## 3.2. Planning the measures of new service introduction using the project evaluation and review technique

In accordance with the recommendations that have been proposed in the previous subsection, in order to introduce a new service at the enterprise it is necessary to implement a range of activities. In order to plan the complicated set of interconnected activities the project evaluation and review technique (PERT) is widely used.

Project evaluation and review technique is used in order to control the implementation of projects of the company for achieving a certain outcome. Their use is effective in cases when the achievement of a goal requires consistent (coordinated) actions of many performers from complex areas of work, a large variety of work and the relationship of the performers.

Project evaluation and review technique allows to:

identify the list of works of the project;

visualize order of works;

determine the duration of each work and the whole project;

identify the critical works of the project and its critical path;

determine the reserves of time for each work.

Project evaluation and review technique is base on depicting the PERT chart, that is a statistical tool designed to analyze and represent the tasks involved in completing a given project. PERT chart is a dynamic model of the project, which reflects the technological dependence and sequence of complex of works, coordinates their accomplishments over time, taking into account the cost of resources and the cost of work underlining narrow (critical) sites.

To create a project model it is necessary to use []:

a list of all activities required to complete the project (work breakdown structure – WBS);

events that are milestones between activities;

the time (duration) that each activity will take to completion;

the dependencies between the activities.

PERT is a method to analyze the involved tasks in completing a given project, especially the time needed to complete each task, and to identify the minimum time needed to complete the total project. PERT network chart consists of circles those are used as events, and arrows for activities. So, to operate with these elements, it is necessary to define them.

PERT event is a point that marks the start or completion of one or more activities. It consumes no time and uses no resources. When it marks the completion of one or more tasks, it is not “reached” (does not occur) until all of the activities leading to that event have been completed []. There are two types of events according PERT:

1) predecessor event;

2) successor event.

Predecessor event is an event that immediately precedes some other event without any other events intervening. An event can have multiple predecessor events and can be the predecessor of multiple events.

Successor event is an event that immediately follows some other event without any other intervening events.

As for PERT activities, they are the actual performance of a task which consumes time and requires resources (such as labor, materials, space, and machinery). It can be understood as representing the time, effort, and resources required to move from one event to another. A PERT activity cannot be performed until the predecessor event has occurred.

A work reflects the labor process, involving people, machines, equipment, material resources or the waiting process. Each work has a specific content. For the correct visualization of order of works precedence so-called fictitious activity or relationships are used. In a PERT chart fictitious activity is depicted by dashed lines. They require neither the time nor the resources, but only point out that the beginning of a work depends on the end of other.

It is necessary to plan duration and scope of work. For planning in PERT different types of required time are used, such as optimistic, pessimistic, more likely and expected.

Optimistic time (O) is the minimum possible time required to accomplish a task, assuming everything proceeds better than is normally expected. Pessimistic time (P) is the maximum possible time required to accomplish a task, assuming everything goes wrong (but excluding major catastrophes). Most likely time (M) is the best estimate of the time required to accomplish a task, assuming everything proceeds as normal.

And expected time (TE) is the best estimate of the time required to accomplish a task, accounting for the fact that things don't always proceed as normal (the implication being that the expected time is the average time the task would require if the task were repeated on a number of occasions over an extended period of time).

In order to implement an innovation project of providing a new service LLC “Tekhnokabel” have to perform a set of activities:

generating the idea of an innovation project;

developing an innovation project;

researching the market;

developing project documents;

protecting the intellectual property;

searching for equipment;

searching for suppliers;

ordering equipment;

installing equipment;

hiring a staff;

developing job descriptions;

training a staff;

starting to provide a new service.

PERT chart for the set of enlisted works is presented on fig. 3.2.

**Fig. 3.2. PERT chart for an innovation project**

Tab. 3.4 represents a list of works for a PERT chart.

**Table 3.4**

**List of works for a PERT chart**

|  |  |
| --- | --- |
| **Work index** | **Work content** |
|
| 0 – 1 | Generating the idea of an innovation project |
| 1 – 2 | Developing an innovation project |
| 2 – 3 | Researching the market |
| 3 – 4 | Developing project documents |
| 4 – 5 | Protecting the intellectual property |
| 5 – 6 | Searching for equipment |
| 5 – 7 | Searching for suppliers |
| 6 – 8 | - |
| 7 – 8 | Ordering equipment |
| 8 – 9 | Installing equipment |
| 9 – 10  | Hiring a staff |
| 10 – 11 | Developing job descriptions |
| 10 – 12 | Training a staff |
| 11 – 12 | - |
| 12 – 13 | Starting to provide a new service |

For calculation of expected time the following formula is used:

 , (3.1)

where *ТЕ* – expected work duration;

 *О* – optimistic work duration;

 *М* – most likely work duration;

 *Р* – pessimistic work duration.

