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Abstract:

This research aims to create an online software specially designed to plan and manage apparel production lines, using different programming codes Hypertext Preprocessor (PHP), Hypertext Markup Language (HTML), and an open source database management system a relational database management system (MySQL), the online database and the website where designed to allow users to have an easy interface to communicate with that database. Nowadays the apparel industry has very rapid growth rate in which many efforts to improve production times and quality is a must, apparel industry consists of numerous operation carried out in a certain sequence by machinery and workers in order to achieve the desired garment. The rapid pace of the industry and the need of accurate and updated follow up created a problem for apparel production lines management in setting up and managing apparel production lines during the operation and dealing with updated data during the operation, so a system was created in order to solve the difficulties that were found in updating or modifying data in production lines in an easy, fast and time-saving manner. Using this system, user can remotely manage all details of production lines, modify and follow-up all process using any device within or outside the factory as long as it's connected to the Internet. In order to assess this system an analytical survey method was used, for conducting this an online questionnaire was designed and distributed to specialists in the field of apparel production and management, according to this questionnaire and the system trial by the specialists, the results indicates the success of the program and its effectiveness in managing, updating and modifying clothing production lines remotely.

Keywords:

Production Lines, Online Software, Production Managing, Apparel.

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Introduction

Apparel manufacturing is labour intensive, which is characterised by low fixed capital investment; a wide range of product designs and hence input materials; variable production volumes; high competitiveness and often high demand on product quality. [1]

The garment production systems are a combination of production processes, materials handling, personnel and equipment that direct workflow and produce finished garments. It is a system that depicts how the two-dimensional fabric is transformed into a three-dimensional garment in a manufacturing system. The type of the production systems used are based on the various factors like utilization of number of machines to assemble a garment, layout of machines, total number of operators involved to produce a garment and number of pieces moving in a production line during the production of a garment. [2]

Each garment production system needs a suitable management philosophy, materials handling procedures, plant layout for garments spreading and worker training. This industry could combine various production systems to achieve their specific garments' production needs like utilizing only one production system or a combination of different systems for one product style. Designing production system ensures the coordination of various production activities. There is no particular production system that is universally accepted, yet there are different types of production systems followed by different organizations as discussed in the following section. [3]

Types of production systems

The garment production systems are combination of production processes, materials handling, personnel and equipment that direct workflow and produce finished garments. It is a system that depicts how the two-dimensional fabric is

transformed into a three-dimensional garment in a manufacturing system. [4]

Different types of production systems are distinct and require different conditions for working. However, they should meet the two basic objectives, that is, to meet the specification of the final product and to be cost-effective in nature. The main aim of any production system is to achieve a minimum possible total production time. This automatically reduces in-process inventory and its cost. The subassembly system reduces temporary storage time to zero by combining temporary storage time with transportation time.

In the apparel industry, four types of production systems are commonly used: bundle system, progressive bundle system (PBS), unit production system (UPS, and finally modular system. [5]

bundle system, is used when a tailor alone makes a complete garment, progressive bundle system (PBS), where bundles of garments parts are moved in sequence from one sewing machine operator to the next, unit production system (UPS), here; garment components are clamped in a hanger and the hanger moves on an overhead rail, and finally modular system which consist of Multi-skilled operators as a group and each of the team members do multiple operations.. [5]

Estimation of Production Requirement

It would be helpful to have an idea about quantity of garments that can be produced per day so that it would be helpful in future planning based on the budget and customer demand. This necessitates the process of determination of the production capability of an industry. [6]

Plant Loading

Plant loading is defined as the allotment of workers or machines for future processing of an order by considering the sequence of processes as in a route sheet and the priority sequencing and utilisation of work centres. Loading establishes the volume of load every work centre should have in a forthcoming period which results in load schedules indicating the evaluation of labour and machine hours necessary to get the master production schedules with the available labour and machine hours in every planning schedule in the short term. [7]

Capacity Study

A capacity study is the evaluation of a garment industry, manufacturing process, machine, or operator to estimate the maximum rate of production. The objective of the capacity study is:

- To find-out the deviation between the actual rate of production to its capacity
- To evaluate the causes for lagging in the actual production
- To achieve the actual production closer to its actual capacity using proper methods and reducing the idle time

Number of Machines

After deciding on the type of product and production capacity, the number of sewing machines and other machinery requirements could be calculated. Otherwise, it can be carried out conversely, that is, after deciding to set-up a factory for a specific number of machines as well as type of product, projected production per day can be determined.

