A MANAGEMENT INFORMATION SYSTEM TO SUPPORT THE PRODUCTION CONTROL IN A BLADE MANUFACTURING COMPANY

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ABSTRACT

Management Information Systems provide managers with information used in decision making and problem solving. A well designed system will definitely assist managers whereas an ill-structured system may cause big losses. There are various mechanisms for the preparation of effective management information systems (MIS).

This study shows how a management information system is developed for production control purposes in a factory producing shaving products. The aim of the study is forming a production control system which will report resources (i.e. machines and labor) performances so that decisions to minimize costs may be taken in advance. First step in every MIS development project is the requirements analysis and determination. For this reason, the current system is analyzed , data flow diagrams and data dictionaries are prepared. Using these tools, weaknesses and strengths of the current system are determined. The next step is to design a new system which also make use of data flow diagrams and data dictionaries. And a data model for whole system is formed and implemented using a fourth generation computer language. The tests last for two months where no questions remain unanswered about the new system.

The key parameters for the production managers are controlled after six months of operation. And the contributions of the MIS system (PCS) are stated by the production managers and the factory manager.

ÖZET

Yönetim Bilgi Sistemleri, yöneticilere karar vermelerinde ve problemleri çözmelerinde kullanılacak bilgileri sağlarlar. İyi tasarlanmış bir sistemin yöneticilere yardımcı olacağı bir gerçekken, kötü yapılanmış bir sistem büyük zararlara yol açabilir. İyi tasarlanmış sistemler oluşturmada değişik bir takım mekanizmalar vardır.

Bu çalışma, traş olma ürünleri üreten bir fabrikada üretim kontrolü için geliştirilmiş bir yönetim bilgi sistemi hakkındadır. Bu çalışmanın amacı, kaynak (makine ve işçilik) performanslarını raporlayan bir üretim kontrol sistemi oluşturmaktır, öyleki maliyetleri minimize edecek kararlar zamanında alınabilsin. Her Yönetim bilgi sistemi geliştirme projesinde ilk adım ihtiyaçların analizi ve saptanmasıdır. Bu nedenle, mevcut sistem incelenir, bilgi akiş şemaları ve bilgi sözlükleri oluşturulur. Bu araçları kullanarak mevcut sistemin kuvvetli ve zayıf tarafları belirlenir. Bir sonraki adım bilgi akış şemaları ve bilgi sözlükleri yardımıyla yeni bir sistem oluşturmaktır. Ve bütün sistem için bir veri modeli oluşturulur, bu model dördüncü kuşak bir bilgisayar dili kullanılarak programlanır. Testler iki ay , yeni sistem hakkında bütün sorular cevaplandırılıncaya kadar sürer.

Üretim müdürleri altı aylık çalışmadan sonra kendileri için önemli değişkenleri kontrol ederler. Ve MIS sisteminin (PCS) katkıları üretim müdürleri ve fabrika müdürü tarafından ifade edilir.

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1. OBJECTIVES AND THE SIGNIFICANCE OF THE STUDY

1.1 PROBLEM DEFINITION AND THE WORK ACCOMPLISHED

The factory considered produces shaving razor blades and disposable shaving products. There are two main divisions and there are several processes in these divisions. These processes are controlled each day by the help of some forms and reports. And there appeared to be a problem in the current system. A new system is requested by the production staff.

The requirement for a new information system which will support production control came at October 1st, 1992 by the Production Director. It was in a form of reports which will be produced by new PCS. There were two other meetings with the Production Director. And there was an interview with Cost Accounting Manager for The Cost Department requirements. After the settled requirements, production staff were interviewed for the analysis of the current system. The analysis of the system showed outstanding number of weaknesses but little strengths.

The main problem in the information system supporting the control process is the lack of a good reporting system. The Current system is weak in providing managers with necessary information for decision making process. Some data about production variables are available, but they are not stored for future use. Furthermore no data is collected for some important production variables.

The result of the analysis may be described as follows :

- The current system is running slowly both for information retrieval and for information gathering just because it is completely manual.

- Production and scrap quantities are available and they are reported to managers. But these are not stored elsewhere. So the manager uses his experience to set standards or to decide on particular machine's performance.

- There are no information for some very important aspects of production control. These are vital for production managers and they control those factors by direct supervising. Those factors are downtimes of machines and actual labor hours of direct workers. Downtime hours of machines and the reasons for downtimes must be controlled in order to reach budget figures for production. And direct labor hours are extremely important to calculate the production unit cost.

- There are conversion errors resulting from using non uniform rates, there are also calculation errors because it is manual.

- It is costly. Both labor costs and material (paper) costs are higher than an automated system.

- It makes production department a closed system such that communication problems create inconsistencies and miserable results in planning of production.

- It needs to be reorganized each time a new product or improvement is made.

- There are no statistical sources of production information in the current system.

- There are nearly 200 forms for each day. And these are not standardized.

- Presentation of information to other departments or top management is poor.

- Production Control staff is unaware of computers and information management techniques.

When weaknesses of the current system outweigh its strengths, an alternative is searched. And a MIS application is requested. Following the meetings and interviews with the requesting managers and candidate users of the new system, the requirements are analyzed. Weaknesses and strengths of the current system are listed.

The second part of the study will present the determination of the needs of production managers. These needs are determined using a variety of fact finding techniques and structured analysis tools. Data flow diagrams showing very detailed operations in production control department are prepared.

A production manager must mainly answer the following questions at the end of each day as a result of the analysis of the requirements:

A) What are production quantities for each product? (Production Quantity)

B) How much of those products are lost due to scrap? (Scrap %)

C) How many hours machines run? Did they perform well? (Machine Efficiency)

D) How many hours employees worked? Did they perform well? (Worker Efficiency)

E) What are the loss times for machines and workers? (Downtime Analysis and indirect hours)

If a manager has all standards relating to these five subjects, he will definitely compare actual figures and standards, then he will search for the reasons of variances.

After the analysis of the system in question, a design proposal is prepared with a design data flow diagram. Data flow diagrams for the design are important to get a complete understanding of the newly proposed system. Database design is the following issue. Entity-Relationship model is used for this purpose and data files and relations among them are clarified. Afterwards, those are implemented using a fourth generation computer language (Paradox System's PAL language).

The system begins to operate after the preparation of the software. Of course, no system is 100% reliable at the beginning. It stays in a test run and walkthroughs are done on the system. As a result of errors, modifications are implemented and they are tested also. In fact, a project can take more time than estimated just because new requirements arising from the usage of the system came.

When an evaluation of the new information system on the last six months is done, key variables show favorable trends. Although total scrap percentages increase slightly, machine efficiencies increase from 70% to 80% and worker efficiencies increase from 80% to above 100%. Downtime percentages of machines in double edge processes also decreased conveniently from 15% to 10%. It is highly probable that the new system will contribute to the management decisions about production control.

Using the system, production managers are now able to view the important key parameters and take actions beforehand. These are machine efficiency, labor efficiency, production and scrap quantities, downtime analysis and direct labor hours. All of this information is nearly ready after one hour session of data entry . Thus production department now has a **production database** and a **fast response standard reporting system** relying on that database. And the information retrieved will continue to assist production managers in their decisions and problems.

1.2. LITERATURE SURVEY AND METHODOLOGY

Senn [1989] talks about phases of information systems development and the tools for the development. He categorizes information systems as transaction processing systems, management information systems and decision support systems. Classical system development cycle is explained and structured analysis development methods are examined.

In classical cycle, there are six activities:

1. Preliminary investigation

2. Determination of system requirements

3. Design of system

4. Development of software

5. Systems Testing

Preliminary investigation begins when a request came for the assistance of information systems. First of all, the project request must be clearly stated. Otherwise further study may lead bad results. A feasibility study is done by experienced analysts or managers to determine the possibility of solutions in relation with information systems techniques. When a requested project is feasible, it should be approved by related managers. There may be other scheduled jobs and information systems staff may be busy on those projects. In that case, it is scheduled accordingly.

Clearly, a request is mostly not a detailed one. An analyst should determine all requirements relating to the current system. For this reason, requirements may be compared with previous similar projects. This may help the analysis of requirements, but shortcuts, if taken, lead to problems in requirements anticipation. One of the other activities is the investigation of requirements. It is done via some fact finding techniques and some structured methods.

Yourdon [1985] talks about structured techniques and strategies for software development. Structured analysis, structured design and structured programming are explained separately. He discusses the problems which may arise from the usage of structured techniques. He also talks about structured walkthroughs, fourth generation languages, prototyping and data modeling. Sumner [1986] also discusses the usage of structured methods.

Fact finding techniques include interviews with users of the current system, questionnaires, review of current records or observation of the current system activities. At this point of the analysis, user involvement comes into the scene. The relation between user involvement and the usefulness of information systems is searched by Franz & Robey [1986]. Their analysis offer modest support for the argument that user involvement increases the usefulness of information systems. Seilheimer [1987] also stresses the importance of the human factor in information system life cycle.

In summary, structured analysis methods are used for the partitioning of complex systems into manageable components and a model can be constructed for the system using these methods.

Elements of structured analysis are graphic symbols, data flow diagrams, data dictionaries and data models.

To prepare a graphical image which shows the features of the system is helpful for the description of the current system. It also shows the function of the current system and its interactions with other systems.

Another tool is a data flow diagram which is developed and promoted simultaneously by De Marco [1978], Weinberg [1978], Gane and Sarson [1979]. Developing data flow diagrams are explicitly stated and linking those data flow diagrams to data dictionaries are explained. Notations used differ between Gane and Sarson and others. De Marco and Weinberg's notation are used in this thesis.

According to the above mentioned notation, external sources or destinations of data are shown in rectangles. These may be people, departments, organizations or other entities. The flow of data is presented as arrows. It is mostly a document or a telephone call. Processes, on the other hand, are in circles. The data used or transformed in the processes. And lastly data stores are shown in rectangles of which one edge is open. And the data is stored for further reference in these data stores.

Using the notation, a top level diagram called context diagram is prepared. It contains a single process. This defines the function of the current system. Afterwards, this process is divided into smaller-scale processes. That activity brings out process hierarchy chart and the processes have their levels in the hierarchy. For each process in each level there should be a data flow diagram. The elements of the system are all shown in data flow diagrams. A data dictionary is a detailed list of those elements. In this way, all elements can be documented and referenced easily.

Analysis of the current system finally leads to the design of the new system. A design process may be divided into two consecutive phases. First phase is the logical design. It is done on paper and features of the new system are considered in this phase. These are identification of reports and output of the system and description of input, calculated, stored data. Specific design tools may be used for these purposes. Data flow diagrams and data dictionary are also used for the new system which will be implemented. Specification of procedures and devices used are listed on a design document.

Hurry in the design phase may lead to some cop-outs. Silhan [1987] discusses ways to avoid these design cop-outs. He talks about quick solutions and standard excuses in the design phase of system development life cycle. He also remarks about faulty observations and their unfavorable results.

Data model is another tool used for the design of database file structures. The entities in the system and their relationships are searched. And some normalization techniques are implemented. When database file structures are retrieved from the model, they are compared to data stores which are in design data dictionary.

Date [1985] and Ullman [1982] talk about principles of database systems. Entity-Relationship model and other data models are explained. Database management systems are discussed also. Entity-Relationship model is used in the data model for this thesis. Tsichritzis and Lochovsky [1982] explains various data models. Normal forms in Entity Relationship model are explicitly presented.

The notation used in entity relationship diagram is simple. The entities are shown in rectangles and relationships are shown in rhombus. The connected lines show a relation between two sides.

Once the design is completed, the source code of the program may be prepared using a computer language. The Paradox database system's PAL language is a 4TH generation language chosen for this purpose. Hogan and Zussman [1988] documented PAL language user guide.

This project is a support system and it is supposed to be effective. Feigenbaum [1979] describes how management control and management information system can together make a company cost effective. On the other hand, the reasons for unsuccessful system projects are discussed by Menkus [1987]. These should be already prevented when the implementation is finished.

The system run parallel with the current system for a couple of months. The users who were unaware of computers learn to use the system and they get management reports. The managers review these reports and errors are recovered.

2. CURRENT PRODUCTION SYSTEM

2.1. INTRODUCTION TO BLADES MANUFACTURING

The Company recently purchased a factory at İkitelli, İstanbul. Most popular shaving products are produced in the factory. One of them is a single disposable product whereas the other one is an old style double edge blades which are used in special razors.

Main raw materials for blade production are steel and plastic. Steel is imported in circular coils which are approximately twenty kg. each. Basically, steel is cut into small pieces and its edges are sharpened. For disposable products, double edge blades are cut into two parts and these blades are covered by plastic handles. All of the operation take place in five sections of the factory.

First section of the factory is where steel is converted to double-edge (D/E) blades. There are nearly fifty eight machines run by nearly one hundred fifty four workers. These machines are capable of producing over ten million D/E blades in a month. Production consist of twelve consecutive processes. These are perforating, hardening, joining, printing, sharpening (grinding), washing (trico), final, sputtering, treatment (afterspray) , wrapping , packing. Following the treatment, a portion of D/E blades are moved to the other section of the factory where the disposable product(s) are produced.

Second section of the factory uses semi-finished products - D/E blades to produce disposable products. In this section, plastic material is used to form handles, caps, seats or platforms that make up disposable products. There are fifty seven machines in this section and twenty of them are injection machines. This section is not very automated thus employs nearly one hundred forty eight people.

Quality control is the third section. Quality tests are applied at certain phases of production. Edge turn test, Wilson hardness test and certain microscope inspections are made on samples taken from the production.

Certain mechanical and electrical work is done at the engineering section. Machines are repaired by a team of nearly twenty workers.

The last section is responsible for handling and distribution of raw materials, indirect materials, and spare parts.

2.1.1. D/E PRODUCTION

As mentioned before D/E blade production comprises twelve phases.

Perforating : Steel coils are moved through press machines and certain shape of blade is given. Holes which are to attach plastic material or shaving razors are formed. There are nine machines and they can strike 340-375 blades per minute per machine. Through cutting 20.8% of the steel (in KG) is lost that is a predetermined engineering scrap. Nearly 0.5% is accepted as a standard production scrap percentage. Two workers can run three machines in this process.

Hardening : Perforated Coils are passed through furnaces in which temperatures are between 850°C and 1100°C. Then they are moved through refrigeration units in which -70°C temperature is stable. Helium is used as refrigerant.

There are five furnaces which each of them have outputs like 480 blades per minute . One worker is necessary for one furnace and scrap percentage is 2.

Joining (cut coils) : Whenever a defect is observed in the middle of a steel coil, the defective part is removed. But joining of undamaged parts is necessary for sharpening operation and also for printing. There are two joining machines which can join 1400 blades per minute. Again one worker is necessary for one machine. The scrap percentage due to defects in coils is 1.75% (in Kg).

Printing : Brand names are printed onto blades with the printing machine. There is one machine which can produce 1448 blades per minute. Special ink is used for this purpose. And brand names are printed only on D/E blades . In printing process 0.25% of the coils (in Kg.) are lost. Again one worker per shift is necessary to operate this machine.

Sharpening : The coils are cut into blade sizes and the edges of the blades are sharpened in this process. Coils are passed through (oil+water) filtration units and between wheels. There are three wheel grades in each unit. These are inspected by microscopes after the process. Blades are 19 machines and each machine can sharp 184 blades per minute. There is 3.5% engineering scrap (in KG) because some of the steel is lost intentionally. However the current scrap percentage is 4.5%. There are 22 people running those machines in three shifts.

Washing : In this process Trichloretilen is sprayed onto blade edges . This is for the purpose of preparing edges for chrome coverage. There is one washing machine and it can wash 1469 blades per minute. There are two people running this operation. Throughout the washing process, 0.25% of blades (in Kg) are lost.

Final (Quality Control) : Fourteen people are employed to make quality control tests on blades. Currently 95% of the washed blades (in KG) usually pass the quality control test.

Sputtering : Here, blade edges are covered by chrome in two type of machines : Saturn and CVC. Saturn machines may process 287 blades per minute whereas CVC machines may process between 172-277 blades per minute. Allowable scrap percentage is 0.25%. Two workers are assigned to three machines used in this process.

Treatment : A mixture called Teflon is sprayed onto the blades. There are five process machines each of which is capable of processing 308 blades per minutes. There are 3 operators for these furnaces. Again 0.25% is allowable scrap rate.

Wrapping : Blades are wrapped by special paper in this process. There are eight wrapping machines. Their output are 160 blades per minute per machine. Three machines are run by two operators. The standard scrap rate is 1% in this process.

Loading & Packing : Blades are loaded into dispensers where each can contain five blades. There are two loading & packing lines. Each line can output 531 blades per minute. Standard scrap percentage is 2% for this level of production. After this process, finished products are ready for shipment.

2.1.2. DISPOSABLE PRODUCTION

Injection moulding : Plastic parts of disposable razors are produced in this section. Several types of plastic grains are mixed and loaded to the injection machines. The melted mix then is moulded into disposable razor parts. Injection machines have different cycle capacities like 6, 12, 18 parts in a cycle. One operator is enough for 3 machines. The defective parts are recycled into the production by the help of breaking machines.

Assembly : Final shape of the product is given in assembly machines. There are cartridge loading machines at which disposable heads are made. Handles are attached to these heads at handle welding machines. A total of 44 workers are employed in cartridge assembly against 69 workers in handle assembly. The assembly process is labor intensive and it needs to be automated.

Two production lines (i.e.. D/E blades and disposable razors) have their own production control managers and staffs. They have also separate control systems.

The scrap rates for each process and man machine distributions throughout the processes are summarized in Tables 1 and 2.

TABLE 1: PROCESS AND SCRAP LIST

Production Line

1) Double/Edge Production			
Processes	Standard Scrap	Engineering Lost	TOTAL
Perforating	0.50%	20.80%	21.30%
Hardening	2.00%		2.00%
Joining	1.75%		1.75%
Printing	0.25%		0.25%
Sharpening	4.50%	3.50%	8.00%
Washing	0.25%		0.25%
Final	5.00%		5.00%
Sputtering	0.25%		0.25%
Treatment	0.25%		0.25%
TOTAL IN KG	*13.95%*	*23.57%*	*34.43%*
Wrapping	1.00%		1.00%
Loading & Packing	2.00%		2.00%
TOTAL IN BLADES	*2.98%*		*2.98%*
1 KG OF COIL = 0.6557	KG BLADES	1154	BLADES TREATED
1120	DOUBLE EDGE BLADES AT THE END		
2) Disposable Production			
Processes	Standard Scrap	Engineering Lost	TOTAL
Perforating	0.50%	25.00%	25.50%
Hardening	2.00%		2.00%
Joining	1.75%		1.75%
Sharpening	4.50%	3.50%	8.00%
Washing	0.25%		0.25%
Final	5.00%		5.00%
Sputtering	0.25%		0.25%
Treatment	0.25%		0.25%
TOTAL IN KG	*13.73%*	*27.63%*	*37.77%*
Splitting	1.00%		1.00%
Injection	0.00%		0.00%
Handle Assembly	1.50%		1.50%
Cartridge Assembly	3.00%		3.00%
TOTAL RAZORS	*5.41%*		*5.41%*
1 KG OF COIL = 0.6223	KG BLADES	1176	BLADES TREATED
2225	DISPOSABLES AT THE END		

TABLE 2 : MAN MACHINE DISTRIBUTIONS THROUGHOUT THE PROCESSES

1) Double Edge Production for one day		
PROCESS	# OF MACHINES	# OF DIRECT WORKERS
Perforating	9	13
Hardening	5	10
Joining	2	5
Printing	1	3
Sharpening	18	22
Washing	1	7
Final	-	14
Sputtering	6	10
Treatment	5	9
Wrapping	9	12
Loading & Packing	2	49
TOTAL	**58**	**154**
2) Disposable Production for one day		
PROCESS	# OF MACHINES	# OF DIRECT WORKERS
Splitting	3	4
Injection	34	27
Handle Assembly	10	71
Cartridge Assembly	10	46
TOTAL	**57**	**148**

2.2. OVERALL VIEW OF MAIN SUBSYSTEMS

The firm has several subsystems to run and control normal production. These are :

a) Marketing & Sales Subsystem

b) Materials & Distribution Subsystem

c) Production Subsystem

d) General Accounting Subsystem

e) Cost Accounting Subsystem

f) Personnel Subsystem

g) Financial Reporting Subsystem

Marketing & Sales Subsystem deals with the control of sales of finished goods. Marketing is responsible to create new ways and means to sell the products. Sales subsystem is nearer to the customer. Sales quantities are projected and handed to Materials & Distribution Subsystem. Sales people are in contact with resellers (wholesalers). They motivate resellers in various ways and they collect actual sales data. These are also reported to Materials & Distribution Subsystem and Financial Reporting Subsystem.

Materials & Distribution Subsystem deals with Manufacturing Resources Planning. The staff are responsible to provide necessary material on time. According to actual sales and production figures, they project production quantities and report them to Production Subsystem. They also control inventories. Purchases are reported to General Accounting Subsystem.

Production Subsystem is responsible for producing high quality products at lower costs and in given quantities. The Staff get raw material and expected production figures from Materials & Distribution Subsystem. Actual production and the usage of resources like labor and raw material are the subjects of production control subsystem. They report actual production to Materials & Distribution Subsystem and Cost Accounting Subsystem. Labor absenteeism is reported to Personnel Subsystem.

Cost Accounting Subsystem controls the cost of products. They get production figures from Production Subsystem and payroll data from Personnel Subsystem. Inventories are physically counted each month. Cost of products are reported to Financial Reporting Subsystem.

General Accounting Subsystem is responsible to organize and record historical data. Purchase data come from Materials & Distribution Subsystem whereas sales figures of finished products come from Marketing & Sales Subsystem. Personnel Subsystem reports payroll data to General Accounting Subsystem. General Accounting Subsystem provides Balance Sheet and Income Statements to Financial Reporting Subsystem at the end of each month .

Personnel Subsystem deals with human resources. The staff try to employ the most qualified labor to run these subsystems. They get actual attendances from

Production Subsystem. They report payroll data to General Accounting Subsystem and Cost Accounting Subsystem.

In Financial Reporting Subsystem , balance sheet and income statement are taken from General Accounting Subsystem. Cost figures come from Cost Accounting Subsystem. Actual sales are from Marketing & Sales Subsystem. The staff prepares reports to be submitted to the headquarters.

The interactions among the subsystems of the manufacturing organization under study are shown in Figure 1.

Production Subsystem includes Production Control System which is the subject of this thesis.

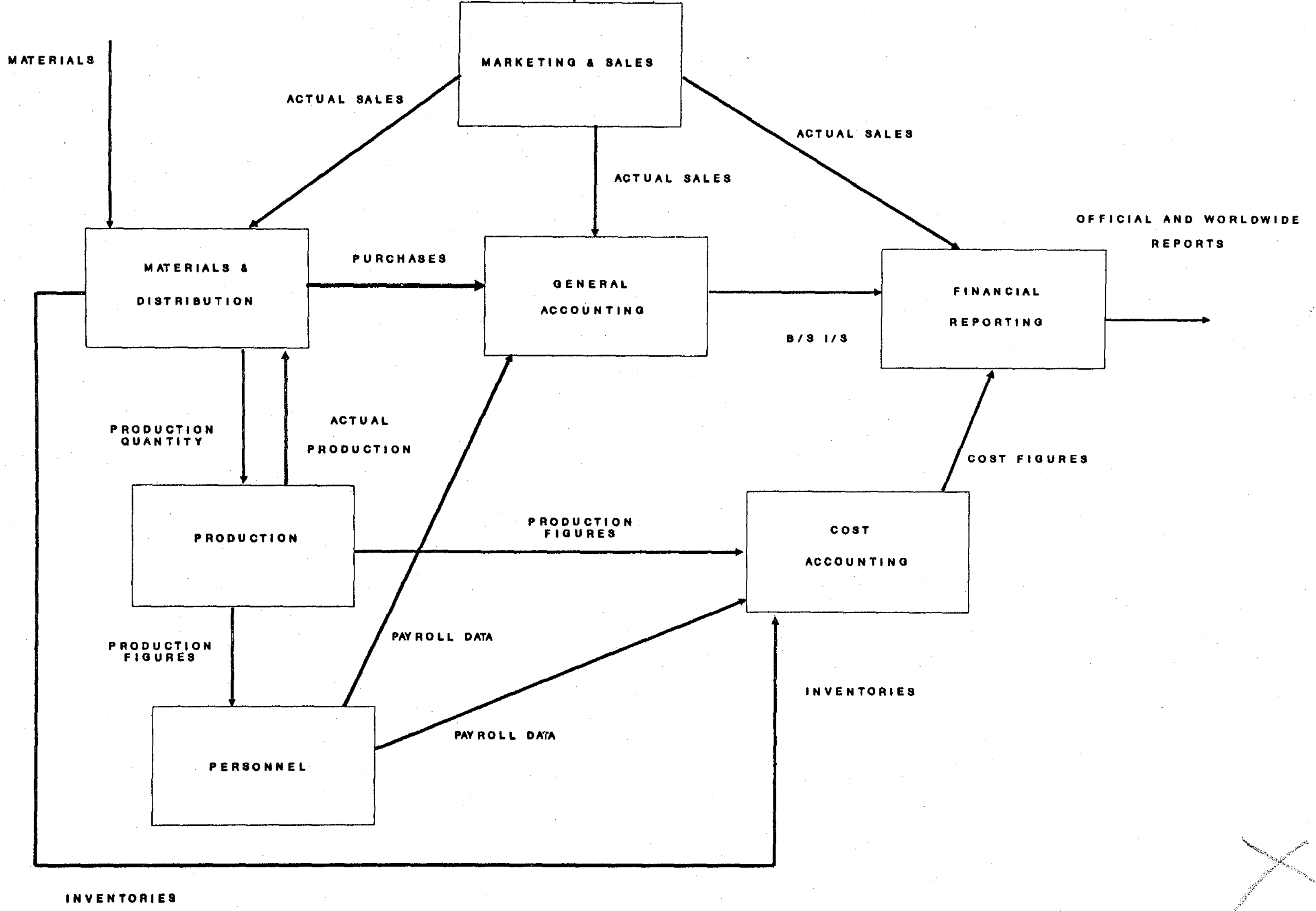


FIGURE 1 : INTERACTIONS AMONG MAIN SUBSYSTEMS

2.3. CURRENT PRODUCTION CONTROL SYSTEM

The analysis of the current production control system leads to data flow diagrams listed through figure 2 to figure 8. General view of the current system is presented in figure 2. The current system is serving to two external departments namely production management and cost accounting management departments. Machines are mainly external sources of information. Data dictionary which is a kind of index of those data flow diagrams is in Appendix B. Data flows, data stores and processes in the current system are listed in the data dictionary. The current system is rather simple in the sense that it doesn't have too much processes or flows.

The statistical data regarding the daily production operations are captured on preprinted forms which are included in Appendix A. The production control system for D/E blades uses thirteen forms (F1-F13) and the production control system for disposable products use four forms (F14-F17).

When data entry forms are scanned through, a lot of similarities are noticed. These forms are created through years by production supervisors. They are used for internal purposes and they are cleared in the following month of production. (i.e. daily labor hours file and daily machine production file in Figure 3 are emptied at the end of one month)

The forms are distributed to operators in each section at the beginning of the first shift of the day. Operators try to fill out these forms. At the end of the last shift, foremen control the forms filled out and clears out conflicting information and he adds missing information as well (Figure 4).

Besides these, a work-in-process form (F20) is filled out at the end of the last shift. Each work-in-process material is reported for the current situation so that following days production schedule is known (Figure 8).

Daily machine forms are filled out for each machine and the operator running the machine is also shown in these forms. Production managers can then review these forms and they may control and warn related operator when some errors occur (Figure 4).

Daily machine forms are processed in the following day of the production. Total quantities are calculated manually and scrap percentages are written on forms. In some cases, unit conversions are done because measurement unit might be different (Figure 5).

Processed machine forms are added together for daily production for each phase (Figure 5). The forms used are F18 for D/E products, F19 for disposable products.

After processing forms, they are inspected. Production managers notice differences from normal operations and take an action where necessary. It may be a breakdown of a machine or a planning error or an operator error. Some of the errors don't even reach production managers because they are not reported on forms (Figure 7).

As it is seen at the forms presented in Appendix A and Data Flow Diagrams, there is no STRUCTURED way of reporting of a BREAKDOWN of a machine. It becomes hard to determine production loss time due to the downtime of machines. And it is impossible to find how much of work hours of a direct worker becomes indirect because of these downtimes.

Workers attendances are controlled anyhow. This is done by comparing machine forms (F1..F17) and predefined schedule (F24). Following day's plan may change the schedule but it is not frequent.

Daily production forms (F18-F19) show total of production for each section of the factory. Production managers have a general view of particular day's production. So following days machine and worker assignments are settled accordingly. Daily Production Forms also show the balance of quantities when used with work in process forms. The following formula is for the balance of quantities :

Beginning Stock + newly entering material= Net output + Ending stock + Scrap quantity.

These figures for all processes are checked and passed to the monthly sheets.

At the end of the month , one page reconciled report (F22) showing beginning WIP, input output quantities, scrap and ending WIP is prepared. The same quantity balance stated before is assured in this report also. And it's sent to cost department (Figure 8).

Standards (F21) used in comparison may be subject to change as shown in Figure 6. These numbers show the quantity a machine can produce in one minute. Apparently they are hard to change as long as no developments on these machines are done. Initially measuring the standard output of machines is acceptable. But measuring may not be exact. Normally, production continues and the data accumulated shows how logical the standards are. But it is stated that these data are not stored. So standards change occasionally when production managers want to measure the standards again.

The usage of the current system necessitates huge cabins for storing a lot of forms. Employees in production control department try to manage large number of data to get daily and monthly reports about production.

