



Trinity College Dublin

Coláiste na Tríonóide, Baile Átha Cliath

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CEU44E01

4E1 Management for Engineers

REFLECTIVE ESSAY – Case Study

Submitted By

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DATE: 25-11-2020

Introduction

I am an assistant project manager to Rassy Brown, who oversees the Nightingale project. Nightingale is the code name given to the development of a handheld electronic medical reference guide. Nightingale will be designed for emergency medical technicians and paramedics who need a quick reference guide to use in emergency.

Project Objective

The objective of the project – Nightingale is to develop a project plan and the product that aim at producing 30 working models in the time for MedCON which is one the biggest medical equipment trade show held each year. These thirty units are to be developed till 2nd of October for MedCON. This equipment trade show is very important for the company because all major medical equipment manufacturers demonstrate and take order for new products at MedCON.

For developing a good project plan, one must identify all the key stakeholders. Stakeholder are people and organizations that are involved in the project. Since stakeholders are the most important key in a project the project objective or project plan should be delivered in accordance to them


Key stakeholders and their objectives for project Nightingale-

- ❖ Product Design Engineer – play a key role in this project, as he/she would be responsible for developing / designing the product, they would be designing a rough prototype and this would help the cost estimator calculate the resources required.
- ❖ Product Development Team – they are the starting point of the project and have very high interest in the successful completion of the product.
- ❖ Medical Technicians and Paramedics (Customer) – they are the direct users of the product; they would be extremely valuable feedbacks.
- ❖ Sponsors/Investors – They play a vital role as the budget of the project is decided by them, moreover their reputation is tied to the success of the project, and they should be keep informed about key developments of the project.
- ❖ Medical Organization – they are the ones who develops norms and standards for any product that is being medically used, therefore they should be consulted in order to make sure that the product doesn't violate any of their norms.

Developing the Project Priority Matrix

Priority matrix is used for identification which criterion is constrained, which should be enhanced, and which should be accepted.

According to the given project outlines the below is the project priority matrix

	Time	Scope	Cost
Constrain			
Enhance			
Accept			

Constrain – Scope: Performance should be up to the level since it plays a key role in acquiring a good hold in the market, moreover, there has been some rumours that the competitors are considering developing a similar product. Therefore, the constraint i.e. performance of the product is fixed

Enhance – Time: Due to MedCon, the deadline is 2nd of October and we need to enhance the project completion date in order to meet the deadline for this we would be using crashing and introducing lag.

Accept – Cost: The cost in developing the product is a very important measure, keeping this in mind the top management have made funding contingent i.e. the cost can be changed for enhancing product performance.

Software Used:

Nightingale being a very important project for the team , therefore the project manager need to plan it accordingly, since the development of the project require extensive planning and team work therefore a good management software must be used on which the plan is drafted accordingly.

For a proper management of Nightingale Microsoft Projects has been used. Microsoft project is a software product used for product management which is developed by Microsoft. It is designed to assist a project manager for tracking projects, managing budgets and analysing workloads Though there were several other management software available, but Microsoft project has been used because of the following reasons –

- Easy to access using student id.
- Lets you plan projects, assign tasks easily.
- Lets you prioritize tasks and we can allot predecessors as well as successors for each task.
- We can update holidays using a personalized calendar
- Predicts length of time for task completion.
- It offers good automatic scheduling capabilities
- Visualizes project plan in different formats.
- Provided Gantt chart (a visual view of tasks scheduled over time) as well as Network diagrams.

Other than these Microsoft Project also has a good interface to work with teams too. MS project does more than just creating a schedule. It can create constraints, establish dependencies among tasks, resolve resource conflicts and moreover help in optimizing the cost and schedule performance during the project