Type of Machines

The succeeding process is to select the proper kinds of machines suitable for the production of garments as well as the number of machines to be purchased in each kind of machine. This step would be useful for estimating the capital investment in machines. Apart from the sewing machines, list other essential equipment such as pressing tables, spreading tables, boiler, generator, furnishings etc.

Raw Materials Requirement

After selection of product category and machines, raw materials such as fabric and other accessories and trims to make the garment with their average consumption have to be listed. This would be helpful for preparing the budget on material sourcing. [8]

Factory Space Requirement

The space needed for setting up of machines, equipment and administrative centre has to be estimated. According to the estimation the factory layout could be planned.

Manpower Requirement

After setting up the machine and materials, the labour, the primary resources for a garment industry could be planned. The manpower calculation includes number of office staff, supervisors and workers. Further, an estimation has to be done for their salaries.

Project Cost

To determine the budget for setting up an apparel industry, one could prepare the cost of the project. For doing that, the assessment of total capital investment, EMI amount, salary for staff, workers' wages and running costs have to be taken into consideration.

Internal Process Flow

Plan out the detailed process flow for execution of an order. This will facilitate deciding what all the departments need to set up and plan to employ the people accordingly.

Supplier Listing

Finding out the good and reliable suppliers for fabrics, trims and other necessary items required

to manufacture the garments is crucial for completion and dispatch of the orders in time.

Plant Layout

It is a floor plan for deciding and orchestrating the chosen equipment and machinery of an industry in the best suitable location to permit the quicker flow of materials at a minimum cost and with the least amount of material handling during the manufacturing process from the receipt of raw materials to the shipment of the finished garments. [9]

Principles of Plant Layout

The following principles have to be followed to have an ideal plant layout. The understanding of these principles would help in learning the aspects that are influencing the plant layout.

Principle of Minimum Travel

Workers and materials must pass through the shortest distance between the processes to avoid wastage of labour and time and reduce the cost of materials handling. This is mainly important for garment industries where

each department is interconnected and the movement of the labour from one department to another must be minimised for increased productivity.

Principle of Sequence

Machineries as well as processes should be arranged in a sequential order which is achieved in the product layout. It contains the arrangement of the working area for each operation in the same order. For a proper flow of materials, the plant layout must offer easy movement of raw materials to the production department and to the packing department (Nahmias 1997; Ramesh Babu 2012). The plant layout, following the principle of sequence, needs to consider the frequency of movement between the different departments, volume of production in each department, total working area available in each department and the nature of operations in each department.

Principle of Usage

Every foot of existing space should be effectively utilised. It includes the proper usage of space both horizontally and vertically. Apart from using the floor space of a room, if the ceiling height is also utilised, more material can be stored in the same room. Use of overhead space saves a lot of floor space.

Principle of Compactness

There should be harmonious fusion of all the related factors so that the final layout looks well integrated and compact.

Principle of Safety and Satisfaction

This layout has built in options for workers to ensure they are safeguarded from the occurrence of fire. The comfort and convenience of the worker has been considered more important while planning this layout. In an apparel unit, factors such as proper lighting, ventilation and prevention of hazardous conditions are very important (Nahmias 1997). Employees must be protected from excessive heat, dust from the raw materials such as fabrics and the trimmings of the threads in sewing, glare and fumes. The safety of workers both during operation, maintenance and transportation of materials should be taken care of.

Principle of Flexibility

The layout must allow modifications with minimum complications and at minimum cost.

Influencing Factors of Plant Layout

The plant layout changes from industry to industry, location to location and plant to plant. The plant layout is influenced by the 3M's, namely materials, machinery and men. [10]

Materials

It is the important aspect that influences the plant layout. For any industry there is a need to offer a proper storage and movement of raw materials, which are necessary for the production of a product, until they are transformed into finished products. It is a common principle that every industry procures the raw materials economically when they are available. This creates the need for appropriate storage so that the goods are moved according to the requirement through production departments.

Worker

While outlining the design it is imperative to consider the type, position and prerequisites of workers. Worker facilities, for example, wellbeing and related services, locker rooms and public facilities influence the design. Employee safety ought to additionally be considered.

Machinery

The machinery required is reliant on the type of product, quantity of production, the type of process and management policy. These decide the size and type of the machinery to be installed which, in turn, influences the plant layout.

