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COMPARATIVE STUDY OF OPERATIONAL DATABASE AND DATA WAREHOUSE

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Abstract

Everyday a new technology is coming to computer world. These technologies are beneficial to us if we have full knowledge about them. In this paper we will try to provide knowledge about two technologies. We are conducting comparative study of operational database and Data warehouse. Operational Database is used in day-to-day operations while Data warehouse is decision support system. These comparisons are going to provide detailed knowledge about these two terms.

Keywords : Schema, Data, Normalization, Operational Database, Data Warehouse

1. Introduction

A **database** is an organized form of data. The term was originated within the computer industry, but its meaning has been broadened by popular use. A database is a collection of information organized under tables and definitions. The data within a database can be easily accessed and manipulated through computer program.

The **data warehouse** is generally described as a decision-support tool that collects its data from operational databases and other various external sources, transforms them into information and made that information available to business analysts in a consolidated and consistent manner.

The data warehouse can be very simply defined as an integrated, subject-oriented, time variant and non-volatile database that provides support for decision-making.[1]

Integrated

The data warehouse is a centralized database system that integrates data from different sources having diverse formats. This integration of the data provides a unified view of an organization. Data integration enhances decision-making and helps the manager to better understand the operations of an organization [1]

Subject-Oriented

The data in DSS database is organized to provide answers to various questions about different areas, within an organization. They are arranged under topics such as product, sales, marketing, finance and so on. The DSS database contains specific category for each topic like customer, product, region and so on. [2]

Time Variant

The data warehouse contains historical data that reflects what happened last week, last month and during last five years so on.

Non-Volatile

Once the data enters the data warehouse, It can never be removed or changed. Thus the data warehouse, represents the entire history of the organization

2. Comparisons

Data warehouse and operational database are two different terms. We are exploring these two terms by making comparisons between them.

2.1 DEFINITION

Operational database

The operational database is the source of data, for the data warehouse of an organization. It contains detailed data that used to carry out day-to-day operations of the business. The data continually changes as updates are made, and reflects the current value of the last transaction[5].

Data warehouse

A data warehouse is a database geared towards the decision-making requirements of an organization. The data warehouse integrates data from the various types of operational systems like relational databases, excel sheets, notepad files etc[1].

2.2 USERS

Database users:

Clerks, DBA, Database Professional and End Users etc use the operational database.

Data warehouse users:

Knowledge workers and Managers of an organization access data warehouses.

2.3 DATA

An operation system stores current up-to-date and detailed data. This data provides information about daily transactions.

Data warehouses usually stores data of last months or years. Data in data warehouse is historical, summarized and multidimensional.

2.4 TYPE OF DATA

In case of database homogenous data is stored, i.e. the data is collected only form single source that mean source data is having only format. In the data warehouse heterogeneous data is stored, i.e. the data is collected from various sources. These sources may have different format.

2.5 WORKLOAD

Database system supports only predefined operations. The queries on database are generally repetitive and predictable.

Data warehouses are designed to accommodate *ad hoc* and *random* queries. We might not know the workload of data warehouse in advance. So a data warehouse is optimized to quench variety of queries.[4]

2.6 SCHEMA DESIGN

Database system often uses fully normalized schemas to optimize update/insert/delete performance, and to guarantee data consistency.

Data warehouse often uses denormalized or partially denormalized schemas (such as a star schema, snowflake) to optimize query performance.

2.7 DATA STRUCTURE

In DATABASE system, the data structure is optimized for validation of incoming data during transactions. The data structure of operational database system supports real time validations.

The data warehouse is loaded with consistent and valid data. No real time validation is required.

2.8 DATA MODIFICATIONS

In database system, End users routinely issue individual data modification statements. The Operational database is always up to date, and reflects the current state of each business transaction.

A data warehouse is updated on a regular basis by the ETL process (run nightly or weekly) using bulk data modification techniques. The end users of a data warehouse cannot directly update the data warehouse.

2.9 TYPICAL OPERATIONS

A typical database operation accesses only a handful of records. For example, "Retrieve the current sale for this customer."

A typical data warehouse query scans thousands or millions of rows. For example, "Find the total sales for all customers last year."

2.10 LANGUAGE USED

To Access/Manipulate/Store data from Operational Database SQL (Structured Query Language) is used.

To Access data/Information from Data warehouse DMQL (Data Mining Query Language) is used.[3]

2.11 DIMENSIONALITY

The data in database system is single dimensional while the data in warehouse is multidimensional

The data warehouse is set to provide the larger picture. In other words, it includes multidimensional data. For instance, a sale manager may ask how many units of product X were sold to customer Y during the last T months. So, he or she can view the data from three dimensions: product, customer and time

2.12 SUMMARIZATION LEVEL

The data in operational database is less summarized as compared to data warehouse.

For example, rather than storing thousands of sales transactions for a given store on a given day, the data warehouse simply stores number of units of a particular commodity sold in a particular day.

2.13 TRANSACTION TYPE

The operational database differs from data warehouse in terms of transaction type.

The data in database is characterized by update transactions, while the data warehouse characterized by query transactions.. In data warehouses new data is loaded periodically from operational database and other external resources as well. This data is read only and can be used to retrieve a number of information.

2.14 ALIAS NAMES

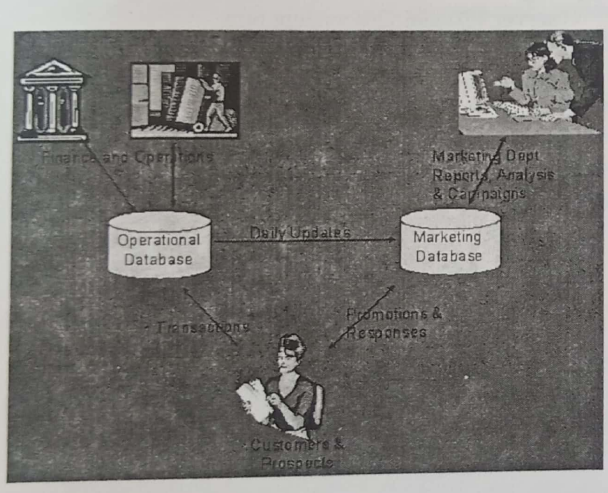
Operational database systems are Transactional database and production system. They are OLTP (Online Transaction Processing) systems. They used to run day-to-day core business of company.[2]

The term Data Warehouse is used interchangeably with DSS (Decision Support system) database. They are OLAP (Online Analytical processing) systems.

2.15 MAIN ROLE

The transactional database is optimized to support transactions that represent daily operations. For example an organization daily maintains information about various operations in various departments like finance, marketing, human resource etc. in operational database.

Fig. 1



This fig.1 shows the operational database is used to carry out daily/current operations of an organization.

The data warehouse is optimized to support data analysis and decision-making . Basically, it takes the summarized data from the operational database, filters them for analysis and decision-making processes. For instance, the manager of the admission and registration department may ask how many students in the university took science last year. The data warehouse satisfies his query. Then he will decide whether to increase number of sections of this particular course or not.

2.16 USAGE

The data in operational database is accessed by thousands of concurrent users i.e. its access frequency is very high.

The data in DSS is accessed by few concurrent users hence its access frequency is medium to low.

2.17 ARCHITECTURE:

Architecture of data warehouse shows that data in warehouse is collected from different sources, using various operational systems. Then data is transformed into summarized form. This data is used by analysts to extract hidden information.

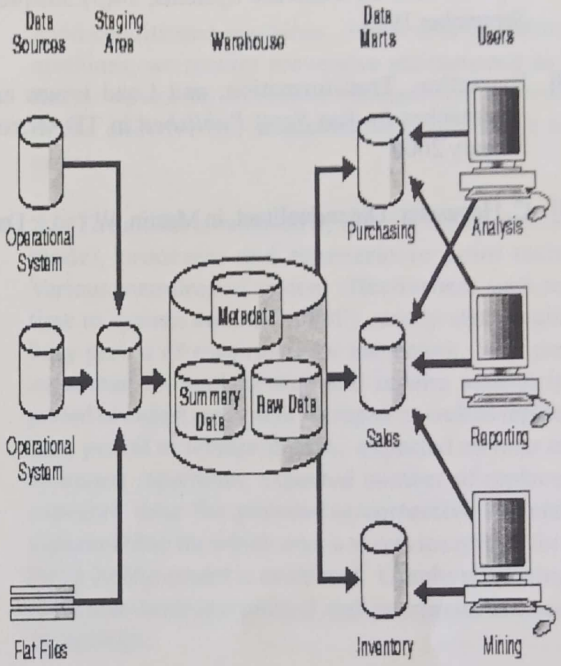


fig-2 (architecture of data warehouse)

While architecture of Operational Database can be relational which stores the data in form of Table or it can be network, which stores data in form of graph, or it can be hierarchical which stores data in form of tree.

Conclusion: -

This paper explains each aspect of operational database and data warehouse. Operational database is used to maintain current information. Data warehouse historical data from various sources and combine them in a common format. The analysts can apply various tools like OLAP and data mining to extract out hidden information that is used by managers to take various decisions. This paper provides a platform to research scholars to explore the terms, data warehouse and operational database.

