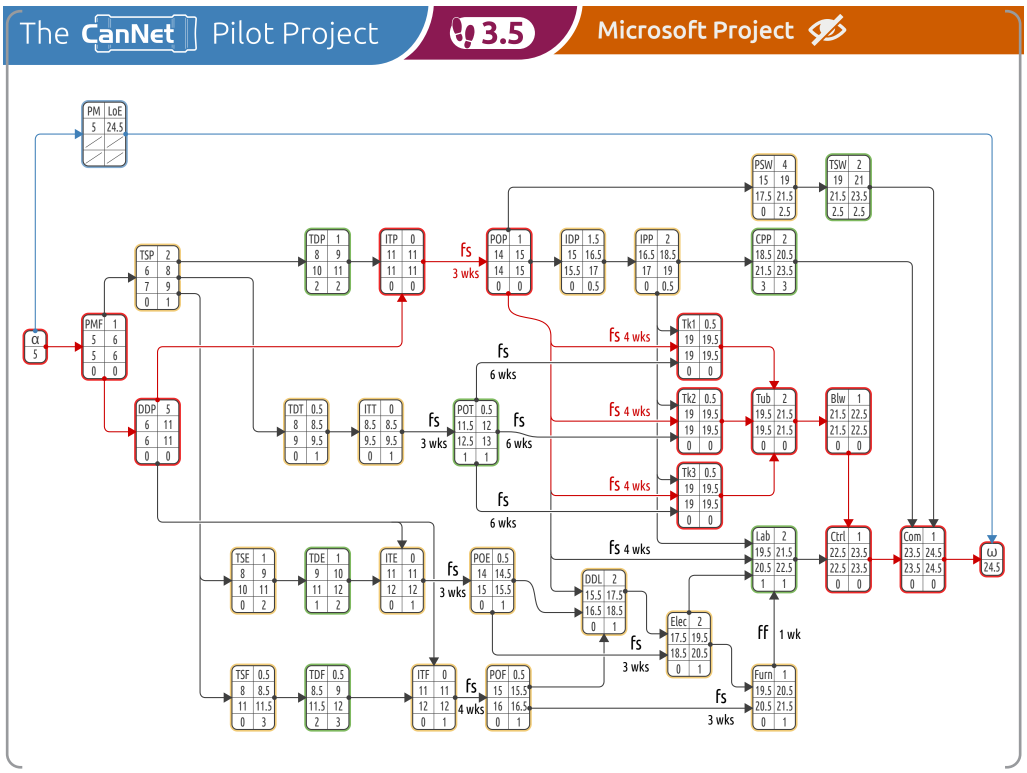
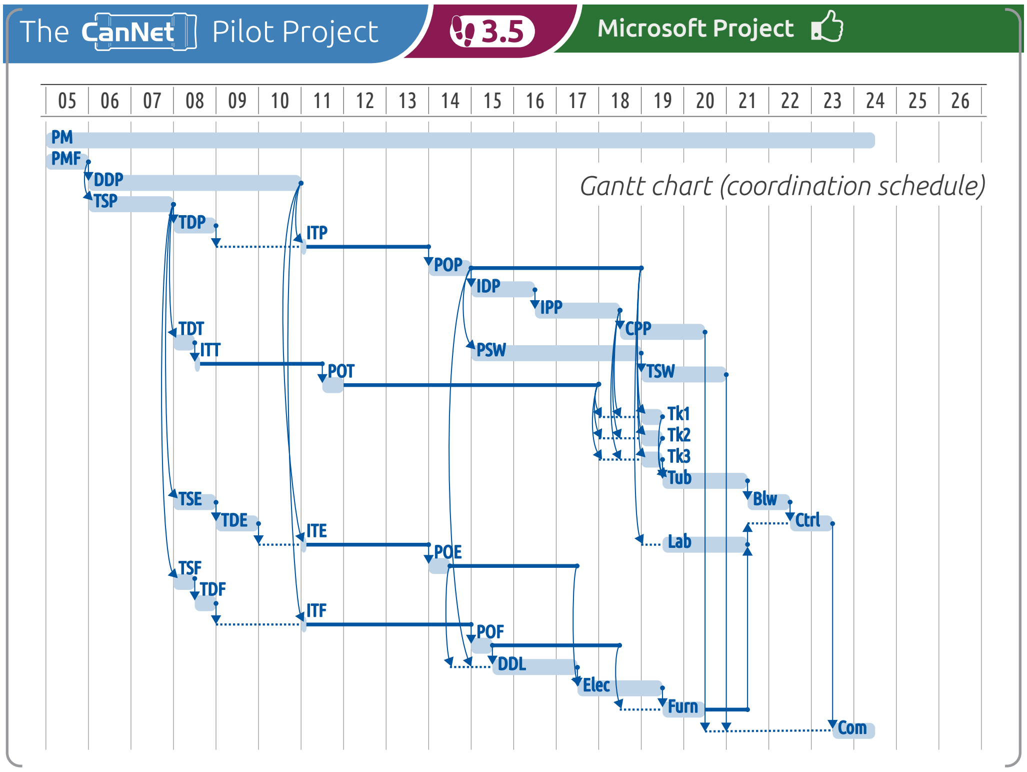
TSF
TDF
ITF
POF
Furn
fs
3 wks
4 wks
6 wks
ff
1 wk
Latest dates


The CanNet Pilot Project
3.5
Microsoft Project
Total floats


The CanNet Pilot Project
3.5
Microsoft Project
Total floats


The CanNet Pilot Project
3.5
Microsoft Project
Free floats


The CanNet Pilot Project
3.5
Microsoft Project


The CanNet Pilot Project
3.5
Microsoft Project
05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Gantt chart (coordination schedule)
PM
PMF
DDP
TSP
TDP
ITP
POP
IDP
IPP
CPP
PSW
TDT
ITT
POT
TSW
Tk1
Tk2
Tk3
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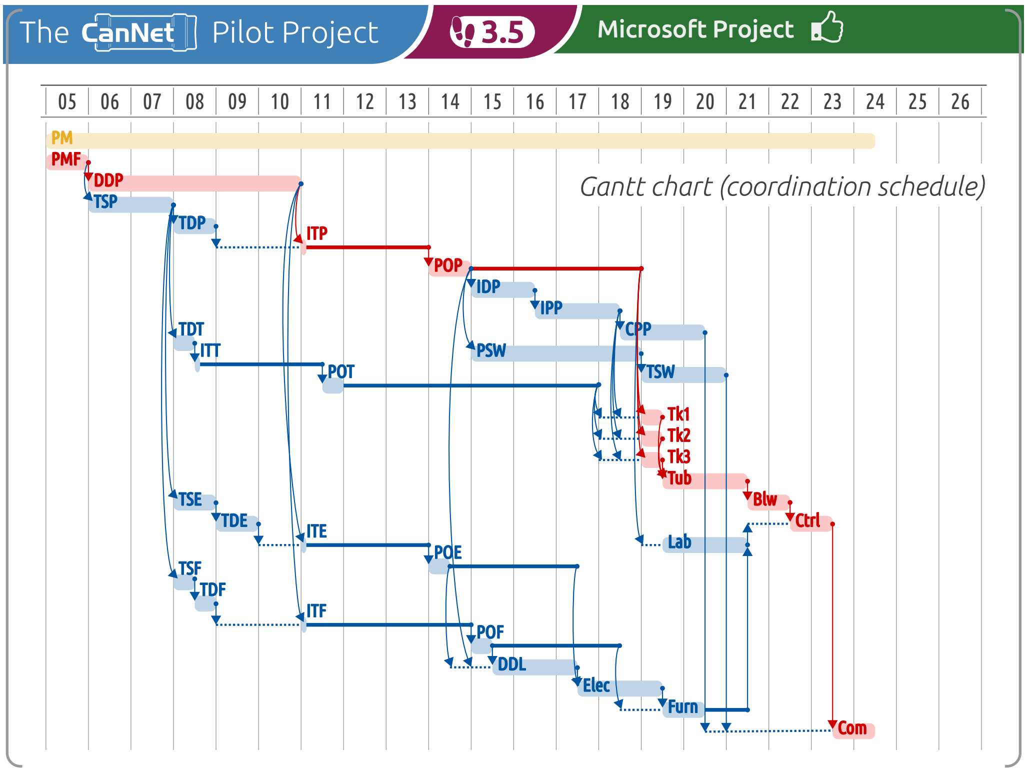
Elec
Furn
Com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3.5
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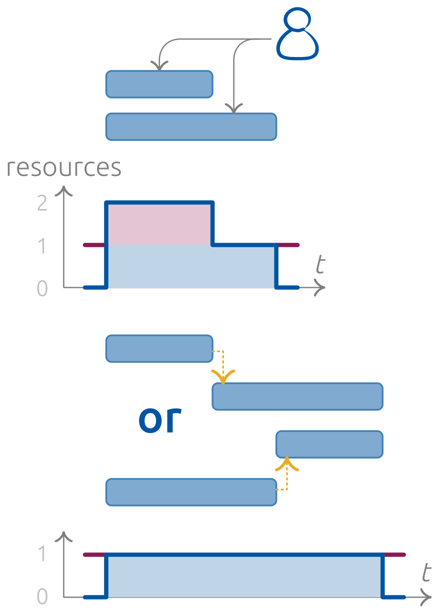
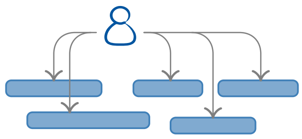
Furn
Com

