

Creating a Network Planning Diagram: Men's Trousers Production Project

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Abstract

Methods of network planning are an instrument to manage and control the flow of complex inter-related activities. To project resulted in success, as an essential part of the project is outlined and described his previous careful planning while successful, cost-effective and quality management. The paper discusses the development of a network planning diagram for men's trousers production project. The results of the work shows a sketch of men's trousers, examination and duration of the activity in cutting room, interdependence of activities in cutting room and diagrams that are made using Critical Path Method (CPM) and display activities in the time diagram using a MS Project software package.

Keywords: Network planning; MS project; Men trousers production

Introduction

A sequencing approach that guarantees the cost efficient running of the manufacturing system is to minimize operational costs that include setup costs (times) which are very important in many manufacturing industries, such as printing, textile, and paper, chemical and automotive industry. Therefore, scheduling problem is a popular topic with continuing interest for operational expert systems [1,2]. On machine scheduling problems involving setup times (costs), the importance of an explicit treatment of sequence-dependent setup times, especially in relation to capacity management is indicated [3]. As for the cost minimization aspect, setup costs are regarded in textile industry via tabu search [4].

The apparel and textile industry is a fascinating example of manufacturing and the supply chain. This sector is under constant pressure, competition is fierce, and there are always rival firms waiting to challenge. The main problems in clothing manufacture include:

- Strong traditions, for instance in the culture of organisations, job design, work organisation, and the way operators are paid; it is the same for their suppliers,
- Unresponsive and inflexible production systems,
- Fabric/cloth purchasing difficulties: due to the nature of the process this takes at least two weeks to produce and often much longer [5].

Today's apparel manufacturing is characterized by short product life cycles, volatile and unpredictable customer demands, tremendous product varieties, and long supply process [6,7]. The combination of short product life cycles, high levels of impulse buying, fashion influences in all product categories, increases in product variety, continual in-season refreshment and the requirements for quick response place pressure on suppliers in developing nations [8].

Overall production of clothing is generally made up of several manufacturing processes such as cutting, sewing, finishing and packaging. Sewing is the dominant process. Given the different models of garments, sewing process may include up to more than a hundred machine hand sewing operations.

Although modern consumers take clothing producing for granted, making clothes is a labor intensive process. To follow today's market trends, apparel industry must rationally manage production costs and

be prepared quickly and on time to respond to market needs. Because of this, a very important part of developing any new products, as well as the monitoring and management of production is the planning. With proper planning we terminating work and define the terms by which we ensure the efficient production with a certain cost control.

The complexity of the project as well as the development of electronic computers have contributed to the development of new planning techniques with the aim of planning to become faster, more accurate and easier. Finally, planning is done with a computer. Solutions are found in a number of network planning techniques whereby realized coordination, monitoring and control of complex processes that need to be timed [9].

With the development of technology and computer, there has been the emergence of computer programs that allow us much quicker, easier and more successful production, as well as production planning, management and control of all production process phases. MS Project software that was used in this work is one of such tool.

Theoretical Part

In everyday life, we are faced with a constant need for optimal use of resources and reduce project costs. Optimal use can only be achieved through good planning project activities. One of the practical and frequently used techniques in planning is the Gantt chart. A Gantt chart is a graphical representation of a business running, production planning and monitoring.

Planning the complex projects with multitude activities is very difficult without the help of computers. Planning activities in the project plans usually modeled respective network plan. Network plan shows the sequence in which the activities are carried out, their duration and their dependencies. The project manager will be during the development of the project plan, usually encounter with problems

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of network plan structure, i.e. how to arrange activities on the project and how to model their dependencies, which activities will be run in parallel and which serial, which resources to use and when to use them, and that are the planned dates for the activities completion in the project plan, and that is the critical path which slows down the whole project [9].

