MIDDLE EAST TECHNICAL UNIVERSITY
INDUSTRIAL ENGINEERING DEPARTMENT

IE 400

SUMMER PRACTICE MANUAL

2009

The purpose of summer practice is to improve your understanding of the industry and experience in industrial engineering. These can best be achieved through guided observations followed by a formal reporting. This manual provides guidelines for the summer practice and the preparation of the practice report of METU Industrial Engineering third year students. First, format and style of the practice report is described. The rest of the manual lists questions that are expected to be addressed in the report. The questions are organized in eight sections. Explanations are given before most of the questions. Students should elaborate on their responses to the questions and provide supporting discussions. A list of references is also provided. In addition to responding to the questions listed, students should also define and formulate an industrial engineering problem, or report exclusively on a project they participated in throughout their summer practices. The Appendix at the end of this manual provides some clues on how these might be done.

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INSTRUCTIONS ON THE FORMAT AND STYLE OF THE REPORT

The report must be written in English, and printed in ink or typed.

The main section headings are to be numbered and written in capital letters. The sub-titles must be written in lower case letters and underlined. All pages should be given page numbers. Figures, drawings, tables, pictures, etc. should be numbered appropriately.

The report should consist of the following sections:

Table of contents (with corresponding page numbers)

Introduction (scope of the summer practice; main difficulties faced during the practice which affected the course of the work)

Main body of the report (detailed explanation of the work carried out including sections on an IE problem or contributed project)

Conclusion (evaluation of the experience gained and feedback on the content of summer practice)

References (list all the material referred to in the report text)

Appendix (all data, tables, diagrams, drawings, etc. which are not immediately relevant to the main text should be included in the appendix).

In writing-up the report, the main sections of the manual and the questions may be followed in the given order. However, the content, the main body or a main section of the report may be reorganized in subsections defined by the student provided that all questions in this guide have been answered.

When a question is not appropriate for the case on hand or a suitable answer is not available, the question can be disregarded. However a clear justification of why the question is not answered should be provided. The student can also attempt to modify and then answer the question so that it is relevant to the practice organization.

It is advisable to add a glossary to the end of the report for technical terms used including the company specific jargon.

The summer practice reports are due within the first two weeks of the following academic term.

EVALUATION OF THE REPORTS

The grading of the reports is as follows: There is a total of 200 points obtainable from the questions section and 100 points obtainable from the problem or participated project section. **IE 400 students must pass separately on both counts and have to score at least 50% in each of the question section.** For the question section any grade between 125 and 160 points or any grade less than 50% of the full score of a section will be considered as 'Incomplete' and the report will be returned to the student for revision. Grades less than 125 will be considered as 'Unsatisfactory' and the summer practice will be repeated in a different work place the following year. For the problem or participated project section, any grade between 40 and 65 points will be considered as incomplete and the report will be returned to the student for the revision of this section. Grades less than 40 for the problem or participated project section will be considered as 'Unsatisfactory' and the summer practice will be repeated in a different work place the following year.

The 200 points will be accorded as follows:

Introductory Features	: 10 points
Analysis of Macro Aspects	: 20 points
An Overview of the Production System	: 35 points
Production Planning and Control System	: 50 points
Quality Planning and Control System	: 20 points
Management Information System	: 20 points
Work Study	: 20 points
Conclusion	: 15 points
Style and Organization of the Report	: 10 points

You are required to fill out the online questionnaire on the website www.ie.metu.edu.tr/~sp. The questionnaire should be filled out until the submission date of your summer practice report. Otherwise your report will be considered as incomplete.

PROBLEM / PARTICIPATED PROJECT SECTION

The content of the problem/participated project section will be evaluated on the basis of the following:

- Problem/Project context (relevance to industrial engineering and significance for the practice organization)
- Technical content of the work reported on
- Style and organization of the section (language, presentation order, clarity)

PROJECT-TYPE SUMMER PRACTICE REPORT

For the students who will submit a project-type summer practice report, the 100 points will be accorded as follows:

Introduction : 5 points
- Description of the company

Literature Review : 10 points
Problem Definition : 30 points
- See Identification and Definition of a Problem part in Appendix A.

Data Gathering and Analysis : 10 points
Solution Approaches : 20 points
Results : 15 points
Conclusion : 10 points

1. INTRODUCTORY FEATURES

1.1 What is the full title of the firm? When was it founded and where is it located? (Give the full mailing address)

1.2 What is the type of ownership of the firm? State the main shareholders and their shares. Is the firm a partnership, a joint venture, a franchise, a part of a holding company or a part of a multinational group?

