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Planning and monitoring of industrial punch development processes

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Abstract
Research and Development (R&D) management is challenging owing to the reason that most of the new products require new technologies and collaboration of many engineering disciplines. Planning and monitoring processes take their places as a hearth of the whole body. If heart stops, not a single, effective, and real answer will be obtained for successfully achieved R&D projects. As in other engineering branches and their applications, Industrial punch development processes require carefully analyzed plans and the effective monitoring. This paper focuses on the planning and monitoring processes of industrial punch production stages. Planning of each stages were conducted based on the PERT (Program Evaluation Review Technique) method via a planning software. Delays and obstacles were analyzed in detail during the monitoring works in order to enlighten similar R&D projects within the scope of this research.

Keywords: Punch development; planning; monitoring; R&D project; PERT.

1. Introduction

Global conditions force engineering companies to find innovative solutions to survive and defeat the competitors. For this reason, they must spend a great deal of resources on R&D projects. R&D is defined as the ability for conducting various type of studies, and using available data for product and technology improvement [1]. Management of R&D projects is extremely important depending on its risky environment. Supervision and management of R&D projects has passed 5 generations in the last century [2,3]. Various success criteria's have R&D management turned into multidisciplinary task. After detailed analysis of the past generations, it can be concluded that main objective of the R&D management is speeding up the product creation [4]. In order to accelerate the production speed efficient and effective planning of the R&D project is the key for the managers.

PERT and CPM (Critical Path Method) are counted as the first project management planning assisting systems [5,6]. CPM method is consisting of deterministic approaches; however, PERT system focuses on the stochastic environments [7,8]. PERT system assumes probabilistic duration for each task by determining pessimistic, realistic, and optimistic times. Depending on these assumes, PERT is more suitable for R&D projects to manage uncertainty [9,10].

Lately, various R&D project are planned and supervised with the aid of PERT and PERT based systems. There are many applications of CPM and PERT based planning for various engineering disciplines. However, as of today advanced planning techniques have been commonly used for the R&D managers [11].

2. Material and method

Planning and monitoring of industrial punch development processes (Fig. 1 and Fig. 2) have been conducted with the aid of a planning software in the light of similar literature researches. Detail of the projects can be altered depending on the volume of work. Therefore, it becomes vital to manage the projects with the help of a time keeper database [12]. Gantter google drive software was used for the planning and monitoring process of this study. Expected task times were calculated according to the optimistic, most likely, and pessimistic times with the following formula eq. (1):

Expected time = (Optimistic time + 4 x Most likely times + Pessimistic time)/6 (1)

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Figure 1. CNC-Punch.

Figure 2. AISI D3 type punches and dies.

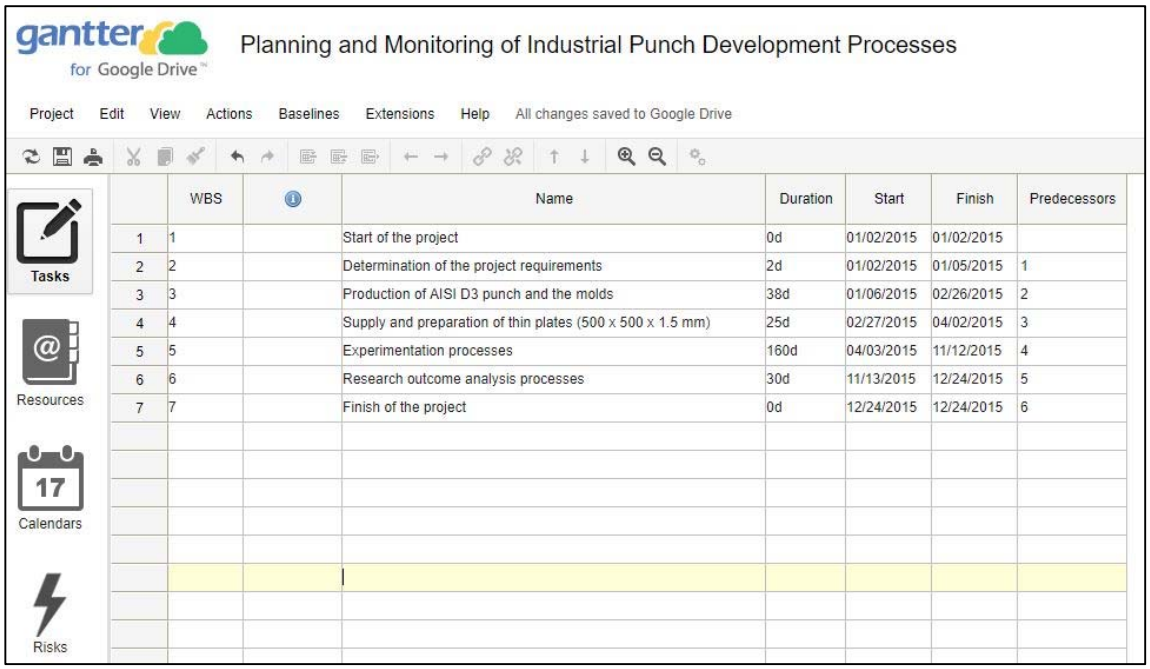
3. Planning of the Punch Development Works