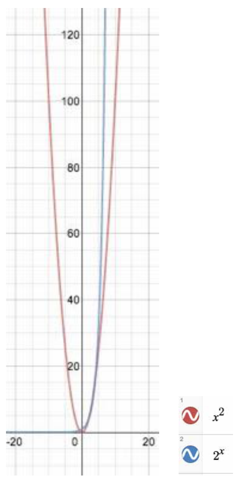
Resource-Constrained Scheduling





2 activities **1** resource ⇢ **2** combinations
3 activities **1** resource ⇢ **6** combinations
4 activities **1** resource ⇢ **24** combinations
5 activities **1** resource ⇢ **120** combinations
720 combinations
5040 combinations
40320 combinations
362880 combinations
3628800 combinations

Resource-Constrained Scheduling



In algorithmics, there are two types of problems:

- Those which complexity grows **polynomially** with the quantity of data to handle ⇢ $O(q) \sim q^c$
- Those which complexity grows **exponentially** with the quantity of data to handle ⇢ $O(q) \sim c^q$

- PDM algorithm ⇢ **polynomial** growth algorithm
- Exact solution for the RC-PSP ⇢ **exponential** growth algorithm
- Sufficiently good solution for the RC-PSP ⇢ **optimization heuristics**
  E.g. → priority-rule-based optimization algorithms

Schedule Analysis

Three aspects to look at
prior to freeze the coord. schedule baseline

Conformity

Does the coord. schedule conform good PDM-based coord. schedule construction?

Achievability

Is the schedule really feasible? sufficient activity duration, appropriate resource assignment, schedule risk analysis, etc.

Adequacy

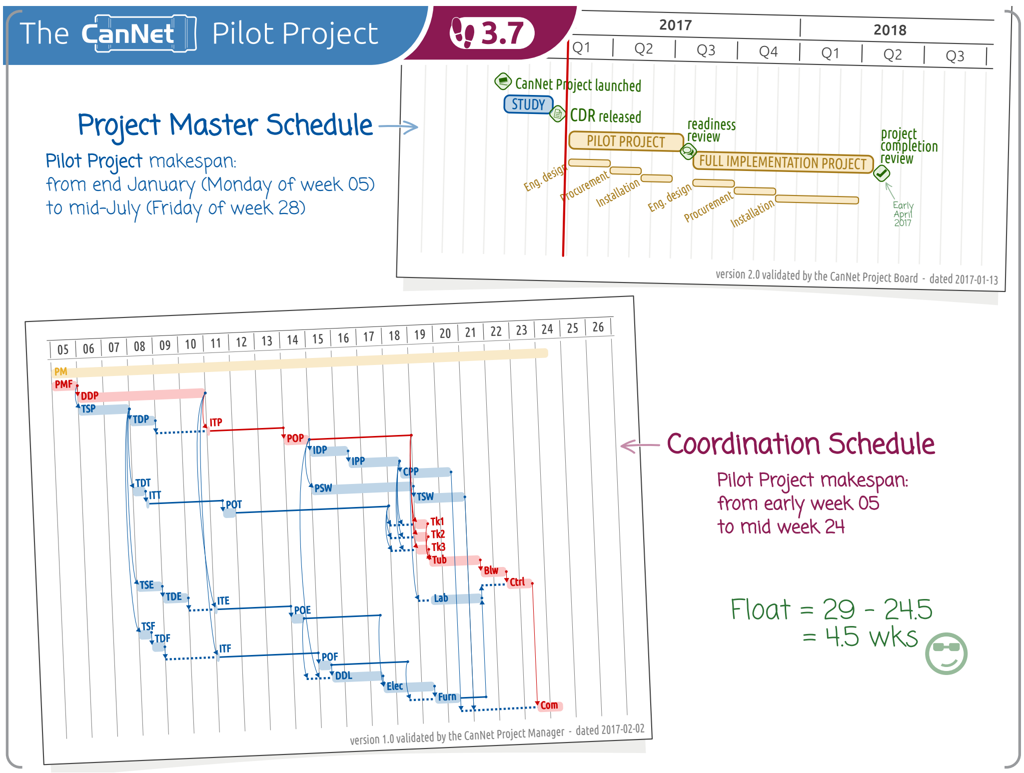
Does the coord. schedule fit the master schedule? What is the global float?

Schedule Analysis | Conformity

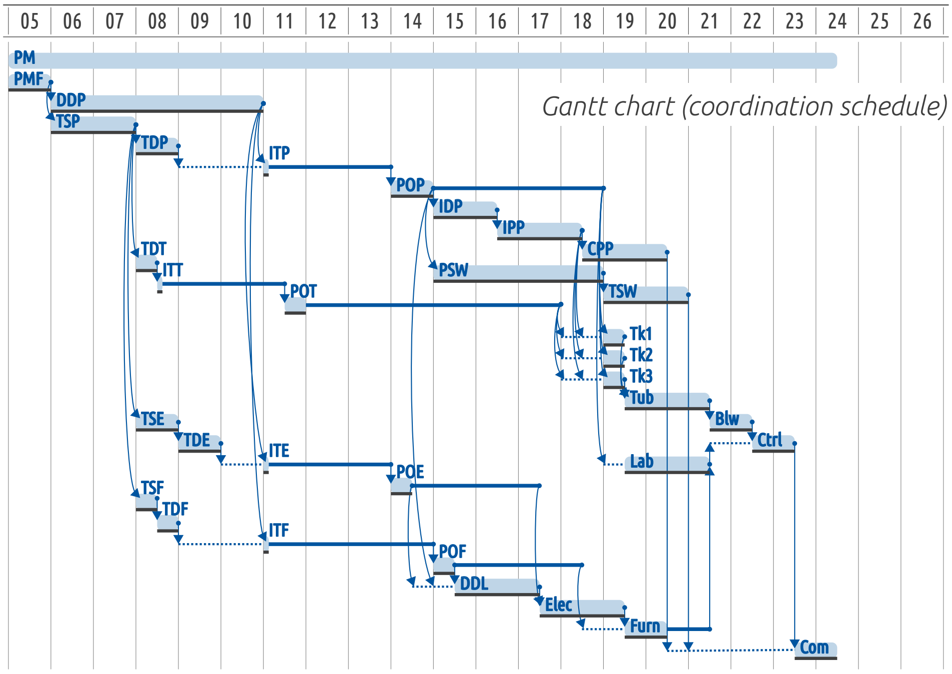
- Size ⇢ # activities < 400
- Task labelling ⇢ action verbs + substantives
- Activity duration < 10% of project duration
- Activity typology ⇢ # LoE activities < min(1 ; 1% of # activities)
- PDM logic
  - # activities with no predecessor = 0
  - # activities with no successor = 0
  - # FS constraints / # constraints > 80%