1.3 Specify the sector and typical products the firm manufactures or typical services it provides to its customers. Include a few samplers of its advertising brochures or pamphlets or catalogue pages in your appendices to illustrate typical products or services, if available. What are the firm's shares in the domestic market and (if any) in the international markets?

1.4 Who are regarded as the customers of your practice organization (consider the end users, retailers, other manufacturers, employees, etc.)?

Identify the stakeholders, i.e. the groups considered by the organization to have any sort of interest in the organization's activities (such as certifying agencies, labor unions, professional societies, government, local community, potential customers, competitors and employees).

1.5 Provide a list of functions performed by the industrial engineers in the practice organization.

2. ANALYSIS OF THE MACRO ASPECTS

2.1 *Production (or service operations) system is the heart of every organization as it consists of all the activities that add value to its output. A production system uses many types of input (e.g. materials, equipment, supplies, labor, energy, money, information) some of which are the products of other organizations and transforms them into goods or services as outputs. These goods and services may also be used as inputs to other production systems. Besides, a production system interacts with its environment (e.g., customers, competitors, national economy, government, technology, creditors, suppliers) during its operation..*

An overall view of any production system whether it manufactures goods or provides services, can be stated by taking the inner working of the system as a <u>black box</u>.. This requires identifying inputs into and outputs from the system.

Study the production (or service operations) system of your practice organization taking an overall view. Sketch the system as a black box identifying its inputs and outputs.

Does the firm produce goods and/or services only for the domestic market? If it exports some or all of its products, give some quantitative details of these for as many past years as you can find data for. Are there any constraints (or regulations) that prevent the firm from competing with similar products (or services) in the foreign market?

Does the firm import raw materials, intermediate goods or any of its inputs (in your black box diagram)? If so, list the countries from which imports arrive.

What are the standards and certificates (such as ISO, TSE, EN, EC, etc.) the firm conforms to with regard to its activities? Describe briefly and exemplify any limitations or norms imposed by these standards.

2.2 *Every organization has a reason for existing and identifies what business it is in. This is its mission. For example, an organization operating a five-star hotel accommodation might have the mission of supplying premium quality service with an elite image. Vision, on the other hand, is the ability to imagine a different and better situation and ways to achieve it. An airline company, for instance, may imagine itself to be among the top three in the world for frequent business travellers. An auto manufacturer may have the vision of getting ninety-nine out of every hundred cars delivered with no defects whatsoever.*

How can you state the mission of your practice organization? Are there differences in missions regarding different goods or services offered by the firm? What visions are there with regard to the services (or goods) and processes performed in your practice organization?

2.3 *When deciding on the location of a manufacturing or service facility, there are many factors to be considered. Some of these are:*

a) distribution needs for the products,

b) availability or physical characteristics of raw materials,

c) physical characteristics of the products, characteristics of the services provided

d) labor availability and quality,

e) transportation facilities,

f) proximity to suppliers, proximity to customers of the provided services,

g) environmental factors,

h) laws, taxation, incentives, government politics etc.

i) cost of land and buildings

Specify the most prevailing factor for selecting the current location of the facility with regard to the factors listed above or the like. Support your ideas with quantitative or qualitative observations. (You may use a sketch, a table, a graph or a map, if necessary).

THE FOLLOWING SECTIONS (2.4 AND 2.5) ARE OPTIONS FOR YOU TO CHOOSE ONE TO STUDY AND REPORT ON:

2.4 *In any enterprise, there will be a need for capital for investments. Such an investment may be required for: (a) replacing old machinery and equipment, (b) capacity expansion, (c) increasing service quality or availability through new facilities, new branches, new products, etc.*

Does top management have plans and proposals for capital investment? If so, state what these investment plans are. If not, explain why top management is not currently considering such plans.

What evaluation methods and criteria are used to select among several alternative investment proposals? Is there a procedure to take into account the effects of inflation in considering future investments? Provide an example as to how investment alternatives were evaluated in the past. If such a procedure is not used, propose and justify a selection procedure.

