CONSTRUCTION SCHEDULING

PhD. Eng. Jerzy Rosłon, ACIOB, PSMB, IPMA
Institute of Building Engineering

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Schedule - planned dates of **activities** and planned **milestones** of the schedule (significant events in the project, e.g. end of a stage, acceptance).

Scheduling - finding such start dates for all activities that meet the constraints related to the relationships between them and the availability of resources, with the simultaneous optimization of the objective function (it may be, for example, minimizing the duration of the project or maximizing NPV).

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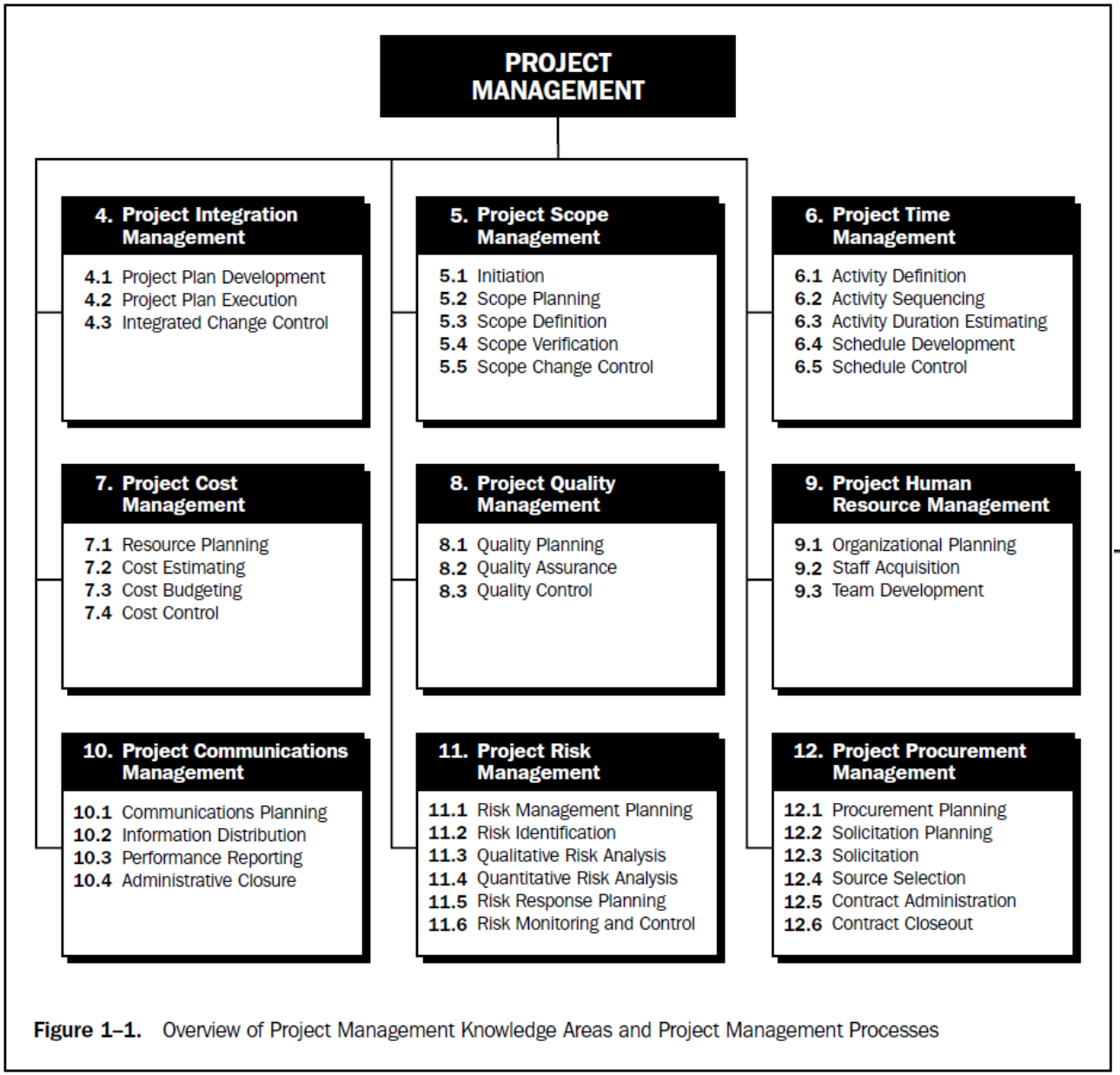

Figure 1–1. Overview of Project Management Knowledge Areas and Project Management Processes

6.4 Schedule Development

.1 Inputs
- .1 Project network diagrams
- .2 Activity duration estimates
- .3 Resource requirements
- .4 Resource pool description
- .5 Calendars
- .6 Constraints
- .7 Assumptions
- .8 Leads and lags
- .9 Risk management plan
- .10 Activity attributes

.2 Tools and Techniques
- .1 Mathematical analysis
- .2 Duration compression
- .3 Simulation
- .4 Resource leveling heuristics
- .5 Project management software
- .6 Coding structure

.3 Outputs
- .1 Project schedule
- .2 Supporting detail
- .3 Schedule management plan
- .4 Resource requirement updates

Project Management Institute. (2004). A Guide to the Project Management Body of Knowledge, Third Edition, PMI, USA.

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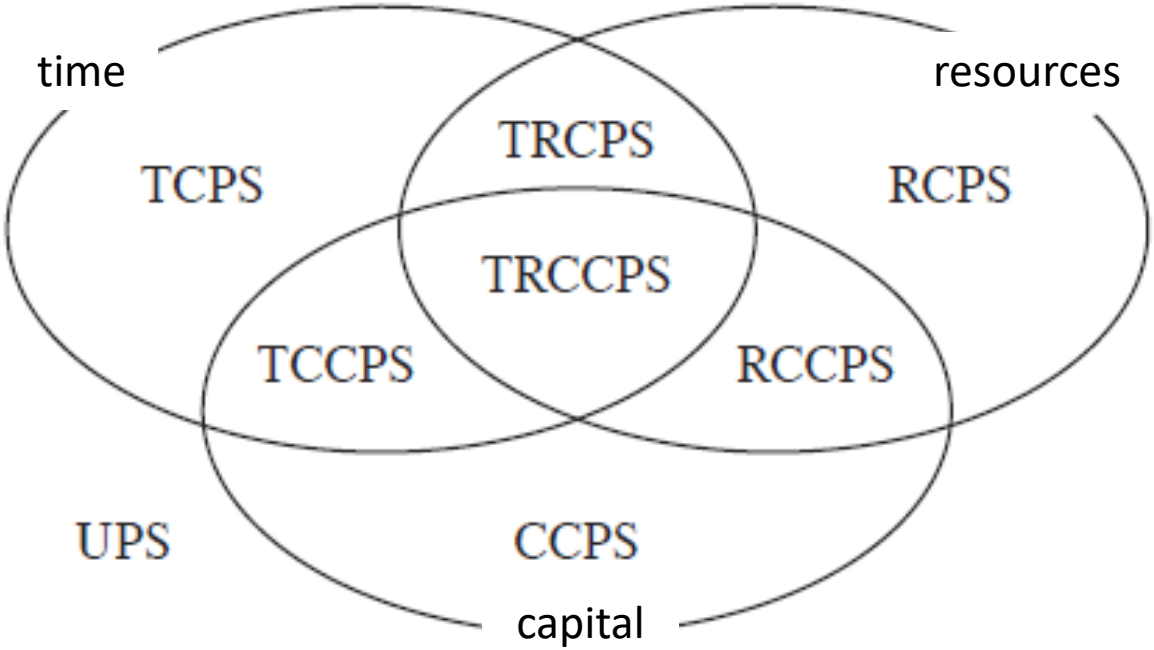

- UPS - *unconstrained project scheduling*
- TCPS - *time constrained project scheduling*
- RCPS - *resource constrained project scheduling*
- CCPS - *capital constrained project scheduling*
- TRCPS - *time and resource constrained project scheduling*
- TCCPS - *time and capital constrained project scheduling*
- RCCPS - *resource and capital constrained project scheduling*
- TRCCPS - *time, resource and capital constrained project scheduling*

Kostrubiec, A. (2003). Harmonogramowanie realizacji projektów-przegląd modeli. W: Inżynieria zarządzania przedsięwzięciami. Red. L. Zawadzka. Gdańsk, 2003.

other examples:

- Deterministic vs. Non-deterministic
- Master project schedule vs. Milestone schedule / summary schedule vs. Detailed project schedule
- *Multi-Mode Resource-Constrained Project Scheduling* - **MRCPS,**
- *Multi-Mode Resource-Constrained Time-Cost Trade-off*, **MRC-TCT** or **RC-TCT**),
- *Time, Resource & Capital Constrained Project Scheduling Problem* - **TRCCPSP**,
- **P-MRCPSP** - *preemptive scheduling*,
- *MRCPSP with Discounted Cash Flows* – **MRCPSPDCF**,

.....and many, many more….

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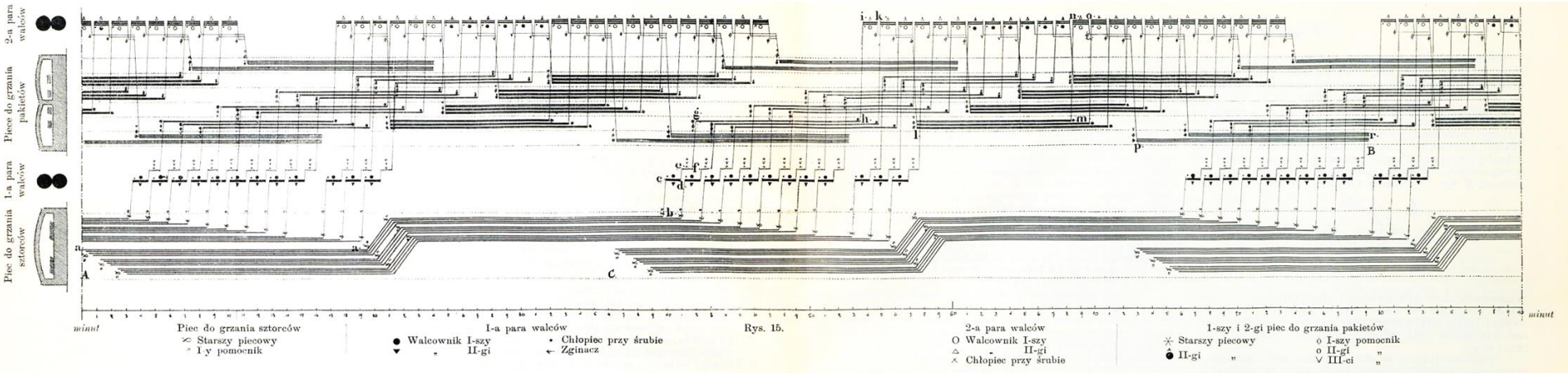
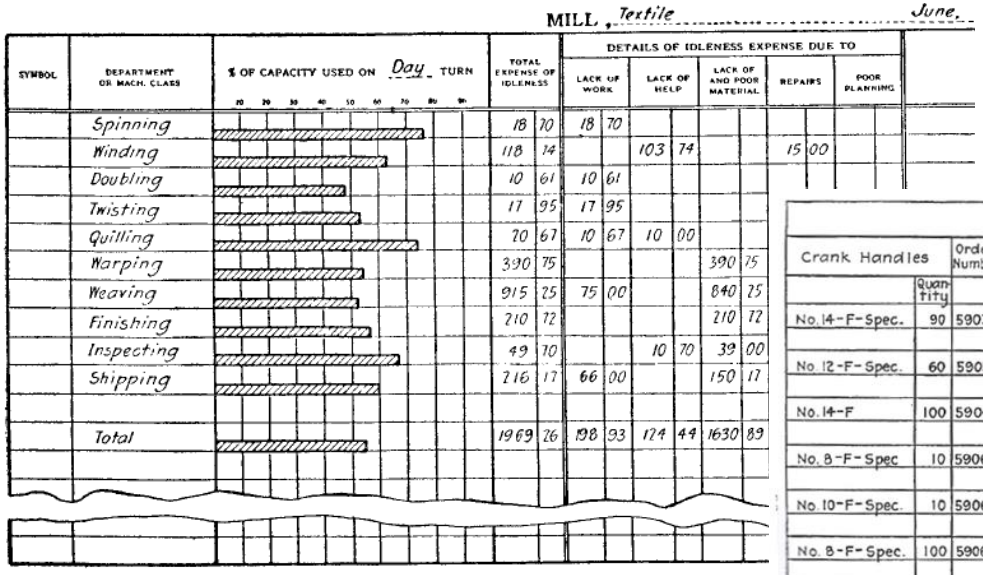
Karol Adamiecki and Henry Gantt