Schedule Analysis | Achievability

- General agreement w.r.t. activity duration
- General agreement w.r.t. activity sequencing
- Schedule criticity ⇢ # critical activities < 0.3 × # activities



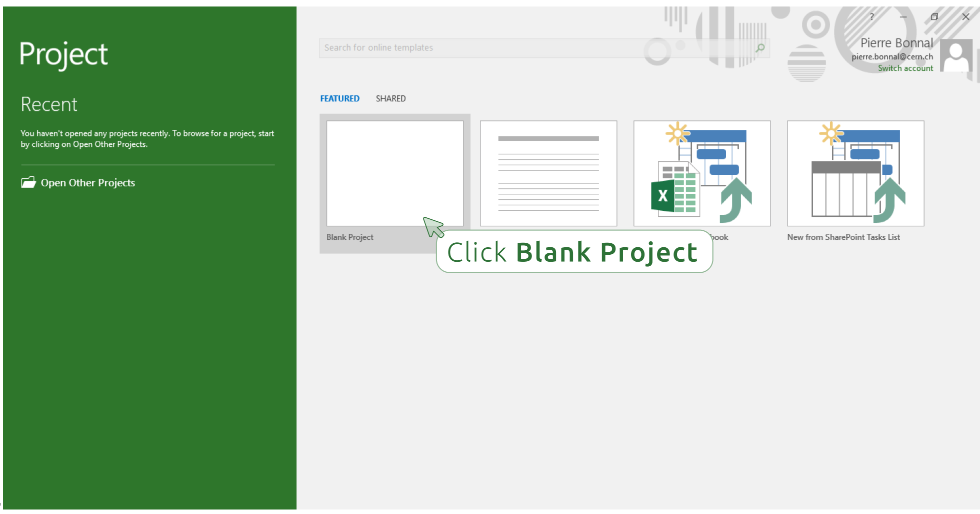
The CanNet Pilot Project 3.7 Microsoft Project



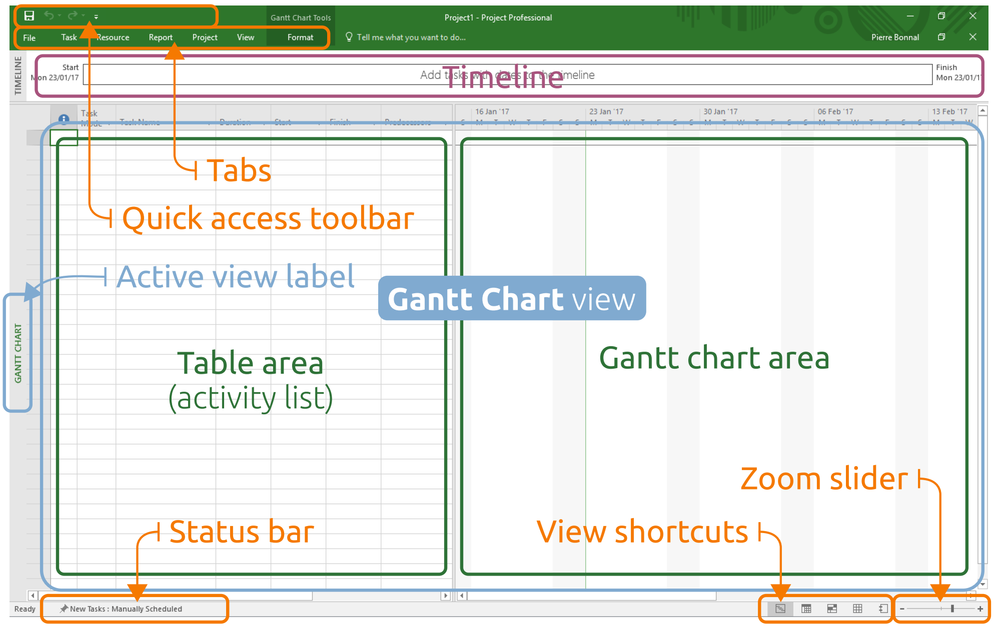
Launching the software

Windows 10 ▸ Start Menu ▸ Microsoft Office ▸ Microsoft Project

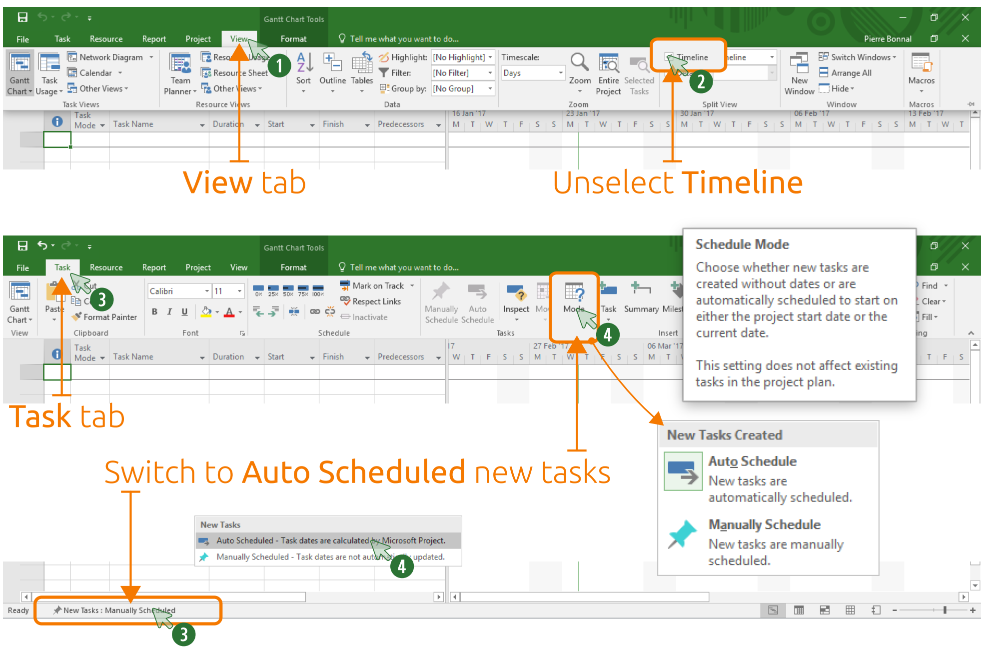
Mac OS X ▸ Launchpad ▸ Windows 10 Applications ▸ Microsoft Project



Getting familiar with Microsoft Project's interface



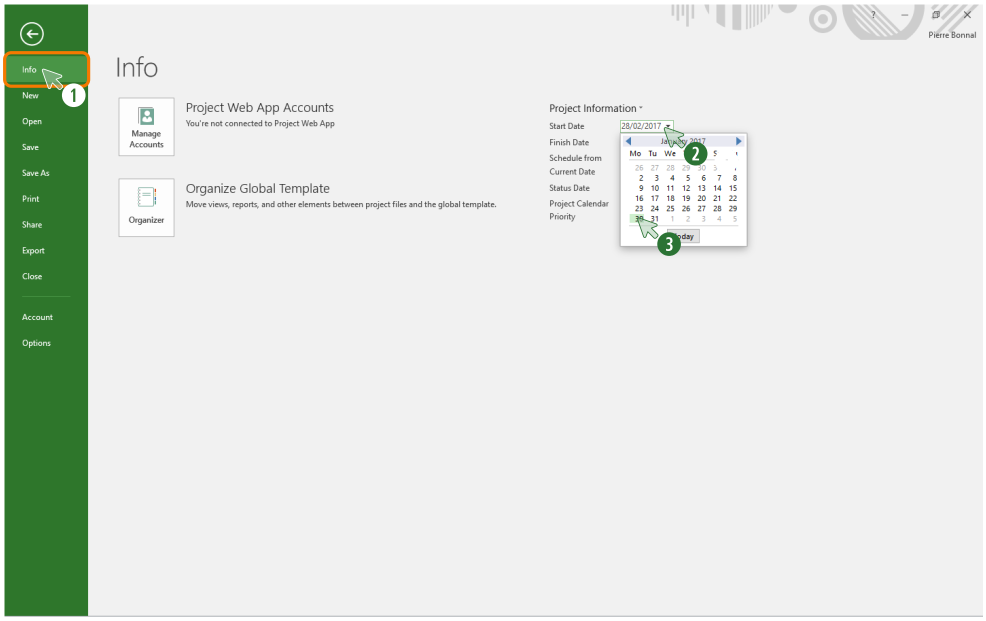
Setting up a *proper scheduling configuration*