2.5 *Technology covers all the knowledge (principles, procedures, reasoning etc.) and means (equipment, tools, components) of producing desirable outcomes from various inputs under given conditions. The search for development, adaptation and implementation of technologies is mostly taken as projects in organizations. A project could be defined as a series of related jobs usually directed toward some major outcome, requiring a significant period of time to perform and it often consists of capital investments and/or activating changes in organizational procedures through various stages. Project management can be defined as planning, directing and controlling the resources of people, equipment, material and money to meet the technical, cost and time constraints of the project. PERT/CPM oriented techniques are frequently used for project management.*

How did the firm obtain its know-how and/or technologies? Have there been improvements, upgrades or renewals in major procedures, processes and technologies? Does the firm use any licensed trademarks, patents, technological know-how, titles, etc.? Describe briefly and exemplify any

limitations imposed by the providers of technology or providers of registered trademarks.

Is there a unit or activity involved in research and development (R&D) for products, services and processes in the firm? If so, describe its status regarding its human resources, machinery/equipment, library and budget. If there is not, how are innovations for new products, services or processes being done?

How is project management exercised with respect to capital investments or technology adoptions?

3. AN OVERVIEW OF THE PRODUCTION SYSTEM

3.1 *A production system takes inputs and transforms them into outputs with some inherent value. The transformation process is, in fact, a flow process of input materials and information. Production systems can be categorized into two classes as manufacturing and service. In manufacturing, the inputs and outputs are usually tangible, and the transformations are often physical. On the other hand, service-oriented production systems may have intangible inputs/outputs, such as information, and transformations that may not be physical.*

Provide a process (operations) chart of a major

- product/subassembly or
- routing for a group of products or
- service process.

3.2 *Capacity is the maximum output of a system in a given period. Capacity is normally expressed as a rate, such as the number of tons of steel that can be produced per week, per month, or per year. For many companies, measuring capacity can be straightforward. It is the maximum number of units that can be produced in a specific time period, for example, the number of cars assembled per month in the automobile industry. However, for some organizations, determining capacity can be more difficult. In job shop production systems, for example, the products are so varied that defining capacity in terms of output is not meaningful. In such systems, capacity should be expressed in terms of resource inputs such as total work time*

available, beds available/day in a hospital, or as a capacity vector indicating production levels of products.

The designed capacity (theoretical capacity) of a system is the maximum capacity that can be achieved under ideal conditions. Most organizations operate their facilities at a rate less than the designed capacity. They do so because they have found that they can operate more efficiently when their resources are not stretched to the limit. This concept is called effective capacity or utilization. Utilization is the maximum capacity a firm can expect to achieve given its product mix, scheduling method, maintenance program, and standards of quality. Another consideration is efficiency.. Depending on how facilities are used and managed, it may be difficult to reach 100% efficiency. Typically, efficiency is expressed as a percentage of the effective capacity. Then the rated capacity is a measure of the maximum useable capacity of a particular facility. Rated capacity can be computed as:

Rated capacity = (Designed capacity) (Utilization) (Efficiency).

How is the rated capacity of your practice organization defined and measured?

3.3 *Production processes –both manufacturing and service- can be categorized as follows:*

Those processes in manufacturing that are characterized by continuous flow as in steel making, sugar refining and chemical processing are called continuous processes, and similarly in service systems, services such as police and fire protection are examples of ongoing processes that operate on a continuous 24-hour basis.

When items are produced in large lots following an unchanging sequence of operations in manufacturing, and standardized services are delivered in service systems, the process becomes a repetitive process. Standardized product types characterize it. Due to unchanging routing of parts, facilities can be arranged as a flow shop. An automobile assembly line in manufacturing, cafeteria and university registration as service systems are good examples of a flow shop.

Intermittent processes are those processes in which items are processed in small lots to customer specifications in manufacturing, and services are tailored to customer specifications in service systems. Job shop, batch shop and project shop typify these. A job shop produces low-volume highly customized products. Product routing

varies widely and facilities are arranged on a functional basis. Metal, plastic, woodworking industries, and providing special-delivery mail service and service department for an automobile dealership where non-standard products are processed, are examples of job shops. Between the extremes of job shops and flows shops is the batch shop.. In batch shops, product variety is lower; batch sizes are larger; and repetitiveness of operations is higher compared to job shops. An example of a batch manufacturer might be a company making small hand tools like drills of different sizes; and examples of batch service might be catering, health care, and providing standard service in groups like scheduling air or bus travel. Project shop produces a single, customized product like large turbines, aircrafts, and ships in manufacturing organizations, and developing software, management, consulting work, preparing for a banquet in service organizations.