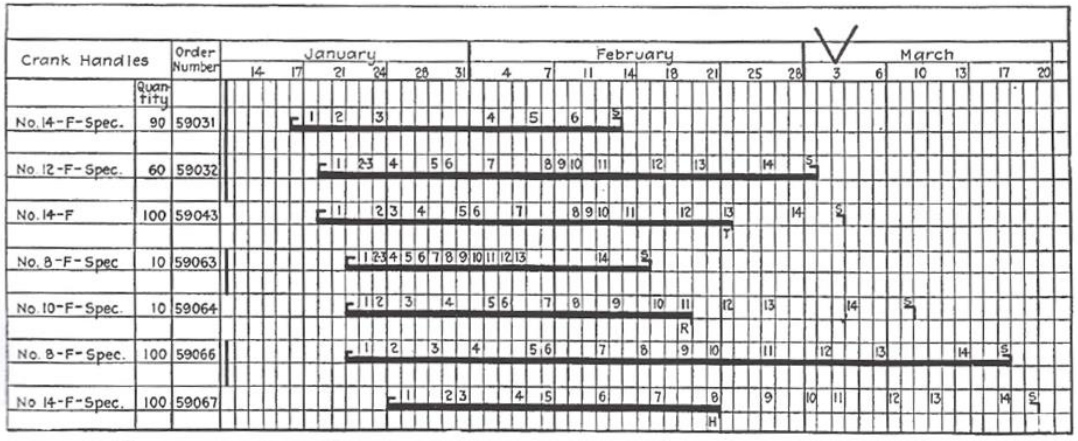


Karol Adamiecki, 1909, Metoda wykreślna organizowania pracy zbiorowej w walcowniach, w: Przegląd Techniczny 19 (47)



MILL, Textile — June.

SYMBOL	DEPARTMENT OR MACH. CLASS	% OF CAPACITY USED ON Day TURN	TOTAL EXPENSE OF IDLENESS	DETAILS OF IDLENESS EXPENSE DUE TO: LACK OF WORK	LACK OF HELP	LACK OF AND POOR MATERIAL	REPAIRS	POOR PLANNING
	Spinning		18 70	18 70				
	Winding		118 14		103 74		15 00	
	Doubling		10 61	10 61				
	Twisting		17 95	17 95				
	Quilling		70 67	10 67	10 00			
	Warping		390 75			390 75		
	Weaving		915 25	75 00		840 25		
	Finishing		210 72			210 72		
	Inspecting		49 70		10 70	39 00		
	Shipping		216 17	66 00		150 17		
	Total		1969 26	198 93	124 44	1630 89		



Crank Handles	Quantity	Order Number
No. 14-F-Spec.	90	59031
No. 12-F-Spec.	60	59032
No. 14-F	100	59043
No. 8-F-Spec	10	59063
No. 10-F-Spec.	10	59064
No. 8-F-Spec.	100	59066
No. 14-F-Spec.	100	59067

January — February — March

https://www.onepager.com/community/blog/a-brief-history-of-the-gantt-chart/

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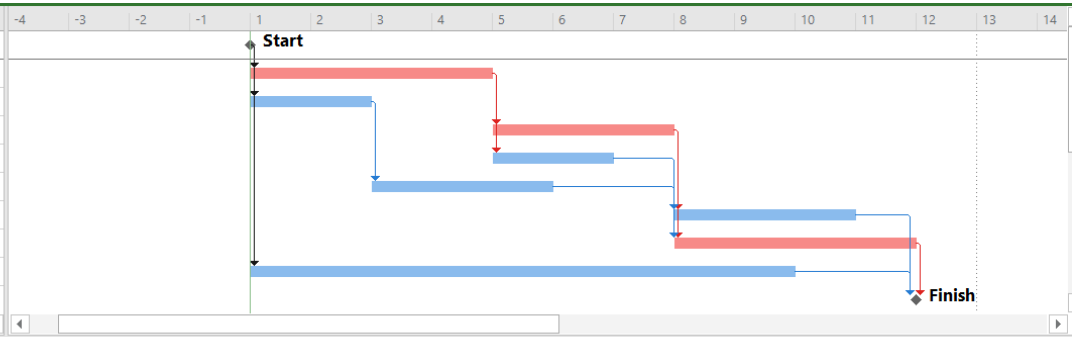
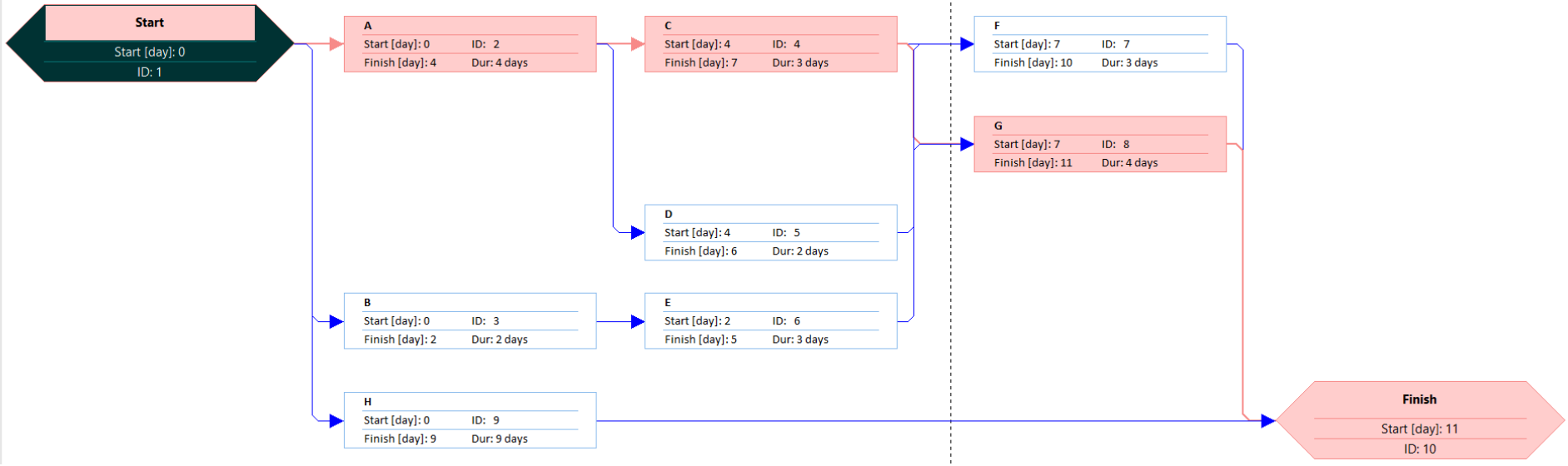
Network vs. Gantt chart

GANTT CHART

	Task	Task Name	Duration	Start [day]	Finish [day]	Predecessors
1		Start	0 days	0	0	
2		A	4 days	0	4	1
3		B	2 days	0	2	1
4		C	3 days	4	7	2
5		D	2 days	4	6	2
6		E	3 days	2	5	3
7		F	3 days	7	10	4;6
8		G	4 days	7	11	4;5
9		H	9 days	0	9	1
10		Finish	0 days	11	11	7;8;9



NETWORK DIAGRAM



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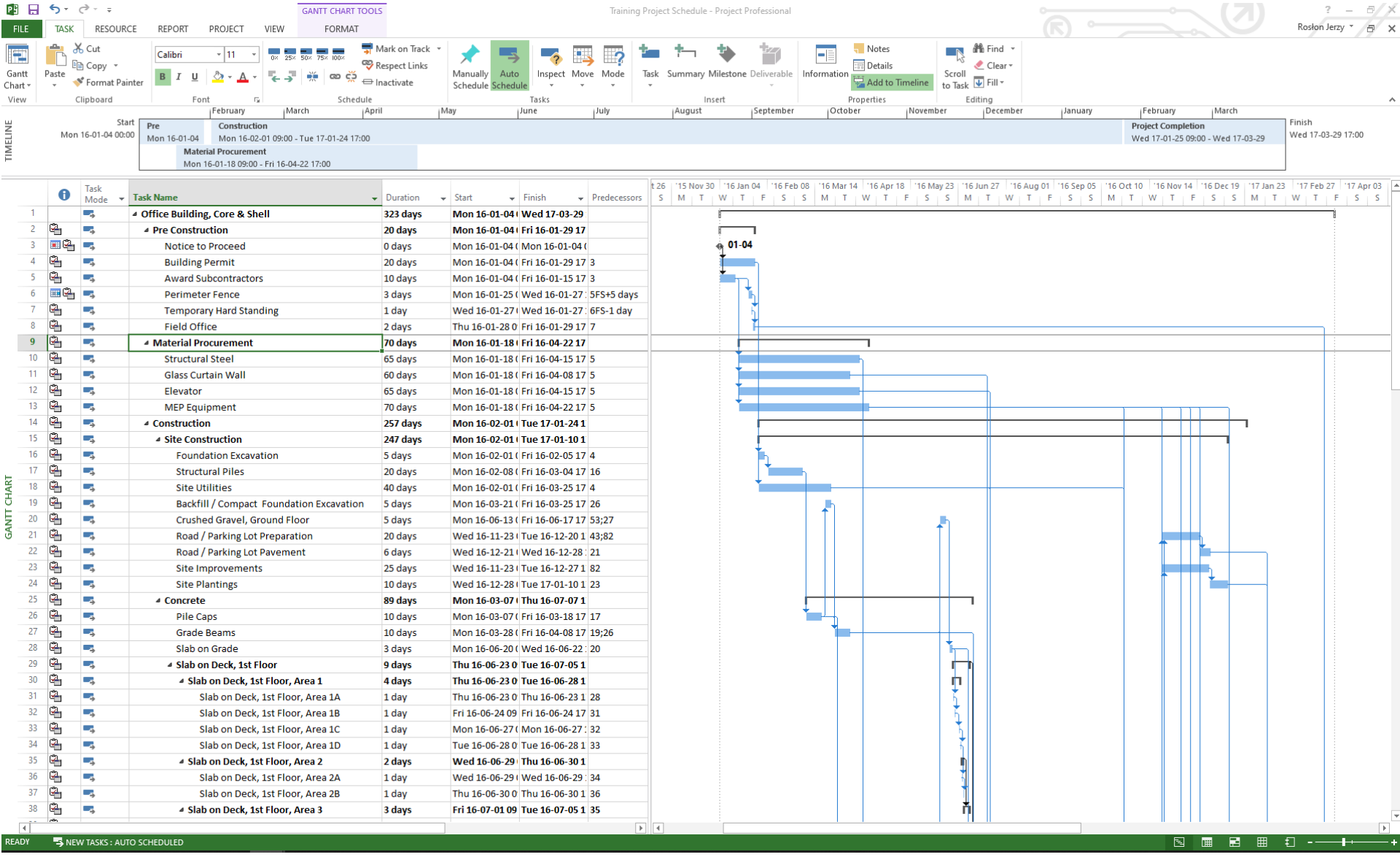
MS Project