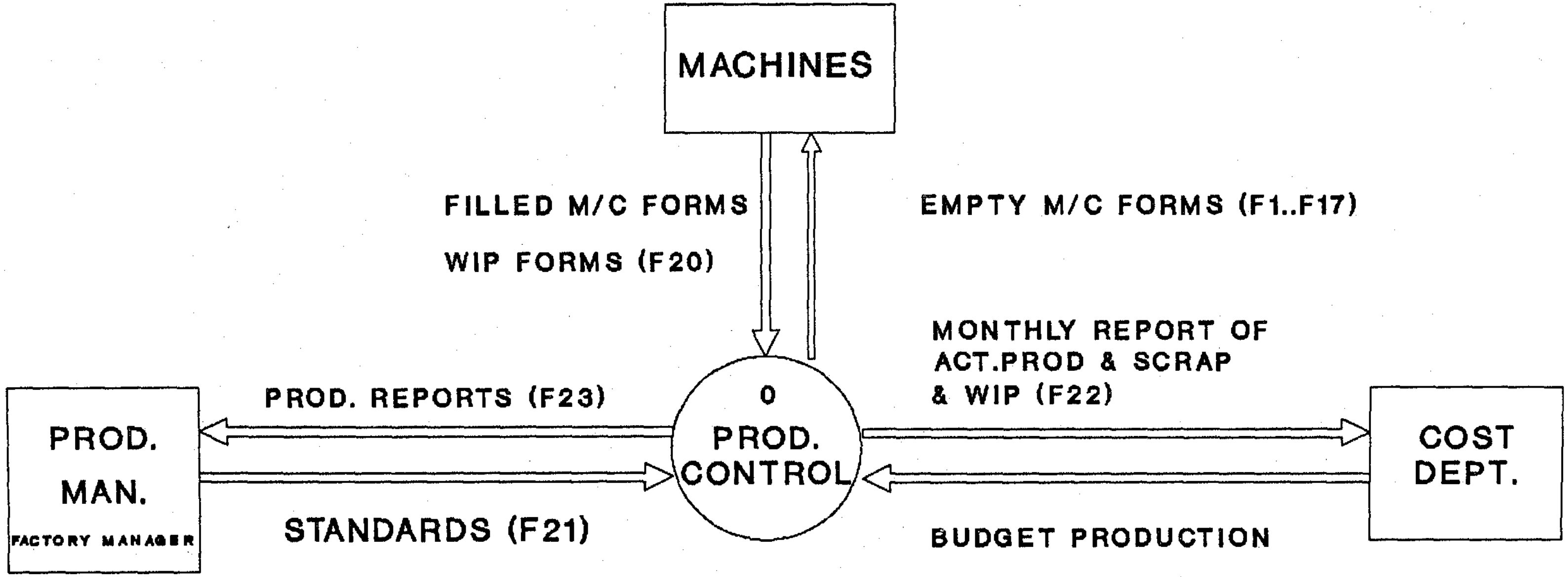


FIGURE 2: CONTEXT DATA FLOW DIAGRAM FOR THE CURRENT SYSTEM

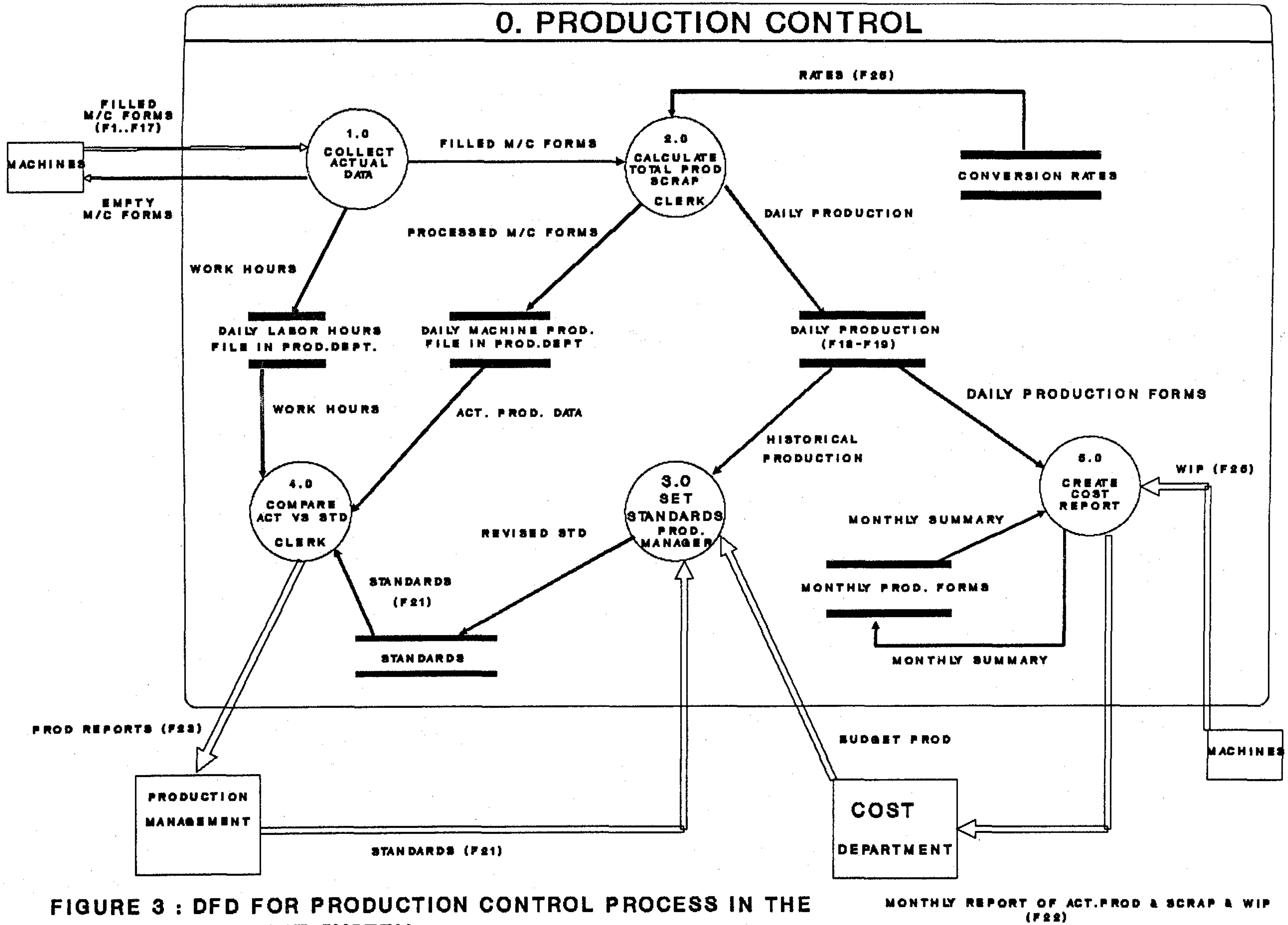


FIGURE 3 : DFD FOR PRODUCTION CONTROL PROCESS IN THE CURRENT SYSTEM

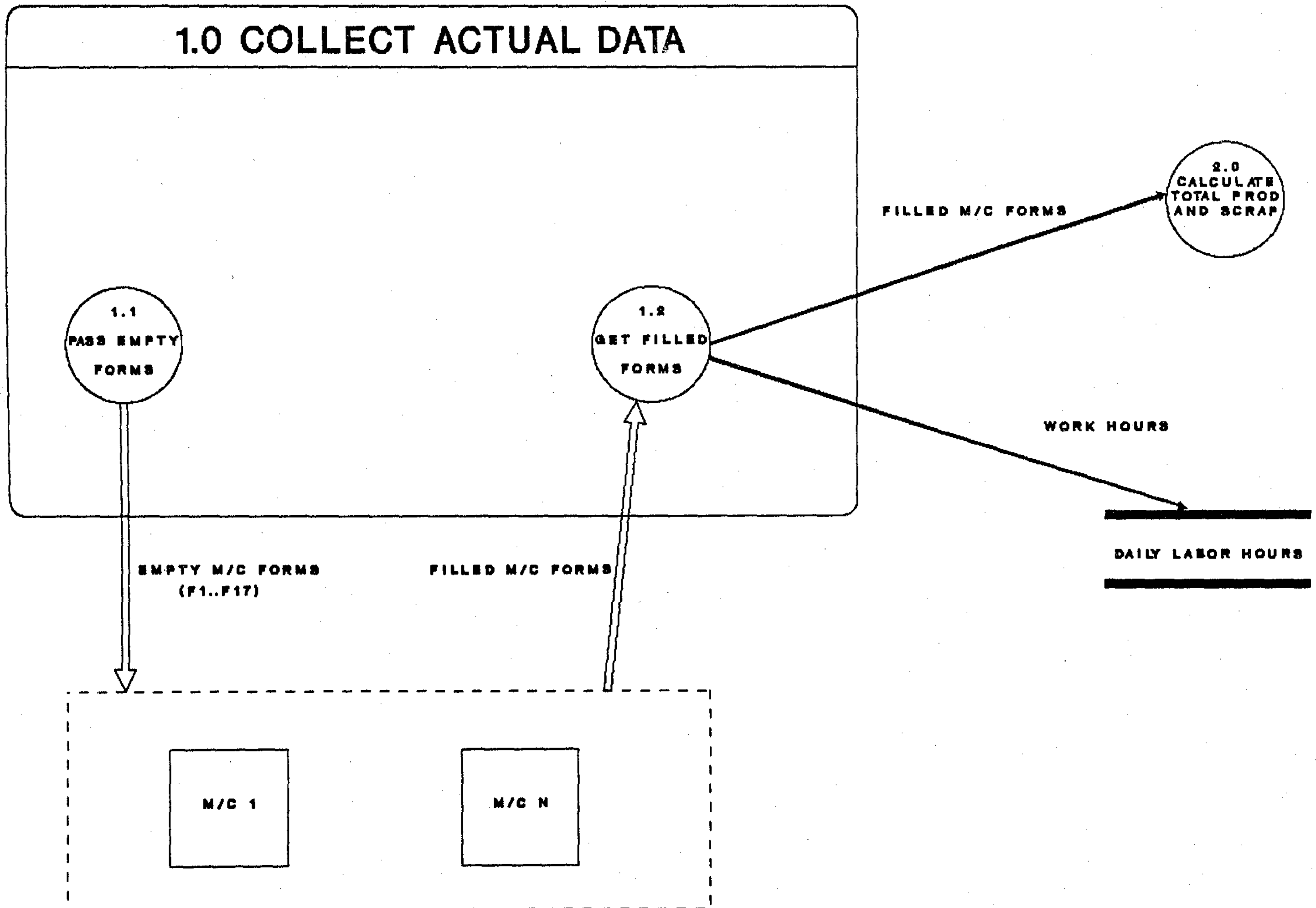


FIGURE 4: DFD FOR COLLECT ACTUAL DATA PROCESS
IN THE CURRENT SYSTEM

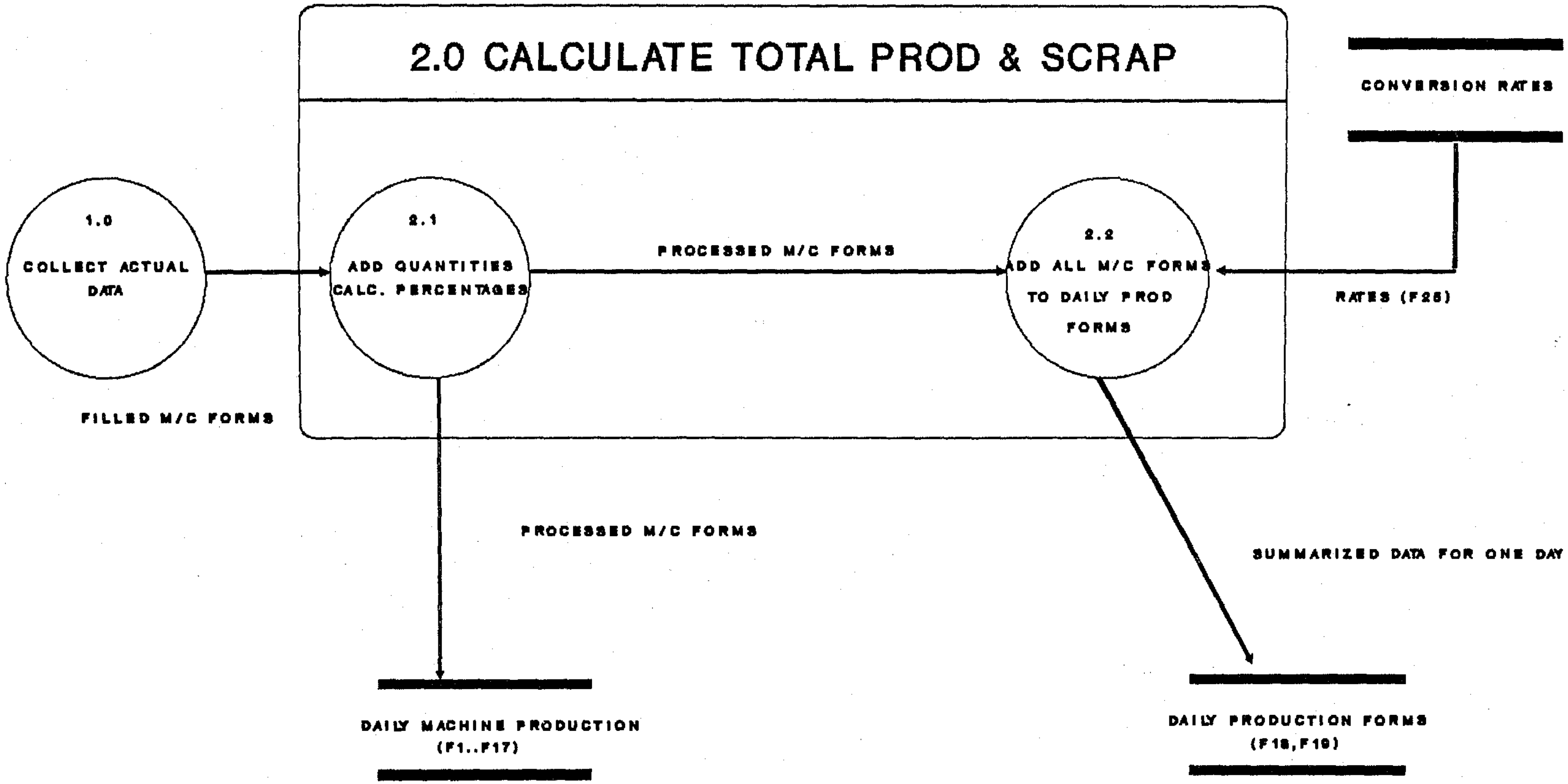


FIGURE 5: DFD FOR CALCULATE TOTAL PROD & SCRAP PROCESS
IN THE CURRENT SYSTEM

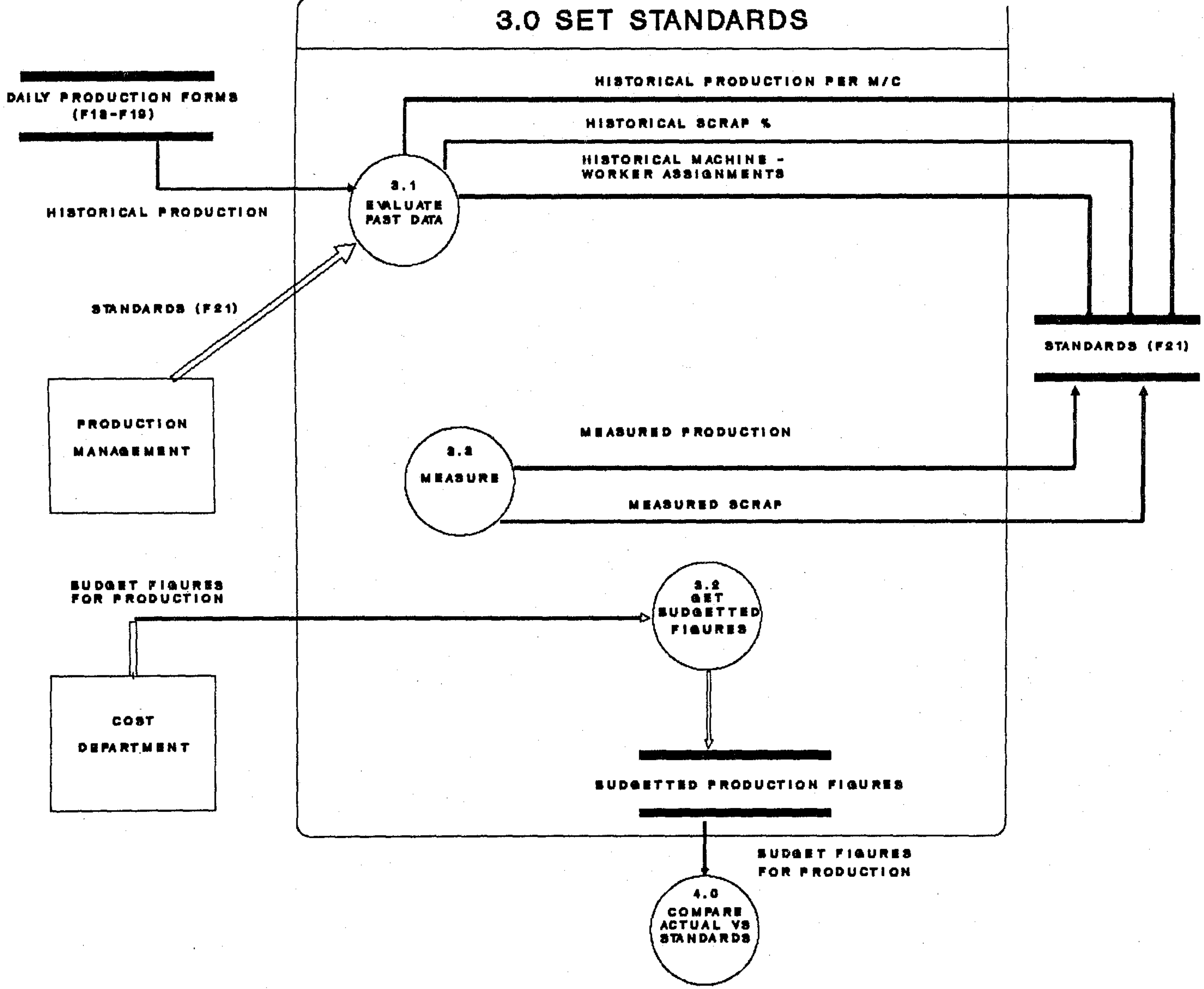


FIGURE 6 : DFD FOR SET STANDARDS PROCESS IN THE CURRENT SYSTEM

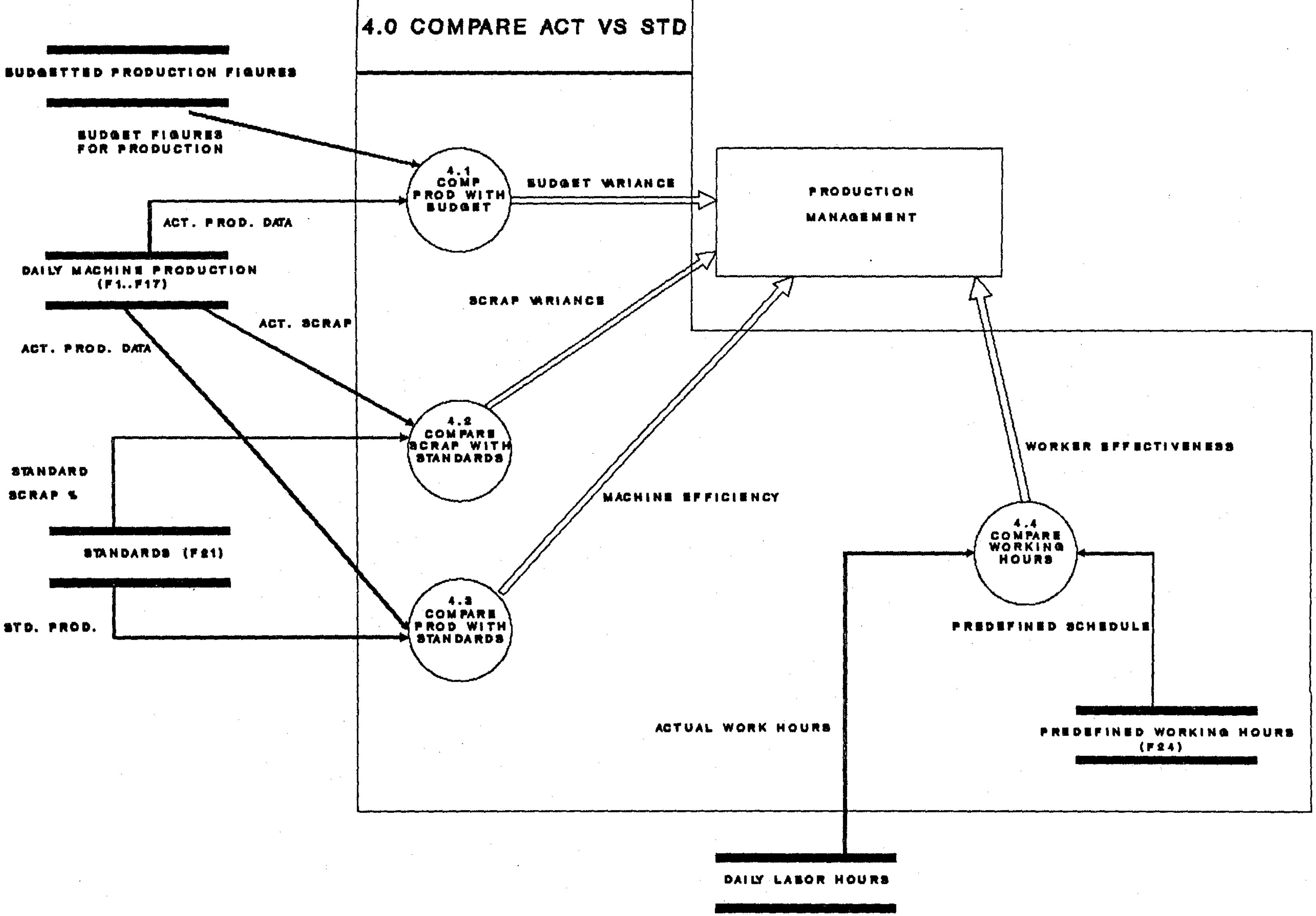


FIGURE 7: DFD FOR COMPARE ACT VS STD PROCESS IN THE CURRENT SYSTEM

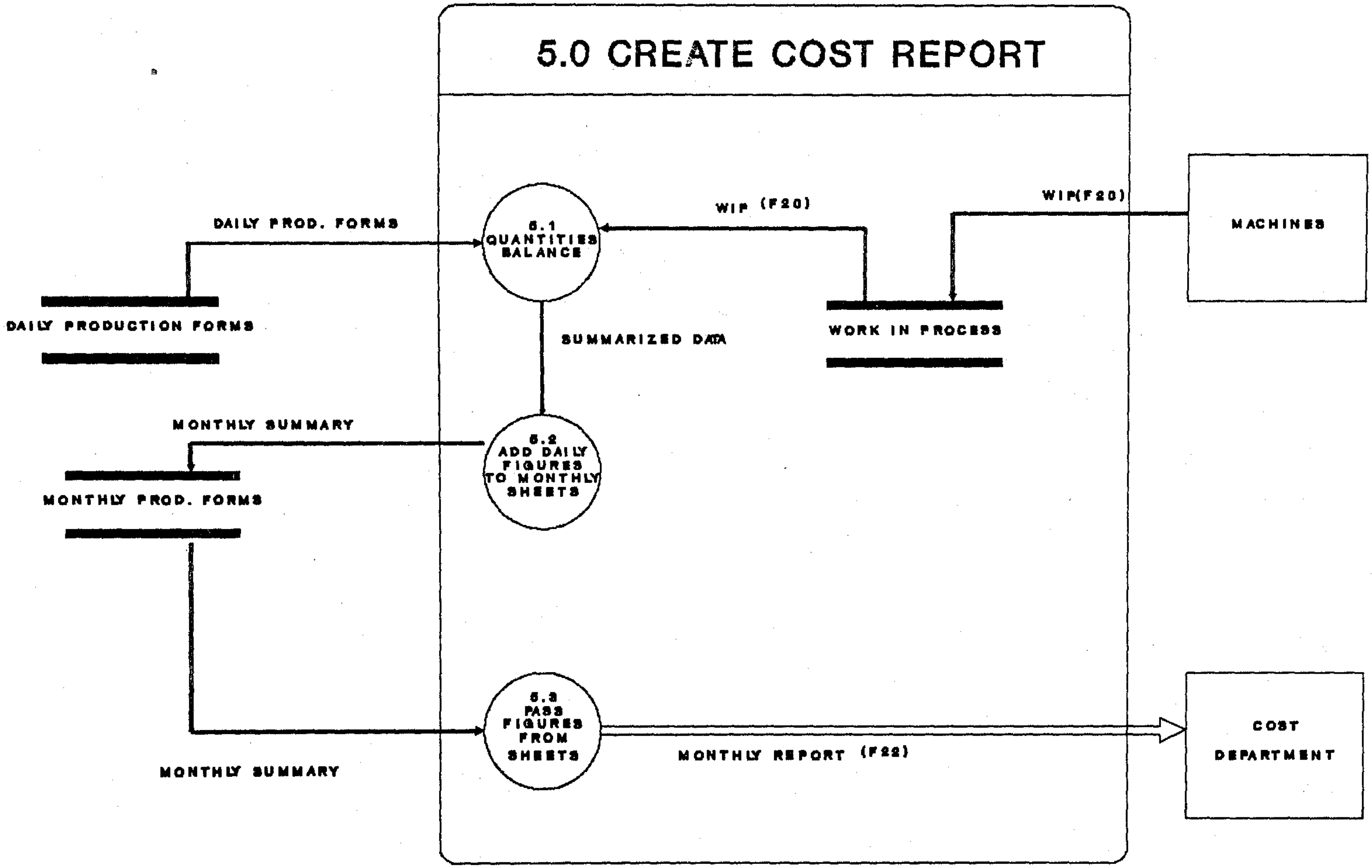


FIGURE 8: DFD FOR CREATE COST REPORT PROCESS IN THE CURRENT SYSTEM

2.4. WEAKNESSES AND STRENGTHS OF THE CURRENT SYSTEM

When the current system is analyzed, a lot of complexities against its current objectives can be found. Main objective of the system is to manage production quantities such that predetermined production figures are reached with efficient use of resources. Most important ones of those resources are raw materials, machines and labor.

A variety of weaknesses are recognized following the analysis of the current system. These weaknesses are stated in the following paragraphs.

The figures used in the production for each resource are controlled by using machine production forms (F1-F17) and time charts for workers. There are different machine forms for each phase of production and there are also huge time charts for workers. Considering a total of 150 machines and 500 workers , it is not difficult to guess how much data is accumulated in one day. (See Appendix B data stores section for the sizes of data in each one.) This necessitates usage of computers that can process data faster than human beings. Although four people in two divisions of the factory process those forms each day, the operation is slow and it becomes cumbersome at the end of each month because of bad filing systems. Assistant production managers also waste their time for paper work instead of concentrating on their supervisory jobs.

The current system is far from catching up with the increasing volume of data. It is clear that a lot of activity is going on the floor everyday and that huge volume of data necessitates good storage techniques. Apart from those, the firm will increase volume of the activities and product differentiations are expected in the near future.

Besides storage of the forms, people prepare daily and monthly summary reports (F18-F19) about production and scrap quantities. Also a report (F22) showing balance of the quantities is prepared for the Cost Department. Although these are routine reports, their preparation takes considerable amount of time. It is mainly because of complexity of retrieving information from a pile of forms. Queries considering previous years are almost impossible to prepare. One of the reason for the slow information retrieval is that there are non standard forms which slow information gathering process.

Lack of information is one of the most important weaknesses of the current system. There are three important areas where some kind of information retrieval system is necessary. First one is the downtimes of machines. The production manager strongly argues that he has to know when a machine stops, why it stops and how long it will last. Information on machines run on a particular shift is already available. But if one of the machines halts by some reason, most of the time it is not reported. And even though it's reported, this information is not recorded anywhere. On the other hand, counting methods prevent information retrieval. In two phases of production (for assembly machines), only global quantities are known. It is not possible to divide this information to machines separately. So an information necessary for machine based evaluations is not collected. And at last, actual direct labor hours are not known. Time recording machines report working hours for payroll purposes. But this information is not enough for departmental direct labor hours. And indirect hours of workers are not known also. As it's seen, these three areas urgently require a formal system of information collection.

Accurate and consistent figures for production variables are necessary for the good performance of a system. Operators make measurements and they fill out machine production forms. Education levels of these operators are rather low. So weighing errors and booking errors are possible. Some of them are eliminated by supervisors but chance of errors is still high because of large amount of nonstandard forms. After then , these forms are processed. A lot of calculation is done by a clerk using a calculator. Small calculation errors in first stages lead to big mistakes and misunderstandings in later stages.

Presentations of production information in variety of unit measures at different stages of the production brings out the problem of conversion rates. These conversions are from kilogram to number of units and there appears to be inconsistencies because there are no fixed factors for these conversions. Although F25 in Appendix A shows those rates for D/E production, there are conflicts between these and the ones the cost accounting department uses. Another source of inconsistency is non standard forms. They allow different units and coil numbering systems so that information in one phase of production may seem very different from the phase following.

Production data is highly sensitive and important for the company. For this reason, security of this data is essential. But most of the time, especially in lunch breaks, production control department is open to curious eyes. So the information about the production and quality of the products may somehow reach to the hands of competitors.

There are two departments which directly communicate with The Production Department. They are the Materials & Distribution Department and the Cost Accounting Department. The Cost Accounting Department is curious about the production data passed by the Production Department. And the production staff are mostly unaware of what the Cost staff are doing. So the communication between these two departments is poor. On the other hand, there is less communication between the Materials and Distribution Department and the Production Department. And it is very informal. To sum it up, flow of information has to be organized among these departments. The same problem exists for internal channels also. Production managers have regular meetings but this is clearly not enough.

Because of poor communication and weak information retrieval methods, coordination of the production activities becomes difficult. This is apparent in several areas. One of them is the planning of the production. The quantities which will be produced are set by the Materials & Distribution Department. This is so because they can use sales data and projections and they can use software to give production quantities. For this reason, production managers try to reach the figures given by others. In this process, there appears shortages or stock piling at some phases of production just because of poor coordination of the activities. Another area where coordination is essential is the costs. Current production related budget issued to headquarters by the cost department is seen unrealistic on some issues by the Production Department. There are disagreements because of informal communication and poor flow of information. To coordinate all of these, a reporting system must be settled as soon as possible to reach to better performance in the total integration of business.

Labor cost is an important aspect of the production. It needs to be controlled strictly. Considering other factories in Morocco or India, there are no comparative advantages of the factory. On the contrary, conversion costs are high. And most of it is labor. So control of direct labor cost is very important.

In the current system, only total labor hours used in the production for one day is known. Allocation of this to separate products or production phases is non existent. The problem is not so urgent for raw material costs. Steel, main raw material, is actually measured. But for plastic material, counting is not important just because it can turn back to production. There is a cost for that also. And this is not determined. When the cost departments objectives are reviewed, it is seen that current system has weaknesses about cost monitoring.

When paper work continues in a system, it will add up on costs in terms of both material costs and labor costs. Because the process itself takes time, supervisors' valuable time is lost and a lot of add up costs are viewed because of bureaucratic jobs. To summarize, the current system neither helps the reduction of production costs nor it has a way to solve problems without additional costs of paper and labor to control production.

The firm has 88% of the Turkish blade market. There are two known competitors . There is little chance for them to compete just because their production control system is good. So the current system has no disadvantages in terms of competing in the Turkish Market. But it certainly has disadvantages when global market is considered. The factory will be weak in competition if it continues to use older manual systems which are mostly human intensive.

It is seen that the current control system must be revised and automated because of its outstanding weaknesses. These are mostly in four dimensions : capability, control, communication and cost. Design of a new system with a growing potential is urgent and this will be valuable to production staff and to the company.

3. DESIGN OF A NEW SYSTEM

3.1 THE DESIGN PROPOSAL

3.1.1. COVER MEMORANDUM

This part proposes a new information (reporting) system for which is based on new information processing technologies and techniques to provide information for decisions and problem solving about production control, thus it will increase performance of production management.

3.1.2. SUMMARY OF RECOMMENDATIONS

Based on the current system study, features of the new system are listed below.

Proposed system is a software system . Standard machine forms which include production quantity, scrap quantity, downtimes and worker data will be entered to the system. This will be daily entry. Daily production reports will show how well machines run against standards set by production management. Lastly it will produce cost data for cost department. All operations (input, processing, and output) will take one and a half hours each day (Figure 10).

3.1.3. RECOMMENDATIONS

- Proposed system will allow entry of machine forms to the system. This system will standardize entry forms so that adequate information will be captured in predetermined forms. It will also be easy to handle this data (Figure 12, 15, 16, 17, 18). And there will be six reports (Figure 14).

- Machine information - type, products produced and standards are entered to the system. A machine base is formed (Figure 13, 19). Conversion errors will be decreased and machine performances can be calculated and reported. A list of machines and their standards will be reported (Figure 25).

- Workers with their codes, names and departments will be entered to the system to manage time schedules and direct labor hours (Figure 13, 20). A list of workers will be reported (Figure 26).

- Products, shifts, production groups and cost codes will be entered to the system (Figure 13, 21).

- The system will work such that all daily information is entered in one hour.

- Downtimes for machines and their reasons will be entered to the system (Figure 16). This is at present **uncollected** information. That information will allow more accurate calculation of costs.

- The system will make daily calculations and it will produce a report which shows machine production quantities, scrap quantities and efficiencies which are found using standards (Figure 22, 24 and Pages 17-18 in Appendix C).

- The system will make necessary controls for entry and it will prevent entry errors at some level.

- The system may produce graphical presentations of data to be used by production staff.

- It will produce a downtime report showing the machine stop durations and their reasons (Figure 27).

The machines in the factory is rather old. The factory operates for more than twenty years. The modifications on machines becomes necessary. And lost hours may be unexpectedly high. The downtime report of the proposed system (PCS) will provide , machine by machine, percentage of time lost in downtimes and the reasons for these downtimes. The managers will be able to differentiate between controllable and uncontrollable halts of machines. And this is extremely important to beat critical production schedules.

- And lastly, it will produce monthly labor hours and reconciliation of production phase by phase (Figure 23).

Phase by phase production control is important in terms of scrap quantities. In some processes like grinding, scrap quantities are extremely important and the managers would simply follow up these reports to see and control day to day scrap quantities.

Figures in part 3.2 shows Data Flow Diagrams for the processes listed on Process Hierarchy Chart (Figure 9). For the detailed explanation of each process, please refer to Appendix C where logical summaries about processes exist.

The new information system will run on IBM PC compatible machines and they will be networked for the integration purposes. And two people in two divisions of the factory will be responsible to operate the computers.

Considering the new system, it is obvious that it will save valuable time of production supervisors. It will produce accurate and consistent information in a readable format for both top management and other departments. It will also indirectly change operational methods of production because the people will work more systematically.

3.1.4. OPTIONAL SOLUTIONS

There are two optional solutions. One of them is to take all of the information directly from machines. It is rather a long term project and it will require complete team for design and a lot of hardware . This has to be considered afterwards. Another solution was to solve everything in spreadsheet softwares, so that it will be more user oriented system. But viewing the increasing volume of data and production staff's computer knowledge, it is not logical to make such a system. This system will prevent integration of business activities.