A production system's operation can also be classified as make-to-stock (MTS), make-to-order (MTO), or assemble-to-order (ATO). This classification is based on the degree of interaction between the firm's production function and the customers of the firm, with MTS involving the least amount of interaction and MTO the highest degree of contact. The MTS firm produces in batches and carries finished-products inventories, where products can be delivered from stocks. The small-appliance industry, in which manufacturers build inventories for future sales, is an example. Since services cannot be stored, service firms cannot operate as an MTS system. In MTO firms, no finished-products inventory is held, and customer orders are backlogged; products are designed and produced under close collaboration between the firm and customer, only after the order is received. Jet engine manufacturing is an example of MTO manufacturing, while an automobile repair shop is an MTO service. ATO is a hybrid firm where parts and subassemblies are made according to forecasts while the final assembly of the products is delayed until customer orders are received. An example of an ATO manufacturer is an automobile factory that, in response to a dealer's order, provides an automatic or manual transmission, air conditioner, interior options, etc.; and an example of an ATO service firm is a fast-food shop.

A production system may be a combination of the above classes.

Explain the type of operations or combination of types in your practice organization.

3.4 *Layout is concerned with determining the best arrangement of the appropriate number of facilities, stock areas, and service centers in the production system. A block plan is a diagrammatic representation of a plant's physical facilities showing internal positions and area allocation to departments.*

Draw a block plan of your practice organization or provide a blueprint, if available.

3.5 *The types of layouts in a production system can be as follows:*

One typical job shop layout is process layout in which all similar equipment and operations are grouped together in the same department. For example, all stamping is done in the press department. Services also may be arranged according to process. Some examples are retail stores that group all similar products such as hardware, sporting goods, and photographic equipment in separate departments for ease of supervision and access by customers; outpatient clinics; travel agencies; insurance companies. A flow shop, on the other hand, uses a product layout. Equipment is arranged so that the product always follows the same routing through the layout. For example, assembly line is a typical example for product layout (automobile industry, home appliances, and electronics industry). Some services also may be arranged in a product layout. For example, in a cafeteria line, people pass from one type of operation to another. Group technology (GT) or cellular layout can be used to develop a hybrid between pure process layout and pure product layout. The equipment is arranged into cells, each containing the equipment used to process a particular family of parts. A project shop uses a fixed-position layout. The product (aircraft, ship, or a person who will have a surgical treatment in a hospital) stays in one place while the material and equipment are brought to it. Most plants are laid out using a combination of these layouts. The layouts are seldom seen in their pure form. Most production systems are laid out using a combination of these layouts.

Discuss the type or combinations of the types of layout you have observed in your practice organization.

3.6 *A Detailed Layout is a diagrammatic representation of a department showing the arrangement of people, materials and equipment as well as the arrangement of supporting activities. Since it is difficult to represent all the details of layout of a production system on a single diagram; usually separate, detailed layout diagrams are drawn for each department.*

Select a typical department within your practice organization, and indicate the type of layout of this department. Discuss how the characteristics of this layout type fit the characteristics of this particular department.

3.7 *Based on the determination of standard times for each part/product/service, unit-manufacturing/service costs can be estimated. Unit-manufacturing/ service cost of a product/service has to be determined to be utilized in various planning and decision making functions. There are three basic cost elements: direct material cost, direct labor cost and overhead cost. Unit-manufacturing or unit-service cost can be calculated as:*

Unit-manufacturing or unit-service cost = Unit direct labor cost + Unit direct material cost + allocated overhead to a unit.

Are unit-manufacturing or unit-service costs calculated in your practice organization? If yes, explain how they are calculated and provide an example. If no, describe how expenses will be accounted for under different cost items for any one of the products/services.

3.8 *Balance sheets and income statements are the basic tools to analyze the firm's financial situation. Ratio analysis is often carried out for this purpose.*

Carry out comparative ratio analysis using the balance sheets and income statements for the last two years and evaluate the financial standing of the organization. (Calculate all the necessary ratios for such analysis), or itemize titles for the balance sheet/income statement for the organization.

YOU DO NOT HAVE TO WORK ON ALL QUESTIONS IN CHAPTERS 4, 5, 6, AND 7. YOU HAVE TO REPORT ON AT LEAST 3 QUESTIONS OF CHAPTER 4, AT LEAST 2 QUESTIONS OF CHAPTER 6 AND AT LEAST ONE QUESTION IN EACH OF CHAPTERS 5 AND 7.