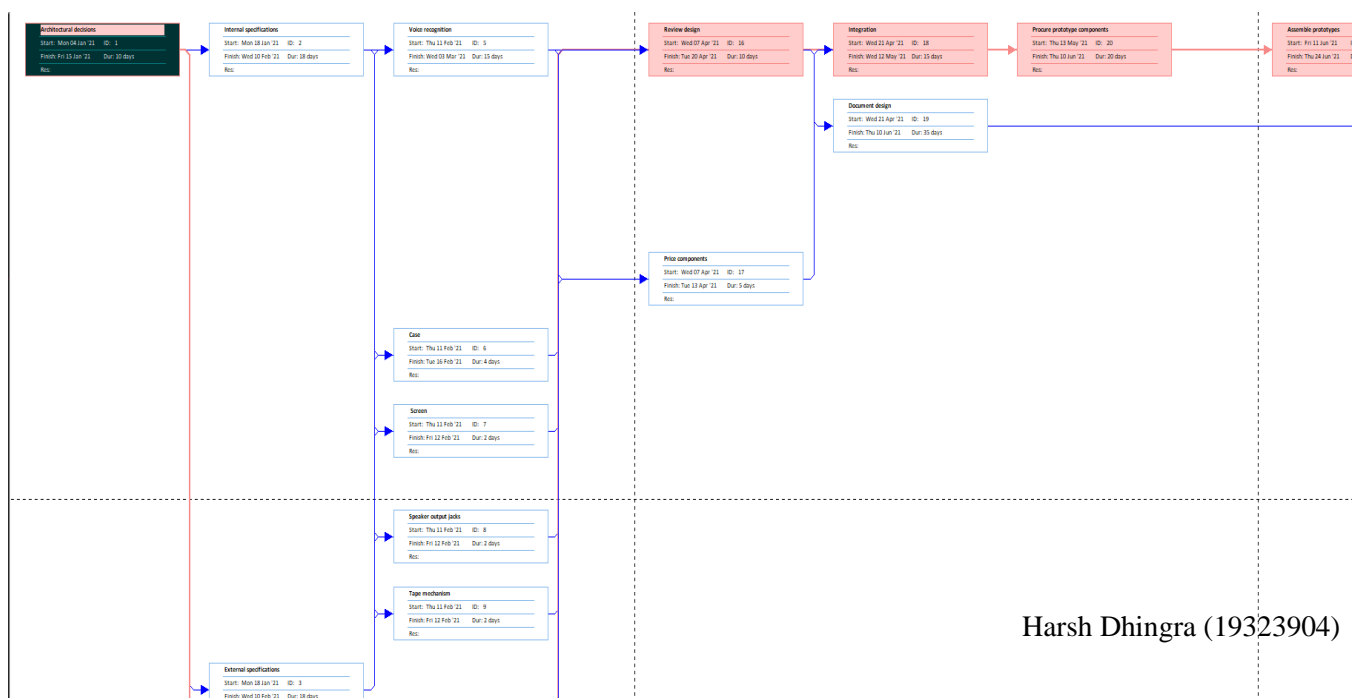
Project Planning

According to the project info. The project is scheduled to be started from 4th of January 2021, and the deadline is 2nd of October 2021, a proper holiday calendar was set up for 2021 and the working schedule was 8 hours a day and 5 days a week i.e. only on working days with weekends as holidays.