Production is the combination of men, materials and machines. The ratio in which these elements are used depends on their costs and on the production processes selected. Before laying out a plant, it is necessary to determine which of these elements are to be stationary and which will be moving during the selection process. The plant layout must offer the space for storage of fuel, be it coal, oil or gas.

Product

A layout is generally designed with the objective

of manufacturing a product. Whether the product is light or heavy, small or big, its arrangement related to the plant location affects the plant layout. The quantity of production, quality of product, size of machinery and space requirement for a machine and other facilities are based on the sales demand and plant layout. A product with relatively inelastic demand should be produced on a mass scale with less specialised equipment.

Production System Modeling and simulation

Simulation is a technique to model a real-life or hypothetical situation on a computer so that it can be used for analysing the behaviour of system. By changing variables predictions can be made on system behavior. It provides predictions on the performance of an existing system. Moreover, by suggesting possible scenarios on system alternative solutions can be compared. Therefore, it is a very useful engineering technique to suggest investment strategies to companies for a particular design problems. [11]

Modeling and simulation are potential tools for analysis of the assembly lines like apparel of a garment manufacturing. The experiment controls the resources of the assembly line process without affecting the real production system. So, simulation analysis is used to model the company and can be used to quantify the performance of the layout, arrangement of the jobs, material handling, resource utilization like money, machine, material and man, inventory, quality (like rework, defect and normal), cost of production or manufacturing cost, lead time in this manufacturing firm. [12]

Firstly, real data taken from the factory floor using time studies and precedence constraints are taken into consideration to model the allocation of operations to the operators for simulation with the objective of minimising the workflow among the operators. Afterwards with the help of the simulation model of the sewing line, the bottlenecks are determined. Finally, possible scenarios are tried in order to increase the efficiency of the line and to suggest investment strategies to manufacturers. [13]

Methodology

The literature reveals some difficulties related to setting up and managing apparel production lines, to name a few difficulties in updating or modifying any data in the production lines except by referring to the system in the factory, and it was also found it difficult to deal with the production lines data during the operation of the production lines when any problem occurred and wasted a lot of time to solve this problem, thus, the researcher designed and set up an online software to overcome this difficulties, this software is supposed to be capable of setting up and managing apparel production lines remotely using any device connected to the internet, so that it can be installed and operated through a website and an analytical survey method will be used to evaluate the users experience by using an online questionnaire, and programming languages were used:

HTML: Hypertext Markup Language (HTML) is the standard markup language for documents designed to be displayed in a web browser. It can be assisted by technologies such as Cascading Style Sheets (CSS) and scripting languages such as JavaScript.

PHP: PHP is a server side scripting language, that is used to develop Static websites or Dynamic websites or Web applications. PHP stands for Hypertext Pre-processor, that earlier stood for Personal Home Pages. PHP scripts can only be interpreted on a server that has PHP installed.

Researchers used PHP in programing the web application because it's:

- PHP runs on various platforms (Windows, Linux, Unix, Mac OS X, etc.)
- PHP is compatible with almost all servers used today (Apache, IIS, etc.)
- PHP supports a wide range of databases
- PHP is free. Download it from the official PHP resource: www.php.net
- PHP is easy to learn and runs efficiently on the server side

MySQL is a freely available open source Relational Database Management System (RDBMS) that uses Structured Query Language (**SQL**).

SQL is the most popular language for adding, accessing and managing content in a database. MySQL is almost used in every open source PHP application.

Therefore, a database was designed and populated on the webserver, afterwards the website interface was designed to allow a communication medium between users and that database.

The website is https://www.fashionied.com/plm/, and here are some screenshots from it for illustration:

Figure 1 Adding Machine Type (English Translation in Blue Font)

Figure 2 Adding Machine Data (English Translation in Blue Font)

Figure 3 Adding Worker Data (English Translation in Blue Font)

Figure 4 Adding Process Data (English Translation in Blue Font)