3.2. DESIGN DATA FLOW DIAGRAMS

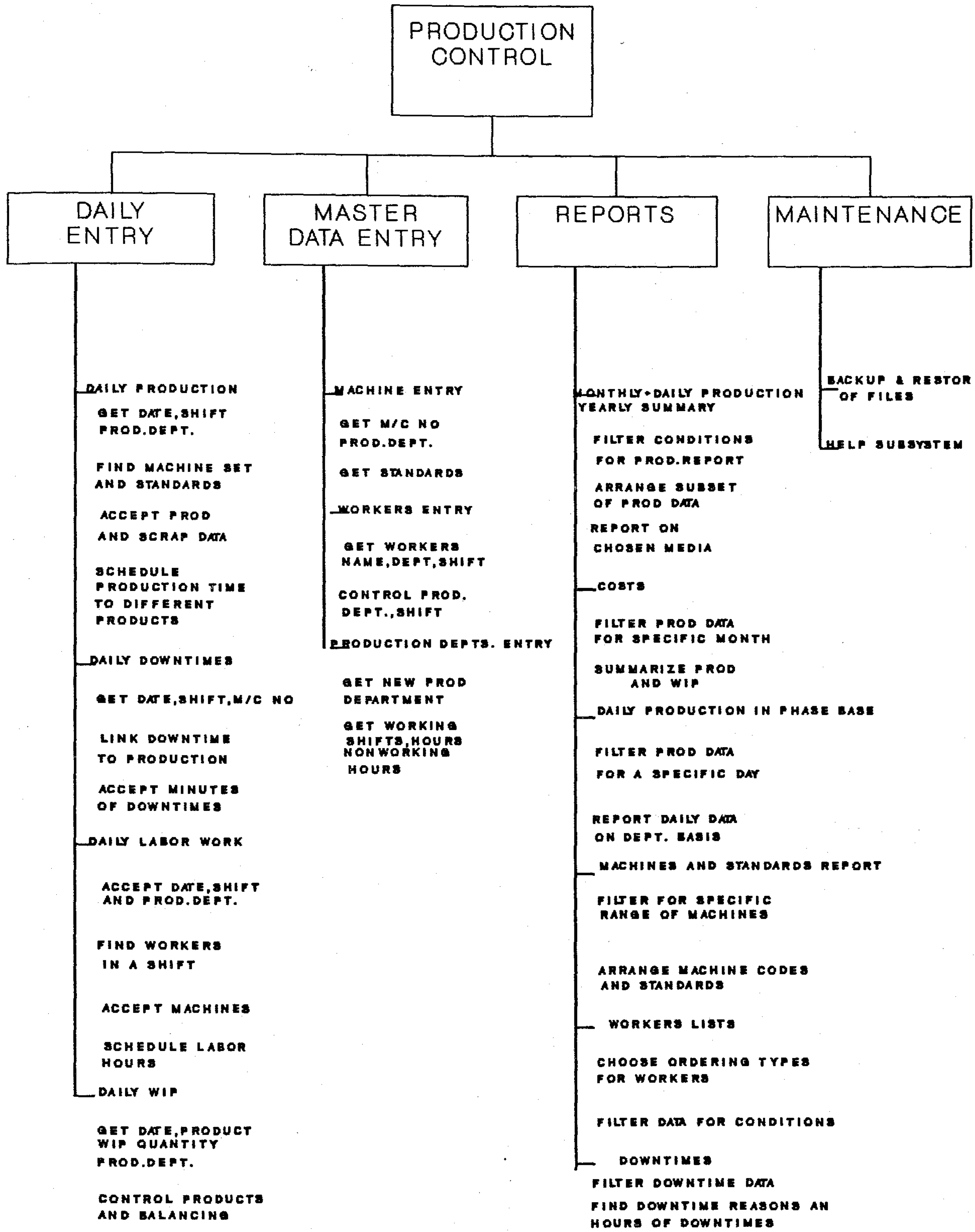


FIGURE 9: DESIGN PROCESS HIERARCY CHART

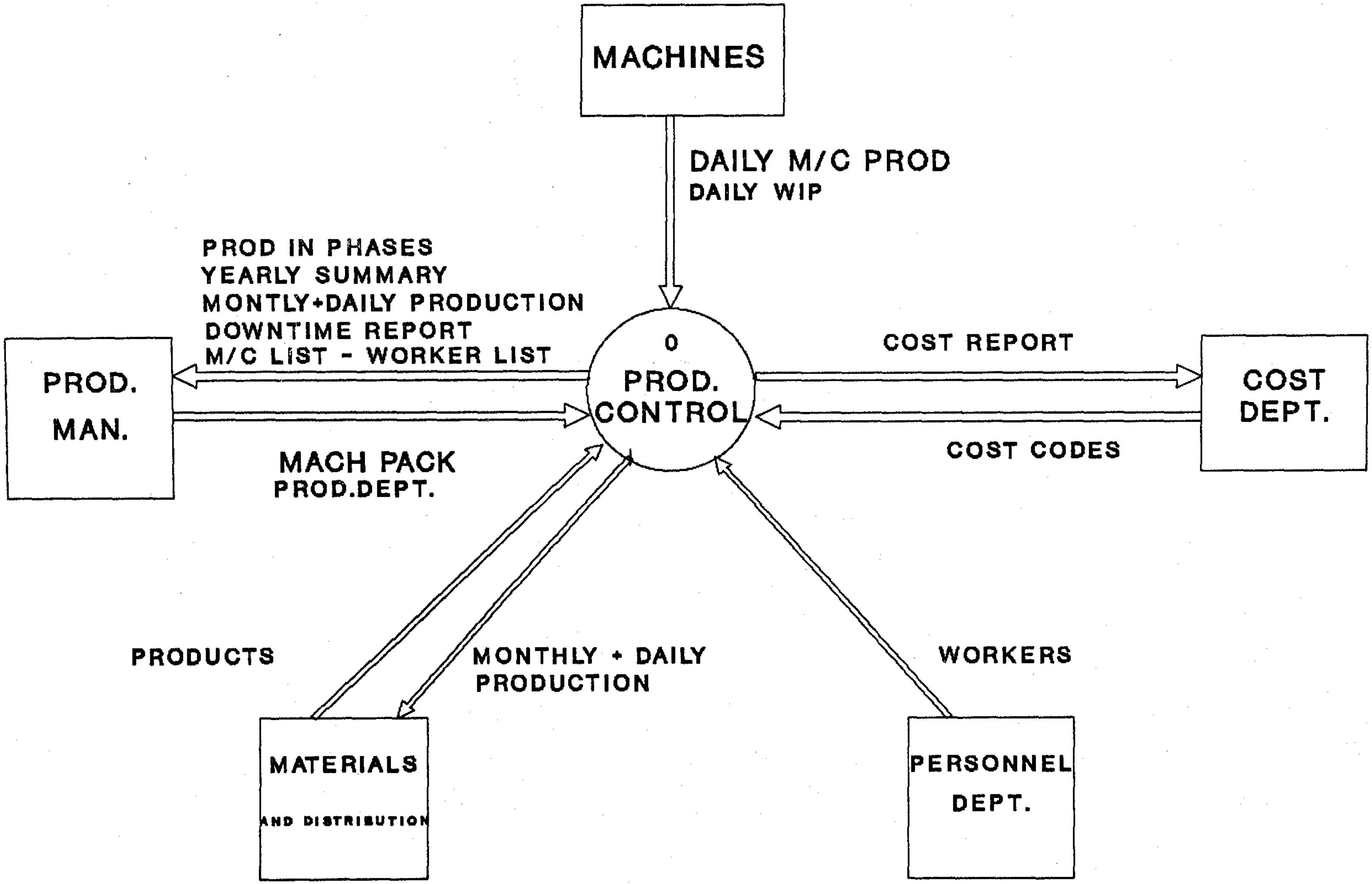
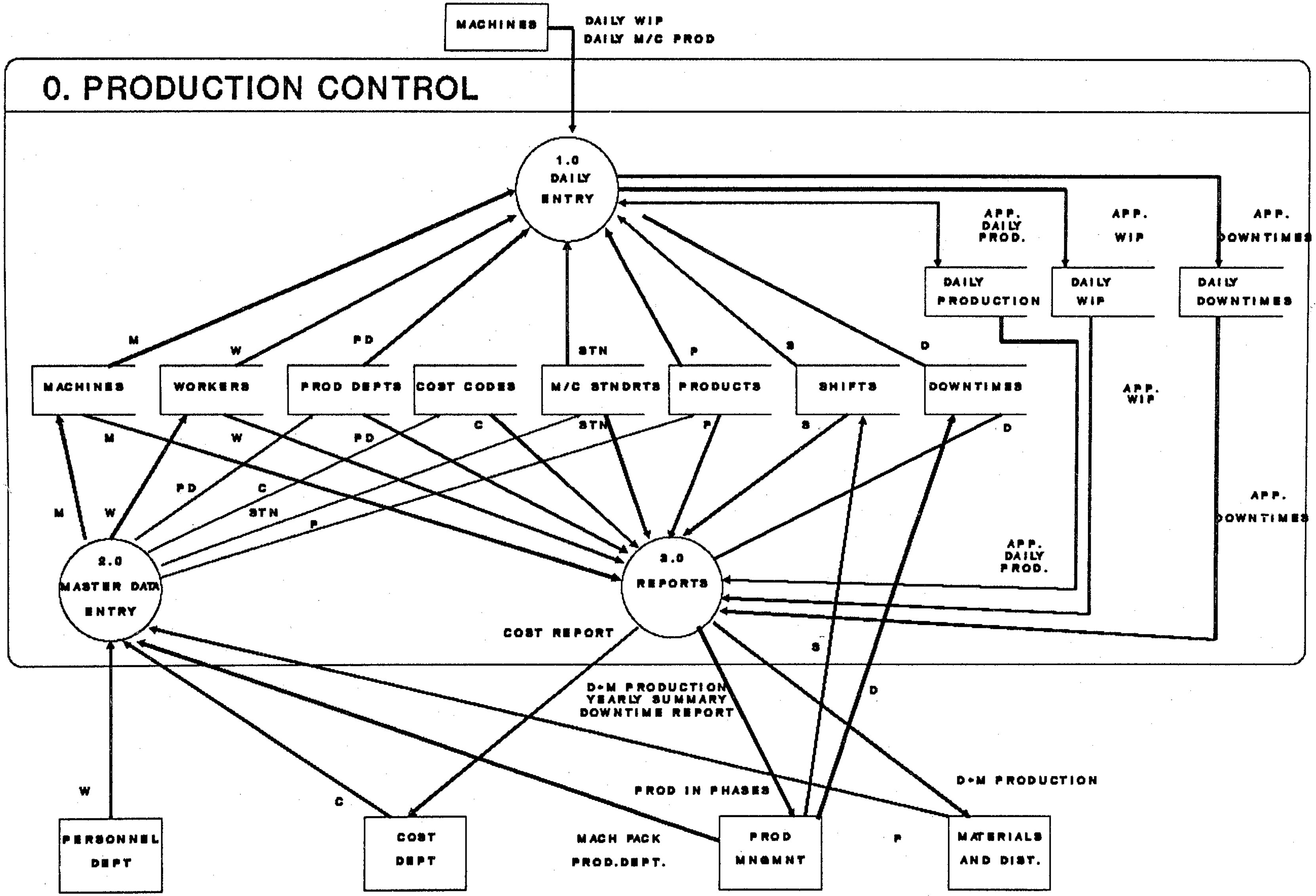