3.4

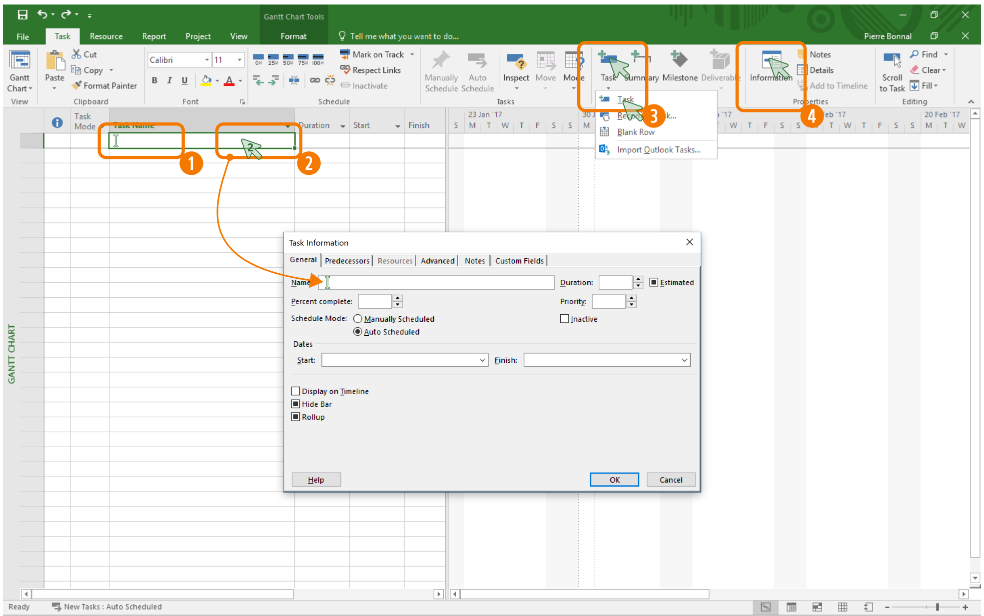
Setting the project start date

The project start date is a temporal constraint



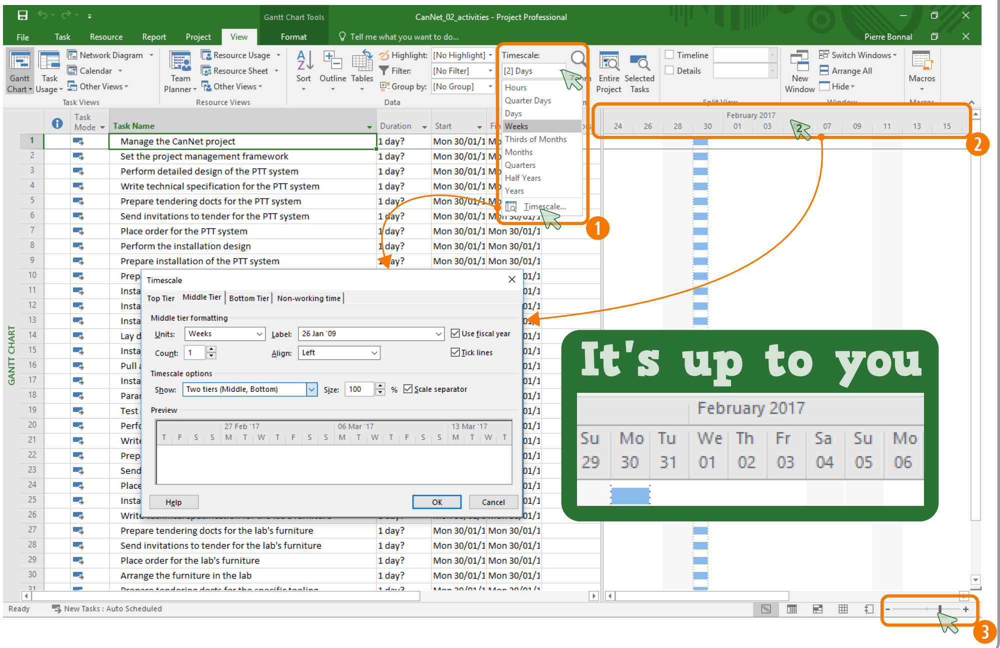
1.4

Entering and editing activity labels



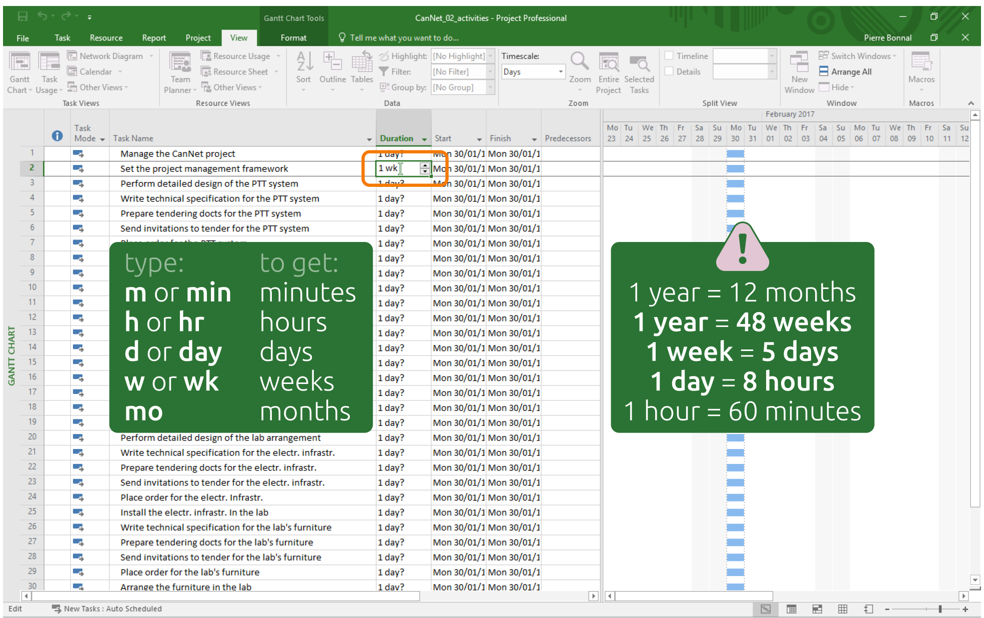
1.4

Adapting the Gantt view timescale



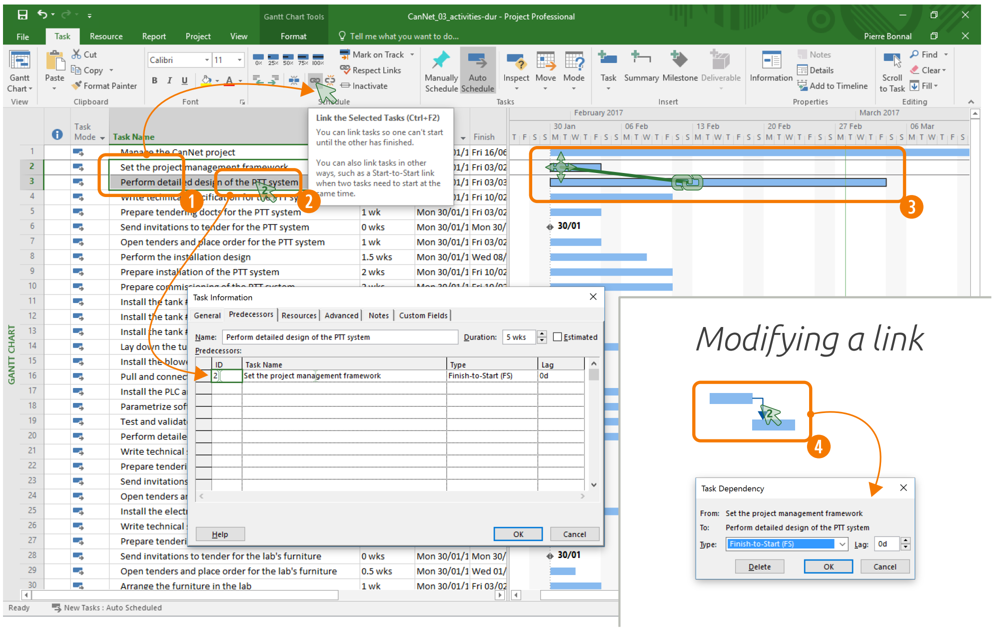
3.1

Entering and updating activity duration