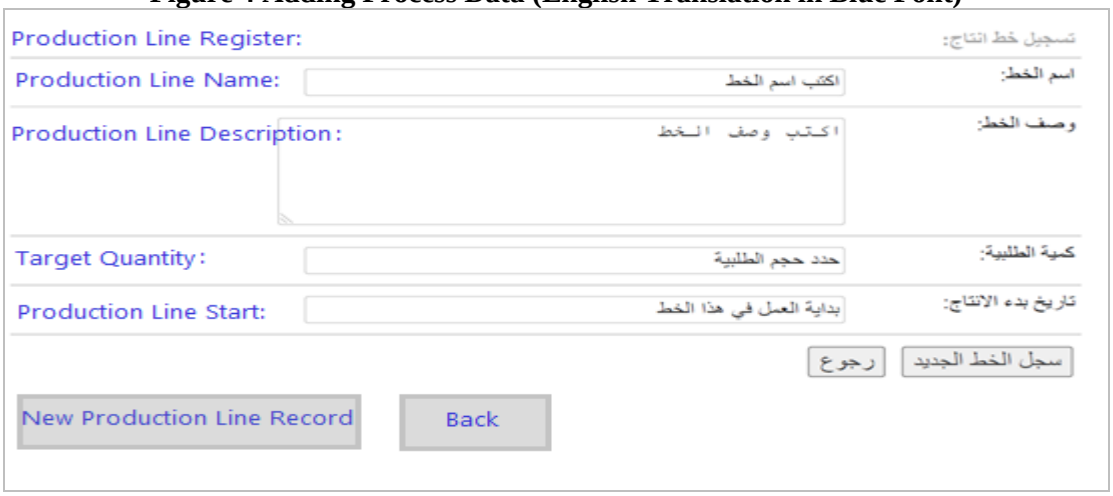


Figure 5 Adding Production Line Data (English Translation in Blue Font)

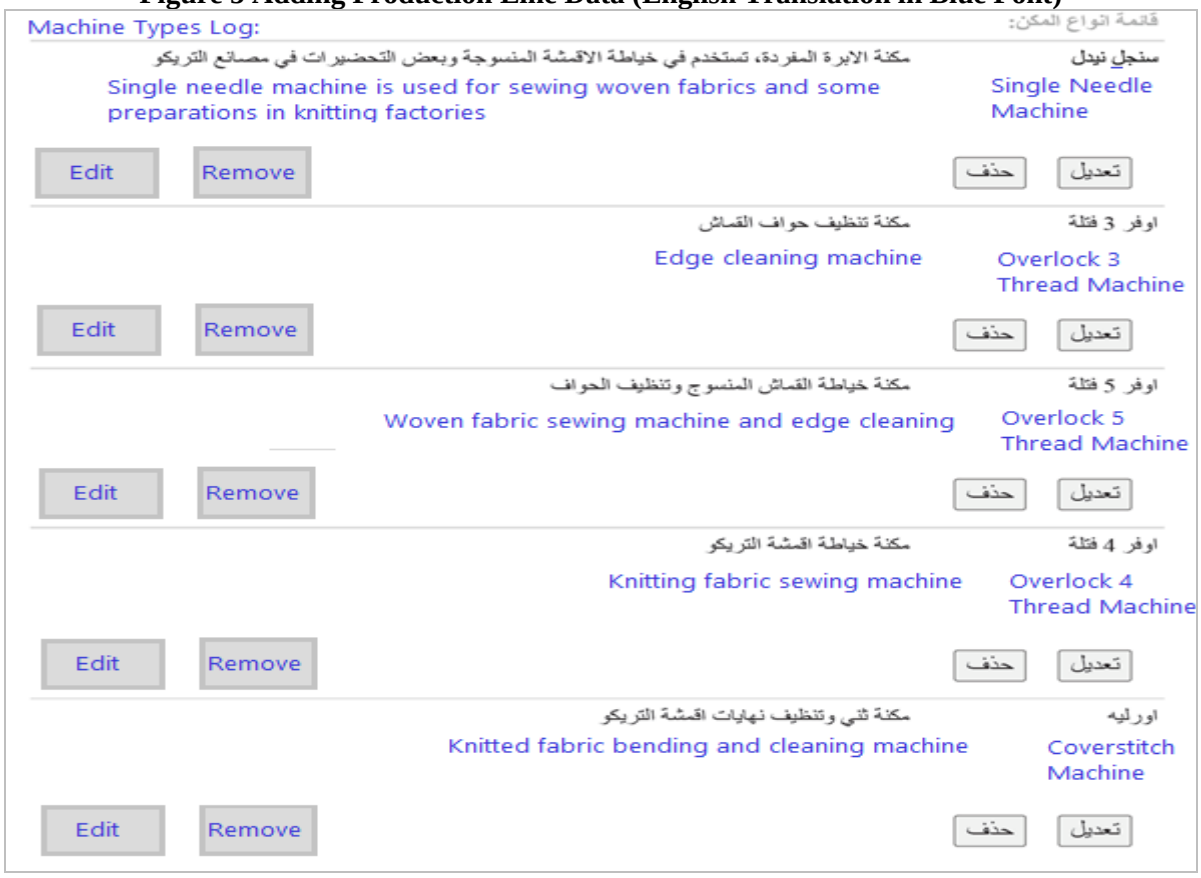


Figure 6 Showing All Machines Data (English Translation in Blue Font)