FIGURE 10: CONTEXT DFD FOR THE DESIGN

FIGURE 11: DFD FOR PRODUCTION CONTROL PROCESS



M- MACHINES W- WORKERS PD- PROD.DEPT. C- COST CODES STN - M/C STNDRTS P- PRODUCTS S- SHIFTS D- DOWNTIMES

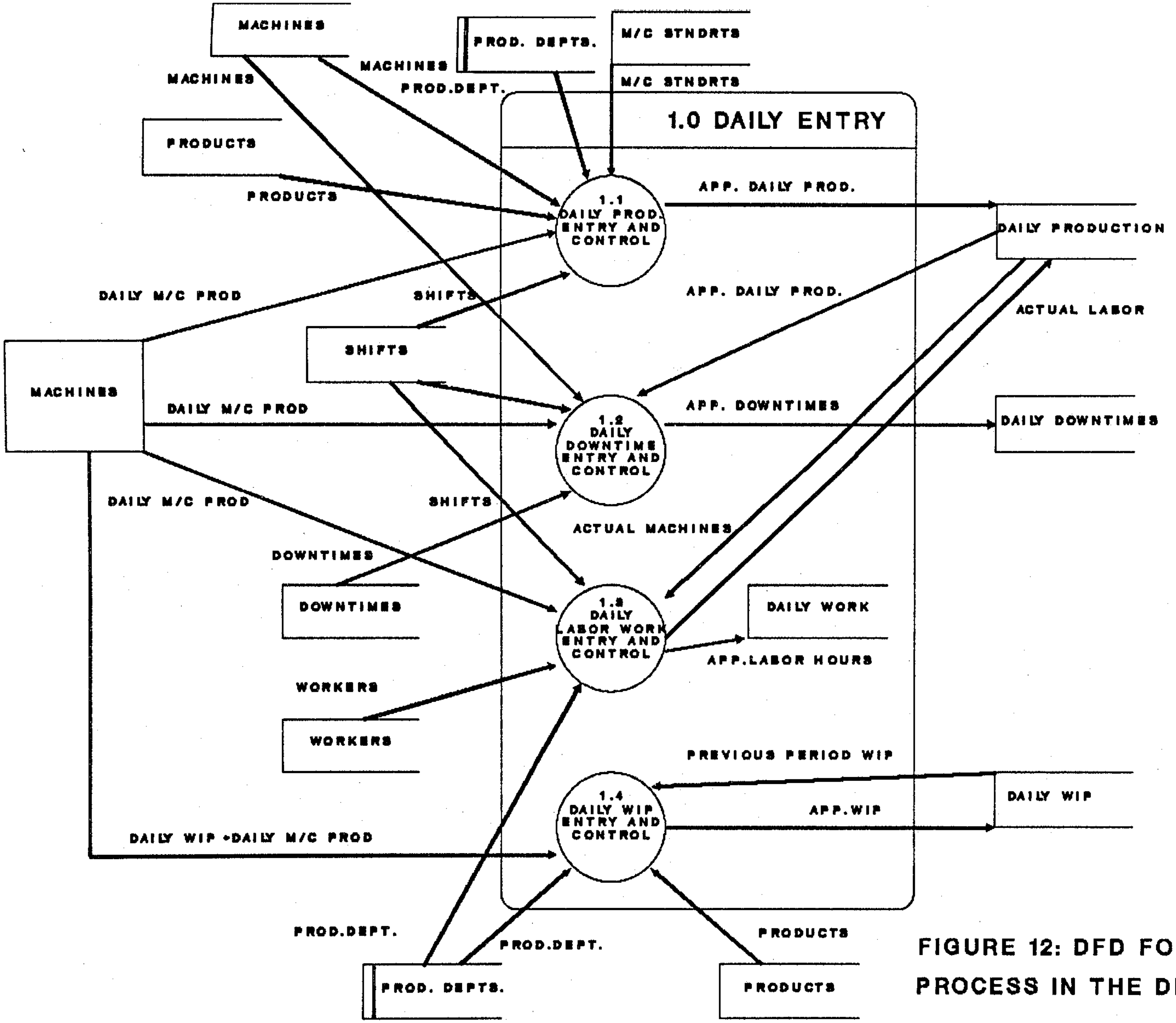


FIGURE 12: DFD FOR DAILY ENTRY PROCESS IN THE DESIGN

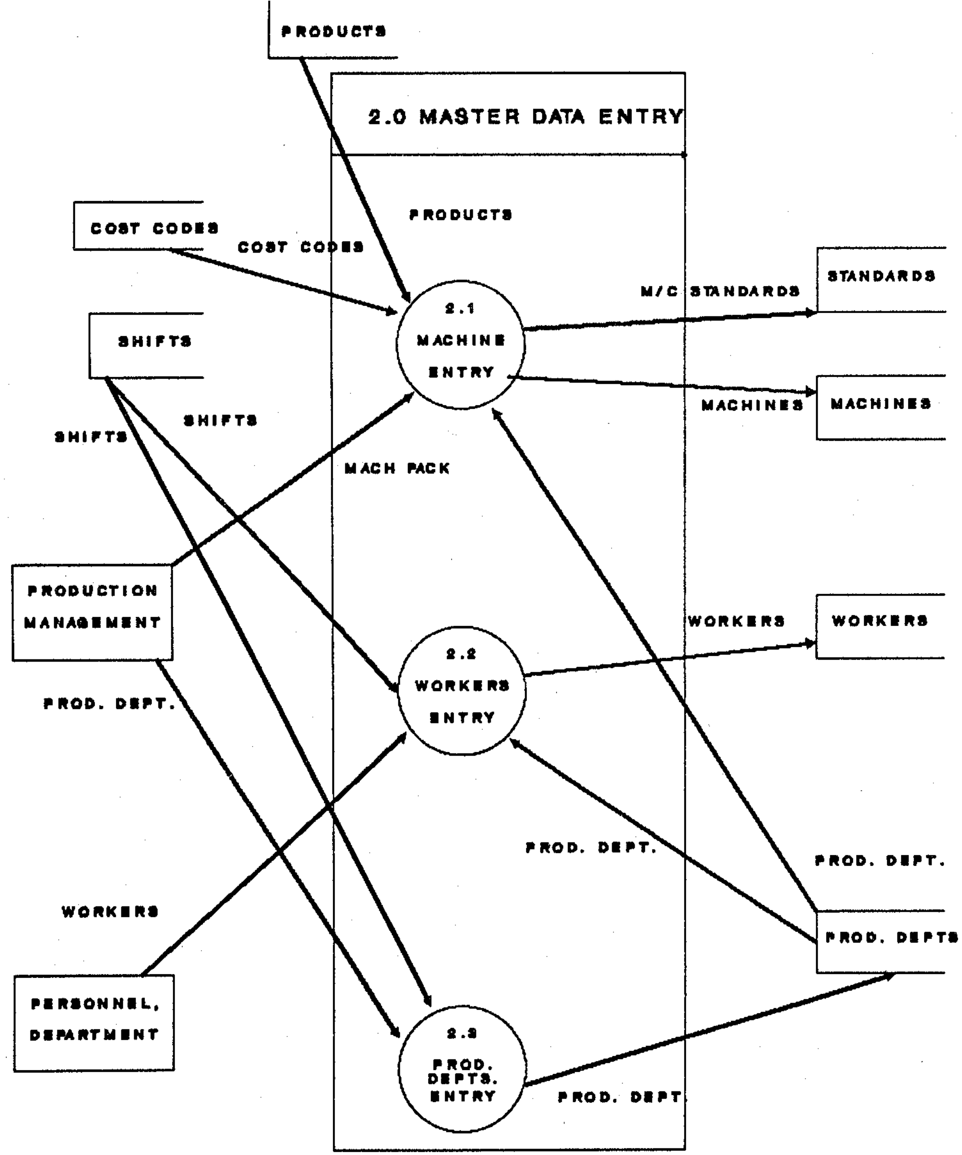


FIGURE 13: DFD FOR MASTER DATA ENTRY PROCESS IN THE DESIGN

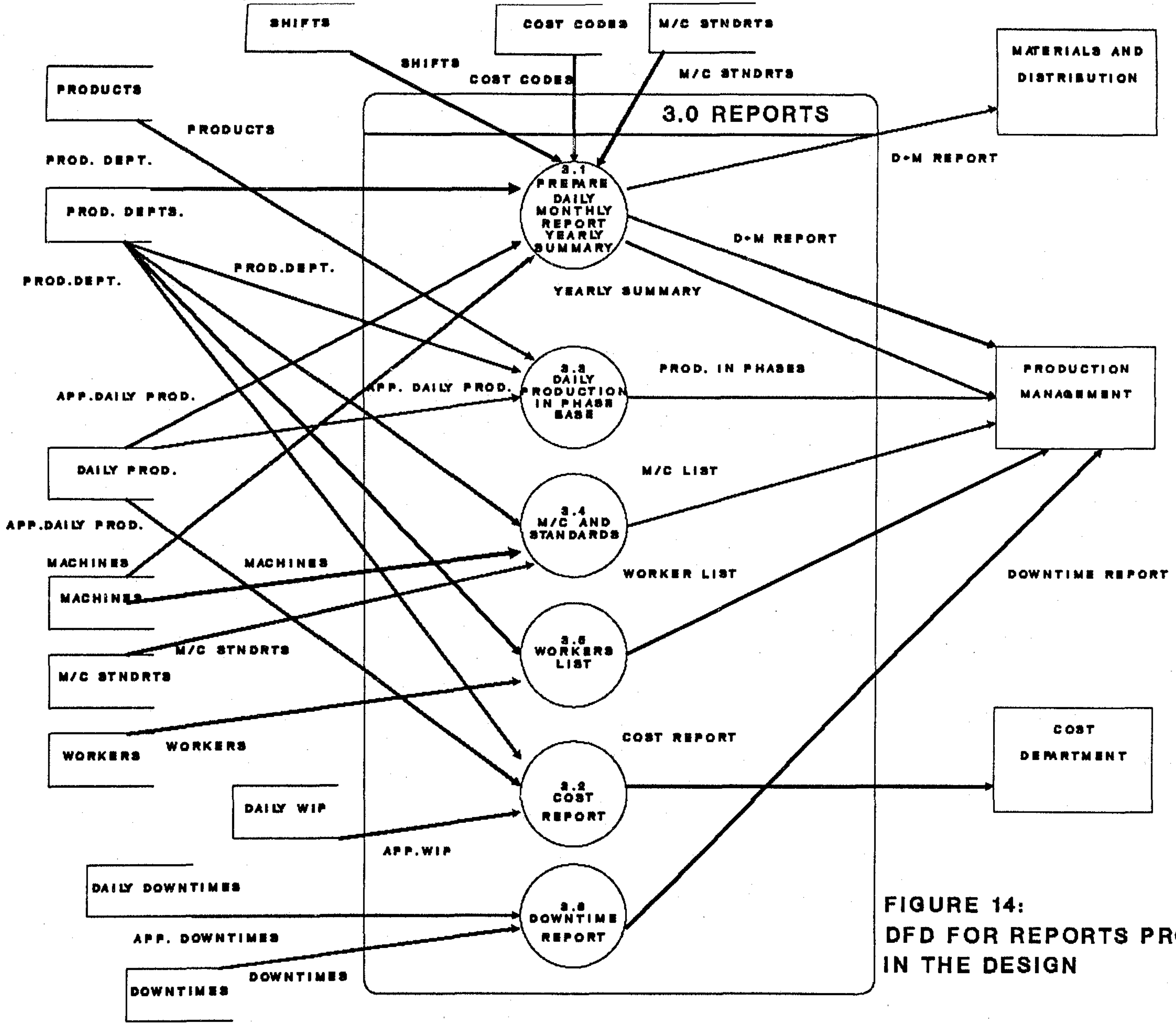


FIGURE 14:
DFD FOR REPORTS PROCESS
IN THE DESIGN

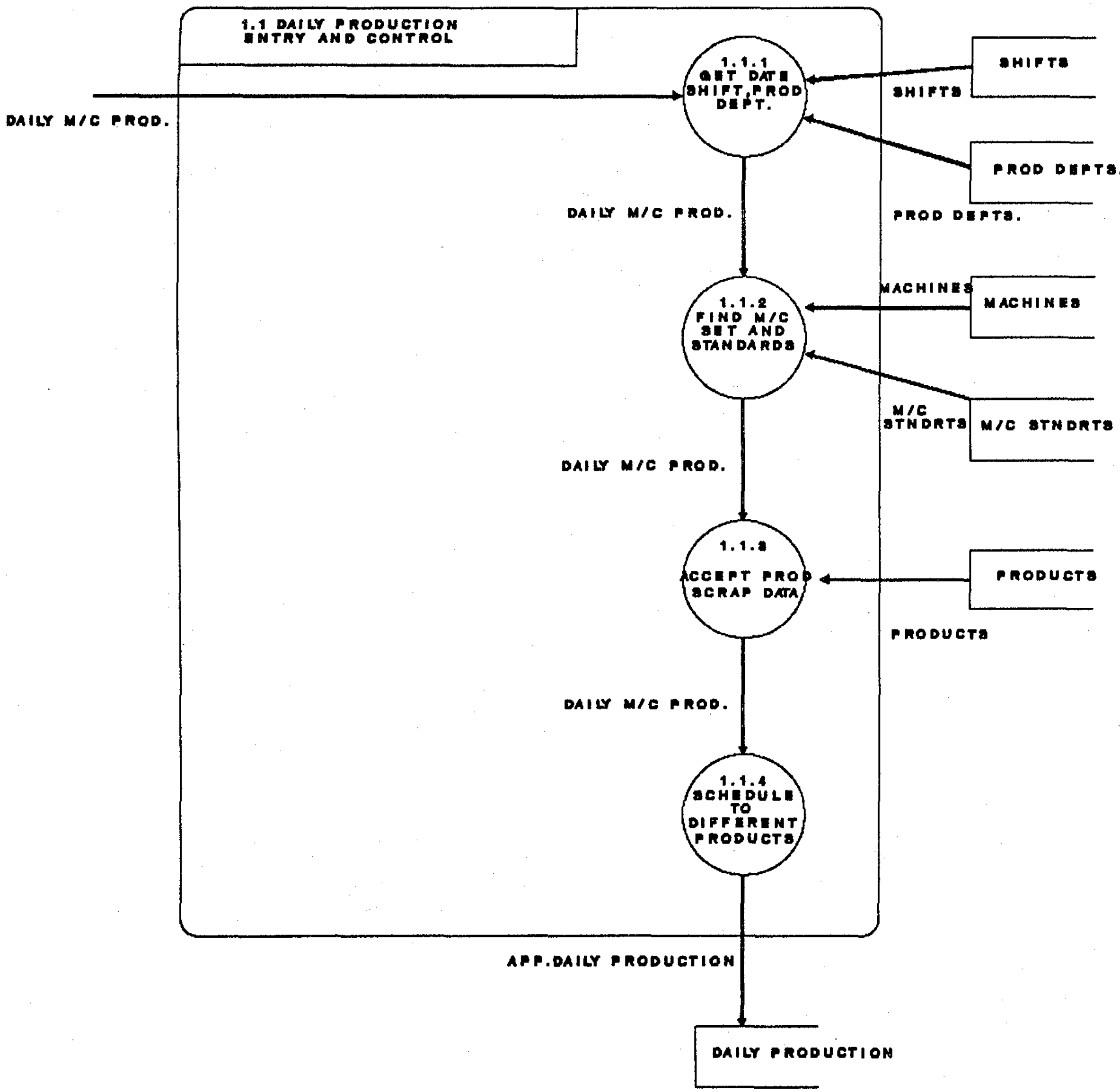


FIGURE 15: DFD FOR DAILY PRODUCTION ENTRY & CONTROL PROCESS IN THE DESIGN

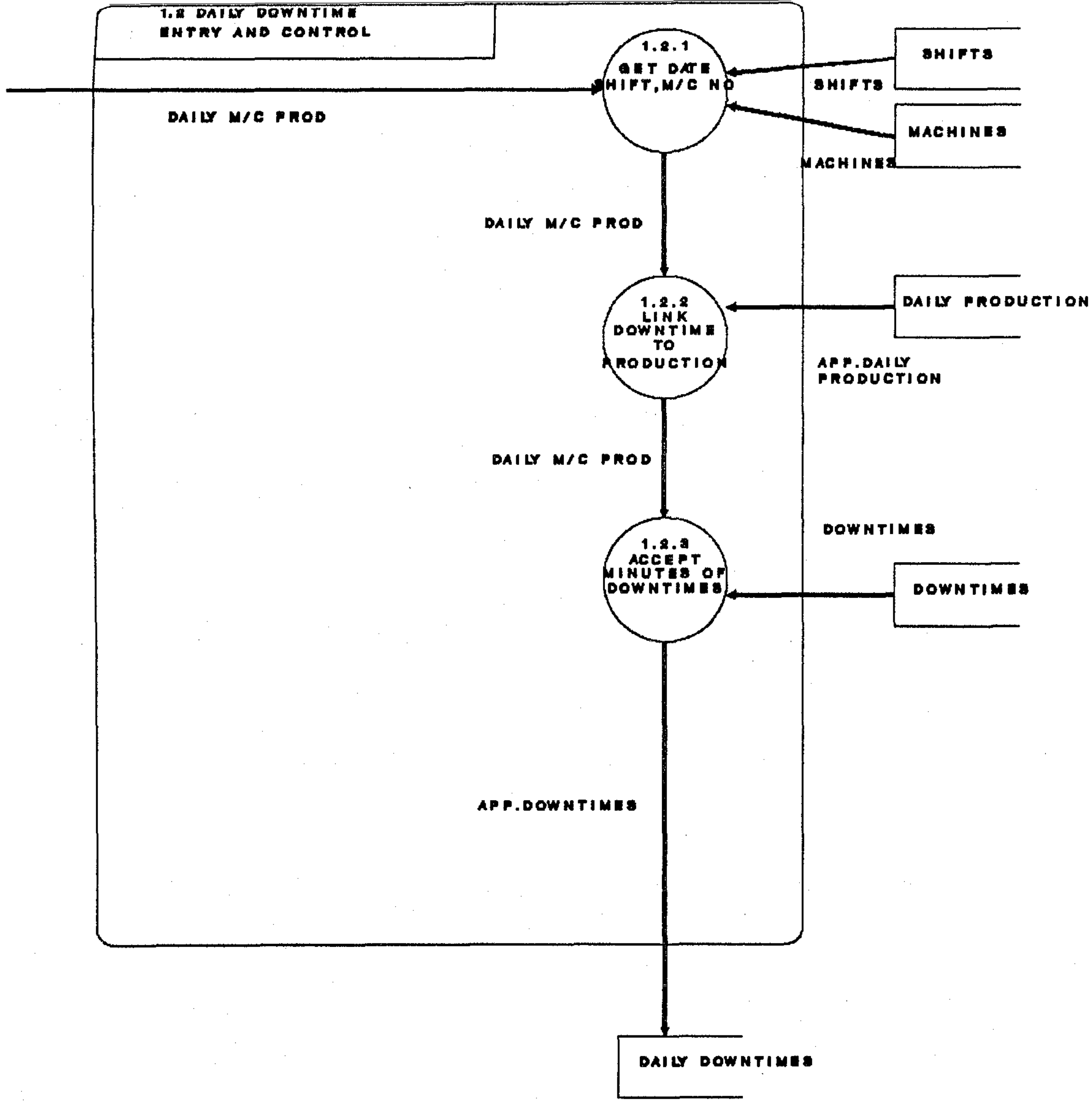


FIGURE 16: DFD FOR DAILY DOWNTIME ENTRY&CONTROL PROCESS IN THE DESIGN

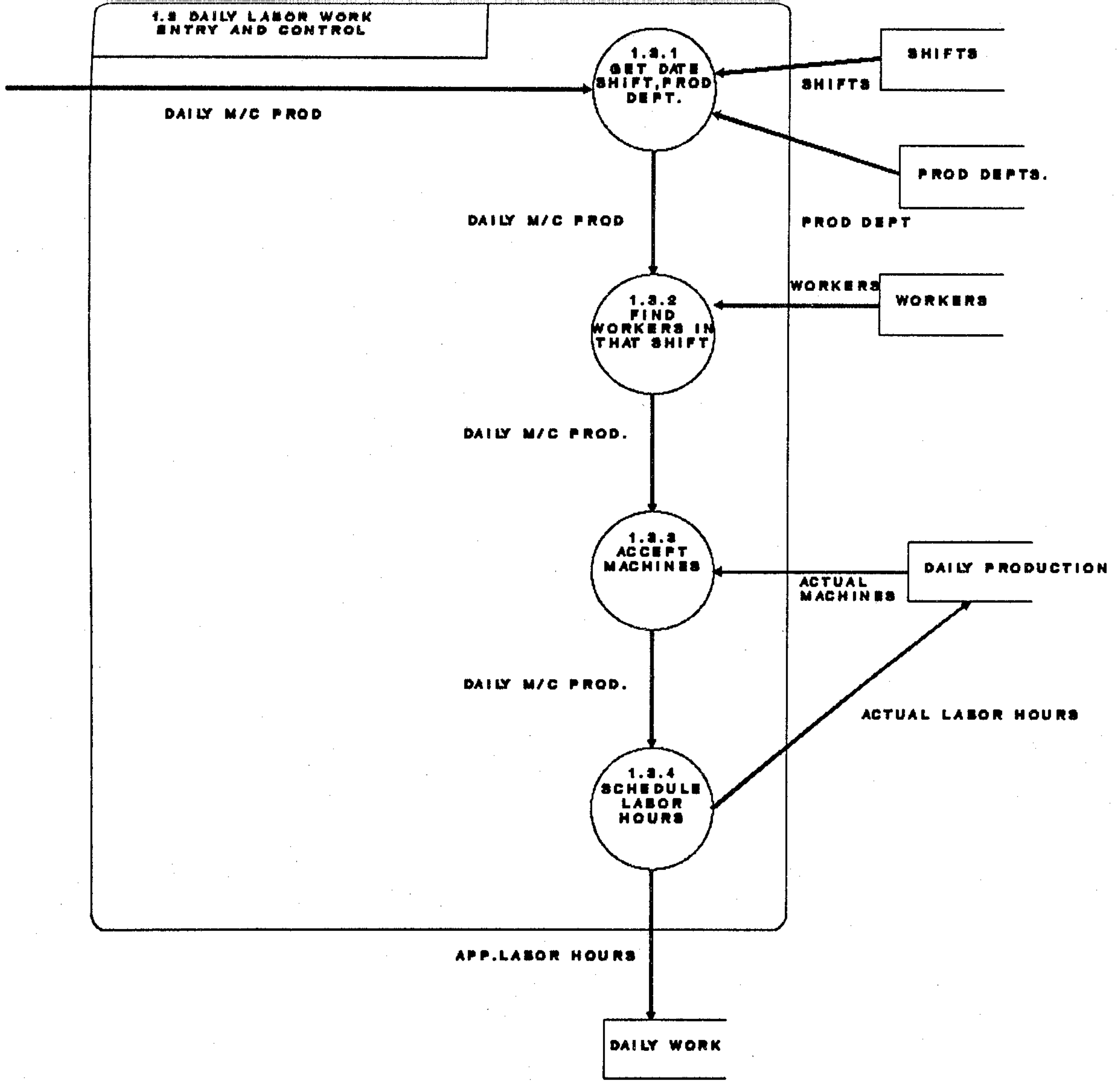


FIGURE 17: DFD FOR DAILY LABOR WORK ENTRY & CONTROL PROCESS IN THE DESIGN

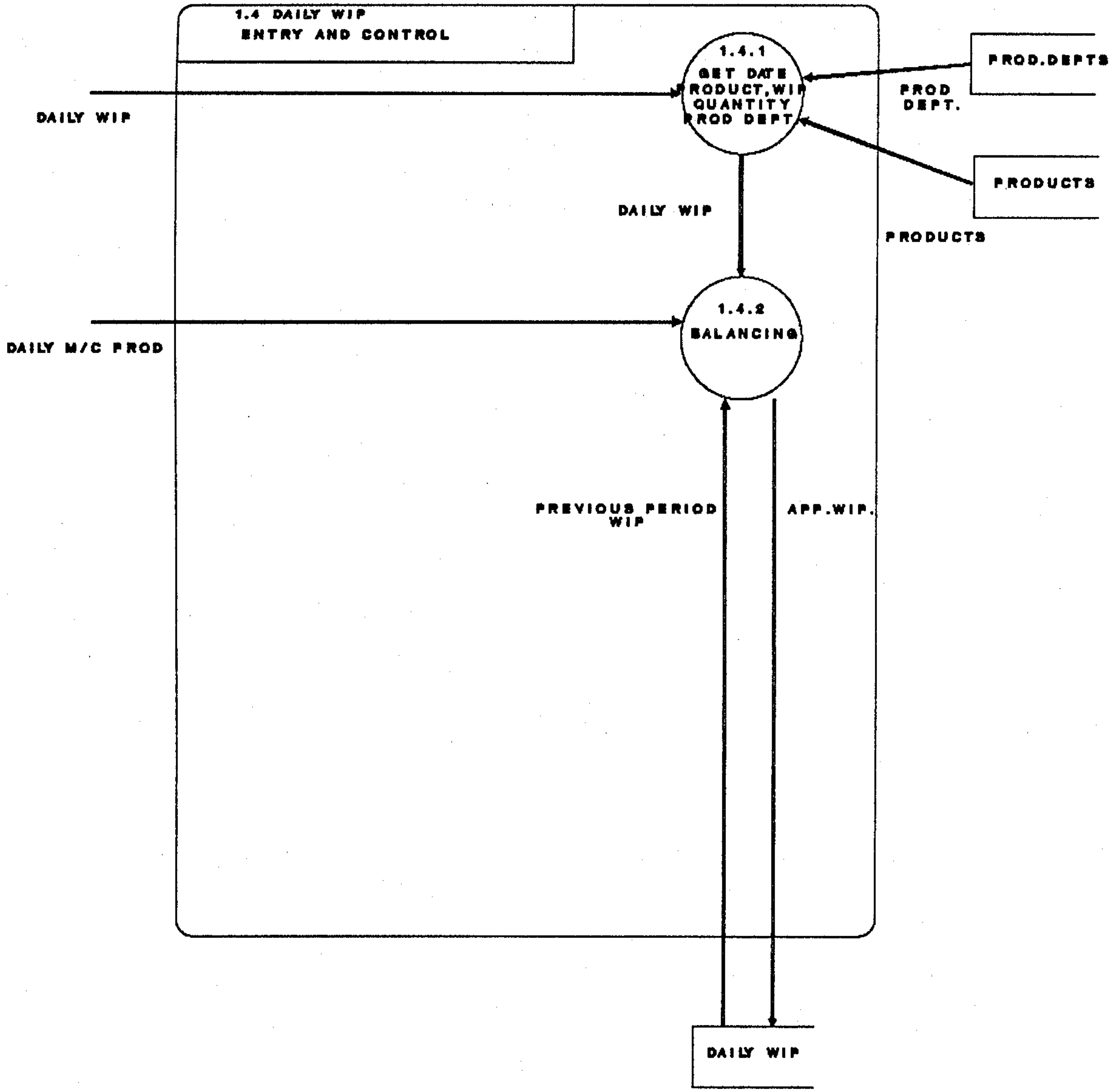


FIGURE 18: DFD FOR DAILY WIP ENTRY & CONTROL PROCESS IN THE DESIGN

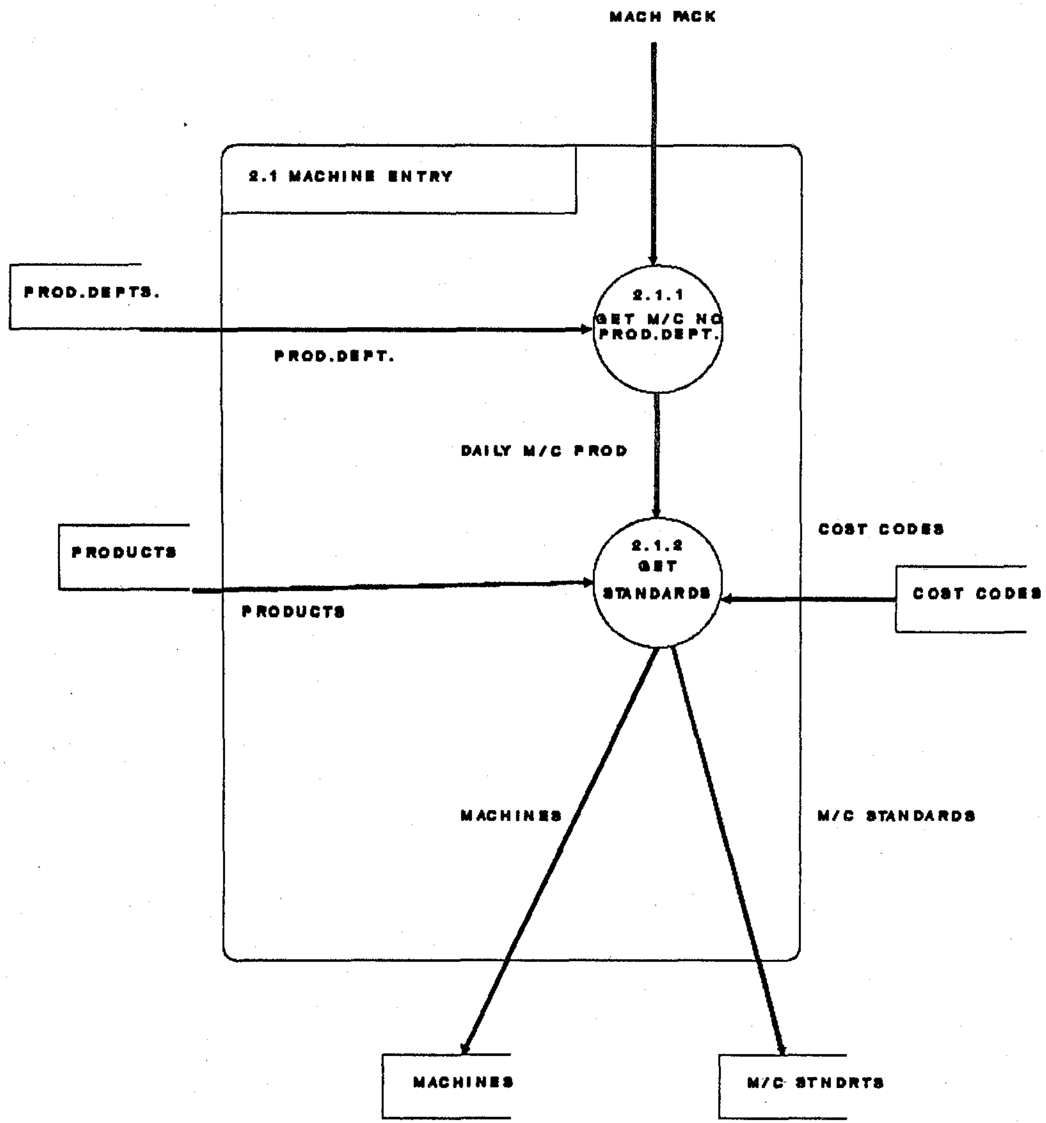


FIGURE 19: DFD FOR MACHINE ENTRY PROCESS IN THE DESIGN

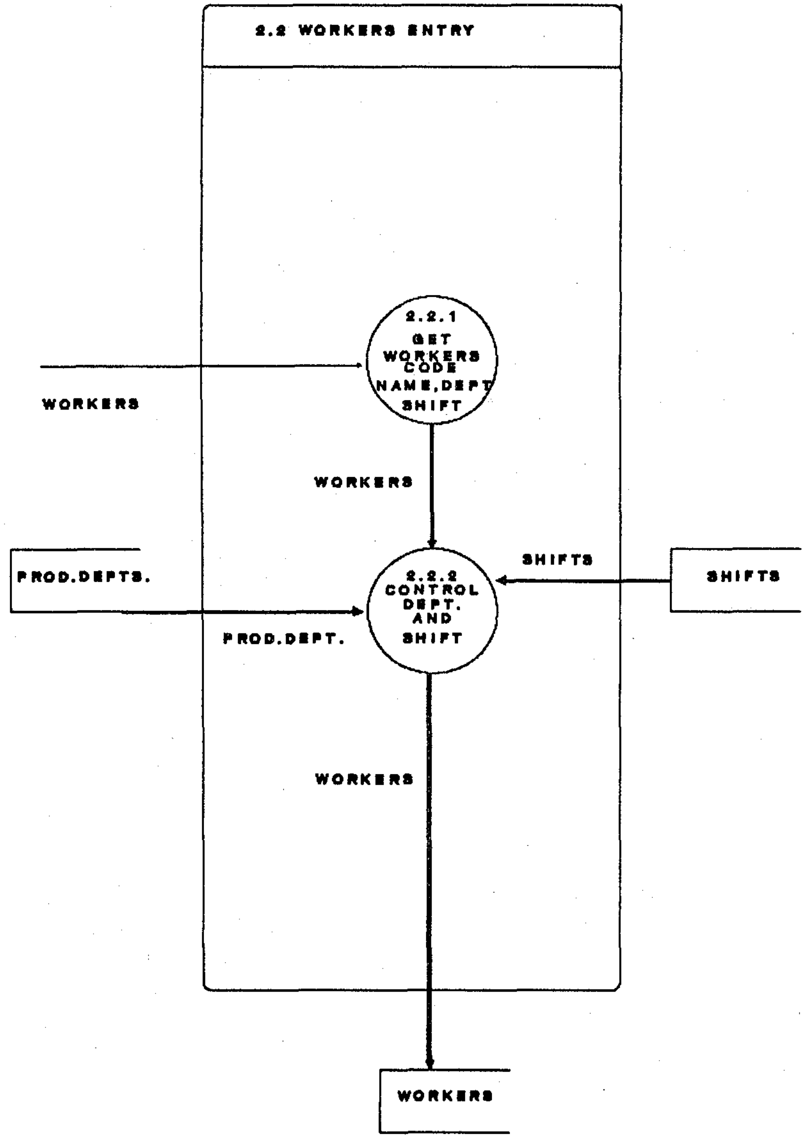


FIGURE 20: DFD FOR WORKERS ENTRY PROCESS IN THE DESIGN

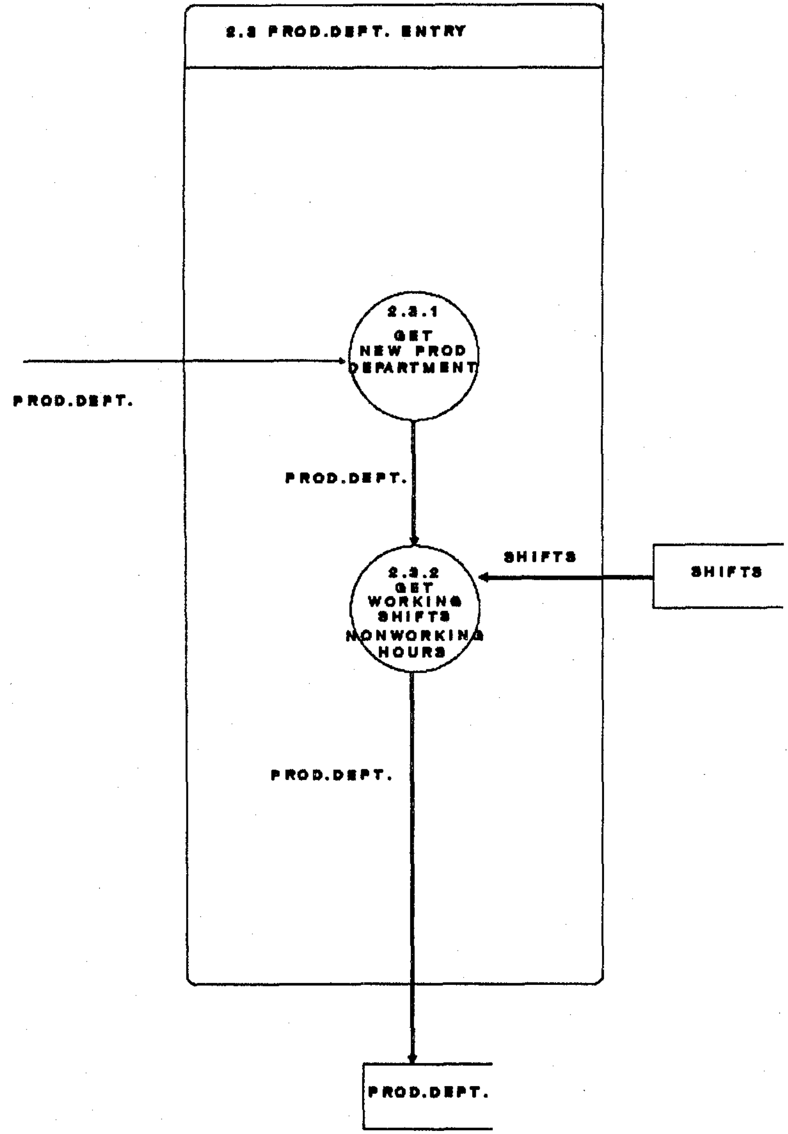


FIGURE 21: DFD FOR PROD DEPT ENTRY PROCESS IN THE DESIGN

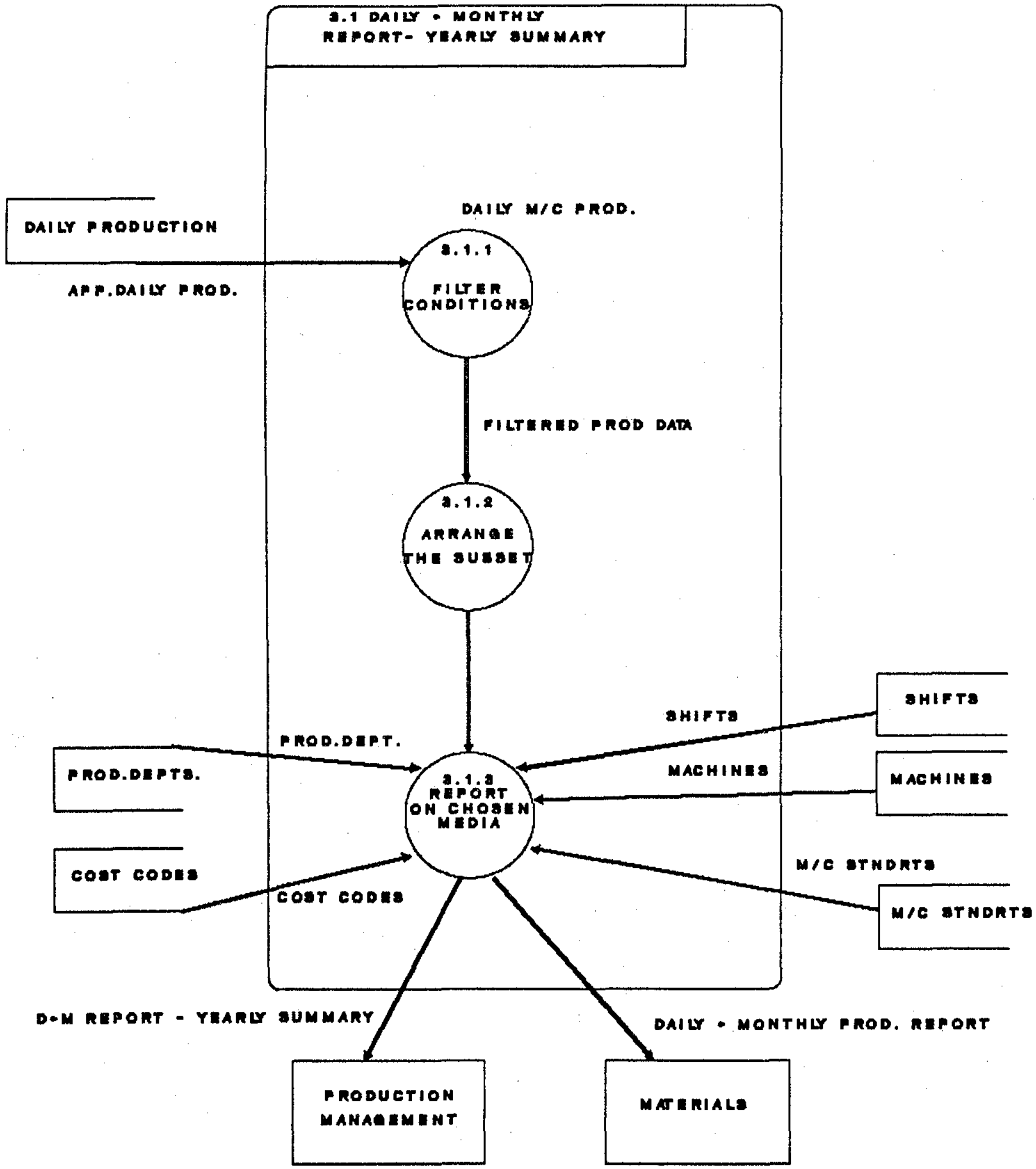


FIGURE 22: DFD FOR DAILY-MONTHLY REPORT YEARLY SUMMARY PROCESS IN THE DESIGN

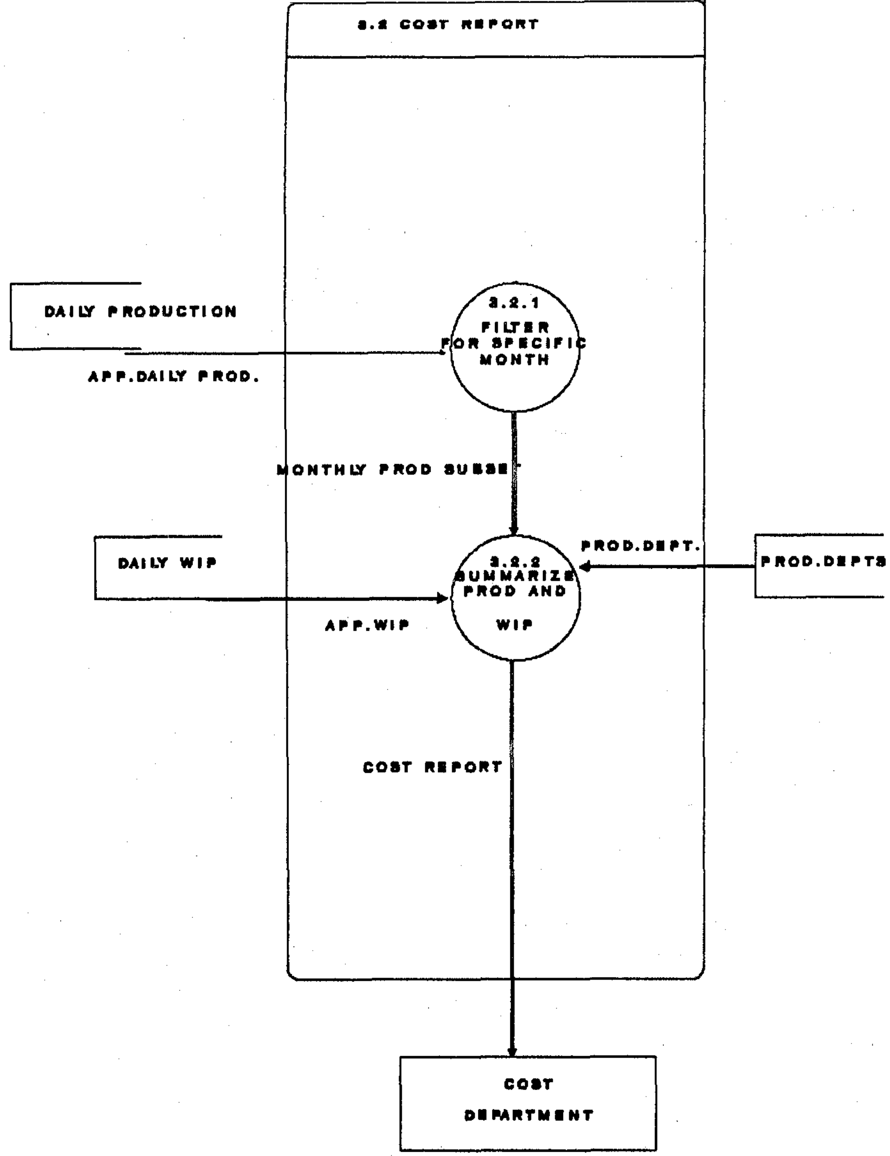


FIGURE 23: DFD FOR COST REPORT PROCESS IN THE DESIGN

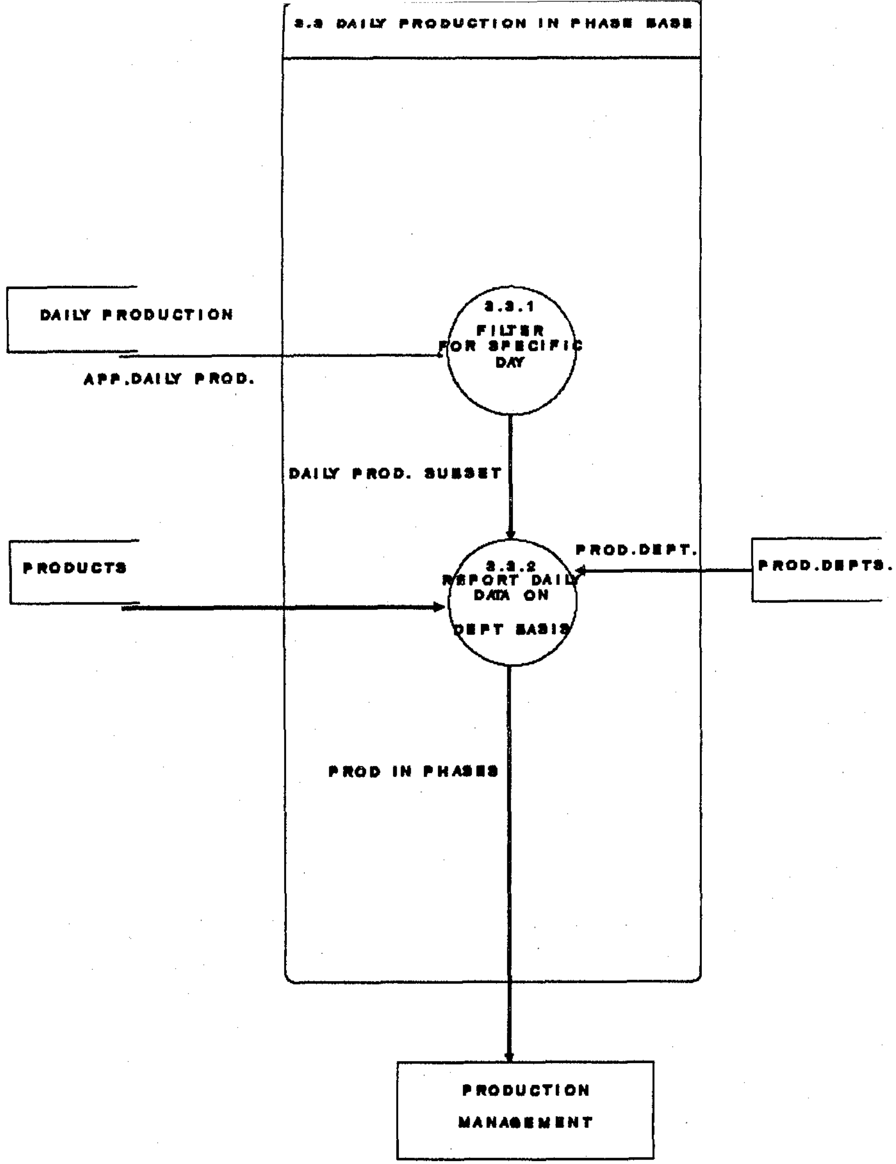


FIGURE 24: DFD FOR DAILY PRODUCTION IN PHASE BASE PROCESS IN THE DESIGN

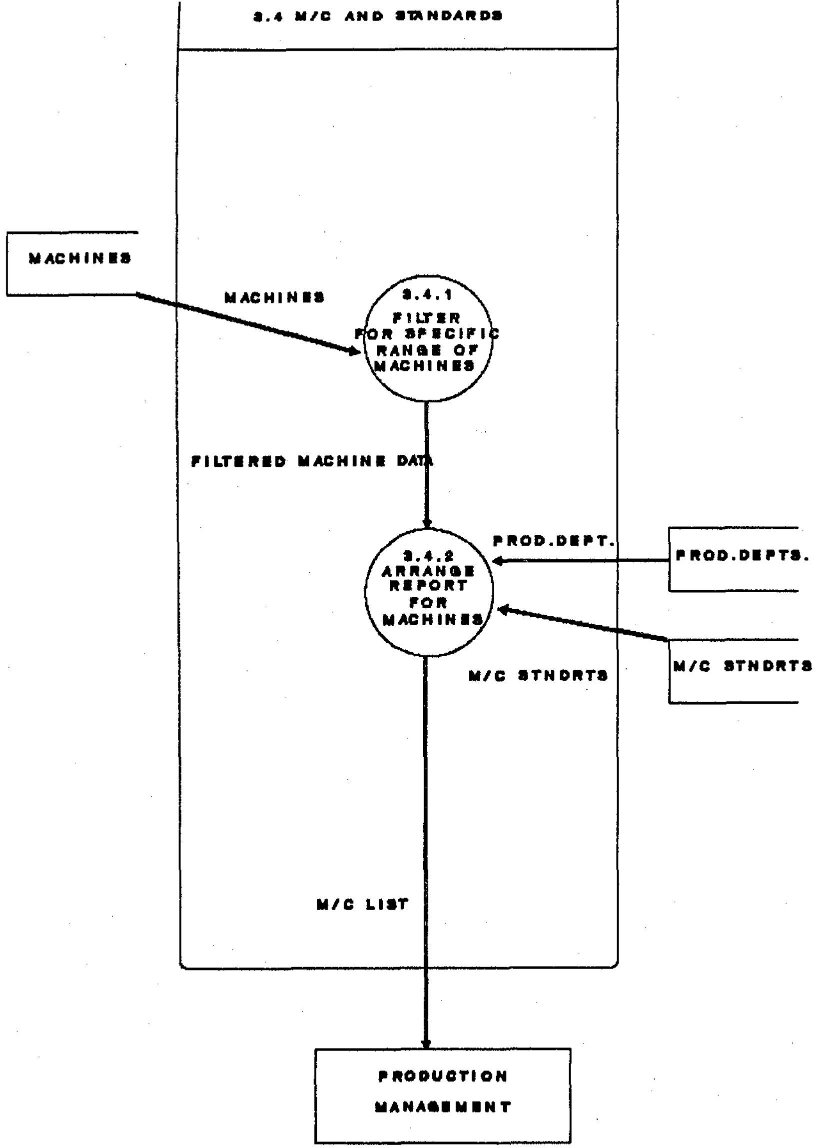


FIGURE 25: DFD FOR M/C AND STANDARDS PROCESS IN THE DESIGN

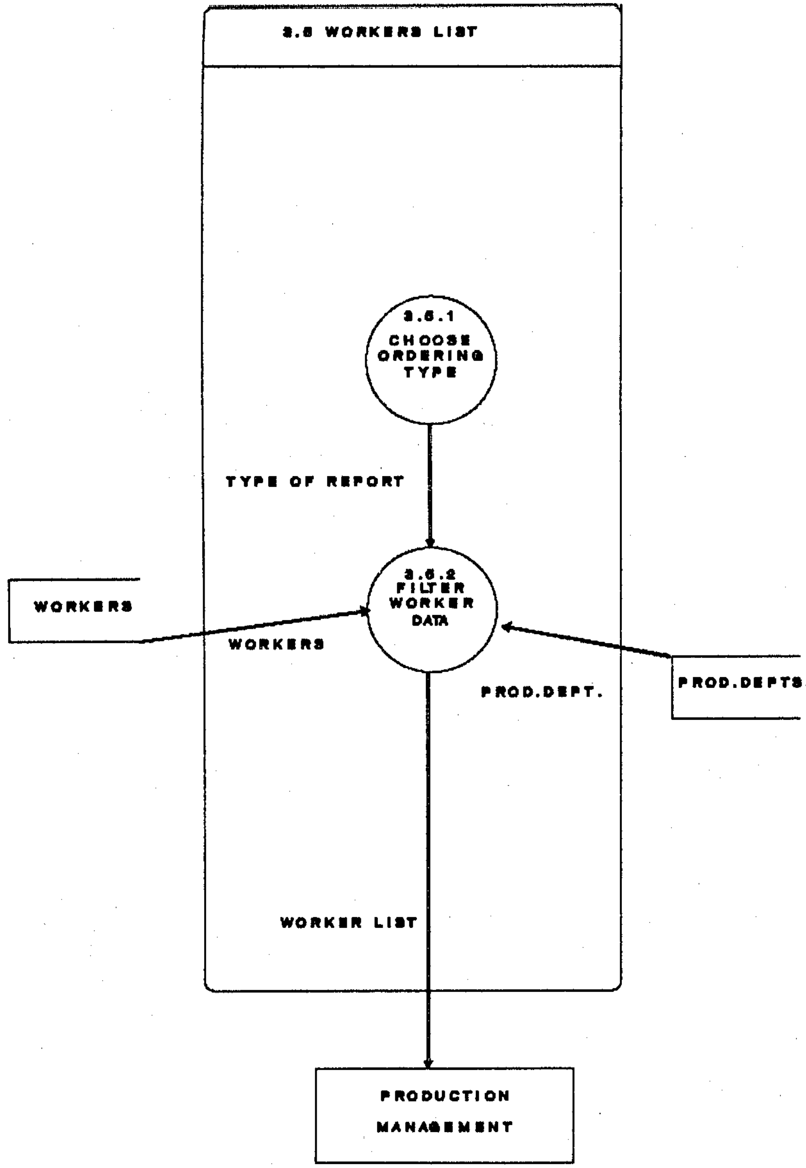


FIGURE 26: DFD FOR WORKERS LIST PROCESS IN THE DESIGN

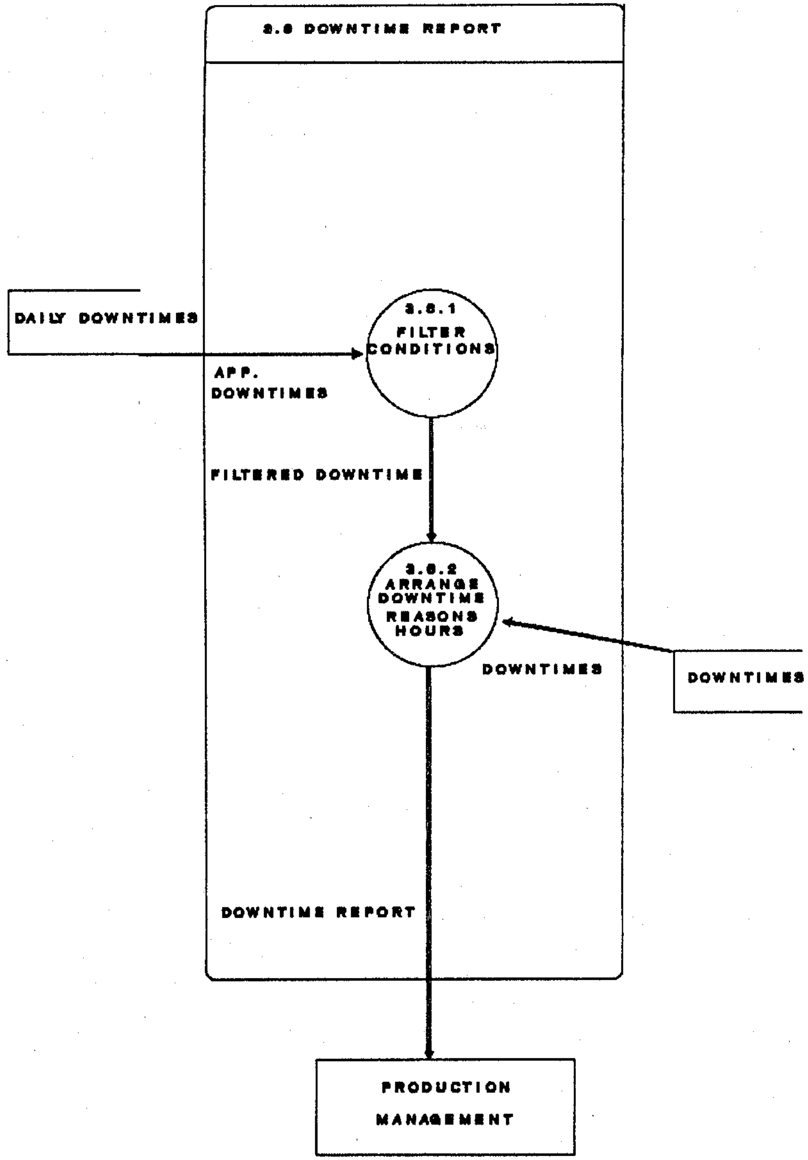


FIGURE 27: DFD FOR DOWNTIME REPORT PROCESS IN THE DESIGN

3.3. DATA MODEL DESIGN

When Data Flow Diagrams and Data Dictionaries are ready, the design elements and the relationships among them are clear. The data which will be stored somewhere and the data which will flow among these stores are known. Each process are stated explicitly. But the data stores are to be matched with database file structures retrieved from a 'data model' which is another tool.

The information which has a meaning by itself, which can stand alone, is an entity. Entities have some attributes and they have some relationships to other entities in the context of the specific problem. They are listed on a diagram (Figure 28) for the thesis problem. The entities are shown in rectangles and relationships are shown in rhombus. 'M' and 'N' shows that relation is many to many whereas '1' and 'N' shows that the relation is one to many. An entity is displayed in two rectangles because it doesn't exist when the related entity doesn't exist. Such entities are called as 'weak'.

Figures from 29 to 38 show attributes of entities and relationships in the data model design.

Verification of data model and the theoretical work is to match data stores with the elements of the data model. It is done and the following are the results of the data model design.