Network planning techniques

Analytical techniques for project management, such as Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), cost estimation, and budgeting, are widely applied in business. Especially when used in large scale projects, these techniques are sensitive to strategic stakeholder behaviour. High costs, long duration, high technological uncertainty, and high diversity of contractors that have to co-operate, are characteristics that are intrinsic to large scale projects and can be abused by contractors to maximize their own interests [10].

The network planning techniques are modern analytical methods of planning and managing complex enterprise, ideas, projects and other realizations. It is based on a comprehensive presentation of detailed planned of project tasks using a network diagram. The name was given by a special procedure which is carried out in the planning and management (techniques) and the graphical representation in the form of a network (Network Planning) [11].

The advantages of applying techniques of network planning are many, and they can achieve the following objectives:

Overview of the project activities,

The interaction of the main sequence and parallel or partial activity,

Review of the all time required to perform the activities,

The establishment of the so-called critical path which is crucial for time-accurate execution of the plan, of alternative directions of activities in the project [12].

The network planning technique usually brings considerable material and time savings. By control assurance of the process and permanent assessment of performance during its execution, the network planning technique has become an instrument to manage rational and cost-effective implementation of the project. Bottlenecks can be easily determined in advance so they can take due measures to eliminate them. The effect of disturbances that occur during implementation of the project can be determined by data processing, and the necessary personnel and resources can be arrange in advance in the most appropriate manner. The network displays can also contradictory tasks and responsibilities more clearly delineate and enforce. The network planning technique is a solid basis for building a wider auxiliary system of planning and management control. It is used in three main phases, of which the first analysis of the structure, the second analysis time, while the third phase was the optimization of resources.

Network planning methods are based on a graphical representation of the sequence of actions in the framework of a project and their interdependencies by the network diagram. They are used to solve various problems of project management. Common to them is that they can be applied in all phases of basic project management (planning, organizing and controlling). They are suitable for the planning of all types of works, notably for works with a large number of technological processes and complex technological processes, for works which require special attention in terms of maintenance and control of the

works, which are supposed to be able to get to major disturbances during the execution [13].

The best known method of time analysis of network diagrams are: CPM - Critical Path Method, PERT - Program Evaluation and Review Technique, MPM - Metra Potential Method, PDM - Precedence Diagramming Method, GERT - Graphical Evaluation and Review Technique. The network planning techniques (arrow diagrams) CPM or PERT shown duration of activity is not proportional to the duration of the particular job. Duration of each activity is assessed or determined and administered by each activity. By monitoring the execution of activities may be at any given range time of information about the current state of the project and its level of readiness. Projects, especially complex, are made of a number subprojects whose activities are interdependent. All these group activities, their mutual influence, as well as the timeline can be very accurately display by network plan [14].

In the garment industry there is assembly lines which are very similar to the above mentioned network diagrams. The fundamental purpose of the assembly lines is to provide an approximate and relatively credible spatial distribution of technological operations (activities) by sub-assembly and assembly lines, while at the same time enable the rational movement of work pieces in the production process, without back strokes [15,16]. A line balancing means balancing the production line or any other assembly line. The main objective of line balancing is to distribute the task evenly over the work station so that idle time of man or machine can be minimized. Assembly line balancing (ALB) is the term commonly used to refer to the decision process of assigning tasks to workstations in a serial production system. The task consists of elemental operations required to convert raw material in to finished goods. Task allocation of each worker was achieved by assembly line balancing to increase an assembly efficiency and productivity [17].

In formulas for calculating the duration of the activities is marked with a small t and index of these activities and time of the event with a big T . Thereby, indices E and L are added to as a mark of the Earliest Time and Latest Time event. If necessary, add a label to which the time of event belongs therewith that the previous activity is indicates with number of events such as (8-9) or generally (i - j), (Figure 1).