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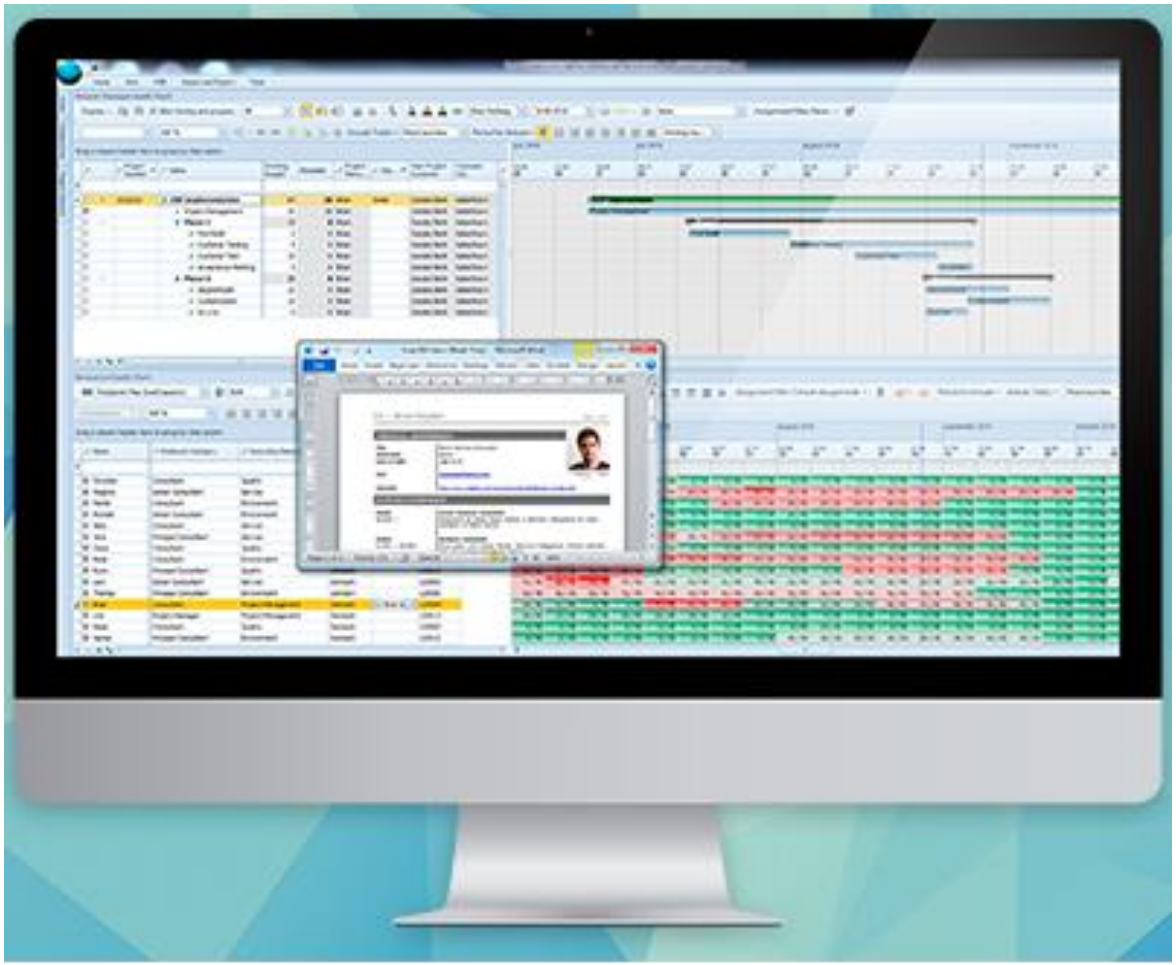
Maconomy People Planner



https://www.deltek.com/en/products/project-erp/maconomy/modules/people-planner

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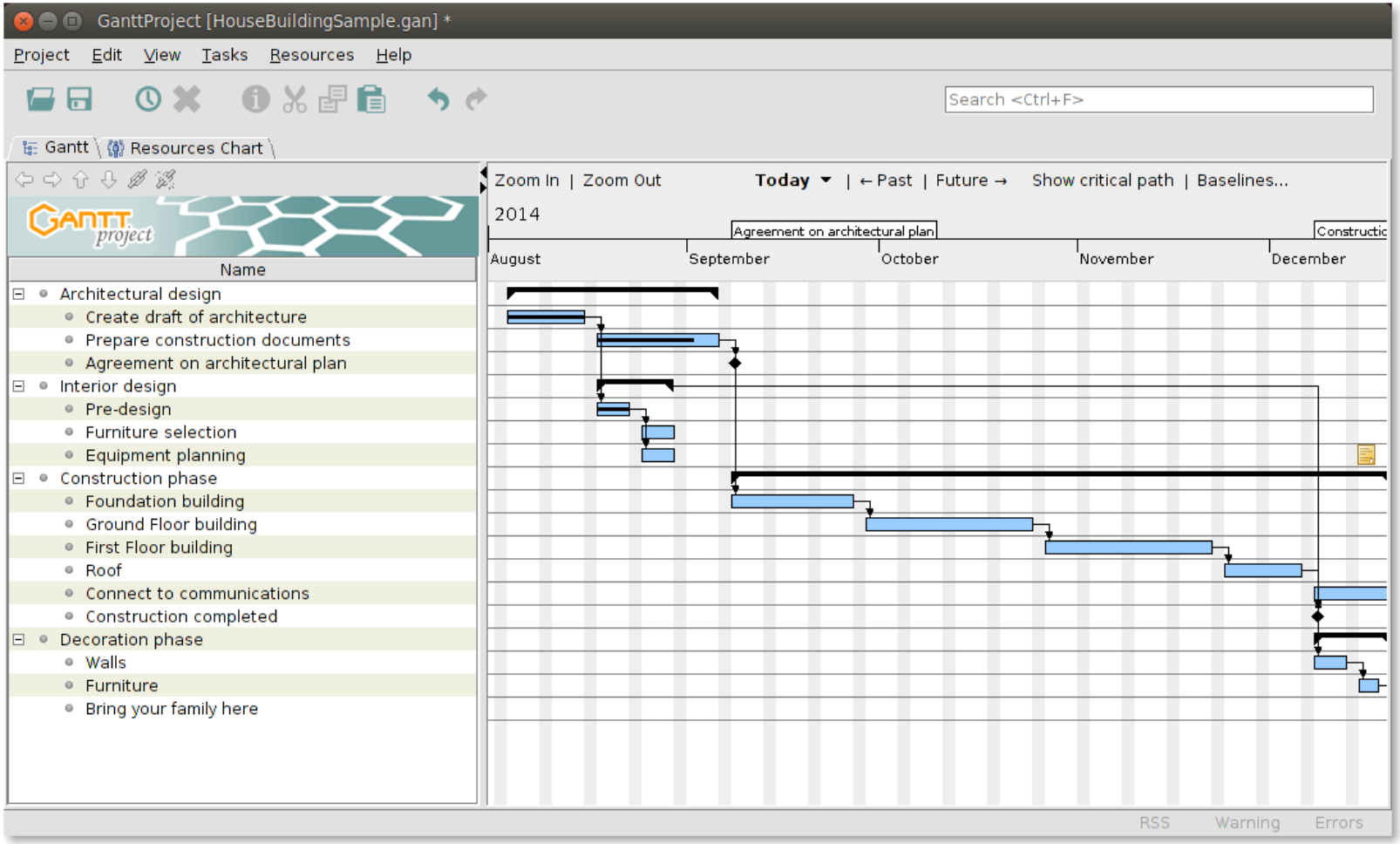
GanttProject



http://www.ganttproject.biz/

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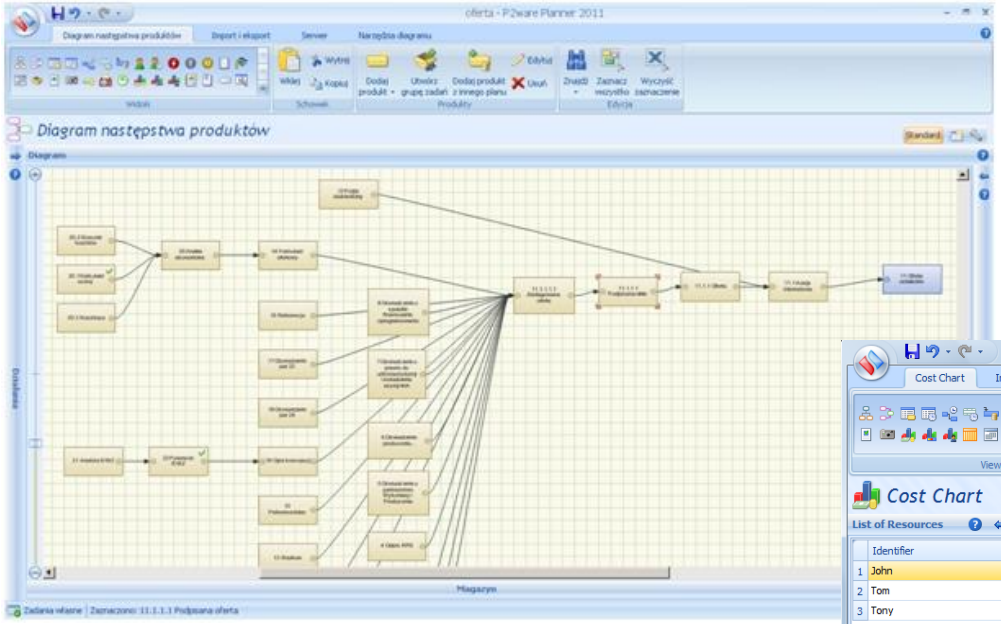
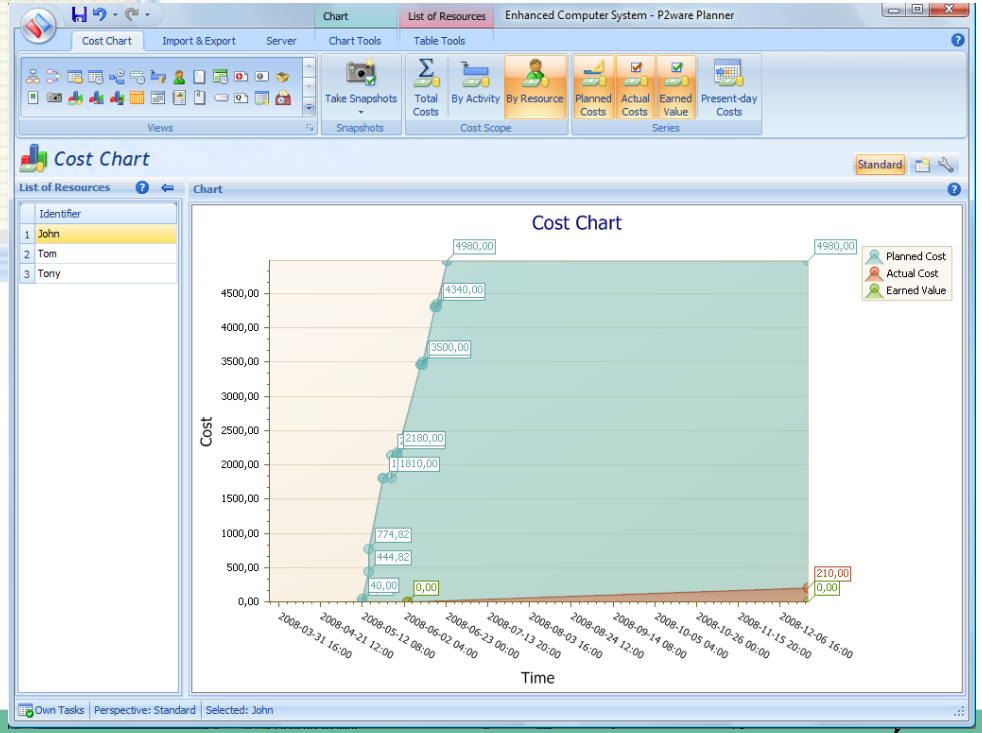
P2ware Planner Suite