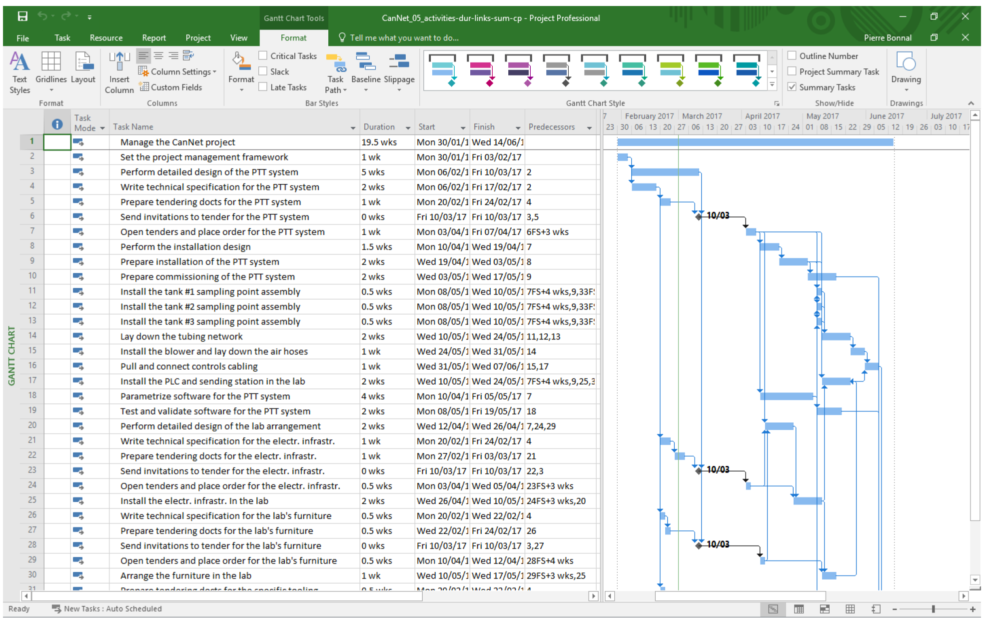
3.2

Defining technical constraints



3.5

Analysing the resulting schedule (before RCPS)



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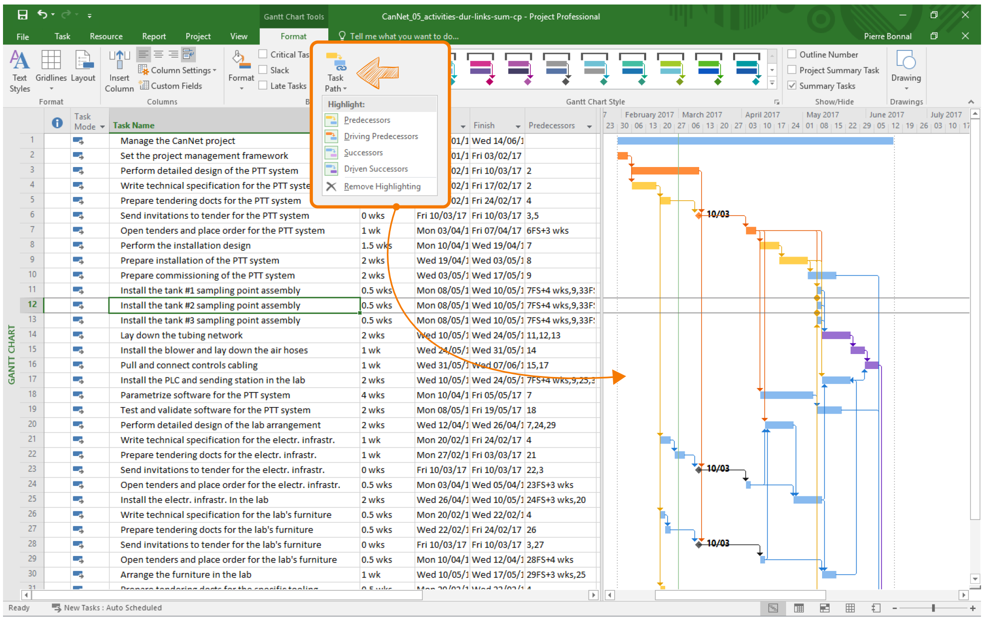

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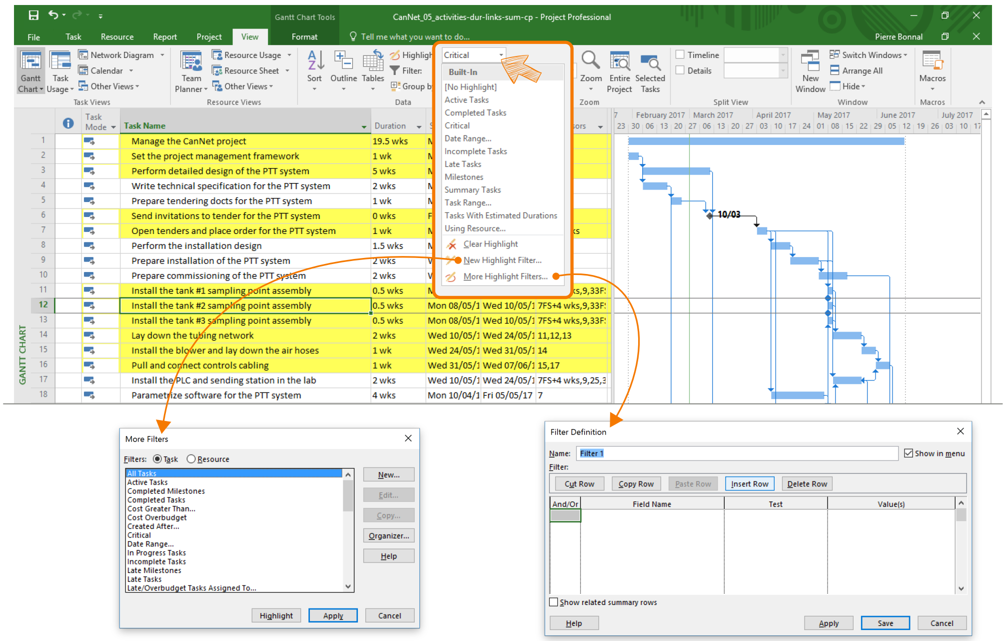

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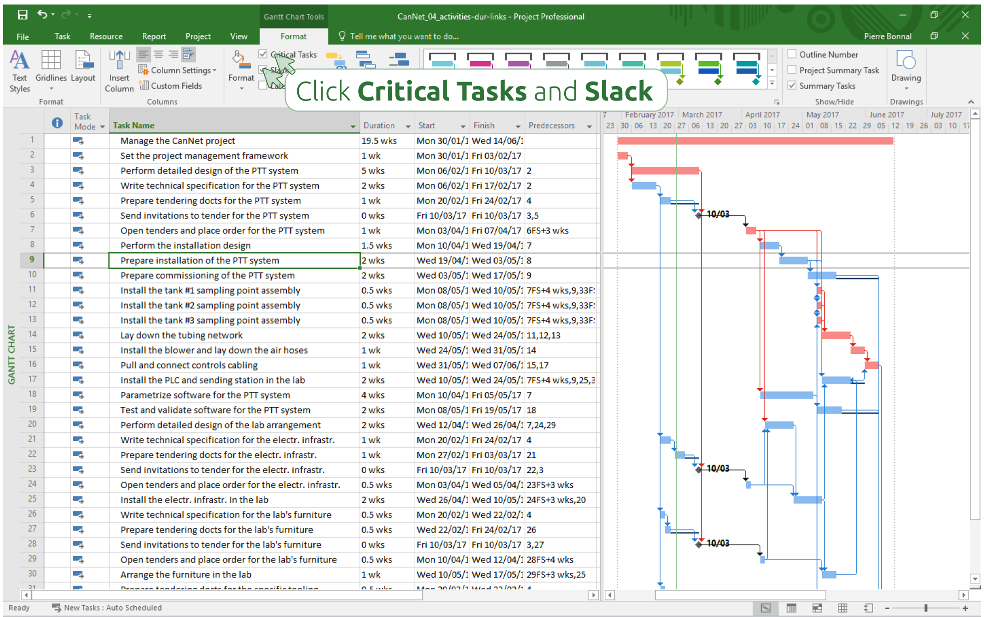