Project management information system

Project Management Information Systems (PMIS) are software applications that help managers track projects from their conception to their execution. PMIS have grown to a great extent over the last decades and have become comprehensive systems that can be used to sustain the whole life-cycle of complex projects [18]. They are software applications that allow individuals or teams to track projects from their conception to their execution, providing project managers and other team members with pertinent information such as the scheduling of resources, budget management, supplier management, time management, task assignments, quality control, documentation and collaborative tools. The goal of PMIS is therefore to boost efficiency by making the development cycle more visible as long as all users are able to track specific tasks and can have a better understanding of how the project is going on. A key improvement is enabling a coherent flow of information between project managers and team members, which significantly helps them to keep people up to date [19].

In particular, PMIS can help practitioners to detect latent issues before they occur, meet deadlines, and collaborate more easily and at a greater extent [20].

The PMIS industry is presently dominated by a number of leading software representatives, such as Microsoft, Oracle and Metier

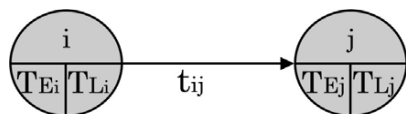


Figure 1: The general form of presentation of two adjacent events and activities between them.

Management Systems (a former Lockheed company), and a number of small independent companies. Demand has remained steady for years but, as companies are increasingly turning to enhanced technical solutions, it is supposed to grow up significantly in the near future. In particular, PMIS are believed to evolve towards a more integrated project lifecycle management and the extensive adoption of web-based or cloud computing tools [21,22].

Project management software represents the set of tools that help performing basic tasks of project management, such as planning, network plans development and activity monitoring. One of such software is MS Project, a software product from Microsoft which is due to its advantages and features, one of the most famous and frequently-used tools for various project and tasks planning. MS Project provides simple and effective planning tasks, the search for optimal solutions in comparison to more resources, monitoring the implementation of production tasks and projects, share information, create the required reports, problem solving, etc.

Another frequently used program to create different types of diagrams is Microsoft Visio. It can be used to create drawings and diagrams as well as technical and organizational charts and lists, flow charts and databases, network diagrams, block diagrams, temporal and spatial maps, etc., and is also very easy to use because of the organized and intuitive user interface.

If the project requires sharing project information with suppliers, customers, remote group or individuals located outside the business network there are a variety of different software programs for projects management that are based on management over the internet. The advantages of such programs are, for example, favorable price, faster and easier method of operation, ease of use, easy integration into existing programs, the ability to update data in the tasks and project plans from anywhere, etc. [23].

Operation Method

The time analysis includes an estimate and determines the time required for the execution of certain activities and the implementation of the project in general. Techniques or methods used in the men's trousers project is CPM by which is calculated budget, forward - backward (progressive and retrograde), and based on that determines the critical path, i.e. the longest time series of activities from initial to final event. Using the methods of CPM allows graphical representation of the project, reducing the time necessary to perform the project and displays which activities are critical and which are not. Activities are shown as arrows, and the events are shown with circles and labeled with natural numbers.

In this paper, during graphical project managing the men's trousers, where used Microsoft Project software package. It is a program that greatly helps in making the project and their successful implementation, saves time, helps to improve the quality of work, and influences on business success.

To create a project of men's trousers a sketch of trousers is needed, (Figure 2). Based on sketches activities are written (technical

operations). With the help of activity was determined the correlations of activities in cutting room, sewing room and finishing. The front parts of trousers have two folds smoothed by the side seam and slit pocket with one welt, while fly is made with a zipper. The back sides of the trousers have a waist gusset and by one pocket with two welts. Waistband is 4 cm wide and has five belt loops. On the left side of the waistband is an extension of the fastening. Trouser legs have cuffs. Waistband, fly, under fly, front and back pockets welt are affixed with the interfacing. Front and back pockets are tailored from pocket lining. Trousers have three buttons, one on the waistband and two buttons on the back pockets welt.

This paper presents only network diagram for the technological process of cutting men's trousers using the CPM and MS Project. View and duration of the activity in the technological process of men's trousers cutting, taken from one factory, are shown in Table 1, and the activities interdependence in Table 2.