http://p2ware.com/pl

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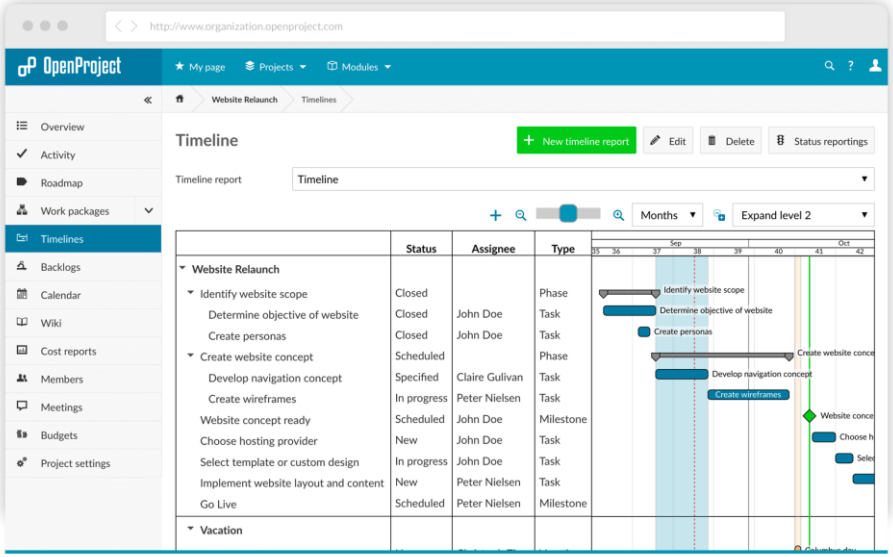
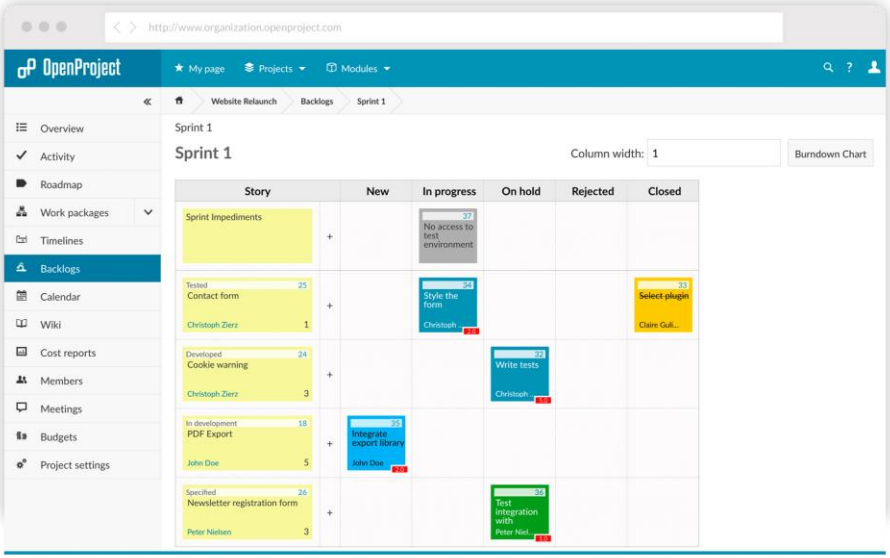
Open Project





https://www.openproject.org/

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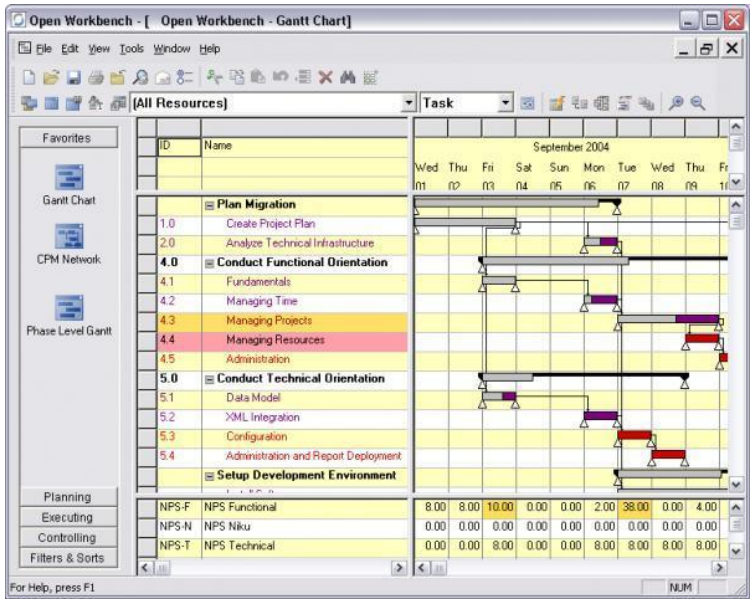
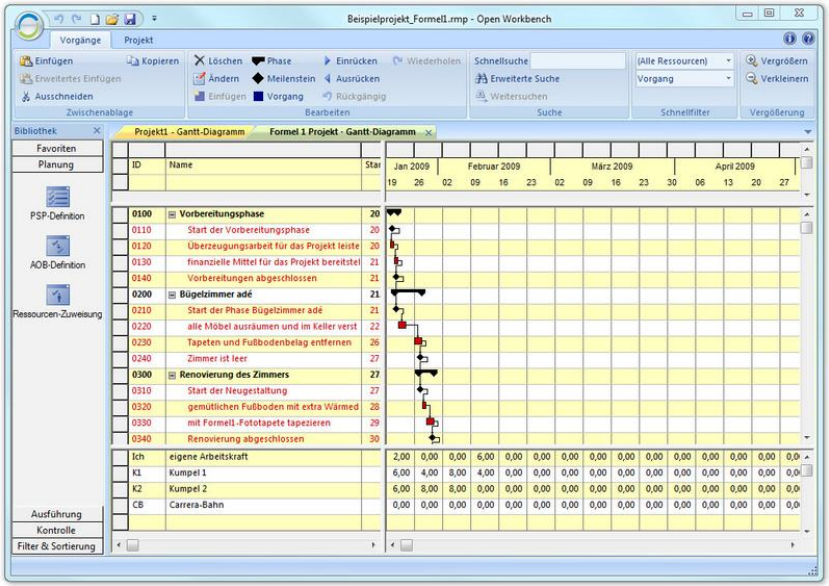
Open Workbench





https://en.wikipedia.org/wiki/Open_Workbench

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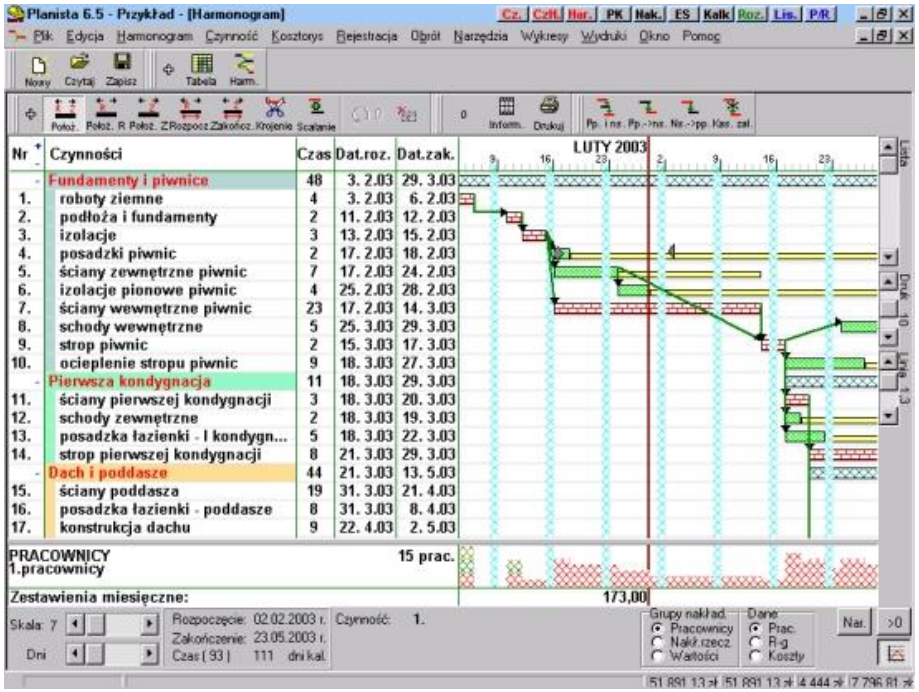
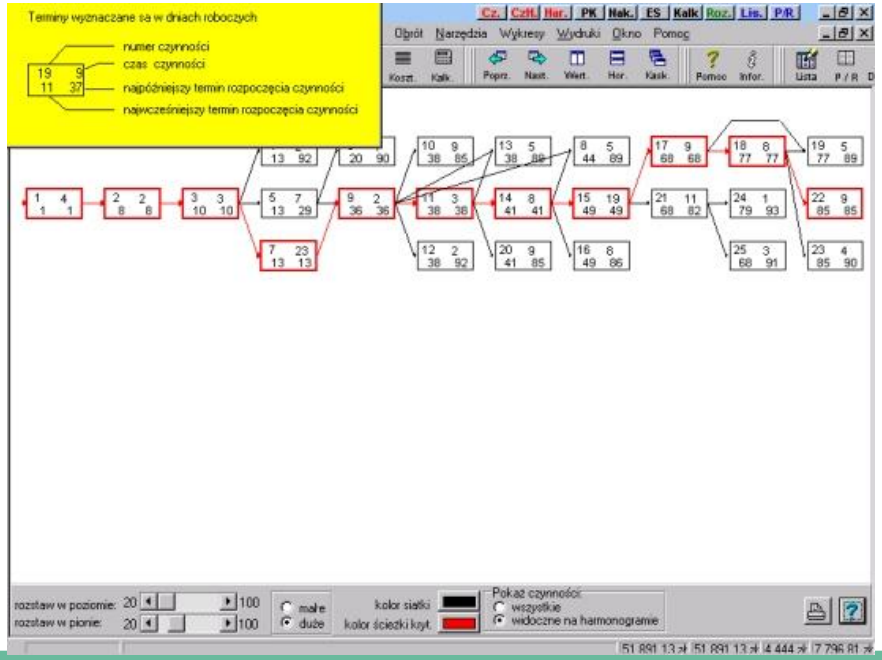
Planista





http://www.planista.com.pl/plan.php

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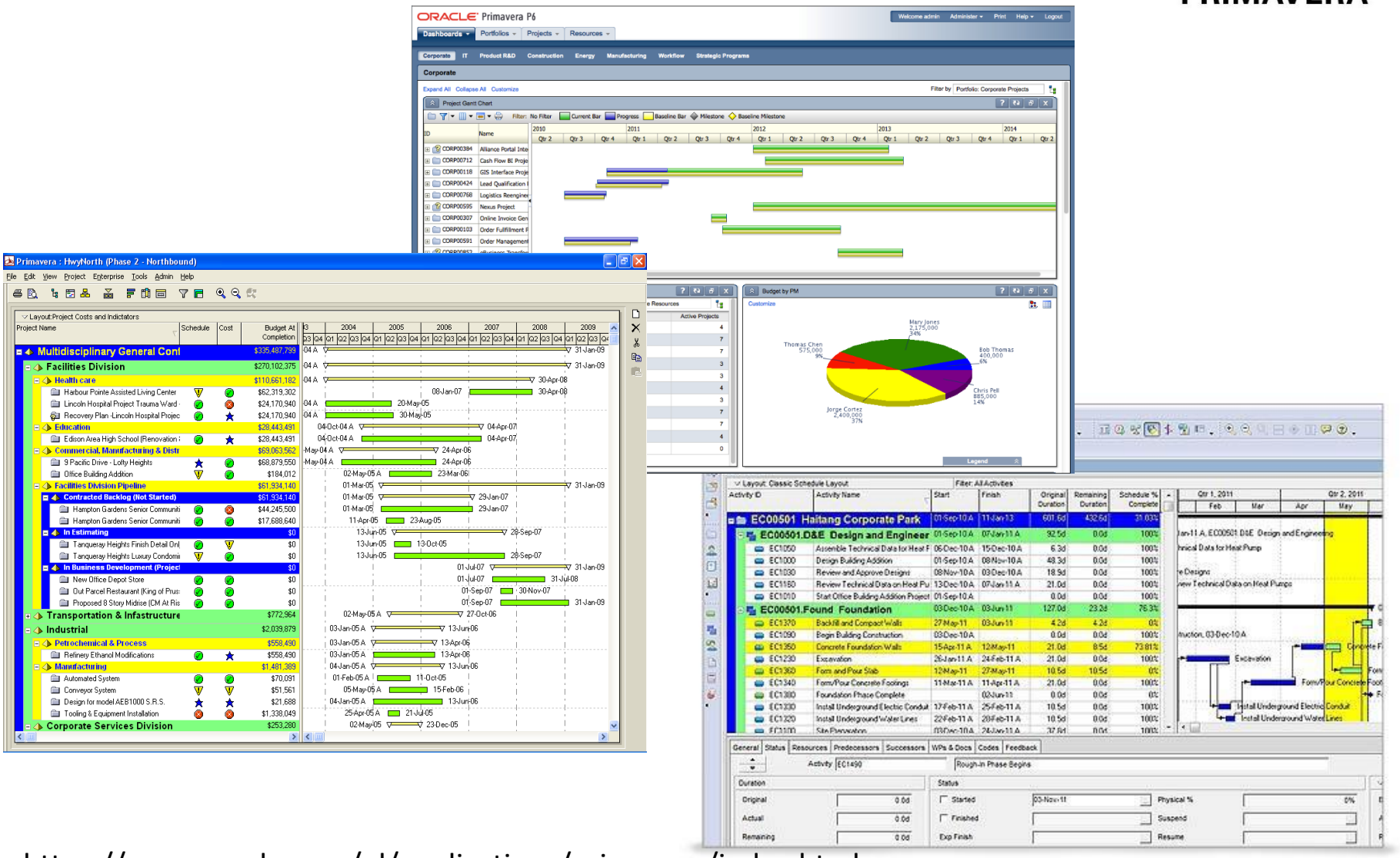
Primavera