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SINGLE UNIT PLC SYSTEM WITH PREVENTIVE/CORRECTIVE MAINTENANCE AND THREE TYPES OF REPAIR

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Abstract

Present paper deals with single unit PLC system with inspection, three types of repairs and two types of maintenances. It is the hypothetical industrial case. Firstly PLC was inspected by the permanently appointed engineer, if some replacement is required, it is replaced by the engineer at the industry itself. Otherwise he tries to repair it. If engineer is unable to repair it, an expert repairman is called on or sent to authorised service station. Various measures related to system reliability are obtained. Graphical study is also being brought out.

1. INTRODUCTION

After consulting ample number of papers from [1] to [7], it has been observed that considerations are depicted regarding the theoretical cases. It has been felt that a hypothetical industrial case may be taken up in which practical side of the unit will be studied with utmost care and slightness. For this purpose, we have taken PLC (programmable logic controller) as a unit. Here, regular engineers are appointed, expert repairman can also be called upon, if required. Besides PLC can be sent to authorised service station. To go deep into the matter two types of maintenances can be consulted and those are preventive and corrective maintenances. As the plant is being closed on Sundays and two hours daily at the lunch time, preventive maintenance can be conducted by the regular engineer.

Whenever fault arises, it is firstly inspected by the regular engineer. If there is any possibility for him to get it repair or replacement, he starts the corrective action otherwise an expert repairman from the concerned industry is called upon. Further there is possibility that machine (PLC) may be sent to authorised service station.

Now-a-days we are much more concerned for quality of the product. For quality oriented products, we require good conditioned machines. For proper conditioning of machines, we require preventive maintenance as a tool. Rather we can say corrective maintenance can be avoided by the effective use of preventive maintenance to large extent.

The model is analysed by making use of semi-Markov model, processes and regenerative point technique. Various measures of system effectiveness such as mean time to system failure (MTSF), steady state availability, busy period of repairman for inspection, busy period of repairman for replacement and repairs separately, busy period of expert repairman for repair as well as replacement, busy period at service station, expected number of visits by expert repairman, expected number of replacements, expected time for preventive/corrective maintenance, expected time for which unit is at service station for repair. Profit for the model is evaluated. Graphs pertaining to the particular cases are plotted and interpretations are made accordingly.

2. NOTATIONS

α : rate from operative state to down state
β : rate from down state to operative state
λ : constant failure rate
p : probability that failed unit is repairable
q : probability that failed unit is not repairable
i(t) : pdf of inspection time after failure
h(t) : pdf of replacement time
$g_1(t)$: pdf of repair time by regular repairman
$g_2(t)$: pdf of repair time by expert visiting repairman
$g_3(t)$: pdf of repair time taken by service station
a : probability that regular repairman is able to repair
b : probability that regular repairman is unable to repair
b_1 : probability that unit is sent to service station
b_2 : probability that expert is called from service station to complete the repair
F_d : unit in down state

F_i : failed unit under inspection of permanent engineer

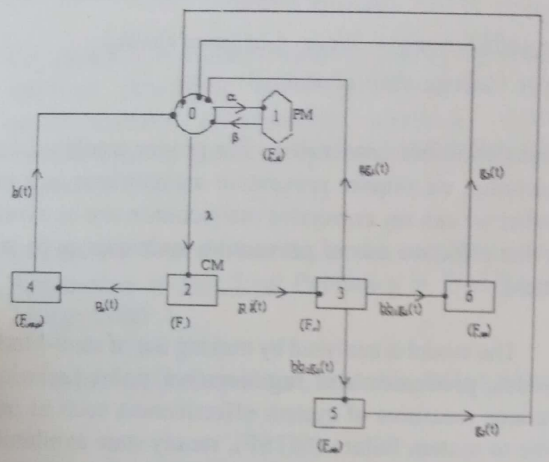
F_r : failed unit under the repair of permanent engineer

F_{ss} : failed unit under repair at service station

F_{re} : failed unit under the repair of expert repairman

F_{rep} : failed unit under replacement

Model:



Operative State

Down State

Regenerative State

Failed State

3. STATE TRANSITION PROBABILITIES

$dQ_{01} = \alpha\, e^{-(\alpha+\lambda)t}\, dt$, $dQ_{02} = \lambda\, e^{-(\lambda+\alpha)t}\, dt$,

$dQ_{10} = \beta\, e^{-\beta t}\, dt$, $dQ_{23} = p\, i(t)\, dt$

$dQ_{24} = q\, i(t)\, dt$, $dQ_{35} = bb_2\, g_1(t) dt$,

$dQ_{36} = bb_1\, g_1(t)\, dt$, $dQ_{30} = ag_1(t)\, dt$

$dQ_{50} = g_2(t)\, dt$, $dQ_{60} = g_3(t)\, dt$,

$dQ_{40} = h(t)\, dt$ (1-11)

The non zero elements of P_{ij} are given below :

$p_{01} = \left(\frac{\alpha}{\alpha+\lambda}\right)$, $p_{10} = 1$, $p_{02} = \frac{\lambda}{\lambda+\alpha}$ $p_{23} = p$,

$p_{24} = q$, $p_{35} = bb_2$

$p_{36} = bb_1$, $p_{30} = a$, $p_{50} = 1$ $p_{60} = 1$,

$p_{40} = 1$ (12-22)

4. MEAN SOJOURN TIMES

$\mu_0(t) = \frac{1}{\alpha+\lambda}$, $\mu_1(t) = \frac{1}{\beta}$,

$\mu_2(t) = \int_0^\infty \bar{I}(t)\, dt$, $\mu_3(t) = \int_0^\infty \bar{G}_1(t)\, dt$

$\mu_4(t) = \int_0^\infty \bar{H}(t)\, dt$, $\mu_5(t) = \int_0^\infty \bar{G}_2(t)\, dt$,

$\mu_6(t) = \int_0^\infty \bar{G}_3(t)\, dt$ (23-29)

5. UNCONDITIONAL MEAN TIME (m_{ij})

$m_{01} = \frac{\alpha}{(\alpha+\lambda)^2}$, $m_{10} = \frac{1}{\beta}$

$m_{02} = \frac{\lambda}{(\alpha+\lambda)^2}$, $m_{23} = \int_0^\infty t\, p\, i(t)\, dt$

$m_{24} = \int_0^\infty t\, q\, i(t)\, dt$, $m_{35} = \int_0^\infty t\, bb_2\, g_1(t)\, dt$

$m_{36} = \int_0^\infty t\, bb_1\, g_1(t) dt$, $m_{30} = \int_0^\infty t\, ag_1(t)\, dt$

$m_{50} = \int_0^\infty t\, g_2(t)\, dt$, $m_{60} = \int_0^\infty t\, g_3(t)\, dt$

$m_{40} = \int_0^\infty t\, h(t)\, dt$ (30-40)

6. MEAN TIME TO SYSTEM FAILURE

Let $\phi_i(t)$ be the c.d.f. of the first passage time from regenerative state i to a failed state. To determine the mean time to system failure (MTSF) of the system, we regard the failed states of the system absorbing. Using probabilistic arguments, and recursive relations for $\phi_i(t)$, we can obtain MTSF after taking Lapalce-Stieltjes transform of recursive relations for MTSF and solving them for $\phi_0^{**}(s)$, the mean time to system failure when the system started at the beginning is given by

$$MTSF = \lim_{s\to 0} \frac{1-\phi_0^{**}(s)}{s} = \mu_0 + p_{01}\mu_1 \qquad (41)$$

7. AVAILABILITY ANALYSIS

Let $A_i(t)$ be the probabilistic that the system is in up-state at instant t given that the system entered regenerative state i at t = 0. Using the arguments of the theory of regenerative processes, the availability $A_i(t)$ is obtained by taking Laplace transform of the recursive relations obtained for $A_i(t)$ and solve them for $A_0^*(s)$, the steady availability of the system is given by

$$A_0 = \frac{N_1}{D_1} \qquad (42)$$

where

$$N_1 = \mu_0 \qquad (43)$$

$$D_1 = \mu_3 p_{02} p_{23} + p_{02}\mu_2 + \mu_0 p_{01}\mu_1 + p_{02}p_{23}[\mu_5+\mu_6] + p_{02}p_{24}\mu_4 \qquad (44)$$

8. BUSY PERIOD ANALYSIS OF REPAIRMAN (Inspection time only)

Let $BI_i(t)$ be the probability that the repairman is busy in inspection at instant t, given that the system entered regenerative state i at t = 0 for $BI_i(t)$. Using probabilistic arguments, and taking Laplace transform of the recursive relations which we obtained for busy period analysis of repairman for inspection and solve them for $BI_0^*(s)$, the fraction of time for which the repairman is busy in inspection only, in steady state, is given by

$$BI_0 = \frac{N_2}{D_1} \qquad (45)$$

where $N_2 = p_{02}\mu_2$ (46)

and D_1 is already specified.

9. BUSY PERIOD ANALYSIS (REPLACEMENT TIME ONLY)

Let $BR_i(t)$ be the probability that the repairman is busy in replacement at time t, given that the steady state entered regenerative state i at t = 0 for $BR_i(t)$. Using probabilistic arguments, and taking Laplace transform of the recursive relations which we obtained for busy period analysis of repairman for replacement and solve them for $BR_0^*(s)$, the fraction of time for which the repairman is busy in replacement only, in steady state, is given by

$$BR_0 = \frac{N_3}{D_1} \qquad (47)$$

where $N_3 = p_{02}\, p_{24}\mu_4$ (48)

and D_1 is already specified.