Figure 3 shows the diagram solved using CPM for the technological process of men's trousers cutting and Figure 4 diagram created by MS Project.

Discussion

To create a men's trousers project a list of activities for the technological process of cutting, sewing and finishing is required. Based on these activities an arrow diagram of technological process of cutting is made by CPM. Activities in the network are connected in time from initial to final network events. Of all the paths in the network, the most important is the one that takes the most forward units, because it also shows how long runs the entire project.

The analyzed project of men's trousers cutting has 26 activities with total activity duration of 576,56 s and has four line (group of activities) that act simultaneously. First group has five activities relating to lining cutting, second group is main line with 13 activities, third group has five activities relating to interfacing cutting and fourth group has three activities relating to pocket lining cutting.

Based on the front - back calculation, where the earliest and latest times overlapping, the critical path was determined. In making the men's trousers project, events that make up the critical path in the technological process of cutting are the following label:

A - B - H - I - J - T - U - V - Z - X - Y - W - Q.

This critical path represents the longest duration of in the entire network diagram for the technological process of men's trousers cutting

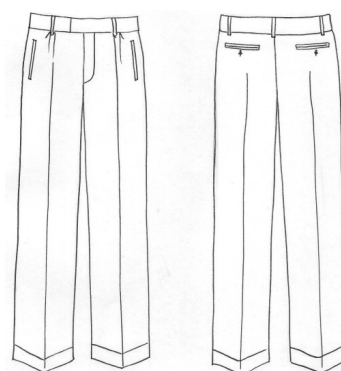


Figure 2: Men trousers design.

Activity label	Activity Description	Activity Duration(seconds)
A	Fabrics spreading for trousers, stapling and labels control, recording and layers slitting.	90,00
B	Basic fabric computer cutting with the brought to the table, marking and cutting parts stacking, and dumping to trolley	90,00
C	Lining spreading for trousers	900
D	Lining rough cutting for trouser legs	468
E	Interfacing spreading for fly, backing for back and front pockets, fly flap and under fly	468
F	Interfacing spreading for welt	288
G	Interfacing spreading for waistband	144
H	Bundle tacking from shelves, table sorting, writing numbers in pair	4644
I	Completing the trousers cutting part from basic fabric	11484
J	Sampling labels on back trousers leg	1116
K	Pocket lining spreading	612
L	Pocket lining cutting	756
M	Lining cutting	1692
N	Lining press cutting with zigzag knife	468
O	Lining marking	504
P	Taking the pocket lining from shelfe	540
R	Interfacing fine cutting for fly, backing for front and back pocket, fly flap and under fly	684
S	Interfacing fine cutting for welt and pocket flap	396
T	Interfacing press cutting for waistband	144
U	Interfacing press cutting for slit pocket	216
V	Interfacing press cutting for back pocket	216
Z	Waistband sticking with fusing press	2088
X	Pocket lining sticking	2340
Y	Welt sticking	2340
W	Waistband sticking	648
Q	Disposal in temporary storage	6500
Total		576,56

Table 1: Overview and duration of the activity in the technological process of men's trousers cutting.

Activity	A	B	C	D	E	F	G	H	I	J	K	L	M
Previous activity	-	A	-	C	-	E	F	B	H	I	-	K	D
Duration	9000	9000	900	468	468	288	144	4644	11484	1116	612	756	1692
Activity	N	O	P	R	S	T	U	V	Z	X	Y	W	Q
Previous activity	M	N	L	G	R	S,J	T	U	V	Z	X	Y	W,P,O
Duration	468	504	540	684	396	144	216	216	2088	2340	2340	648	6500

Table 2: The activities interdependence in the technological process of men's trousers cutting.