ENTITIES

Machines	:	Machine Number, output per hour, output per lab hour
Workers	:	Worker code, name
Cost Codes	:	Cost code, cost code explanation
Production Group	:	Group Code, name, number of shifts, shift change type, normal hours, normal nonworking hours, abnormal hours, abnormal nonworking hours, date, remaining wip. Normal Abnormal differentiation is for Saturdays or the days the production is non regular.
Products	:	Product Code, name
Shifts	:	Set date, Shift number, starting time for normal days, ending time for normal days, starting time for abnormal days, ending time for abnormal days. Set date is added because the shift times may be changing through years.
Downtimes	:	Downtime reason Code, Reason explanation

RELATIONSHIPS

RUNS	-	between Machines - Workers (M-M) One machine can have many workers. And one worker may work in two or more machines at the same time.
BELONGS TO	-	between Machines - Prod Depts (N-1) One department has many machines. But one machine can't be in two departments.
PRODUCES	-	between Machines - Products (M-M) One machine may produce many products. And one product may be produced in two or more machines at the same time.
IN DEPT	-	between Workers - Prod Depts (N-1) One worker is in one department . But one department can contain many workers
IN SHIFT	-	between Workers - Shifts (N-1) One shift contains many workers whereas one worker works in one shift in a day.
MACHINE DOWNTIME	-	between Machines - Downtimes (M-M) One machine can halt because of many reasons. And one reason may be a cause for the downtimes of many machines (e.g. Electrical failure)
COST CODE PRODUCT PROD DEPT	-	between Cost Codes - Products - Prod Depts (1-N-M)

		One product and one department can identify a cost accounting code.
REMAINS	-	between Prod Depts - Products (M-M) One department can have many types of products remaining in work-in-process for a day. And one product may be remaining in many departments for a certain day.

CONSTRAINTS

Machine number, cost code, worker code are numbers

Group Code	-	first character letter other 3 number shows division
Number of Shifts	<=	Maximum Shift Number
Shift Change Type	<=	Number of Shifts
Product Code	-	Two characters + five digit number

KEYS

Keys show attribute(s) that uniquely identifies a record.

Machines	:	Machine Number
Workers	:	Worker code
Cost Codes	:	Cost code
Production Group	:	Group Code
Products	:	Product Code
Shifts	:	Set date + Shift number
Downtimes	:	Downtime reason Code

FUNCTIONAL MAPPINGS

Prod Group Code , Product Code -- Cost Code

Prod Group Code --> Machines

Prod Group Code --> Workers

Shifts --> Workers

MANY TO MANY RELATIONS

Runs

Produces

Machine Downtime

RELATIONAL SCHEMA

The following shows the fields of database files constructed. Underlined fields are primary keys.

Machines(Machine Number, Product Code, output per hour, output per lab hour, Prod Dept Code)

Workers(Worker code, name, Prod Group Code, Shift No)

Cost Codes(Cost code, cost code explanation, Prod Group Code, Product Code)

Production Group(Group Code, name, number of shifts, sh ift change type, normal hours, normal nonworking hours, abnormal hours, abnormal nonworking hours, date, remaining wip)

Products(Product Code, name)

Shifts(Set date, Shift number, starting time for normal days, ending time for normal days, starting time for abnormal days, ending time for abnormal days)

Downtimes(Downtime reason Code, Reason explanation)

Runs(Date, worker code, machine number, start time, ending time)

Machine Downtime(Date, Machine number, Product Code, Downtime Code, Downtime Minutes)

Produces(Date, Machine Number, Start Time, Finish Time, Product Code)

Remains(Date, Prod. Depts., Product Code, WIP quantity)

SECOND NORMAL FORM

Refer to Tsichritzis and Lochovsky [1982] for second normal form.

"Machines" table decomposes into two :

Machines(Machine Number, Prod. Dept. Code)

Stndrts(Machine Number, Product Code, Output per Hour, Output per Labor Hour)

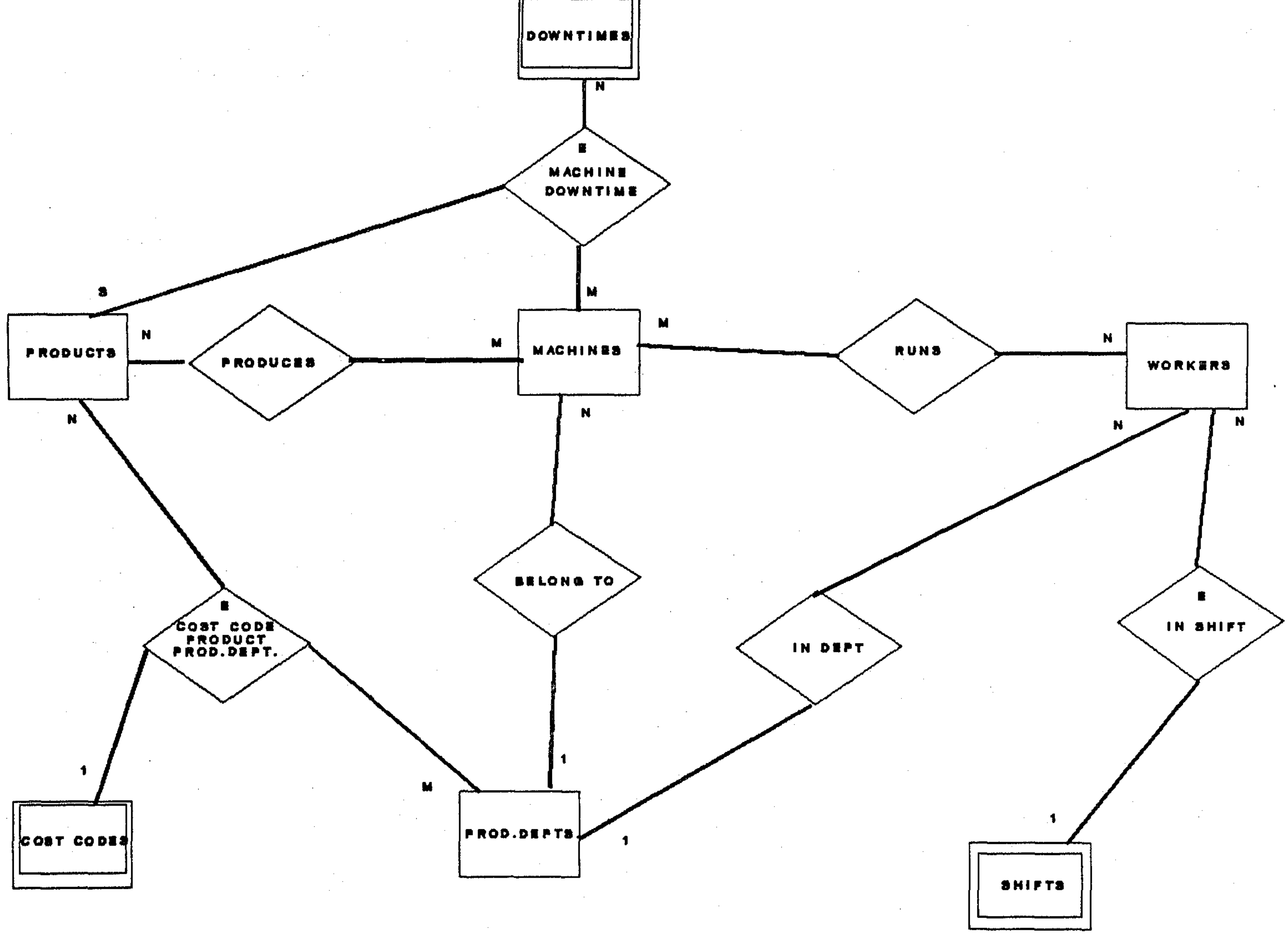


FIGURE 28: ENTITY RELATIONSHIP DIAGRAM FOR PCS DATA MODEL

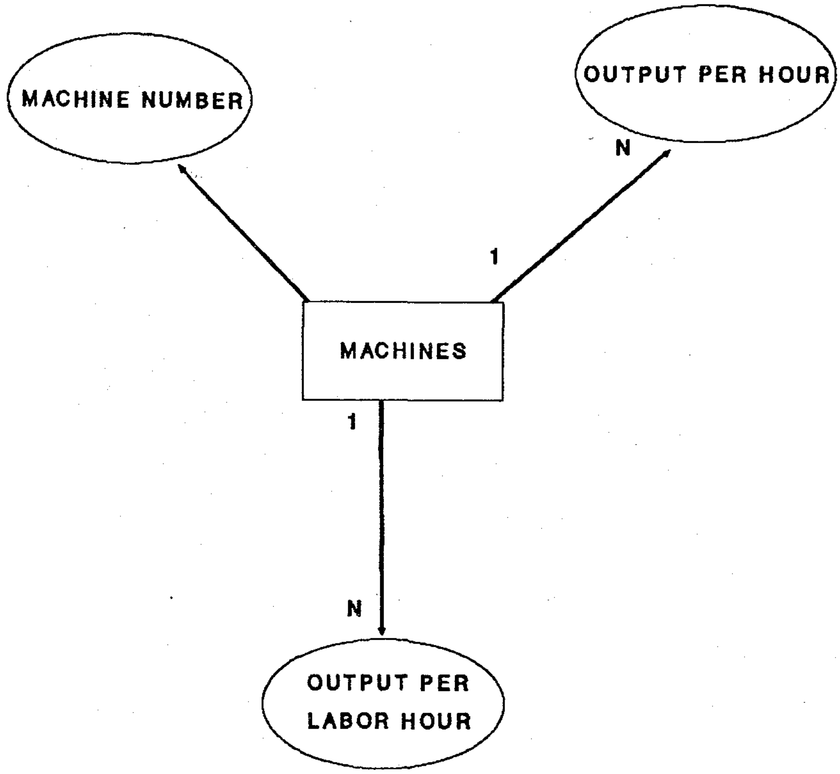
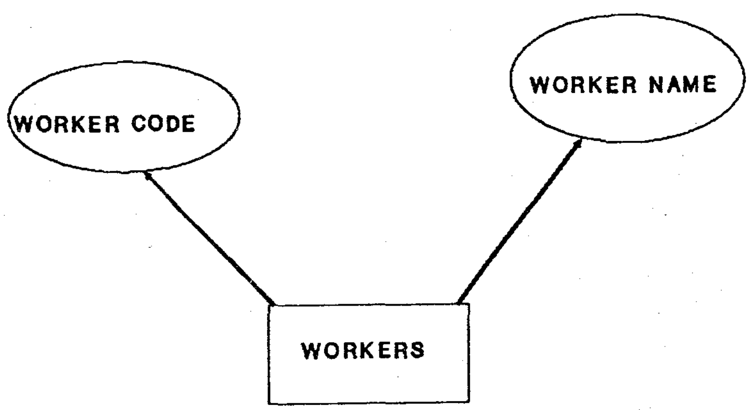


FIGURE 29: MACHINES ENTITY AND ITS ATTRIBUTES



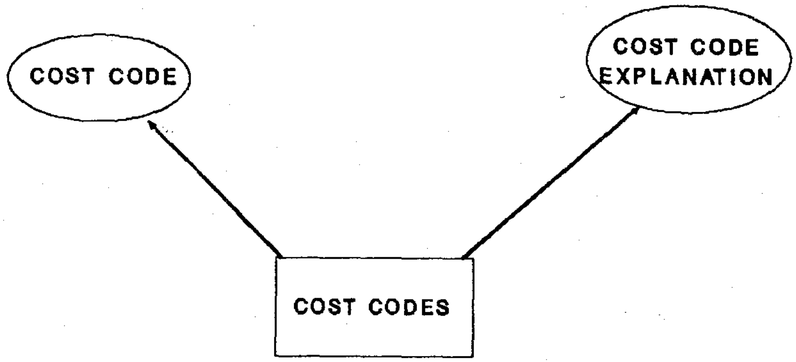


FIGURE 31: COST CODES ENTITY AND ITS ATTRIBUTES

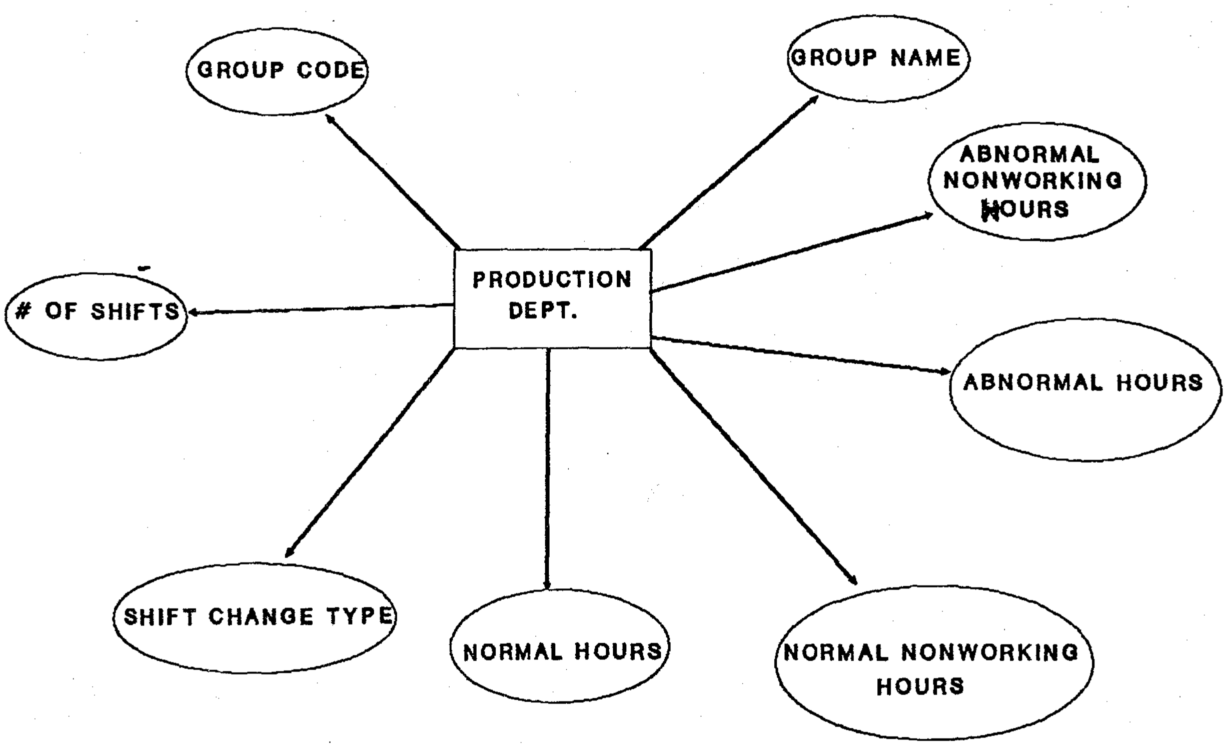


FIGURE 32: PRODUCTION DEPT ENTITY AND ITS ATTRIBUTES

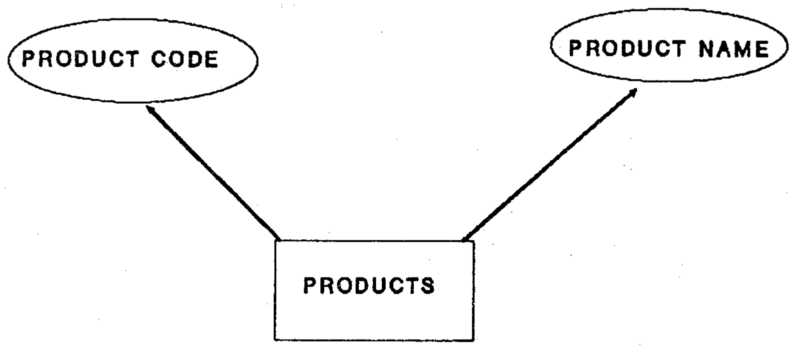


FIGURE 33: PRODUCTS ENTITY AND ITS ATTRIBUTES

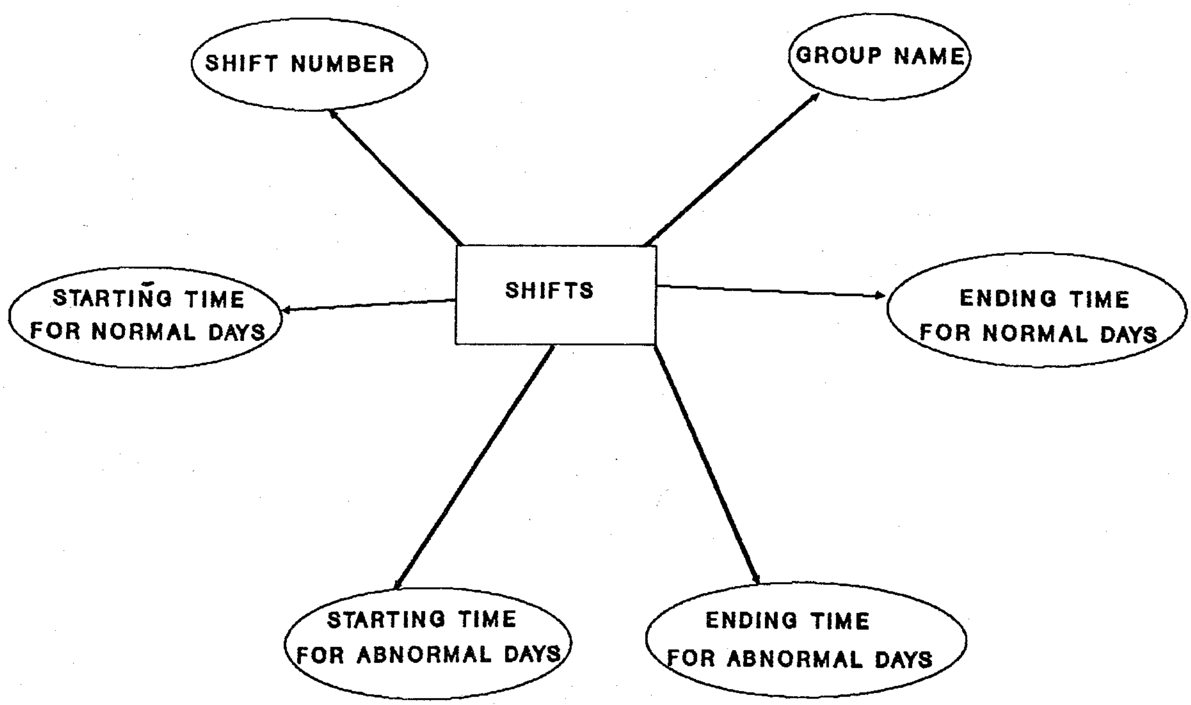


FIGURE 34: SHIFTS ENTITY AND ITS ATTRIBUTES

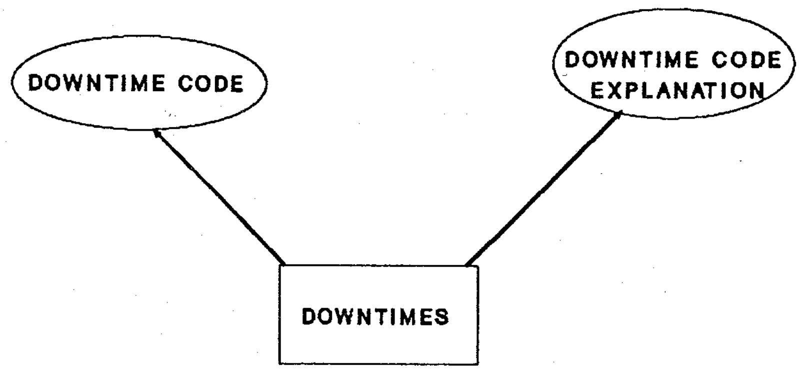
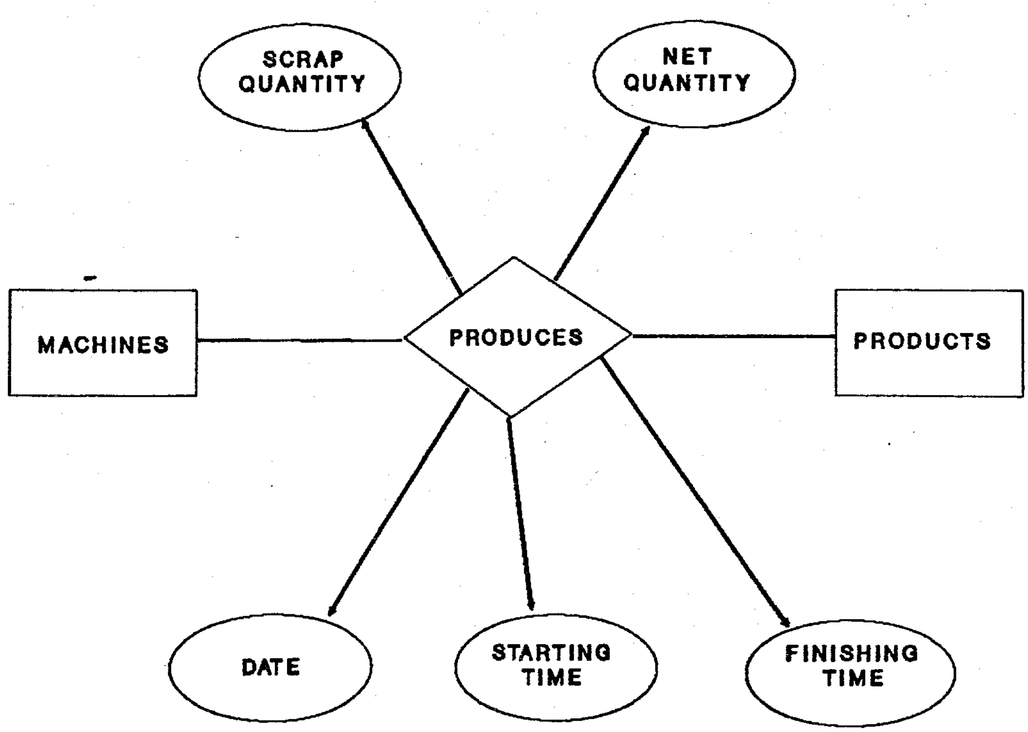


FIGURE 35: DOWNTIMES ENTITY AND ITS ATTRIBUTES



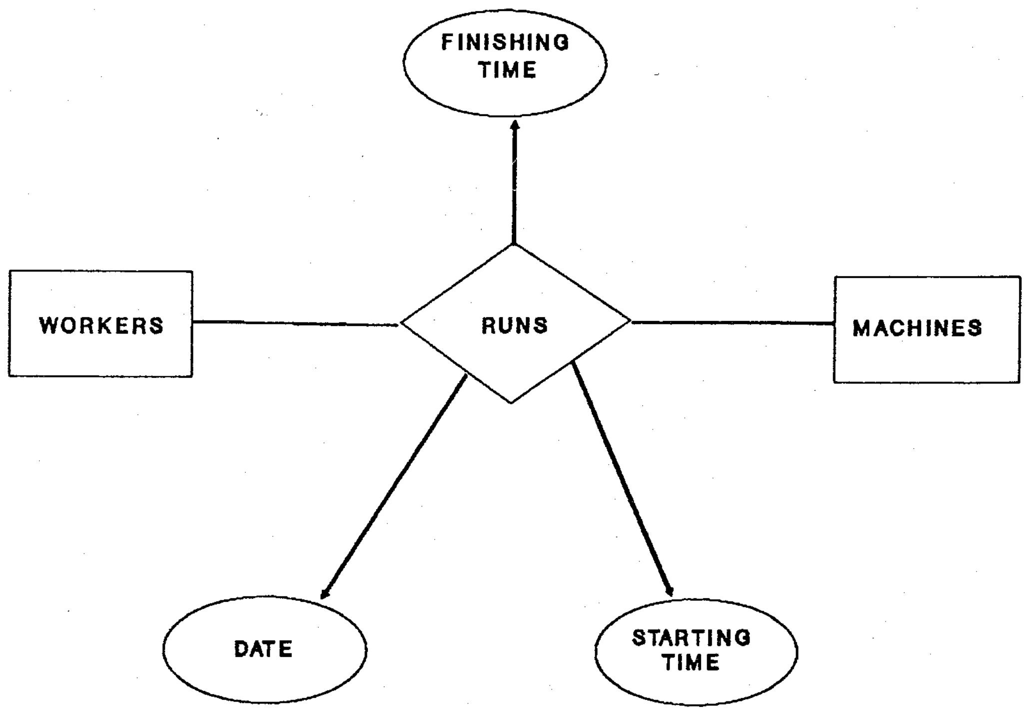


FIGURE 37: RUNS RELATIONSHIP AND ITS ATTRIBUTES

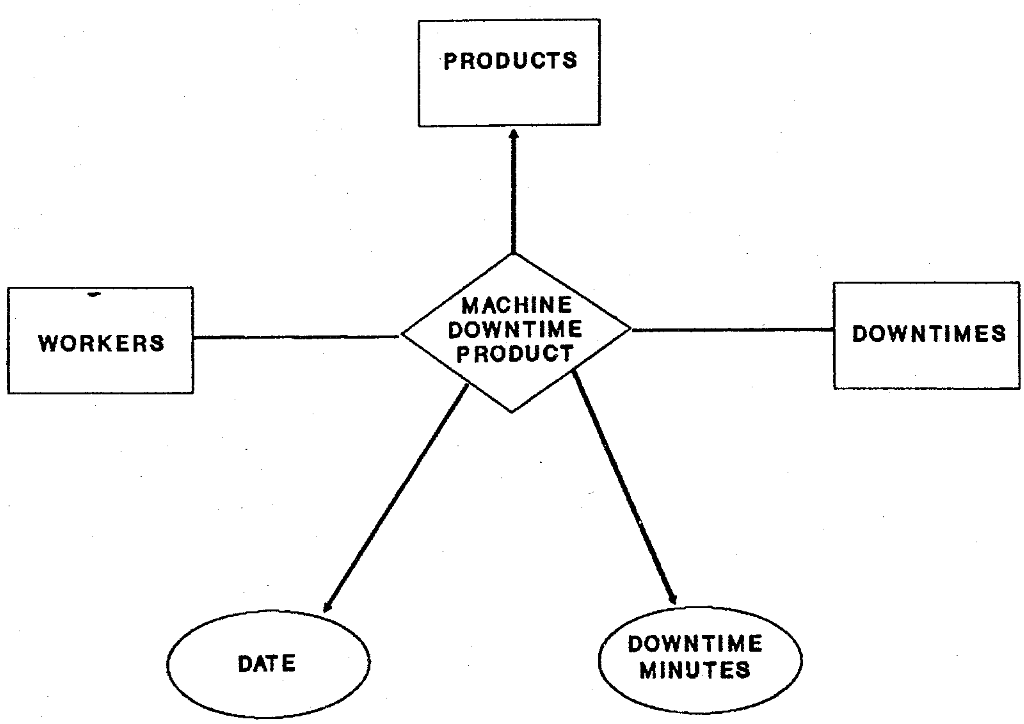


FIGURE 38: MACHINE DOWNTIME PRODUCT RELATIONSHIP AND ITS ATTRIBUTES

3.4. EXAMPLE OPERATIONS

Verified data model enables to construct data files. And processes in Appendix C are implemented using PAL (Paradox Application Language). It is ready to operate. In This section, example operations are presented and the contributions are discussed.

'Production Control Systems' contains three main categories of operations. First one is the base operations where machines, workers, shifts, products, cost accounting codes, production groups, downtime reason codes are introduced to the system (Figure 13). Second comes daily operation in which production, downtimes and labor hours are recorded (Figure 12). Reports are the last of the operations (Figure 14).

MACHINES

An example machine information is shown in figure 39. The number of machine is 14 and it is in hardening department. There are two types of products which can be hardened. One of them is GB70701 and 29760 of them are hardened in one hour. And 38809 blades are hardened in one labor hour. Cost accounting code for that job is 7221.

The system uses these standards to calculate performances of machines (**Machine Efficiency**) and performances of workers running these machines (**Productivity**). Also, It will not accept any products for the machine if it is not introduced here.

M A C H I N E I N F O R M A T I O N

CODE : *14*

PRODUCTION GROUP : *A02*◄ HARDENING

M A C H I N E S T A N D A R D S

PRODUCT CODE	STD / HOUR	STD / LABOR HOUR	COST CODE
GB70701	*29,760*	*38,809*	*7221*
GD17001	*29,760*	*38,809*	*7225*

Figure 39. Machine Information Screen

WORKERS

Workers code, name, their department and their shifts are introduced for each worker. As shown in figure 40, Sıdıka Aydın has 230 code, she is in A02 (Hardening Department) and she works in the third shift from 23:00 PM to 07:00 am.

Worker's department and his shift are the parts of production schedule. They are recommended to stay fixed for a week.

W O R K E R I N F O R M A T I O N

CODE : *230*

NAME : *SIDIKA AYDIN* ◄

DEPT. : *A02*

SHIFT : *3*

Figure 40 . Worker Information Screen

SHIFTS

Shift hours don't change very much. But 'Production Control Systems' is ready to response in such a case. Shift numbers and their beginning and ending hours are shown in figure 41. For example, second shift begins at 15:00 PM and it ends at 23:00 PM for normal days (Monday thru Friday). On Saturdays however, it begins at 12:30 PM and it ends at 18:00 PM.

Overtimes and undertimes of workers and machines are known by the help of start and end times in this screen

S H I F T   C H A N G E

CHANGE DATE	SHIFT NO	NORMAL DAY START TIME	NORMAL DAY END TIME	ABN. DAY START TIME	ABN. DAY END TIME
20.10.91	*1*	*07:00*	*15:00*	*07:00*	*12:30*
20.10.91	*2*	*15:00*	*23:00*	*12:30*	*18:00*
20.10.91	*3*	*23:00*	*07:00*	*18:00*	*23:30*
20.10.91	*4*	*08:30*	*17:30*	*08:30*	*11:30*

Figure 41 . Shift Change Screen

PRODUCTS

An example product is shown in figure 42. It is a double edge blade and its name is XXXXXXXX. It is measured in quantities.

```
         P R O D U C T   I N F O R M A T I O N
    CODE        : GB70701
    EXPLANATION : XXXXXXXX
    UNIT        : EACH
```

Figure 42 . Product Information Screen

COST ACCOUNTING CODES

An example code is shown in figure 43. 7221 means the hardening of XXXXXXXX product.

```
    C O S T   A C C O U N T I N G   C O D E S

    CODE        :  7221
    EXPLANATION :  FIRIN   XXXXXXXX
```

Figure 43 . Cost Accounting Codes Screen

PRODUCTION GROUPS

Department information is highly important for calculations. Looking at figure 44, A02 is the hardening department. And the machines work for 3 shifts in hardening. The workers change two shifts each week. For example, Sıdıka Aydın is now in the third shift, next week she will be working on the second shift not on the first one. From Monday to Friday, machines run for 480 minutes for each shift and they DON'T stop at meal breaks of workers. On Saturdays, they work 330 minutes.

```
                 P R O D U C T I O N   G R O U P S
==========================================================================
   GROUP CODE   : A02

   EXPLANATION : FIRIN
==========================================================================
   HOW MANY WORKING SHIFTS :   3
   HOW MANY SHIFT CHANGES FOR A WORKER   :   2
==========================================================================
   M E A L   H O U R S
   NORMAL WORK     :  480 MINUTES   MEAL BREAK  :  0 MINUTES
   ABNORMAL WORK   :  330 MINUTES   MEAL BREAK  :  0 MINUTES
```

Figure 44 . Production Groups Screen

DOWNTIME REASON CODES

In figure 45, it is clear that 3 means a setup of a machine. This code will be used in daily downtime entries. There can be up to 99 downtime codes.

```
        D O W N T I M E   R E A S O N S
                C O D I N G


   CODE           :      3


   EXPLANATION : SET UP
```

Figure 45 . Downtime Reasons Screen

DAILY PRODUCTION ENTRY

One of the most important operations is daily production entry. It is done for a particular shift of a particular day. Each departments machines are entered separately. In the first shift of 3.3.92, hardening machines 14,16,17 are active (Figure 46). Machine 14 produced GB70701 (XXXXXXXX) from 7:00 to 15:00. A total of 105.7 KG is the net output, 2.2 KG is lost. 2.04% of the perforated steel is lost during that operation. On the other hand, Machine 16 produced two types of products, but operator doesn't know exactly when GB70701 is produced or GD17001 is produced. So 8 hours machine time is divided into two parts in relation with their net output quantities.

For GB70701 -> 8 x 60 minutes x (68.3/(68.3+30.5))

= 331 = 5 hours 31 minutes

For GD17001 -> 8 x 60 minutes x (30.5/(68.3+30.5))

= 149 = 2 hours 29 minutes

D A I L Y P R O D U C T I O N E N T R Y 07:00-15:00

DATE : 3.03.92 SHIFT NO : 1 PRODUCTION GROUP : A02

MACHINE CODE	PRODUCT CODE	STARTING TIME	FINISHING TIME	COST CODE	NET QUANTITY	SCRAP QUANTITY
14	GB70701	07:00	15:00	7221	105.700	2.200
16	GB70701	07:00	12:31	7221	68.300	4.800
16	GD17001	12:31	15:00	7225	30.500	2.500
17◄	GD17001	07:00	15:00	7225	96.200	1.900

Figure 46. Daily Production Entry

DAILY DOWNTIME ENTRY

If a machine stops for some reason, it is recorded in daily downtime entry. It is shown that machine 14 stopped 50 minutes for the reason 3 (Setup) while producing GB70701 in the first shift of 3.3.92 (Figure 47).

These figures are used in downtime analysis. And lost times of machines can be controlled.

D A I L Y D O W N T I M E H O U R S 07:00-15:00

DATE : 3.03.92 SHIFT NO : 1 MACHINE CODE : 14

PRODUCT : GB70701 XXXXXXXX Enter downtime in MINUTES

DOWNTIME REASON	DOWNTIME MINUTES
3	50

Figure 47 . Daily Downtime Entry Screen

DAILY LABOR HOURS ENTRY

In order to find direct labor hours, machines that each worker run are entered to the system also. In figure 48, 378 - Nazmiye Eren run machine 14 from 7:00 to 15:00 at the first shift of 3.3.92 . There are other workers because information about all workers in one division of the factory are entered together at each day.

The information input here serves for the purposes of direct labor hours and productivity calculations.

