



Project Scheduling

with  **Microsoft
Project 2016**



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

2

Scheduling the CanNet Project by hand





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, rinsed 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 project context (2)

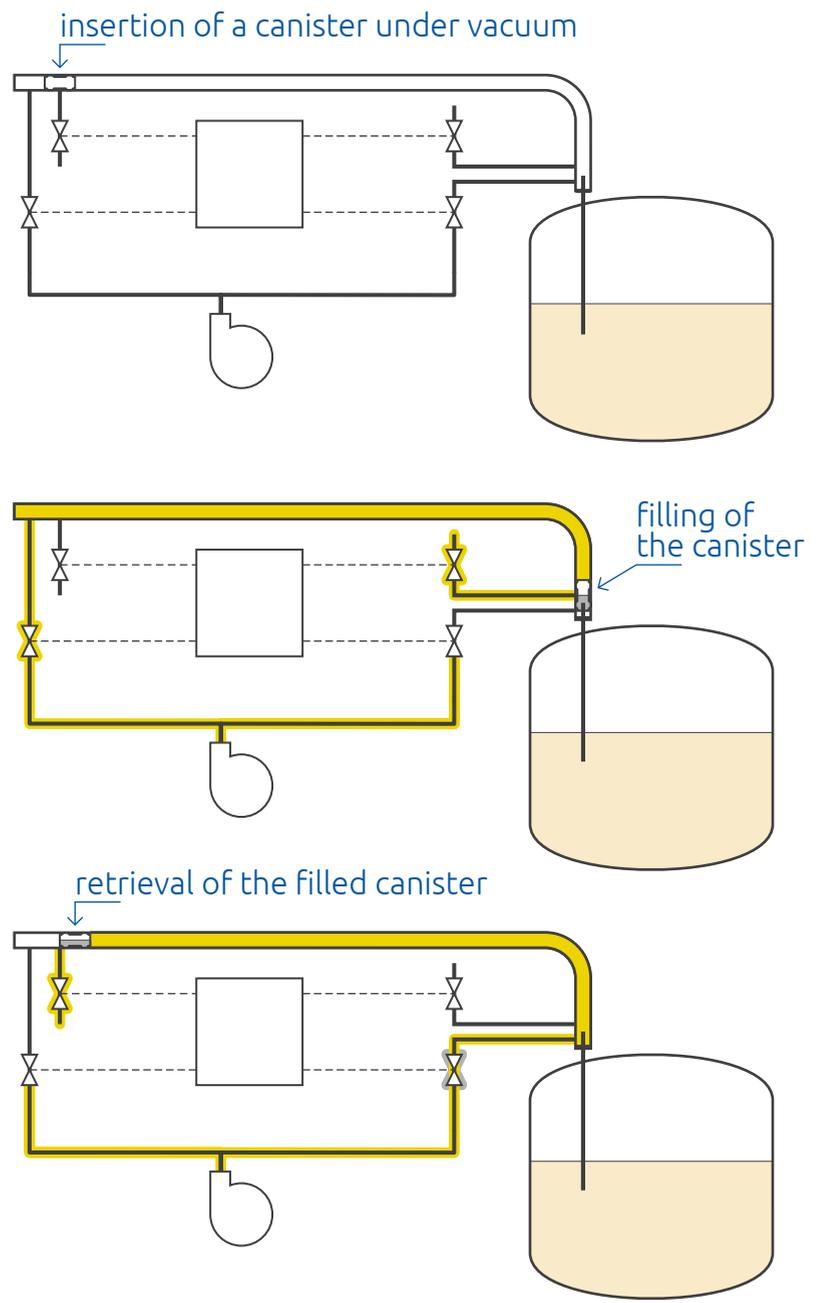
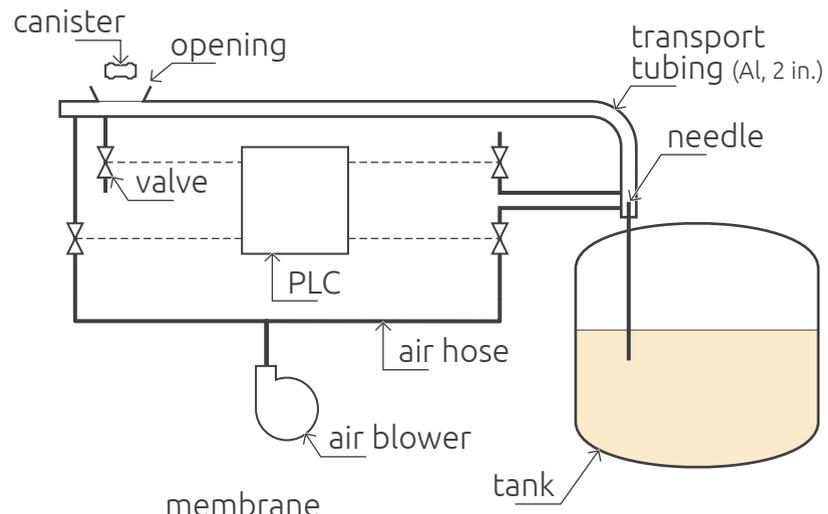
some possible solutions ③

- ➔ 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

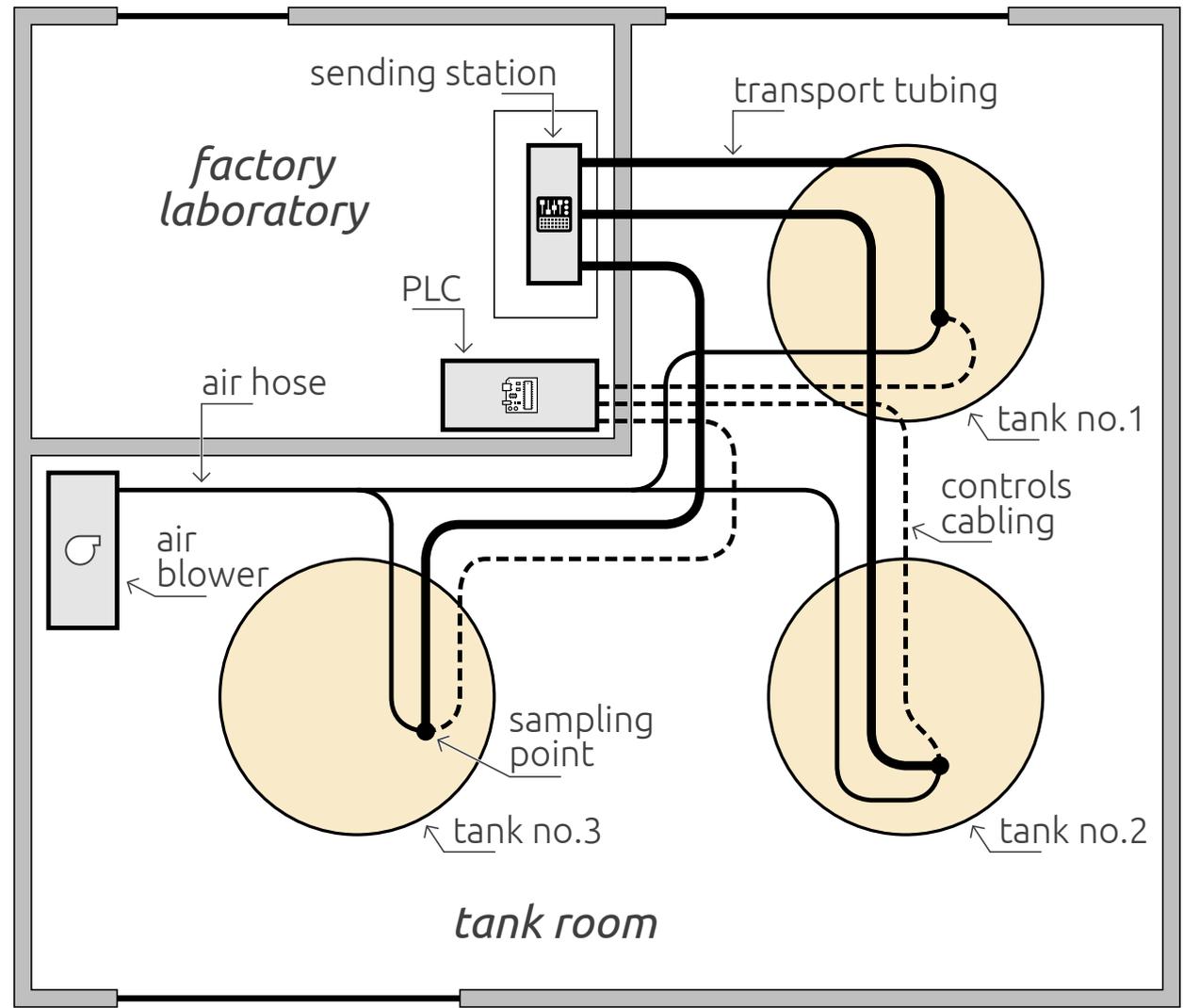
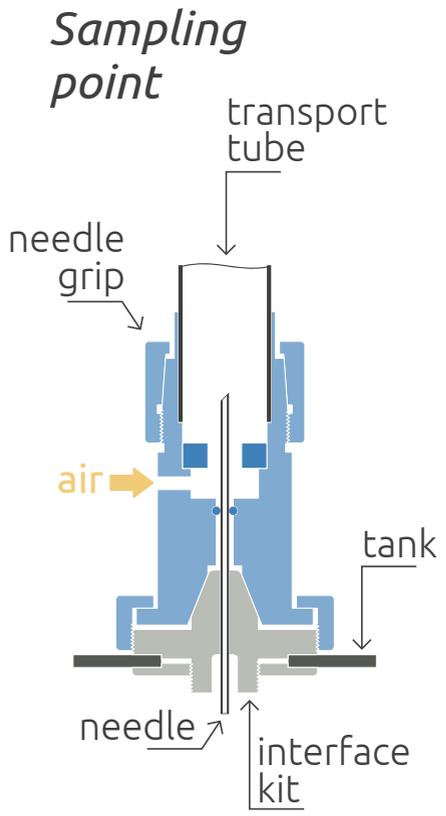
the preferred solution ④

- ➔ Its feasibility was demonstrated during the study phase ← 
- ➔ The initiative is named **CanNet** (canister network) 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

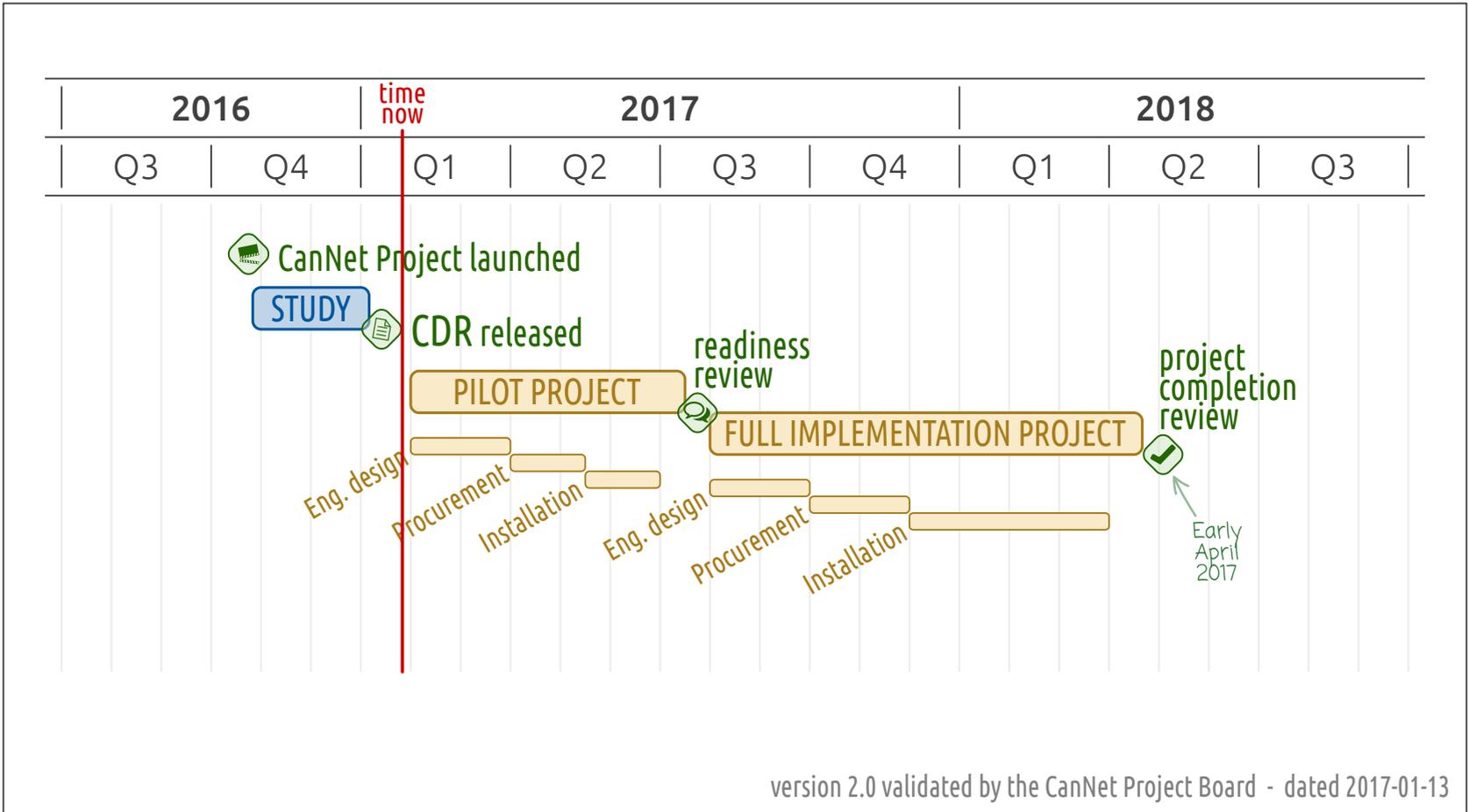
The process



The layout



The project master schedule



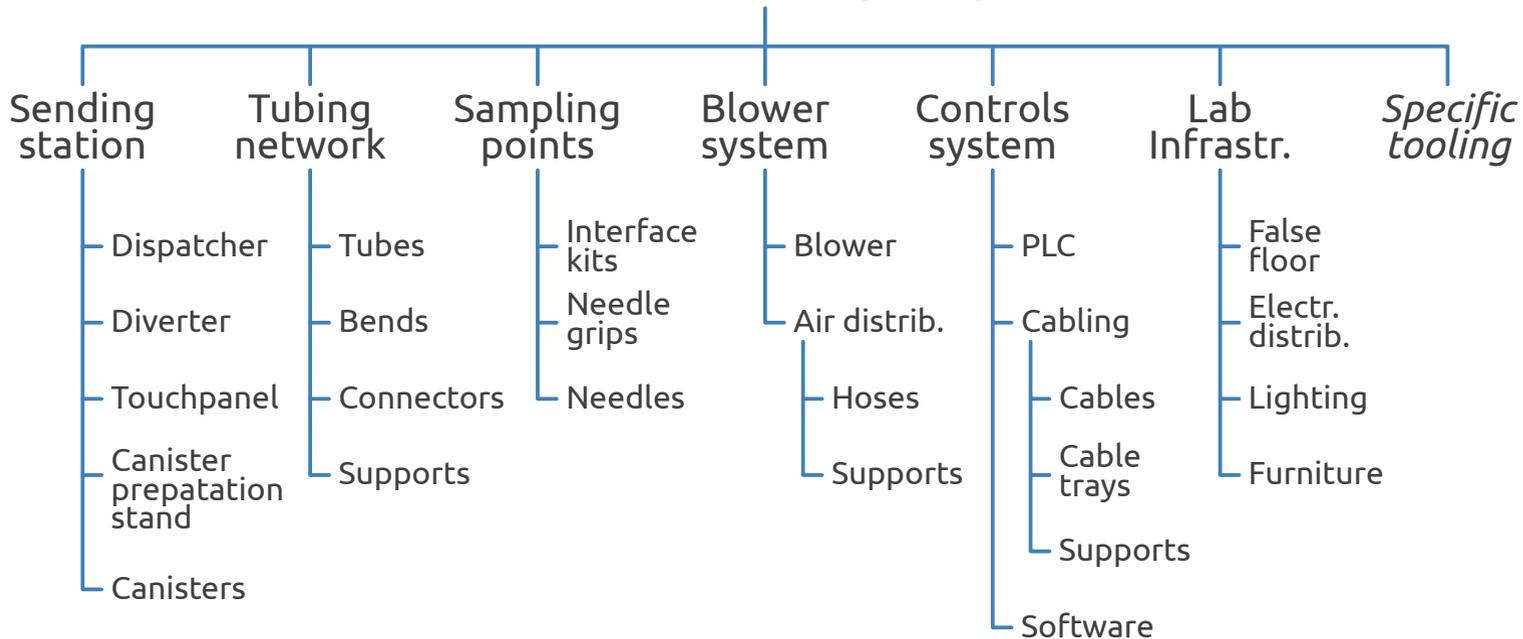
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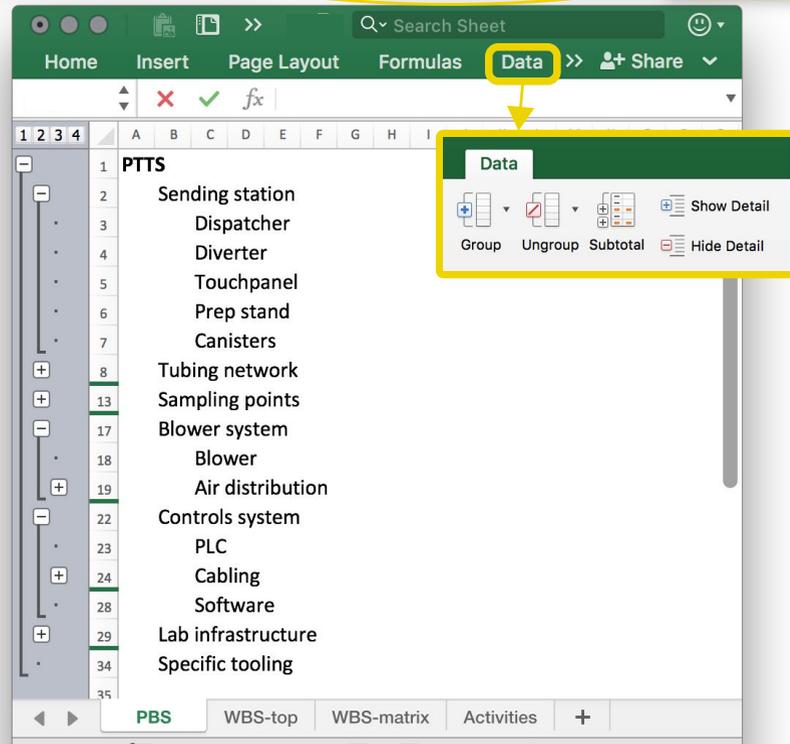
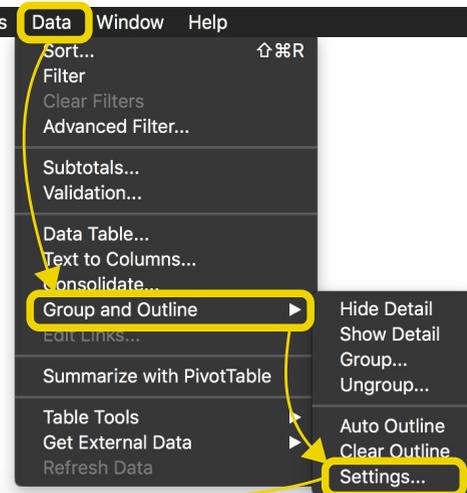
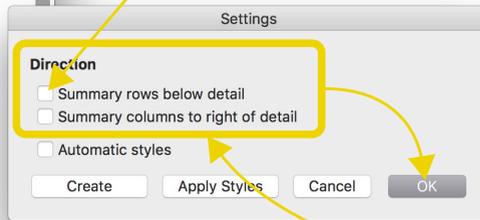
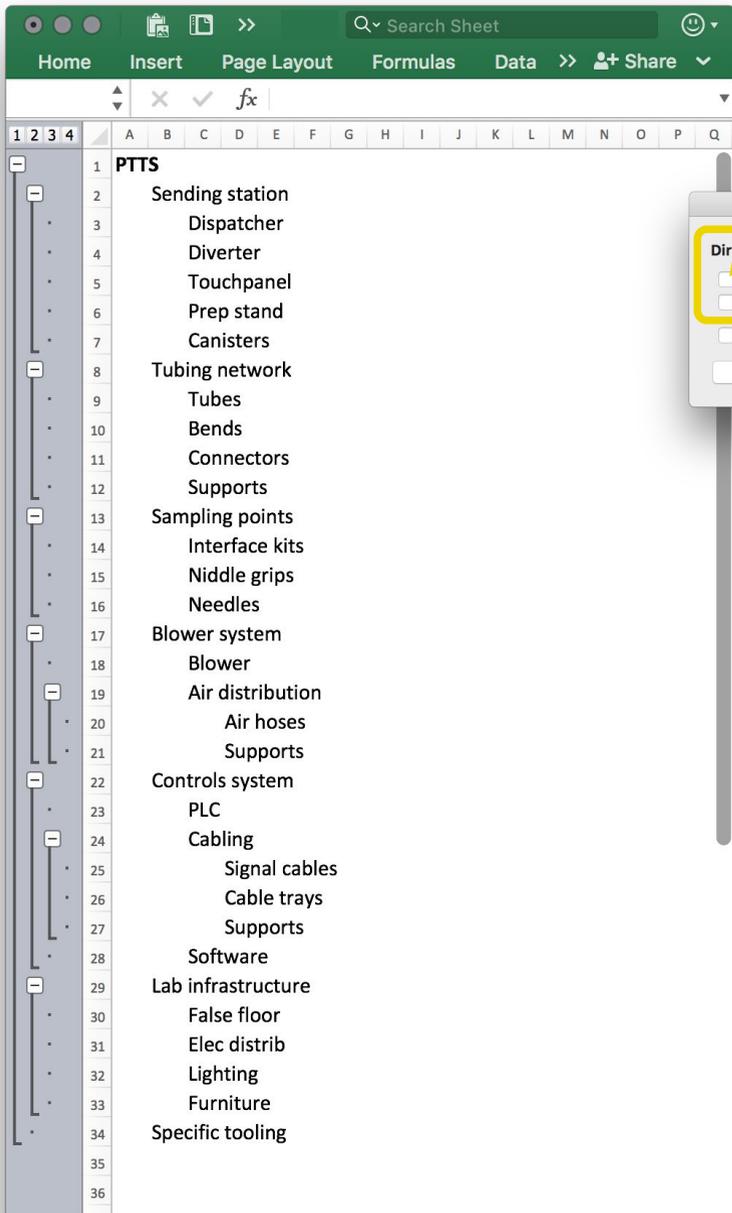
PBS, WBS and list of activities