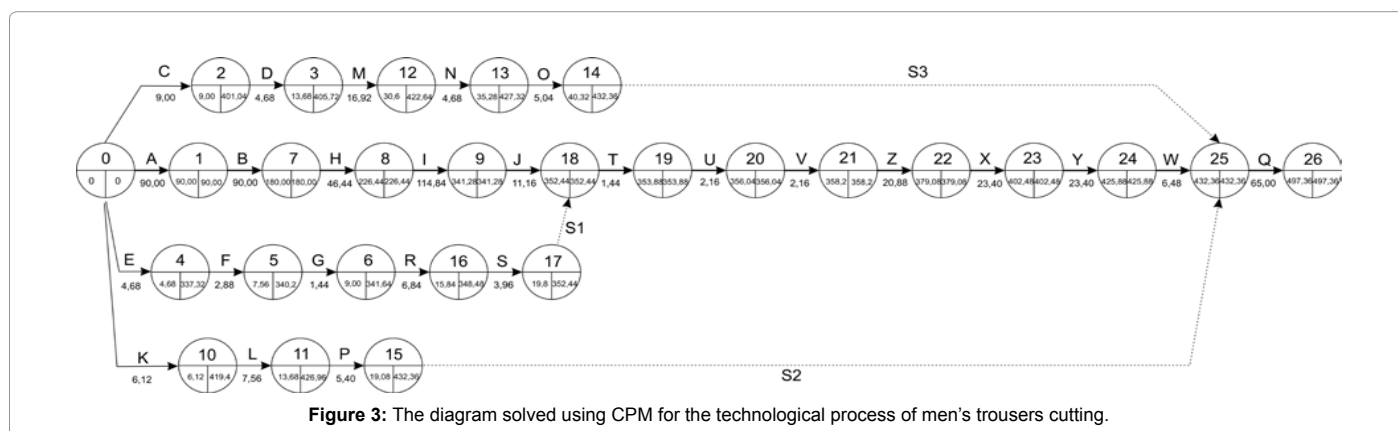


Figure 3: The diagram solved using CPM for the technological process of men's trousers cutting.

and is 497,36 s. That time is shorter for 13.7% of the total duration of the activity in the technological process of cutting which is 576,56 s. Activities which are on critical path can not be delayed. Accordingly, the critical path determines the total duration of the process covered by

the network diagram, and because of that has great significance for the operation of the planning process. Events on first, third and fourth line occurs simultaneously with the critical path, and they do not affect the duration of making trousers.