ORACLE
PRIMAVERA



https://www.oracle.com/pl/applications/primavera/index.html

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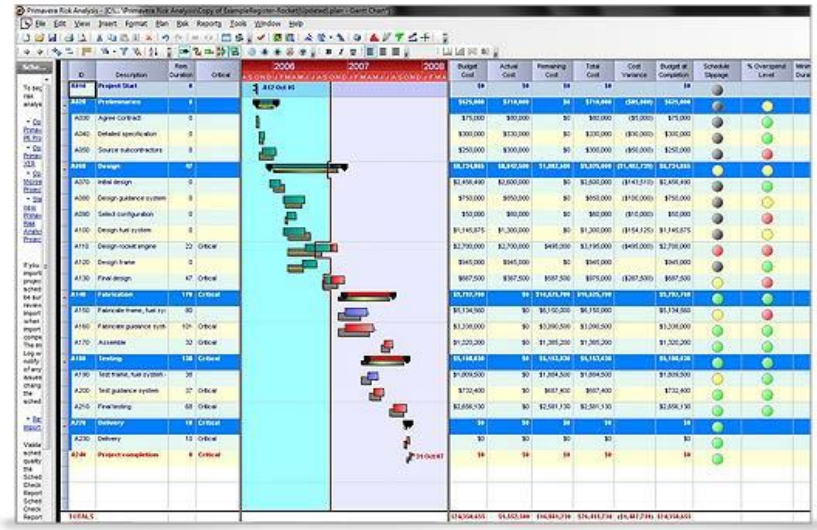
Pertmaster - Oracle's Primavera Risk Analysis



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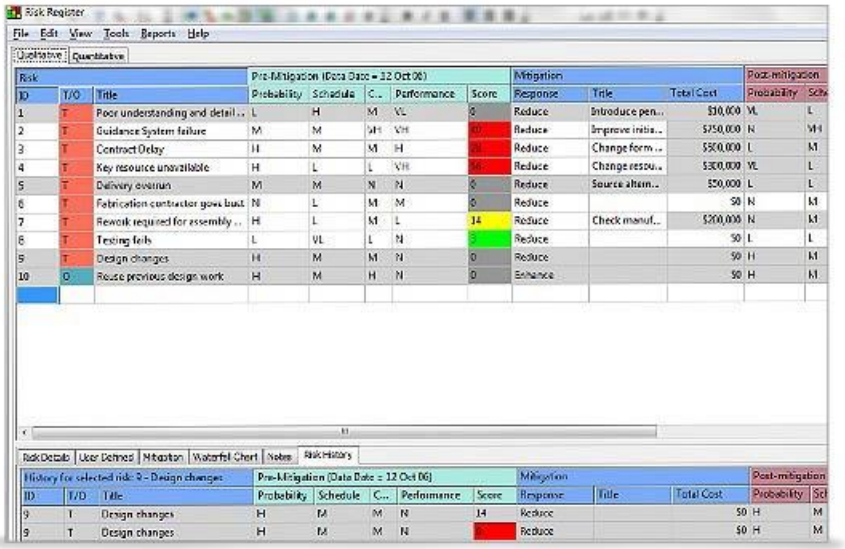

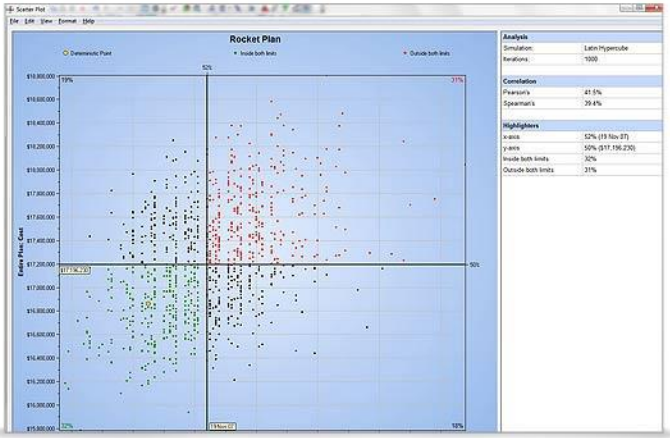

https://www.oracle.com/pl/applications/primavera/index.html

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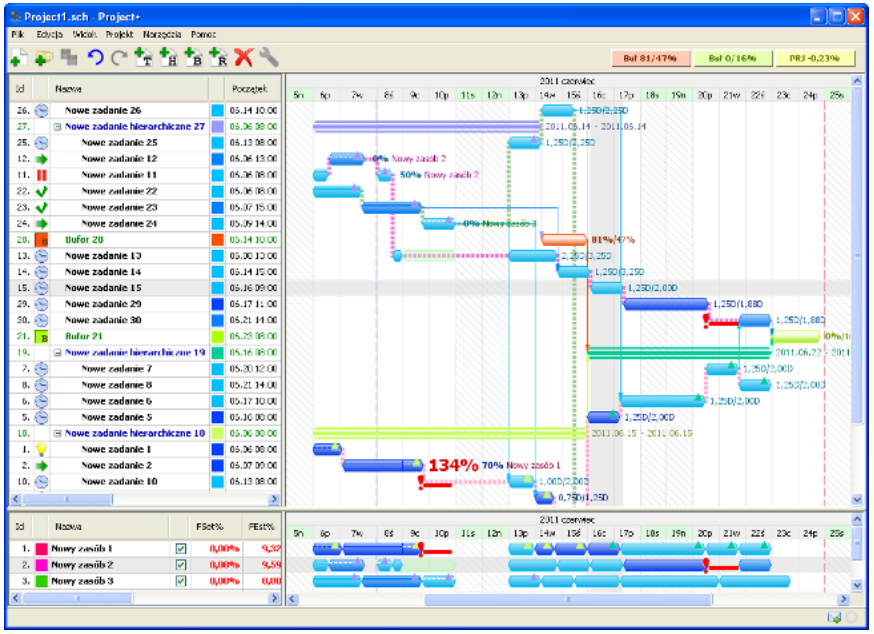
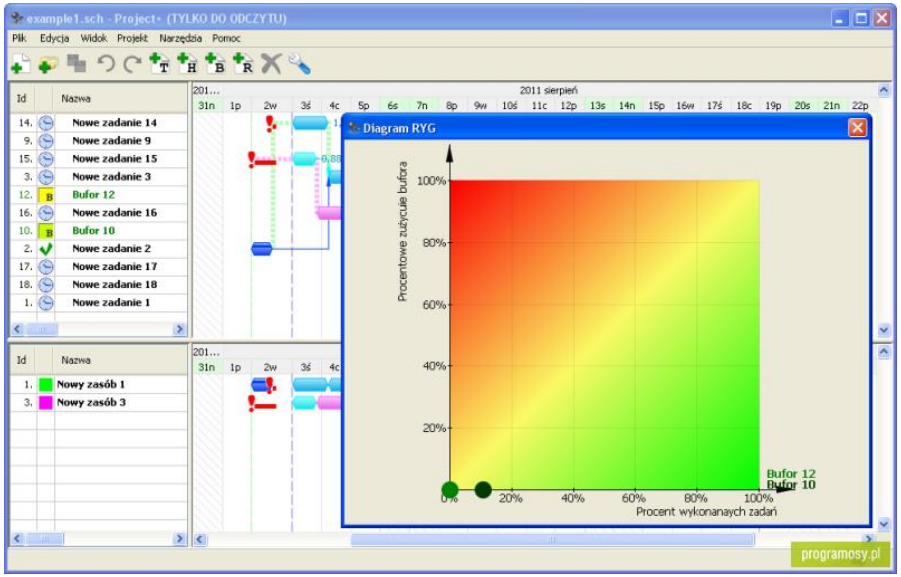
Project+

CCPMsoft





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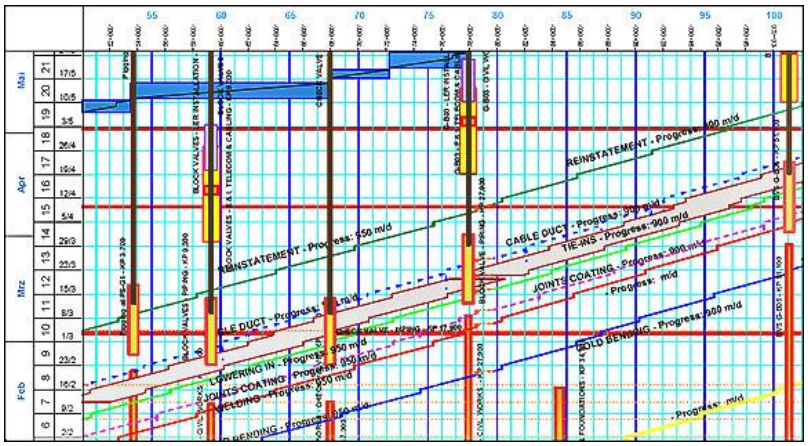
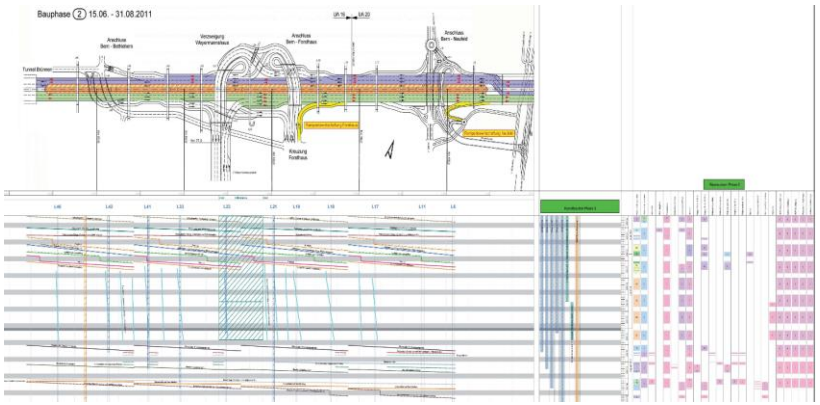
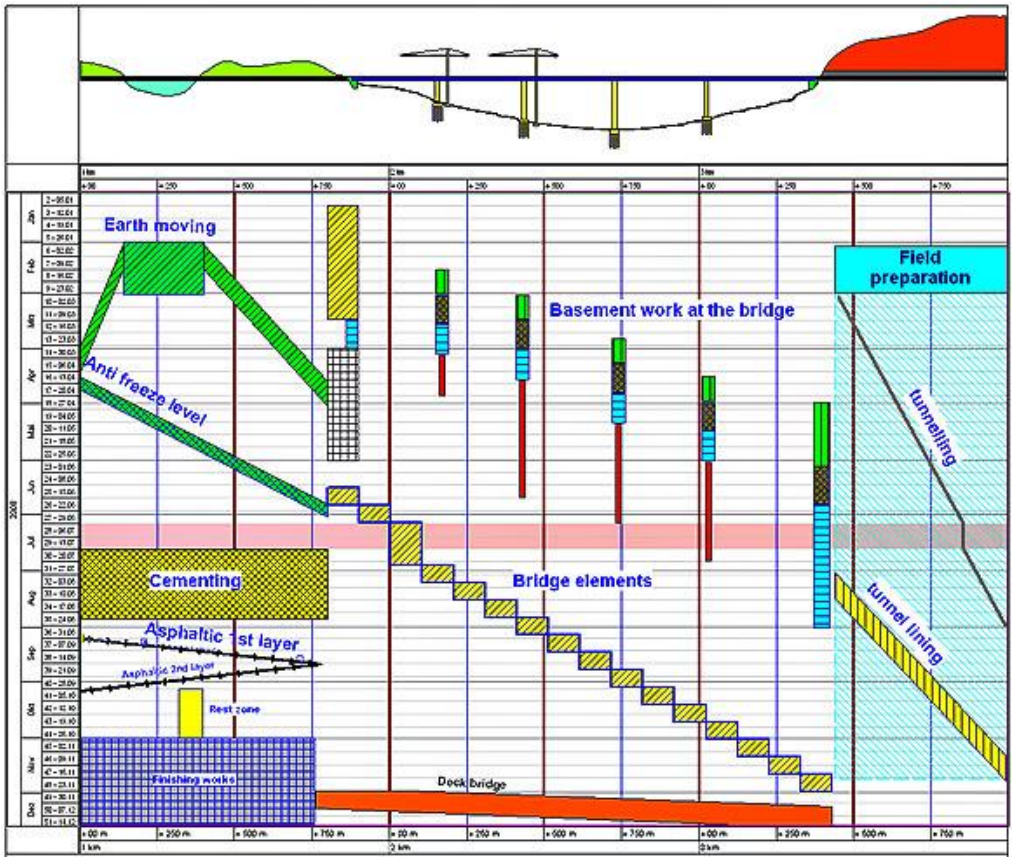