4. PRODUCTION PLANNING AND CONTROL SYSTEM

4.1 *Production planning and control can be viewed as a system. It contributes to the overall objectives of the organization through its impacts on the cost, volume, quality and timeliness of production or service operations.*

Production planning and control consists of interrelated and interacting subsystems. They need to operate and behave in harmony so that the overall planning and control system is more than just the total of their outcomes (synergy). Some of the subsystems that can be found in most production planning and control systems are:

- *forecasting and demand management*
- *aggregate production planning*
- *inventory planning and control*
- *detailed scheduling*

Forecasting is a basic element of management decision making. Indeed, virtually every significant management decision is predicated on some forecast of the future. At the corporate level, forecasting forms the essence of long range planning. Within the functional areas, finance and accounting rely on forecasts of demand for budgetary planning and cost control. Production and operations management uses forecasts in making periodic decisions involving process selection, capacity planning and facility layout and for decisions pertaining to production planning, scheduling and inventory.

Discuss the forecasting activities of the firm. Identify purposes of forecasts. Provide the forecasting methods that the firm uses. Choose an example of forecasting activities and specify factors such as: the need for forecasting, sources of data or method of collecting opinions, any model used, forecast accuracy measurement and computer support in forecasting.

4.2 *Decision of what and how much to produce brings the problem of determining type(s) of product(s) to be produced or services to be provided. This requires an analysis of the market as well as examining the past data.*

Who makes (or has made) such decisions in your practice organization? How are these decisions made?

Volume and timing of production is a set of decisions related to the allocation of scarce resources. Every organization has limits on its resources (number and quality of key personnel, amount and sources of capital, available funds in cash, office space, land and buildings, materials and supplies, tools, equipment and apparatus, etc.). The issue is how to allocate these scarce (i.e., limited) resources to the best advantage of an organization.

These allocation decisions, in general, are known as production plans in manufacturing firms and as activity plans in service organizations.

What resources are scarce and subject to a production or an activity plan to exercise a tight control for their usage? Name a few of these limited resources. What are the current limits? What determines these limits?

What are the main concerns (like customer satisfaction, total cost, time losses, utilization rate, etc.) in allocating such resources? Is there any measurement of the extent to which these concerns are fulfilled? If yes, describe a few examples. If no, suggest some measures. Evaluate such existing (or proposed) measures.

How are allocation plans made? Are they reviewed on some periodic basis?

4.3 *Inventory, in very general terms, is any value or resource accumulated and left idle for some reason. Material inventories of various classes may be held such as: raw materials, spare parts, supplies, purchased components, work-in-process or finished goods. Inventories may occur in service organizations too, in the form of material inventories for supplies or backlog of service load in progress (or being held for some reason).*

Inventory control policies are mainly classified as periodic review and continuous review control policies. Monitoring the inventory position after every transaction indicates a continuous review policy. In the periodic review policy, inventory level is observed at equally spaced points in time.

Define major items of inventory by their functions. Explain reasons (uncertainty, seasonal fluctuations, cycle stocks, quantity discounts, pipeline effect, etc.) for holding these items. Justify any one of the items' inventory, stating what would happen (cost, time losses, faulty processing, transportation difficulties, etc.) if that inventory were not carried. Discuss the inventory control policies exercised in your practice organization for the major items you

specified above. How would you measure the performance in managing these inventories? Propose and compute the value(s) for at least one such measure.

Is there a materials requirement planning (MRP) activity carried out in your practice organization? If yes, describe how it is performed. If no, state the reasons for not needing (or the impossibility for implementing) it; describe what could be gained if some form of MRP were implemented in your practice organization.

4.4 *Resource allocation (with regard to equipment, personnel, vehicles, tools, funds, materials, space, etc.) in the short term (on per-shift, daily, or weekly basis) at the operational level is carried out through detailed scheduling.*

Explain the detailed scheduling activities carried out in the firm. Are there any records of detailed schedules in the form of timetables, daily lists, charts, order forms or the like? If yes, provide an example and explain how it is prepared. If no, state the reasons of not needing (or the impossibility in realizing) any sort of a schedule. Take a suitable activity or area in your practice organization (department, division, hall, or functional unit) for which a detailed schedule exists or an allocation of some resource can be observed for a short term. Apply an appropriate performance measure on the implementation of a predetermined detailed schedule or (if no predetermined schedule exists) the allocation of a resource as it is realized.