10. BUSY PERIOD ANALYSIS (REPAIR TIME ONLY)

Let $B_i(t)$ be the probability that the repairman is busy in repair at time t, given that the steady state entered regenerative state i at t = 0 for $B_i(t)$. Using probabilistic arguments, and taking Laplace transform of the recursive relations which we obtained for busy period analysis of repairman for repair and solve them for $B_0^*(s)$, the fraction of time for which the repairman is busy in repair only, in steady state, is given by

$$B_0 = \frac{N_4}{D_1} \qquad (49)$$

where $N_4 = p_{02}\, p_{23}\, \mu_3$ (50)

and D_1 is already specified.

11. BUSY PERIOD ANALYSIS FOR EXPERT REPAIRMAN

Let $BE_i(t)$ be the probability that the expert repairman is busy at time t, given that the steady state entered regenerative state i at t = 0 for $BE_i(t)$. Using probabilistic arguments, and taking Laplace transform of the recursive relations which we obtained for busy period analysis of expert repairman and solve them for $BE_0^*(s)$, the fraction of time for which the expert repairman is busy in steady state, is given by

$$BE_0 = \frac{N_5}{D_1} \qquad (51)$$

where $N_5 = p_{02}\, p_{23}\, p_{35}\, \mu_5$ (52)

and D_1 is already specified.

12. BUSY PERIOD ANALYSIS AT SERVICE STATION

Let $SS_i(t)$ be the probability that the unit is at service station at time t. Using probabilistic arguments, and taking Laplace transform of the recursive relations which we obtained for busy period analysis at service

station and solve them for $SS_0^*(s)$, the fraction of time for which the unit is busy at service station, in steady state, is given by

$$SS_0 = \frac{N_6}{D_1} \quad (53)$$

$$N_6 = p_{02}\, p_{36}\, p_{23}\, \mu_6 \quad (54)$$

and D_1 is already specified.

13. EXPECTED NUMBER OF VISITS OF THE EXPERT REPAIRMAN

Let $V_i(t)$ be the probability that the expert repairman visits the plant at time t . Using probabilistic arguments, and taking Laplace-Stieltjes transform of the recursive relations obtained for expected number of visits of the expert repairman and solving them for $V_0^{**}(s)$, the expected number of visits of expert repairman per unit time, in steady state, is given by

$$V_0 = \frac{N_7}{D_1} \quad (55)$$

where $N_7 = q_{02}q_{36}q_{23}$ (56)

and D_1 is already specified.

14. EXPECTED NUMBER OF REPLACEMENTS

Let $RP_i(t)$ be the probability that the unit is being replaced at time t . Using probabilistic arguments, and taking Laplace-Stieltjes transform of the recursive relations obtained for expected number of replacements and solving them for $RP_0^{**}(s)$, the expected number of replacements per unit time, in steady state, is given by

$$RP_0 = \frac{N_8}{D_1} \quad (57)$$

Where $N_8 = p_{02}\, p_{24}$ (58)

and D_1 is already specified.

15. EXPECTED TIME FOR CORRECTIVE/ PREVENTIVE MAINTENANCE

Let $CP_i(t)$ be the probability that corrective or preventive maintenance is being brought out. At time t . Using probabilistic arguments, and taking Laplace transform of the recursive relations obtained for expected time for corrective or preventive maintenance and solving them for $CP_0^*(s)$, the expected fraction of time for corrective/preventive maintenance, in steady state, is given by

$$CP_0 = \frac{N_9}{D_1} \quad (59)$$

Where $N_9 = p_{01}\, \mu_1$ (60)

and D_1 is already specified.

16. EXPECTED TIME FOR WHICH THE UNIT IS AT SERVICE STATION

Let $S_i(t)$ be the probability that the unit is sent to service station at time t . Using probabilistic arguments and taking Laplace-Stieltjes transform of the recursive relations for expected time for which the unit is at service station and solving them for $S_0^{**}(s)$, the expected number of times per unit time, the unit sent to service station, in steady state, is given by

$$S_0 = \frac{N_{10}}{D_1} \quad (61)$$

where $N_{10} = p_{02}p_{23}p_{36}$ (62)

and D_1 is already specified.

17. PROFIT ANALYSIS

In steady state, the expected total profit is given by

$$P = C_0A_0 - C_1BI_0 - C_2BR_0 - C_3B_0 - C_4BE_0 - C_5BS_0 - C_6V_0 - C_7RP_0 - C_8S_0 \quad (63)$$

where

C_0 = revenue per unit up time

C_1 = cost per unit up time for which engineer is busy for inspection

C_2 = cost per unit up time for which replacement is done.

C_3 = cost per unit up time for which repair is done.

C_4 = cost per unit up time for which expert repairman is busy.

C_5 = cost per unit up time for which unit is at service station.

C_6 = cost per visit of the expert repairman.

C_7 = cost for the replacements.

C_8 = cost for the unit at service station.

18. GRAPHICAL INTERPRETATION

The following particular case is taken up for the graphical representation :

$$h(t) = \delta e^{-\delta t}, \quad i(t) = \gamma e^{-\gamma t},$$

$$g_1(t) = \beta_1 e^{-\beta_1 t} \quad g_2(t) = \beta_2 e^{-\beta_2 t}$$

$$g_3(t) = \beta_3 e^{-\beta_3 t}$$

Figures 1 and 2 show the behaviour of MTSF and profit respectively w.r.t. failure rate (λ) and for different values of inspection rate and repair rate of regular engineer respectively.

- MTSF decreases with increase in failure rate (λ). However, it attains higher values on decreasing the inspection rate.
- Profit decreases with failure rate (λ). Graph cuts 0 axis and goes negative, which means industry is going to be in loss after that failure rate.

Figures 3 and 4 show behaviour of profit with revenue per unit up time for different corrective and preventive inspection rates respectively. As we increase the inspection rate, we get higher values of profits in both the cases. Here, we are also able to find out the cut off point of revenue per unit up time for which we get profits.

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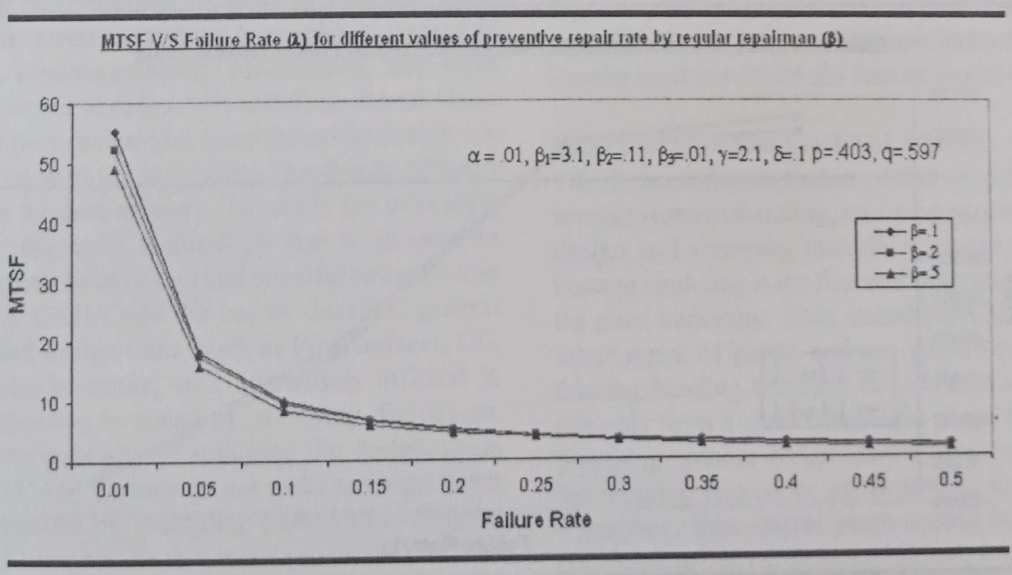