The Initial Gant chart Schedule and Initial Gantt Chart is as follows-

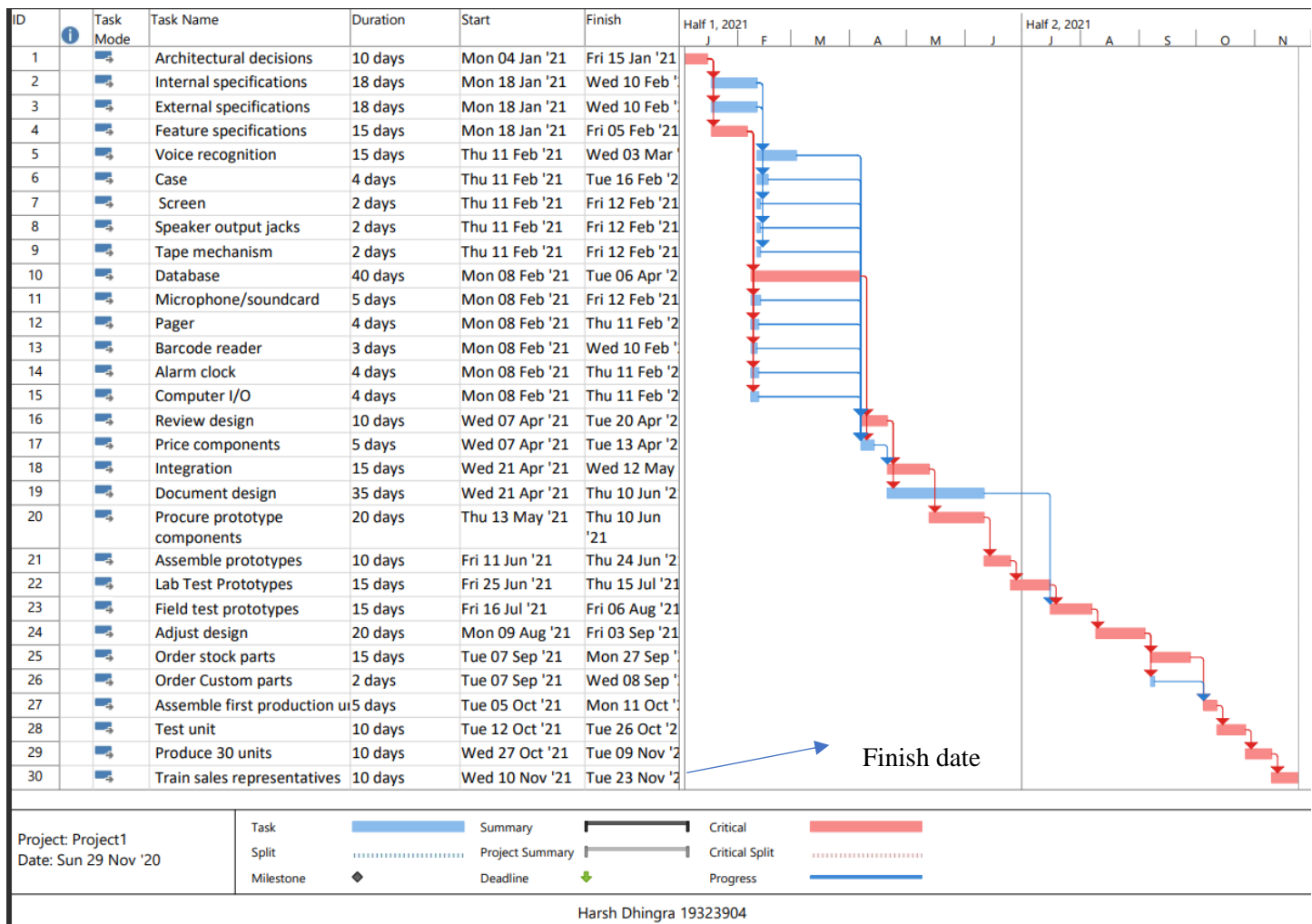
Task Name	Duration	Start	Finish	Predecessors
Architectural decisions	10 days	Mon 04 Jan '21	Fri 15 Jan '21	None
Internal specifications	18 days	Mon 18 Jan '21	Wed 10 Feb '21	1
External specifications	18 days	Mon 18 Jan '21	Wed 10 Feb '21	1
Feature specifications	15 days	Mon 18 Jan '21	Fri 05 Feb '21	1
Voice recognition	15 days	Thu 11 Feb '21	Wed 03 Mar '21	2,3
Case	4 days	Thu 11 Feb '21	Tue 16 Feb '21	2,3
Screen	2 days	Thu 11 Feb '21	Fri 12 Feb '21	2,3
Speaker output jacks	2 days	Thu 11 Feb '21	Fri 12 Feb '21	2,3
Tape mechanism	2 days	Thu 11 Feb '21	Fri 12 Feb '21	2,3
Database	40 days	Mon 08 Feb '21	Tue 06 Apr '21	4
Microphone/soundcard	5 days	Mon 08 Feb '21	Fri 12 Feb '21	4
Pager	4 days	Mon 08 Feb '21	Thu 11 Feb '21	4
Barcode reader	3 days	Mon 08 Feb '21	Wed 10 Feb '21	4
Alarm clock	4 days	Mon 08 Feb '21	Thu 11 Feb '21	4
Computer I/O	4 days	Mon 08 Feb '21	Thu 11 Feb '21	4
Review design	10 days	Wed 07 Apr '21	Tue 20 Apr '21	5,6,7,8,9,10,11,12,13,14,15
Price components	5 days	Wed 07 Apr '21	Tue 13 Apr '21	5,6,7,8,9,10,11,12,13,14,15
Integration	15 days	Wed 21 Apr '21	Wed 12 May '21	16,17
Document design	35 days	Wed 21 Apr '21	Thu 10 Jun '21	16
Procure prototype components	20 days	Thu 13 May '21	Thu 10 Jun '21	18
Assemble prototypes	10 days	Fri 11 Jun '21	Thu 24 Jun '21	20
Lab Test Prototypes	15 days	Fri 25 Jun '21	Thu 15 Jul '21	21
Field test prototypes	15 days	Fri 16 Jul '21	Fri 06 Aug '21	19,22
Adjust design	20 days	Mon 09 Aug '21	Fri 03 Sep '21	23
Order stock parts	15 days	Tue 07 Sep '21	Mon 27 Sep '21	24
Order Custom parts	2 days	Tue 07 Sep '21	Wed 08 Sep '21	24
Assemble first production unit	5 days	Tue 05 Oct '21	Mon 11 Oct '21	25FS+5 days,26FS+10 days
Test unit	10 days	Tue 12 Oct '21	Tue 26 Oct '21	27
Produce 30 units	10 days	Wed 27 Oct '21	Tue 09 Nov '21	28
Train sales representatives	10 days	Wed 10 Nov '21	Tue 23 Nov '21	29