4.5 *A recent trend in manufacturing management that also started to find some implementation in services is the application of Just-in-Time (JIT) philosophy. The objective of JIT is to work towards reducing organizational slacks carried to assure a smooth operation (for instance, large inventories, extra allowances for scraps, buffers among machinery, promising extended delivery dates, excessive supervision, redundancies in record keeping, etc.) ideally to a zero level in all activities. This is to be achieved in gradual steps through the process of continuous improvement.*

Are there organized and focused studies for the purpose of reducing such undesired "slack"? If yes, describe an example. If no, state an example of allowance or slack you have observed, that is used in the organization to assure safe (uninterrupted) operation. What do you think has caused the need for such an assurance?

5. QUALITY PLANNING AND CONTROL SYSTEM

5.1 *There is little agreement on what constitutes quality. Most people conceive quality as an attribute of a product or service that can be improved. However, quality is not only associated with products and services, but also includes processes, environment and people. It is an ever-changing state; what is considered quality today may not be enough to be considered quality tomorrow. Hence, quality can be defined as a dynamic state associated with products, services, processes, environments and people, that meets or exceeds expectations.*

The following is just a few other definitions proposed for "quality":

- *Quality is fitness for use.*
- *Quality is conformance to requirements.*
- *Quality is the total composite product and service characteristics of marketing, engineering, manufacture and maintenance through which the product and service in use will meet the expectations of customers.*
- *Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs.*

Hence, a high quality product or service should well meet expectations of all involved customers or stakeholders.

Quality control is exercised at all four stages of a product/service life cycle:

a) Product/service design stage (innovation, robust design, tolerance design)
b) Manufacturing/service process design stage (innovation, robust design, tolerance design)
c) Manufacturing/service delivery stage (detecting problems and correcting them, compensating for known problems, screening undesirable products.)
d) Usage stage (warranty and repair).

Choose a product/service and explain how the organization defines quality of it. How are customer requirements translated into product or service specifications (or characteristics)? Provide examples. Also describe the quality control activities that take place throughout the life cycle of that product/service.

5.2 *Recent trends in quality management focus on quality assurance that emphasizes the preventive aspects of quality management. Quality is viewed as the job of everyone, and continuous improvement*

towards the eventual goal of meeting and exceeding customer requirements is a basic principle of the modern quality management approach.

Discuss at least three quality assurance activities taking place in the firm that are proactive (preventive) rather than reactive (detection and correction oriented).

Describe and discuss how responsibility of quality is shared in the firm (quality organization).

6. MANAGEMENT INFORMATION SYSTEM

6.1 *Every organization has an information system that is designed to meet its information requirements. Data are recorded, classified, summarized and processed to produce information in this system. Management information system should support decision making at three different levels:*

a) Strategic level decisions (e.g. plant expansion, determination of product lines, mergers, diversification, capital expenditures, etc.).
b) Tactical level - implementation of plans (e.g. allocation of resources to different products, formulation of budgets, funds flow analysis, plant layout decisions, personnel problems).
c) Operational level, day-to-day routine operations (e.g. receiving and shipping operations, scheduling, inventory control and allocating workers to jobs).

Specify the decision makers (individual or group, their positions within the organizational structure) and the related subject of decision making with regard to one decision making activity in each of these decision levels.

6.2 *Computers are widely used in processing data and providing information for managerial decision making. They are also employed in organization to improve productivity and provide better utilization of resources. The physical units making up a computer system are called hardware.*

Identify the computer system (computer networks, stand-alone PC's, workstations, main frames , etc) their types and approximate capacities in use and their spread (functions or departments with extensive or low computer support in their operations) in your practice organization. Take a particular division or department that has access to a computer (as a system, as connected to a network or as a stand-alone computing facility). Itemize types of data recorded and processed. Discuss the level of decision supported in light of section 6.1 above. What are decided based on that specific data?

6.3 *The effectiveness of a computer and the ease with which it can be utilized depends upon a number of factors such as the mode of operation of the computer system, availability of high level language compilers, application programs (utility programs, file handling software, database management system software) and so on.*

Identify the software used in the firm. Name a few application programs available in the organization for enterprise wide application (Enterprise Resource Planning (ERP), reservation system, stock keeping, accounting etc.) except standard office programs (word processors, spreadsheets, presentation organizers). Discuss the level of decision supported in light of section 6.1. Give an example of what is performed based on that specified software.

7. WORK STUDY

7.1 *Work Study is a term used for those techniques, particularly method study and work measurement, that are used in the examination of human work in all its context and lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to bring improvement.*

Method study is the systematic recording and critical examination of existing and proposed ways of doing work as a means of developing and implementing easier and more effective methods and reducing costs.