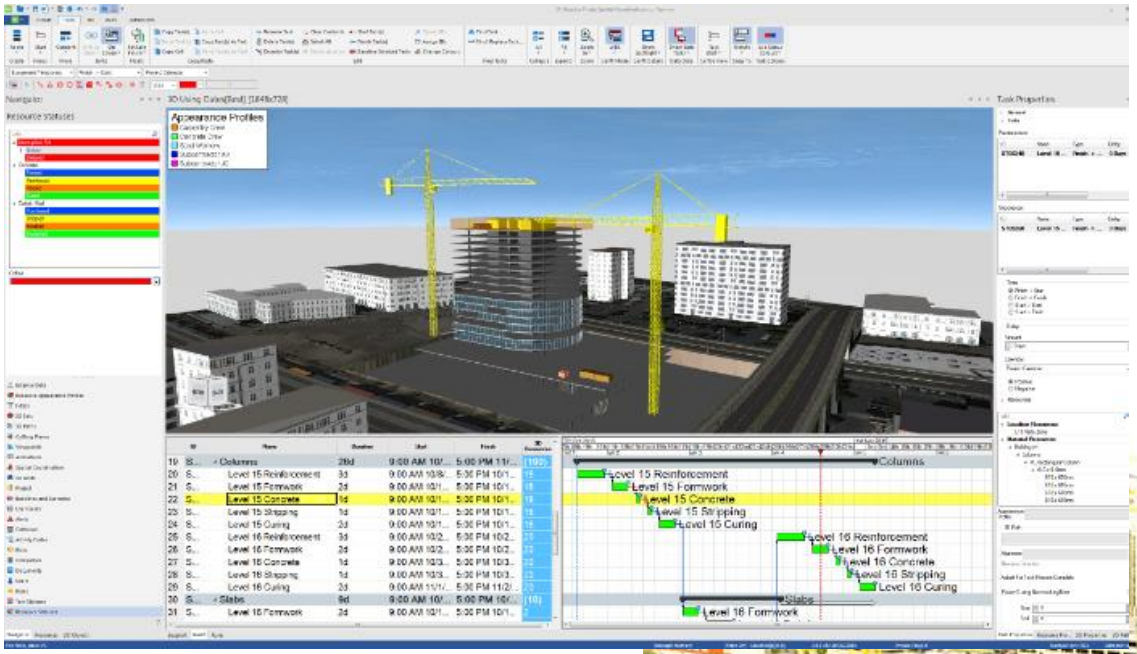
http://www.tilos.org

TIME – BIM 4D

- **In BIM the 3D models are complemented by 4th dimension – Time**
- **The model can include whole life cycle of a project**
- **BIM 4D allows for importing of schedules from other applications, and for rendering visualizations of the construction works**
- **It also allows for: better supply coordination, analysis od different implementation variants, monitoring, delays reporting**

https://synchroltd.com/

Synchro Pro



https://synchroltd.com/synchro-pro/

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Further reading:

- Project Management Institute. (2004). A Guide to the Project Management Body of Knowledge, Third Edition, PMI, USA.
- CLOEMC - Construction Manager's Library - www.cloemcv.il.pw.edu.pl
- Neumann, K., Schwindt, C., Zimmermann, J. (2012). Project scheduling with time windows and scarce resources: temporal and resource-constrained project scheduling with regular and nonregular objective functions. Springer Science & Business Media.
- Sprecher, A., Kolisch, R., & Drexl, A. (1993). Semi-active, active and non-delay schedules for the resource-constrained project scheduling problem (No. 307). Manuskripte aus den Instituten für Betriebswirtschaftslehre der Universität Kiel.
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- Google scholar

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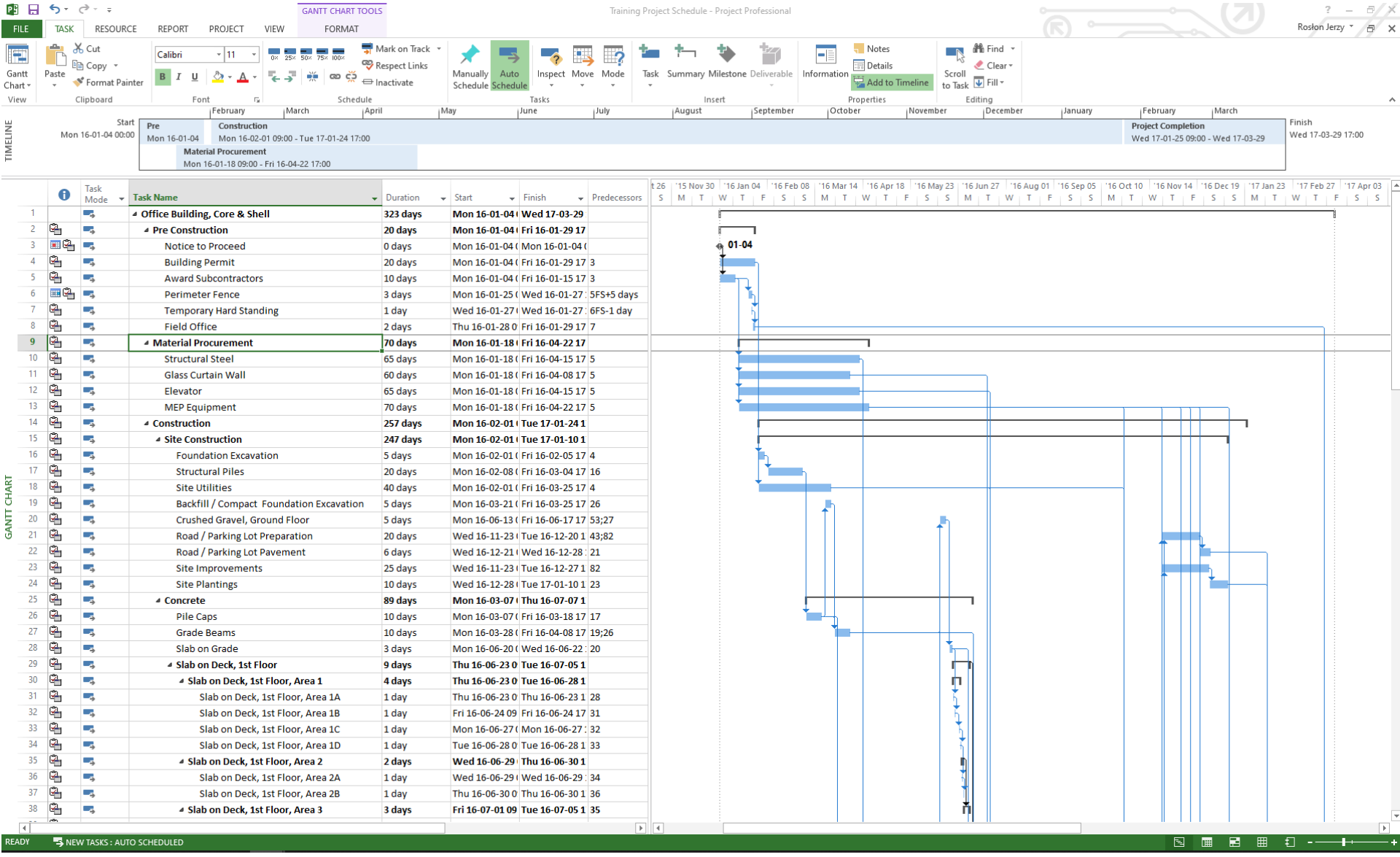
Basics of MS Project - Review



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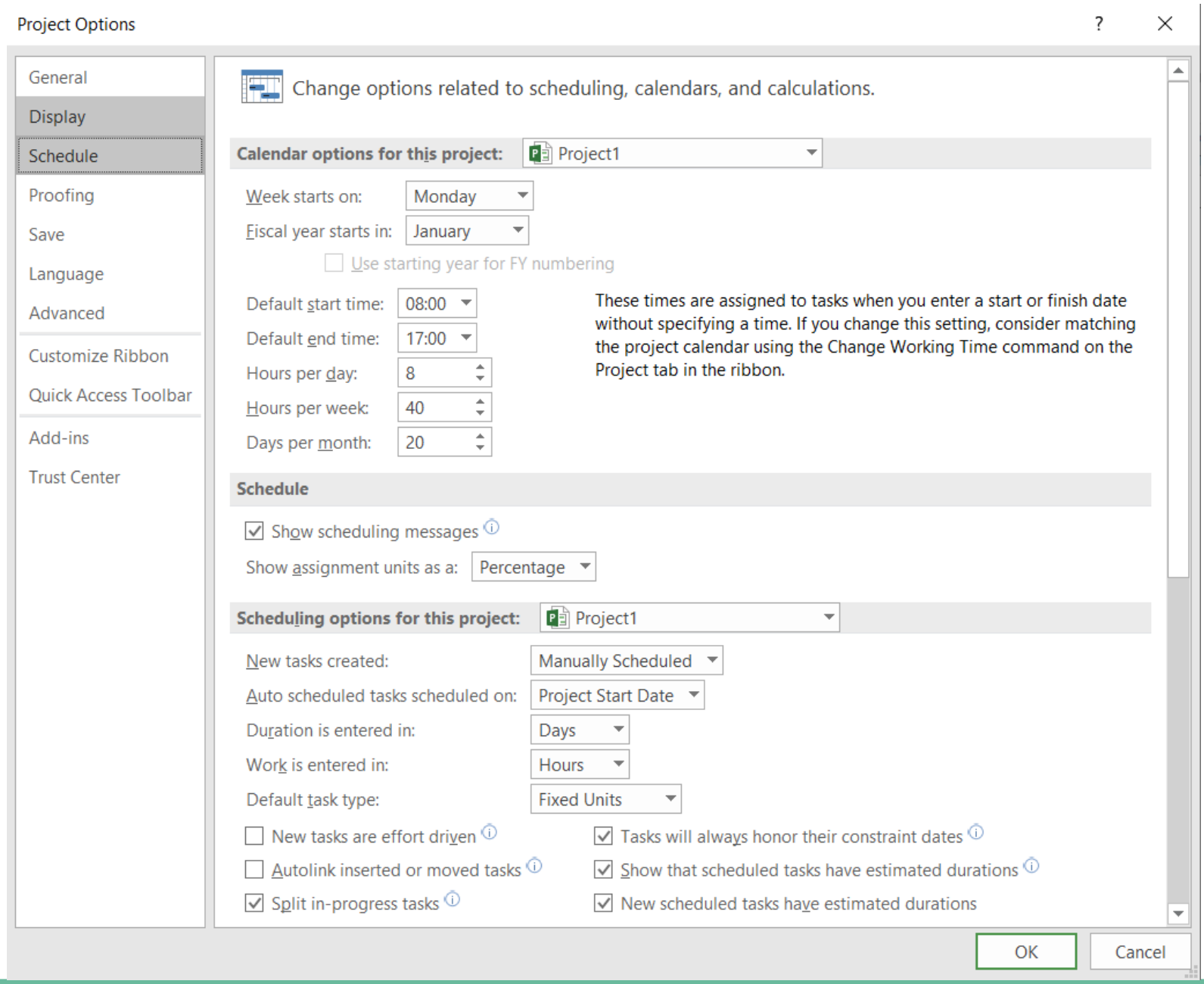