Figure - 1

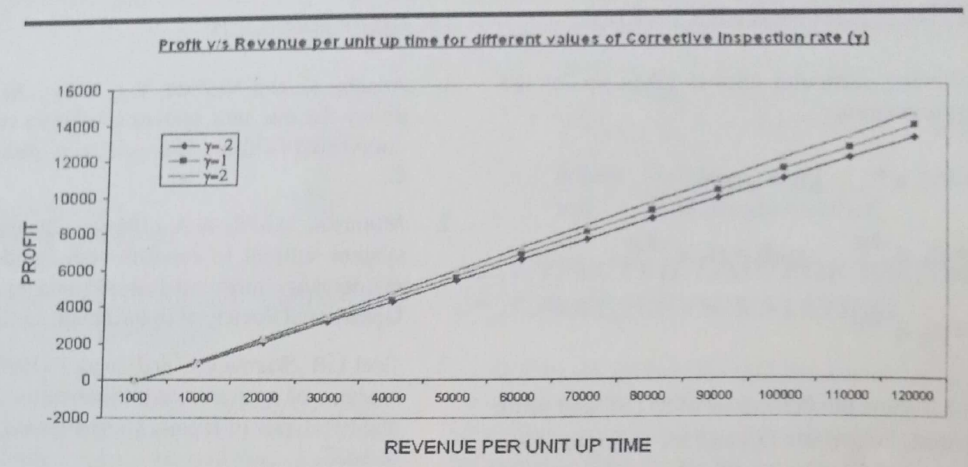

Figure - 2

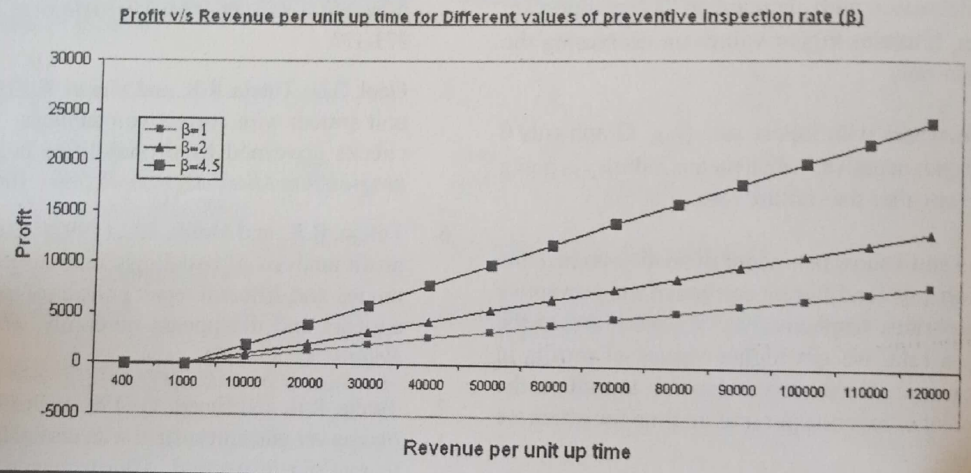

Figure - 3

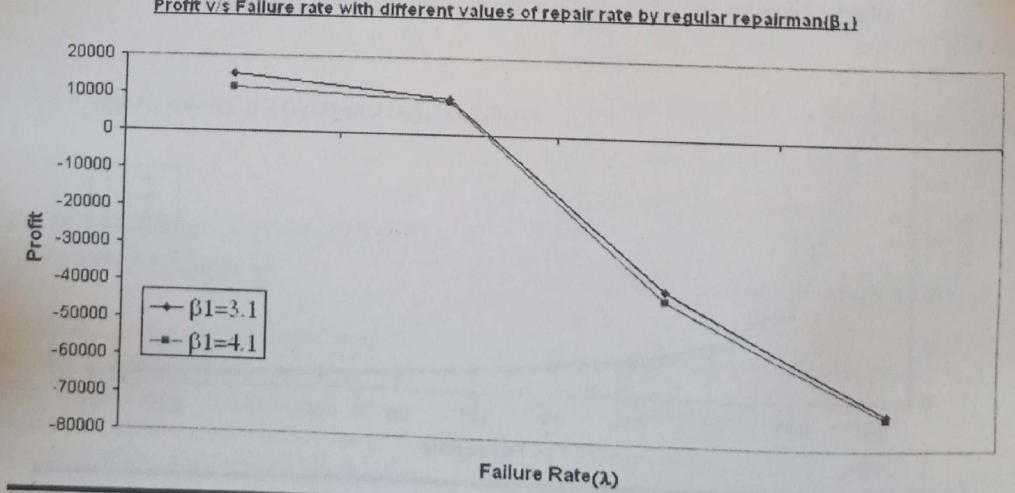

Figure - 4

EXTRACTION OF THIN-METAL FEATURES FROM SOLID MODEL

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Abstract

With the development of modern industry, thin -metal parts in mass production have been widely applied in mechanical, communication, electronics, and light industries in recent decades; but the advances in thin -metal part design and manufacturing remain too slow compared with the increasing importance of thin -metal parts in modern industry. This paper proposes a method for automatically extracting features from an arbitrary solid model of thin -metal parts; whose characteristics are used for classification and graph-based representation of the thin -metal features to extract the features embodied in a thin -metal part. The extracting feature process can be divided for valid checking of the model geometry, feature matching, and feature relationship. Since the extracted features include abundant geometry and engineering information, they will be effective for downstream application such as feature rebuilding and stamping process planning.

Key words: *Thin -metal part, Feature extraction, Feature representation*

Introduction

With the development of modern industry, mass produced thin -metal parts have been widely applied in mechanical, communication, electronics, and light industries in recent decades. Nevertheless, the advances in thin metal part design and manufacturing remain too slow compared with the increasing importance of thin -metal parts in modern industry. To satisfy the increasing requirement, the main technology that is adopted to improve competence of design and manufacturing for thin -meal parts is CAD/CAM. In recent decades, general computer aided design tools, such as Pro/Engineer, UG, CATIA, Ideas, Inventor, etc., are widely utilized in stamping industries to speed up stamping die design. Because of the specialty of stamping die design, these general CAD/CAM systems do not make any significant changes expected by stamping companies. Special designed CAD systems for thin metal production are then developed based on those general CAD/CAM software packages. Striker System, UGS/Progressive Die Wizard, HMCAD, etc., to some extent, have gained from some stamping companies. All these software are built based on their special languages, known as thin metal features, for describing the thin metal products. In the stamping industry, the customers and suppliers often use different CAD tools which speak different languages. For the purpose of exchanging engineering information that can be passed to CAPP systems for the process planning between different CAD systems, neutral file formats such as STEP and IGES are employed. The translation from thin metal feature model to neutral model resul : in the loss of all the engineering information crucial for th. downstream design process. How to deal with this neutral model and make it acceptable to those special CAD systems, manually rebuilding the model is an alternative solution, but the process is so time-consuming and expensive that it becomes the bottle-neck for those thin metal feature based CAD software. Feature extraction is such a tool for extracting features from arbitrary solid model created with any types of CAD tools and rebuilding the feature model automatically and effectively. Nevertheless, feature extraction is still far from being used in thin metal design. The main objective of this paper is to reveal how thin -metal features are extracted from solid model. To extract features, thin -metal features are sorted, and then represented with diagram structure. Extracted features can thus be used to rebuild the feature model directly.

FEATURES OF THIN-METAL PARTS

The design and manufacture of thin -metal parts generally involve feature modeling, stamping process planning, die design and stamping manufacturing in a single setup. Feature modeling is the first and basic stage, which is also the most important. Thin -metal parts are different from other types of parts; and are generally fabricated by forming, bending, blanking, etc. A kind of stamping process can only form a class of specific shape thin -metal part. Stamping process design should take into consideration the working procedure of features in thin -metal parts. Therefore, thin -metal parts should be analyzed and compared so that the shapes which are similar in geometry

can be classified to automate the stamping process planning.

Classification of thin -metal features

In order to provide meaningful information for stamping process planning of thin -metal parts, the feature definition of thin -metal parts is given below.

Definition 1 A thin -metal feature is a 3D geometric shape that can be manufactured by one or more specific stamping operations. From the definition, a feature should contain two kinds of information. One is engineering information related to the stamping processes. The other is the geometric description of feature shape, which includes all edges, faces and bodies. Engineering information varies with different types of features. For example, a Hole feature should include the diameter, while a Drawing feature should include die radius, punch radius and taper angle. Some typical features based on the characteristics of thin -metal parts are illustrated in Table 1. For the benefit of managing the thin -metal features and their relationships, a hierarchical structure is introduced to represent the thin -metal parts. The features' classification scheme introduced here is based on how much information it should carry and what kind of information it carries. Hence features of thin -metal parts are divided into two categories, cellular features and composites,.

Definition 2 Cellular feature is a 3D geometric shape that is associated with one (or more) shape class(es). In the feature model, the part could be seen as an assembly of volumetric quasi-disjoint cells (feature entities) other than a boundary represented solid (Li *et al*., 2001). In terms of the definition, cellular features are basic features forming the thin -metal part, while composites are features integrated as a whole by other kind of cellular features. Cellular features can be further divided into three sub categories, Primitives, Add-ons and Connects. Primitives are features that can exist in thin -metal part independently, Add-ons are features that must be added to other features to form thin -metal part, Connects are features acting as a bridge between different types of features (Li *et al*., 2001).

Diagram-based representation

The procedure of extracting features is to match the geometry shapes of the thin -metal part with the feature library. Therefore, features in the feature library should be pre-defined. In Table 2, thin -metal features are described based on diagram. The purpose of this representation is to use the topological properties of a certain class of shapes to facilitate their extraction from a solid model.

Besides the above features, there are still some other features that cannot be described by one diagram. For example, if the Cutout feature gets across multiple features, the diagrammatic representation is different. As illustrated in Fig.1, P means Planar, B means Bending, F means adjacent face. In case 1, the Cutout feature gets across two Wall features and one Bending feature; and in case 2, the Cutout feature gets across one Wall feature and one Bending feature, therefore, their diagram representations are totally different.