Product Breakdown Structure (PBS)

OrgaDairy PTTS Pneumatic Tube Transport System





Row	Item
1	PTTS
2	Sending station
3	Dispatcher
4	Diverter
5	Touchpanel
6	Prep stand
7	Canisters
8	Tubing network
9	Tubes
10	Bends
11	Connectors
12	Supports
13	Sampling points
14	Interface kits
15	Niddle grips
16	Needles
17	Blower system
18	Blower
19	Air distribution
20	Air hoses
21	Supports
22	Controls system
23	PLC
24	Cabling
25	Signal cables
26	Cable trays
27	Supports
28	Software
29	Lab infrastructure
30	False floor
31	Elec distrib
32	Lighting
33	Furniture
34	Specific tooling

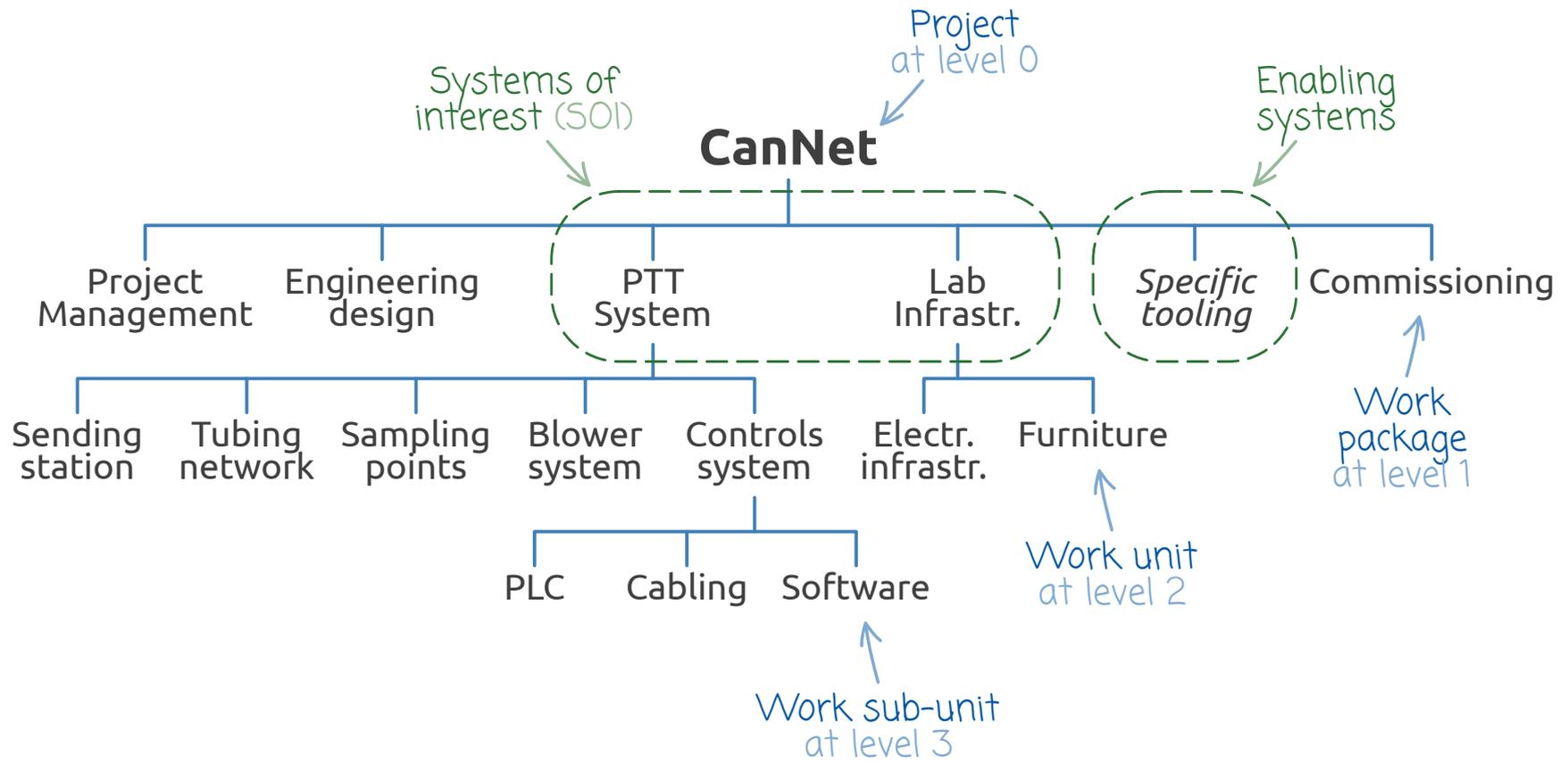
Row	Item
1	CanNet
2	Project management
3	Engineering design
4	PTT System
5	Sending station
6	Tubing network
7	Sampling points
8	Blower system
9	Controls system
10	PLC
11	Cabling
12	Software
13	Lab infrastructure
14	Electr. infrastr.
15	Furniture
16	Specific tooling
17	Commissioning

becomes
simplified

← added

← added

Work Breakdown Structure (WBS)





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 docs
- Award contract/place order
- Develop/parametrize software
- Test/validate software
- Prepare construction/installation
- Prepare commissioning/acceptance
- Construct/install
- Commission/perform acceptance

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

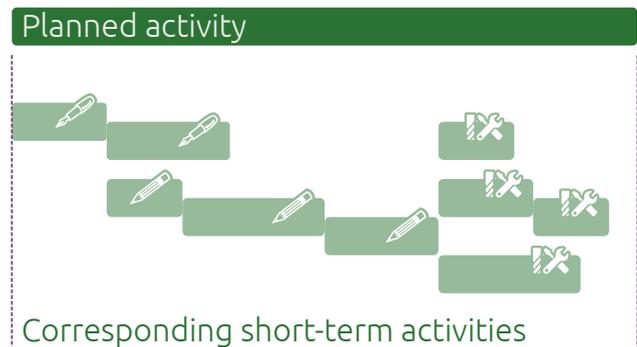
Activity vs. Planned Activity

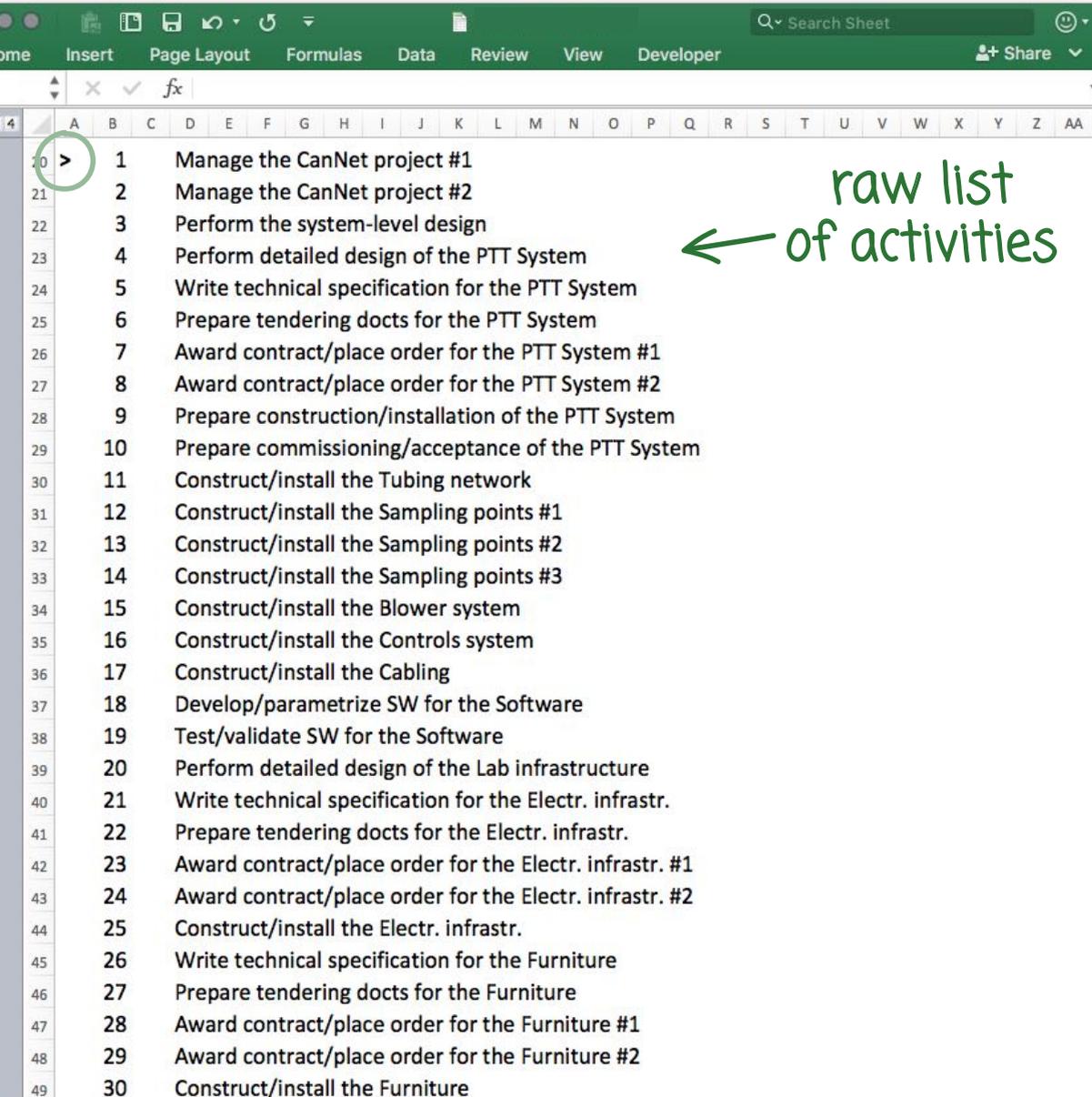
The **ANSI #748** project management standard for reporting distinguishes two types of activities:

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

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

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





	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
10	'>	1																									
21		2																									
22		3																									
23		4																									
24		5																									
25		6																									
26		7																									
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42		23																									
43		24																									
44		25																									
45		26																									
46		27																									
47		28																									
48		29																									
49		30																									

raw list
← of activities

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

List of activities (LoA) with adjusted 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

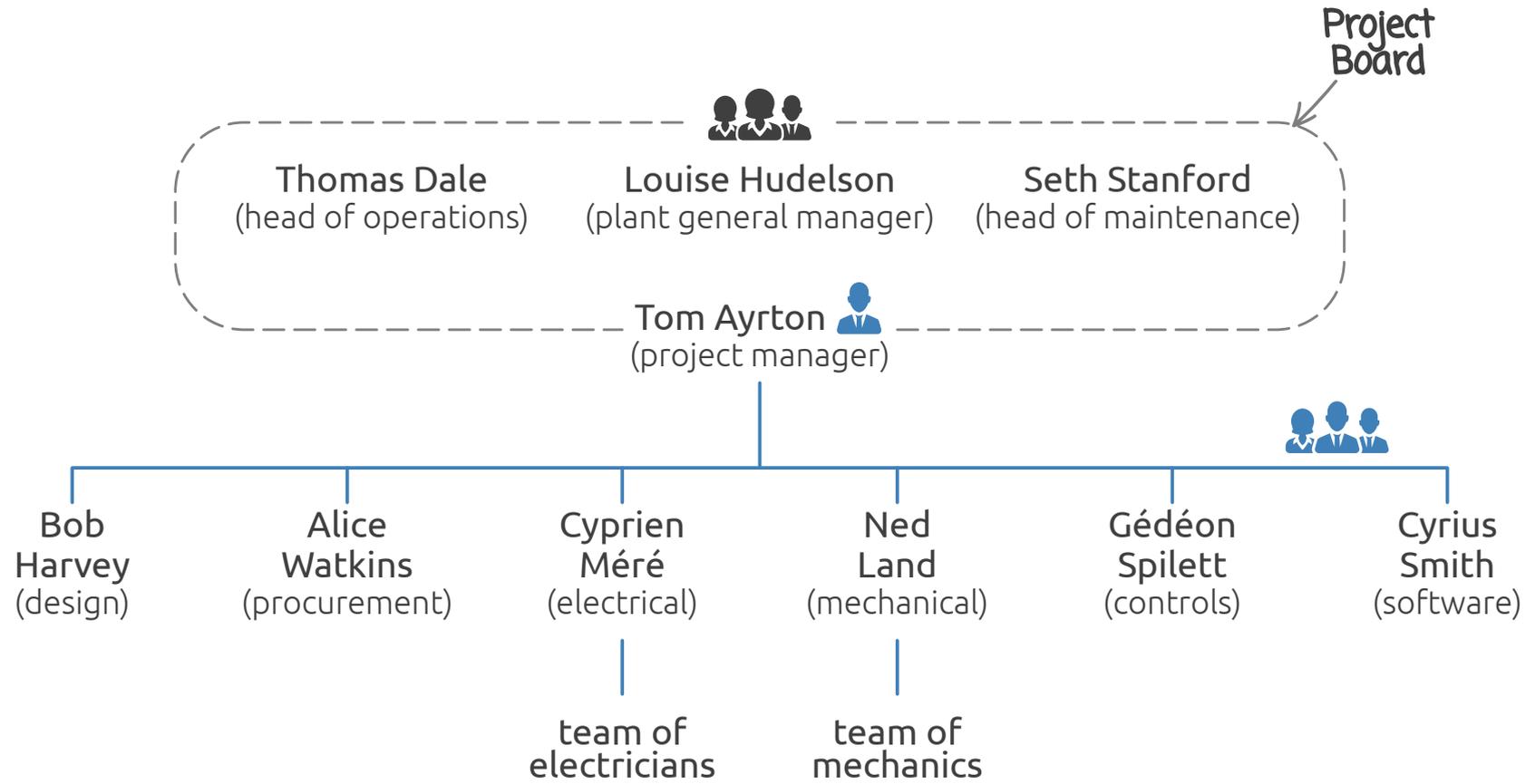
Debug and commission the pilot PTT system

2.2

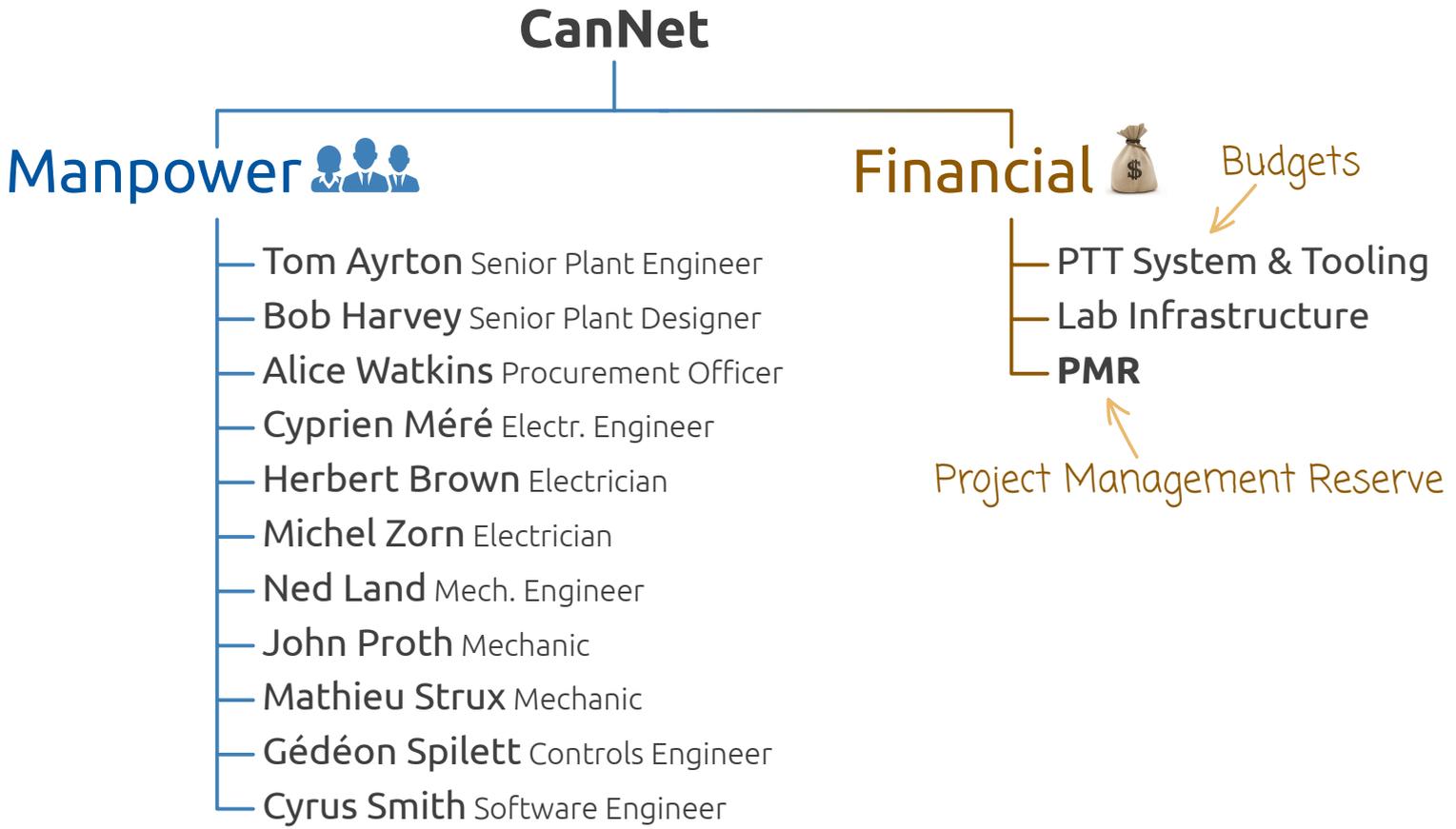
OBS, RBS and RACI matrix



Organisational Breakdown Structure (OBS)



Resource Breakdown Structure (RBS)



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V			
	<div style="border: 1px solid black; padding: 5px; width: fit-content;">Generate Act + Res</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-top: 10px;">Generate Initials</div> <p style="font-size: 2em; color: green; margin-top: 20px;">RACI matrix</p> <p style="font-size: 2em; color: green; margin-top: 10px;">RBS</p> <p style="font-size: 2em; color: green; margin-top: 10px;">list of activities</p>			<p style="font-size: 1.2em; color: green; transform: rotate(-45deg);">Human Resources</p> <p style="font-size: 1.2em; color: green; transform: rotate(-45deg);">Financial Resources</p>	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 Spillett Controls Engineer	Cyrus Smith Software Engineer	PTT System Budget	Lab Infrastr. Budget	Project Management Reserve							
1	CanNet																								
2	Manage the CanNet project			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													

legend

Executes

Follows up

Is informed

Provide help

Is required

Is responsible

Excel interface showing a project plan with activities and resources.

Buttons: Generate Act + Res, Generate Initials

Activity List (Rows 30-50):

- 30 Open tenders and place order for the lab's furniture
- 31 Arrange the furniture in the lab
- 32 Prepare tendering docs for the specific tooling
- 33 Send invitations to tender for the specific tooling
- 34 Open tenders and place order for the specific tooling
- 35 Debug and commission the pilot PTT system
- 37 >
- 38 a Manage the CanNet project
 - 39 r Tom Ayrton | Senior Plant Engineer
 - 40 r Bob Harvey | Senior Plant Designer
 - 41 r Cyprien Méré | Electr. Engineer
 - 42 r Ned Land | Mech. Engineer
 - 43 r Gédéon Spilett | Controls Engineer
 - 44 r Project Management Reserve
- 45 a Set the project management framework
 - 46 r Tom Ayrton | Senior Plant Engineer
- 47 a Perform detailed design of the PTT system
 - 48 r Bob Harvey | Senior Plant Designer
- 49 a Write technical specification for the PTT system
 - 50 r Ned Land | Mech. Engineer

Resource List (Columns D-V):

- 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 | Controls Engineer, Gédéon Spilett | Software Engineer, Cyrus Smith | Budget
- Financial Resources:** PTT System | Budget, Lab Infrastr. | Budget, Project Management Reserve

Activity-Resource Matrix (Rows 30-35):

Activity	Tom Ayrton	Bob Harvey	Alice Watkins	Cyprien Méré	Herbert Brown	Michel Zorn	Ned Land	John Proth	Mathieu Strux	Gédéon Spilett	Cyrus Smith	PTT System	Lab Infrastr.	Project Management Reserve
30 Open tenders and place order for the lab's furniture	F	I	X	X				I						R
31 Arrange the furniture in the lab	I			F	X	X				X				
32 Prepare tendering docs for the specific tooling	I		X					X						
33 Send invitations to tender for the specific tooling	I		X											
34 Open tenders and place order for the specific tooling	I		X				X						R	
35 Debug and commission the pilot PTT system	F				X		X		X	X				

← list of activities & resources

2.3

Duration Estimates

 3.1

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!