It is noticed that 7013 - Kenan Baycan run three machines in the same shift. So his working time is to be divided into 3 portions. Calculation logic is as follows:

Machines and number of workers for them are listed :

Machine	No of workers
3	2
6	2
7	1

D A I L Y L A B O R H O U R S 07:00-15:00

DATE : 3.03.92 PRODUCTION GROUP : A SHIFT NO : 1

WORKER CODE	NAME	MACHINE CODE	START TIME	FINISH TIME
236◄	FATMA SERBEST	6	07:00	15:00
502	NACIYE HACIOGLU	3	07:00	15:00
7013	KENAN BAYCAN	3	07:00	09:00
7013	KENAN BAYCAN	6	09:00	11:00
7013	KENAN BAYCAN	7	11:00	15:00
378	NAZMIYE EREN	14	07:00	15:00
1662	NEBAHAT BALCI	16	07:00	15:00
1707	SEFER YILDIZ	17	07:00	15:00
1703	DURSUN POLAT	21	07:00	15:00
342	SEBILE GEMICI	26	07:00	15:00
376	GULIZAR DEMIR	55	07:00	15:00
1643	CIGDEM KURTBAS	55	07:00	15:00
409	REMZIYE YILMAZ	58	07:00	15:00
516	AYSE BILIR	58	07:00	15:00
1684	NURI SIMSEK	58	07:00	15:00
1690	HATICE MISTIN	58	07:00	15:00
1708	BILAL DALGA	59	07:00	15:00
7070	SADIK GUNAYDIN	59	07:00	09:00
7070	SADIK GUNAYDIN	60	09:00	12:00

Figure 48 . Daily Labor Hours Screen

So he spends 1/2 unit of his time in machine 3, 1/2 unit of his time in machine 6 and 1 unit of his time in machine 7. A total of 2 unit makes 8 hours. So 1/2 unit is 2 hours and 1 unit is 4 hours. And time duration from 7:00 to 15:00 is divided accordingly:

Machine	No of hours	Beginning Time	Ending Time
3	2	7:00	9:00
6	2	9:00	11:00
7	4	11:00	15:00

PRODUCTION REPORT

In figure 49 , production report shows the daily and month-to-date performance of machines in hardening process. In the previous system, there were no calculation of machine efficiencies and worker efficiencies. What the new system brings is the calculation and presentation of these production parameters. For example, One of the hardening machines is machine 14 which worked for 24 hours, it hardened 532,224 blades and 8,813 of them are lost. Remember that these numbers are not in KG but in units. 1.61% of entering perforated steel are lost in the process.

On the other hand, the production manager sees 3.38% scrap in machine 16. This seems remarkable. There seems a problem in labor hours when machine 16 did XXXXXXXX also.

Machine efficiencies are found using standard output per hour.

$$\text{Machine Efficiency} = 100 \times \frac{\text{Net Output}}{\text{Emh} \times \text{Soph}}$$

19.06.92 PRODUCTION REPORT G R O U P : A02 HARDENING Page : 1

3.03.92 (ALL SHIFTS)

MACHINE CODE	COST ACC. CODE	COST ACCOUNTING CODE EXPLANATION	MACHINE HOURS	NET PRODUCTION	SCRAP QUANTITY	SCRAP %	MACHINE EFF. %	WORKER EFF. %
14	7221	HARDENING XXXXXXXX	24:00	532,224	8,813	1.63	74.52	57.14
	TOTALS		24:00	532,224	8,813	1.63	74.52	57.14
16	7221	HARDENING XXXXXXXX	21:31	455,328	13,478	2.88	73.48	54.53
	7225	HARDENING YYYYYYYY	02:29	56,120	4,600	7.58	78.47	58.23
	TOTALS		24:00	511,448	18,078	3.38	73.99	54.91
17	7221	HARDENING XXXXXXXX	00:00					
	7225	HARDENING YYYYYYYY	24:00	557,888	9,016	1.59	80.71	59.90
	TOTALS		24:00	557,888	9,016	1.59	80.71	59.90
		DEPARTMENT TOTALS	072:00	1,601,560	35,907	2.19	76.72	57.32

END OF REPORT

Figure 49 . Production Report

Where Emh = Expected machine hours

Soph = Standard output per hour

Labor efficiencies are found using standard output per labor hours.

$$\text{Labor efficiency} = 100 \times \frac{\text{Net Output}}{\text{ALH} \times \text{SOPLH}}$$

Where ALH = Actual Labor Hours

SOPLH = Standard output per labor hours

MACHINE LIST

Machines and their standards are listed in this report. This is much like machine information entry listing.

WORKERS LIST

Workers are grouped and listed in order. Their codes, names, departments and shifts are listed.

PRODUCTION IN PHASE BASES

Daily production is summed up in this report. In figure 50, every phase's production and scrap quantities are shown.

PRODUCTION IN PHASE BASES report date : 19/06/92

DATE : 3/03/92
PRODUCT : XXXXXXXX

PRODUCTION DEPT.	NET OUTPUT	SCRAP QTY	SCRAP %
PERFORATING	467	2	.42
HARDENING	572	13	2.21
JOINING	497	9	1.80
PRINTING	515		0.00
SHARPENING	395	19	4.50

PRODUCT : YYYYYYYY

PRODUCTION DEPT.	NET OUTPUT	SCRAP QTY	SCRAP %
PERFORATING	154	1	.45
HARDENING	334	7	2.17
JOINING	304	6	1.97
PRINTING	304		0.00
SHARPENING	124	4	3.28

Figure 50 . Daily Production Report

DOWNTIME REPORT

In figure 51, one can see how much of a machine time is lost in the current day, month to date, year to date. In the report machine 16 lost 40 minutes to set up and the operator waited for material 30 minutes. And this is 3.13% of usable time of the machine.

It is possible to see all reasons together for machine 16. Looking year-to-date, it lost 7.64% of its usable time. Main reasons are 'setup' and 'no program'. It means that it is either a production management problem or the capacity of the machine is higher than it its actual use.

27.05.92

D O W N T I M E   R E P O R T

MACH CODE	DOWNTIME CODE	DOWNTIME REASON EXPLANATION	4.03.92 (ALL SHIFTS) LOST TIME HRS	MINS	%	MONTH TO DATE (10 DAYS) LOST TIME HRS	MINS	%	YEAR TO DATE (30 DAYS) LOST TIME HRS	MINS	%
16	3	SET UP		40	4.17	4	10	2.89	4	10	2.89
16	4	SUB STD MATERIAL		30	3.13		30	.35		30	.35
16	5	NO PROGRAM				5	10	3.59	5	10	3.59
16	6	MECHANICAL BREAKDOWN					20	.23		20	.23
16	7	ELECTRICAL BREAKDOWN					20	.23		20	.23
16	8	MISCELLANEOUS					30	.35		30	.35
MACHINE TOTAL			1	10	7.29	11		7.64	11		7.64
17	3	SET UP		40	2.78	3	20	1.98	9	40	2.00
17	5	NO PROGRAM							3		.62
17	6	MECHANICAL BREAKDOWN				1	40	.99	1	40	.35
17	7	ELECTRICAL BREAKDOWN							6	30	1.35
17	8	MISCELLANEOUS				1		.60	1		.21
MACHINE TOTAL				40	2.78	6		3.57	21	50	4.53

Figure 51 . Downtime Report

COST REPORT

Production quantity reconciliation is made on cost report. There were 4,956,450 opening work in process (perforated blades). 18,809,944 blades were passed from perforation in this month. 18,829,152 blades were net output whereas 360,354 blades were bad. 338170 of them are recorded. So 1.91% scrap is seen (Figure 52).

This report is extremely important in terms of finding wasted material that is not recorded as scrap. The balance of quantities doesn't hold if there are measurement errors, conversion errors or data entry errors. And this report will point them for the correction of these errors.

27.05.92 PRODUCTION QUANTITIES RECONCILIATION

Page : 1

XXXXXXXX IN KG

PROD. DEPT.	OPENING BALANCE	GROSS IN	NET OUTPUT	OTHER OUTPUT	SCRAP QUANTITY	ENDING BALANCE	INP/OUT FACTOR	
PERFORATING	0.000	6,936.400	5,471.200	0.000	1,465.200	0.000	1387	1720
HARDENING	2,071.100	5,471.200	4,350.250	.000	73.250	3,118.800	1720	1728
JOINING	27.900	4,350.250	4,301.100	.000	77.050	0.000	1728	1728
PRINTING	46.069	4,301.100	889.500	3,453.700	3.969	0.000	1728	1720
SHARPENING	499.600	889.500	1,281.390	.000	107.710	0.000	1720	1780
WASHING	138.720	1,281.390	1,419.790	.000	.320	0.000	1780	1780
FINAL	58.350	1,419.790	1,412.359	.000	65.781	0.000	1780	1780
SPUTTERING	1,093.360	1,412.359	2,556.019	-50.300	0.000	0.000	1780	1770
PROCESS	90,447.000	4,524,153.630	4,500,000.000	114,600.630	0.000	0.000	1	1
WRAPPING	3,020,350.000	4,500,000.000	766,000.000	0.000	8,350.000	6,746,000.000	1	1
DISPENSER LOAD	3,486,460.000	766,000.000	1,738,800.000	105,000.000	9,360.000	2,399,300.000	1	1

XXXXXXXX IN QUANTITIES

PROD. DEPT.	OPENING BALANCE	TRANSFER FROM PREVIOUS DEPT.	GROSS IN	NET OUTPUT	OTHER OUT.	RECORDED SCRAP	CLOSING BALANCE	SCRAP %
PERFORATING	0	9,620,787	9,620,787	9,410,464	0	210,323	0	2.186
HARDENING	3,562,292	9,410,464	12,972,756	7,517,232	0	91,188	5,364,336	.703
JOINING	48,211	7,517,232	7,565,443	7,432,301	0	133,142	0	1.765
PRINTING	79,607	7,432,301	7,511,908	1,529,940	5,940,364	41,604	0	.554
SHARPENING	859,312	1,529,940	2,389,252	2,280,874	0	108,378	0	4.536
WASHING	246,922	2,280,874	2,527,796	2,527,226	0	570	0	.023
FINAL	103,863	2,527,226	2,631,089	2,513,999	0	117,090	0	4.450
SPUTTERING	1,946,181	2,513,999	4,460,180	4,524,154	-89,031	25,057	0	.562
PROCESS	90,447	4,614,601	4,500,000	114,601	0	0	0	0.000
WRAPPING	3,020,350	4,500,000	7,520,350	766,000	0	8,350	6,746,000	.111
DISPENSER LOAD	3,486,460	766,000	4,252,460	1,738,800	105,000	9,360	2,399,300	.220

Figure 52 . Cost Report

4. CONCLUSION

4.1 KEY VARIABLES AND CONTRIBUTIONS

What PCS does is giving the information about some parameters that every production manager will be willing to get. There may be other important parameters, but PCS is giving information about the following seven parameters which come out of new system development methodologies. These parameters are :

- Expected operating time of machines
- Net output of machines
- Quantity and percentage of scrap
- Machine Efficiencies
- Productivity (Output / Labor Hour)
- Downtime hours
- Direct hours of workers

The information system created (PCS) is operating for six months. The results obtained from the system are shown statistically in order to show its impact on important production key parameters. The explanation of those are below.

The figures about important key parameters are listed in Tables 3 through 7. These show contribution points of The PCS system which provides information about production activities.

Expected operating time of machines are given in Production Report (Figure 49). Machines are not scheduled at some days and their time is not counted in the report.

Net output from machines is given in The Production Report, The Production in phase bases Report (Figure 50) and The cost Report (Figure 52). It is may be the most important parameter which is to be controlled.

Quantity of scrap is to be minimized wherever it is possible. Table 3 shows actual scrap percentages for all processes in the factory. Excluding April which have 9 working days because of the strike, scrap percentages are relatively stable but slightly increased in the six months. Assuming the entry of steel equivalent to 29,000,000 blades in one month, one percent difference in those total scrap percentages makes 290,000 blades which could be sold. That explains why the control of PCS is so important.

Machine efficiencies for each process are presented in Table 4. In general, there are remarkable increases for disposable processes (Splitting, Injection and Assemblies). There is a general tendency to use machines more efficiently. It is good and the efficiencies must be controlled day by day using Production Report.

On the other hand, worker efficiencies signal better conditions (Table 5). Average productivity for the factory is above 100% in the last month. That is the effect of headcount decreases after the strike. The PCS showed excess labor two months before the Strike. Hence, it is necessary to view Production report each day so that working schedules can be prepared more efficiently.

1) SCRAP PERCENTAGES (IN QUANTITIES)						
Processes	FEBRUAR	MARCH	APRIL	JUNE	JULY	AUGUST
Perforating	2.04	2.02	1.95	2.11	2.11	1.90
Hardening	1.11	1.30	1.32	1.60	1.31	1.75
Joining	1.60	1.69	1.62	1.57	1.35	1.26
Printing	0.38	0.34	0.45	0.48	0.47	0.48
Sharpening	4.84	3.89	3.10	3.59	5.02	5.18
Washing	0.01	0.07	0.00	0.01	0.04	0.02
Final	5.00	4.85	4.67	3.87	5.06	5.81
Sputtering	0.43	0.46	0.46	1.12	0.37	0.33
Treatment	0.01	0.01	0.00	0.56	0.00	0.12
Wrapping	0.70	0.96	0.85	0.56	0.71	0.70
Loading & Packing	0.61	1.46	0.90	0.98	0.65	0.80
Splitting	1.13	1.08	0.90	1.34	1.09	1.41
Injection	0.00	0.00	0.00	0.00	0.00	0.00
Handle Assembly	1.25	1.05	0.91	0.98	0.61	0.77
Cartridge Assembly	4.05	3.75	3.11	3.80	3.79	4.61
TOTAL FOR DOUBLE EDG	15.66	15.89	14.39	15.34	15.97	17.07
TOTAL FOR DISPOSABLE	6.32	5.79	4.86	6.02	5.42	6.68

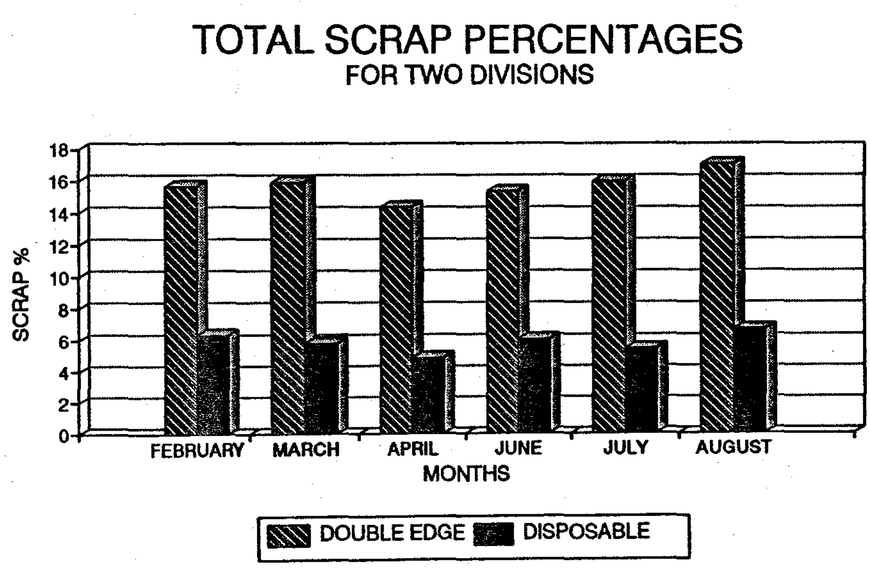


TABLE 3. CHANGES IN SCRAP PERCENTAGES FOR THE PREVIOUS SIX MONTH

2) MACHINE EFFICIENCIES (IN %)						
Processes	FEBRUAR	MARCH	APRIL	JUNE	JULY	AUGUST
Perforating	77	76	72	77	74	80
Hardening	78	75	78	74	78	79
Joining	64	52	47	61	52	53
Printing	61	51	47	61	52	53
Sharpening	87	81	71	87	105	110
Washing	63	54	53	51	50	52
Sputtering	92	78	74	81	83	83
Treatment	90	72	73	82	88	87
Wrapping	83	78	82	86	80	80
Loading & Packing	86	90	77	79	100	100
Splitting	42	38	33	57	65	78
Injection	88	86	84	84	89	89
Handle Assembly	46	42	37	63	78	88
Cartridge Assembly	48	44	39	65	76	78
Final	NA	NA	NA	NA	NA	NA
AVERAGE	72	66	62	72	76	79

AVERAGE OF MACHINE EFFICIENCIES
FOR ALL MACHINES

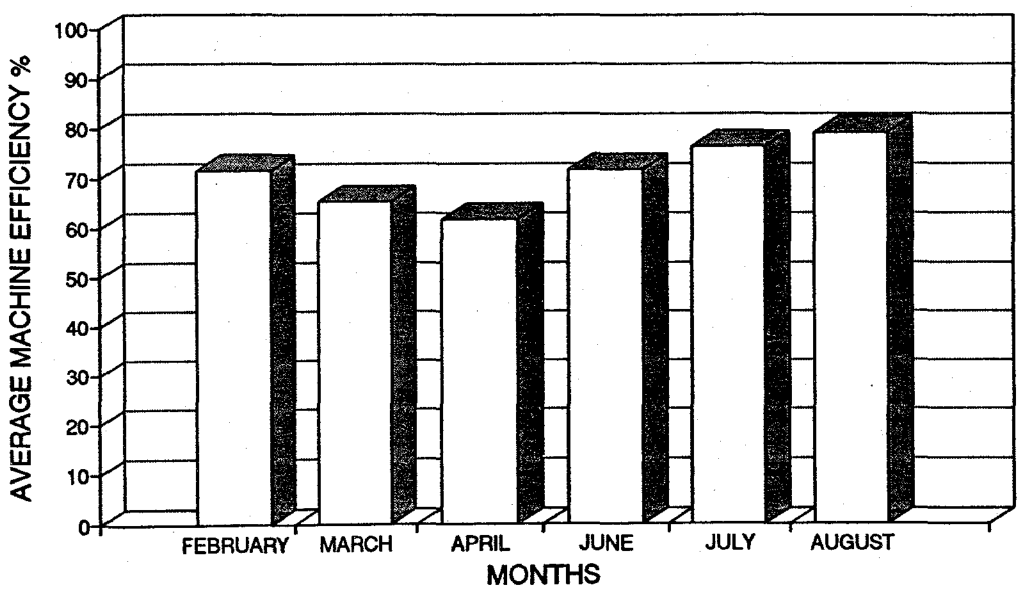


TABLE 4. CHANGES IN MACHINE EFFICIENCIES FOR THE PREVIOUS SIX MONT

Total labor hours for double edge processes decreased whereas more labor hours are realized for disposable processes (Table 6).

Downtimes are collected throughout six months and table 7 is prepared out of that data. It seems that downtime reporting is not healthy for disposable processes. On the other hand, a visible decrease is shown for double edge processes. This is good because indirect hours of direct workers decrease in relation to that. The PCS gives that information separately in the Downtime report (Figure 51).

Although there may be general improvements in production operations, the effect of the new MIS system on these production parameters can not be denied. Furthermore, it can generally be said that the new MIS system contributes to the management of production operations in a favorably way.

3) WORKER EFFICIENCIES (IN %)						
Processes	FEBRUAR	MARCH	APRIL	JUNE	JULY	AUGUST
Perforating	62	44	34	61	68	119
Hardening	48	39	34	45	58	67
Joining	86	77	84	89	126	136
Printing	75	61	57	73	63	69
Sharpening	89	71	74	82	84	99
Washing	55	61	52	43	95	129
Sputtering	99	71	80	87	112	187
Treatment	100	75	76	71	79	157
Wrapping	57	42	54	62	73	58
Loading & Packing	107	118	89	95	117	105
Splitting	NA	23	22	45	54	68
Injection	NA	55	42	62	106	112
Handle Assembly	NA	60	42	76	106	125
Cartridge Assembly	NA	77	53	101	126	133
Final	NA	20	20	23	21	NA
AVERAGE	78	62	57	71	91	112

AVERAGE OF WORKER EFFICIENCIES
FOR ALL PROCESSES

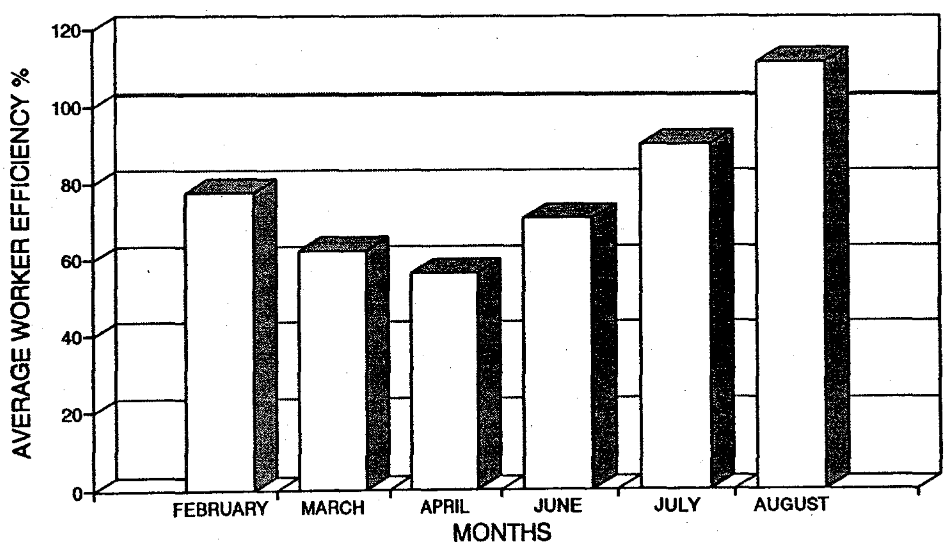


TABLE 5. CHANGES IN PRODUCTIVITIES FOR THE PREVIOUS SIX MONTHS

4) TOTAL LABOR HOURS						
Processes	FEBRUAR	MARCH	APRIL	JUNE	JULY	AUGUST
Perforating	1,724	1,637	410	995	1,058	585
Hardening	1,340	1,233	383	708	723	618
Joining	638	696	172	406	372	343
Printing	479	438	129	246	371	335
Sharpening	3,113	3,083	1,004	1,579	2,185	1,852
Washing	1,057	746	295	582	404	294
Final	0	1,693	612	933	833	589
Sputtering	2,038	2,155	637	799	1,259	674
Treatment	1,915	1,982	649	824	938	773
Wrapping	1,223	1,107	581	851	400	0
Loading & Packing	3,423	2,543	2,160	2,866	1,683	0
Splitting	NA	605	199	257	442	416
Injection	NA	4,028	1,826	2,304	2,363	2,158
Handle Assembly	NA	14,605	7,247	9,106	14,040	14,413
Cartridge Assembly	NA	6,701	3,340	4,084	7,022	7,901
TOTAL FOR DOUBLE EDG	16,949	17,313	7,029	10,788	10,225	6,062
TOTAL FOR DISPOSABLE	0	25,939	12,612	15,751	23,868	24,887
TOTAL FOR THE FACTOR	16,949	43,252	19,641	26,539	34,092	30,949

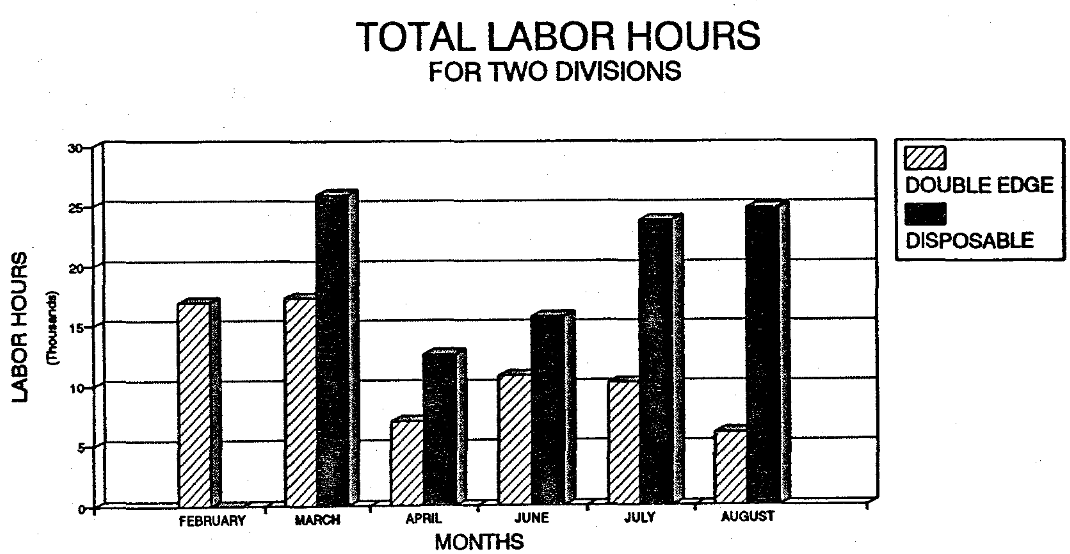


TABLE 6. CHANGES IN TOTAL LABOR HOURS FOR THE PREVIOUS SIX MONTHS

5) DOWNTIME PERCENTAGES OF MACHINES						
Processes	FEBRUAR	MARCH	APRIL	JUNE	JULY	AUGUST
Perforating	3.14	5.27	5.91	5.92	8.64	2.29
Hardening	3.32	6.91	3.41	6.59	2.60	1.75
Joining	30.73	41.83	46.86	35.06	31.76	26.65
Printing	34.40	47.86	47.13	33.26	41.05	30.62
Sharpening	8.09	7.41	13.10	12.54	4.84	4.11
Washing	36.52	44.14	49.36	46.23	28.30	16.22
Sputtering	6.68	15.53	18.75	10.37	7.50	6.42
Treatment	7.47	30.91	32.40	24.18	5.65	3.41
Wrapping	10.18	10.45	4.93	7.38	17.46	NA
Loading & Packing	11.60	2.76	15.10	14.08	6.51	NA
Splitting	NA	0.00	NA	0.00	0.00	0.00
Injection	NA	0.46	3.16	0.37	2.93	0.00
Handle Assembly	NA	0.17	1.23	0.00	0.00	0.00
Cartridge Assembly	NA	1.67	0.76	3.78	1.65	0.00
Final	NA	0.00	2.60	NA	0.00	0.00
AVERAGE FOR DOUBLE EDGE	15.21	21.31	23.70	19.56	15.43	11.43
AVERAGE FOR DISPOSABLE	0.00	0.46	1.94	1.04	0.92	0.00

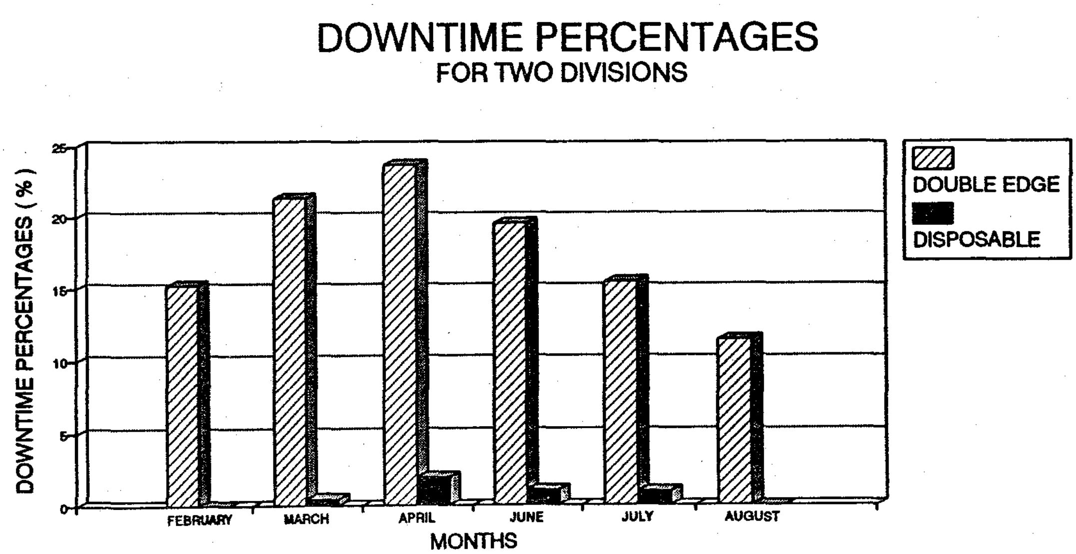


TABLE 7. CHANGES IN DOWNTIME PERCENTAGES FOR THE PREVIOUS SIX MO

The PCS system is now holding nearly 34,000 daily labor data, 16,000 daily production data and 4000 daily downtime data. In the last six months, it acted as a fast response standard reporting system and the data is also reached for statistical purposes in management reports and presentations. It reduced clerical work of production managers and provided them much time in the control process. It also provided an easy way of the management of production information. Because of all these reasons, a little resistance has been shown by the potential users. However, it has been accepted as the main application used in the production control department.Also, computer technology is introduced to the factory via this system. It is presented in Africa Middle East and Eastern Europe Group factory managers conference and drew attention from other factories also.

Classical steps of systems development are followed in this study. Preliminary investigation begins with the factory managers request about a new system. Several meetings are held with related production people. Weaknesses and strengths of the current system are determined and data flow diagrams of the current system is prepared. A new system which will provide necessary information about important production variables is proposed.

The proposed system is explained by a data flow diagram and a data dictionary. All features of the system are clearly stated in these systems development tools. On the other hand, a data model is created to show databases in the system. Data stores in the data flow diagrams are matched with databases in the data model to resolve any conflicts before software preparation. After then, a database package is used in writing the necessary software to accomplish processes in the new system. Lastly, the new system is tested by running it parallel with the current system.

Maintenance of the system will be done for the following years. Because the system is developed using the structured methods, it will be easy to maintain and further enhancements will surely be needed. The requirements may in two directions. The users may wish to create their own reporting system or they want to control other production variables not included in the developed system (e.g. reasons of machine scrap).Besides the parameters followed by the new system, there are other production parameters such as indirect labor, spare parts, supplies, utilities, quality control labor. Some of these will be controlled by Fourthshift system and they will be working together with the PCS system in production management. The gateways to other systems like Fourth Shift will also be available. Data export and import utilities may be developed. These efforts would contribute to the integration of the business. And the contributions of the PCS system will be more clear and measurable when the company has an integrated system of operations management.

One other advancement may be adding features necessary for production planning like estimates about production variables and preparation of following months schedules. It is closely related to creating an MIS system for production planning and it may be a completely new system which will be integrated to the PCS system.

Future enhancements will be the result of new requirements of the production staff. And these requirements will be easily met because of the environment created by the PCS.