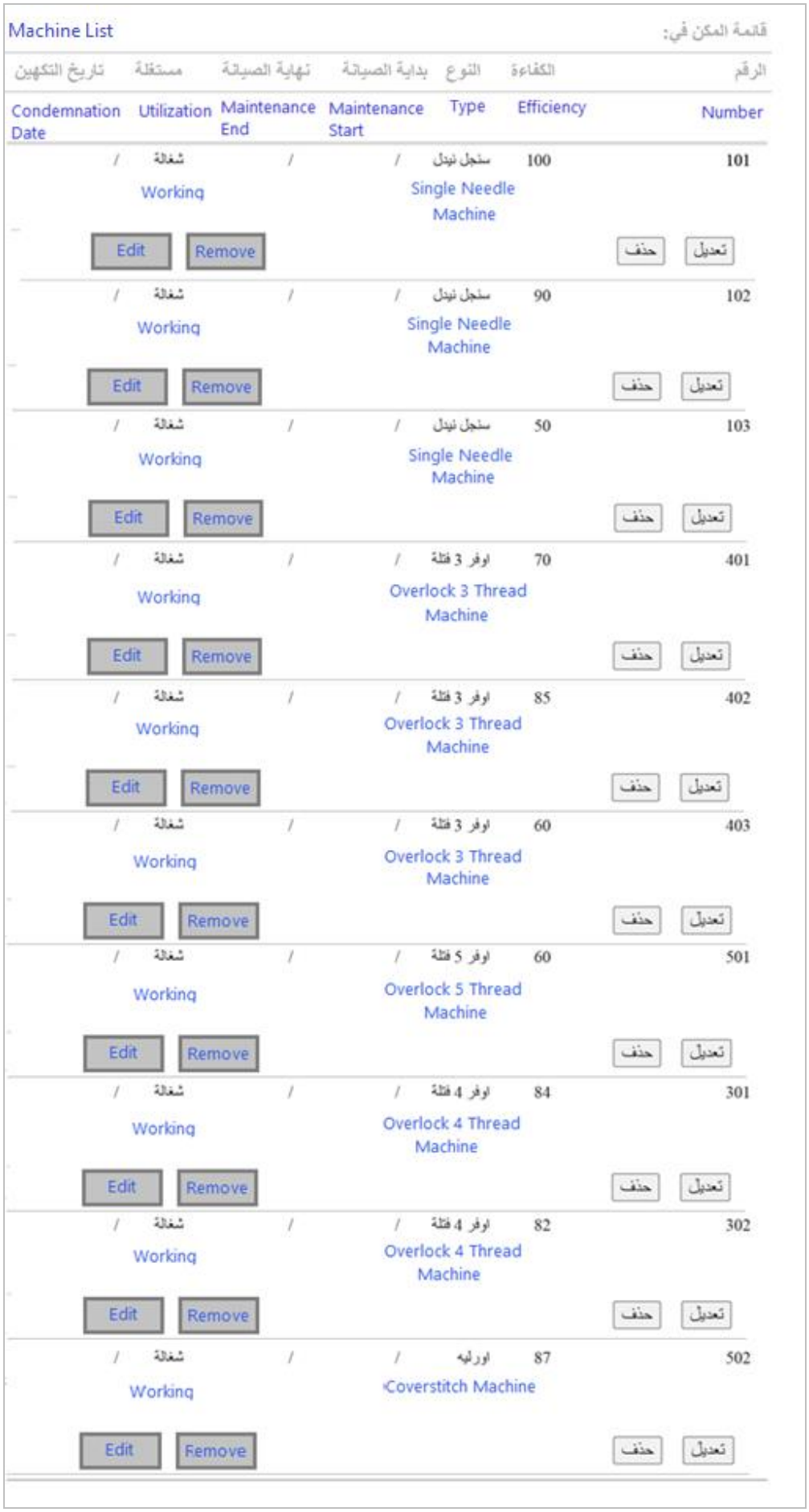