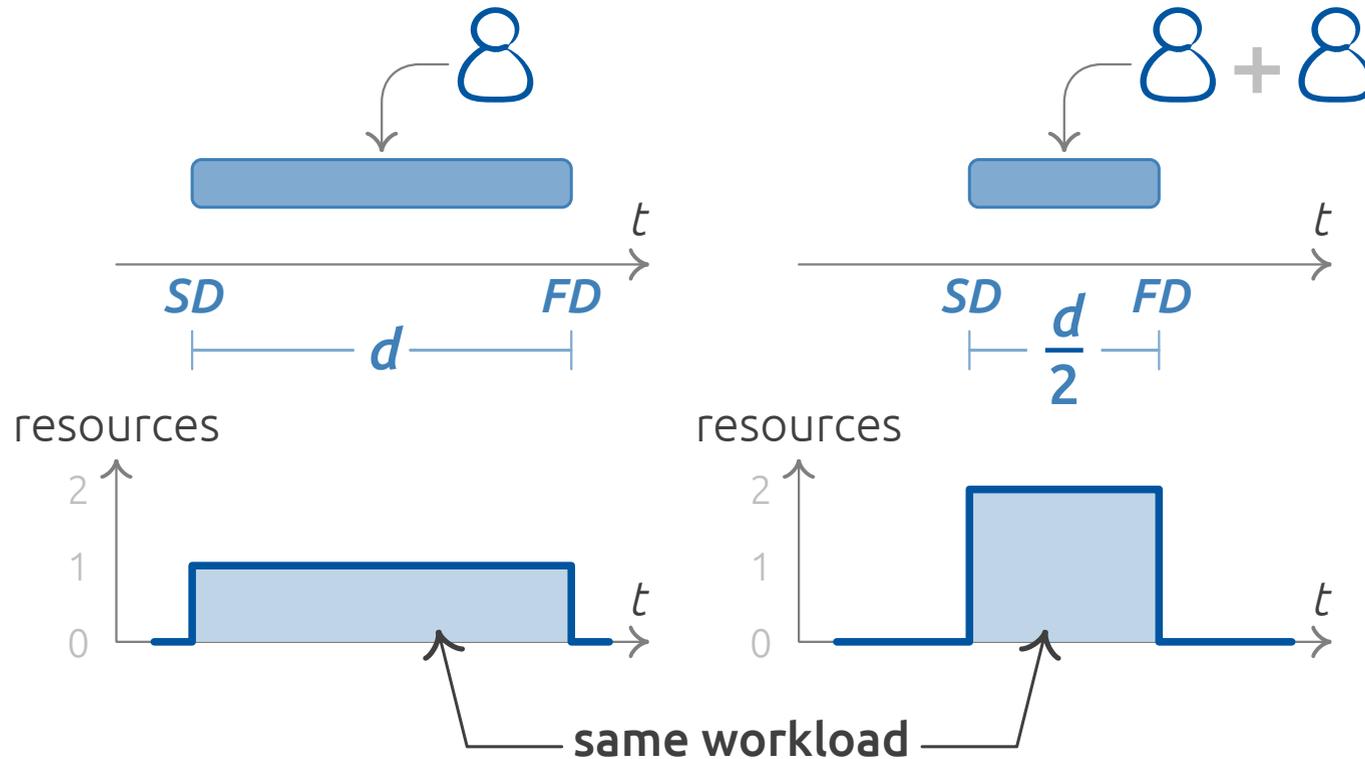
→ No more than **5%** to **10%** of the project duration

→ 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  **#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

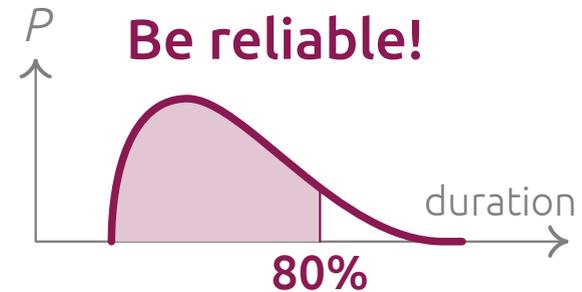
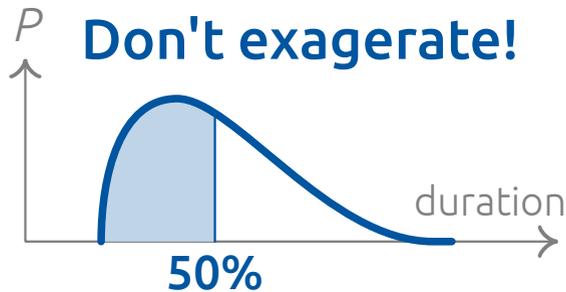
professional
knowledge
database

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

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

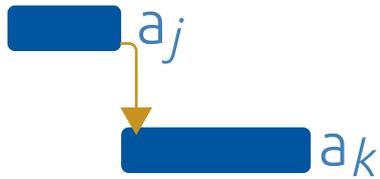
2.4

Technical Constraints + Loops

 3.2

 3.3

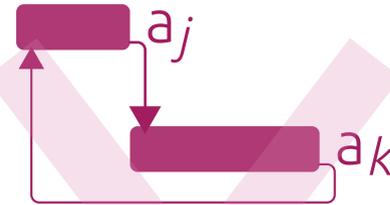
Technical Constraints



	a_j	a_k
a_j		
a_k	x	

Precedence Matrix

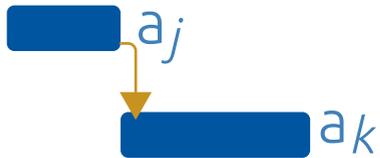
ATTENTION
The activity net shall be free of loops!



	a_j	a_k
a_j		x
a_k	x	

Technical Constraints

finish-start



start-start



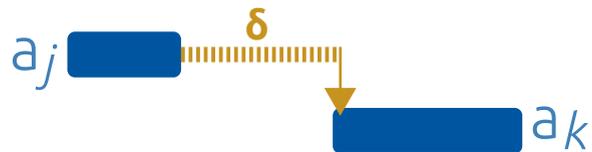
finish-finish



start-finish



positive lag



negative lag



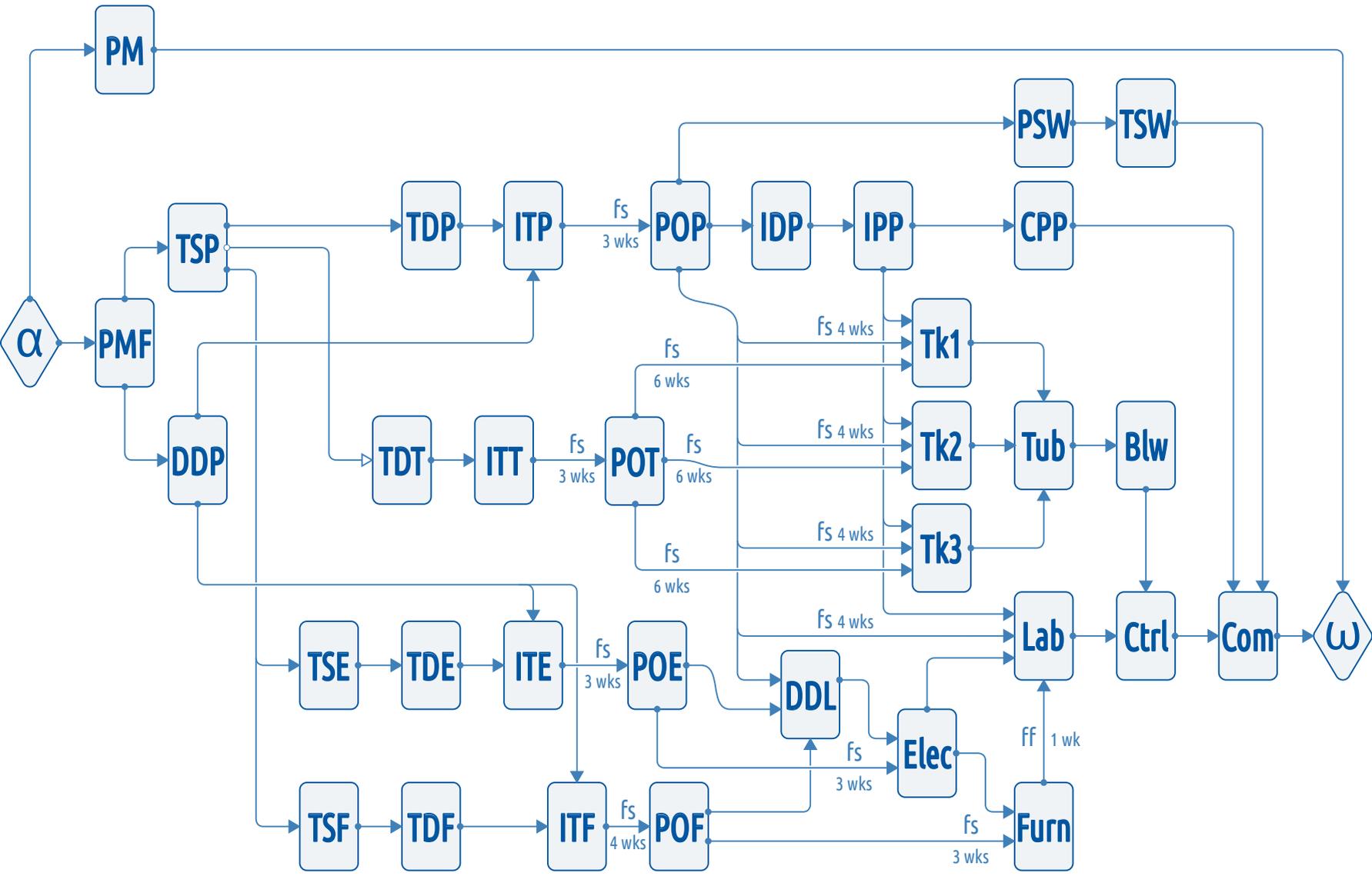
List of activities (**LoA**) + duration estimates [weeks] + predecessors

α ← project start node

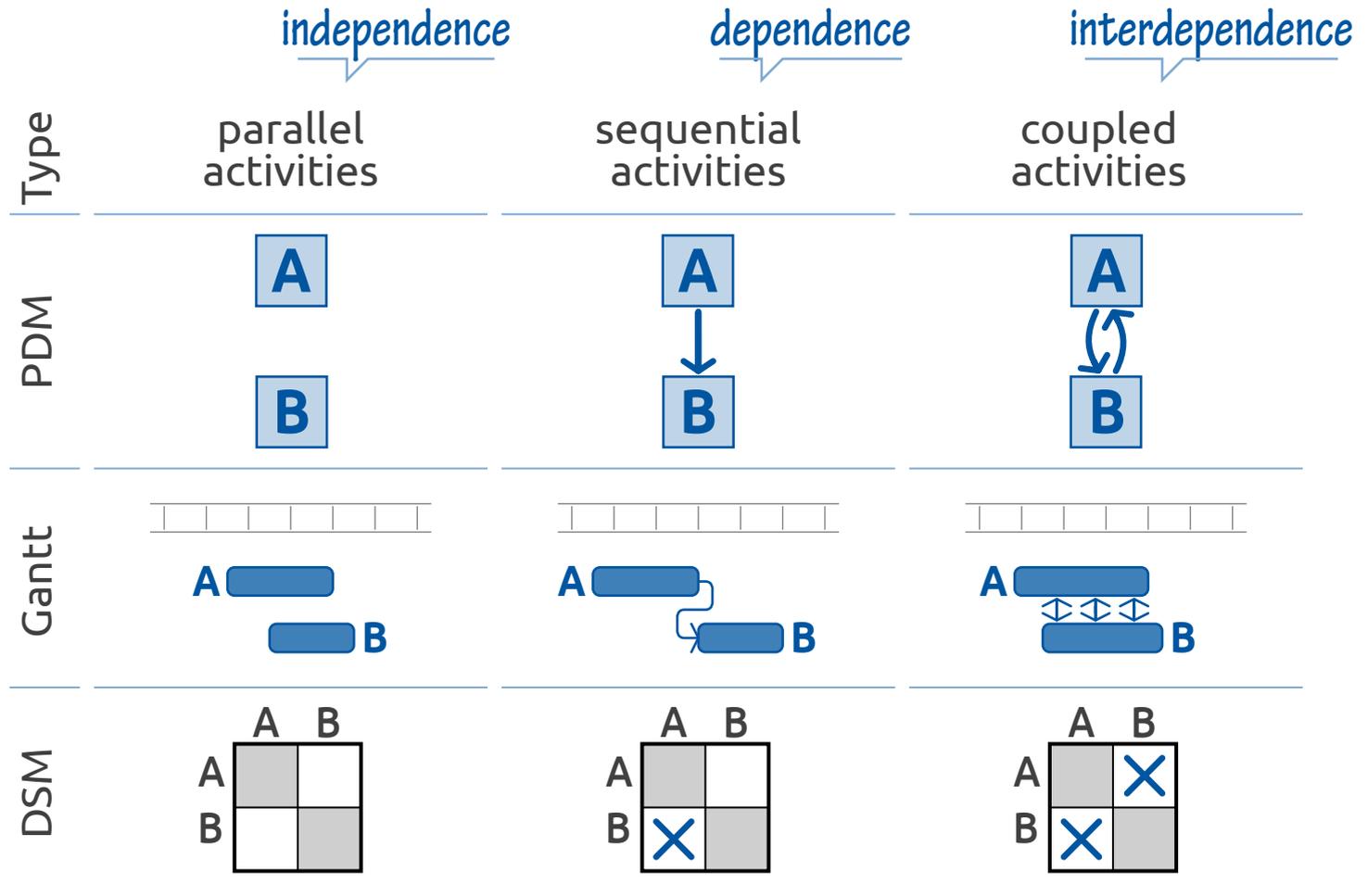
Activity	Predecessors	LoE
PM	α	
PMF	α	1
DDP	sPMF	5
TSP	PMF	2
TDP	TSP	1
ITP	DDP, TDP	0
POP	ITP f_s+3 wks	1
IDP	POP	1.5
IPP	IDP	2
CPP	IPP	2
Tk1	POP f_s+4 wks, IPP, POT f_s+6 wks	0.5
Tk2	POP f_s+4 wks, IPP, POT f_s+6 wks	0.5
Tk3	POP f_s+4 wks, IPP, POT f_s+6 wks	0.5
Tub	Tk1, Tk2, Tk3	2
Blw	Tub	1
Ctrl	Blw,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

← project finish node



Design Structure Matrix



2.5

also referred to as
Time Constraints

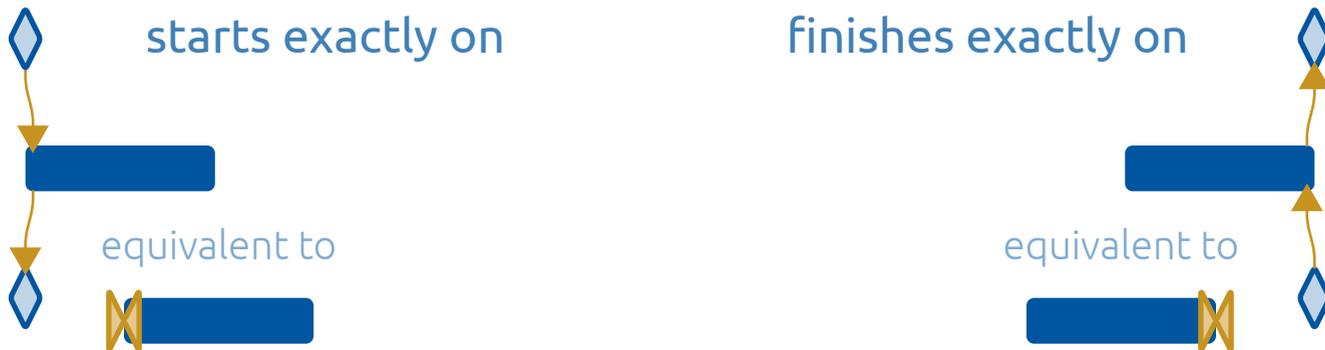
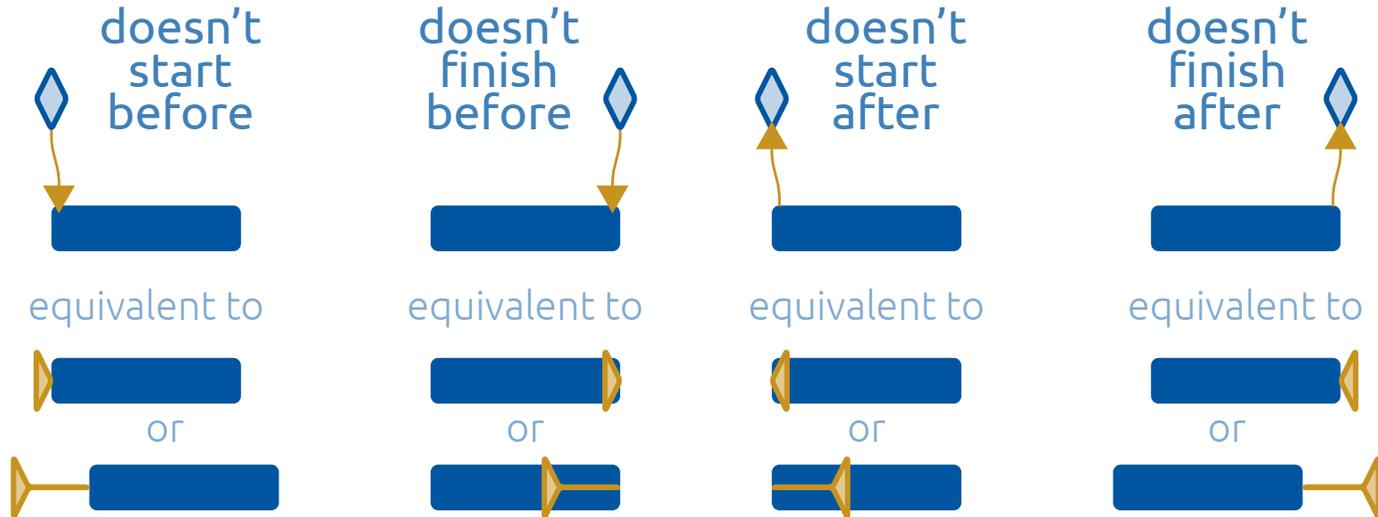


Temporal Constraints + Calendars

 3.4

PDM Scheduling

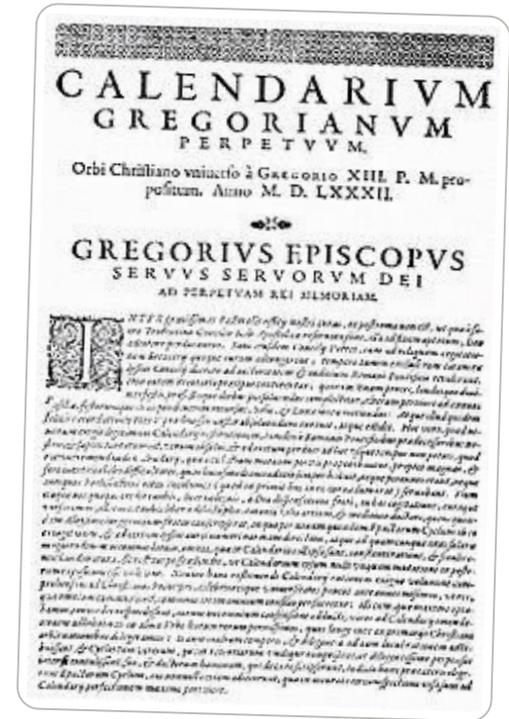
Six possible temporal constraints



Calendars

The Gregorian Calendar and the calendar handling issue

- ➔ 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

2.6

Precedence
Diagramming
Method



PDM Scheduling

 3.5

PDM Scheduling

- ➔ A given **set of activities**: $A = \{ a_1, a_2, \dots, a_n \}$
- ➔ 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

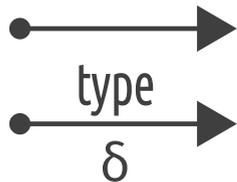
“a PDM convention”

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!
$E_\omega (L_\omega)$	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

- 1 Calculation of the **earliest dates** by propagation (**forward pass**) from left to right
- 2 Calculation of the **latest dates** by propagation (**backward pass**) from right to left
- 3 Calculation of the **total floats** and **free floats**

The CPM algorithm

$E_\alpha \leftarrow$ Project start date

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

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

$$ES_j \leftarrow \begin{cases} E_\alpha & \text{if } \Gamma_j^{-1} = \emptyset \\ \max_{k \in \Gamma_j^{-1}} \{ES_k + DUR_k\} & \text{otherwise} \end{cases}$$

$L_\omega \leftarrow E_\omega$

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

$$LF_j \leftarrow \begin{cases} L_\omega & \text{if } \Gamma_j = \emptyset \\ \min_{k \in \Gamma_j} \{LF_k - DUR_k\} & \text{otherwise} \end{cases}$$

$TF_j \leftarrow LF_j - EF_j$

$FF_j \leftarrow \min_{k \in \Gamma_j} \{ES_k\} - EF_j$

PDM Scheduling

The real PDM algorithm!