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APPENDIX A . DATA DICTIONARY FOR THE CURRENT SYSTEM

DATA FLOWS

DATA FLOW NAME :Production Package
DESCRIPTION : Daily entering materials, net production, scrap produced for each coil in each machine.
FROM PROCESSES : Directly from machines
TO PROCESSES : 1.0 Calculate Total Prod and Scrap
3.0 Compare actual vs standards
DATA STRUCTURES : Production Package
- Machine information
- Operator information
- Production date, time
- Coil information
- Entering Material
- Net Quantity Produced
- Scrap Quantity
- Reason for scrap

DATA FLOW NAME : Work Hours
DESCRIPTION : Daily actual working hours for each worker
FROM PROCESSES : Directly from machines
TO PROCESSES : 3.0 Compare actual vs standards
DATA STRUCTURES : Work hours
- Workers daily attendance
- Machine he worked

DATA FLOW NAME :Rates
DESCRIPTION : Conversion rates for different product units
FROM PROCESSES :
TO PROCESSES : 1.0 Calculate Total Prod and Scrap
DATA STRUCTURES : Conversion rates
- KG to quantity conversion
- Shipper to quantity conversion

DATA FLOW NAME :Daily Production
DESCRIPTION : Daily total production and scrap quantities for each phase of production
FROM PROCESSES : 1.0 Calculate Total Prod and Scrap
TO PROCESSES : 4.0 Create cost report
2.0 Set standards
DATA STRUCTURES : Daily production
- Phase information
- Incoming material, net output, scrap quantities and work in process for each phase

---

DATA FLOW NAME :Monthly Package
DESCRIPTION : Monthly total production and scrap quantities for each phase of production
FROM PROCESSES : 4.0 Create cost report
TO PROCESSES :
DATA STRUCTURES : Monthly Package
- Phase information
- Incoming material, net output, scrap quantities and work in process for each phase

---

DATA FLOW NAME :Budget Figures for Production
DESCRIPTION : Monthly total production for each product
FROM PROCESSES :
TO PROCESSES : 2.0 Set Standards
DATA STRUCTURES : Production Quantity in Budget

DATA FLOW NAME :Standards
DESCRIPTION : Standards for production, scrap for each machine and standard working hours for each worker
FROM PROCESSES : 2.0 Set Standards
TO PROCESSES : 2.0 Set Standards
3.0 Compare actual versus standards
DATA STRUCTURES : Standards
- Products produced for each machine
- Standard production and scrap for each m/c
- Standard labor hours for each m/c

DATA FLOW NAME :Efficiencies
DESCRIPTION : Comparison results in percentage , machine efficiency and scrap percentages
FROM PROCESSES : 3.0 Compare actual versus standards
TO PROCESSES :
DATA STRUCTURES : Efficiencies
- Machine efficiency
- Scrap percentage for each machine

DATA FLOW NAME :Historical Production
DESCRIPTION : Accumulated production data for each phase of production
FROM PROCESSES : 2.0 Set standards
2.1 Evaluate past data
TO PROCESSES :
DATA STRUCTURES : Historical Production
- Date
- Production group
- Input quantity
- Output quantity
- Scrap quantity
- Scrap percentage

DATA FLOW NAME :Historical Production per M/C
DESCRIPTION : Actual Production accumulated through years
FROM PROCESSES : 2.1 Evaluate past data
TO PROCESSES :
DATA STRUCTURES :Machine Standards
- Output per minute for each machine

DATA FLOW NAME :Historical Scrap per M/C
DESCRIPTION : Actual scrap percentage through years
FROM PROCESSES : 2.1 Evaluate past data
TO PROCESSES :
DATA STRUCTURES :Scrap Percentages for each phase

DATA FLOW NAME :Historical Machine Worker Assignments
DESCRIPTION : Actual worker - machine assignments
FROM PROCESSES : 2.1 Evaluate past data
TO PROCESSES :
DATA STRUCTURES :Standards for man/machine ratio

DATA FLOW NAME :Standard scrap %
DESCRIPTION : Percentage that is derived by either statistical data or measurements.
FROM PROCESSES :
TO PROCESSES : 3.2 Compare scrap with standards
DATA STRUCTURES :Standard scrap %

DATA FLOW NAME :Standard Production
DESCRIPTION : Production that is derived by either statistical data or measurements.
FROM PROCESSES :
TO PROCESSES : 3.2 Compare production with standards
DATA STRUCTURES :Standard production

DATA FLOW NAME :Machine Efficiency
DESCRIPTION : Comparison between ideal production figures and actual production
FROM PROCESSES : 3.2 Compare production with standards
TO PROCESSES :
DATA STRUCTURES :Machine Efficiency

DATA FLOW NAME :Scrap Variance
DESCRIPTION : Comparison between ideal scrap figures and actual scrap
FROM PROCESSES : 3.2 Compare scrap with standards
TO PROCESSES :
DATA STRUCTURES :Scrap Comparison result

DATA FLOW NAME : Budget Variance
DESCRIPTION : Comparison between budget production figures and actual production
FROM PROCESSES : 3.2 Compare production with budget
TO PROCESSES :
DATA STRUCTURES : Budget Variance

DATA FLOW NAME : Predefined schedule
DESCRIPTION : Weekly working program
FROM PROCESSES :
TO PROCESSES : 3.4 Compare working hours
DATA STRUCTURES : Weekly Program
- Each Workers shift and department

DATA FLOW NAME : Work In Process
DESCRIPTION : Daily semi-finished goods quantities in each phase of production
FROM PROCESSES : Directly from machines
TO PROCESSES : 0. Production control
4.0 Create Cost Report
4.1 Quantities Balance
DATA STRUCTURES : WIP
- Date
- Production Group
- Product
- Quantity Left

DATA FLOW NAME : Revised Standards
DESCRIPTION : Revised Standards for production, scrap for each machine and standard working hours for each worker
FROM PROCESSES : 2.0 Set Standards
TO PROCESSES :
DATA STRUCTURES : Revised Standards
- Products produced for each machine
- Standard production and scrap for each m/c
- Standard labor hours for each m/c

DATA FLOW NAME : Monthly Summary
DESCRIPTION : Daily total prod & scrap quantities for each phase of production.
FROM PROCESSES : 4.0 Create Cost Report
TO PROCESSES : 4.0 Create Cost Report
DATA STRUCTURES : Monthly Summary
- Date
- Production Group
- Input, output quantities, scrap, and WIP for each phase

DATA FLOW NAME :Measured Production
DESCRIPTION : Physically counted production quantity in a minute for a machine
FROM PROCESSES : 2.2 Measure
TO PROCESSES :
DATA STRUCTURES :Measured production
- Machine number
- Output per minute

DATA FLOW NAME :Measured Scrap
DESCRIPTION : Physically counted scrap quantity for a machine in a period of time
FROM PROCESSES : 2.2 Measure
TO PROCESSES :
DATA STRUCTURES :Measured Scrap
- Machine number
- Scrap Quantity in a period

DATA FLOW NAME :Actual Production Data
DESCRIPTION : Actual Net production quantities for each a machine in a period of time
FROM PROCESSES :
TO PROCESSES : 3.1 Compare Production with Budget
3.3 Compare Production with Standards
DATA STRUCTURES :Actual Production
- Date
- Machine number
- Net output produced

DATA FLOW NAME :Actual Scrap
DESCRIPTION : Actual Scrap quantities for each machine
FROM PROCESSES :
TO PROCESSES : 3.2 Compare Scrap with Standards
DATA STRUCTURES :Actual Production
- Date
- Machine number
- Scrap quantity

DATA FLOW NAME :Worker effectiveness
DESCRIPTION : How much did a worker follow the schedule
FROM PROCESSES :
TO PROCESSES : 3.4 Compare working hours
DATA STRUCTURES :Worker effectiveness
- Date
- Worker code
- attendance percentage

DATA FLOW NAME :Summarized Daily Production
DESCRIPTION : Daily totals for each quantity (Input,Output,Scrap,WIP)

FROM PROCESSES : 4.1 Quantities Balance
TO PROCESSES : 4.2 Add daily figures to monthly sheets
DATA STRUCTURES : Summarized Daily Prod
- Date
- Production Group
- Input Quantity
- Output Quantity
- Scrap Quantity

DATA STORES

DATA STORE : Daily Labor Hours
DESCRIPTION : Actual working hours of workers
INBOUND DATA FLOWS : Work Hours
OUTBOUND DATA FLOWS : Work Hours
DATA DESCRIPTION : Worker code
Workers department
Beginning and ending times for specific shift
VOLUME : Daily 400, decreasing Saturdays
ACCESS : Accessed once each day

DATA STORE : Daily Machine Production
DESCRIPTION : Actual production of machines
INBOUND DATA FLOWS : Production Package
OUTBOUND DATA FLOWS : Production Package
DATA DESCRIPTION : Production Date, shift
Coil numbers
Entering coil quantities to the machine
Net output from that coil
Scrap measured
[Reason of scrap]
VOLUME : Daily 400, decreasing Saturdays
ACCESS : Accessed once each day

DATA STORE : Conversion Rates
DESCRIPTION : Kg to Quantity conversion rates for each phase of production
Shipper to quantity conversion for each product
INBOUND DATA FLOWS :
OUTBOUND DATA FLOWS : Rates
DATA DESCRIPTION : Production phase
Product code
Conversion rate
VOLUME : Maximum of 250
ACCESS : Accessed each day for calculations

DATA STORE : Monthly Production

DESCRIPTION : Monthly production quantities for each phase for each product
INBOUND DATA FLOWS :Monthly Package
OUTBOUND DATA FLOWS : Monthly Summary
DATA DESCRIPTION : Entering materials for each phase
Total net output for each phase
Total recorded scrap for each phase
Total WIP for each phase
VOLUME : 25 for each month
ACCESS : Accessed monthly for reporting, revised each day

DATA STORE : Standards
DESCRIPTION : Standards for production per machine, scrap percentage for a phase, standard work hours, budgeted production
INBOUND DATA FLOWS :2.0 Set Standards
OUTBOUND DATA FLOWS : 2.0 Set Standards
3.0 Compare actual vs standards
DATA DESCRIPTION : Standard machine output per hour
Standard scrap % for each phase
Standard schedule of workers
Budget production quantities
VOLUME : 150 for machines, 400 for workers, max 250 for scraps
ACCESS : This can be accessed everytime , revised not frequently

---

DATA STORE : Daily Production
DESCRIPTION : Daily Machine Production which pass through calculation process
INBOUND DATA FLOWS :1.0 Calculate Total Prod and Scrap
OUTBOUND DATA FLOWS : 4.0 Create cost report
2.0 Set standards
DATA DESCRIPTION : Date
Total entering material for each phase
Total net output for each phase
Total recorded scrap for each phase
Total WIP for each phase
Total scrap % for each phase
VOLUME : 1 for each product daily
ACCESS : Accessed each day

DATA STORE : Standards for man/machine ratio
DESCRIPTION : Man/machine ratio for each phase of production
INBOUND DATA FLOWS :2.1 Evaluate past data
OUTBOUND DATA FLOWS : 3.4 Compare working hours
DATA DESCRIPTION : Production phase

	Man/machine ratio for the machine in that phase
VOLUME :	150, doesn't grow
ACCESS :	Accessed each day

DATA STORE :	Standards for scrap
DESCRIPTION :	Standard scrap % for each phase of production
INBOUND DATA FLOWS :	2.1 Evaluate past data
OUTBOUND DATA FLOWS :	3.2 Compare scrap with standards
DATA DESCRIPTION :	Production phase and product name Scrap % for that phase
VOLUME :	250, doesn't grow
ACCESS :	Accessed each day

DATA STORE :	Standards for production per machine
DESCRIPTION :	Standard hourly production for each machine
INBOUND DATA FLOWS :	2.1 Evaluate past data
OUTBOUND DATA FLOWS :	3.3 Compare production with standards
DATA DESCRIPTION :	Machine code Scrap output in hours
VOLUME :	150, doesn't grow
ACCESS :	Accessed each day

DATA STORE :	Budgeted Production Figures
DESCRIPTION :	Production quantities decided outside of Production Department
INBOUND DATA FLOWS :	
OUTBOUND DATA FLOWS :	3.1 Compare budget production with actual production
DATA DESCRIPTION :	Product name Output needed per period
VOLUME :	10, doesn't grow
ACCESS :	Accessed each day

DATA STORE :	Predefined Working Hours
DESCRIPTION :	Schedule of working hours for a week
INBOUND DATA FLOWS :	
OUTBOUND DATA FLOWS :	3.4 Compare working hours
DATA DESCRIPTION :	Workers name Workers department Workers shift for that week
VOLUME :	400, for each week
ACCESS :	Accessed each day, revised at the beginning of week

DATA STORE :	Work In Process
DESCRIPTION :	Work In Process for each process

for each day
INBOUND DATA FLOWS :
OUTBOUND DATA FLOWS : 4.1 Quantities Balance
DATA DESCRIPTION : Date
Prod group
Product Code
WIP Quantity
VOLUME : 40 , for each day
ACCESS : Accessed each day for balancing

PROCESSES

PROCESS NAME : Calculate total production and scrap
DESCRIPTION : Raw production data is added and daily production and scrap quantities are found.
INPUT : Daily Machine Production
Conversion rates
OUTPUT : Daily Production
LOGIC SUMMARY : Add entering material quantities for each shift
Add output quantities for each shift
Add scrap quantities for each shift
Calculate scrap % for each shift

PROCESS NAME : Set Standards
DESCRIPTION : Standards are set according to machine specialities , historical data, budget figures
INPUT : Historical production
Budget Figures for Production
OUTPUT : Standards
LOGIC SUMMARY : Get budget production figures
Measure a sample machines performance in minutes
View scrap percentages through months

PROCESS NAME : Compare actual versus standards
DESCRIPTION : Actual production, scrap quantities and man-machine assignments are compared against standard values.
INPUT : Work Hours
Prod package
Standards
OUTPUT : Efficiencies
LOGIC SUMMARY : Standards are already available
Daily figures for production, scrap for each phase of production and actual labor hours are examined and variances are given to management

---

PROCESS NAME : Add quantities , calculate percentages
DESCRIPTION : Daily production forms are processed

such that all entering material quantity, net output and scrap quantity are added for each machine, scrap percentages are calculated.

INPUT : Daily machine production
OUTPUT : Production package
LOGIC SUMMARY : Add quantities manually, calculate scrap percentages, Check whether any specific machine has problems. If so, warn supervisor about those

---

PROCESS NAME : Add all M/C forms to daily production forms
DESCRIPTION : Summarize all daily production in one page
INPUT : Daily machine production
OUTPUT : Production package
LOGIC SUMMARY : Summarize totals for all machines in a page

PROCESS NAME : Evaluate past data
DESCRIPTION : Statistical production data is used to have standards for man/machine ratio, scrap percentage and net production
INPUT : Historical production
OUTPUT : Historical man-machine assignments
Historical scrap percentages
Historical production per machine
LOGIC SUMMARY : Past data accumulated through years creates production standards

---

PROCESS NAME : Compare production with budget
DESCRIPTION : Actual production quantities for each product are compared with budget quantities from cost Dept
INPUT : Actual production
Budget Figures for Production
OUTPUT : Budget variance
LOGIC SUMMARY : Budget facts are known by the beginning of the fiscal year, Existent production is compared with those and variances are determined

---

PROCESS NAME : Compare scrap with standards
DESCRIPTION : Actual scrap percentages for all phases of production are compared with scrap standards
INPUT : Actual scrap
Scrap standard percentages
OUTPUT : Comparison result
LOGIC SUMMARY : Standard scrap percentages are known through years, Actual scrap for each phase is compared with those. In case of high scrap, machine supervisor controls what is wrong with the machine.

PROCESS NAME : Compare production with standards
DESCRIPTION : Actual net production for all phases of production are compared with standards
INPUT : Actual production
Scrap production

OUTPUT : Machine efficiency
LOGIC SUMMARY : Standard production is derived by two ways : by statistically and by measuring physically. And actual daily net production is compared with those.

PROCESS NAME : Compare labor hours
DESCRIPTION : Labor hours are compared both to predefined job program and to man-machine ratios.
INPUT : Standards for Man/machine ratio
Daily labor hours
Predefined Working Hours
OUTPUT : Worker efficiency
LOGIC SUMMARY : Labor hours are decided at the beginning of a week. And man/machine ratios are known by the beginning of the year. Actual labor hours are controlled and worker effectiveness is found

---

PROCESS NAME : Add daily figures to monthly sheets
DESCRIPTION : In order to prepare monthly report, daily production are compiled on monthly sheets.
INPUT : Actual daily production
OUTPUT : Monthly package
LOGIC SUMMARY : A sheet containing all days of a month as rows and all production phases as columns filled up each day using daily production package.

PROCESS NAME : Create Cost Report
DESCRIPTION : A summary of monthly sheet is taken to a one page report. It shows each phase's reconciliation
INPUT : Monthly Summary
OUTPUT : Monthly Package
LOGIC SUMMARY : For each phase of production, pass total quantity input, output, scrap, beginning WIP, and ending WIP to one line of a report. If they balances , it is OK Otherwise search for possible reasons
- Check whether previous stages balances
- Check net output
- Check WIP quantity
- Check Scrap quantity

PROCESS NAME : Measure
DESCRIPTION : Physical Measurement of Production & Scrap
INPUT :
OUTPUT : Measured Production
Measured Scrap
LOGIC SUMMARY : Pass one bunch of material after weighing from a machine and give one minute. After then count actually produced quantity and scrap quantity. Repeat these for various quantities and reach to reasonable values for that machines standards

---

PROCESS NAME : Quantity Balance

DESCRIPTION :	Balance quantities for each phase
INPUT :	WIP
	Daily Production
OUTPUT :	Summarized daily production
LOGIC SUMMARY :	Beginning WIP + Input Material -Net output - Scrap = Ending WIP The above equality is tested for each phase of production. If It is OK then pass it to monthly sheets else search for reasons.

APPENDIX B . DATA DICTIONARY FOR THE PROPOSED SYSTEM

DATA FLOWS

DATA FLOW NAME : Daily Machine Production
DESCRIPTION : Actual machine production and scrap figures for a machine and operators of the machine.
FROM PROCESSES : External entity Machines
TO PROCESSES : 1.0 Daily Entry
1.1 Daily Production Entry and Control
1.2 Daily Downtime Entry and Control
1.3 Daily Labor Work Entry and Control
1.1.1 Get Date, Shift, Prod Department
1.2.1 Get Date, Shift, M/C No
1.3.1 Accept Date, Shift, Prod Department
DATA STRUCTURES: Production Details
Downtime Details
Labor Hours Details

DATA FLOW NAME : Yearly Summary
DESCRIPTION : Performance of the machines, in terms of scrap, net quantity and labor efficiencies totaled from the beginning of the year.
FROM PROCESSES : 3.0 Reports
3.1 Daily + Monthly Report and Yearly Summary
3.1.3 Report on Chosen media
TO PROCESSES : External entity Production Management
DATA STRUCTURES: Total Hours
Total Production & Scrap
Efficiencies

DATA FLOW NAME : Monthly + Daily Production
DESCRIPTION : Performance of the machines in terms of Scrap, net quantity & labor efficiency totaled daily + monthly
FROM PROCESSES : 3.0 Reports
3.1 Daily + Monthly Report and Yearly Summary
3.1.3 Report on Chosen media
TO PROCESSES : External entity Production Management
DATA STRUCTURES: Total running hours of a machine
Total Production & Scrap for a machine
Efficiencies for a machine

DATA FLOW NAME : Cost Report
DESCRIPTION : Reconciled quantity tables for each product beginning ending WIP for phases.
FROM : 3.0 Reports
3.2 Cost Report
3.2.2 Summarize Production and WIP
TO : External entity Cost Department

DATA STRUCTURES: Input and Output for each phase phase
WIP for each phase

DATA FLOW NAME : Cost Codes
DESCRIPTION : Cost accounting codes given by cost department.
FROM PROCESSES : External entity Cost Department
2.0 Master Data Entry
Cost Codes (Data Store)
TO PROCESSES : 2.0 Master Data Entry
2.1 Machine Entry
2.1.2 Get Standards
3.0 Reports
3.1 Daily + Monthly Report and Yearly Summary
3.1.3 Report on Chosen media
DATA STRUCTURES: Cost Codes

DATA FLOW NAME : Workers
DESCRIPTION : Worker codes, names, departments and shifts they work.
FROM PROCESSES : External entity Personnel Department
2.0 Master Data Entry
2.2 Workers Entry
2.2.2 Control Production Dept and Shift
Workers (Data Store)
2.2.1 Get Workers name, dept, shift
TO PROCESSES : 1.3 Daily Labor Work Entry and Control
1.3.2 Find Workers in a Shift
2.2 Workers Entry
2.2.2 Control Production Dept and Shift
3.5 Workers List
3.5.2 Filter Workers
Workers (Data Store)
DATA STRUCTURES: Worker Details

DATA FLOW NAME : Products
DESCRIPTION : Product Code, Name
FROM PROCESSES : External entity Materials Department
2.0 Master Data Entry
Products (Data Store)
TO PROCESSES : 2.0 Master Data Entry
2.1 Machine Entry
2.1.2 Get Standards
Products (Data Store)
1.0 Daily Entry
1.1 Daily Production Entry and Control
1.1.3 Accept Production and scrap data
1.4 Daily WIP entry and control
1.4.2 Balancing
3.0 Reports

3.3 Daily Production in Phase Base
3.3.2 Report Daily Data on Department Basis
DATA STRUCTURES: Product Code and name

DATA FLOW NAME : Machines
DESCRIPTION : Machine Code and Department
FROM PROCESSES : 2.0 Master Data Entry
2.1 Machine Entry
Machines (Data Store)
TO PROCESSES : Machines (Data Store)
1.0 Daily Entry
1.1 Daily Production Entry and Control
1.1.2 Find Machine Set and Standards
1.2 Daily Downtime Entry and Control
1.2.1 Get Date, Shift, M/C No
3.0 Reports
3.1 Daily + Monthly Report and Yearly Summary
3.1.3 Report on Chosen media
3.4 M/C and standards
3.4.2 Arrange M/C and Standards Report
DATA STRUCTURES: Machine Code and Department

DATA FLOW NAME : Prod.Dept.
DESCRIPTION : Production Department and Name
FROM PROCESSES : External entity Production Management
2.0 Master Data Entry
2.3 Prod. Depts. Entry
2.3.2 Get Working Shifts, hours, nonworking hours
Prod.Depts (Data Store)
TO PROCESSES : 2.0 Master Data Entry
2.1 Machine Entry
2.2 Workers Entry
2.1.2 Get Standards
2.2.2 Control Production Dept and Shift
Prod. Depts. (Data Store)
1.0 Daily Entry
1.4 Daily WIP Entry and Control
1.4.1 Get Date,Product,WIP,quantity,Prod Depts
3.0 Reports
3.1 Daily + Monthly Report and Yearly Summary
3.2 Cost Report
3.3 Daily Production in Phase Base
3.4 M/C and Standards
3.5 Workers List
2.3.1 Get New Prod Dept
3.1.3 Report on Chosen media
3.2.2 Summarize Production and WIP
3.3.2 Report Daily Data on Department Basis

3.4.2 Arrange M/C and Standards Report
3.5.2 Filter Workers
DATA STRUCTURES: Production Dept Code & Name

DATA FLOW NAME : M/C Stndrts
DESCRIPTION : Net output per one hour and net output per one labor hour for each machine
FROM PROCESSES : 2.0 Master Data Entry
2.1 Machine Entry
2.1.2 Get Standards
M/C Stndrts (Data Store)
TO PROCESSES : M/C Stndrts (Data Store)
1.0 Daily Entry
1.1 Daily Production Entry and Control
1.1.2 Find Machine Set and Standards
1.3.2 Find Workers in a Shift
3.0 Reports
3.4 M/C and standards
3.4.2 Arrange M/C and Standards Report
DATA STRUCTURES: Product Produced,Net output per hour,Net output per labor hour

---

DATA FLOW NAME : Shifts
DESCRIPTION : Shift start and End times for normal and abnormal (e.g. Saturdays) days.
FROM PROCESSES : 2.0 Master Data Entry
Shifts (Data Store)
External entity Production Management
TO PROCESSES : Shifts (Data Store)
1.0 Daily Entry
1.1 Daily Production Entry and Control
1.2 Daily Downtime Entry and Control
1.3 Daily Labor Work Entry and Control
2.0 Master Data Entry
2.2 Workers Entry
2.3 Prod. Depts. Entry
3.0 Reports
3.1 Daily + Monthly Report and Yearly Summary
3.1.3 Report on Chosen media
1.1.1 Get Date, Shift, Prod Department
1.2.1 Get Date, Shift, M/C No
1.3.1 Accept Date, Shift, Prod Department
2.2.2 Control Production Dept and Shift
2.3.2 Get Working Shifts, hours, nonworking hours
DATA STRUCTURES: Shift No, Start time, Finish Time, for normal and abnormal days

---

DATA FLOW NAME : Downtimes
DESCRIPTION : Downtime Reason Codes

FROM PROCESSES : 2.0 Master Data Entry
Downtimes (Data Store)
External entity Production Management
TO PROCESSES : Downtimes (Data Store)
1.0 Daily Entry
1.2 Daily Downtime Entry and Control
1.2.3 Accept Minutes of Downtimes
3.0 Reports
3.6 Downtime Report
3.6.2 Arrange Downtime Reasons and Hours of Downtimes
DATA STRUCTURES: Downtime Reason Code and Explanation

DATA FLOW NAME : App Daily Prod
DESCRIPTION : Approved daily production and scrap figures for each machine
FROM PROCESSES : 1.0 Daily Entry
1.1 Daily Production Entry and Control
1.1.4 Schedule Production Time to Different Products
Daily Production (Data Store)
TO PROCESSES : Daily Production (Data Store)
3.0 Reports
3.1 Daily + Monthly Report and Yearly Summary
3.2 Cost Report
3.3 Daily Production in Phase Base
1.2 Daily Downtime Entry and Control
1.2.2 Link Downtime to Production
3.1.1 Filter Conditions for Production Dept.
3.2.1 Filter Production data for specific month
3.3.1 Filter Production data for specific day
DATA STRUCTURES: Production Details

DATA FLOW NAME : App WIP
DESCRIPTION : Approved WIP for each phase of production
FROM PROCESSES : 1.0 Daily Entry
1.4 Daily WIP Entry and Control
1.4.2 Balancing
Daily WIP (Data Store)
TO PROCESSES : Daily WIP (Data Store)
3.0 Reports
3.2 Cost Report
3.2.2 Summarize Production and WIP
DATA STRUCTURES: WIP

DATA FLOW NAME : App Downtimes
DESCRIPTION : Approved downtime hours of machines
FROM PROCESSES : 1.0 Daily Entry
1.2 Daily Downtime Entry and Control
1.2.3 Accept Minutes of Downtimes
Daily Downtimes (Data Store)

TO PROCESSES : Daily Downtimes (Data Store)
3.0 Reports
3.6 Downtime Report
3.6.1 Filter Downtime Data
DATA STRUCTURES: Downtime Details

DATA FLOW NAME : Mach Pack
DESCRIPTION : Machine Code, Department and it's standards
FROM PROCESSES : External entity Production Management
TO PROCESSES : 2.0 Master Data Entry
2.1 Machine Entry
2.1.1 Get M/C no, Prod dept
DATA STRUCTURES: Machine Details

DATA FLOW NAME : Actual Machines
DESCRIPTION : Actual Machines run at specific day and shift
FROM PROCESSES : Daily Production (Data Store)
TO PROCESSES : 1.0 Daily Entry
1.3 Daily Labor Work Entry and Control
1.3.3 Accept Machines Worked On
DATA STRUCTURES: Machine Codes

DATA FLOW NAME : Actual Labor
DESCRIPTION : Actual Labor Hours for a specific production
FROM PROCESSES : 1.3 Daily Labor Work Entry and Control
1.3.4 Schedule Labor Hours
TO PROCESSES : Daily Production (Data Store)
DATA STRUCTURES: Actual Labor Hours

DATA FLOW NAME : Previous Period Wip
DESCRIPTION : WIP quantities for the previous period
FROM PROCESSES : Daily WIP (Data Store)
TO PROCESSES : 1.4 Daily WIP Entry and Control
1.4.2 Balancing
DATA STRUCTURES: WIP

DATA FLOW NAME : Daily WIP
DESCRIPTION : WIP quantities for a day
FROM PROCESSES : External entity Machines
TO PROCESSES : 1.0 Daily Entry
1.4 Daily WIP Entry and Control
1.4.1 Get date, product, wip, quantity, Prod depts
DATA STRUCTURES: WIP

DATA FLOW NAME : Downtime Report
DESCRIPTION : Report of downtime hours for each machine
FROM PROCESSES : 3.0 Reports
3.6 Downtime Report
3.6.2 Arrange Downtime Reasons and Hours of Downtimes

TO PROCESSES : External entity Production Management
DATA STRUCTURES: Downtime Details

DATA FLOW NAME : Worker List
DESCRIPTION : The list of workers by chosen order
FROM PROCESSES : 3.0 Reports
3.5 Workers List
3.5.2 Filter Workers
TO PROCESSES : External entity Production Management
DATA STRUCTURES: Worker code, Name, Dept, Shift

DATA FLOW NAME : M/C list
DESCRIPTION : List of machines and their standards
FROM PROCESSES : 3.0 Reports
3.4 M/C and Standards
3.4.2 Arrange M/C and Standards Report
TO PROCESSES : External entity Production Management
DATA STRUCTURES: Machine Details

DATA FLOW NAME : Daily Production
DESCRIPTION : Entered Production figures for a specific day and shift
FROM PROCESSES : 1.1.2 Find Machine Set and Standards
1.1.3 Accept Production and scrap data
TO PROCESSES : 1.1.3 Accept Production and scrap data
1.1.4 Schedule Production Time to Different Products
DATA STRUCTURES: Production Details

DATA FLOW NAME : Filtered Production data
DESCRIPTION : Production data filtered on machine, date, prod. dept.
FROM PROCESSES : 3.1.1 Filter Conditions for Production Dept.
TO PROCESSES : 3.1.2 Arrange subset of production data
DATA STRUCTURES: Production Details

DATA FLOW NAME : Monthly Production Subset
DESCRIPTION : Production data filtered on a month
FROM PROCESSES : 3.2.1 Filter Production data for specific month
TO PROCESSES : 3.2.2 Summarize Production and WIP
DATA STRUCTURES: Production Details

DATA FLOW NAME : Daily Prod Subset
DESCRIPTION : Production data filtered on a specific day
FROM PROCESSES : 3.3.1 Filter Production Data for Specific Day
TO PROCESSES : 3.3.2 Report Daily Data on Department Basis
DATA STRUCTURES: Production Details

DATA FLOW NAME : Prod in Phases
DESCRIPTION : Production & Scrap quantities for each phase on a specific day
FROM PROCESSES : 3.3.2 Report Daily Data on Department Basis
TO PROCESSES : External entity Production Management

DATA STRUCTURES: Production Details

DATA FLOW NAME : Filtered Machine Data
DESCRIPTION : Machine Data for specific range of machines
FROM PROCESSES : 3.4.1 Filter for specific range of Machines
TO PROCESSES : 3.4.2 Arrange M/C and Standards Report
DATA STRUCTURES: Machines Details

DATA FLOW NAME : Type of report
DESCRIPTION : Workers list type
FROM PROCESSES : 3.5.1 Choose Ordering of Workers
TO PROCESSES : 3.5.2 Filter Workers
DATA STRUCTURES: Type of report

DATA FLOW NAME : Filtered Downtime
DESCRIPTION : Downtime data filtered on specific date, machine range
FROM PROCESSES : 3.6.1 Filter Downtime Data
TO PROCESSES : 3.6.2 Arrange Downtime Reasons and Hours of Downtimes
DATA STRUCTURES: Downtime Details

DATA FLOW NAME : App Labor Hours
DESCRIPTION : Approved labor hours of workers
FROM PROCESSES : 1.3 Daily Labor Work Entry and Control
1.3.4 Schedule Labor Hours
TO PROCESSES : Daily Work (Data Store)
DATA STRUCTURES: Labor Hours

DATA STORES

DATA STORE : Machines
DESCRIPTION : Machine Codes and their Production Departments
INBOUND DATA FLOWS :Machines
OUTBOUND DATA FLOWS : Machines
DATA DESCRIPTION : Machine Code
Machine Dept Code
VOLUME : 75, 75 is added for future expansion
ACCESS : It can be accessed anytime. Maximum 225 access for one day.

DATA STORE : Workers
DESCRIPTION : Workers codes, names, their Departments and the shift they work for the current week.
INBOUND DATA FLOWS :Workers
OUTBOUND DATA FLOWS : Workers
DATA DESCRIPTION : Worker Code
Worker Name
worker dept
worker shift
VOLUME : 400 workers, it is expected to decrease.
ACCESS : It can be accessed anytime. Average 460 access per day.

DATA STORE : Prod. Depts.
DESCRIPTION : Names of production Departments. Number of shifts for each Department and shift change type for each of them. Working and nonworking hours of machines in each Department.
INBOUND DATA FLOWS :Production Department
OUTBOUND DATA FLOWS : Production Department
DATA DESCRIPTION : Production Department code
Production Department name
Number of shifts
Number of shifts change for the worker in that department
Working hours for one shift
Nonworking hours for one shift
VOLUME : 20 departments, it is stable
ACCESS : Nearly 950 per day

DATA STORE : Cost codes
DESCRIPTION : Cost accounting codes and explanations for them
INBOUND DATA FLOWS :Cost codes
OUTBOUND DATA FLOWS : Cost codes
DATA DESCRIPTION : Cost Accounting Code
Cost Accounting code explanation
VOLUME : 78 , it can increase slightly
ACCESS : Average 750 access for a day. Accessed for one of the reports.

DATA STORE : M/C Stndrts

DESCRIPTION : Standard output per hour for a machine, standard output per labor hour for a machine
INBOUND DATA FLOWS :M/C Stndrts
OUTBOUND DATA FLOWS : M/C Stndrts
DATA DESCRIPTION : Machine Code
Product Code
Output per hour
Output per labor hour
VOLUME : 150, it can increase by new products.
ACCESS : Accessed for daily Production entry and Daily + Monthly Production report. Average 850 access for a day.

DATA STORE : Products
DESCRIPTION : Product Codes and their names
INBOUND DATA FLOWS :Products
OUTBOUND DATA FLOWS : Products
DATA DESCRIPTION : Product Code
Product Name
VOLUME : 10, it may increase slightly
ACCESS : Accessed 240 times Averagely for a day. Accessed for daily Production entry , Daily + Monthly Production report and for production in phase base report.

DATA STORE : Shifts
DESCRIPTION : Shift codes and starting and finishing times for shifts. Same information is repeated for abnormal days (e.g. Saturdays)
INBOUND DATA FLOWS :Shifts
OUTBOUND DATA FLOWS : Shifts
DATA DESCRIPTION : Shift Code
Starting time for normal days
Ending time for normal days
Starting time for abnormal days
Finishing time for abnormal days
VOLUME : 4, it is stable
ACCESS : 10 Average accesses, mostly for reports

DATA STORE : Downtimes
DESCRIPTION : Downtime Reason codes and their explanations
INBOUND DATA FLOWS :Downtimes
OUTBOUND DATA FLOWS : Downtimes
DATA DESCRIPTION : Downtime Code
Downtime Code explanation
VOLUME : 9 , it may increase due to increased needs of downtime reporting.
ACCESS : Accessed daily. 550 Average for a day.