EXTRACTING FEATURES FROM SOLID MODEL

To constitute a feature model, the user can either use the method of adding features one by one according to the given drawings or 3D model, or, automatically rebuild the feature model from the extracted features. Obviously, the method of feature extraction is more efficient. The feature extraction process can be divided to validity checking for the geometry model, feature matching and

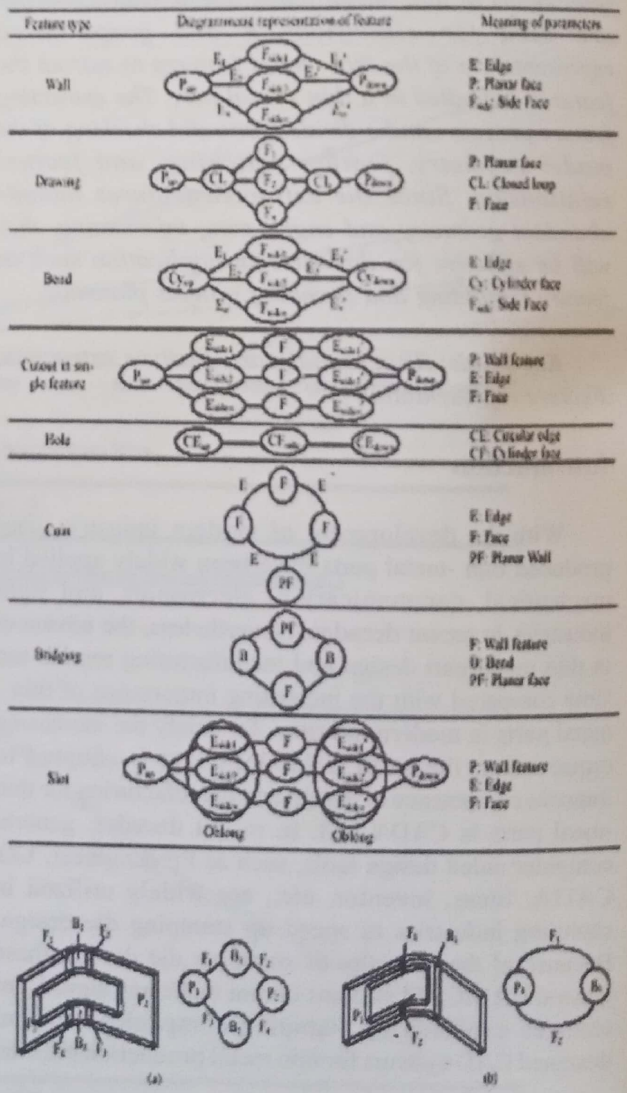


Fig. 1: Special Diagrammatic representation for Cutouts (a) Case1; (b) Case 2.

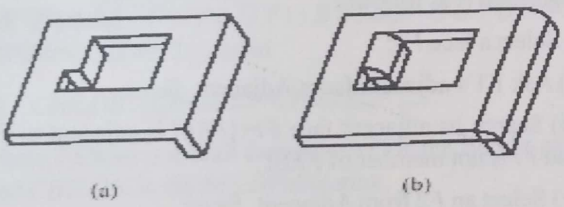
Validity checking for the solid model

Before feature extraction, the solid model should be checked to ensure it is valid. Thin -metal parts are generally fabricated by forming, bending, blanking, etc. Therefore, features are jointed smartly, i.e. two Wall features must be connected by one Bending feature, otherwise, it is unacceptable to the stamping process planning. In some solid models, Wall and Wall, or Wall and Cutout are connected directly, as in Fig.2a. In this case, the solid model must be modified, as in Fig.2b.

When the solid model is transferred from other CAD model, isolated faces or edges may occur, as in Fig.3. In this case, the face or edge should be marked, so that it will not be wrongly extracted in feature extraction.

Matching thin -metal features

Fig.4 presents a flow chart describing the feature extracting process. The input module can accept all kind of solid models that can be translated to IGES or STEP format. To begin extracting features, a planar face on a Wall of the part should be pre-defined. From this face, its pair face belonging to the Wall feature is



(a) Invalid solid model, (b) Modified model

Fig.2 model for thin metal parts

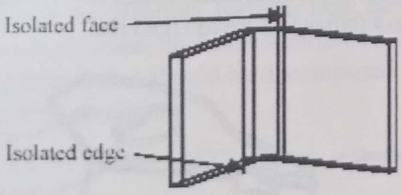


Fig.3 isolated edge and face in solid model

searched by comparing rules with the feature library. This Wall feature can also be named as Base feature. In the Wall feature that has been extracted, there may be some children features which satisfy the following conditions:

(a) $FEi?FEj=Lk$, and (b) $FEi=\{Fi, Ei\}$

where FE is a feature, L is a closed loop, F is a face and E is an edge. Different types of children features have different

geometry shapes, a Hole can be determined as:

$FE\text{Hole}=\{NL=1?TL=CIRCLE?HL=HB\}$ (1)

where N is the number of loop, T is the type of loop, and H is the thickness of the loop face. And a Slot can be determined by:

$FE\text{Slot}=\{NL=3?TL=CIRCLE?HL=HB\}$ (2)

If a feature does not satisfy Eqs.(1) and (2), but has the attribute:

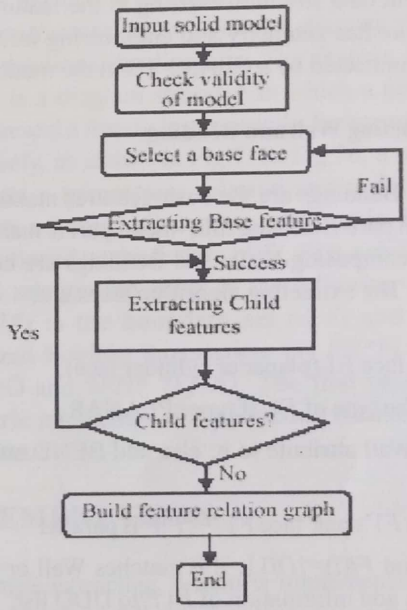


Fig.4 Flow Chart Describing the Feature extracting Process

$FE\text{Cutout}=\{NL>1?TL=CIRCLE?HL=HB\}$ (3)

This feature can be classified as Cutout feature. Bending feature can be adjacent to a Wall feature or a Cutout feature. If a feature satisfies the following conditions, we call it a Bending feature:

$FE\text{Cutout}=\{FEi?FEj=Fk, Fi//Fj, Fj=CYLINDER, Rinn>0\}$ (4)

where R is radius. By such matching and searching method, features in thin -metal part can be extracted one by one. During the extraction procedure, there may be some very

complicated features that failed to be extracted. We consider these features as unrecognized feature. And they need to be extracted manually. In the automatic feature extracting model, 80% of the feature types can be extracted. Since the other 20% seldom existed in the thin -metal part, the procedure of feature extraction system is relatively effective. (1) Extracting algorithms of some typical features In the procedure of feature extraction, different types of feature have different feature-matching algorithms. Extracting cellular features is relatively simple, while Composites extraction is much complex. Some cellular features like Cutouts' multiple features are also very complicated. Some typical features' extracting algorithms are discussed below.

To record the engineering information of the features, User Define Object (UDO) is employed. UDO is an independent data structure existing in the feature model. Each feature has geometry and engineering information, which is connected by a CLASS_ID in the model data.

(a) Extracting Wall and Bending

Walls and Bendings are the basic features making up the thin -metal part. Since the thin -metal part is manifold, all the faces composing Walls and Bendings are connected smoothly. The extracting algorithm steps are:

i) Given a face *F*1 (planar or cylinder face);

ii) Judge the type of *F*1, if type=PLANAR,

then add Wall attribute to it, else add BEND attribute to UDO list;

iii) Search *F*1's pair face *F*1?={*F*|*F* is parallel

with *F*1 and *Ff*(*i*)=?*Df*1}, if it matches Wall or Bending rules, then add information of *F*1??to UDO list;

iv) Record information of thickness, Bending's radius and location to UDO list.

(b) Extracting Hole, Slot and Cutout in single feature

Holes, Slots and Cutouts are local features which must be added to Wall, Bending, or Drawing. An algorithm consisting of the following steps is used to search the features:

i) Given an inner loop *L*1 in a face;

ii) Judge the type and edge number of *L*1, if number=1 and edge type is circle, then add HOLE to UDO list, else if the loop is like an oblong, then add SLOT to UDO list, else add CUTOUT to UDO list;

iii) Search faces including *L*1, if the faces are connected to a closed loop, add faces information to UDO list;

iv) Record information of thickness, location, etc. in UDO list.

(c) Extracting Array

An Array is the concourse of two or more Holes, Slots or Cutouts, normally is located on a Wall feature. The extracting algorithm for array features consists of the following steps:

i) Given a group of Holes, Slots or Cutouts Group1 in one Wall;

ii) Check the relations among Group1, extract members of the Group1 that match array library, and add them to UDO list;

iii) Delete single member information from UDO list;

iv) Add ARRAY to UDO list.

(d) Extracting Cutout throughout multiple features

In thin -metal part, there are probably some Cutouts with multiple basic features as shown in Fig.5.

Cutout2 passes through Base0, Bending1 and Wall3, so the three features constitute a closed loop.