a. Initial Schedule



b. Network Diagram

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c. Initial Gantt Chart

From the initial Gantt we can conclude that it is very unlikely or impossible that the project will be able to complete the 4th of October deadline. The project is very wide and is dependent upon various activities. In any project there are several modules that are completed or must be completed individually, and such activities lie in the critical path; any delay in the activities on the critical path leads to delay of the overall project.

There are several activities that lie on the Gantt chart that are highly delaying this project. Those activities in the initial stage of the networks are Architectural Design and it's the root of development of any product, Feature Specifications, Database, Review Design, Integration while in the latter stage of the project most of the activities lie on the critical path.

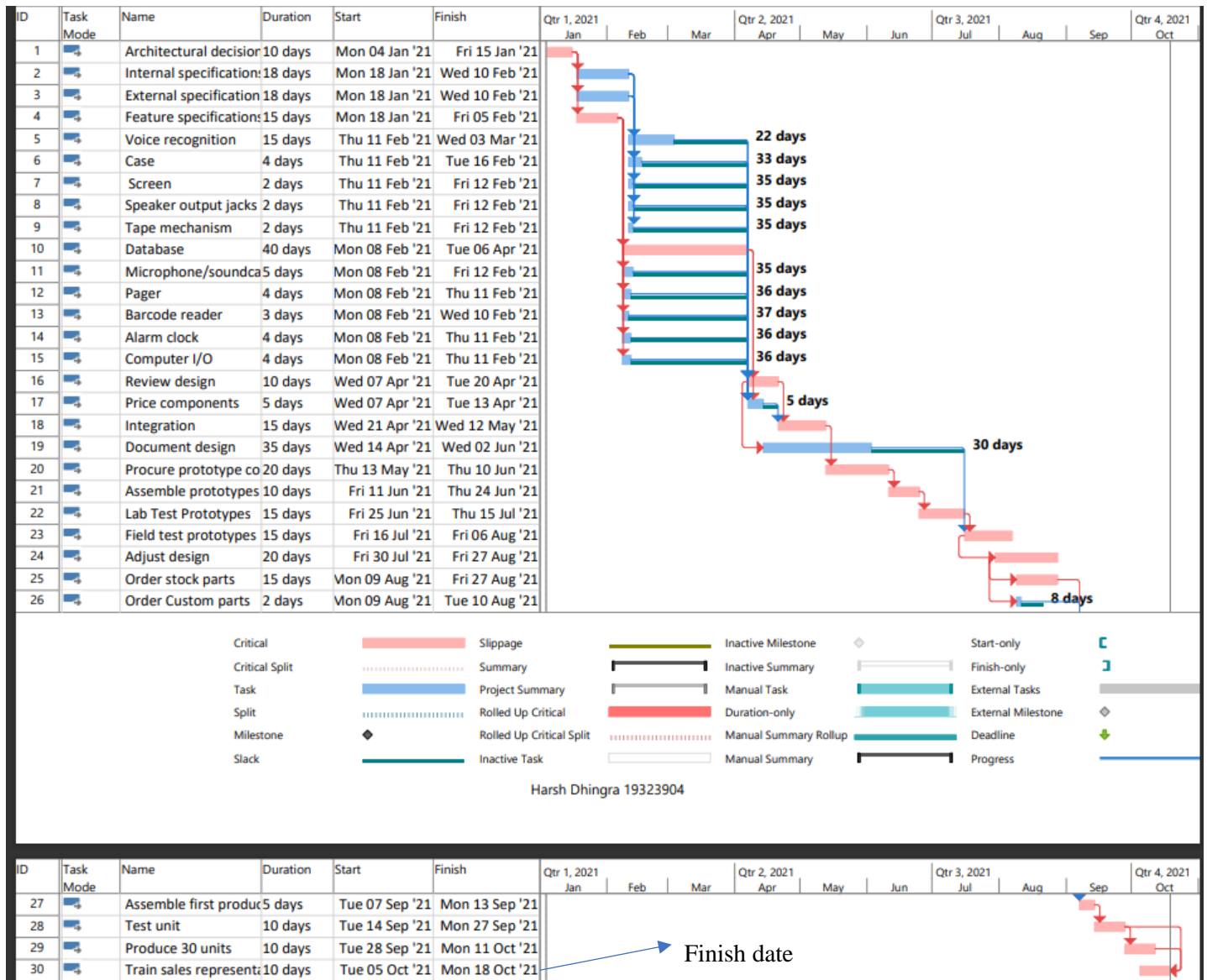
Assessing the Sensitivity of the network –