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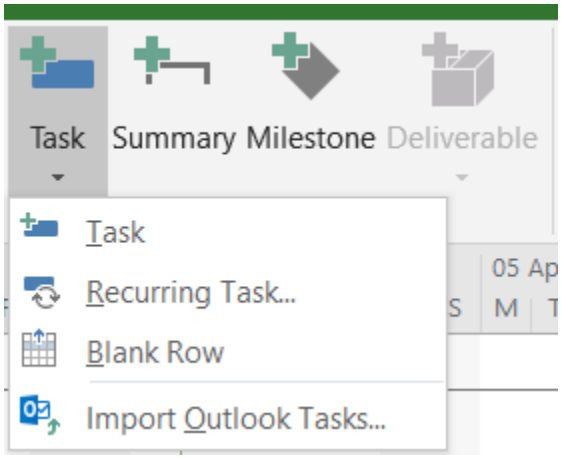
Tasks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Summary
Milestone
Deliverable
Task
Recurring Task...
Blank Row
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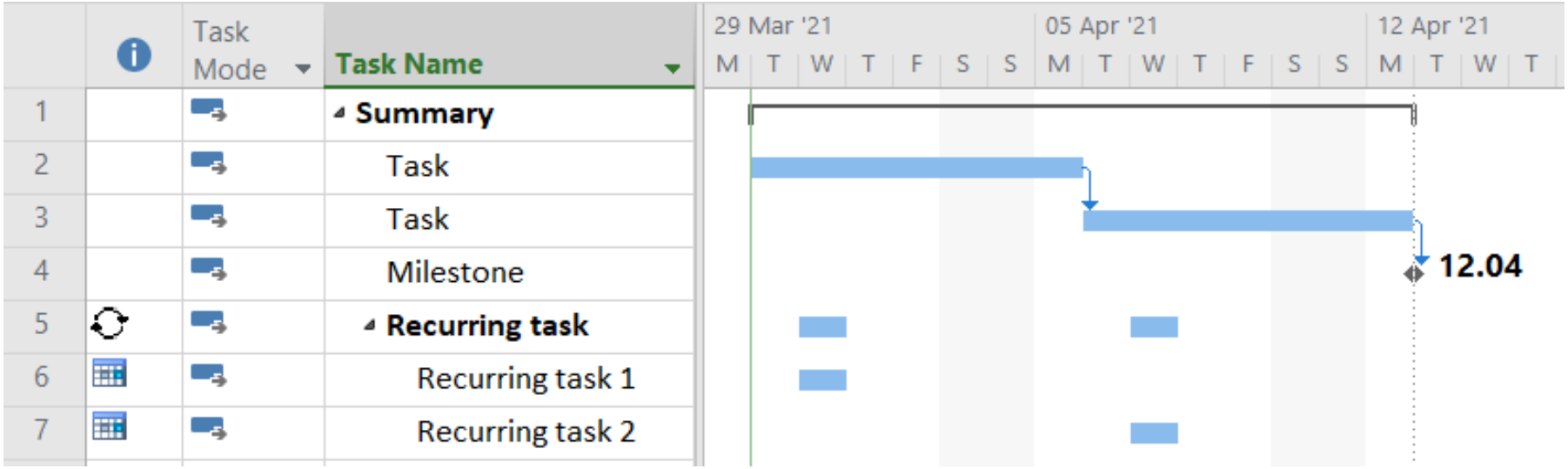
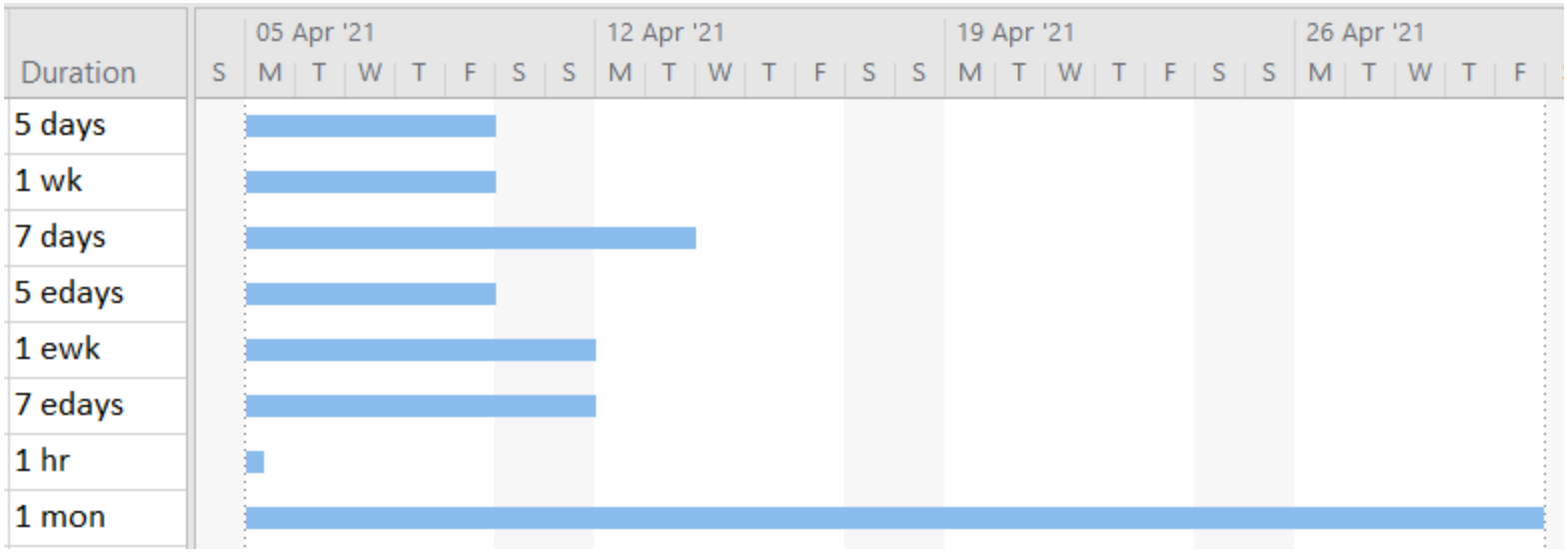

Task Mode
Task Name
29 Mar '21
05 Apr '21
12 Apr '21
M T W T F S S M T W T F S S M T W T
1 Summary
2 Task
3 Task
4 Milestone
5 Recurring task
6 Recurring task 1
7 Recurring task 2
12.04

Duration



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Precedence relationships

Finish-to-Start, FS

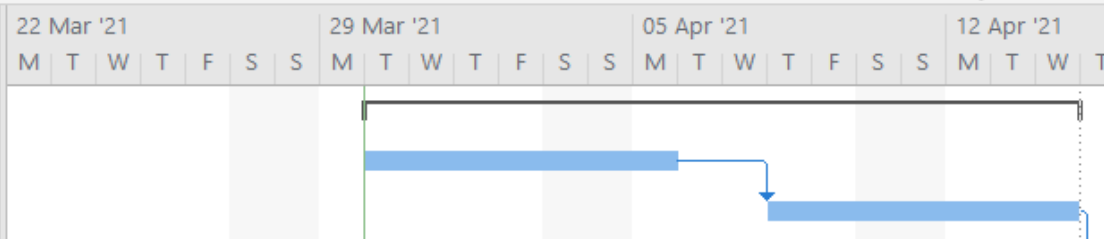
Finish-to-Finish, FF

Start-to-Start, SS

Start-to-Finish, SF

+ lead/lag

Task Name	Duration	Predecessors
Summary	**12 days**	
Task	5 days	
Task	5 days	2FS+2 days



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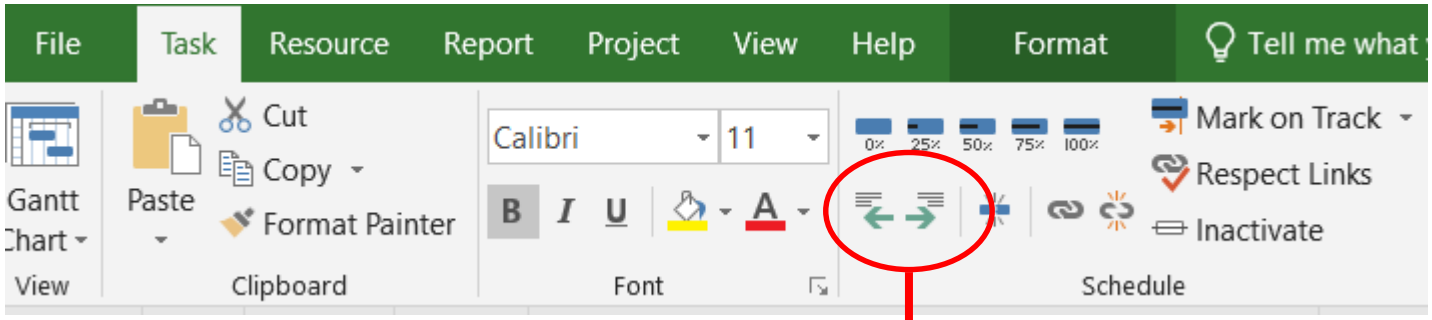

WBS

2.4	MEP Equipment
3	**Construction**
3.1	**Site Construction**
3.1.1	Foundation Excavation
3.1.2	Structural Piles
3.1.3	Site Utilities
3.1.4	Backfill / Compact Foundation Excavation
3.1.5	Crushed Gravel, Ground Floor
3.1.6	Road / Parking Lot Preparation
3.1.7	Road / Parking Lot Pavement
3.1.8	Site Improvements
3.1.9	Site Plantings
3.2	**Concrete**
3.2.1	Pile Caps

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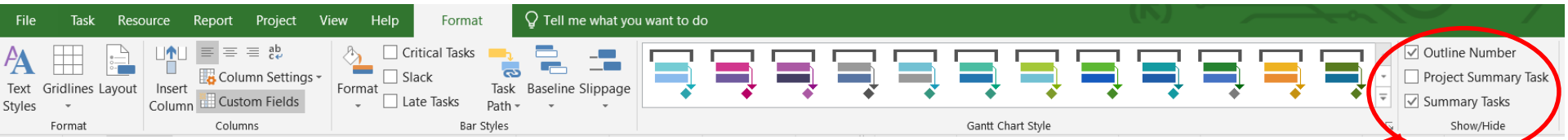