According to the rule defining the Cutout feature, this loop is a Cutout feature, whose heuristic extracting algorithm is as follows:

i) Select a face *F*1;

ii) Ask *F*1's adjacent faces Adjacent_faces;

iii) Search its adjacent face *Fi*={*Fi*|*Fi* is adjacent to *F*1, and *Fi* is not member of *FE*b};

iv) Select an *F*2 from Adjacent_faces;

v) Repeat ii) and iii), add the faces to Adjacent_faces;

vi) Check the last searched face *Fn*, if *Fn*?*F*1=*Edge*, then add *Fn* to Adjacent_faces; and

vii) Add engineering information such as CUTOUT type of feature and father feature to UDO list.

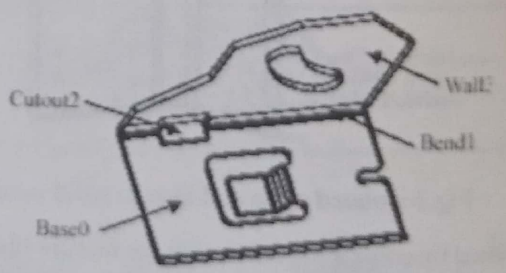


Fig.5 A thin metal part that has a cutout throughout multiple features

(2) Feature merging and decomposing During the feature extracting procedure, some features which are not acceptable to the following stamping process planning may be extracted. In this case, these features should be edited. In Fig.6, there are two thin -metal parts.

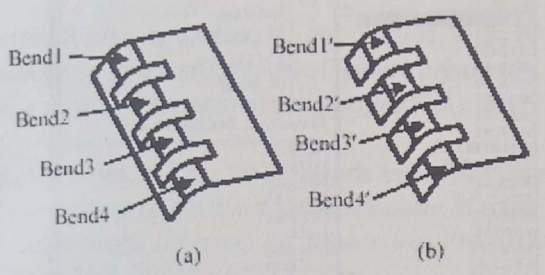


Fig.6 Case of feature merging and decomposing
(a) Bending that should be merged
(b) Bending that should not be merged

In Fig.6a, four Bendings are extracted by the methods mentioned above, but obviously, in a real feature model, they constitute one Bending feature. In this case, we must merge the four Bendings. Merging Bendings should satisfy:

i) *B*1?*B*2?*B*3?...=*FE*Wall;

ii) *AXIS*1=*AXIS*2=*AXIS*3=...;

iii) *DIR*1=*DIR*2=*DIR*3=...;

iv) *B*1?*B*2=*CUTOUT*1;*B*2?*B*3=*CUTOUT*2; *B*3?*B*4=*CUTOUT*3; ...; and

v) *CHILDB*1=*CHILDB*2=*CHILDB*3= ....

where *FE*Wall is a Wall feature, *AXIS* is the Bend's axis, and *CHILDBi* is the *Bi*'s child feature.

According to the above conditions the four Bendings should be merged into one Bending, and the feature UDO list should also be modified. But in Fig.6b, if Bending1?, Bending2?, ... are extracted as single Bending, the hollow parts among the Bending features may be erroneously extracted. In this case, the features should be decomposed. Bending feature that should be decomposed must satisfy the following conditions:

i) *CF*1?*CF*2?*CF*3?...=*FE*Bending;

ii) *AXIS*1=*AXIS*2=*AXIS*3=...;

iii) *RCF*1=*RCF*2=*RCF*3=...;

iv) *LRB*?(*LR*1+*LR*2+*LR*3+...)=*NULL*;

v) *B*1?*B*2=*NULL*; *B*2?*B*3=*NULL*; *B*3?*B*4=*NULL*; ...; and

vi) *CHILDB*1=*CHILDB*2=*CHILDB*3=....

where *FE*Bending is the Bending feature, *CF* is cylinder face, *RCFi* is radius of *CF*, *LR* is the length of each sub Bending.

Constituting feature relation diagram

To simplify the relationship among the features, we classify the relationships as parent-son, adjacent-on and array-on. Parent-son relation means that a feature is another feature's son feature, Adjacent-on means that a feature is adjacent to another feature, and Array-on means that some features that have the same geometry and engineering information are arrayed on one feature. In Fig.7a, Bending2 is adjacent to Base0, Wall4 is adjacent to Bending2, and Hole3 is Wall4's child feature.

The feature relationship is often described by adiagram structure, and we call this diagram structure as feature relationship diagram. The feature adjacency diagram is a diagram structure in which a node and an edge represent a feature instance and a feature relationship, respectively, as shown in Fig.7. In Fig.7b, a solid arrow represents a parent_son relation and a dotted arrow represents a feature adjacent-on relationship. If a feature *Fi* is positioned on the feature of *Fj*, *Fi* is a child of *Fj*. An adjacent relationship exists in the following two cases, where ?*Fi* is the boundary set of *Fi* and ?* is the regularized Boolean intersection: (1) *Fi*?**Fj* ?Ö, or (2) *Fi*?**Fj*=Ö and ?*Fi*?* ?*Fj* ?Ö. The first case is called volumetric interaction and the second is called adjacent interaction.

IMPLEMENTATION

The feature extracting system is implemented by using object-oriented modeling principles and C++ programming language based on the platform of UGNX2.0, as shown in Fig.8a. In the system, all extracted features are listed in the left item list; the correlative features (father, children, and array) are listed in the right item list. For instance, Hole1 has eight array features (Hole2, Hole3, ...) and one parent feature Base0. The parent of Bend13 is Base0, and its children, Wall16. Buttons in the bottom part can be used to edit the extracted features. All the extracted features can be directly applied to downstream feature rebuilding. In the part shown in Fig.8b, all features can be extracted automatically. But in some special cases, features may be extracted manually.

CONCLUSION

The significance of this research is in the

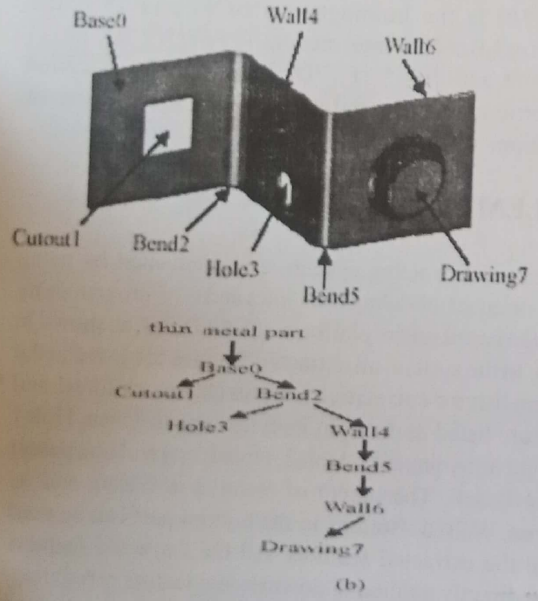
development of a methodology for feature extraction. The C++ Programming language based on the platform of UGNX2.0 is used as a tool to test all algorithms. The main contributions of this research include:

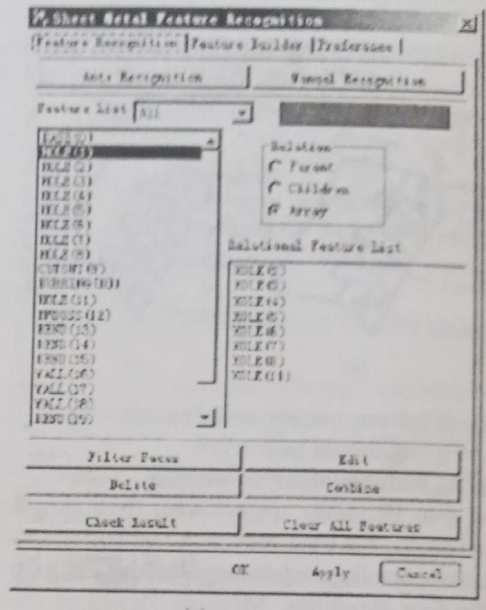
(a) Arbitrary 3-D solid model of thin -metal parts can be input to the feature extraction system;

(b) According to the characteristic of the thin -metal part, thin -metal features are classified, and feature types are represented graphically.

(c) With the methodology of automatically extracting features, almost all the thin -metal features can be extracted, which makes it possible to apply this feature extraction system into industry. Our future work will focus on extracting more abundant engineering information on complex thin -metal features to enhance the performance of automatic feature extraction.