According to the current plan the project is scheduled to be completed by 23rd of November that too if the project goes smoothly as planned without any interferences or without any challenges that could harm the completion of the project. There are various redundancies in the network; moreover, if anything goes wrong during the planned pipeline, the project can be delayed for an unplanned time. e.g. if an Engineer gets sick while working this could delay the whole project.

There is various obstacle for the project to be completed by October 2nd. Egg – Database is the major activity in the project and any unforeseen obstacle can delay. Any delay in the database activity will result into a total delay of the project. The biggest obstacle is POC (proof of concept a small exercise to test the design idea or assumption), therefore it must pass several testing's else all the work done would go in vain and hence would lead to delay of the project.

Review Design, Price components these two are one of those activities which have the most number of predecessors that is they are dependent upon various several activities that needed to be completed before its start and moreover the entire project also depend upon these activities therefore they are the most critical activities. Test Unit, production of 30 units and Train sales representatives are in the latter part of the project.

and lies on the critical path any delay in these can lead to delaying the whole project. Moreover, the team has limited amount of time since overtime is not allowed and weekends are holiday. Other problems associated with the project is since it's a new concept it should be kept a secret also it requires lots and lots of Research and Development must be carried for a complete success of the project. Since the original schedule results are very disappointing, in order to reduce the project time a follow-up meeting was setup. Ken Clark, a development engineer gave some ideas in order to shorten the project span. So, the following changes were made, the changed Gantt Chart is as follows



d. Gantt chart after Ken Clark changes on introducing lag

From all the changes proposed only those changes were made that would affect the time span of the project i.e. only those activities predecessors were changed which were on the critical path. All the changes resulted in decreasing the project span. The project now was ending on 18th of October, but still it couldn't meet the proposed the deadline. Therefore, we needed another strategy in order to achieve the deadline. In order to meet the deadline, the only way left was to increase the budget for certain activities. By increasing the budget on several activities, I observed different changes in time span vs budget, however the best optimal solution according to me is as follows with Total Cost = €85,000, Completion Date = 27th September 2021 i.e.

Task	Cost
Database	€40,000
Procure Prototype Components	€35,000
Order Stock Parts	€10,000

Gantt Chart Obtained for the same is as follows



e. Final optimal Solution after introducing lag and crash with crashing encircled

Here we get the final optimal solution as the project completes way before the deadline i.e. on Monday 27th September, 2021.