Main tasks of the industrial punch development works were categorized as seen in Table 1.

Table 1. Main task of the project and expected durations

Main Tasks	Optimistic duration (day)	Most likely time (day)	Pessimistic time (day)	Expected Durations (day)
Start of the project	0	0	0	0
Determination of the project requirements	1	2	2	2
Production of AISI D3 punch and the molds	7	39	70	38
Supply and preparation of thin plates (500 x 500 x 1.5 mm)	10	25	40	25
Experimentation processes	90	145	295	160
Research outcome analysis processes	25	30	35	30
Finish of the project	0	0	0	0

Start of the project task duration was taken as 0 days as seen in Table 1. These types of tasks are called milestone tasks. Milestone tasks do not require any time and resources. Important events can be marked as milestone tasks with the same manner. These types of tasks can also be used for the external mission of the R&D projects [12]. Planning of the project was given in Figure 3.



	WBS	Name	Duration	Start	Finish	Predecessors
1	1	Start of the project	0d	01/02/2015	01/02/2015	
2	2	Determination of the project requirements	2d	01/02/2015	01/05/2015	1
3	3	Production of AISI D3 punch and the molds	38d	01/06/2015	02/26/2015	2
4	4	Supply and preparation of thin plates (500 x 500 x 1.5 mm)	25d	02/27/2015	04/02/2015	3
5	5	Experimentation processes	160d	04/03/2015	11/12/2015	4
6	6	Research outcome analysis processes	30d	11/13/2015	12/24/2015	5
7	7	Finish of the project	0d	12/24/2015	12/24/2015	6

Figure 3. Planning of the project.

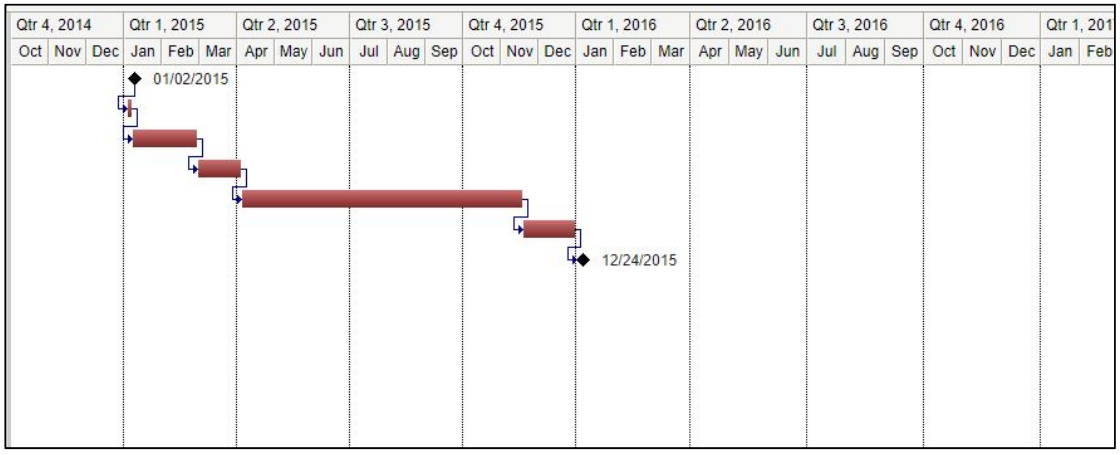


Figure 4. Task dependencies.

Task dependencies were arranged (Figure 4) as per the project requirements. Task constraint were chosen as the earliest option. Resources are defined as the workforce, materials and equipment that are consumed in a project to reach the project targets. The workforce information of the R&D project is given in Table 2.