$E_\alpha \leftarrow$ Project start date

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

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

$$ES_j \leftarrow \begin{cases} E_\alpha & \text{if } \Gamma_j^{-1} = \emptyset \\ \max_{k \in \Gamma_j^{-1}} \{ \bullet \} & \text{otherwise} \end{cases}$$

$$ES_k + DUR_k + LAG_{kj} \text{ if } \sigma_{kj} = "FS"$$

$$ES_k + LAG_{kj} \text{ if } \sigma_{kj} = "SS"$$

$$ES_k - DUR_j + LAG_{kj} \text{ if } \sigma_{kj} = "SF"$$

$$ES_k + DUR_k - DUR_j + LAG_{kj} \text{ if } \sigma_{kj} = "FF"$$

$L_\omega \leftarrow E_\omega$

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

$$LF_j \leftarrow \begin{cases} L_\omega & \text{if } \Gamma_j = \emptyset \\ \min_{k \in \Gamma_j} \{ \bullet \} & \text{otherwise} \end{cases}$$

$$LF_k - DUR_k - LAG_{kj} \text{ if } \sigma_{jk} = "FS"$$

$$LF_k - DUR_k + DUR_j - LAG_{kj} \text{ if } \sigma_{jk} = "SS"$$

$$LF_k + DUR_j - LAG_{kj} \text{ if } \sigma_{jk} = "SF"$$

$$LF_k - LAG_{kj} \text{ if } \sigma_{jk} = "FF"$$

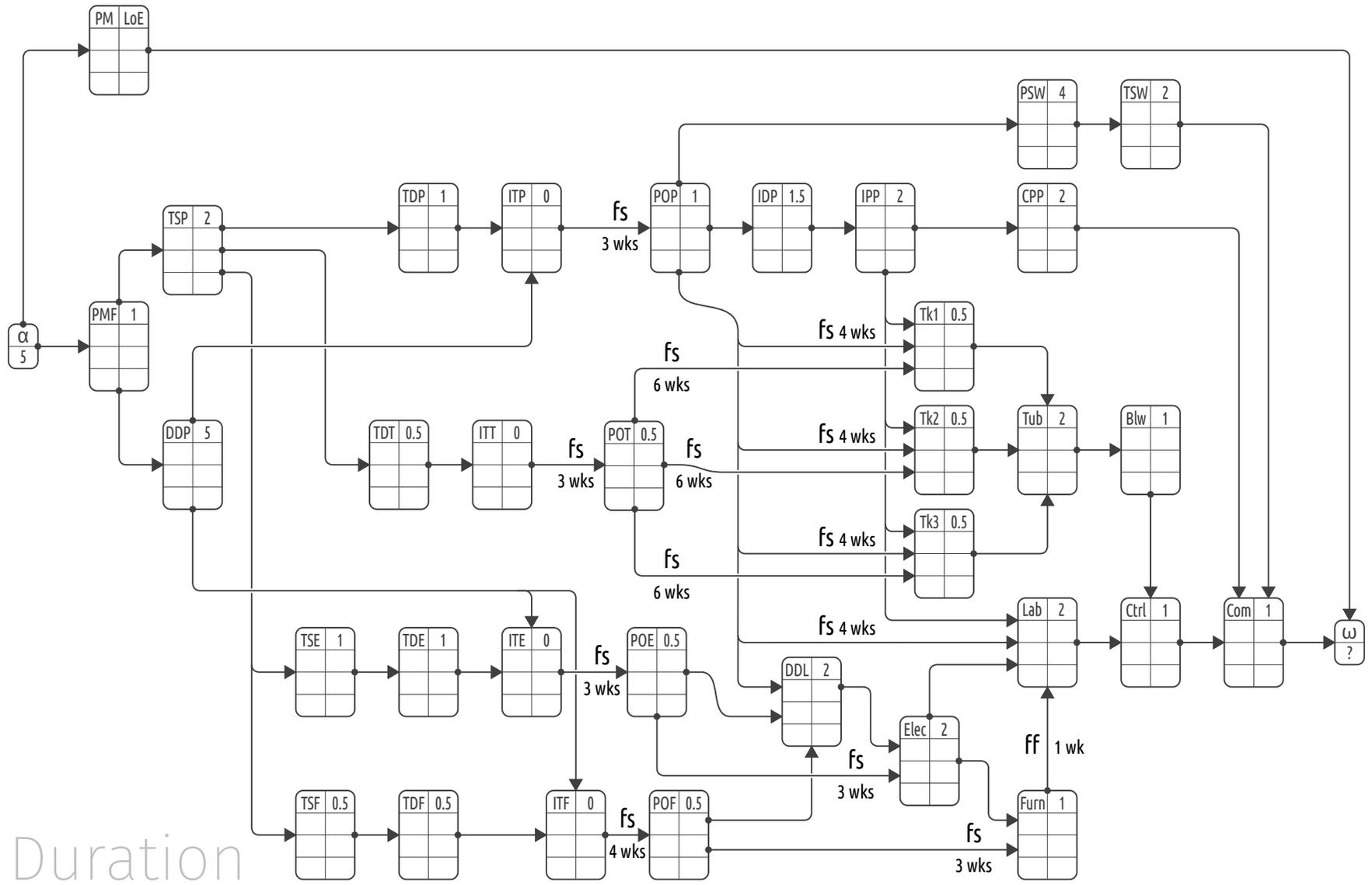
$TF_j \leftarrow LF_j - EF_j$

$FF_j \leftarrow \min_{k \in \Gamma_j} \{ ES_k \} - EF_j$

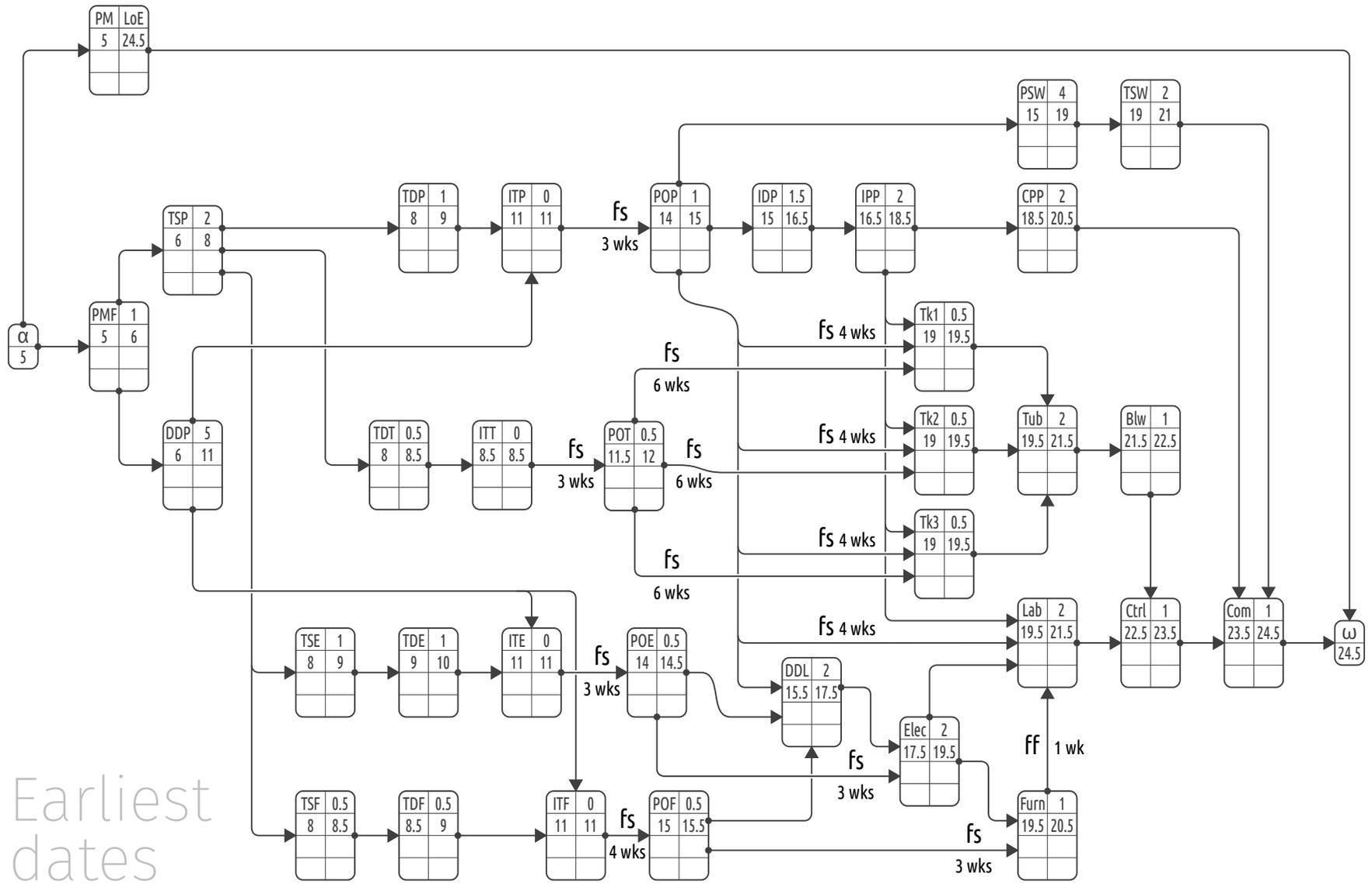
PDM Scheduling

Floats and Critical Path(s)

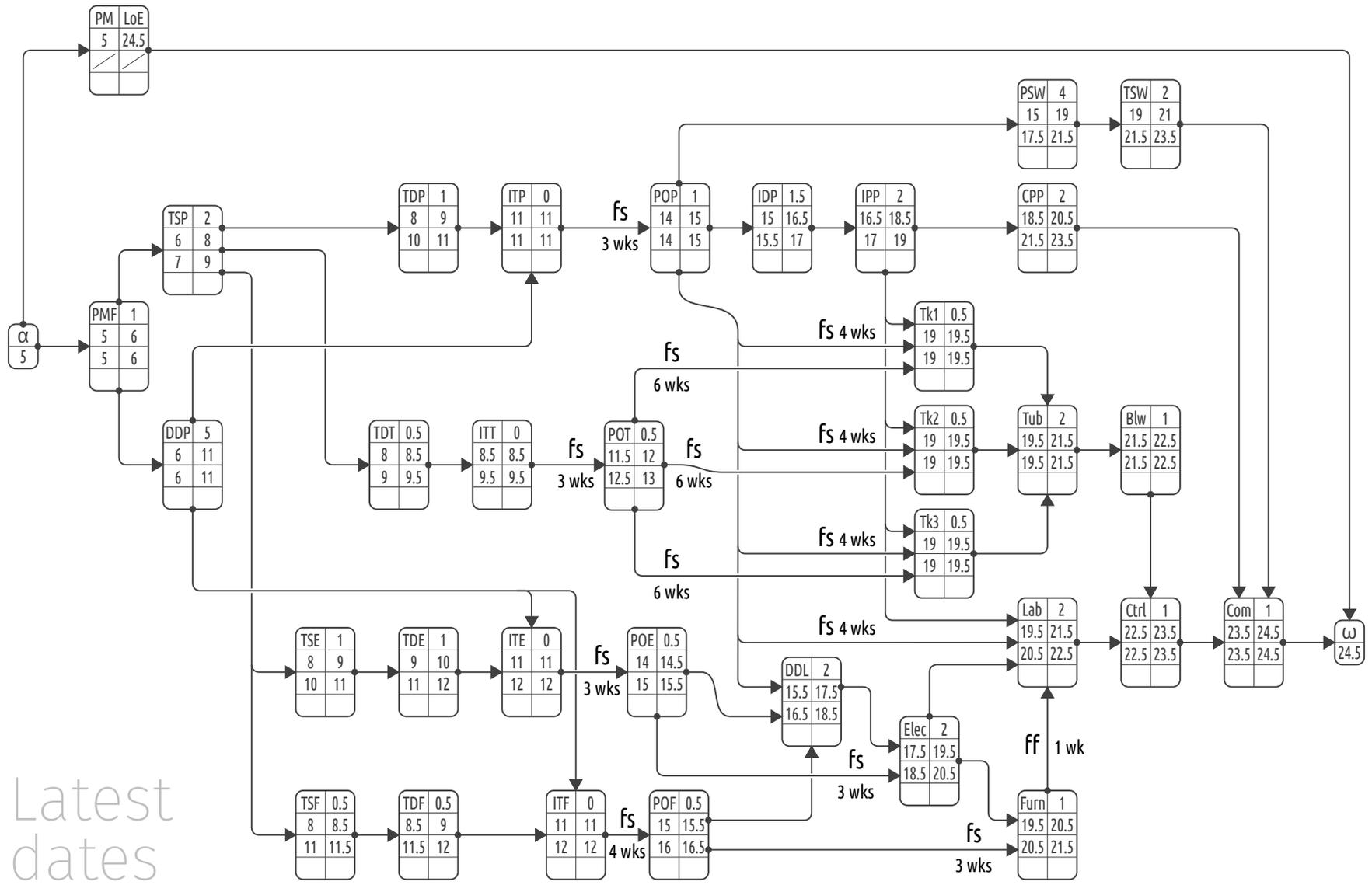
- So called **total floats**, **free floats** and **critical paths** are obtained from PDM calculations
- **Free float** ^{Free slack in Microsoft Project} = the amount of time that an activity can be delayed from its earliest start date without causing a delay to **the earliest dates of subsequent activities**
- **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 ($TF_{ID} = 0$)