Now with all the activities the project is well matched with actual project priority matrix. Amount spend on crashing after lag is €85,000 and is delivered a week before the deadline, without compromising the scope of the product

Accessing Crashing Activities and Lag

Project Crashing and introducing lag are both used to shorten project duration

Project crashing is an exercise carried out to reduce the time of a project by investing more money. This becomes necessary when the deadline must be met. For crashing only, the critical are considered since duration of the project could be reduced by crashing these activities only. It is possible that when a project is crashed another non-critical activity may become critical and in the next cycle this must be considered for further crashing. Introducing lags on the other hand gives it enough break time to assess the project and makes the project efficient rather than cutting down the duration of the project.

Well it's the combination of these two techniques used in the project in order to successfully reduce the length of the project (Nightingale) and meet the deadline i.e. well concluded from Fig e

Task Name	Duration	Start	Finish	Predecessors	Early Finish	Early Start	Late Finish
Architectural decisions	10 days	Mon 04 Jan '21	Fri 15 Jan '21		Fri 15 Jan '21	Mon 04 Jan '21	Fri 15 Jan '21
Internal specifications	18 days	Mon 18 Jan '21	Wed 10 Feb '21	1	Wed 10 Feb '21	Mon 18 Jan '21	Tue 02 Mar '21
External specifications	18 days	Mon 18 Jan '21	Wed 10 Feb '21	1	Wed 10 Feb '21	Mon 18 Jan '21	Tue 02 Mar '21
Feature specifications	15 days	Mon 18 Jan '21	Fri 05 Feb '21	1	Fri 05 Feb '21	Mon 18 Jan '21	Fri 05 Feb '21
Voice recognition	15 days	Thu 11 Feb '21	Wed 03 Mar '21	2,3	Wed 03 Mar '21	Thu 11 Feb '21	Wed 24 Mar '21
Case	4 days	Thu 11 Feb '21	Tue 16 Feb '21	2,3	Tue 16 Feb '21	Thu 11 Feb '21	Wed 24 Mar '21
Screen	2 days	Thu 11 Feb '21	Fri 12 Feb '21	2,3	Fri 12 Feb '21	Thu 11 Feb '21	Wed 24 Mar '21
Speaker output jacks	2 days	Thu 11 Feb '21	Fri 12 Feb '21	2,3	Fri 12 Feb '21	Thu 11 Feb '21	Wed 24 Mar '21
Tape mechanism	2 days	Thu 11 Feb '21	Fri 12 Feb '21	2,3	Fri 12 Feb '21	Thu 11 Feb '21	Wed 24 Mar '21
Database	32 days	Mon 08 Feb '21	Wed 24 Mar '21	4	Wed 24 Mar '21	Mon 08 Feb '21	Wed 24 Mar '21
Microphone/soundcard	5 days	Mon 08 Feb '21	Fri 12 Feb '21	4	Fri 12 Feb '21	Mon 08 Feb '21	Wed 24 Mar '21
Pager	4 days	Mon 08 Feb '21	Thu 11 Feb '21	4	Thu 11 Feb '21	Mon 08 Feb '21	Wed 24 Mar '21
Barcode reader	3 days	Mon 08 Feb '21	Wed 10 Feb '21	4	Wed 10 Feb '21	Mon 08 Feb '21	Wed 24 Mar '21
Alarm clock	4 days	Mon 08 Feb '21	Thu 11 Feb '21	4	Thu 11 Feb '21	Mon 08 Feb '21	Wed 24 Mar '21
Computer I/O	4 days	Mon 08 Feb '21	Thu 11 Feb '21	4	Thu 11 Feb '21	Mon 08 Feb '21	Wed 24 Mar '21
Review design	10 days	Thu 25 Mar '21	Thu 08 Apr '21	5,6,7,8,9,10,11,12,13,14,15	Thu 08 Apr '21	Thu 25 Mar '21	Thu 08 Apr '21
Price components	5 days	Thu 25 Mar '21	Wed 31 Mar '21	5,6,7,8,9,10,11,12,13,14,15	Wed 31 Mar '21	Thu 25 Mar '21	Thu 08 Apr '21
Integration	15 days	Fri 09 Apr '21	Thu 29 Apr '21	16,17	Thu 29 Apr '21	Fri 09 Apr '21	Thu 29 Apr '21
Document design	35 days	Thu 01 Apr '21	Fri 21 May '21	16SS+5 days	Fri 21 May '21	Thu 01 Apr '21	Tue 29 Jun '21
Procure prototype components	16 days	Fri 30 Apr '21	Mon 24 May '21	18	Mon 24 May '21	Fri 30 Apr '21	Mon 24 May '21
Assemble prototypes	10 days	Tue 25 May '21	Tue 08 Jun '21	20	Tue 08 Jun '21	Tue 25 May '21	Tue 08 Jun '21
Lab Test Prototypes	15 days	Wed 09 Jun '21	Tue 29 Jun '21	21	Tue 29 Jun '21	Wed 09 Jun '21	Tue 29 Jun '21
Field test prototypes	15 days	Wed 30 Jun '21	Tue 20 Jul '21	19,22	Tue 20 Jul '21	Wed 30 Jun '21	Tue 20 Jul '21
Adjust design	20 days	Wed 14 Jul '21	Wed 11 Aug '21	23SS+10 days	Wed 11 Aug '21	Wed 14 Jul '21	Wed 11 Aug '21
Order stock parts	12 days	Wed 21 Jul '21	Fri 06 Aug '21	24SS+5 days	Fri 06 Aug '21	Wed 21 Jul '21	Fri 06 Aug '21
Order Custom parts	2 days	Wed 21 Jul '21	Thu 22 Jul '21	24SS+5 days	Thu 22 Jul '21	Wed 21 Jul '21	Thu 29 Jul '21
Assemble first production unit	5 days	Mon 16 Aug '21	Fri 20 Aug '21	25FS+5 days,26FS+10 days	Fri 20 Aug '21	Mon 16 Aug '21	Fri 20 Aug '21
Test unit	10 days	Mon 23 Aug '21	Fri 03 Sep '21	27	Fri 03 Sep '21	Mon 23 Aug '21	Fri 03 Sep '21
Produce 30 units	10 days	Tue 07 Sep '21	Mon 20 Sep '21	28	Mon 20 Sep '21	Tue 07 Sep '21	Mon 20 Sep '21
Train sales representatives	10 days	Tue 14 Sep '21	Mon 27 Sep '21	29FF+5 days,28FF+5 days	Mon 27 Sep '21	Tue 14 Sep '21	Mon 27 Sep '21