Fig.7 Information on feature relations (a) thin metal parts (b) feature relation diagram





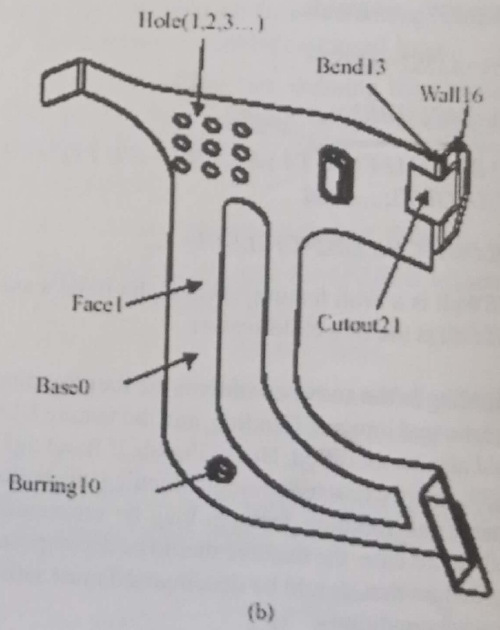


Fig.8 Example of feature extracting (a)The interface of feature extracting(b)Thin metal part

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ANALYSIS OF INDUCTION MACHINE AS A SELF EXCITED INDUCTION GENERATOR

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Abstract

As a result of increasing environmental concern, the impact of conventional electricity generation on the environment is being minimized and efforts are being made to generate electricity from renewable sources.. A 3-phase induction machine is widely used as a generator in these sources. It is capable to generate the power from variable speed as well as constant speed prime movers. This topic has received considerable attention in recent years in view of the suitability of induction machine as a generator. Research is going on to explore the suitability of using an available induction motor as a generator. If it can be established by a proper study that the normal motors can be employed as generators, considerable expenditure and efforts towards a tailor made design of the generator could be eliminated. This paper presents the steady state analysis of 3 - phase induction machine as a capacitor self-excited induction generator(SEIG). Efforts have been made to analyze its behavior due to change of load on generated voltage and frequency. Effect of capacitance on self excited induction generator is also studied.

Index Terms—*Self excited Induction generator, Voltage , Frequency*

I. INTRODUCTION

Induction generator is simply an induction machine. When an induction machine operates in the negative slip region then the machine operation of machine is called generating mode. In this generating mode the machine operates at speed greater then the synchronous speed as shown by the torque-slip characteristics of induction machine .

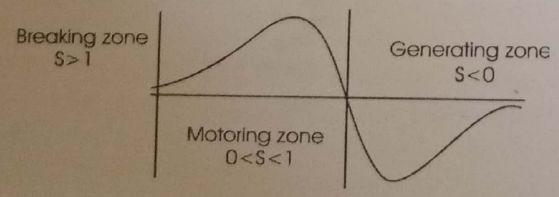


Fig.1 Torque-Slip Characteristics

Air-gap power

$$Pg = \frac{I_2^2 R_2}{S}$$

If slip is positive then machine act as motor. If slip is negative , Pg is negative then machine act as induction generator. Pg is negative means that power flows from rotor to stator i.e. t here is no power drawn from stator and rotor becomes thesource of generation. Hence generates power at negative slip or at speed greater then synchronous speed.

II. TYPE OF IG

Following classifications presents brief overview of application of induction machine as a generator.

A. GRID EXCITED IG

When the supply connected induction Machine is driven above synchronous speed, the slip becomes negative and the machine starts feeding power to the supply. However, in grid excited induction generator the reactive power requirement of the machine is taken from the gird and active power is feed to the grid as shown in the fig.2

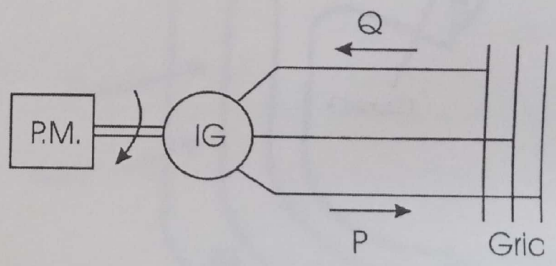


Fig.2 Grid connected induction generator

B. SELF EXCITED IG

In the case of self-excited induction generator (also called stand alone induction generator), the shunt capacitors are the only external source of magnetizing current. Therefore, in order to obtain the required operating voltage at the desired frequency, the amount of capacitance must be chosen carefully. For self excitation sufficient residual magnetism must be present in the rotor. A tribune run by hydel , wind, diesel, petro, or a dc motor supplies the input mechanical power. The self excited Induction Generator is as shown in fig. 3

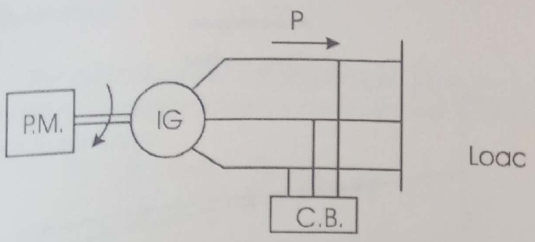


Fig.3 Self excited induction generator

If an appropriate capacitor bank is connected across the terminals of an externally driven induction machine, a voltage is developed across the terminal. The residual magnetism in the rotor initiates voltage buildup which is augmented by the capacitor current to cause a continual rise in voltage.

III. MODELLING OF SEIG

The characteristic of steady state operation can be derived using the equivalent circuit of the induction machine.

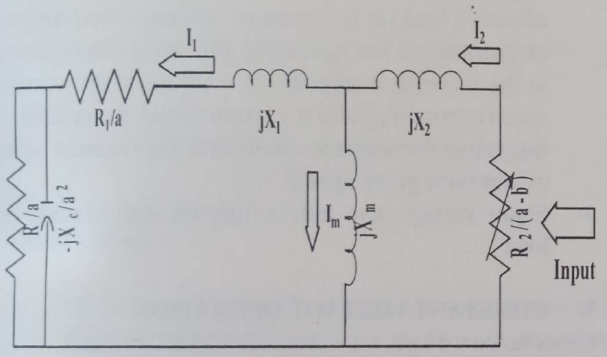


Fig.4 Equivalent single-phase circuit of self excited induction generator reduced to rated frequency

The slip s can be expressed as

$$s = (a-b)/a$$

where , a = frequency of generated voltage / rated frequency

b = Actual rotor speed / synchronous speed corresponding to rated frequency

Since s is negative, b is greater than a.

Load Resistance is in parallel with shunt capacitance, so

$$R_L = \frac{RX_c^2}{a(a^2R^2 + X_c^2)}$$

$$X_L = \frac{R^2X_c}{a^2R^2 + X_c^2}$$

As it is seen that this circuit does not contain any e.m.f source nor current source, so

$$Y_S + Y_m + Y_r = 0$$

Equating the real part and the imaginary part of the above equation to zero respectively will yield the equilibrium equations describing the operating point at excited frequency.

$$\frac{R_L + \frac{R_1}{a}}{(X_1 - X_L)^2 + (R_L + \frac{R_1}{a})^2} + \frac{\frac{R_2}{a-b}}{X_2^2 + (\frac{R_2}{a-b})^2} = 0 \quad (1)$$

$$\frac{1}{X_m} - \frac{X_2}{X_2^2 + (\frac{R_2}{a-b})^2} - \frac{X_1 - X_L}{(X_1 - X_L)^2 + (R_L + \frac{R_1}{a})^2} = 0 \quad (2)$$

Rewriting (1) as a fifth order polynomial

$$Q_5a^5 + Q_4a^4 + Q_3a^3 + Q_2a^2 + Q_1a + Q_0 = 0 \quad (3)$$

Where Q_i , i = 0 , . . . , 5 are functions of machine parameters shown in appendix

Only the positive real root of equation (3) is physically acceptable

Solving equation (2) for X_m and using equation (1),

$$X_m = \frac{(R_L + \frac{R_1}{a})[X_2^2 + (\frac{R_2}{a-b})^2]}{(\frac{R_2}{a-b})(X_1 - X_L) - X_2(R_L + \frac{R_1}{a})}$$

Now using the magnetizing characteristic [appendix] and X_m, the air gap voltage E_1 at rated frequency can be determined.

So, the rms value of V is given by

$$V = [\frac{R_L^2 + X_L^2}{(R_L + \frac{R_1}{a})^2 + (X_1 - X_L)^2}]^{\frac{1}{2}} aE_1$$

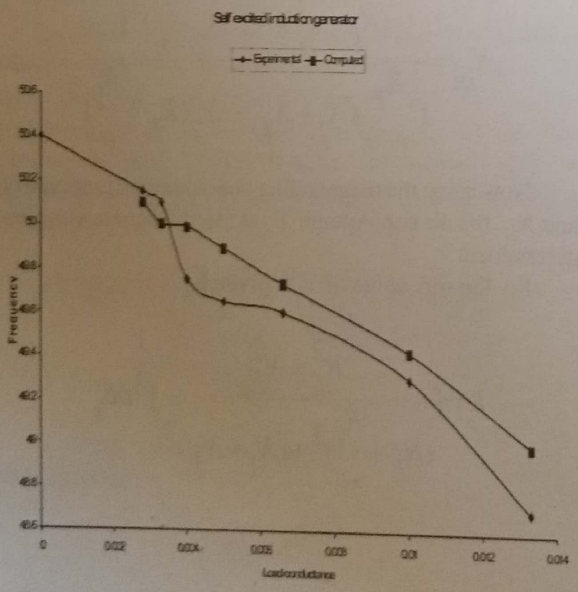
Load current, $I_L = \frac{V}{R}$

IV. COMPUTED RESULTS

Induction machine coupled with d.c machine with specifications[appendix] is used to carry out the experimental data and simulated results.