Table 2. Workforce of the R&D project

Workforce Definition	Duty
Project manager	Management of the R&D project
Draftsman	Technical drawing of the punch system
Mechanical Engineer	Supervision of drawing works
Purchasing Manager	Material supply
Quality Engineer	QA&QC works
Production Engineer	Production of punches
Skilled worker (Q: 5 workers)	Production works

By adding project resources, it was provided to have great control on the progress reports. Workforces were added into the software as seen in Figure 5.

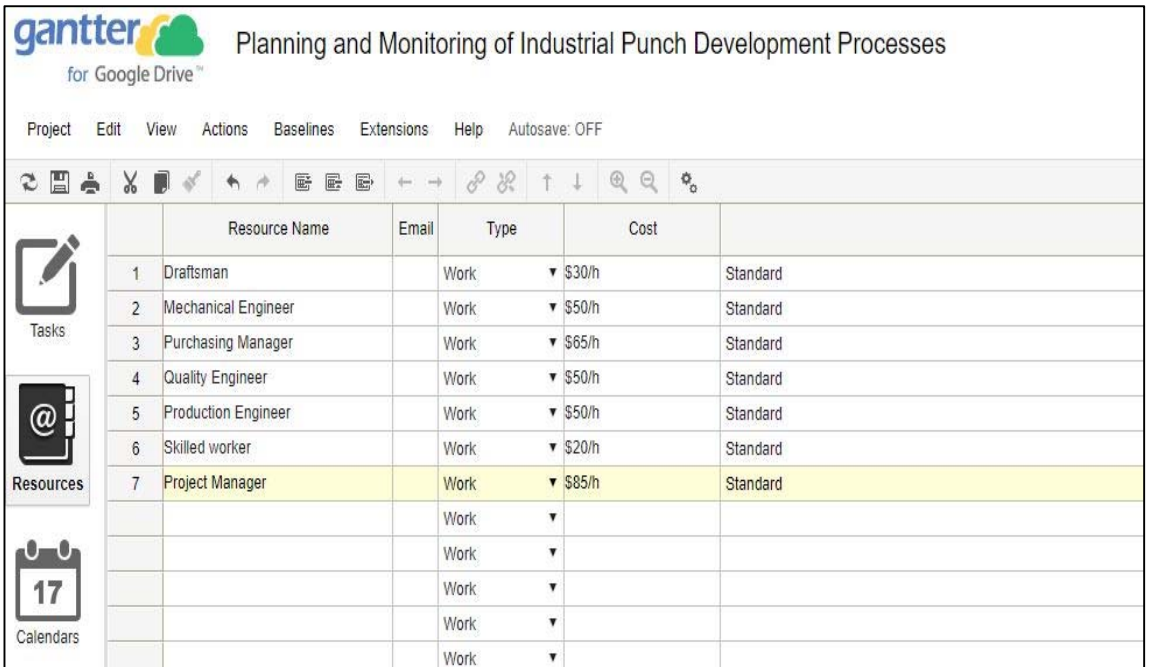


Figure 5. Workforces and unit rates.

After the work force defining process, responsible personnel of the R&D projects were linked with the project tasks. This process can be found in Figure 6.