f. Final plan with early start early finish and late finish

Risk Management:

There are always unforeseen events during a project that would cause a delay in completion of a project. In context of a project risk is an uncertain event or condition that can have a positive or negative impact on project objectives. A risk can cause major consequences if not dealt with good planning. Some risks can be predicted in the start of the project, but several occur during the production phase or completion phase. Egg Mid staffing crisis, shortage of goods to make a product, price hike of raw material, failure of prototypes etc. There risk management plays a vital role in any project.

Risk management is where you identify and evaluate potential risks to your project, so that you can prepare to avoid or deal with them. Risk management identifies what can go wrong during the project and what can be done about the event before the project begins, also provides us with contingency plans. It is a proactive approach.

Risk management approach involves four phases-

- ✓ Risk Identification - attempting to anticipate all the possible things that could impact successful completion of the project
- ✓ Risk Assessment - ranking the risks in terms of probability of occurrence and potential impact
- ✓ Risk Response Development - developing a strategy to respond to the risk or mitigate the risk should it occur, developing contingency plans.
- ✓ Risk Response Control – Implementing risk strategy, Monitoring and controlling the execution of the risk response strategy

Risk identification is the first and most important process of risk management. It should focus on both objectives and events that caused them. In risk identification critical thinking is a key factor. Risk identification should be carried out efficiently with the project team and all the potential risks should be noted for the same:

Not all the identified risks deserve attention. Some are not important, and some pose tremendous threats to the project. The best way to assess all the risks is through scenario analysis. In scenario analysis team members assess the significance of each risk event in terms of Probability of the event and Impact of the event.