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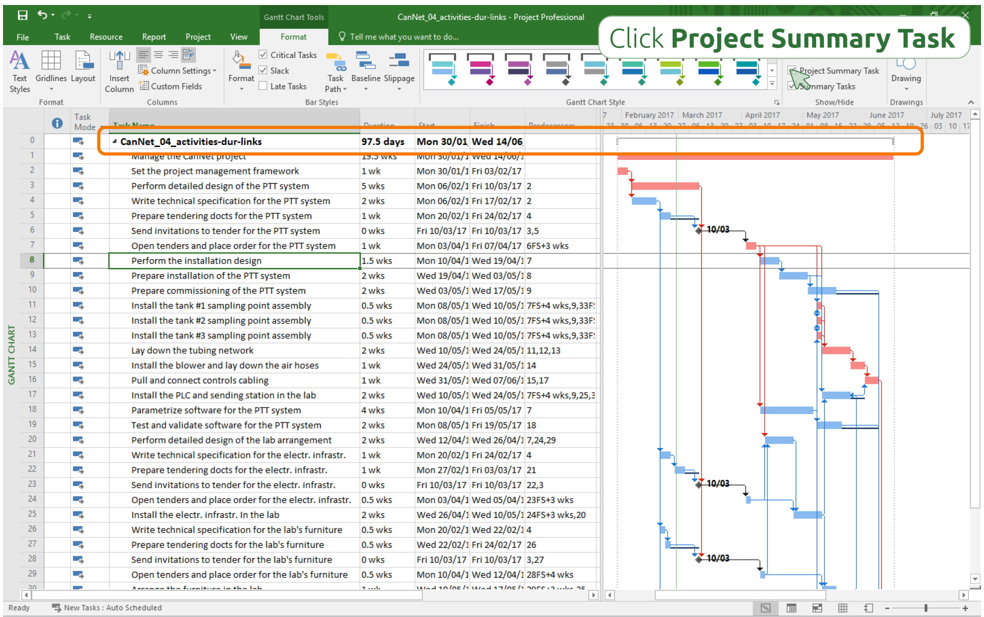
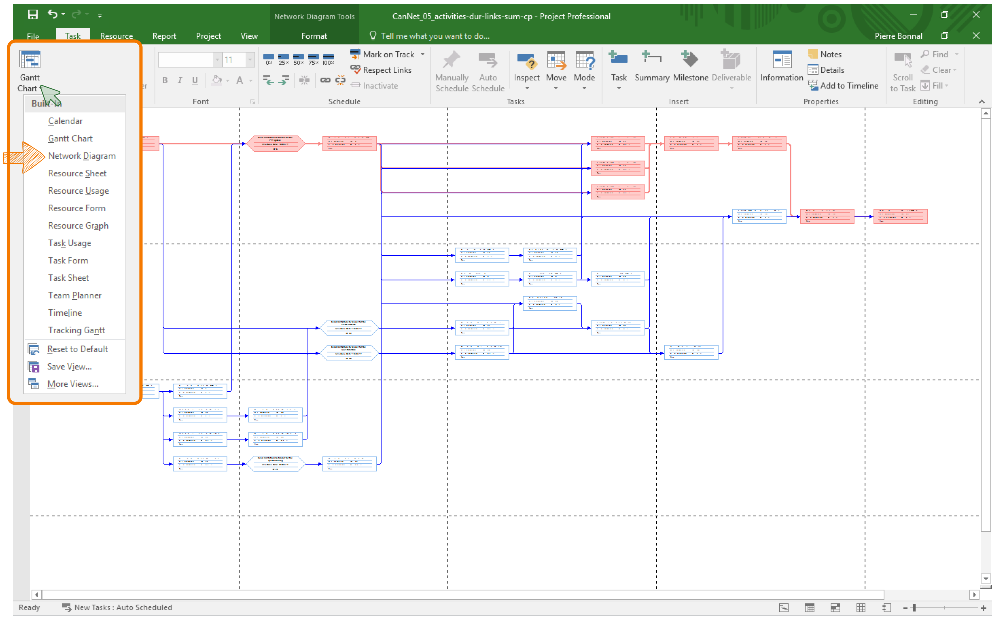
Analysing the resulting schedule (before RCPS)



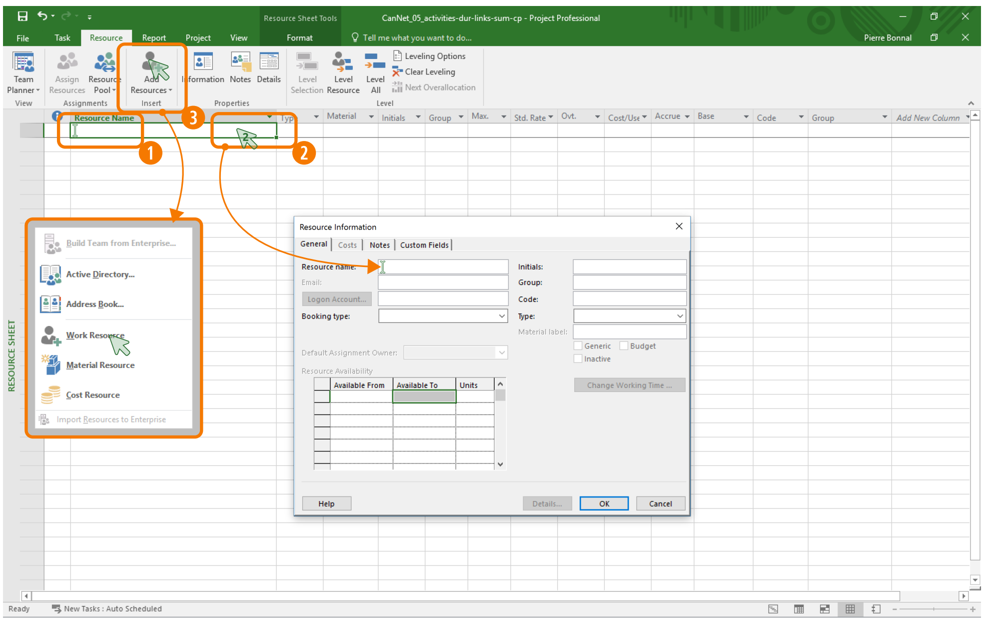
3.5

Analysing the resulting schedule (before RCPS)