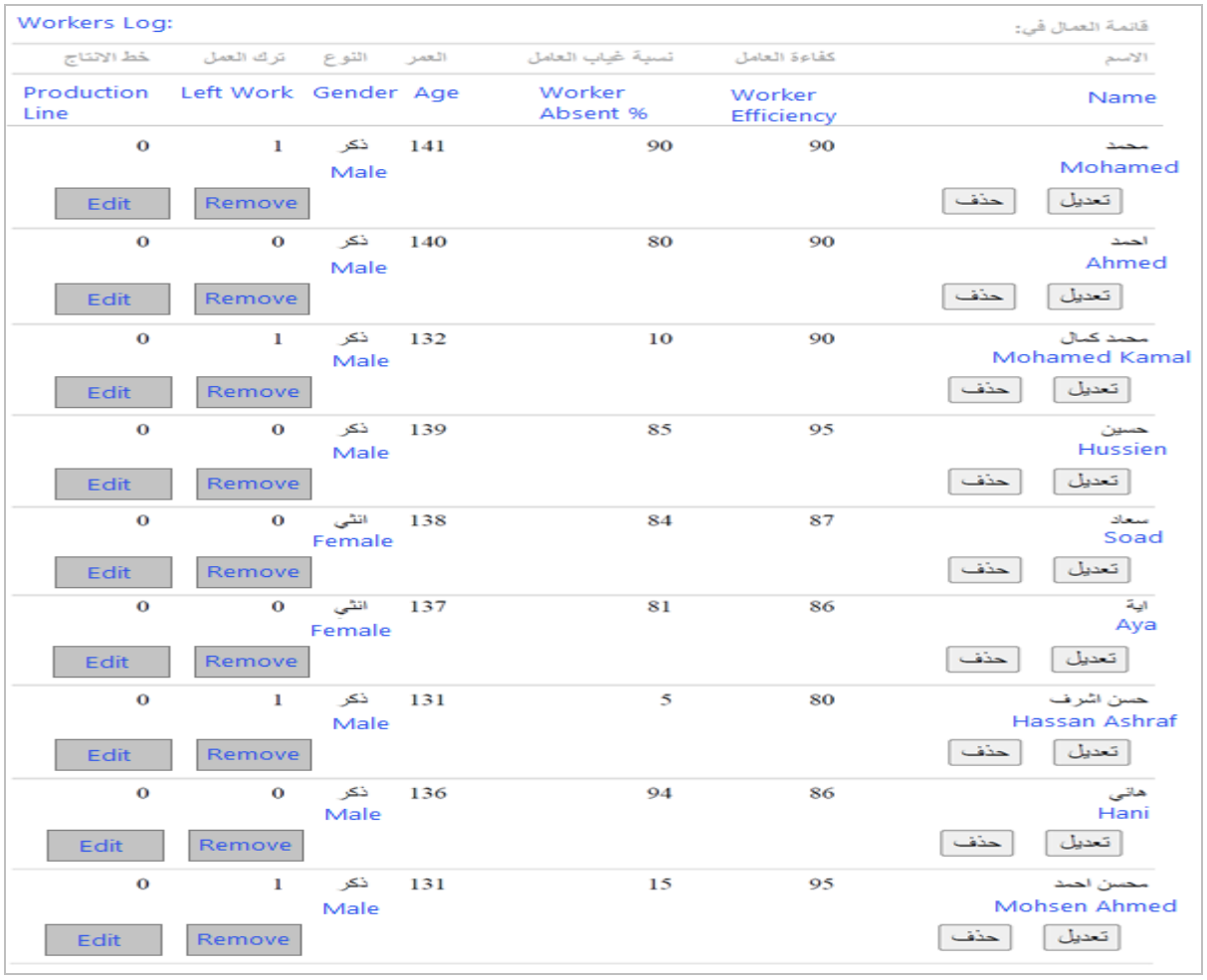