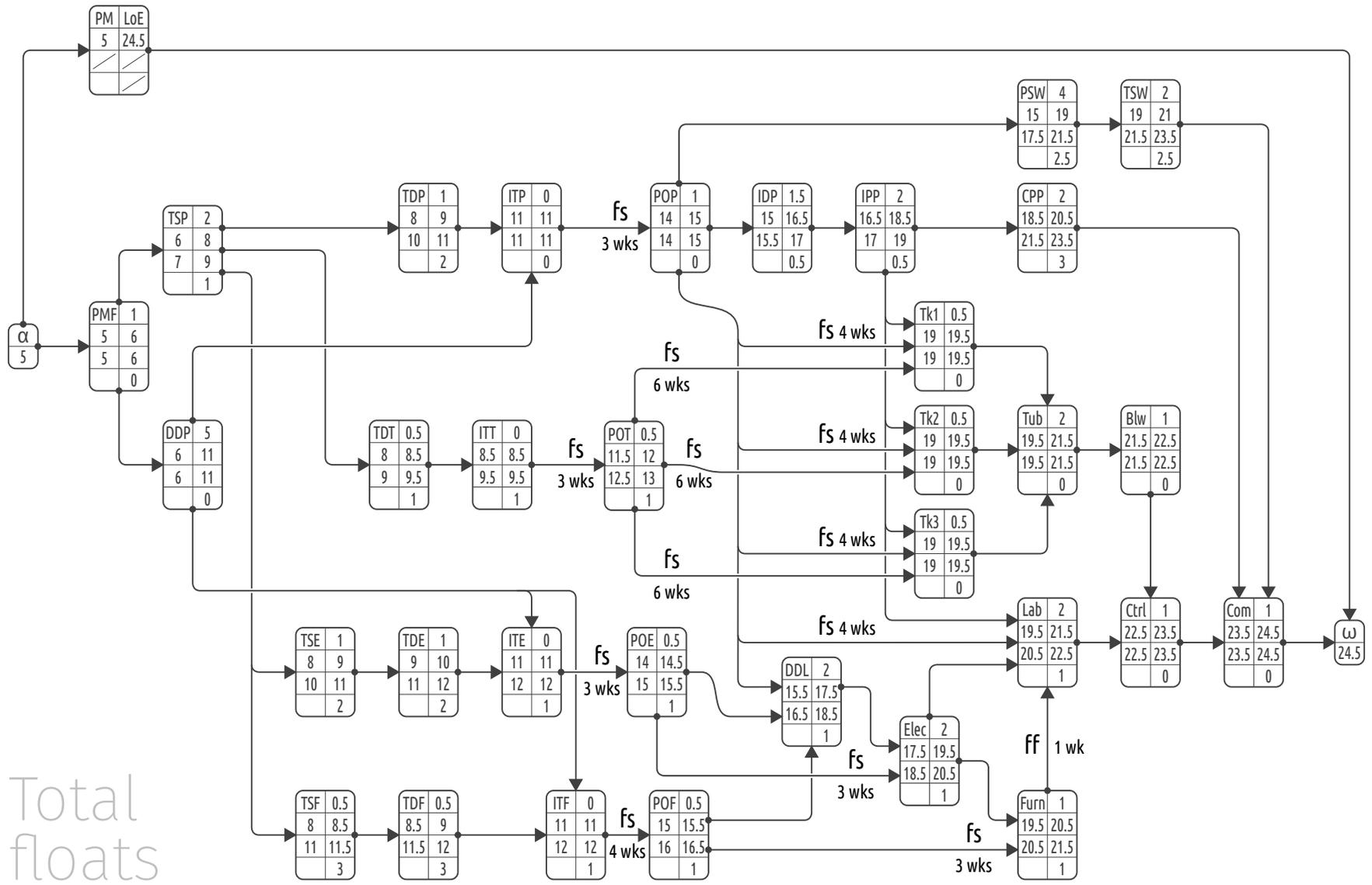
Duration



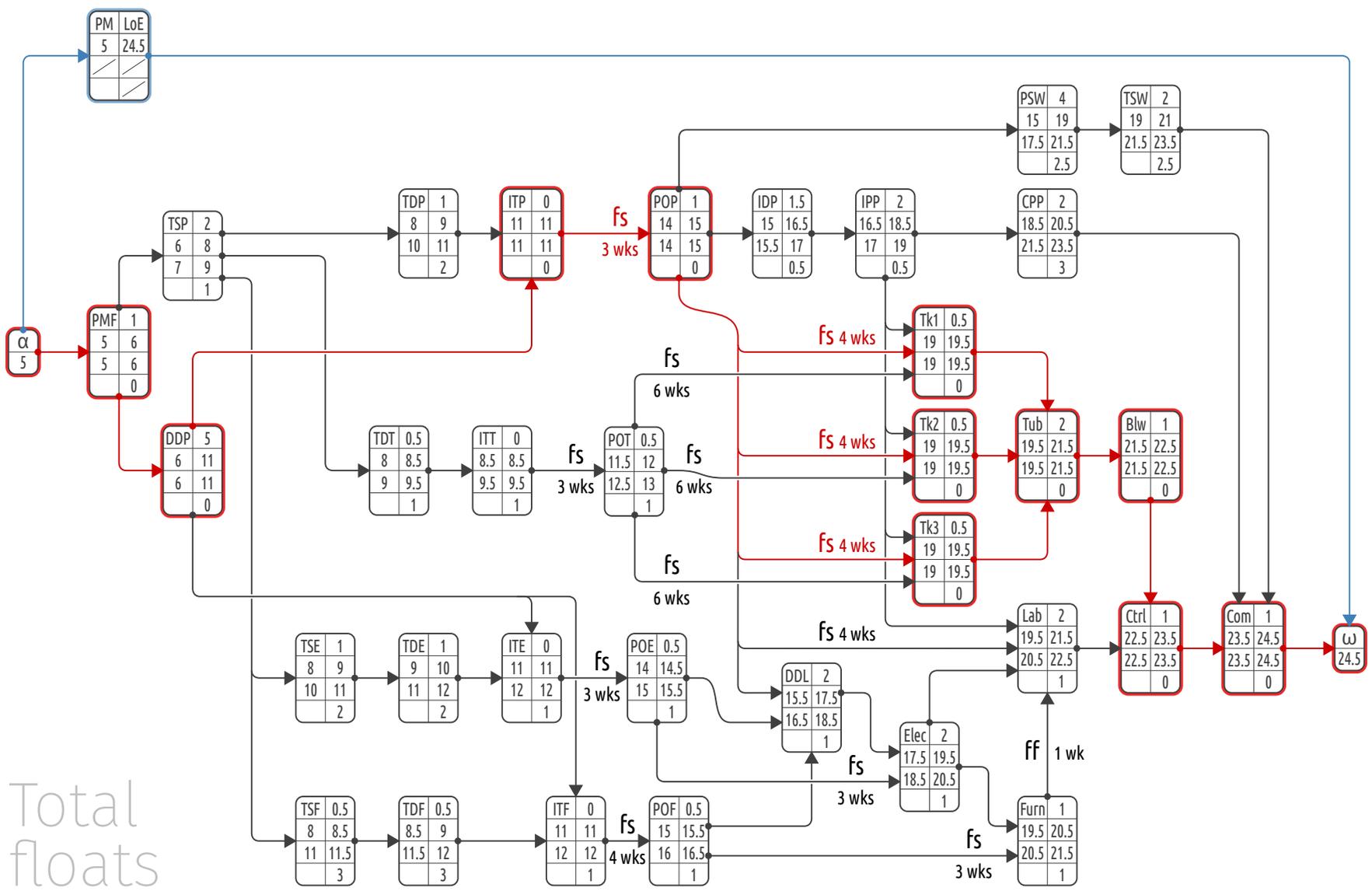
Earliest dates



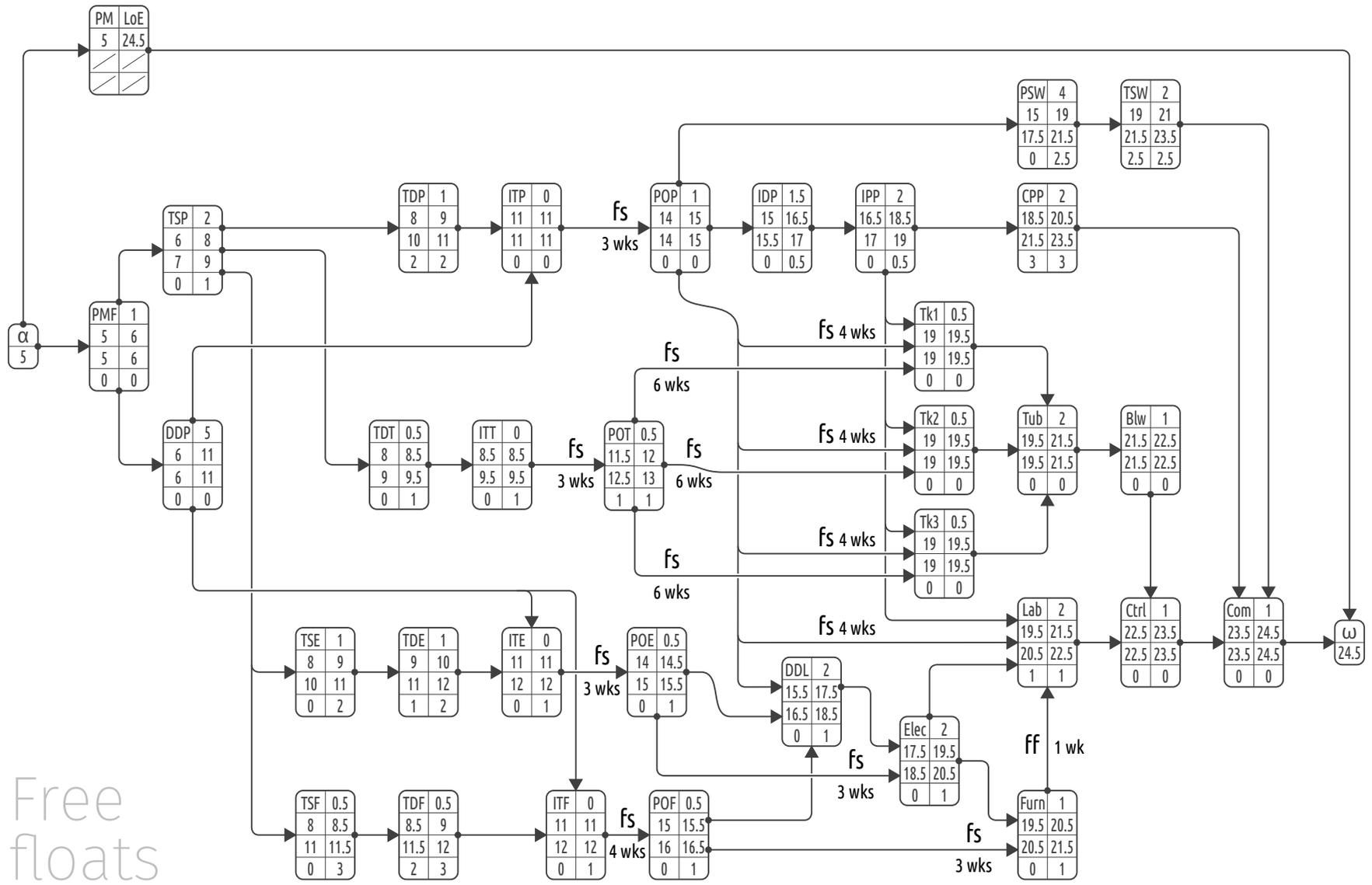
Latest dates



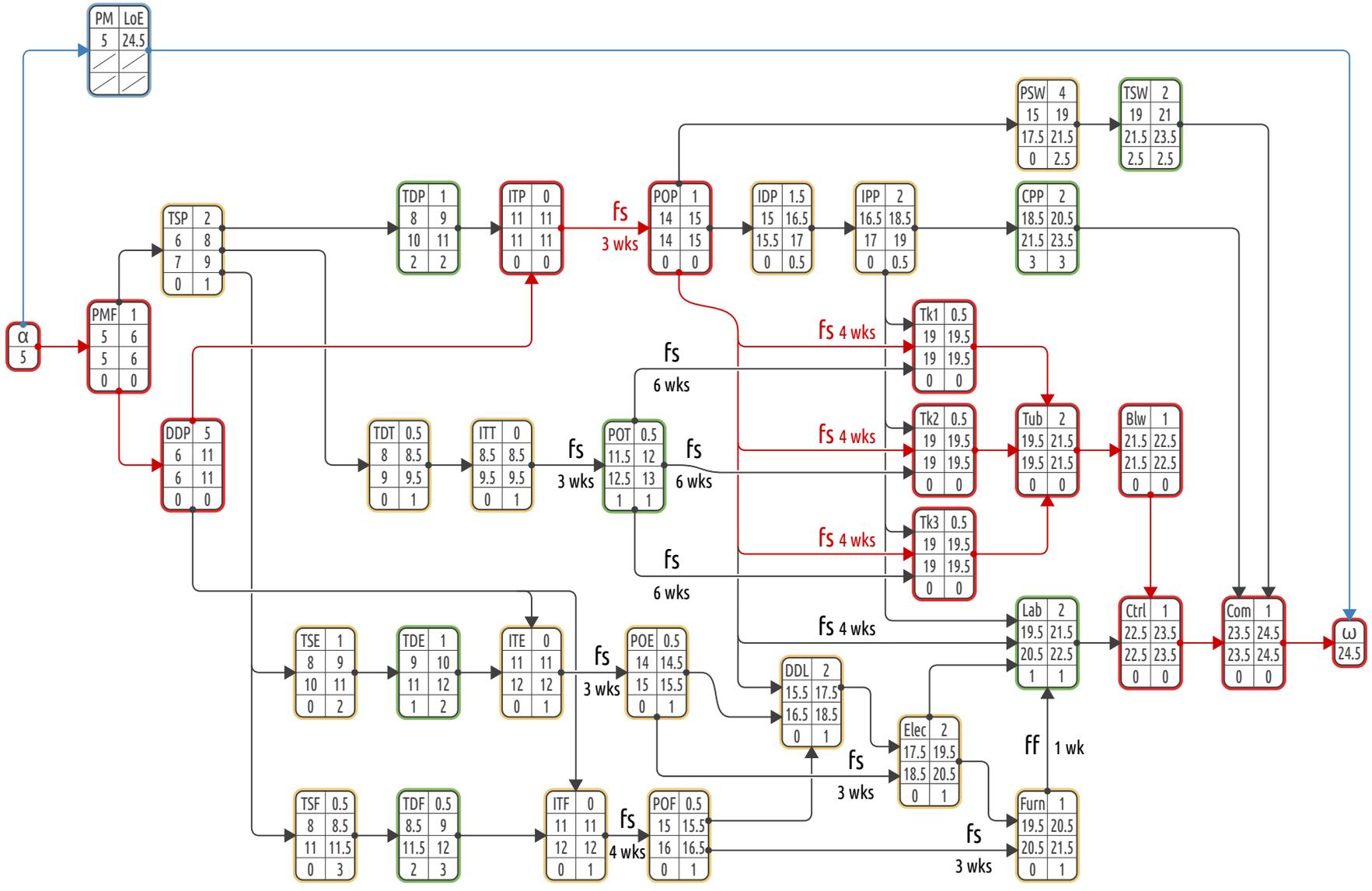
Total floats

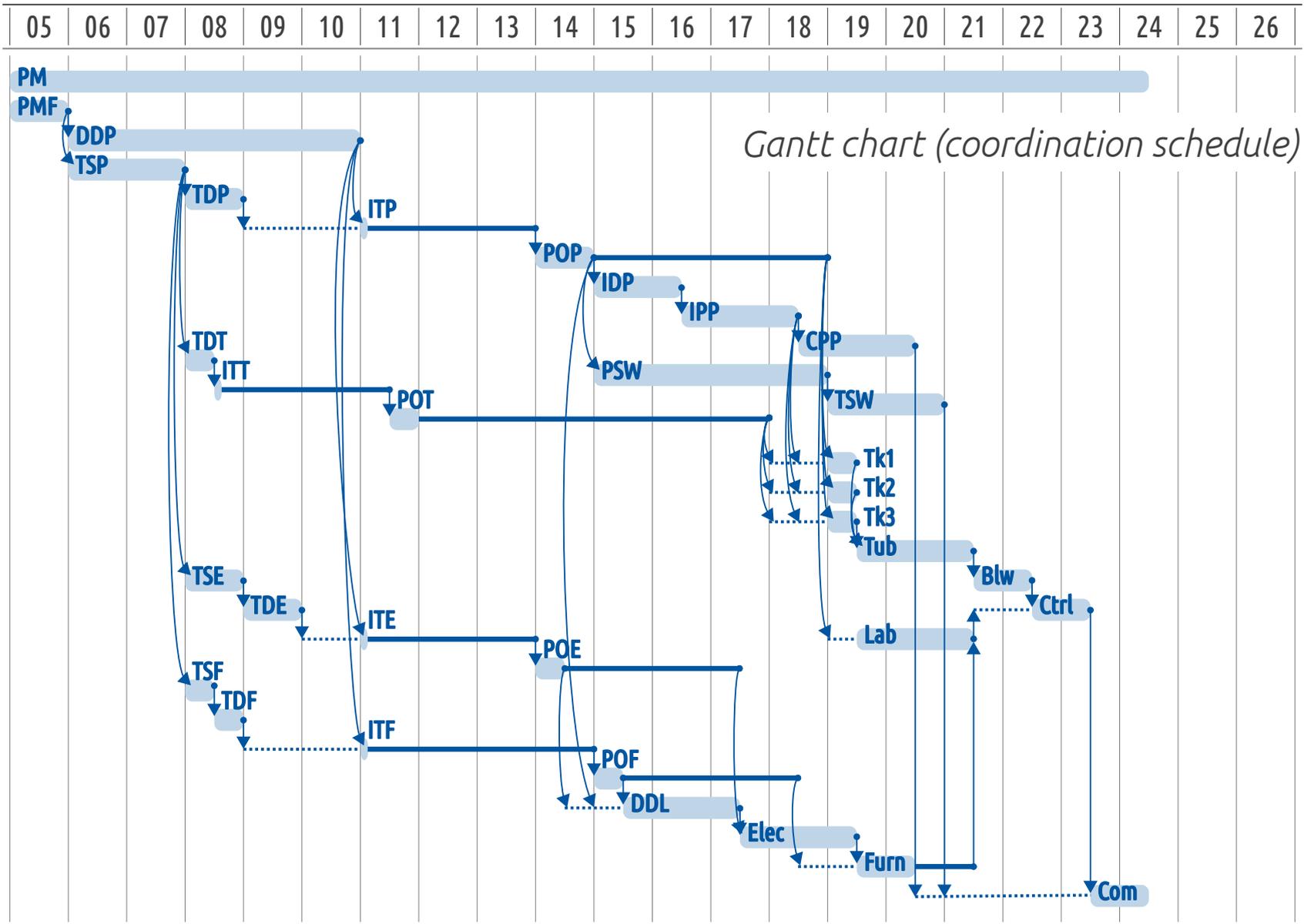


Total floats



Free floats





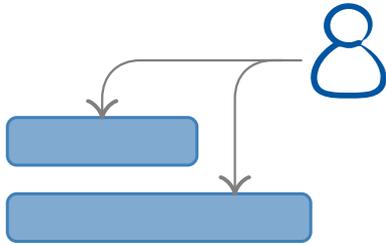
Gantt chart (coordination schedule)

2.7

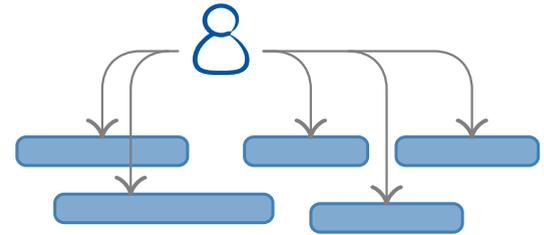
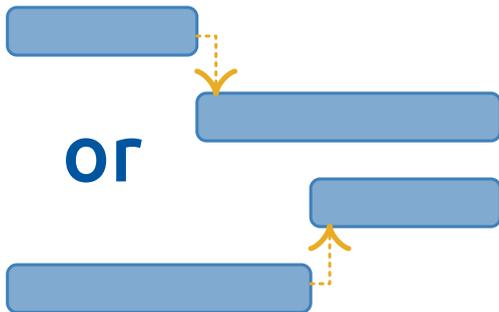
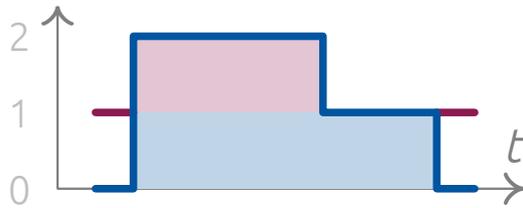
Resource-Constrained Project Scheduling

 3.6

Resource-Constrained Scheduling



resources

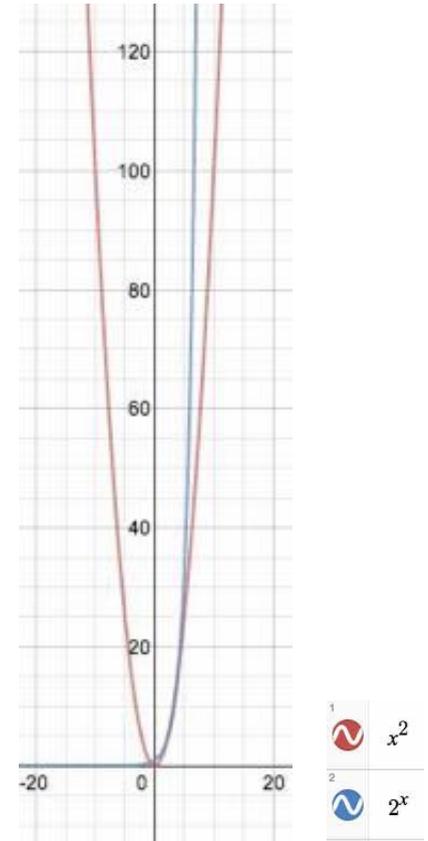


2 activities	1 resource	⇒	2 combinations
3 activities	1 resource	⇒	6 combinations
4 activities	1 resource	⇒	24 combinations
5 activities	1 resource	⇒	120 combinations
			720 combinations
			5040 combinations
			40320 combinations
			362880 combinations
			3628800 combinations

Resource-Constrained Scheduling

In algorithmics, there are two types of problems:

- ➔ Those which complexity grows **polynomially** with the quantity of data to handle $\rightsquigarrow O(q) \sim q^c$
- ➔ Those which complexity grows **exponentially** with the quantity of data to handle $\rightsquigarrow O(q) \sim c^q$
- ➔ PDM algorithm \rightsquigarrow **polynomial** growth algorithm
- ➔ Exact solution for the RC-PSP \rightsquigarrow **exponential** growth algorithm
- ➔ Sufficiently good solution for the RC-PSP \rightsquigarrow **optimization heuristics**
E.g. \rightarrow priority-rule-based optimization algorithms



2.8

Resulting **Schedule Analysis**

 3.7

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 



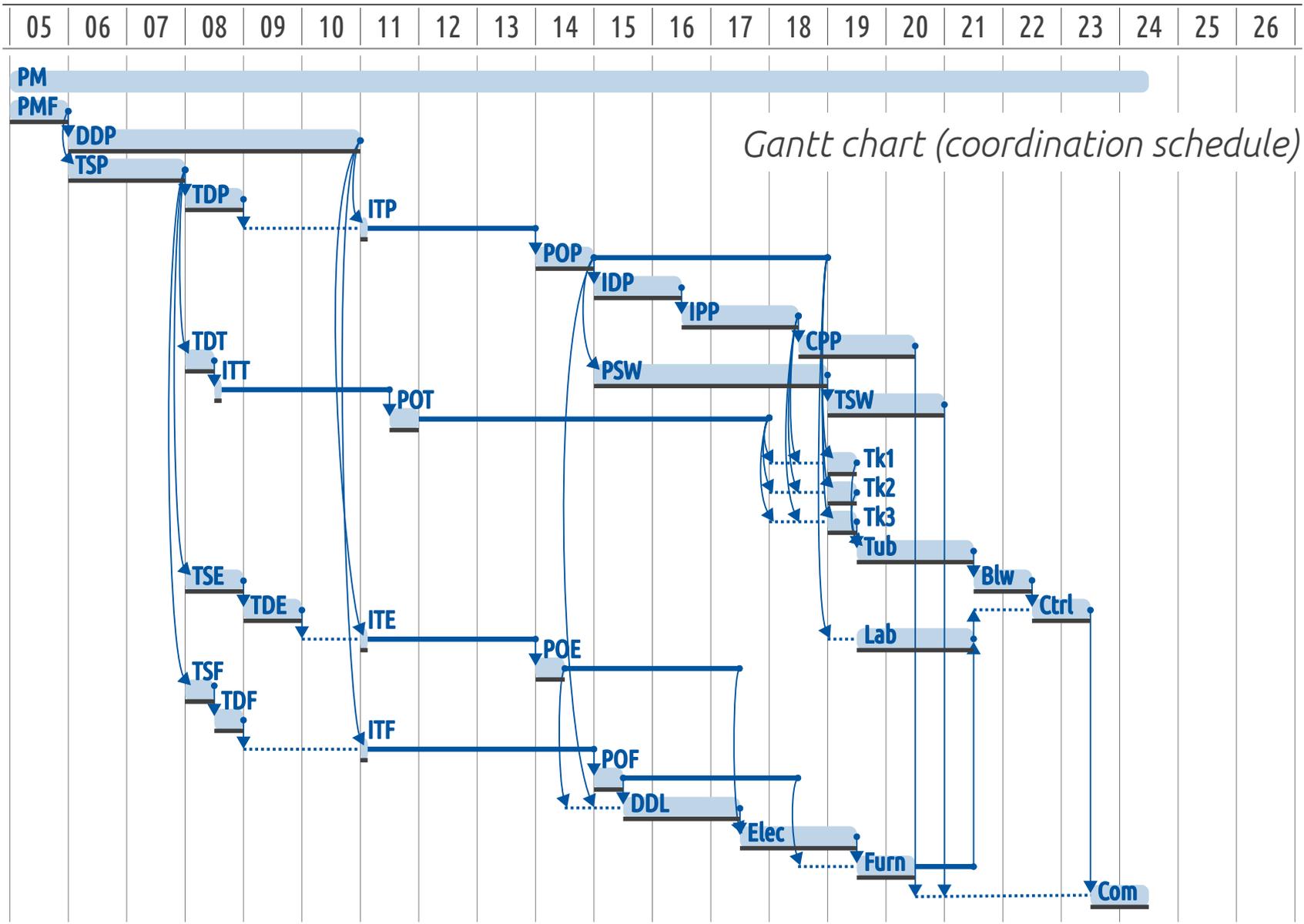
Does the coord. schedule fit the master schedule?
What is the global float?

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 criticality → $\# \text{ critical activities} < 0.3 \times \# \text{ activities}$



Gantt chart (coordination schedule)

3

Scheduling the Project with **Microsoft Project**



Launching the software

 **Windows 10** ▶ Start Menu ▶ Microsoft Office ▶ Microsoft Project

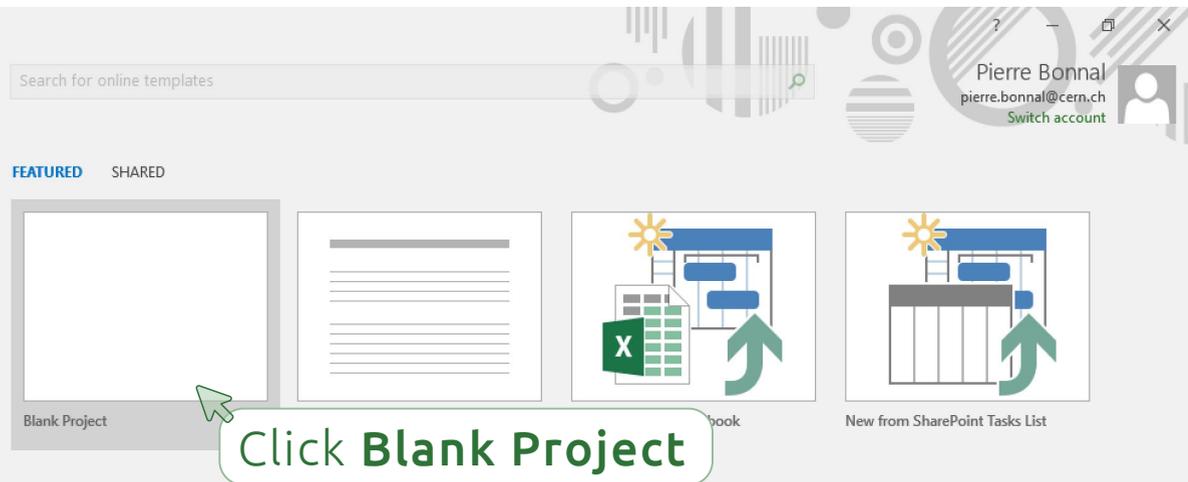
 **Mac OS X** ▶ Launchpad ▶ Windows 10 Applications ▶ Microsoft Project

Project

Recent

You haven't opened any projects recently. To browse for a project, start by clicking on Open Other Projects.

 Open Other Projects



The screenshot shows the Microsoft Project application window. At the top, there is a search bar for online templates and a user profile for Pierre Bonnal. Below the search bar, there are two tabs: 'FEATURED' and 'SHARED'. The 'FEATURED' tab is active, displaying four project templates. The first template, 'Blank Project', is highlighted with a green arrow pointing to it. A callout box with the text 'Click Blank Project' is positioned over the arrow. The other templates include a 'Book' and 'New from SharePoint Tasks List'.