Optimistic, pessimistic, most likely and expected time for all the activities during the project is presented on the tab. 3.5. Evaluation of the time required for activities were performed by specialists of a company. Determination of optimistic, pessimistic and most likely time for implementation of early proposed activities was done on the anvil. It was based on previous extensive experience in different projects.

**Table 3.4**

**Planning of work duration and work scope**

|  |  |  |  |
| --- | --- | --- | --- |
| **Work index** | **Work content** | **Duration of work** | **Scope of work, person** |
| **Optimistic** | **Most likely** | **Pessimistic** | **Expected** |
| 0 – 1 | Generating the idea of an innovation project | 7 | 10 | 20 | 11 | 1 |
| 1 – 2 | Developing an innovation project | 4 | 7 | 10 | 7 | 2 |
| 2 – 3 | Researching the market | 6 | 8 | 14 | 7 | 1 |
| 3 – 4 | Developing project documents | 17 | 22 | 26 | 22 | 2 |
| 4 – 5 | Protecting the intellectual property | 5 | 6 | 9 | 6 | 1 |
| 5 – 6 | Searching for equipment | 80 | 90 | 110 | 92 | 10 |
| 5 – 7 | Searching for suppliers | 10 | 13 | 22 | 14 | 2 |
| 6 – 8 | - | 0 | 0 | 0 | 0 | 0 |
| 7 – 8 | Ordering equipment | 8 | 11 | 15 | 11 | 1 |
| 8 – 9 | Installing equipment | 8 | 9 | 12 | 9 | 3 |
| 9 – 10  | Hiring a staff | 5 | 9 | 6 | 10 | 2 |
| 10 – 11 | Developing job descriptions | 3 | 6 | 8 | 6 | 1 |
| 10 – 12 | Training a staff | 4 | 5 | 7 | 5 | 1 |
| 11 – 12 | - | 0 | 0 | 0 | 0 | 0 |
| 12 – 13 | Starting to provide a new service | 1 | 1 | 1 | 1 | 4 |

So the most durable work is searching for equipment because choice of equipment defines a technology of service providing which is critical for quality.

Calculation of the time characteristics of events is presented in the tab. 3.5. It gives a possibility to define earliest and latest start and finish for activities within all the project, and float that is a measure of the excess time and resources available to complete a task. It is the amount of time that a project task can be delayed without causing a delay in any subsequent tasks (free float) or the whole project (total float).

So, we can see from the tab. 3.5 critical events that has total float equal to zero. The event with zero float not necessarily lays on the critical path since its path may not be the longest. We can conclude that all the events, except event 7, are laying on the critical path.

**Table 3.5**

**Calculation of the time characteristics of events**

|  |  |  |
| --- | --- | --- |
| і | j | Тіl |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 0 |   | 11 |   |   |   |   |   |   |   |   |   |   |   |   | 11-11=0 |
| 1 |   |   | 7 |   |   |   |   |   |   |   |   |   |   |   | 18-7=11 |
| 2 |   |   |   | 7 |   |   |   |   |   |   |   |   |   |   | 25-7=18 |
| 3 |   |   |   |   | 22 |   |   |   |   |   |   |   |   |   | 47-22=25 |
| 4 |   |   |   |   |   | 6 |   |   |   |   |   |   |   |   | 53-6=47 |
| 5 |   |   |   |   |   |   | 92 | 14 |   |   |   |   |   |   | 134-14=120 145-92=**53** |
| 6 |   |   |   |   |   |   |   |   | 0 |   |   |   |   |   | 145-0=145 |
| 7 |   |   |   |   |   |   |   |   | 11 |   |   |   |   |   | 145-11=134 |
| 8 |   |   |   |   |   |   |   |   |   | 9 |   |   |   |   | 154-9=145 |
| 9 |   |   |   |   |   |   |   |   |   |   | 10 |   |   |   | 160-10=154 |
| 10 |   |   |   |   |   |   |   |   |   |   |   | 6 | 5 |   | 170-5=165 170-6=**164** |
| 11 |   |   |   |   |   |   |   |   |   |   |   |   | 0 |   | 170-0=170 |
| 12 |   |   |   |   |   |   |   |   |   |   |   |   |   | 1 | 171=1=170 |
| 13 |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 171 |
| Тje | 0 | 0+11=11 | 11+7=18 | 18+7=25 | 25+22=47 | 47+6=53 | 53+92=145 | 53+14=67 | 145+0=**145** 67+11=78 | 145+9=154 | 154+10=164 | 164+6=170 | 164+5=169 170+0=**170** | 170+1=171 | -  |
| R | 0 | 11-11=0 | 18-18=0 | 25-25=0 | 47-47=0 | 53-53=0 | 145-145=0 | 134-67=67 | 145-145=0 | 154-154=0 | 164-164=0 | 170-170=0 | 170-170=0 | 171-171=0 | -  |