Figure 7 Showing All machines Type (English Translation in Blue Font)



Workers Log: قائمة العمال في:

خط الانتاج	ترك العمل	النوع	العمر	نسبة غياب العامل	كفاءة العامل	الاسم
Production Line	Left Work	Gender	Age	Worker Absent %	Worker Efficiency	Name
0	1	ذكر Male	141	90	90	محمد Mohamed
Edit	Remove					حذف تعديل
0	0	ذكر Male	140	80	90	احمد Ahmed
Edit	Remove					حذف تعديل
0	1	ذكر Male	132	10	90	محمد كمال Mohamed Kamal
Edit	Remove					حذف تعديل
0	0	ذكر Male	139	85	95	حسين Hussien
Edit	Remove					حذف تعديل
0	0	انثي Female	138	84	87	سعاد Soad
Edit	Remove					حذف تعديل
0	0	انثي Female	137	81	86	اية Aya
Edit	Remove					حذف تعديل
0	1	ذكر Male	131	5	80	حسن اشرف Hassan Ashraf
Edit	Remove					حذف تعديل
0	0	ذكر Male	136	94	86	هاني Hani
Edit	Remove					حذف تعديل
0	1	ذكر Male	131	15	95	محسن احمد Mohsen Ahmed
Edit	Remove					حذف تعديل

Figure 8 Showing All Workers Data (English Translation in Blue Font)

Machine Log: قائمة المكن في:

الزمن	وصف العملية	اسم العملية
Time	Process Description	Process Name
20	خياطة كتف التي شيرت T-shirt Shoulder Seam	خياطة كتف Shoulder Seam
Edit Remove		حذف تعديل
40	خياطة جنب التي شيرت T-shirt Side Seam	خياطة جنب Side Seam
Edit Remove		حذف تعديل
50	تركيب الكم في جير و البدن Stitch Sleeves to the Arm Holes	تركيب كم Sleeve Seam
Edit Remove		حذف تعديل
35	ثني نهاية الكم بعد تركيبه Fold and sew Sleeve Hem	ثني نهاية الكم Sleeve Hem
Edit Remove		حذف تعديل
55	تركيب الريب في رقبة البدن بعد خياطة الكتفين Stitch the ribbing to the neckline after the shoulders sewing	تركيب الريب في الرقبة Stitch the ribbing to the neckline
Edit Remove		حذف تعديل

Figure 9 Showing All processes Data (English Translation in Blue Font)

Figure 10 Showing All Production Lines Data (English Translation in Blue Font)