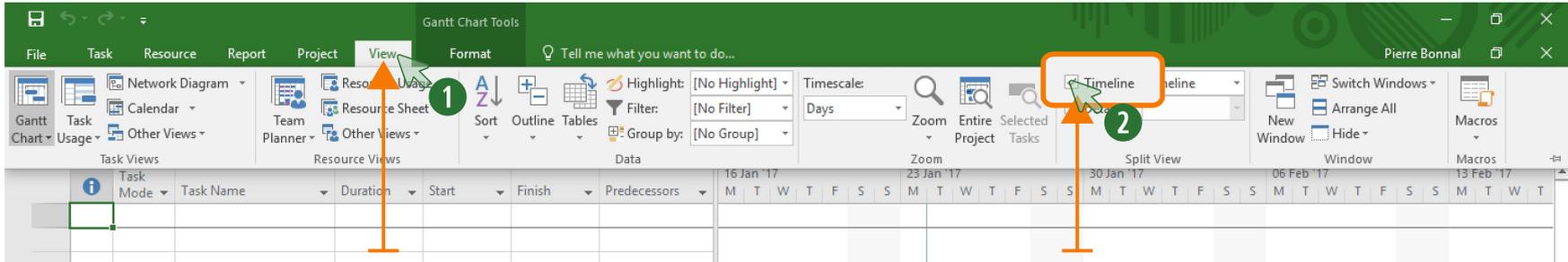
Getting familiar with Microsoft Project's interface

The image shows the Microsoft Project Professional interface with several components highlighted and labeled:

- Timeline:** A purple box at the top highlights the timeline area, which includes the start and finish date fields and the text "Add tasks with dates to the timeline".
- Menu Bar:** An orange box highlights the menu bar with options: File, Task, Resource, Report, Project, View, and Format.
- Quick access toolbar:** An orange box highlights the quick access toolbar at the top left of the main workspace.
- Active view label:** A blue box highlights the "Gantt Chart" label on the left side of the workspace.
- Table area (activity list):** A green box highlights the table area on the left, which contains task names, durations, and predecessors.
- Gantt chart area:** A green box highlights the Gantt chart area on the right, which displays task bars over a timeline.
- Status bar:** An orange box highlights the status bar at the bottom left, showing "New Tasks : Manually Scheduled".
- View shortcuts:** An orange box highlights the view shortcuts at the bottom right, including icons for Gantt Chart, Task Sheet, Resource Sheet, and other views.
- Zoom slider:** An orange box highlights the zoom slider at the bottom right, used for adjusting the view's zoom level.

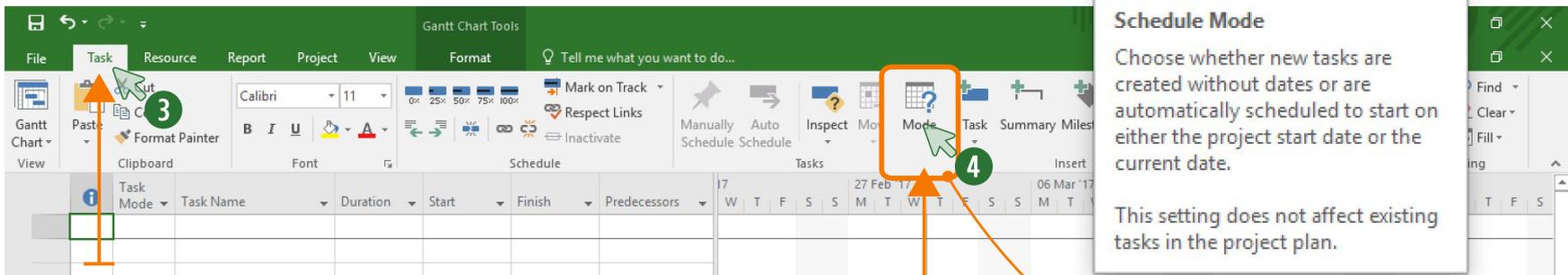
Additional labels include "Gantt Chart view" in a blue box and "Zoom slider" and "View shortcuts" in orange boxes with arrows pointing to their respective UI elements.

Setting up a *proper scheduling configuration*



View tab

Unselect Timeline



Task tab

Switch to Auto Scheduled new tasks

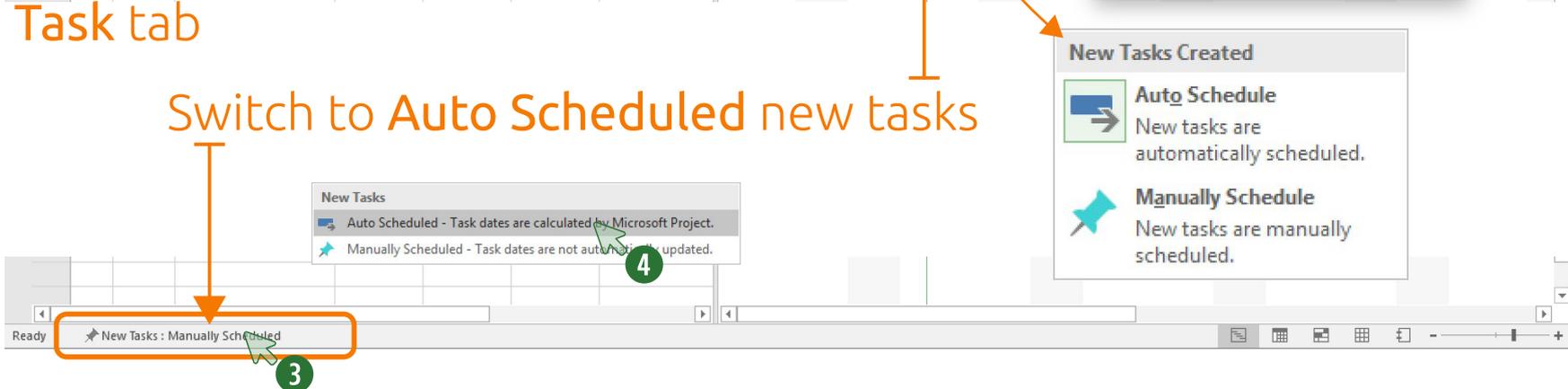
Schedule Mode

Choose whether new tasks are created without dates or are automatically scheduled to start on either the project start date or the current date.

This setting does not affect existing tasks in the project plan.

New Tasks Created

- Auto Schedule**
New tasks are automatically scheduled.
- Manually Schedule**
New tasks are manually scheduled.



3

Setting the project start date

The project start date is a temporal constraint

3.4

Info

Project Web App Accounts
You're not connected to Project Web App

Organize Global Template
Move views, reports, and other elements between project files and the global template.

Project Information ▾

Start Date 28/02/2017

Finish Date

Schedule from

Current Date

Status Date

Project Calendar

Priority

Mo	Tu	We	Th	Fr	Sa	Su
26	27	28	29	30	31	
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

Entering and editing activity labels

The screenshot displays the Microsoft Project interface with the Gantt Chart Tools ribbon active. The ribbon includes tabs for File, Task, Resource, Report, Project, View, and Format. The Task tab is selected, showing options like Mark on Track, Respect Links, and Inactivate. A Gantt chart is visible with a task bar highlighted. Four numbered callouts indicate key elements: 1. The 'Task Name' field in the Gantt chart; 2. The task bar; 3. The 'Task' button in the ribbon; 4. The 'Information' button in the ribbon. A 'Task Information' dialog box is open, showing the 'General' tab with fields for Name, Duration, Percent complete, Priority, Schedule Mode (Manually Scheduled/Auto Scheduled), Dates (Start/Finish), and checkboxes for Display on Timeline, Hide Bar, and Rollup.

Adapting the Gantt view timescale

CanNet_02_activities - Project Professional

File Task Resource Report Project View Format Tell me what you want to do...

Task Views Resource Views

Task Mode	Task Name	Duration	Start	Finish
1	Manage the CanNet project	1 day?	Mon 30/01/17	Mon 30/01/17
2	Set the project management framework	1 day?	Mon 30/01/17	Mon 30/01/17
3	Perform detailed design of the PTT system	1 day?	Mon 30/01/17	Mon 30/01/17
4	Write technical specification for the PTT system	1 day?	Mon 30/01/17	Mon 30/01/17
5	Prepare tendering docs for the PTT system	1 day?	Mon 30/01/17	Mon 30/01/17
6	Send invitations to tender for the PTT system	1 day?	Mon 30/01/17	Mon 30/01/17
7	Place order for the PTT system	1 day?	Mon 30/01/17	Mon 30/01/17
8	Perform the installation design	1 day?	Mon 30/01/17	Mon 30/01/17
9	Prepare installation of the PTT system	1 day?	Mon 30/01/17	Mon 30/01/17

Timescale

Top Tier Middle Tier Bottom Tier Non-working time

Middle tier formatting

Units: Weeks Label: 26 Jan '09 Use fiscal year

Count: 1 Align: Left Tick lines

Timescale options

Show: Two tiers (Middle, Bottom) Size: 100 % Scale separator

Preview

February 2017						
Su	Mo	Tu	We	Th	Fr	Sa
29	30	31	01	02	03	04
						05
						06

It's up to you

Ready New Tasks : Auto Scheduled

Entering and updating activity duration

CanNet_02_activities - Project Professional

File Task Resource Report Project View Format Tell me what you want to do...

Network Diagram Resource Usage Highlight: [No Highlight] Timescale: Days

Gantt Task Calendar Team Resource Sheet Sort Outline Tables Filter: [No Filter]

Chart Usage Other Views Planner Other Views Group by: [No Group]

Task Views Resource Views Data Zoom Entire Selected Project Tasks

Timeline Details Switch Windows Arrange All New Window Hide Macros

						February 2017																											
						Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su														
						23	24	25	26	27	28	29	30	31	01	02	03	04	05	06	07	08	09	10	11	12							
1	Task Mode	Task Name	Duration	Start	Finish																												
1		Manage the CanNet project	1 day?	Mon 30/01/1	Mon 30/01/1																												
2		Set the project management framework	1 wk	Mon 30/01/1	Mon 30/01/1																												
3		Perform detailed design of the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
4		Write technical specification for the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
5		Prepare tendering docs for the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
6		Send invitations to tender for the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
7		Place order for the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
8		Perform detailed design of the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
9		Write technical specification for the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
10		Prepare tendering docs for the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
11		Send invitations to tender for the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
12		Place order for the PTT system	1 day?	Mon 30/01/1	Mon 30/01/1																												
13		Perform detailed design of the lab arrangement	1 day?	Mon 30/01/1	Mon 30/01/1																												
14		Write technical specification for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
15		Prepare tendering docs for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
16		Send invitations to tender for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
17		Place order for the electr. Infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
18		Install the electr. infrastr. In the lab	1 day?	Mon 30/01/1	Mon 30/01/1																												
19		Write technical specification for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
20		Prepare tendering docs for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
21		Send invitations to tender for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
22		Place order for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
23		Perform detailed design of the lab arrangement	1 day?	Mon 30/01/1	Mon 30/01/1																												
24		Write technical specification for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
25		Prepare tendering docs for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
26		Send invitations to tender for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
27		Place order for the electr. Infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
28		Install the electr. infrastr. In the lab	1 day?	Mon 30/01/1	Mon 30/01/1																												
29		Write technical specification for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
30		Prepare tendering docs for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
31		Send invitations to tender for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
32		Place order for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
33		Perform detailed design of the lab arrangement	1 day?	Mon 30/01/1	Mon 30/01/1																												
34		Write technical specification for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
35		Prepare tendering docs for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
36		Send invitations to tender for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
37		Place order for the electr. Infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
38		Install the electr. infrastr. In the lab	1 day?	Mon 30/01/1	Mon 30/01/1																												
39		Write technical specification for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
40		Prepare tendering docs for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
41		Send invitations to tender for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
42		Place order for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
43		Perform detailed design of the lab arrangement	1 day?	Mon 30/01/1	Mon 30/01/1																												
44		Write technical specification for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
45		Prepare tendering docs for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
46		Send invitations to tender for the electr. infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
47		Place order for the electr. Infrastr.	1 day?	Mon 30/01/1	Mon 30/01/1																												
48		Install the electr. infrastr. In the lab	1 day?	Mon 30/01/1	Mon 30/01/1																												
49		Write technical specification for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
50		Prepare tendering docs for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
51		Send invitations to tender for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												
52		Place order for the lab's furniture	1 day?	Mon 30/01/1	Mon 30/01/1																												

type: m or min to get: minutes
 h or hr hours
 d or day days
 w or wk weeks
 mo months

1 year = 12 months
 1 year = 48 weeks
 1 week = 5 days
 1 day = 8 hours
 1 hour = 60 minutes

Edit New Tasks : Auto Scheduled

Defining technical constraints

The screenshot displays the Microsoft Project Professional interface with a Gantt chart and a task list. The task list includes:

Task ID	Task Name	Duration	Start	Finish
1	Manage the CanNet project		30/01/1	Fri 16/06
2	Set the project management framework		30/01/1	Fri 03/02
3	Perform detailed design of the PTT system		30/01/1	Fri 03/03
4	Write technical specification for the PTT system		30/01/1	Fri 10/02
5	Prepare tendering docs for the PTT system	1 wk	Mon 30/01/1	Fri 03/02
6	Send invitations to tender for the PTT system	0 wks	Mon 30/01/1	Mon 30/01/1
7	Open tenders and place order for the PTT system	1 wk	Mon 30/01/1	Fri 03/02
8	Perform the installation design	1.5 wks	Mon 30/01/1	Wed 08/02
9	Prepare installation of the PTT system	2 wks	Mon 30/01/1	Fri 10/02
10	Prepare commissioning of the PTT system	2 wks	Mon 30/01/1	Fri 10/02
11	Install the tank			
12	Install the tank			
13	Install the tank			
14	Lay down the tu			
15	Install the blow			
16	Pull and connect			
17	Install the PLC a			
18	Parametrize sof			
19	Test and validat			
20	Perform detaile			
21	Write technical			
22	Prepare tenderi			
23	Send invitations			
24	Open tenders ar			
25	Install the elect			
26	Write technical			
27	Prepare tenderi			
28	Send invitations to tender for the lab's furniture	0 wks	Mon 30/01/1	Mon 30/01/1
29	Open tenders and place order for the lab's furniture	0.5 wks	Mon 30/01/1	Wed 01/02
30	Arrange the furniture in the lab	1 wk	Mon 30/01/1	Fri 03/02

The Gantt chart shows a dependency between task 2 and task 3, with a green link icon. A tooltip titled "Link the Selected Tasks (Ctrl+F2)" explains that tasks can be linked so one can't start until the other has finished. A "Task Information" dialog box is open, showing the "Predecessors" tab with a table:

ID	Task Name	Type	Lag
2	Set the project management framework	Finish-to-Start (FS)	0d

The "Task Dependency" dialog box is also shown, with "From: Set the project management framework" and "To: Perform detailed design of the PTT system". The "Type" is set to "Finish-to-Start (FS)" and "Lag" is "0d".

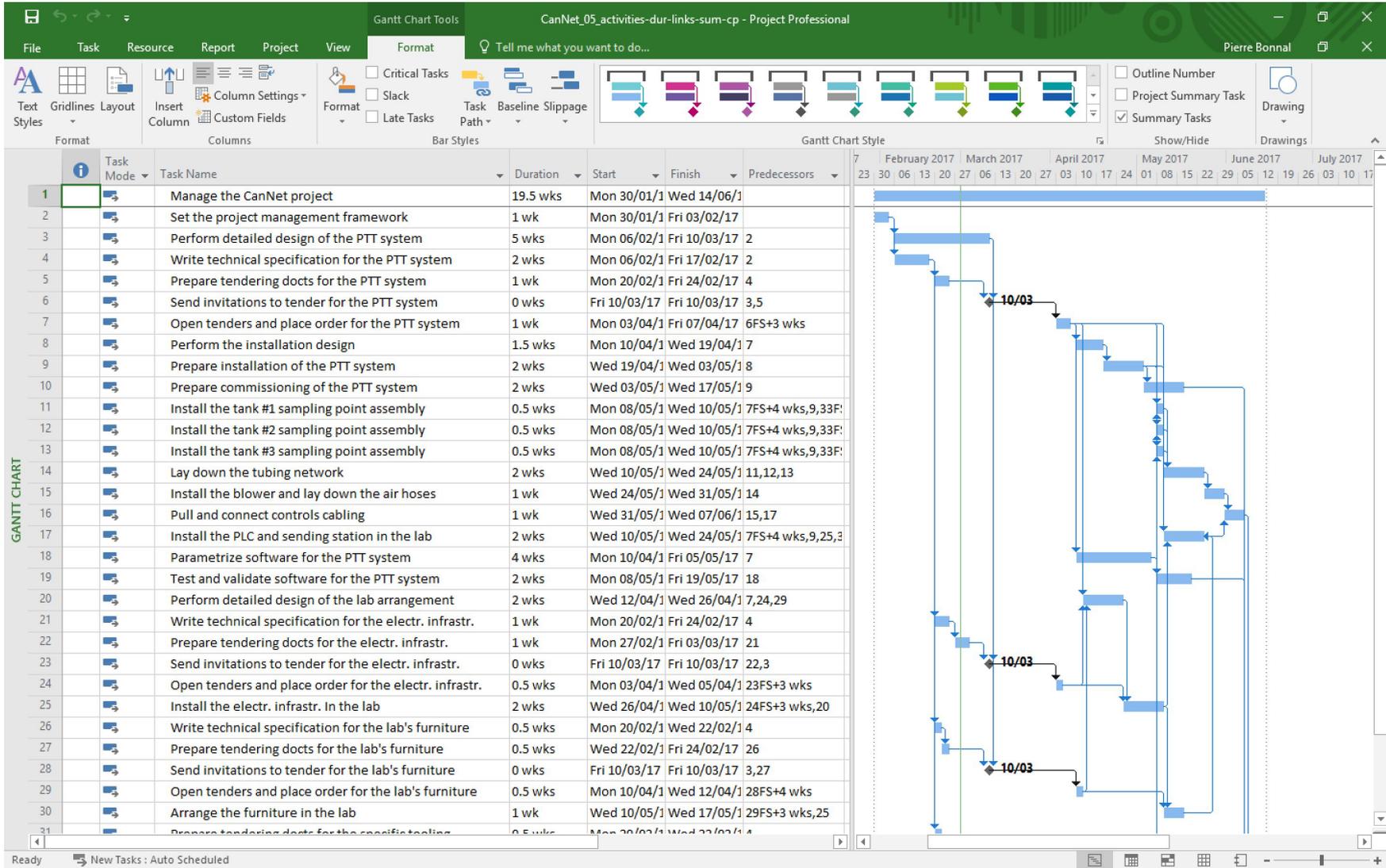
Annotations in the image include:

- 1: Points to the task list.
- 2: Points to the task name "Perform detailed design of the PTT system".
- 3: Points to the dependency link in the Gantt chart.
- 4: Points to the dependency link in the Gantt chart.

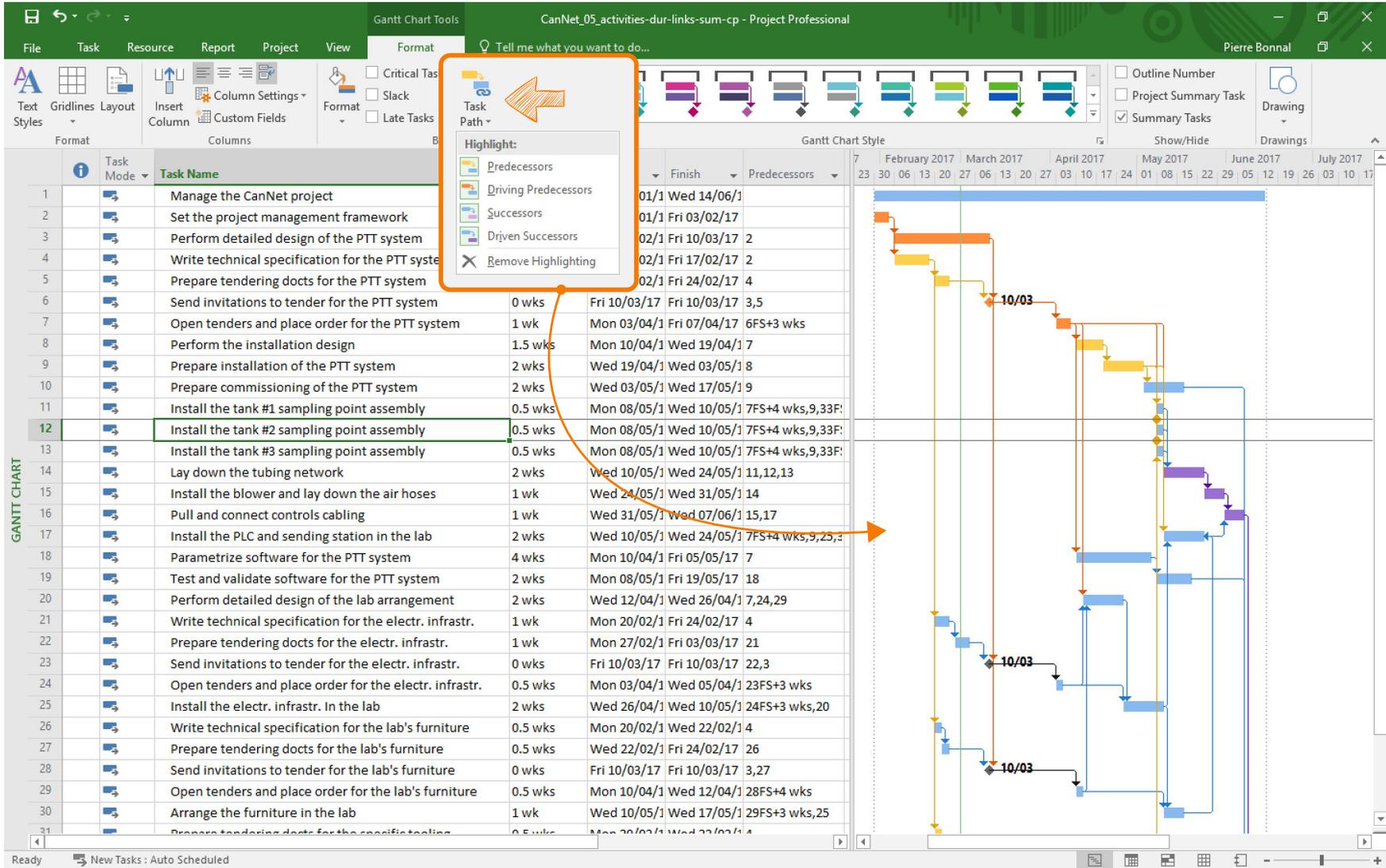
Modifying a link

The diagram illustrates the process of modifying a task dependency link. It shows a task bar with a dependency link icon. A mouse cursor is shown clicking on the link icon, which opens the "Task Dependency" dialog box. The dialog box shows the "From" task, the "To" task, and the "Type" of the dependency (Finish-to-Start (FS)). The "Lag" is set to 0d. The "Delete" button is highlighted, indicating that the link can be removed or modified.