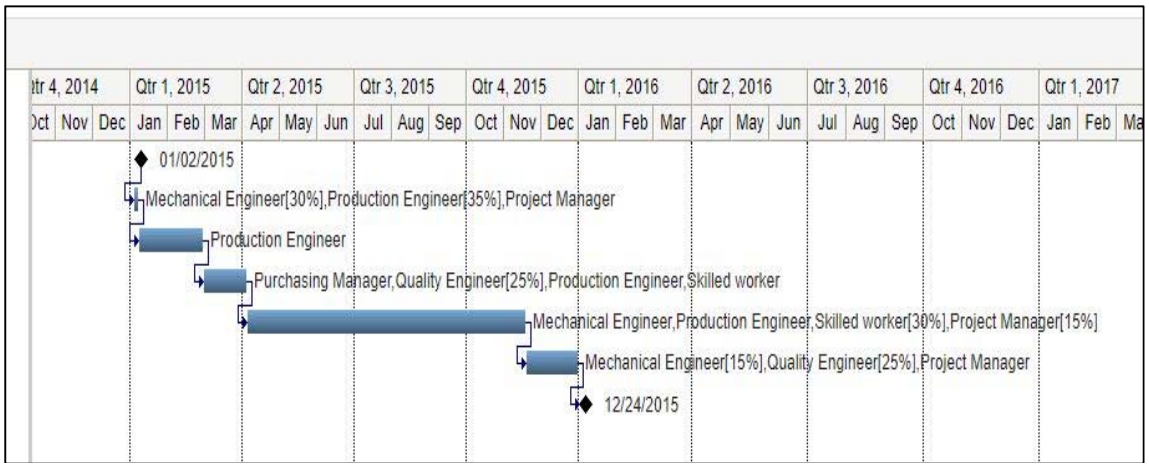


Figure 6. Project tasks and workforces.

The project material list was added into the software, after the completion of the tasks and workforces linking processes. Project material list is given in Table 3.

Table 3. Project material list

Material Description	Amount
Production drawing (hardcopy)	1 no.
AISI D3 steel	20 kg

Project material list was integrated into project schedule (Fig 7 and Fig. 8). Material type resources do not affect

the project schedule if they are supplied in timely manner.