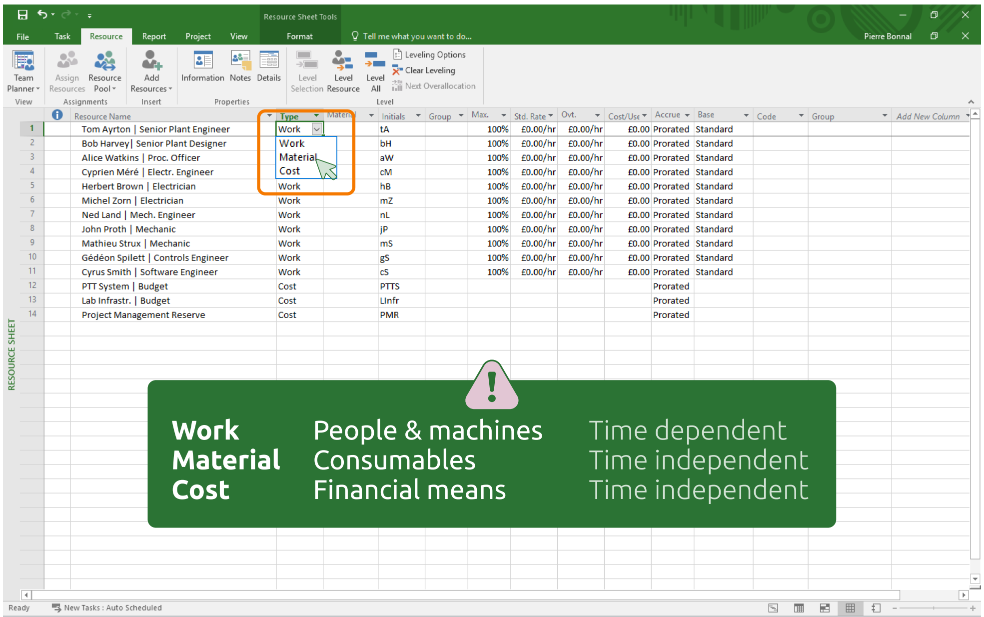
2.1

Entering and editing resources



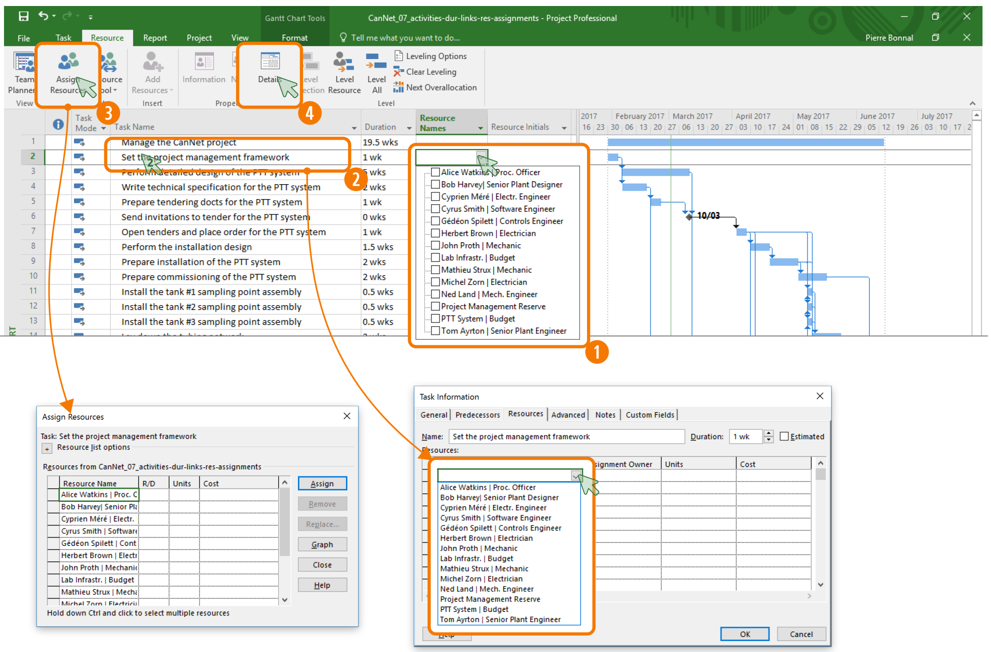
2.1

Entering and editing resources



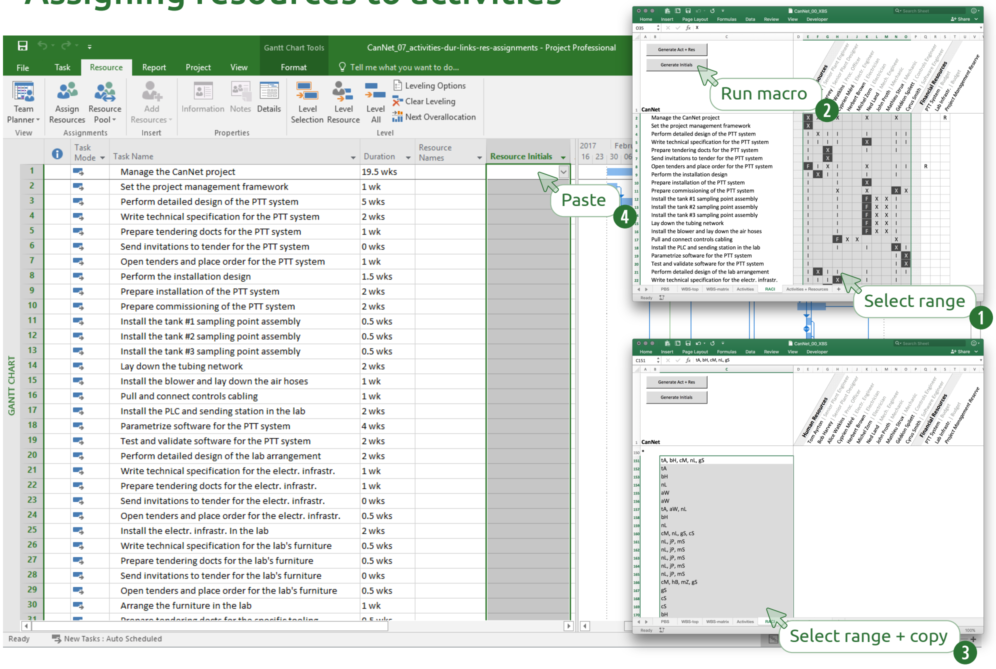
2.3

Assigning resources to activities



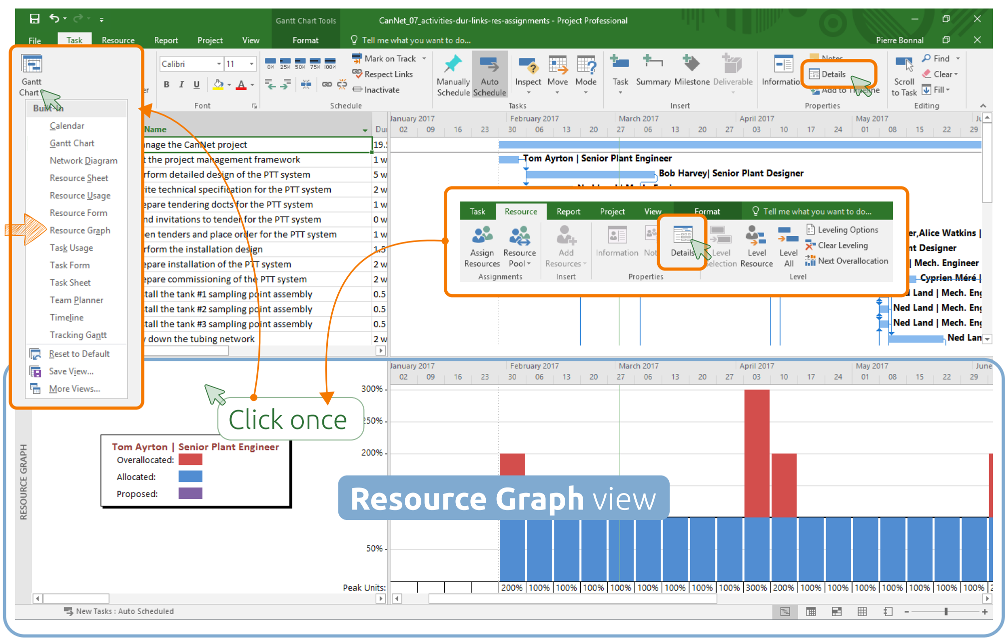
2.3

Assigning resources to activities



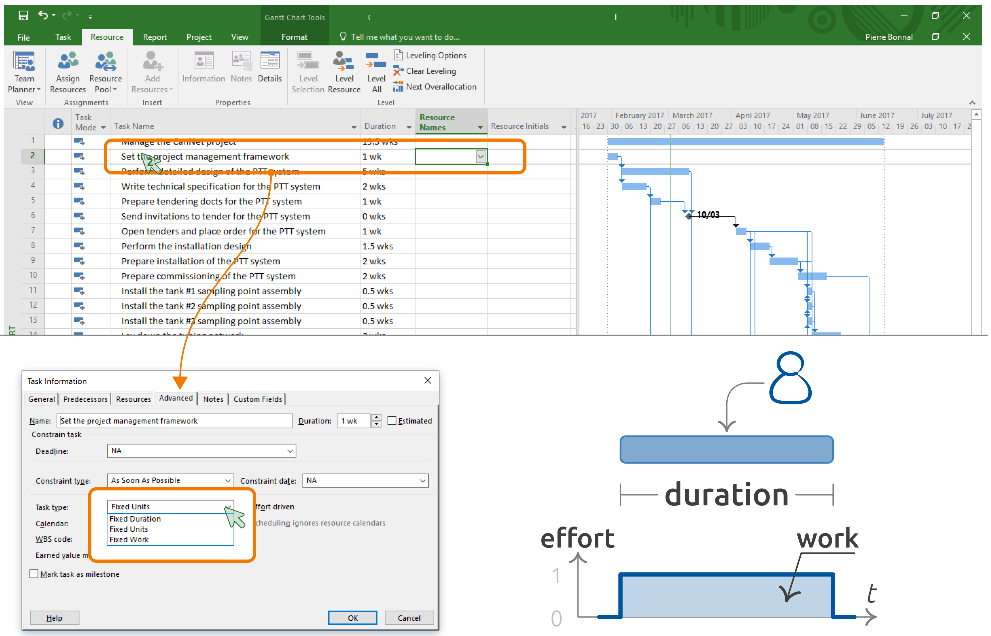
2.3

Assigning resources to activities



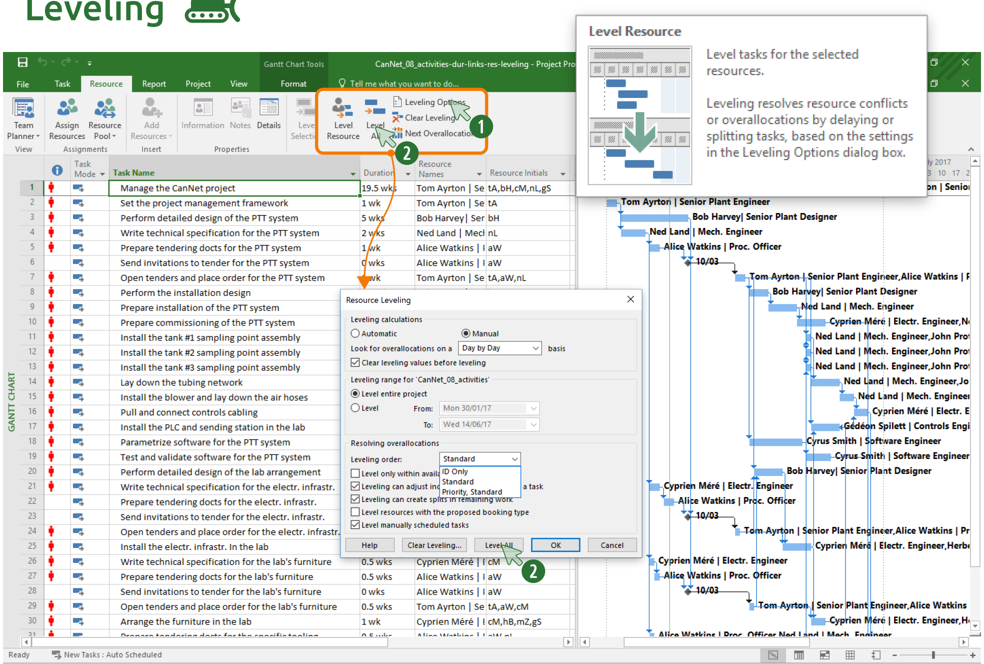
3.6

Before leveling



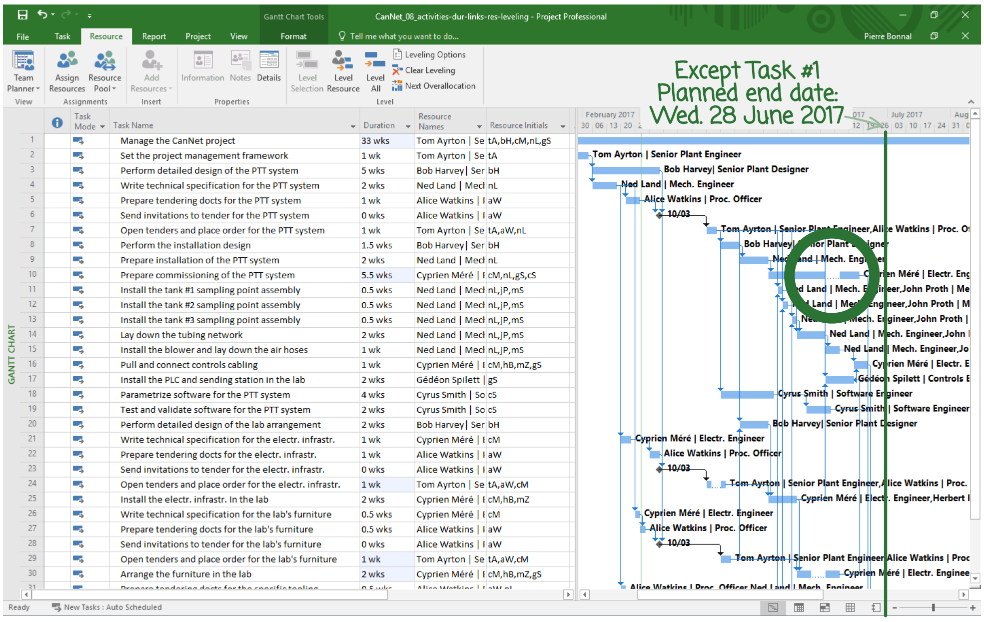
3.6

Leveling



3.6

Schedule analysis