Work measurement is the application of techniques designed to determine the time needed by a qualified worker to carry out a specified job at a given performance level.

Work Study is mostly used to increase production using a given quantity of resources with little or no further capital investment. In other words, it deals with increasing the productivity. Through the tools and techniques of work study, basic standards and operation routings are developed that will improve planning and control.

Apply one of the work measurement techniques (stopwatch, predetermined time standards or work sampling, etc.) to either

a) a member of the office staff, or
b) an assembly operator, or
c) one or more machine operators, or
d) any routine manual task operator

and evaluate the results. Apply method study to define more effective methods.

7.2 *Jobs within an organization are not all alike. Some are more demanding physically, some require unusual mental skill; some must be performed under unfavorable working conditions. 'Job Evaluation' is a systematic procedure for establishing a hierarchy of jobs. A 'Job Description' gives a brief definition of the job and presents a detailed account of the job content based on the results of job analysis. A 'Job Specification' describes the skills involved in the job and other mental, physical, educational requirements that the job demands from the worker.*

Job Evaluation studies are used in classifying workers and staff into 'wage groups'. Since the requirements of each job are described in detail, the findings are also taken into consideration in the execution of employment and training activities of the firm.

Has there been any 'Job Evaluation' study in the firm? If so, discuss briefly the method and the current implementation of the findings of the study. If not, explain how the wage differentiation among the personnel is determined.

8. CONCLUSION

8.1 *The following questions are prepared to obtain your own assessment of the summer practice. You can add as many ideas as you wish besides answering these questions. You should not, however, ignore any question. Your answers, additional ideas and suggestions will guide the reorganization of this manual in the future.*

Is the procedure you have followed in this summer practice sufficient in its scope, method and general approach? If not, identify the drawbacks. State your suggestions for an improved procedure. If you found it sufficient, state what you enjoyed most about it. What was the most difficult part in your study of a potential IE problem?

If you had another four weeks in the same firm, what would you be occupied with and why?

What do you expect to learn in your future training as an industrial engineer that will help improve your understanding of production systems? How can you further develop your capability of handling problems of these systems?

Drawing on your experience of this practice, discuss the differences between industrial engineering and other engineering disciplines with respect to their responsibilities and ways of approaching their duties in the production environment.

If industrial engineers are employed by the firm, what are the areas they work in? If no industrial engineer is employed, what activities (if any) do you think are suitable for IEs in your practice organization? Discuss top management's impression and attitudes towards industrial engineering functions and activities.

8.2 *You are required to fill out the online questionnaire on the website* **www.ie.metu.edu.tr/~sp**. *The questionnaire should be filled out until the submission date of your summer practice report. Otherwise your report will be considered as incomplete.*

APPENDIX A

A NOTE ON THE DEFINITION AND FORMULATION OF INDUSTRIAL ENGINEERING PROBLEMS

You are required to identify, define and formulate an industrial engineering problem. The problem may be related to one or more areas of interest in industrial engineering. The problem has to be examined with its specifics for your practice organization.

You are advised to take the view outlined below (an excerpt from "Notes on System Design" by Prof. Dr. Çağlar Güven, February 1998) in identifying and describing a problem:

Engineers are expected to 'solve problems'.. To see what this means we can adopt a simplified view: a problem is something that needs a solution but does not have one. At first sight the difficulty seems to be finding a solution but as far as IEs are concerned, often that's not even half the difficulty. Forget about well-defined textbook problems and solutions. Real-life problems have a bothersome habit: they don't come singly. They stick firmly together and often we cannot tell one from the other. Instead we observe a tangled web, and as we do so, we have to try hard to catch glimpses of individual problems. The usual inclination is to forget about the other problems in the web once we believe we have identified one. We shall say more of this later; for the moment let me put it like this: it may very well be better to spend more of your time trying to identify and structure issues than trying to solve problems. In any given problem situation there will always be more than one issue involved. Consider for example, the design of a fast-food outlet: Forecasting the demand for food ingredients, scheduling the staff, pricing the foods, capacity planning, planning daily purchases, selecting a location, training the staff and several other aspects similar to these are the issues you have to consider. Which ones are you going to address? Structuring an issue means studying and selecting one for further analysis using models within a systemic framework. The reason why structuring issues is at least as important as solving problems can be explained as follows: We do not really know what we mean by a solution. When we talk about a problem we imply that there exists a set of conditions that is less than satisfactory and needs improvement. The nature of the improvement however is often not clear at all and the dynamics of the improvement process is equally complicated. The end result is obtained one way or another and is likely to be the product of the joint effort of many people. One might say then that suggesting questions can be more important, potentially more originative, than suggesting answers. In this way issues will be unfolded that might otherwise have gone unnoticed. It all comes to this: an IE will perhaps be most useful if she can point out meaningful problem areas and if she can structure them; the rest will be collectively taken care of by the organization, one way or

another. But even so, this does not mean that you can forget about looking for solutions altogether; for you see, looking for solutions is in fact part of looking for problems.