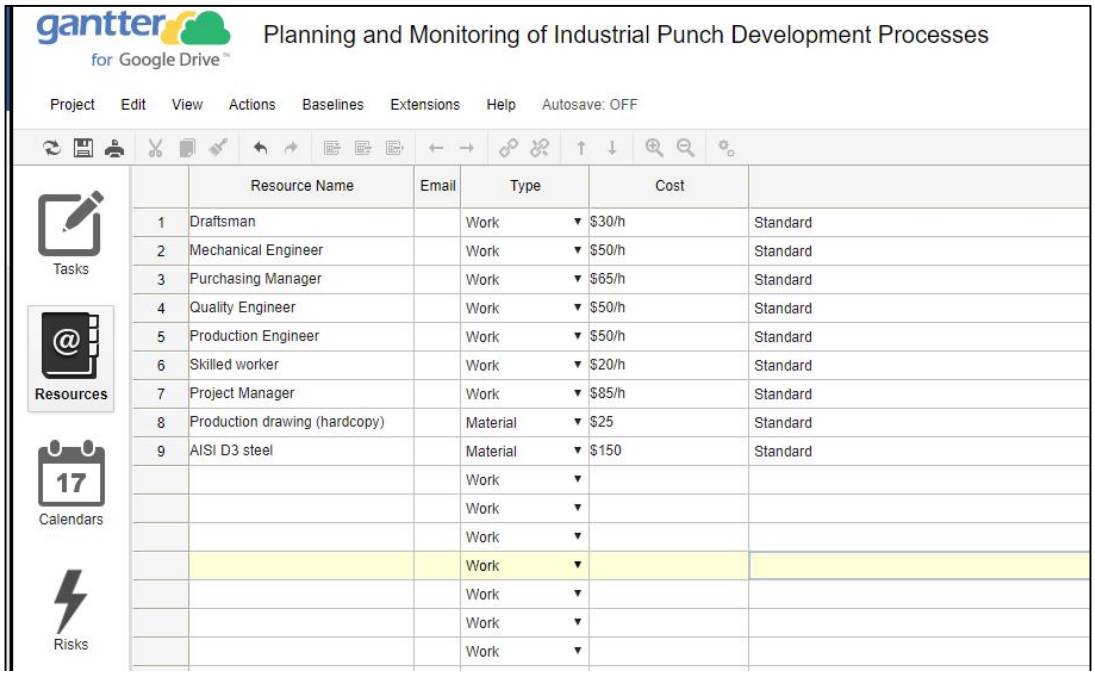


Figure 7. Material and cost integration

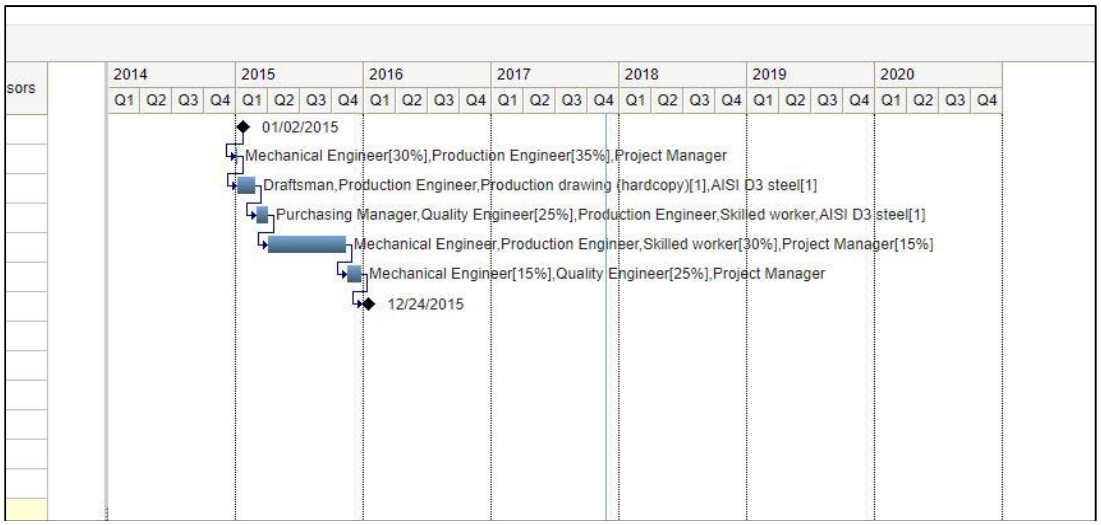
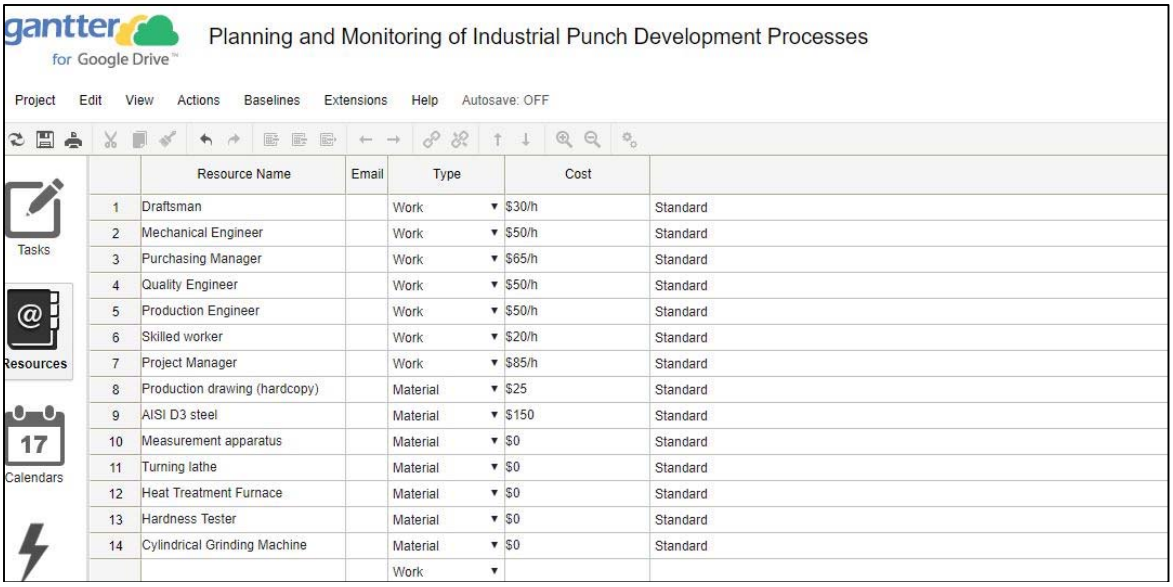


Figure 8. Materials and responsible personal.

Equipment list is also entered as seen in Table 4. And each equipment was attended to the tasks as per the project requirements (Fig. 9). No cost was reflected as equipment expenditures due to the availability of the equipment in the production site.

Table 4. Equipment list

Equipment Description	Amount
Measurement apparatus	1
Turning lathe	1
Heat Treatment Furnace	1
Hardness Tester	1
Cylindrical Grinding Machine	1