Analysing the resulting schedule (before RCPS)



Analysing the resulting schedule (before RCPS)



Analysing the resulting schedule (before RCPS)

CanNet_05_activities-dur-links-sum-cp - Project Professional

Task Mode	Task Name	Duration	Start	Finish
1	Manage the CanNet project	19.5 wks		
2	Set the project management framework	1 wk		
3	Perform detailed design of the PTT system	5 wks		
4	Write technical specification for the PTT system	2 wks		
5	Prepare tendering docs for the PTT system	1 wk		
6	Send invitations to tender for the PTT system	0 wks		
7	Open tenders and place order for the PTT system	1 wk		
8	Perform the installation design	1.5 wks		
9	Prepare installation of the PTT system	2 wks		
10	Prepare commissioning of the PTT system	2 wks		
11	Install the tank #1 sampling point assembly	0.5 wks		
12	Install the tank #2 sampling point assembly	0.5 wks	Mon 08/05/1	Wed 10/05/1 7FS+4 wks,9,33F:
13	Install the tank #3 sampling point assembly	0.5 wks	Mon 08/05/1	Wed 10/05/1 11,12,13
14	Lay down the tubing network	2 wks	Wed 10/05/1	Wed 24/05/1 14
15	Install the blower and lay down the air hoses	1 wk	Wed 24/05/1	Wed 31/05/1 15,17
16	Pull and connect controls cabling	1 wk	Wed 31/05/1	Wed 07/06/1 15,17
17	Install the PLC and sending station in the lab	2 wks	Wed 10/05/1	Wed 24/05/1 7FS+4 wks,9,25,3
18	Parametrize software for the PTT system	4 wks	Mon 10/04/1	Fri 05/05/17 7

More Filters

Filters: Task Resource

- All Tasks
- Active Tasks
- Completed Milestones
- Completed Tasks
- Cost Greater Than...
- Cost Overbudget
- Created After...
- Critical
- Date Range...
- In Progress Tasks
- Incomplete Tasks
- Late Milestones
- Late Tasks
- Late/Overbudget Tasks Assigned To...

Buttons: Highlight, Apply, Cancel

Filter Definition

Name: Filter 1 Show in menu

Filter:

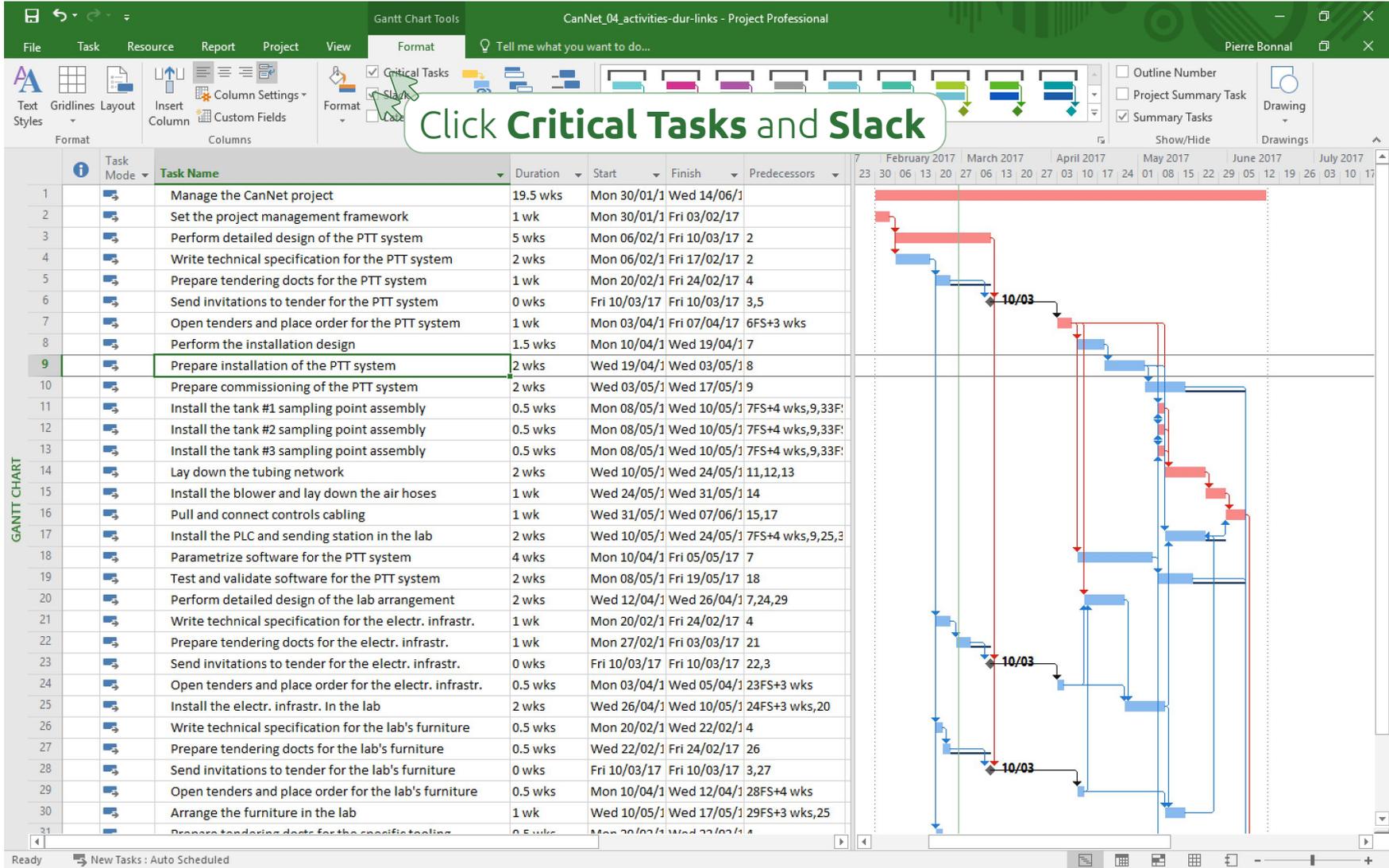
Buttons: Cut Row, Copy Row, Paste Row, Insert Row, Delete Row

And/Or	Field Name	Test	Value(s)

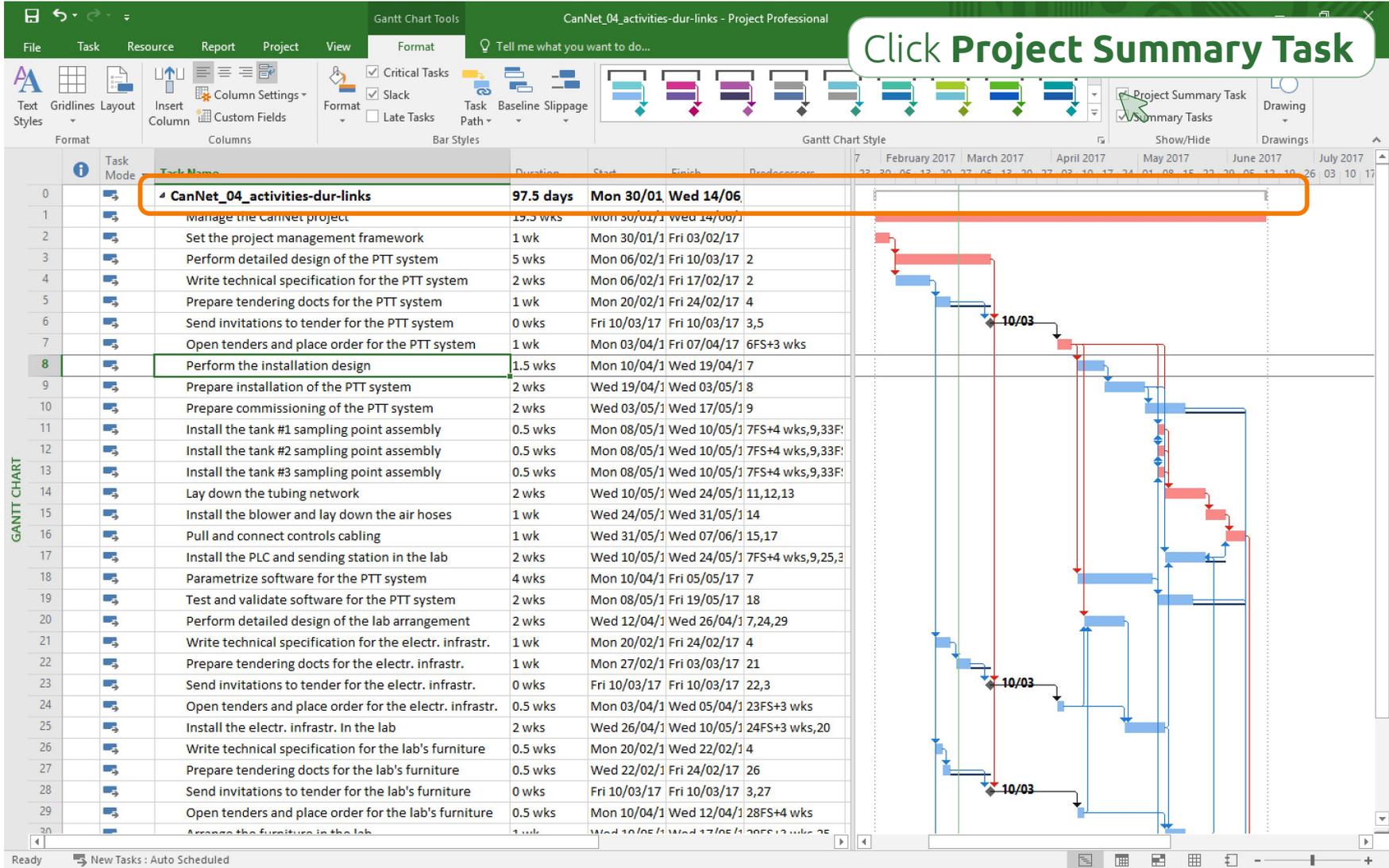
Show related summary rows

Buttons: Help, Apply, Save, Cancel

Analysing the resulting schedule (before RCPS)



Analysing the resulting schedule (before RCPS)



Analysing the resulting schedule (before RCPS)

The screenshot displays the Microsoft Project Professional interface. The title bar indicates the project name is "CanNet_05_activities-dur-links-sum-cp - Project Professional". The ribbon includes tabs for File, Task, Resource, Report, Project, View, Format, and Tell me what you want to do... The ribbon is divided into sections: Font, Schedule, Tasks, Insert, Properties, and Editing. The Schedule section includes options like "Mark on Track", "Respect Links", and "Inactivate". The Tasks section includes "Manually Schedule", "Auto Schedule", "Inspect", "Move", and "Mode". The Insert section includes "Task", "Summary Milestone", and "Deliverable". The Properties section includes "Notes", "Details", and "Add to Timeline". The Editing section includes "Find", "Clear", "Scroll to Task", and "Fill".

A "Gantt Chart" menu is open on the left side of the screen, highlighted with an orange border. The menu items are: Gantt Chart, Calendar, Network Diagram, Resource Sheet, Resource Usage, Resource Form, Resource Graph, Task Usage, Task Form, Task Sheet, Team Planner, Timeline, Tracking Gantt, Reset to Default, Save View..., and More Views... An orange arrow points to the "Gantt Chart" option.

The main workspace shows a network diagram with tasks represented by boxes and arrows indicating dependencies. The tasks are color-coded: red for summary tasks and blue for detail tasks. The diagram is overlaid on a grid with vertical dashed lines representing task durations.

The status bar at the bottom left shows "Ready" and "New Tasks : Auto Scheduled". The bottom right corner contains icons for various views and a zoom slider.

Entering and editing resources

The screenshot displays the Microsoft Project interface with the Resource Sheet tab active. The ribbon includes 'Resource', 'Report', 'Project', 'View', and 'Format'. The Resource Sheet grid shows a new row with a green background, indicating it is selected. Three orange callouts are present: 1 points to the 'Add Resources' button in the ribbon, 2 points to the 'Resource Name' cell in the grid, and 3 points to the 'Add Resources' button in the context menu. The 'Resource Information' dialog box is open, with the 'Resource name' field highlighted by an orange arrow.

Resource Information Dialog Box Fields:

- General tab selected
- Resource name: [Text Field]
- Email: [Text Field]
- Logon Account...: [Text Field]
- Booking type: [Dropdown Menu]
- Default Assignment Owner: [Dropdown Menu]
- Resource Availability table:

Available From	Available To	Units
- Initials: [Text Field]
- Group: [Text Field]
- Code: [Text Field]
- Type: [Dropdown Menu]
- Material label: [Text Field]
- Generic:
- Budget:
- Inactive:
- Change Working Time ...: [Button]
- Buttons: Help, Details..., OK, Cancel

Entering and editing resources

Resource Sheet Tools

File Task Resource Report Project View Format Tell me what you want to do... Pierre Bonnal

Team Planner View Assign Resources Pool Assignments Add Resources Insert Information Notes Details Level Selection Level Resource All Level Leveling Options Clear Leveling Next Overallocation

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt.	Cost/Use	Accrue	Base	Code	Group	Add New Column
1	Tom Ayrton Senior Plant Engineer	Work		tA		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
2	Bob Harvey Senior Plant Designer	Work		bH		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
3	Alice Watkins Proc. Officer	Material		aW		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
4	Cyprien Méré Electr. Engineer	Cost		cM		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
5	Herbert Brown Electrician	Work		hB		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
6	Michel Zorn Electrician	Work		mZ		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
7	Ned Land Mech. Engineer	Work		nL		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
8	John Proth Mechanic	Work		jP		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
9	Mathieu Strux Mechanic	Work		mS		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
10	Gédéon Spilett Controls Engineer	Work		gS		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
11	Cyrus Smith Software Engineer	Work		cS		100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard			
12	PTT System Budget	Cost		PTTS						Prorated				
13	Lab Infrastr. Budget	Cost		Linfr						Prorated				
14	Project Management Reserve	Cost		PMR						Prorated				



Work People & machines Time dependent

Material Consumables Time independent

Cost Financial means Time independent

Ready New Tasks : Auto Scheduled

Assigning resources to activities

The screenshot shows the Microsoft Project Professional interface. The Gantt chart displays a project schedule from January 2017 to July 2017. The task list includes:

Task ID	Task Name	Duration
1	Manage the CanNet project	19.5 wks
2	Set the project management framework	1 wk
3	Perform detailed design of the PTT system	2 wks
4	Write technical specification for the PTT system	2 wks
5	Prepare tendering docs for the PTT system	1 wk
6	Send invitations to tender for the PTT system	0 wks
7	Open tenders and place order for the PTT system	1 wk
8	Perform the installation design	1.5 wks
9	Prepare installation of the PTT system	2 wks
10	Prepare commissioning of the PTT system	2 wks
11	Install the tank #1 sampling point assembly	0.5 wks
12	Install the tank #2 sampling point assembly	0.5 wks
13	Install the tank #3 sampling point assembly	0.5 wks

The Resource Names list is open, showing a list of resources with checkboxes:

- Alice Watkins | Proc. Officer
- Bob Harvey | Senior Plant Designer
- Cyprien Méré | Electr. Engineer
- Cyrus Smith | Software Engineer
- Gédéon Spilett | Controls Engineer
- Herbert Brown | Electrician
- John Proth | Mechanic
- Lab Infrastr. | Budget
- Mathieu Strux | Mechanic
- Michel Zorn | Electrician
- Ned Land | Mech. Engineer
- Project Management Reserve
- PTT System | Budget
- Tom Ayrton | Senior Plant Engineer

The 'Assign Resources' dialog box is shown. The task is 'Set the project management framework'. The resources list includes:

Resource Name	R/D	Units	Cost
Alice Watkins Proc. Officer			
Bob Harvey Senior Plant Designer			
Cyprien Méré Electr. Engineer			
Cyrus Smith Software Engineer			
Gédéon Spilett Controls Engineer			
Herbert Brown Electrician			
John Proth Mechanic			
Lab Infrastr. Budget			
Mathieu Strux Mechanic			
Michel Zorn Electrician			
Ned Land Mech. Engineer			
Project Management Reserve			
PTT System Budget			
Tom Ayrton Senior Plant Engineer			

The 'Task Information' dialog box, Resources tab, is shown. The task is 'Set the project management framework' with a duration of 1 wk. The resources list is:

Resource Name	Assignment Owner	Units	Cost
Alice Watkins Proc. Officer			
Bob Harvey Senior Plant Designer			
Cyprien Méré Electr. Engineer			
Cyrus Smith Software Engineer			
Gédéon Spilett Controls Engineer			
Herbert Brown Electrician			
John Proth Mechanic			
Lab Infrastr. Budget			
Mathieu Strux Mechanic			
Michel Zorn Electrician			
Ned Land Mech. Engineer			
Project Management Reserve			
PTT System Budget			
Tom Ayrton Senior Plant Engineer			

Assigning resources to activities

CanNet_07_activities-dur-links-res-assignments - Project Professional

File Task Resource Report Project View Format Tell me what you want to do...

Team Planner View Assign Resources Resource Pool Add Resources Information Notes Details Level Selection Level Level Level Clear Leveling Next Overalllocation

Task Mode	Task Name	Duration	Resource Names	Resource Initials
1	Manage the CanNet project	19.5 wks		
2	Set the project management framework	1 wk		
3	Perform detailed design of the PTT system	5 wks		
4	Write technical specification for the PTT system	2 wks		
5	Prepare tendering docs for the PTT system	1 wk		
6	Send invitations to tender for the PTT system	0 wks		
7	Open tenders and place order for the PTT system	1 wk		
8	Perform the installation design	1.5 wks		
9	Prepare installation of the PTT system	2 wks		
10	Prepare commissioning of the PTT system	2 wks		
11	Install the tank #1 sampling point assembly	0.5 wks		
12	Install the tank #2 sampling point assembly	0.5 wks		
13	Install the tank #3 sampling point assembly	0.5 wks		
14	Lay down the tubing network	2 wks		
15	Install the blower and lay down the air hoses	1 wk		
16	Pull and connect controls cabling	1 wk		
17	Install the PLC and sending station in the lab	2 wks		
18	Parametrize software for the PTT system	4 wks		
19	Test and validate software for the PTT system	2 wks		
20	Perform detailed design of the lab arrangement	2 wks		
21	Write technical specification for the electr. infrastr.	1 wk		
22	Prepare tendering docs for the electr. infrastr.	1 wk		
23	Send invitations to tender for the electr. infrastr.	0 wks		
24	Open tenders and place order for the electr. infrastr.	0.5 wks		
25	Install the electr. infrastr. In the lab	2 wks		
26	Write technical specification for the lab's furniture	0.5 wks		
27	Prepare tendering docs for the lab's furniture	0.5 wks		
28	Send invitations to tender for the lab's furniture	0 wks		
29	Open tenders and place order for the lab's furniture	0.5 wks		
30	Arrange the furniture in the lab	1 wk		
31	Prepare tendering docs for the specific tooling	0.5 wks		

CanNet_00_XBS

Home Insert Page Layout Formulas Data Review View Developer

Generate Act + Res
Generate Initials

Run macro

2

CanNet

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 docs 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.