1. Identification and Definition of the Problem

Various industrial engineering problems exist in a production environment as interwoven with each other. Deficiencies occurring in production planning may be the consequence of ill-structured forecasting done by the marketing department. The problems encountered, say in raw material inventory holding, may be the result of economic crisis experienced in the sectors providing the raw material. The low utilization of machinery may be due to high level of absenteeism among workers for which the major reason could be poor industrial relations. Deficiencies in production planning, problems in raw material inventory holding, and low utilization of machinery are all symptoms of the problems.

Problems are identified by observing such symptoms through a careful analysis of the existing system. A trouble-shooting exercise is essential in order to define an industrial engineering problem. Possible causes of the symptoms should be studied. Observations of symptoms should be validated by objective measurements (e.g.: low utilization of machinery should be proven by data collected on utilization rates). This analysis can be supported by some of the questions in this document. The guidance and proposals of the authorities in the firm may also help in the identification of an industrial engineering problem. In studying the problem situation you may use the following analysis tools:

- cause-effect diagrams (fish bone diagrams)
- pareto analysis
- relations diagram
- logic tree analyses
- flowcharts
- check sheets
- rich pictures
- brainstorming
- run charts
- influence diagrams

- multivoting
- nominal group technique
- stratification
- affinity diagrams
- precedence diagrams

2. Formulation of the Problem

At the end of the first step, you should have identified the virtues or benefits, pitfalls, shortcomings or disadvantages of existing practices pinpointing functions that are partially or completely lacking. Such an evaluation forms the basis for the redesign and improvement of the existing system.

A clear formulation of a problem starts with:

- an exact description of the decision maker (owner of the problem),
- the goal or the objective (direction of and satisfactory amount of improvement) of the decision maker,
- performance criteria (to be used in evaluating goodness of a solution in achieving the objective),
- an identification of alternative courses of action (to achieve the objectives), and
- a clear recognition of the limitations, restrictions and requirements of the system. An analysis of the interactions of the problem with various subsystems in the firm can also be carried out during this phase.

You are encouraged in this formulation stage to think and comment about specific modelling approaches appropriate for the problem you defined.

APPENDIX B

A NOTE ON REPORTING ABOUT A PARTICIPATED PROJECT DURING THE SUMMER PRACTICE

You may have taken a role within the scope of industrial engineering on an ongoing project in your practice organization. Instead of identifying and formulating a separate problem, you may report on this project and your specific part in it. However, you are required to verify that the project is in a relevant area of interest with regard to industrial engineering and that a well identified problem had initiated the project work.

If the project you participated in is completed, you are required to submit a report consisting of at least the following sections:

- Introduction (Products/Services/Manufacturing/Service Provision processes addressed in the project, context of the problem, composition of the project team)
- Problem statement (Description of what issue was tried to be solved/improved/implemented, its relevance as an IE problem)
- Approach Taken (what stages were initially planned for the project, why and how were they modified during the work on the project, your role specific within the approach)
- Summary of Work Done (a sample list of data gathered or facts collected and analyzed, methods used in these, typical results of calculations/experiments/ estimations etc.)
- Conclusions and Recommendations (Outcomes of the project, Suggestions made, initiated actions, extensions of the results, your evaluation of the outcomes)

If the project you participated in was still in progress at the end of your practice period, you are required to submit a report consisting of at least the following sections:

- Introduction (Products/Services/Manufacturing/Service Provision processes addressed in the project, context of the problem, composition of the project team)

- Problem statement (Description of what issue was tried to be solved/improved/implemented, its relevance as an IE problem)
- Approach Taken (what stages were initially planned for the project, your specific role within the approach)
- Project Schedule (a project activity network or a Gantt chart)
- Work Done To Date (a sample list of data gathered or facts collected and analyzed until the time you quit the organization, methods used in these, typical results of calculations/experiments/ estimations etc. done that far in time)
- Expectations of the Outcomes (Prospective benefits, your evaluation of the outcomes)

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