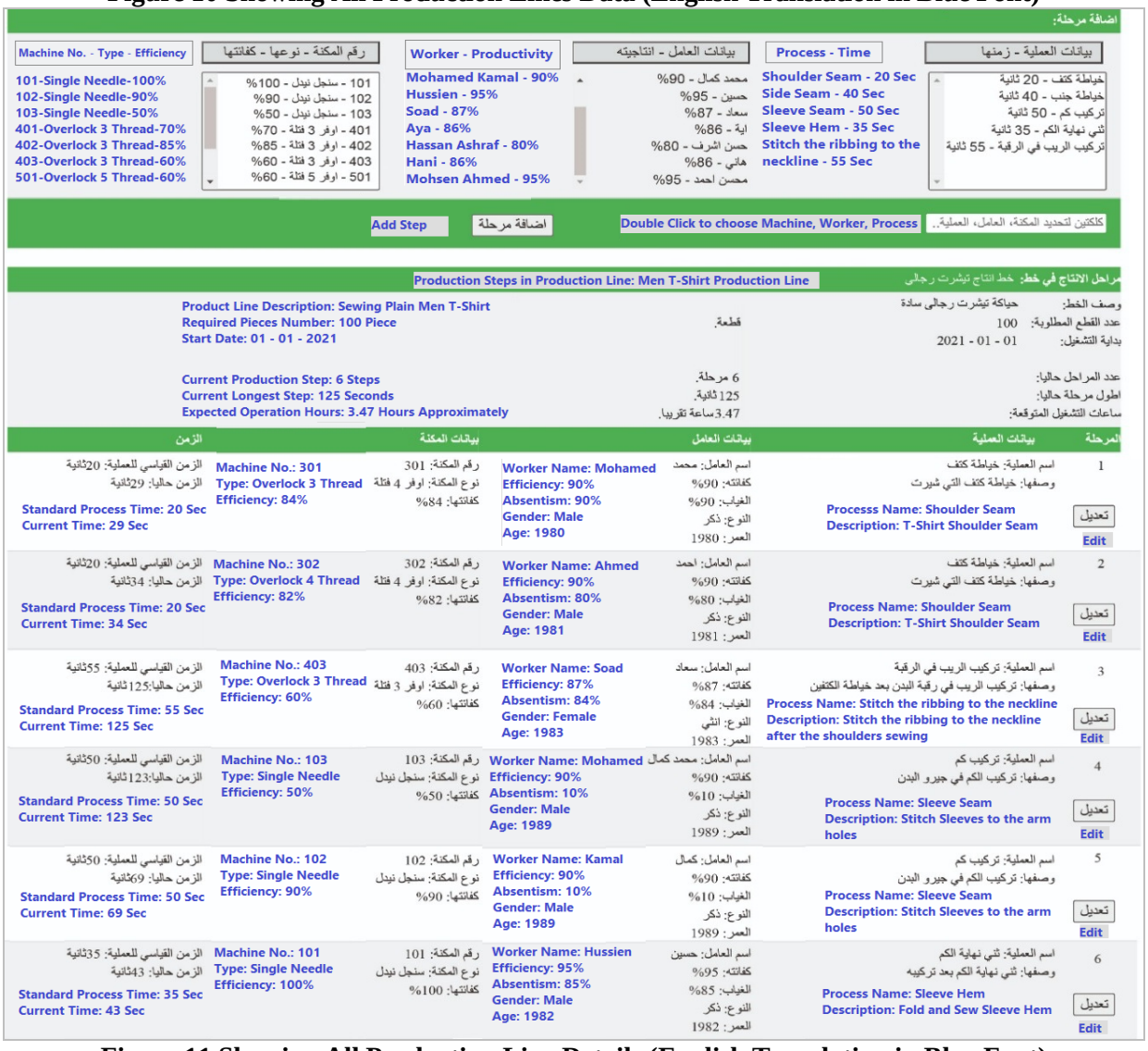


Figure 11 Showing All Production Line Details (English Translation in Blue Font)

Using this setup, users are capable of commination to the software remotely from any computer, tablet or mobile phone, allowing them to reach updated and fresh information about their production lines, and updating the line as well using any available device in hand, as long as it is connected to internet.

In order to identify requirements of this online software, an analytical survey method by using an electronic questionnaire in English language (to ensure respondents' accurate understanding and responding) was developed, and tested, some phrases were reworded, and others were modified according to the pilot study requirements. The questionnaire introduction informed participants' of the questionnaire's purpose, which is studying set up and manage apparel production lines, in order to develop criteria for its application. A number of 23 have participated in this research.

in order to evaluate the purposed system a questionnaire consisted of 20 questions was developed, the questions:

1. The system allows the effective conversion of raw materials?
2. The system helps in providing effective conversion of labour data?
3. The system allows the effective conversion of machines' data?
4. The system allows making production planning process design and edit?
5. The system has the ability to use various kinds of fabrics?
6. The system is able to manage various kinds of garments?
7. The system has the accessibility for various users?
8. The system has the accessibility form different places?
9. The system Provides comprehensive planning for Repetitive orders?
10. The system improves the Line arrangement?
11. The system helps to make the Calculations of line productivity?
12. The system helps to Calculate order production time?
13. The system allows to edit production lines and remove workers and machinery?
14. The system ensures the best usage of all resources?
15. The system helps to minimize the production time?
16. The system determines and deals with production bottlenecks?
17. The system helps to reduce set up costs?
18. The system provides better production scheduling?
19. The system Provides enough communication between various involved personnel?
20. The system has better accessibility and update to production data?

Result and Discussion

The results of the questionnaire show the participants' valuation for the online software which is studying set up and manage apparel production lines, Questionnaire results are interesting which show that the participants strongly agree that the system allows the effective conversion of raw materials and also helps in providing effective conversion of labor data. The participants agree that the system allows the effective conversion of machines' data, making production planning process design and edit and has the ability to use various kinds of fabrics. The participants also strongly agree that the system is able to manage various kinds of garments ,has the accessibility for various users, and has the accessibility from different places, even worldwide as the software is web based and can be accessed from any device as long as it is connected to the internet. The results show that the participants agree that the system Provides comprehensive planning for Repetitive orders, improves the line arrangement , helps to make the Calculations of line productivity , helps to Calculate order production time , allows to edit production lines and remove workers and machinery , ensures the best usage of all resources , helps to minimize the production time , determines and deals with production bottlenecks , helps to reduce set up costs, provides better production scheduling , Provides enough communication between various involved personnel and has better accessibility and update to production data.

One comment on the software was the language used, however most of the words used in the design stage of this software was developed upon the requirements of real people working in garment production, another recommendation is to expand the software in the future to include more areas of garment production, and this can be done progressively and according to factory needs.

All these results are an indication of the success of the online software and the success of its effectiveness in managing apparel production lines

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