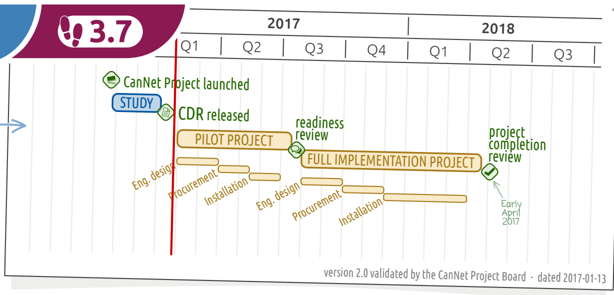


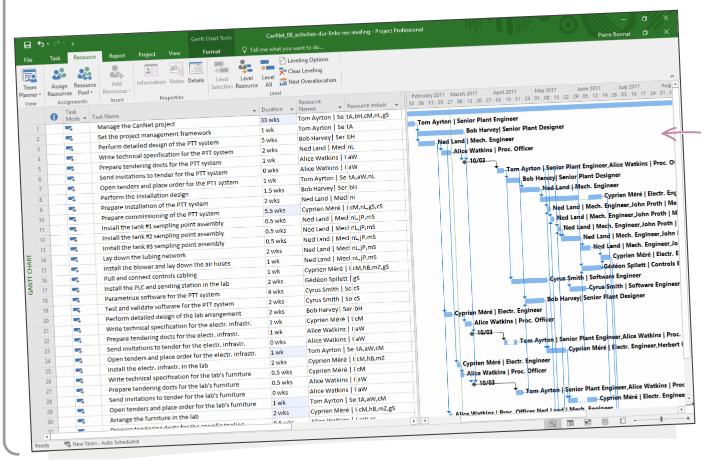
The CanNet Pilot Project

3.7

Project Master Schedule

Pilot Project makespan:
from end January (Monday of week 05)
to mid-July (Friday of week 28)





Coordination Schedule

Pilot Project makespan:
from early week 05
to mid week 26

Float = 29 - 26.5
= 2.5 wks

3.7

Baselining

Set Baseline

Take a snapshot of your schedule that includes information about tasks, resources, and assignments.

Compare multiple baselines to see how your project has changed over time.