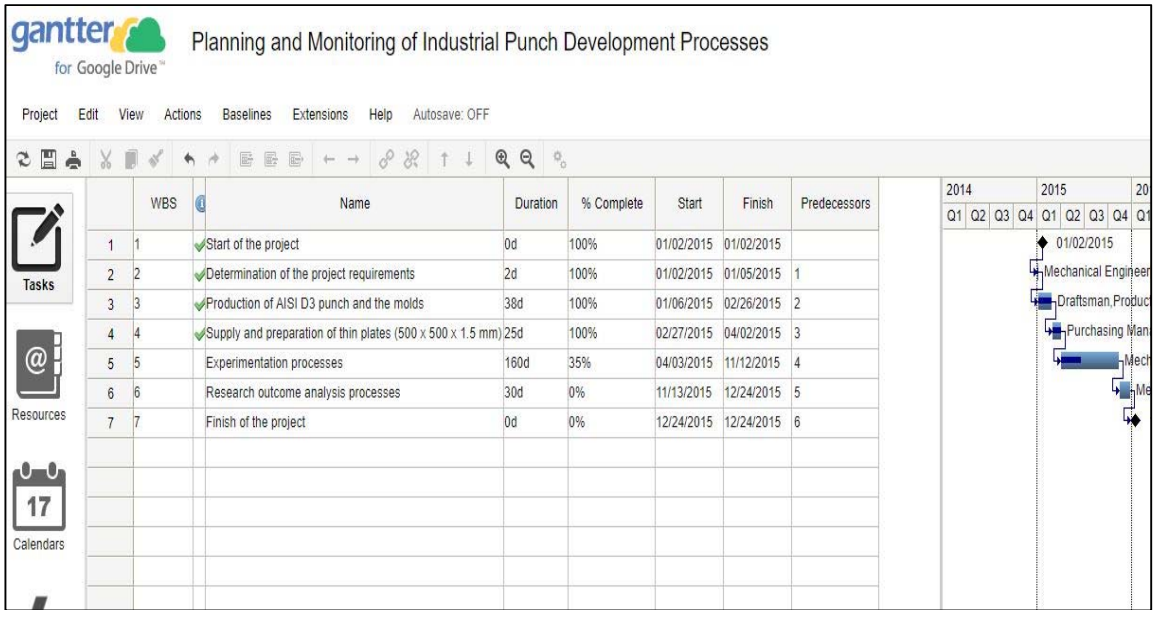


	Resource Name	Email	Type	Cost	
1	Draftsman		Work	$30/h	Standard
2	Mechanical Engineer		Work	$50/h	Standard
3	Purchasing Manager		Work	$65/h	Standard
4	Quality Engineer		Work	$50/h	Standard
5	Production Engineer		Work	$50/h	Standard
6	Skilled worker		Work	$20/h	Standard
7	Project Manager		Work	$85/h	Standard
8	Production drawing (hardcopy)		Material	$25	Standard
9	AISI D3 steel		Material	$150	Standard
10	Measurement apparatus		Material	$0	Standard
11	Turning lathe		Material	$0	Standard
12	Heat Treatment Furnace		Material	$0	Standard
13	Hardness Tester		Material	$0	Standard
14	Cylindrical Grinding Machine		Material	$0	Standard
			Work		

Figure 9. Equipment integration.

4. Monitoring works

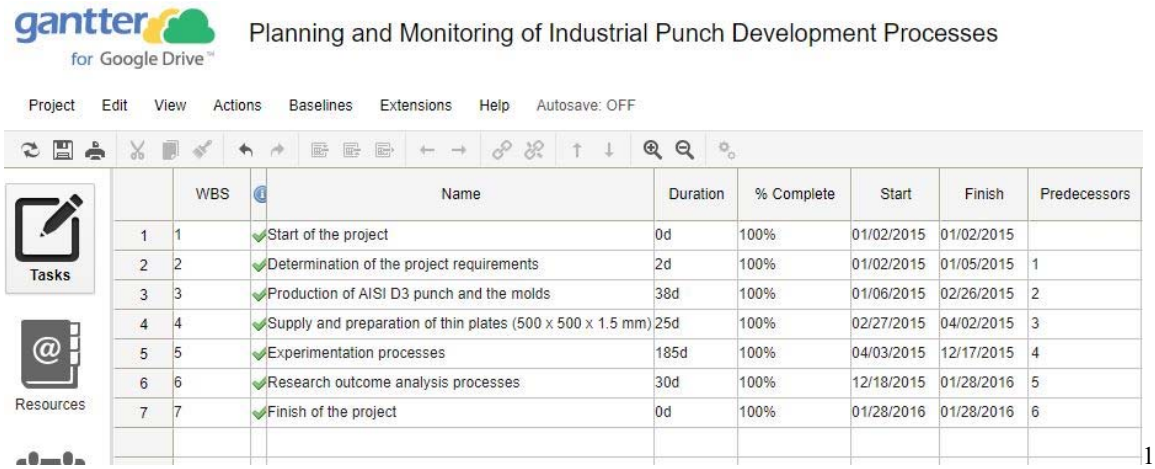
The R&D projects started on 2 February 2014 as planned. No problems and delays were encountered during the first three months. However, there was a delay on the experimentation processes due to the key personal lost. Production engineer quit the job when the task was achieved 35 % (Fig. 10) and new recruitment engineer handed over the job after 25 days.