DATA STORE : Daily Production
DESCRIPTION : Daily net Production and scrap quantities for each machine
INBOUND DATA FLOWS :App.Daily Production
Actual Labor

OUTBOUND DATA FLOWS : Actual machines
App. Daily Production
DATA DESCRIPTION : Date
Machine code
starting time for Production
ending time for Production
product code
net quantity
scrap quantity
actual labor hours used
VOLUME : Increasing Average of 100 daily
ACCESS : Accessed everyday average of 1150 times

DATA STORE : Daily WIP
DESCRIPTION : Daily Work in process quantities for each phase of Production for each product.
INBOUND DATA FLOWS :App WIP
OUTBOUND DATA FLOWS : APP WIP, Previous Period WIP
DATA DESCRIPTION : Date
Prod dept code
Product code
WIP quantity
VOLUME : Increasing nearly 40 each day.
ACCESS : Accessed nearly 80 times each day

DATA STORE : Daily Downtimes
DESCRIPTION : Daily downtime reasons and minutes of those for each Machine
INBOUND DATA FLOWS :App. downtimes
OUTBOUND DATA FLOWS : App. downtimes
DATA DESCRIPTION : Date
Machine code
shift number
product code
downtime reason code
downtime minutes
VOLUME : Increasing 75 each day
ACCESS : Accessed nearly 800 times each day

DATA STORE : Daily work
DESCRIPTION : Machines that workers work and their working times
INBOUND DATA FLOWS :App. labor hours
OUTBOUND DATA FLOWS :
DATA DESCRIPTION : Date
Worker code
starting time
ending time
Machine code
VOLUME : Increasing nearly 350 each day
ACCESS : Accessed 350 times each day

<u>PROCESSES</u>

PROCESS NAME	: Daily Entry
DESCRIPTION	: Entry of daily Production, downtime, labor hours, WIP
INPUT	: Daily M/C Prod Daily WIP App. Daily Prod Machines Workers Prod.depts. M/C Stndrts Products Shifts Downtimes
OUTPUT	: App. Daily Prod App. WIP App. Downtimes
LOGIC SUMMARY	: Get daily data from user Control master codes and accept accordingly Produce daily production, wip, downtimes, labor hours

---

PROCESS NAME	: Daily Production Entry and Control
DESCRIPTION	: Entry of net production, scrap quantities for machines for each shift
INPUT	: Daily M/C Production Shifts Machines M/C Stndrts Products
OUTPUT	: App. Daily Prod
LOGIC SUMMARY	: Get date, shift, prod.dept. Find M/C set and standards Accept Production quantities Schedule time to different products if one machine produces more than one product. Approve Production figures

---

PROCESS NAME	: Get Date, Shift, Prod Department
DESCRIPTION	: Input date,shift and production department for entry
INPUT	: Daily M/C Production Shifts Prod.depts.
OUTPUT	: Daily M/C production
LOGIC SUMMARY	: Get date,shift,prod dept. Control shift no and Production Department

---

PROCESS NAME	: Find Machine Set and Standards
DESCRIPTION	: According to prod.dept. bring machine set and assign starting-ending times for Production items

INPUT : Machines
M/C Stndrts
Daily M/C Production
OUTPUT : Daily M/C Production
LOGIC SUMMARY : Using machine database find related group machines
Assign start-finish times as start-finish times of that shift

---

PROCESS NAME : Accept Production and scrap data
DESCRIPTION : Accept Production and scrap figures for all Machines
INPUT : Products
Daily M/C Production
OUTPUT : Daily M/C Production
LOGIC SUMMARY : Get a Machine code
Find available Product codes
Let user choose one of them
Accept net output and scrap quantities

PROCESS NAME : Schedule Production Time to Different Products
DESCRIPTION : If there is at least one Machine which produces more than one Product in a shift, it's time should be divided into two sections. That process is the division of Machine's time into different products in relation to their net quantities
INPUT : Daily M/C Production
OUTPUT : Daily M/C Production
LOGIC SUMMARY : Search for same machine repeated in a shift
Divide it's time such that :

bt = starting time of the shift
z= sum of net quantities

$$z = \sum_{i}^{n}$$

where q_i= net quantity produced for i^{th} repetition

et = ending time of the shift

$$bt_i = bt + \sum_{k=1}^{i-1} q_k (et-bt) / z$$

$$et_i = bt + \sum_{k=1}^{i} q_k (et-bt) / z$$

Replace start-finish times with bt_i and et_i

PROCESS NAME : Daily Downtime Entry and Control

DESCRIPTION	: Entry of Machine Downtimes together with their reasons and time durations
INPUT	: Machines Daily M/C Production Shifts Downtimes App. Daily Prod
OUTPUT	: App. Downtimes
LOGIC SUMMARY	: Get date, shift, M/C no Link Downtime to a Production item Accept minutes of Downtimes

---

PROCESS NAME	: Get Date, Shift, M/C No
DESCRIPTION	: Get Downtime day and shift no , get specific Machine number, Control shift no, machine number
INPUT	: Daily M/C Production Shifts Machines
OUTPUT	: Daily M/C Production
LOGIC SUMMARY	: Get date,shift,m/c no from user Validate shift no and Machine no

---

PROCESS NAME	: Link Downtime to Production
DESCRIPTION	: Find related production item when Downtime has occurred
INPUT	: Daily M/C Production App. Daily Prod
OUTPUT	: App. Downtimes
LOGIC SUMMARY	: Find related Production item according to date, machine no and shift no Bring various product codes so that user identifies the Downtime Accept the choice of Product

---

PROCESS NAME	: Accept Minutes of Downtimes
DESCRIPTION	: Accept reasons for Downtimes and their durations
INPUT	: Daily M/C Production Downtimes
OUTPUT	: App. Downtimes
LOGIC SUMMARY	: List reasons of downtimes Accept minutes of Downtimes If total duration is less than Production time it is OK ELSE let user correct this problem

---

PROCESS NAME	: Daily Labor Work Entry and Control
DESCRIPTION	: Entry of labor hours and the machines workers run.
INPUT	: Shifts Daily M/C Production Workers Actual Machines

OUTPUT : Actual Labor
App. Labor Hours
LOGIC SUMMARY : Get date,shift,Production Department
Find Workers in that Shift
Accept Machines
If there is anyone who runs more than one machine, schedule his working time
Transfer labor hours to Production items

PROCESS NAME : Accept Date, Shift, Prod Department
DESCRIPTION : Get date, shift no and production Department
INPUT : Daily M/C Production
Shifts
Prod.depts.
OUTPUT : Daily M/C Production
LOGIC SUMMARY : Get date, shift no, and prod.dept.
Control shift no and Production Department

PROCESS NAME : Find Workers in a Shift
DESCRIPTION : Find workers in that Department and Working at that Shift
INPUT : Daily M/C Production
Workers
OUTPUT : Daily M/C Production
LOGIC SUMMARY : Find Worker codes which contain that shift number
Assign start-finish times as starting and finishing times for particular shift

---

PROCESS NAME : Accept Machines Worked On
DESCRIPTION : Accept machines that workers run one by one, make sure that they are from actual machines
INPUT : Daily M/C Production
Actual Machines
OUTPUT : Daily M/C Production
LOGIC SUMMARY : Accept Machine code
Control whether it is one of actual Machines

PROCESS NAME : Schedule Labor Hours
DESCRIPTION : If one worker run more than one machine, its available time is divided into logical sections. And they are passed to Production
INPUT : Daily M/C Production
OUTPUT : Actual Labor hours
App. Labor hours
LOGIC SUMMARY : Search for people who run two or more machines
Identify number of people who run same machine (N_i= Number of people in machine I)
Divide workers time (T_i) into separate sections (D_i)

$$D_i = (T_i / sum(1/N_i))*1/N_i$$

PROCESS NAME	: Daily WIP Entry and Control
DESCRIPTION	: Using previous period WIP and daily machine Production, Find current date's WIP. If it matches Daily WIP given, it's OK. Otherwise don't accept WIP till conflict is solved.
INPUT	: Daily WIP Daily M/C Production Prod.depts. Products Previous Period WIP
OUTPUT	: App. WIP
LOGIC SUMMARY	: Get date, product, WIP quantity, prod dept Balance quantities

---

PROCESS NAME	: Get date, product, wip, quantity, Prod depts
DESCRIPTION	: Entry of WIP quantities by each phase and each Product
INPUT	: Daily WIP Prod.depts. Products
OUTPUT	: Daily WIP
LOGIC SUMMARY	: Get date, product, prod dept Control product, prod dept Accept WIP quantities

---

PROCESS NAME	: Balancing
DESCRIPTION	: Balance given WIP quantity with predetermined one. Previous days WIP and todays production together give a predetermined result.
INPUT	: Daily WIP Daily M/C Production Previous Period WIP
OUTPUT	: App. WIP
LOGIC SUMMARY	: Balance according to following rule Previous WIP + Entering material - Net Output = Todays WIP If there are problems, let user modify accordingly

---

PROCESS NAME	: Master Data Entry
DESCRIPTION	: Base codes and explanations are entered to the system
INPUT	: Workers Cost codes Mach Pack Prod.depts. Products
OUTPUT	: Machines Workers Prod.depts. Cost codes M/C Stndrts Products

LOGIC SUMMARY : Accept master data code
- 4 digits for Cost codes
- a number for Worker codes
- 4 digits for Prod.depts.
- a number for Machines
- 7 digits for Product codes

Accept it's explanation
Accept machine standards for each machine

PROCESS NAME : Machine Entry
DESCRIPTION : Entry of Machines and their standards
INPUT : Products
Cost codes
Mach Pack
OUTPUT : Machines
M/C standards
LOGIC SUMMARY : Get machine code
control Machine code
Get it's Department
control in Prod.depts.
Get a Product code
control it
Get output per hour and output per labor hour
Get cost code related and control it
Accept it as a new machine entry if all controls are passed

PROCESS NAME : Get M/C no, Prod Dept
DESCRIPTION : Get new Machine no and the Department which it belongs
INPUT : Mach Pack
Prod.depts.
OUTPUT : Daily M/C Production
LOGIC SUMMARY : Get M/C no, control it to be a number
Control if it exists
If it exists find related Prod.depts. and standards
ELSE get a Prod.depts. code and control it

PROCESS NAME : Get Standards
DESCRIPTION : Get standards for previously determined machine
INPUT : Daily M/C Production
Cost codes
Products
OUTPUT : Machines
M/C Stndrts
LOGIC SUMMARY : Get a product , control if it exists
If exists , accept output per hour, output per lab hour get related cost code, control if exists
If exists , accept all line as a standard and pass machines and M/C Stndrts

---

PROCESS NAME : Workers Entry
DESCRIPTION : Accept or change a worker's information
INPUT : Shifts
Workers
OUTPUT : Workers
LOGIC SUMMARY : Get Workers code, name, dept and shift
Control dept and shift
Accept it if it passes the control

PROCESS NAME : Get Workers code, name, dept, shift
DESCRIPTION : Get a workers code, his name, his Production Department and his current Shift
INPUT : Workers
OUTPUT : Workers
LOGIC SUMMARY : Get Workers code, control if it's a number
control it's existence
If it exits already, bring that workers information
Get a name
Get a Production Department, control it to be 4 digits
Get a Shift code, control if it is a number

PROCESS NAME : Control Production Dept and Shift
DESCRIPTION : Control the existence of production dept & shift no
INPUT : Prod.depts.
Workers
Shifts
OUTPUT : Workers
LOGIC SUMMARY : Control whether Production Department exists
Control whether Shift exists
Accept Workers data if everything is OK

PROCESS NAME : Prod. Depts. Entry
DESCRIPTION : Get Production Department code and name, get also the shifts for that Department, how many Shifts Workers in that Department change for a week. Working and nonworking hours of that Department
INPUT : Shift
Prod.depts.
OUTPUT : Prod.depts.
LOGIC SUMMARY : Get new Production Department and control it
If it exists bring it's information
ELSE get Shift information, control it get working and nonworking hours

---

PROCESS NAME : Get New Prod Dept
DESCRIPTION : Get Production Department code and it's name
INPUT : Prod.depts.
OUTPUT : Prod.depts.

LOGIC SUMMARY	: Get new Prod.depts. code if it exists bring its information ELSE accept it as a new one

---

PROCESS NAME	: Get Working Shifts, hours, nonworking hours
DESCRIPTION	: Get working Shifts, shift change amount, working hours, non working hours for that Department
INPUT	: Prod.depts. Shifts
OUTPUT	: Prod.depts.
LOGIC SUMMARY	: Get Shifts that Department operates, control shift no Get shift change amount of workers in that Department Get working hours for normal + abnormal days Get nonworking hours for normal+abnormal days Accept Prod.depts.

PROCESS NAME	: Reports
DESCRIPTION	: Produce presentations of production data
INPUT	: Machines Workers Prod.depts. Cost codes M/C Stndrts Products Shifts Downtimes App. Daily Prod App. WIP App. Downtimes
OUTPUT	: D+M Production Yearly Summary Downtime Report Production in phases Cost Report Workers list M/C list
LOGIC SUMMARY	: Filter Production data Arrange according to report type Give it to chosen media

---

PROCESS NAME	: Daily Monthly Report- Yearly Summary
DESCRIPTION	: Filter Production data, find efficiencies according to time span given.
INPUT	: App. Daily Prod Prod.depts. Cost codes Shifts Machines M/C Stndrts

OUTPUT : D+M report- Yearly Summary
LOGIC SUMMARY : Filter Production data according to conditions
Arrange it on machine basis
Report efficiencies

Scrap % = 100* (scrap quantity / scrap+net quantity)

M/C efficiency = 100* (Net quantity / (standard output per hour * expected machine hours))

Workers efficiency = 100* (Net quantity / (standard output per labor hour * actual labor hours))

PROCESS NAME : Filter conditions for Production Report
DESCRIPTION : Filter Production data according to time span, machine codes, Production Departments.
INPUT : App. Daily Prod
OUTPUT : Filtered Production data
LOGIC SUMMARY : Make a query on Production data and choose according to given time span, machines and Production Departments.

PROCESS NAME : Arrange subset of production data
DESCRIPTION : Arrange filtered data sorted on machine code
INPUT : Filtered Production data
OUTPUT : Filtered Production data
LOGIC SUMMARY : Sort data on machine code, date and starting times

---

PROCESS NAME : Report on Chosen media
DESCRIPTION : Report efficiencies on paper or screen or another file for further reference.
INPUT : Filtered Production data
Prod.depts.
Cost codes
Shifts
Machines
M/C Stndrts
OUTPUT : Monthly+Daily Production
Yearly Summary
LOGIC SUMMARY : Report efficiencies on paper or screen or another file for further reference.

PROCESS NAME : Cost Report
DESCRIPTION : Give monthly balance of quantities with WIP
INPUT : App. WIP
App. Daily Prod
Prod.depts.
OUTPUT : Cost Report

LOGIC SUMMARY	: For a given month give total quantities produced together with beginning of month WIP and month end WIP for each phase of production.

PROCESS NAME	: Filter Production data for specific month
DESCRIPTION	: Query Production data for specific month
INPUT	: App. Daily Prod
OUTPUT	: Monthly Production subset
LOGIC SUMMARY	: According to given month, choose appropriate portion

---

PROCESS NAME	: Summarize Production and WIP
DESCRIPTION	: Summarize Production quantities and WIP together for each phase of Production
INPUT	: Monthly Production Subset App. WIP Prod.depts.
OUTPUT	: Cost Report
LOGIC SUMMARY	: Report previous WIP - Net quantity Produced, Scrap quantity and ending WIP for each phase.

PROCESS NAME	: Daily Production in Phase Base
DESCRIPTION	: Summarize Production data on phase base for a specific day.
INPUT	: App. Daily Prod Products Prod.depts.
OUTPUT	: Production in phases
LOGIC SUMMARY	: Filter Production data for specific day Report daily data on Production Department basis

---

PROCESS NAME	: Filter Production Data for Specific Day
DESCRIPTION	: Query on Production data for one specific day
INPUT	: App. Daily Prod
OUTPUT	: Daily Production subset
LOGIC SUMMARY	: Query according to specific day and Product

PROCESS NAME	: Report Daily Data on Department Basis
DESCRIPTION	: Report daily Production and scrap for each phase
INPUT	: Daily Production subset Products Prod.depts.
OUTPUT	: Production in phases
LOGIC SUMMARY	: Give total net Production quantity, total scrap quantity and percentage for each phase of Production

---

PROCESS NAME	: M/C and Standards
DESCRIPTION	: Give list of Machines and the Products they produce also with hourly standards

INPUT	: Machines Prod.depts. M/C Stndrts
OUTPUT	: M/C list
LOGIC SUMMARY	: Filter for specific range of Machines Arrange Products and standards for each Machine

---

PROCESS NAME	: Filter for specific range of Machines
DESCRIPTION	: Query machine data for specific machines
INPUT	: Machines
OUTPUT	: Filtered Machine data
LOGIC SUMMARY	: Choose a set of Machines for output

PROCESS NAME	: Arrange Report for Machines
DESCRIPTION	: Find each Machine's Department, Products and their standard Production
INPUT	: Filtered Machine data Prod.depts. M/C Stndrts
OUTPUT	: M/C list
LOGIC SUMMARY	: Give one by one each machine code, products it produces and their standard output per hour and output per labor hour

---

PROCESS NAME	: Workers List
DESCRIPTION	: Give one of four options for the list of Workers
INPUT	: Workers Prod.depts.
OUTPUT	: Worker list
LOGIC SUMMARY	: Get report type (there are four) Filter worker data and report accordingly

---

PROCESS NAME	: Choose Ordering of Workers
DESCRIPTION	: Choose between four options : sorted on 1. Worker Code 2. Worker name 3. Workers Department 4. Workers Shift no
INPUT	:
OUTPUT	: Type of report
LOGIC SUMMARY	: Get ordering type from user

PROCESS NAME	: Filter Workers
DESCRIPTION	: Filter and sort according to chosen option
INPUT	: Workers Prod.depts.
OUTPUT	: Worker list
LOGIC SUMMARY	: Query according to chosen option Report Workers code, name, dept, shift

---

PROCESS NAME : Downtime Report
DESCRIPTION : Report of machines downtime minutes and downtime reasons as daily, monthly, yearly.
INPUT : App. Downtimes
Downtimes
OUTPUT : Downtime Report
LOGIC SUMMARY : Filter Downtime data for machines or Departments
Arrange Downtime reasons and minutes of downtimes.

PROCESS NAME : Filter Downtime Data
DESCRIPTION : Query on machines and Prod.depts.
INPUT : App. Downtimes
OUTPUT : Filtered Downtime
LOGIC SUMMARY : Query Downtime data, get a subset of Machines and Prod.depts.

PROCESS NAME : Arrange Downtime Reasons and Hours of Downtimes
DESCRIPTION : Sort downtime data on machine code, Downtime reasons and date.
Give minutes of downtimes and their percentage.
INPUT : Filtered Downtime
Downtimes
OUTPUT : Downtime report
LOGIC SUMMARY : Sort Downtime data on machine code, reason codes, date.
Arrange minutes of Downtimes and their percentages.

APPENDIX C . FORMS USED IN THE CURRENT SYSTEM

GÜNLÜK İMALÂT FORMU

MAKİNA : ______________________

TARİH : ______________________

1	ham çelikten gelen mal		presten çıkan mal			notlar
	coil	kilo	coil	iyi	bozuk	
posta						
operatör						
posta						
operatör						
posta						
operatör						
toplam						
A. toplam						

7/15 POSTA ŞEFİ   15/23 POSTA ŞEFİ   23/07 POSTA ŞEFİ

FIRIN İMALAT FORMU

Tarih : ...../...../198...

M/C : 2	PRESTEN GELEN (KG)			FIRINDAN ÇIKAN MAL (KG)				
	COIL NO.	COILIN GİRİŞ KİLOSU	COILIN GİRİŞ SAATİ	COILIN BİTİŞ KİLOSU	COILIN BİTİŞ SAATİ	FİRE	Kaç Kg. Sonra 600 Taşların Tomeya Alındığı	İNDİRİLEN MAL VE SEBEBİ - NOTLAR
POSTA								
OPERATÖR								
TOPLAM								
POSTA								
OPERATÖR								
								Kısım Şefi : İsim İmza
								Posta Şefi : İsim İmza
TOPLAM								

GÜNLÜK İMALÂT FORMU

MAKİNA : ....

TARİH : ....

3	Fırından gelen mal		kaynaktan çıkan mal			notlar
	coil	kilo	coil	iyi	bozuk	
posta						
operatör						
posta						
operatör						
posta						
operatör						
toplam						
A. toplam						

7/15 POSTA ŞEFİ 15/23 POSTA ŞEFİ 23/07 POSTA ŞEFİ

GÜNLÜK İMALÂT FORMU

MAKİNA :

TARİH :

4	kaynaktan gelen mal		baskıdan çıkan mal			notlar
	coli	kilo	coli	iyi	bozuk	
posta						
operatör						
posta						
operatör						
posta						
operatör						
toplam						
A. toplam						

7/15 POSTA ŞEFİ 15/23 POSTA ŞEFİ 23/07 POSTA ŞEFİ

YAĞLI GRİNDİNG İMALAT FORMU

Tarih : ..../..../198..

10	BASKIDAN GELEN KG.			YAĞLI GRİNDİNGTEN ÇIKAN MALIN KG.				
	COİLİN NO	COİLİN GİRİŞ KİLOSU	COİLİN GİRİŞ SAATİ	COİLİN BİTİŞ KİLOSU	COİLİN BİTİŞ SAATİ	FİRE	Kaç Kg. Sonra 600 Taşların Tornaya Alındığı	İNDİRİLEN MAL VE SEBEBİ
POSTA								
OPERATÖR								
TOPLAM								
POSTA								
OPERATÖR								
TOPLAM								

GÜNLÜK İMALÂT FORMU

MAKİNA :

TARİH :

5	y. grindingten gelen mal		tri yıkamadan çıkan mal			notlar
	coil	kilo	coil	iyi	bozuk	
posta						
operatör						
posta						
operatör						
posta						
operatör						
toplam						
A. toplam						

7/15 POSTA ŞEFİ 15/23 POSTA ŞEFİ 23/07 POSTA ŞEFİ

GÜNLÜK İMALÂT FORMU

MAKİNA : ______________

TARİH : ______________

11	finalden gelen mal		sputteringten çıkan mal			notlar
	coil no.	kilo	coil no.	iyi	bozuk	
posta						
operatör						
posta						
operatör						
posta						
operatör						
toplam						
A. toplam						

7/15 POSTA ŞEFİ. 15/23 POSTA ŞEFİ 23/07 POSTA ŞEFİ

GÜNLÜK IMALÂT FORMU

MAKİNA : ____________________

DÜNKÜ STOK : ____________________

TARİH : ____________________

12	SPUTTERİNGTEN GELEN MAL		prosesten çıkan mal					
	askı	kilo	askı	fırın	lip	saat	iyi	fire
posta								
OPERATÖR								
posta								
OPERATÖR								
posta								
ÖPERATÖR								

STOK : ____________________

GÜNLÜK İMALÂT FORMU

MAKİNA : ....

TARİH : ....

14	prosesten gelen mal		yağlamadan çıkan mal					
	askı	kilo	askı	kilo	çift tr.	tek tr.	banyo	fire
posta								
operatör								
posta								
operatör								
posta								
operatör								
toplam								
A. toplam								

GÜNLÜK İMALÂT FORMU

MAKİNA :..................................

TARİH :..................................

ÇIPLAK STOK :......................   TEK SAR. STOK :........................

16	yağlamadan gelen mal				wrapingten çıkan mal				
	askı	sıra	adet	banyo	kasa	sıra	adet	fire	not
posta									
operatör									
toplam									
posta									
operatör									
toplam									
posta									
operatör									
toplam									
A. toplam									

ÇIPLAK STOK :......................   TEK SAR. STOK :........................

GÜNLÜK FİNAL FORMU

TARİHİ : ..../........../19..........

7	STROPİNGTEN GELEN MAL		finalden çıkan mal		diğer bozuklar				TOPLAM
	coil	kilo	coil	iyi	fırın	baskı	grind	strop	
Posta									
KONTROL EDEN									
Saat									
A. TOPLAM									

F11

GÜNLÜK İMALÂT FORMU

MAKİNA : ____________

TARİH : ____________

WRAPİNGTEN ALINAN : ____________

DİSP. LOADİNG STOKU : ____________

19	wrapingten gelen mal				disp. load. çıkan mal		
	cinsi	kasa	sıra	adet	iyi	fire	not
POSTA 07/15							
OPERATOR							
OPERATOR							
TOPLAM							
POSTA 15/23							
OPERATOR							
OPERATOR							
TOPLAM							
POSTA 23/07							
OPERATOR							
OPERATOR							
TOPLAM							
A. TOPLAM							

DİSP. LOADİNG STOKU : ....

SELOFAN İMALAT FORMU

TARİH : ....

DİSPANSER STOKU : ....

22		disps. gelen mal		selofandan çıkan mal		
	mc	operatör	GİREN MAL	koli	fire	n o t
POSTA 07/15	1					
	2					
	3					
TOPLAM						
POSTA 15/23	1					
	2					
	3					
TOPLAM						
POSTA 23/07	1					
	2					
	3					
TOPLAM						
A. TOPLAM						

DİSPANSER STOKU : ....

VARDİYA USTASI: ______________ KALİTE KONTROL : ______________

VARDİYA : ______________ STOK KONTROL : ______________

TARİH : ______________ BÖLÜM : ______________

CİNSİ	MC KODU	ZAMAN PERİODU	BASKI SAYISI	KG MİKTAR	GÖZ ADEDİ	ADET MİKTAR	OPERATÖR KODU	DURMA SÜRESİ	AR… AÇI…
CAP 8811									
PLATFORM 8812									
HANDLE 8813									
DİSPENSER 8801									
OVER CAP									
NOT									

Ay: ....

YARMA MC. PERMATİK İMALAT FORMU

GÜN	GELEN MAL	KESİLEN SERİ NO.	KESİLEN	BOZUK MİKTAR	FİRE %	NOT
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
Yekün						

AYLIK

Sap Yapıştırma - Kutu - Koli İmalat Formu

Ay ____________

Gün	Vardiya sayısı	Sapa verilen miktar	Yapıştırılan miktar	Bozuk miktarı	Yapılan Koli Ad.	Sapsız mal stoku	Not
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
Yekûn							

POSTA BAŞI : ______________ KALİTE KONTROL : ______________
VARDİYA : ______________ STOK KONTROL : ______________
TARİH : ______________ BÖLÜM : ______________

İMALAT CİNSİ	MC KODU	MAMUL KOLİ	TEMİZ ADET	ISKARTA	OPERATÖR KODU	DURMA SÜRESİ	KALAN SAPSIZ MAL	ARIZA AÇIKLAMA
	155							
	156							
	157							
	158							
	159							
	160							
TOPLAM								

TOPLAM İMALAT FORMU 29 TARİH: ....120........

	gelen mal	çıkan iyi mal	bozuk	fire %	stok	n o t l a r
pres						
fırın						
banyo						
kaynak						
baskı						
grinding						
y. grinding						
tri yıkama						
stroping						
final						
yıkama						
sputtering						
proses						
yağlama						
wraping						
dispanser						
selofan						

TOPTAN İMALÂT FORMU

Tarih 24 / 3 / 1992

BÖLÜM	MEVCUT STOK	GELEN MAL	TOPLAM	ÇIKAN İYİ MAL	BOZUK MAL	FİRE %	DEVREDEN STOK	NOTLAR
KESİM MAKİNASI								
KALİTE KONTROL								
ASSEMBLY								
SAP TAKMA								
KUTU KOLİ								

29.1.992

PERMATİK BÖLÜMÜ OCAK-1992 STOK ENVANTERİ

Single cap (PT) :
Single cap(KR) :
Single seat :
Single kapak :

Twin cap :
Twin seat :
Twin kapak :

Beyaz handle :
Mavi Handle :
Kırmızı handle :
Yunan handle :

İç dispenser :
Dış dispensır :
Rubi dispenser :

K-500 :
A-825 :
Hazır mal (cap) :
(seat) :

Permatik 1 kartela :
" kutu :
" koli :

Permatik 2 kartela :
" kutu :
" koli :

Kromatik 1 kartela :
" kutu :
" koli :

Koli bandı :
Koli çemberi :
Hotmelt :
Yarma taşı :

Mavi boya :
Kırmızı boya :
Beyaz boya :

F21

KISIM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	ÇALIŞMA DURUMU	
PERFORATING							
PERFORATING							
PERFORATING							
PERFORATING	8						
PERFORATING							
PERFORATING							
PERFORATING							
PERFORATING							
PERFORATING (THIN)	1						
HARDENING							
HARDENING							
HARDENING	5						
HARDENING							
HARDENING							
COIL JOIN	2						
COIL JOIN							
PRINTING	1						
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING	15						
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING							
SHARPENING							

PERMASHARP

AY: 30.11.91 - 30.12.91

AYLIK TRAŞ BIÇAGI URETIMI

URETIM SAFHALARI	BR	DONEMBAŞI AÇILIŞ (WIP)	ONCEKI SAFHADAN DEVIR ALINAN	BRUT URETIME GIREN	NET URETIMDEN ÇIKAN	DIGER ÇIKIŞLAR	KAYDEDILEN FIRE	GORUNMEYEN FIRE	DONEMSONU KAPANIŞ (WIP)
PERFORATION	KG								
HARDENING	KG								
JOINING	KG								
PRINTING	KG								
SHARPENING	KG								
WASHING	KG								
FINAL	KG								
SPUTTERING	KG								
TREATMENT	KG								
YAGLAMA	AD								
WRAPPING	AD								
PACKING	AD								

HAZIRLAYAN:

ONAY:

(1) 2562 Koli (42)'lik
576 Koli (21)'lik

15.6.1992 TARİHİNDEN İTİBAREN TATBİK EDİLECEK HAFTALIK İMALAT PROGRAMI

PRES VARDİYA USTALARI

07/15	KENAN BAYCAN	7013
15/23	SATILMIŞ ŞAHİN	1692
23/07	İSMET HACIALİ	1727
07/15	NACİYE HACIOĞLU	502
"	FATMA SERBEST	236
"	SANİYE ÇETİNTAŞ	511
15/23	HALİDE ÖZTÜRK	503
"	SADİYE ÇAVUŞ	323
"	ŞENGÜL ERASLAN	1462
23/07	AYŞE KIRAT	514
"	EMİNE ÖZKILIÇ	1656
"	FATMA ÖZCAN	231
D.İZİN	HAFİYE DURMUŞ	1665

IRIM

7/15	AHMET DOĞU	1701
"	YUSUF KEKEÇ	421
"	SIDIKA AYDIN	230
5/23	MUSTAFA TOPÇU	1682
"	NAZMİYE EREN	378
"	NEBAHAT BALCI	1662
3/07	SÜLEYMAN Ü.KAYA	557
"	SEFER YILDIZ	1707
"	RESMİYE ÇALIŞKAN	392

AYNAK

7/15	AHMET BAHTİYAR	1709
5/23	PAKİZE KARAMUK	42
"	NEDİME GÜMÜŞ	64
3/07	DURSUN POLAT	1703
"	ELANE AKGÜN	273

ASKI

7/15	NECATİ ÖZKAN	1706
5/23	SEBİLE GEMİCİ	342
3/07	FATMA YALÇIN	348

İ YIKAMA

7/15	AHMET AŞIKOĞLU	1705
"	SEHER AKTOP	
5/23	GÜLİZAR DEMİR	376
"	ÇİĞDEM KURTBAŞ	1643
/07	TÜRKAN HACIOĞLU	1597
"	HANİFE ÇAMUR	1564
30/17.30	HÜDAVERDİ E.Cİ	1683

GRİNDİNG

GRD.	30	07/15	EROL GÜLSEVER	552
"	31	"	VURAL NAYIR	1674
"	32	"	MEHMET KURTULAN	1678
"	33	15/23	AZİM YALNIZ	492
"	34	07/15	REMZİ UYSAL	1715
"	36	"	AHMET DÖNMEZ	551
"	37	"	YUSUF TERLEMEZ	1722
"	38	"	RECEP AKMAN	1710
"	39	15/23	HÜSEYİN KAHRAMAN	7061
"	40	"	İKRAM ÇAKMAK	686
"	41	"	YAKUP YILDIRIM	1675
"	42	"	N.EMİN ÇETİNDAĞ	1681
"	37	"	HÜRREM GÜL	545
"	44	"	BÜLENT ÖNER	1695

YEDEK OPERATÖRLER

07/15	MUSTAFA İŞEN	544
15/23	İHSAN TAŞDEMİR	782
8.30/17.30	NURETTİN SATIŞ	7074

TAŞLAMA

07/15	NEMİŞ HATİP	1725
15/23	İBRAHİM BİLKAN	1679

TAŞ AÇMA

8.30/17.30	CELİL YILDIZ	1721

PLEYT REVİZYON

8.30/17.30	FİKRET CAN	496

VARDİYA USTALARI

07/15	SAİM SU	7067
15/23	VEDAT ÜNLÜ	473
8.30/17.30	CEMİL BAŞ	703

YAĞLI BİLEME

07/15	FETHİ TOSUN	1677
8.30/17.30	AHMET GÜNDOĞAN	1724
"	SEYFİ DEVECİOĞLU	567

POSTA ŞEFLERİ

07/15	MUAMMER BOZKURT	7016
15/23	FİKRET ERANIL	7073
23/07	MEHMET BOZKURT	7034

SPUTTERİNG

07/15	NEVZAT BALTACI	677
"	ERCAN DÖĞURLU	1728
"	AZİME KURTULUŞ	408
"	AYTEN CANİK	1637
15/23	BİLAL BALCA	1708
"	ZELİHA BAHTİYAR	512
"	AYŞE KILIÇ	504
"	ARZU ÇİFTÇİ	1717
23/07	VELİ ÇELİK	7069
"	ŞABAN ÇETİN	1716
"	CEMİLE ERSOY	534
"	FATMA GERÇİK	333
8.30/17.30	SADIK GÜNAYDIN	7070

PROCESS

07/15	HASAN ERDOĞAN	1700
"	MELİHA SÖNMEZ	344
"	FATMA MOLLA	535
15/23	HALİL UYSAL	1694
"	SELİME TOPÇU	413
"	ASİYE GÜVEN	1638
23/07	İSMAİL KAHRAMAN	1726
"	NEBİYE ÖZKILIÇ	532
"	AYŞE HACI	1463

YAĞLAMA

07/15	SAİME HAYATSEVER	394
15/23	FATMA BOŞNAK	321
23/07	YASVİYE AYTINAY	365

KISIM ŞEFLERİ

8.30/17.30	SEFER ÇINAR	569
"	TEVFİK DEMİREL	
"	EMİN HOCAOĞLU	
"	İSMET HOŞEL	
"	YUNUS BAYCAN	
"	SAKIP TOSUN	678

SEKRETER

8.30/17.30 GÜLŞEN ŞENTÜRK

Y.HİZMETLER

8.30/17.30 MUSTAFA SÖYLEMEZ

NOT: ÜRETİM MÜDÜRÜMÜN HABERİ OLMADAN PROGRAMDA DEĞİŞİKLİK YAPILAMAZ.

ÜRETİM MÜDÜRÜ
SALİH YEŞİLOĞLU