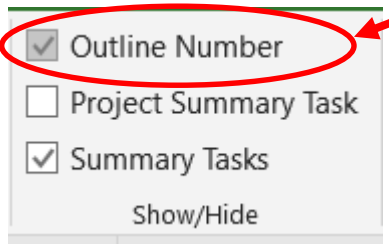

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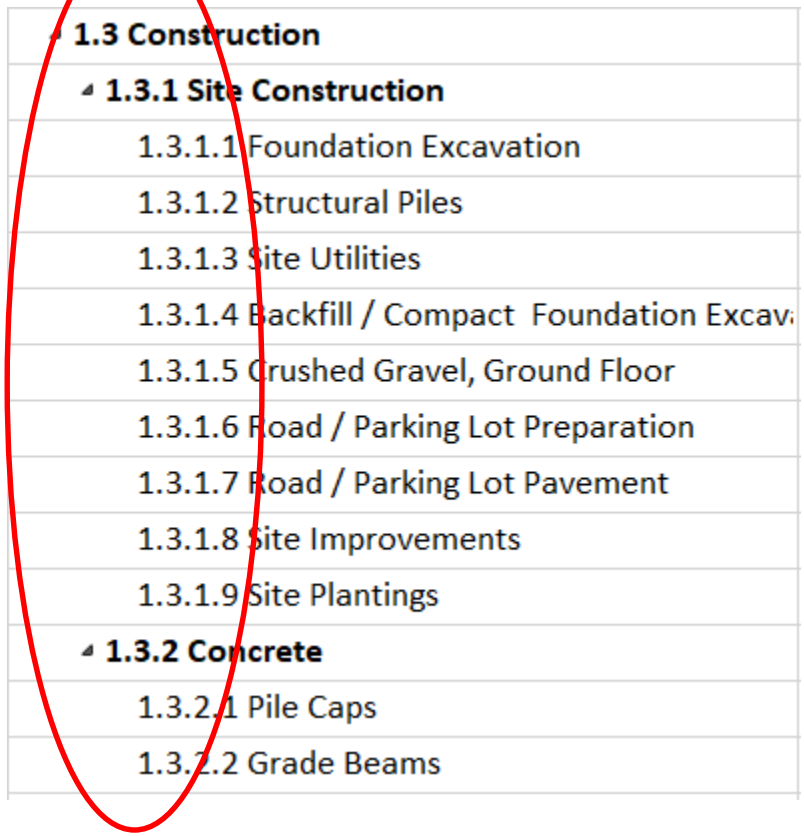

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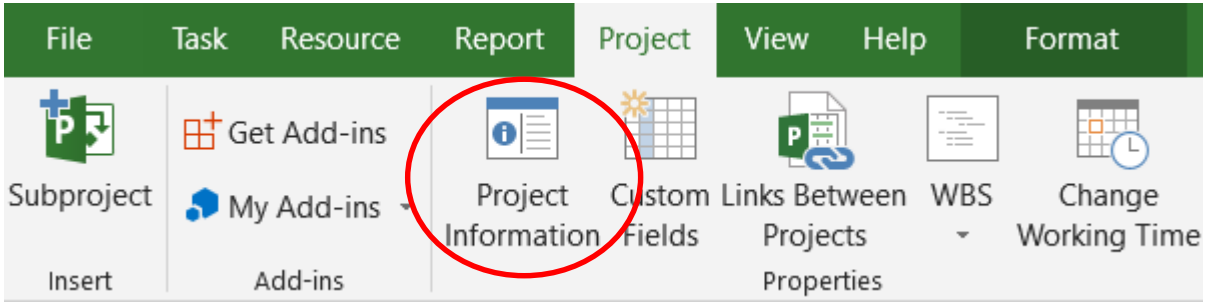
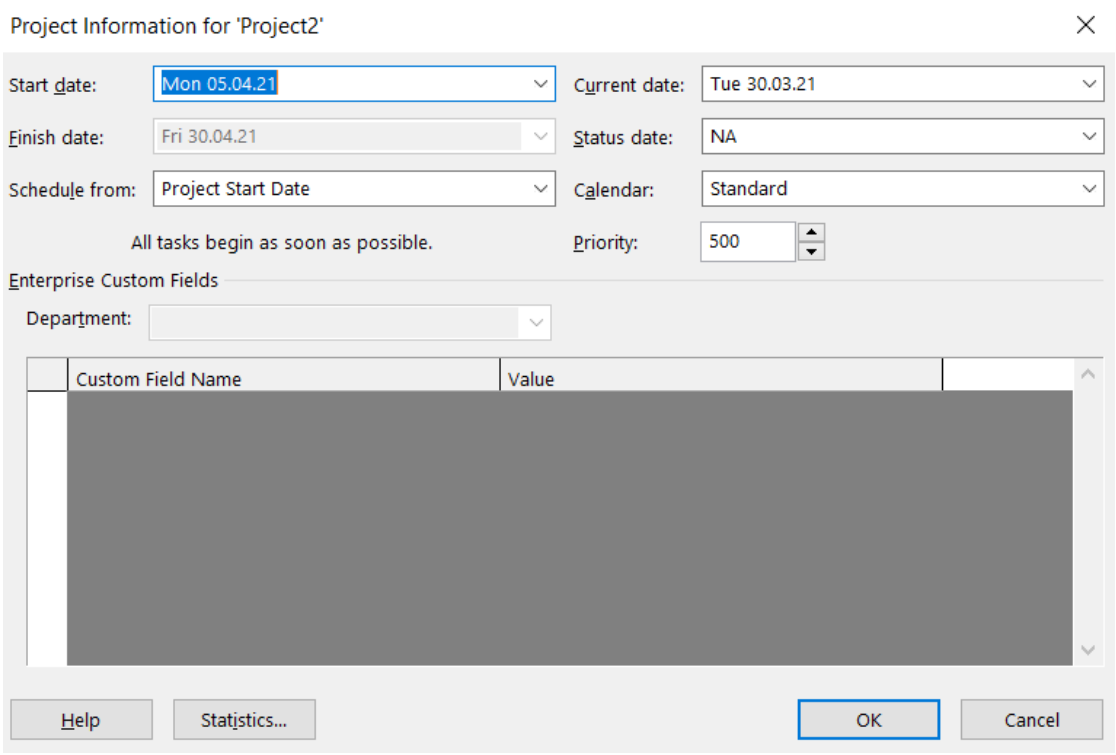
Project information





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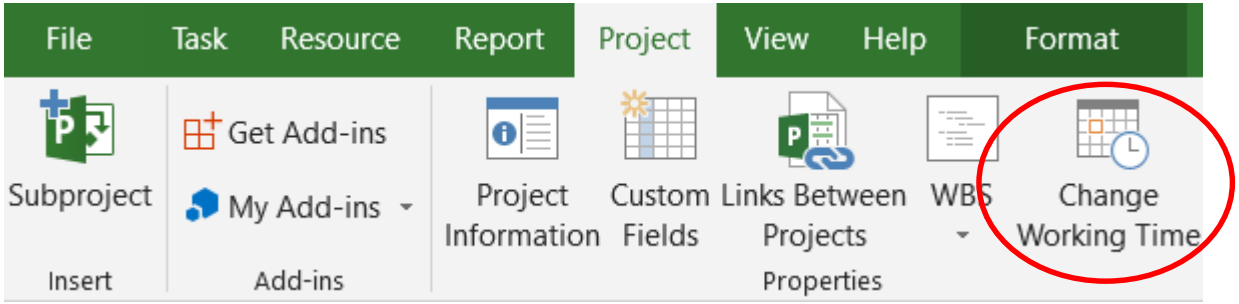
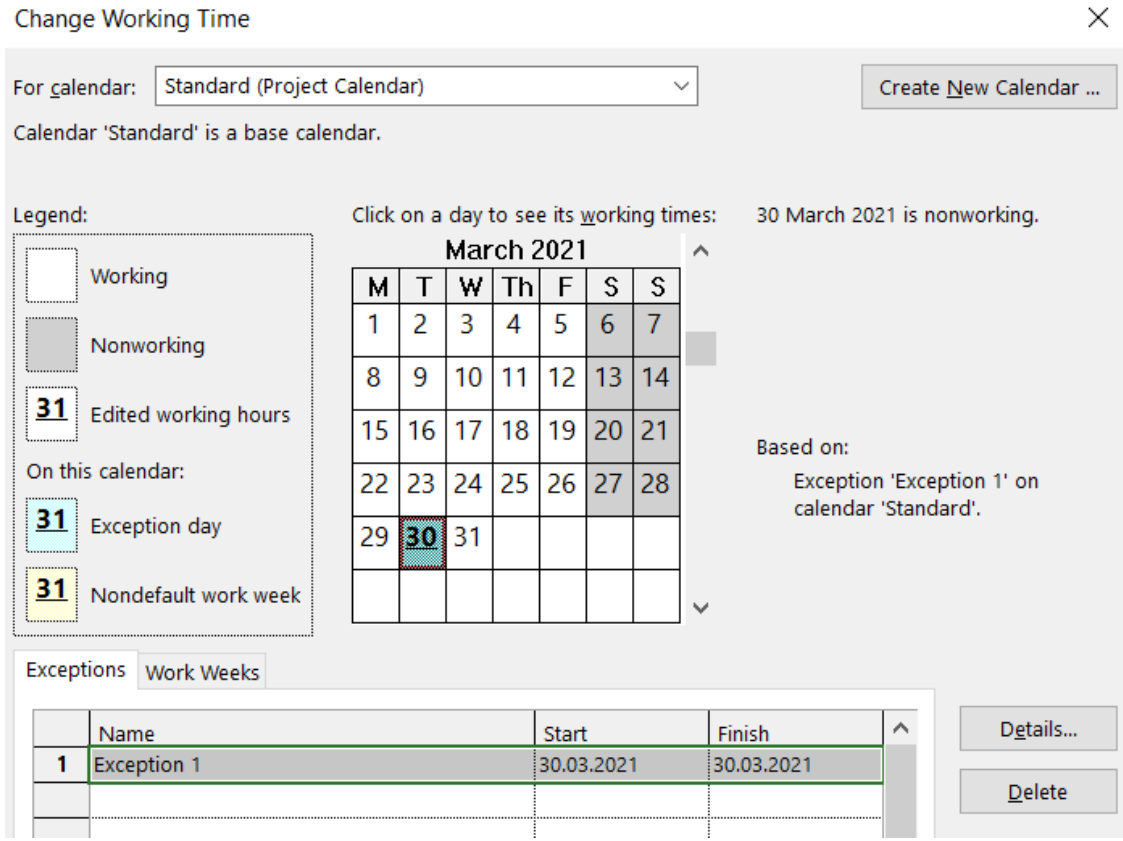
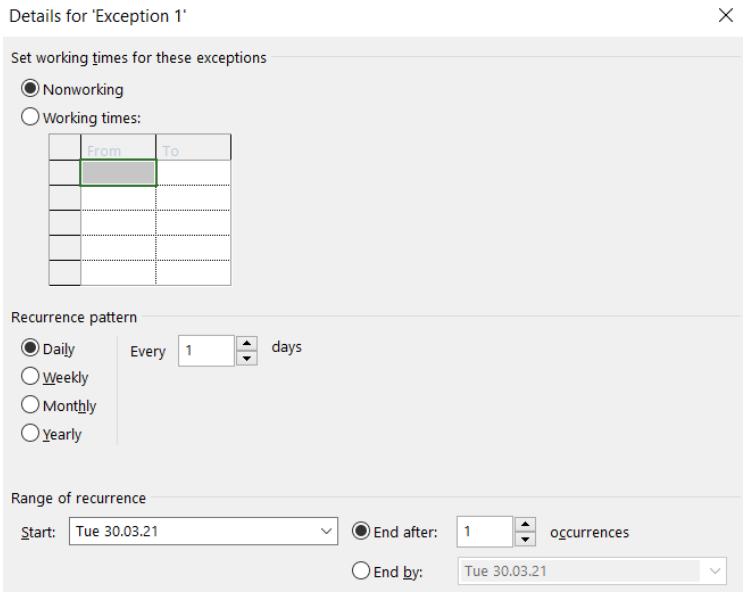
Calendar







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Task

- In response to the ongoing changes on the market,
  a construction design firm plans to modernize one of the computer labs and software
- Prepare a schedule based on the provided data
- File: 6_2_Task_-_Design_company_-_computer_office_modernization.docx
- Please send your schedules to: projekty.ipb@gmail.com

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