	WBS	Name	Duration	% Complete	Start	Finish	Predecessors
1	1	Start of the project	0d	100%	01/02/2015	01/02/2015	
2	2	Determination of the project requirements	2d	100%	01/02/2015	01/05/2015	1
3	3	Production of AISI D3 punch and the molds	38d	100%	01/06/2015	02/26/2015	2
4	4	Supply and preparation of thin plates (500 x 500 x 1.5 mm)	25d	100%	02/27/2015	04/02/2015	3
5	5	Experimentation processes	160d	35%	04/03/2015	11/12/2015	4
6	6	Research outcome analysis processes	30d	0%	11/13/2015	12/24/2015	5
7	7	Finish of the project	0d	0%	12/24/2015	12/24/2015	6

Figure 10. Experimentation process delay.

The project completion time delayed according to the key personal lost for 25 days. No acceleration action was taken by Project Manager in order to reduce total project costs. The project was completed on 28 January 2016 (Fig. 11 and Fig. 12).



	WBS	Name	Duration	% Complete	Start	Finish	Predecessors
1	1	Start of the project	0d	100%	01/02/2015	01/02/2015	
2	2	Determination of the project requirements	2d	100%	01/02/2015	01/05/2015	1
3	3	Production of AISI D3 punch and the molds	38d	100%	01/06/2015	02/26/2015	2
4	4	Supply and preparation of thin plates (500 x 500 x 1.5 mm)	25d	100%	02/27/2015	04/02/2015	3
5	5	Experimentation processes	185d	100%	04/03/2015	12/17/2015	4
6	6	Research outcome analysis processes	30d	100%	12/18/2015	01/28/2016	5
7	7	Finish of the project	0d	100%	01/28/2016	01/28/2016	6

Figure 11. Delayed completion duration-I.

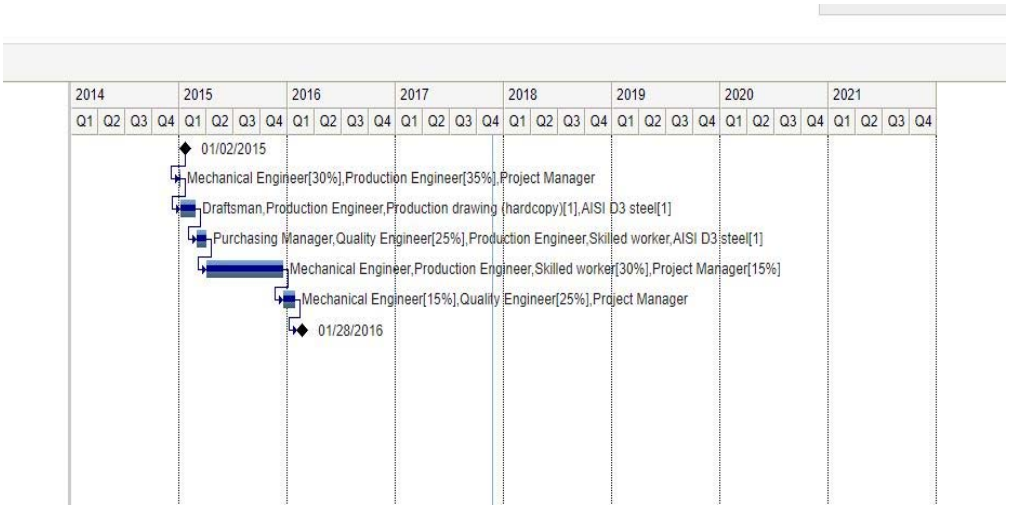


Figure 12. Delayed completion duration-II.

5. Conclusions

With the increasing complexity of the projects, it becomes a common requirement for project manager to plan and monitor R&D projects with a single software. Project costs and requirements can be effectively planned and monitored through the software. In the light of the execution of this research, it can be concluded that the industrial punch development project planning and monitoring will be a good example for similar projects.

Acknowledges

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