After the risks are identified and assessed we need to go to risk response development phase and then to risk response control phase

Risk Assessment Table

TASK NO.	TASK NAME	POSSIBLE FALIURE	PROBABILIT Y	IMPAC T	DETECTION DIFFICULTY	RISK VALUE
1	Architectural decisions	Initial fault in design or scope	2	5	3	30
4	Feature specifications	Features not compatible with design	2	6	2	24
10	Database	Low amount of data	4	4	3	48
16	Review design	Design not precise	5	4	3	60
18	Integration	Not able to make exact design	4	4	3	48
20	Procure prototype components	Components not available	1	5	1	5
21	Assemble prototypes	Problem in assembly	2	4	1	8
22	Lab test prototypes	Faulty prototype	3	3	2	18
23	Field test prototypes	Prototype not working correctly in field	4	5	3	60
24	Adjust design	A lot of adjustment required	3	3	4	36
25	Order stock parts	Parts not available	1	5	3	15
27	Assemble first production unit	Parts not compatible	3	4	2	24
28	Test unit	Failure in testing due to error	2	4	2	16

29	Produce 30 units	Resources not available or faulty	5	5	2	50
30	Train sales representatives	Training not enough	2	4	3	24

Risk analysis Table

Risk Analysis		
Event	Response	Contingency
Faulty architectural design	Mitigate - review the design	Outsourcing
Insufficient Collection of data	collect data once again	Constant review of data
Improper Testing	Go to real world for testing	Create better testing conditions
Unavailability of resources for manufacturing	Avoid - Place order well on time	Manufacturing should be outsourced

Team management

Team management is the key for any successful project. It is the ability of a manager to administer and coordinate the team members to perform a task. For a good team management, one must understand the team dynamics. Several characteristics of team dynamics are –

- Clear direction: There must be clear understanding of the purpose and goal that are to be achieved goal the team to understand the working
- Open doors for communication: for a team to work efficiently there must more and more communication among the team members
- Collaboration spirit: the team members must be willing to work together and must accept the ideas of others as well as their own
- Following rules: some set of rules must be set for a team to work as that will lead to elimination of ambiguity and will help in setting proper procedure and setting for the workplace.
- Mutual accountability: teams must accept responsibility as a team and as individuals. They must not be blaming others of their failures and mistakes. They must celebrate success together and deal with failures together.
- Team Trust

To build up a team one must lay strong foundations, therefore building a strong team plays a major role in any project. Rassy Brown should consider applying Tuckman's model of team building

Bruce Tuckman described 5 stages of team or group development, which he said that each team follows in order to be well- performing:

1) Forming: In this stage, members get oriented and acquainted to the team roles. The stage is marked by uncertainty and members look forward to lead and search for authority. Further, they get to know each other. This step establishes connection and trust among the team members. This step is important. To implement such a crucial step the team manager should conduct team introduction meets, group activities so that the team can easily bond.

2) Storming: This is most critical stage to pass through, where the team performance may decline, as there will be conflicts and competition between the members. Team progresses to subsequent stages only if it overcomes these difficulties and accepts the differences. As a result of this people begin to see themselves as a team. Meetings and daily stand-ups should be held regularly so that conflicts in opinions amongst team members should be resolved

3) Norming: Here, the conflicts are resolved, the team members cooperate with each other and understand their individual roles. As the sense of cohesion and unity develops, the performance of team also increases. Every team member is ready to take their respective roles and perform and do

their best to achieve the team goals. The danger is here is that the members may get so focused that they often don't share conflicting ideas. For this project manager must implement regular team meetings and everyone should be encouraged to share their ideas

4) Performing: The team becomes well- established, mature and we'll functioning. Members aim for the accomplishment of team goals. The project manager must encourage good performance and provide regular feedbacks

5) Adjourning: Most of the team goals are established and the group disbands. The final tasks are wrapped up and results documented. This step is the final stage and marks the completion of the project. To implement this the project manager should encourage team members to wrap up tasks quickly and a farewell should be organized for a team and the project should be ended on a good note.

Team Dynamics and Team Management impacts the outcome of any project. In order to achieve success in Nightingale Rassy Brown must follow all the steps for a smooth working of the project.

Conclusion

Nightingale project is a very useful project and it tend to serve society by introducing great technology, developed to help medical technicians. The plan is well explained and meets the deadline and the cost is within the budget. Crashing and introduction of lag helped to achieve the deadline. For the good delivery of project risk assessment is done well before hand.

Resources Used:

1. Nightingale Project Handout
2. Lecture Notes, Management for engineers.
3. Project Management, The managerial process - Book