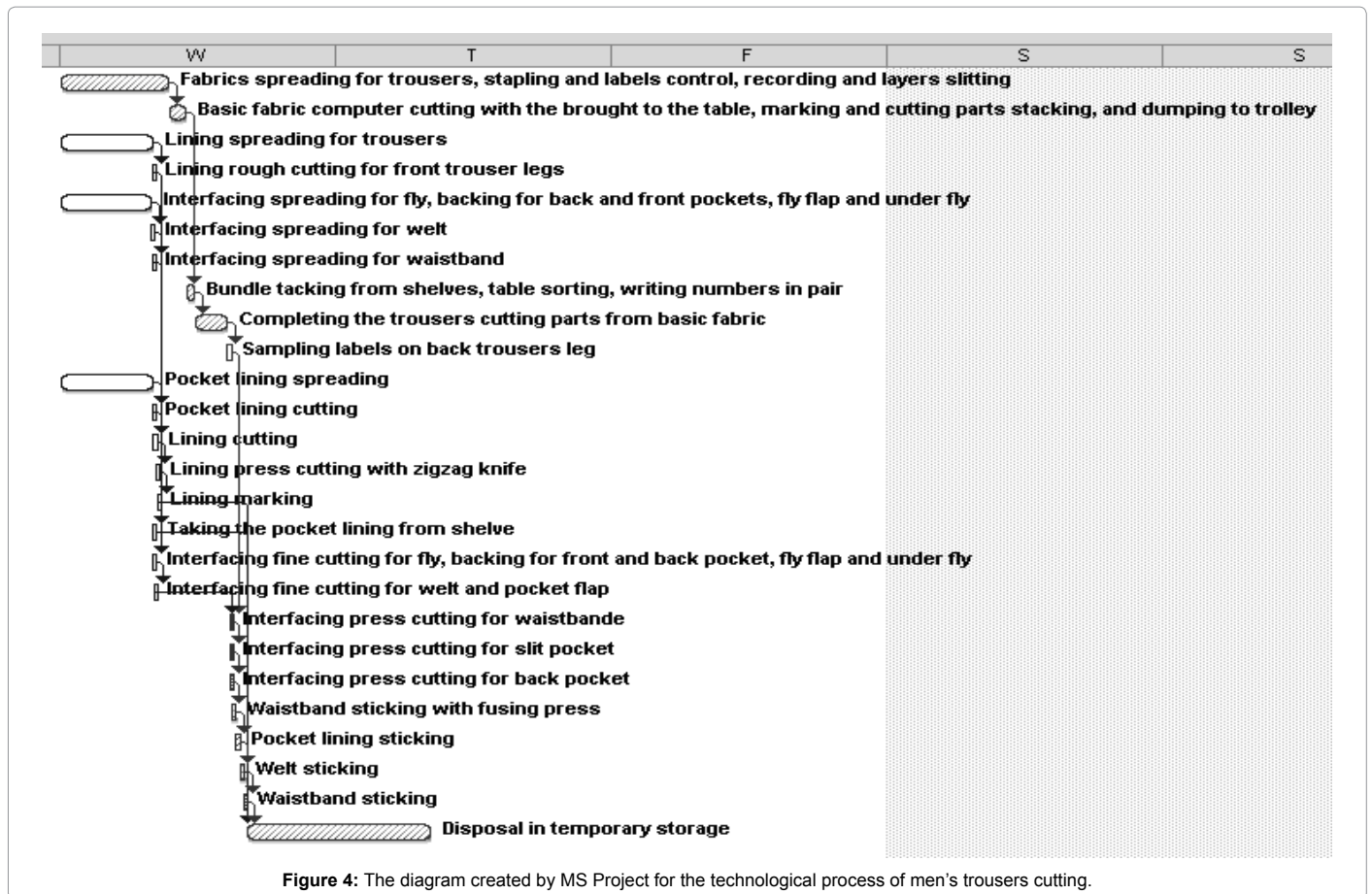


Figure 4: The diagram created by MS Project for the technological process of men's trousers cutting.

Activities S1, S2 and S3 are the so called virtual (fictional) activities. They are not real time activities and their duration is zero. They show that the following activities are depended to two or more of the previous activities.

Conclusion

The man most learned about the environment through eyesight, most spotting, comparing and receives information that is stored in the brain in the form of images. It is often said that a picture provides much more information than text with a detailed description or table.

Network diagrams are used as a tool by making their time performance order of activities, as well as clear communication tool to project team members. Show us the path of the project, defining the start and end time of each activity. For a brief diagram overview is easy to determine the logic of project execution. Besides showing the order in which actions are performed, network diagrams are telling us what shared resources they use. From them we can easily read the flow of information within the project. For this reason, the network diagram is a very useful tool to visualize, especially towards to project client that requires a quick, easy and transparent project progress. Use of network diagram provides an overview of the earliest and latest time of technological operations that overlap and represent critical events, or give critical path. Network diagrams can be used in every project, exclusive of its range, characteristics. The most useful information will give us in complex projects that consist of a number related and parallel activity.

In this paper we obtained the critical path that represents the longest duration in the entire network diagram for the technological process of

men's trousers cutting and is 497,36 s. This time is shorter for 13,7% from the total duration of the activity in the technological process of cutting, that is 576,56 s. Activities that are in the critical path must be completed in the estimated time, because completion overrunning of critical activities leading to the completion overrunning of the entire project, and thereby moving the production period. Other three groups of activities (lines) occur simultaneously with the critical path.

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