Human Resources
Tommy
Bob
Alice
Michael
Maggie
Neil
Anna
Maggie
Cyril
Financial Resources
PTT System
Lab Interiors
Project Management Resource

Select range

1

CanNet_00_XBS

Home Insert Page Layout Formulas Data Review View Developer

Generate Act + Res
Generate Initials

Select range + copy

3

CanNet

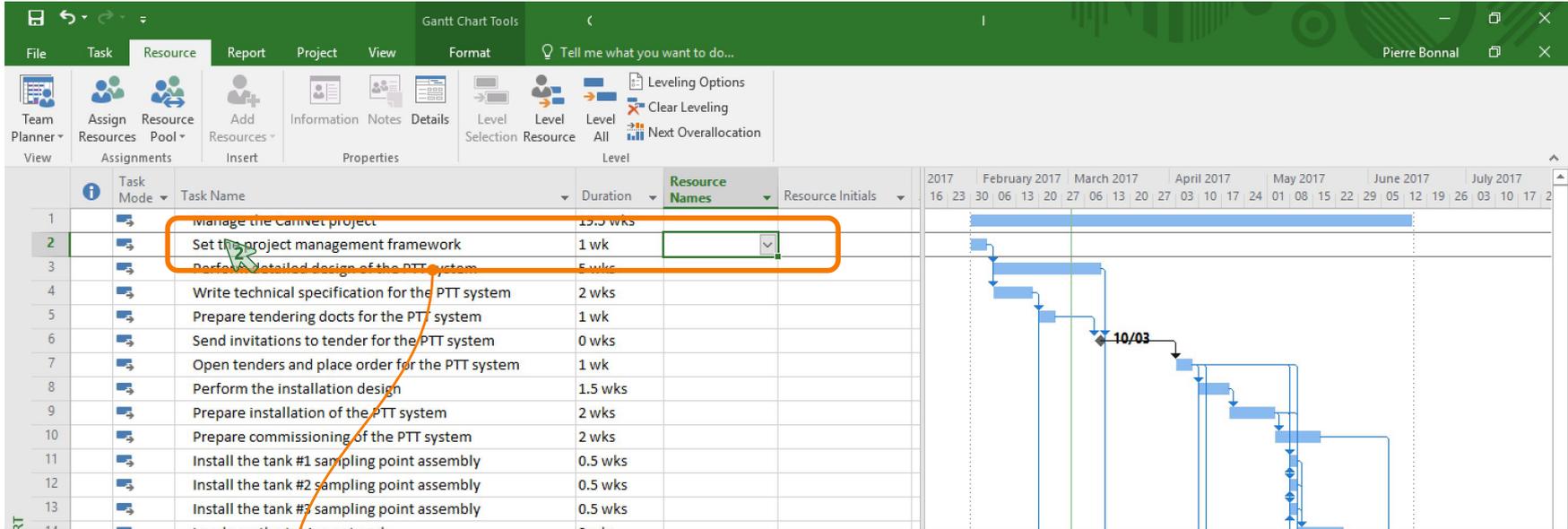
TA, BH, CM, nL, gS
TA
BH
nL
aW
aW
TA, aW, nL
BH
nL
CM, nL, gS, cS
nL, JP, mS
CM, HB, mZ, gS
gS
cS
cS
BH
cS

GANTT CHART

Assigning resources to activities

The screenshot displays the Microsoft Project Professional interface. The top ribbon includes 'Task', 'Resource', 'Report', 'Project', 'View', and 'Format'. The 'View' tab is active, showing the 'Gantt Chart' view. A task list on the left shows various project activities. The main area displays a Gantt chart with resource bars for 'Tom Ayrton | Senior Plant Engineer' and 'Bob Harvey | Senior Plant Designer'. A 'Details' button in the ribbon is highlighted with an orange box. A callout box points to the 'Details' button with the text 'Click once'. Below the Gantt chart, the 'Resource Graph' view is shown, displaying a bar chart of resource usage over time. A legend for 'Tom Ayrton | Senior Plant Engineer' indicates 'Overallocated' (red), 'Allocated' (blue), and 'Proposed' (purple). A large blue box with the text 'Resource Graph view' is overlaid on the graph. The bottom status bar shows 'New Tasks : Auto Scheduled'.

Before leveling



Task Information

General | Predecessors | Resources | **Advanced** | Notes | Custom Fields

Name: Set the project management framework Duration: 1 wk Estimated

Constrain task

Deadline: NA

Constraint type: As Soon As Possible Constraint date: NA

Task type: **Fixed Units** (selected)

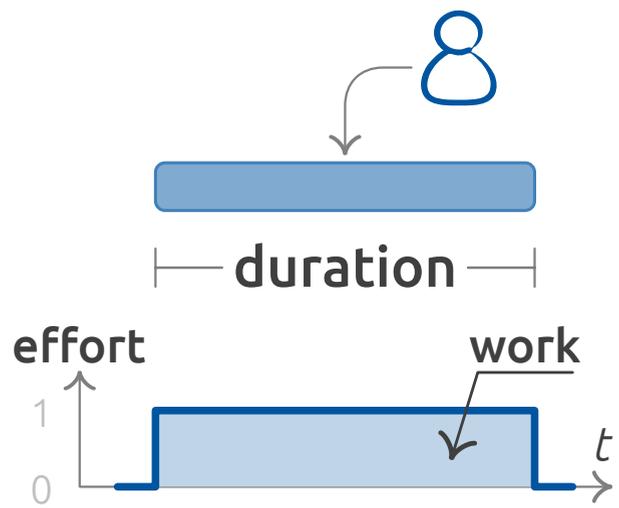
Calendar: Effort driven

WBS code: Scheduling ignores resource calendars

Earned value m

Mark task as milestone

Help OK Cancel



Leveling

CanNet_08_activities-dur-links-res-leveling - Project Pro

File Task Resource Report Project View Format Tell me what you want to do...

Team Planner View Assign Resources Assignments Resource Pool Add Resources Insert Information Notes Details Level Selection

Task Mode	Task Name	Duration	Resource Names	Resource Initials
1	Manage the CanNet project	19.5 wks	Tom Ayrton Se	ta,bH,cM,nL,gS
2	Set the project management framework	1 wk	Tom Ayrton Se	ta
3	Perform detailed design of the PTT system	5 wks	Bob Harvey Ser	bH
4	Write technical specification for the PTT system	2 wks	Ned Land Mech	nL
5	Prepare tendering docs for the PTT system	1 wk	Alice Watkins i	aW
6	Send invitations to tender for the PTT system	0 wks	Alice Watkins i	aW
7	Open tenders and place order for the PTT system	1 wk	Tom Ayrton Se	ta,aW,nL
8	Perform the installation design			
9	Prepare installation of the PTT system			
10	Prepare commissioning of the PTT system			
11	Install the tank #1 sampling point assembly			
12	Install the tank #2 sampling point assembly			
13	Install the tank #3 sampling point assembly			
14	Lay down the tubing network			
15	Install the blower and lay down the air hoses			
16	Pull and connect controls cabling			
17	Install the PLC and sending station in the lab			
18	Parametrize software for the PTT system			
19	Test and validate software for the PTT system			
20	Perform detailed design of the lab arrangement			
21	Write technical specification for the electr. infrastr.			
22	Prepare tendering docs for the electr. infrastr.			
23	Send invitations to tender for the electr. infrastr.			
24	Open tenders and place order for the electr. infrastr.			
25	Install the electr. infrastr. in the lab			
26	Write technical specification for the lab's furniture	0.5 wks	Cyprien Méré i	cM
27	Prepare tendering docs for the lab's furniture	0.5 wks	Alice Watkins i	aW
28	Send invitations to tender for the lab's furniture	0 wks	Alice Watkins i	aW
29	Open tenders and place order for the lab's furniture	0.5 wks	Tom Ayrton Se	ta,aW,cM
30	Arrange the furniture in the lab	1 wk	Cyprien Méré i	cM,hB,mZ,gS
31	Prepare tendering docs for the specific tooling	0.5 wks	Alice Watkins i	aW

Level Resource

Leveling Options

Level Resource

Leveling calculations

Automatic Manual

Look for overallocations on a Day by Day basis

Clear leveling values before leveling

Leveling range for 'CanNet_08_activities'

Level entire project

Level From: Mon 30/01/17 To: Wed 14/06/17

Resolving overallocations

Leveling order: Standard

Level only within available task

Leveling can adjust in priority, Standard a task

Leveling can create splits in remaining work

Level resources with the proposed booking type

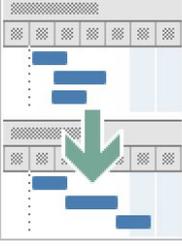
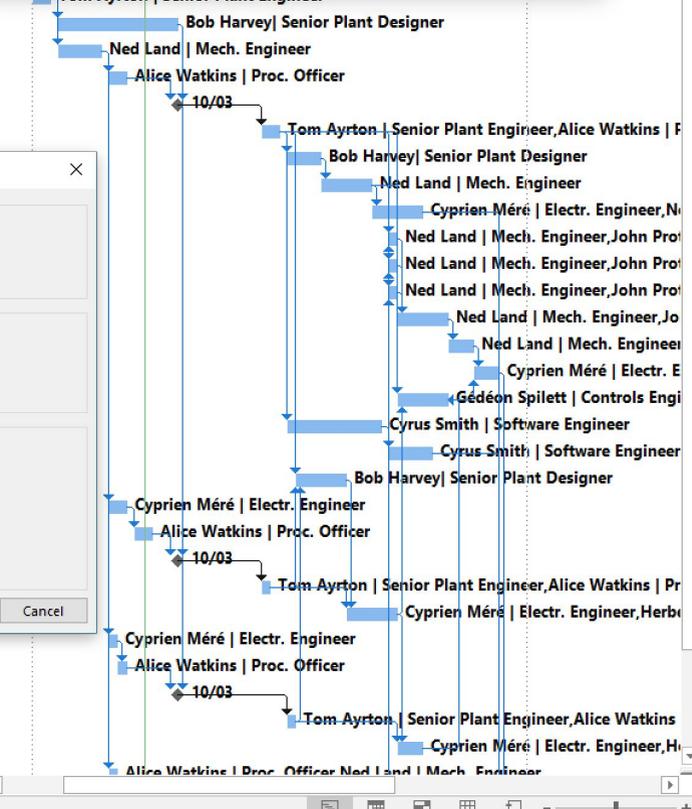
Level manually scheduled tasks

Help Clear Leveling... Level-All OK Cancel

Level Resource

Level tasks for the selected resources.

Leveling resolves resource conflicts or overallocations by delaying or splitting tasks, based on the settings in the Leveling Options dialog box.

Tom Ayrton | Senior Plant Engineer

Bob Harvey | Senior Plant Designer

Ned Land | Mech. Engineer

Alice Watkins | Proc. Officer

Tom Ayrton | Senior Plant Engineer, Alice Watkins | Proc. Officer

Bob Harvey | Senior Plant Designer

Ned Land | Mech. Engineer

Cyprien Méré | Electr. Engineer, Ned Land | Mech. Engineer, John Pro

Cyprien Méré | Electr. Engineer

Gédéon Spilett | Controls Engineer

Cyrus Smith | Software Engineer

Cyrus Smith | Software Engineer

Bob Harvey | Senior Plant Designer

Cyprien Méré | Electr. Engineer

Alice Watkins | Proc. Officer

Tom Ayrton | Senior Plant Engineer, Alice Watkins | Proc. Officer

Cyprien Méré | Electr. Engineer, Herb

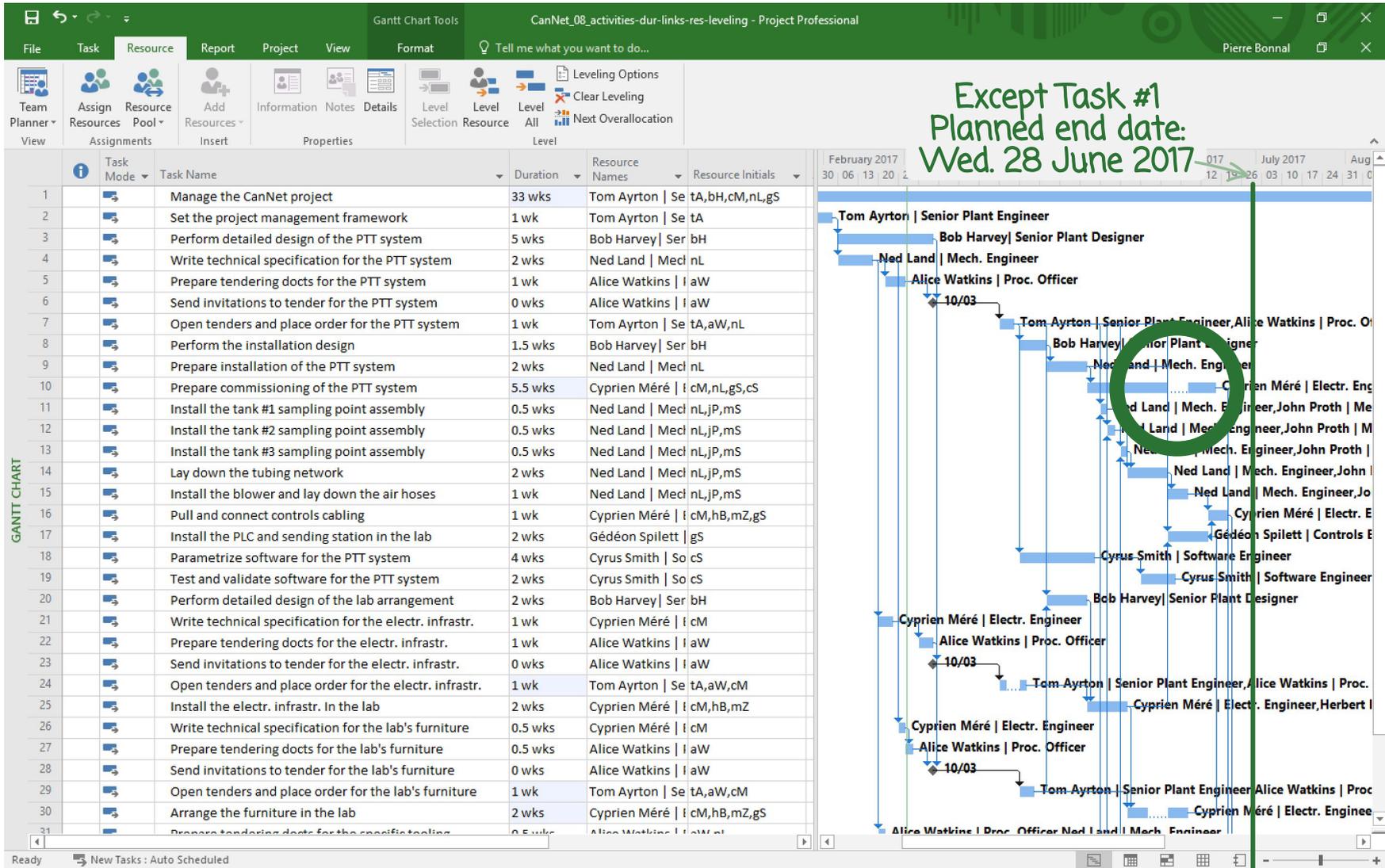
Cyprien Méré | Electr. Engineer

Alice Watkins | Proc. Officer

Tom Ayrton | Senior Plant Engineer, Alice Watkins | Proc. Officer

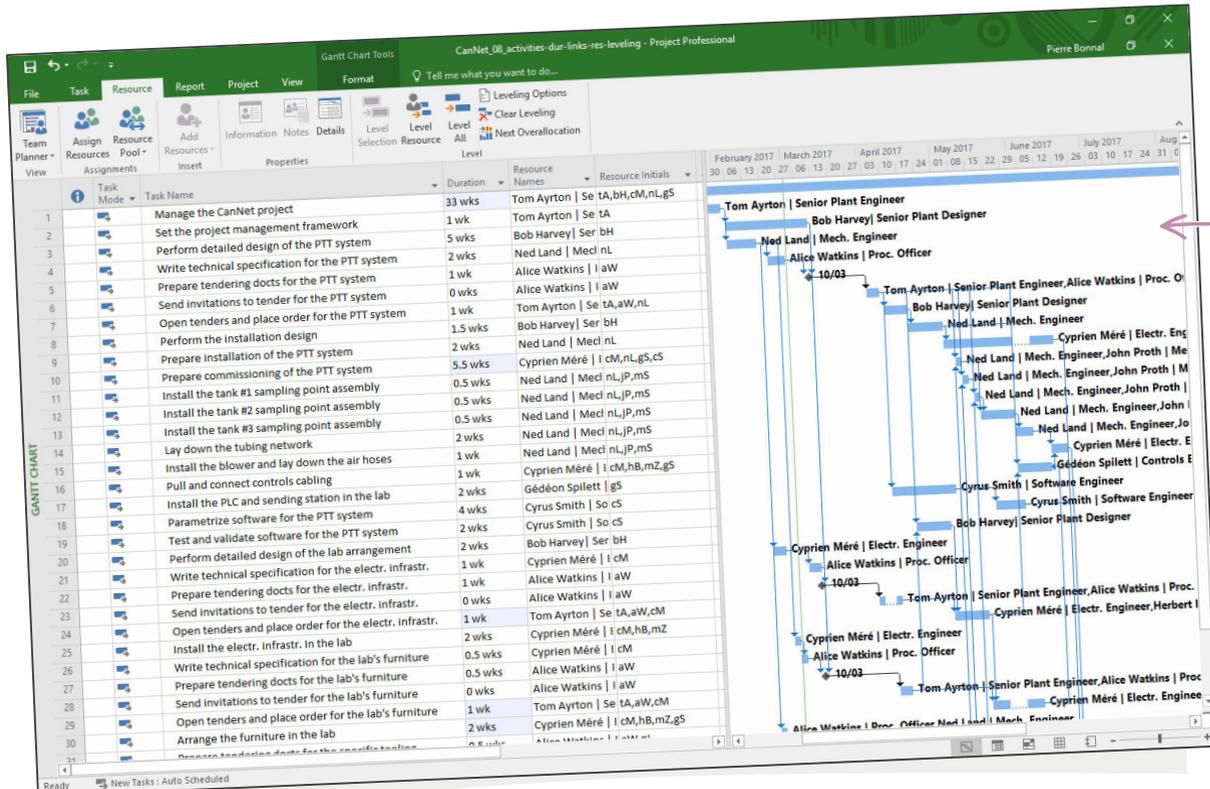
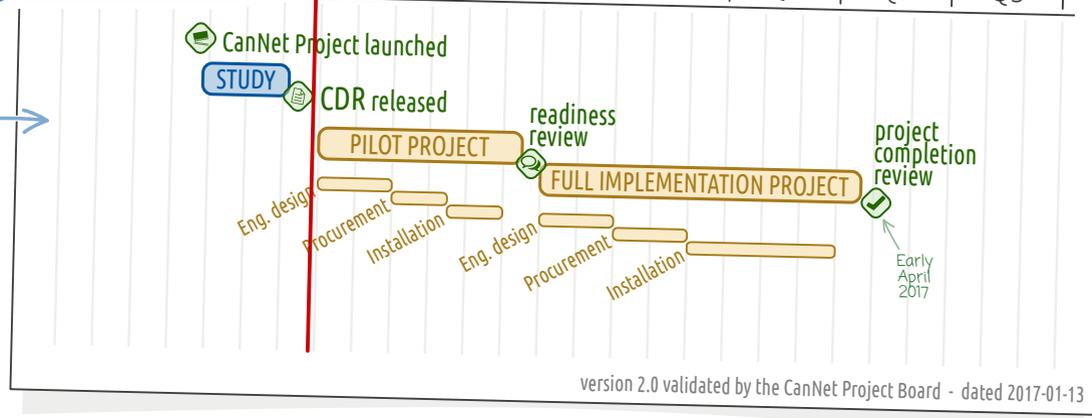
Cyprien Méré | Electr. Engineer, Herb

Schedule analysis



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

$$\text{Float} = 29 - 26.5 = 2.5 \text{ wks}$$


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.

The screenshot shows the Microsoft Project Professional interface. The main window displays a Gantt chart on the right and a task list on the left. The task list includes tasks such as 'Manage the CanNet project', 'Set the project management framework', and 'Perform detailed design of the PTT system'. The Gantt chart shows the project schedule with tasks and resources assigned. A 'Set Baseline' dialog box is open, and a 'View' dialog box is also visible. Arrows and numbers 1 and 2 highlight specific actions.

1 Points to the 'Set Baseline...' button in the 'Set Baseline' dialog box.

2 Points to the 'Baseline' checkbox in the 'View' dialog box.

Task ID	Task Name	Duration	Resources
1	Manage the CanNet project	33 wks	Tom Ayrton Senior Plant Engineer
2	Set the project management framework	1 wk	Tom Ayrton Senior Plant Engineer
3	Perform detailed design of the PTT system	5 wks	Bob Harvey Senior Plant Designer
4	Write technical specification for the PTT system	2 wks	Ned Land Mech. Engineer
5	Prepare tendering docs for the PTT system	1 wk	Alice Watkins Proc. Officer
6	Send invitations to tender for the PTT system	0 wks	Alice Watkins Proc. Officer
7	Open tenders and place order for the PTT system	1 wk	Tom Ayrton Senior Plant Engineer
8	Perform technical specification for the PTT system	1 wk	Bob Harvey Senior Plant Designer
9	Prepare in-house technical specification for the PTT system	1 wk	Ned Land Mech. Engineer
10	Prepare contract documents for the PTT system	1 wk	Cyprien Méré Electr. Engineer
11	Install the PTT system	1 wk	Ned Land Mech. Engineer
12	Install the PTT system	1 wk	Ned Land Mech. Engineer
13	Install the PTT system	1 wk	Ned Land Mech. Engineer
14	Lay down the PTT system	1 wk	Ned Land Mech. Engineer
15	Install the PTT system	1 wk	Ned Land Mech. Engineer
16	Pull up and connect the PTT system	1 wk	Cyprien Méré Electr. Engineer
17	Install the PTT system	1 wk	Gédéon Spilett Controls Engineer
18	Parameterize the PTT system	1 wk	Cyrus Smith Software Engineer
19	Test and validate the PTT system	1 wk	Cyrus Smith Software Engineer
20	Perform detailed design of the PTT system	1 wk	Bob Harvey Senior Plant Designer
21	Write technical specification for the PTT system	1 wk	Cyprien Méré Electr. Engineer
22	Prepare tendering docs for the PTT system	1 wk	Alice Watkins Proc. Officer
23	Send invitations to tender for the PTT system	1 wk	Alice Watkins Proc. Officer
24	Open tenders and place order for the electr. infrastr.	1 wk	Tom Ayrton Senior Plant Engineer, Alice Watkins Proc. Officer
25	Install the electr. infrastr. in the lab	2 wks	Cyprien Méré Electr. Engineer, Herbert I.
26	Write technical specification for the lab's furniture	0.5 wks	Cyprien Méré Electr. Engineer
27	Prepare tendering docs for the lab's furniture	0.5 wks	Alice Watkins Proc. Officer
28	Send invitations to tender for the lab's furniture	0 wks	Alice Watkins Proc. Officer
29	Open tenders and place order for the lab's furniture	1 wk	Tom Ayrton Senior Plant Engineer, Alice Watkins Proc. Officer
30	Arrange the furniture in the lab	2 wks	Cyprien Méré Electr. Engineer
31	Prepare tendering docs for the specific tooling	0.5 wks	Alice Watkins Proc. Officer

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Setting up an effective **Microsoft Project** working configuration





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