Floats for each event (R) is calculated by a formula:

, (3.2)

where Tjl – latest term for event j;

 Tje – earliest term for event j.

Also it is necessary to calculate floats of activities to indicate critical activities. It is measured of the excess time and resources available to complete a task. It is the amount of time that a project task can be delayed without causing a delay in any subsequent tasks (free float) or the whole project (total float), calculated basing on early and late floats. It gives a possibility to define earliest and latest start and finish for activities within all the project, and float that is a measure of the excess time and resources available to complete a task. It is the amount of time that a project task can be delayed without causing a delay in any subsequent tasks (free float) or the whole project (total float).

For calculation a total float (TF) it is necessary to use following formula:

, (3.3)

where Tjl – the latest finish of activity i-j;

tij – duration of activity i-j;

Tie – the earliest beginning of the activity i-j.

For calculation an early float (EF) it is necessary to use following formula:

, (3.4)

where Tje – the earliest finish of the activity i-j.

For calculation a late float (LF) it is necessary to use following formula:

, (3.5)

where Til – the latest beginning of the activity i-j.

For calculation a free float (FF) it is necessary to use following formula:

 (3.6)

Calculation of the floats for the innovation project is presented in the tab. 3.6.

**Table 3.6**

**Calculation of the time characteristics of works of the innovation project**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Work index** | **Beginning of the activity** | **tij** | **End of the activity** | **Floats** |
| **Тіe** | **Тіl** | **Тje** | **Тjl** | **Total float** | **Early float** | **Late float** | **Free float** |
| 0 – 1 | 0 | 0 | 11 | 11 | 11 | 0 | 0 | 0 | 0 |
| 1 – 2 | 11 | 11 | 7 | 18 | 18 | 0 | 0 | 0 | 0 |
| 2 – 3 | 18 | 18 | 7 | 25 | 25 | 0 | 0 | 0 | 0 |
| 3 – 4 | 25 | 25 | 22 | 47 | 47 | 0 | 0 | 0 | 0 |
| 4 – 5 | 47 | 47 | 6 | 53 | 53 | 0 | 0 | 0 | 0 |
| 5 – 6 | 53 | 53 | 92 | 145 | 145 | 0 | 0 | 0 | 0 |
| 5 – 7 | 53 | 53 | 14 | 67 | 134 | 67 | 0 | 67 | 0 |
| 6 – 8 | 145 | 145 | 0 | 145 | 145 | 0 | 0 | 0 | 0 |
| 7 – 8 | 67 | 134 | 11 | 145 | 145 | 67 | 67 | 0 | 0 |
| 8 – 9 | 145 | 145 | 9 | 154 | 154 | 0 | 0 | 0 | 0 |
| 9 – 10  | 154 | 154 | 10 | 164 | 164 | 0 | 0 | 0 | 0 |
| 10 – 11 | 164 | 164 | 6 | 170 | 170 | 0 | 0 | 0 | 0 |
| 10 – 12 | 164 | 164 | 5 | 170 | 170 | 1 | 1 | 1 | 1 |
| 11 – 12 | 170 | 170 | 0 | 170 | 170 | 0 | 0 | 0 | 0 |
| 12 – 13 | 170 | 170 | 1 | 171 | 171 | 0 | 0 | 0 | 0 |

So we can see from it that only 3 activities have floats. It causes quite high level of risk, so for successful implementation this project needs strict control of time to complete tasks.