Computed results

V_{ab} (Volt)	f (hz)	Load current (Amp)	Load Resistance (Ohm)	Load Conductan (Mho)
276	50.1	.7	350	.0028
274	50	.916	300	.0033
273	49.99	1.09	250	.004
270	49.89	1.35	200	.005
265	49.73	1.76	150	.0066
254	49.42	2.5	100	.01
241	49	3.2	75	.0133



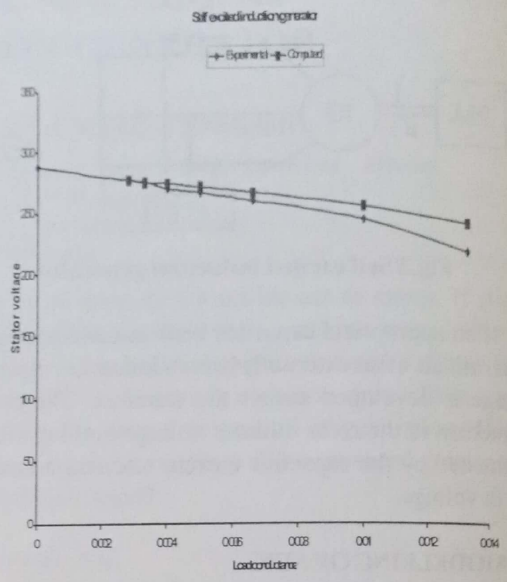


Fig.6 Stator voltage vs. Load conductance

Observations

- For a constant speed of prime mover, the frequency decreases with increase in load conductance. As effective load on the machine increases, resulting in an increase in the operating slip. As a consequence to the increase in slip that is measure of the relative speed of rotating field w.r.t rotor speed, the generated frequency decreases to conform to the required value of slip for a given speed.
- Stator voltage also falls a little bit with increase of load.

V. CONSTANT VOLTAGE OPERATION

Capacitance = 54 μF, V1 = 240, V2 = 230, V3 = 220

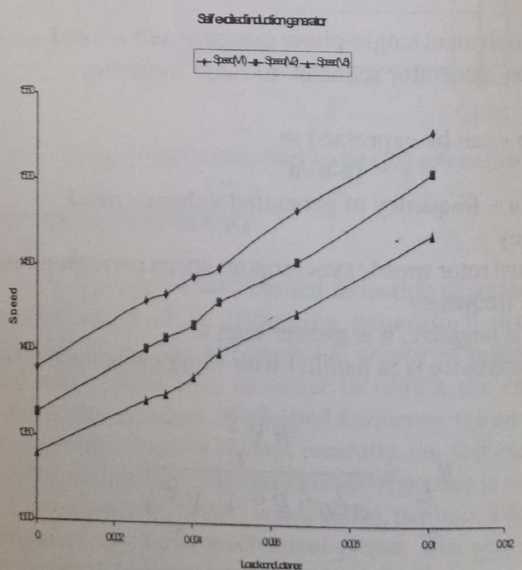


Fig.7Speed vs. Load conductance at different voltages

Observations

- For constant voltage operation (with a given value of excitation capacitance) speed must increase to meet the load requirement

C1 = 54 μF, C2 = 59.4 μF

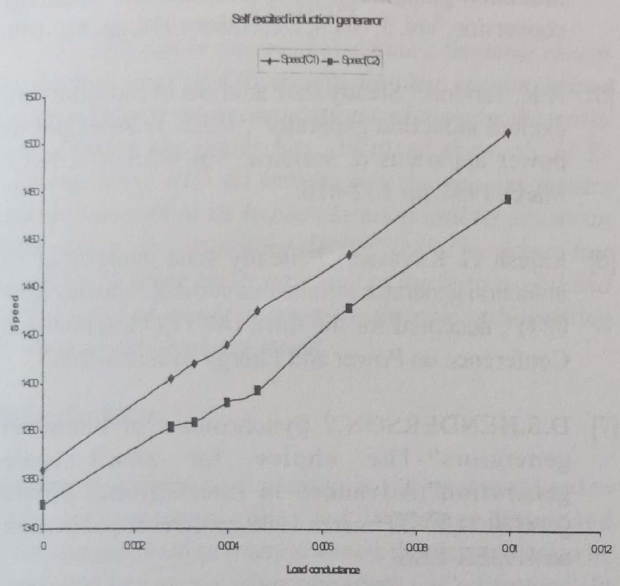


Fig.8 Speed vs. Load conductance at different capacitances

Observations

- For the same load and terminal voltage, capacitance requirement decreases with an increase in operating speed.

VI. CONCLUSIONS

In this paper, a simple method has been proposed for the steady state analysis of induction machine as a capacitor self excited induction generator. Close agreement between simulated and experimental results confirms the accuracy of modeling proposed. Efforts have been made to analyze its behavior due to change of load on generated voltage and frequency. Effect of capacitance on self excited induction generator is also studied. The following points are concluded

- Since self excited induction generator is isolated , its stator frequency is free to vary with the rotor speed and the operating slip remains small. This in turn results in high efficiency.
- For constant voltage operation (with a given value of excitation capacitance) speed must increase to meet the load requirement.
- For the same load and terminal voltage ,capacitance requirement decreases with an increase in operating speed.

VII. SCOPE OF FUTURE WORK

- Effect of terminal capacitor on the power factor and efficiency of machine can be studied.
- Transient analysis of induction machine under both modes can be carried out using suitable tool.
- Comparative study may be done for different techniques to analyze the induction machine under different modes.

Appendix

$$Q_0 = -bR_2\left(\frac{R_3}{R}\right)^2$$

$$R_3 = R_1 + R$$

$$Q_1 = R_2\left(\frac{R_3}{R}\right)^2 + R_3\left(\frac{R_2}{R}\right)^2 + b^2R_3\left(\frac{X_2}{R}\right)^2$$

$$Q_2 = -2bR_3\left(\frac{X_2}{R}\right)^2 - bR_2\left[\left(\frac{R_1}{X_c}\right)^2 + \left(\frac{X_1}{R}\right)^2 - 2\frac{X_1}{X_c}\right]$$

$$Q_3 = R_2\left[\left(\frac{X_1}{R}\right)^2 + \left(\frac{R_1}{X_c}\right)^2 - 2\frac{X_1}{X_c}\right] + R_3\left(\frac{X_2}{R}\right)^2 + R_1\left(\frac{R_2}{X_c}\right)^2 + b^2R_1\left(\frac{X_2}{X_c}\right)^2$$

$$Q_5 = R_2\left(\frac{X_1}{X_c}\right)^2 + R_1\left(\frac{X_2}{X_c}\right)^2$$

$$Q_4 = -b\left[Q_5 + R_1\left(\frac{X_2}{X_c}\right)^2\right]$$

Magnetizing characteristics of 3-phase squirrel cage induction machine

$X_m < 82.292$	$E_1 = 344.411 - 1.61X_m$
$95.569 > X_m >= 82.292$	$E_1 = 465.12 - 3.077X_m$
$108.00 > X_m >= 95.569$	$E_1 = 579.892 - 4.278X_m$
$X_m >= 108.00$	$E_1 = 0$

Equation for VI relationship of squirrel cage induction machine

$Y = -0.15X^5 + 2.2X^4 - 9.5X^3 - X^2 + 120X + 0.0028$

Electrical details of 3-phase squirrel cage induction machine

(Number of poles 4)

$R_1 = 3.35\Omega$, $R_2 = 1.76\Omega$, $X_1 = X_2 = 4.85\Omega$

V_L (volts)	I_L (Amp)	Rating (KW)	Stator connection	RPM
230	8.6	2.3/ 3HP	Δ	1440

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Learning the E way : Key issues and Applications

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Abstract

This paper has tried to capture the most recent application area of E-learning that has revolutionized the knowledge process acquisition and transfer the world over. Further the paper has discussed the tools of E-learning along with an insight into the success factors and the barriers in its implementation and its use as an information disseminating device/tool. The paper has also tried to bring up as case one of the most useful and critical area of its application-i.e. the role of E learning in the staff development mode.

Introduction

Electronic learning or eLearning is a general term used to refer to computer-enhanced learning. It is used interchangeably in so many contexts that it is critical to be clear what one means when one speaks of 'e Learning'. In many respects, it is commonly associated with the field of advanced learning technology (ALT), which deals with both the technologies and associated methodologies in learning using networked and/or multimedia technologies.

Different kinds of e-learning areas, for which software are being developed are:

- Consulting and Workshops
- Recruitment Training
- Assessments
- Simulations
- Leadership and Business skills training
- Simple Learning Management Systems, and
- E-Learning as a marketing tool - Training kits for customers to educate them about a product.

Goals of e-learning E-Learning lessons are generally designed to guide students through information or to help students perform in specific tasks. Information based e-Learning content communicates information to the student. Examples include content that distributes the history or facts related to a service, company, or product. In information-based content, there is no specific skill to be learned. In performance-based content, the lessons build off of a procedural skill in which the student is expected to increase proficiency. Growth of e-learning

The worldwide e-learning industry is estimated to be worth over 38 billion euros according to conservative estimates, although in the European Union only about 20% of e-learning products are produced within the common market. Developments in internet and multimedia technologies are the basic enabler of e-learning, with content, technologies and services being identified as the three key sectors of the e-learning industry. By 2005, more than 3.2 million students were participating in on-line learning at institutions of higher education in the United States. Many higher education, for-profit institutions, now offer on-line classes. By contrast, only about half of private, non-profit schools offer them. The Sloan report, based on a poll of academic leaders, says that students generally appear to be at least as satisfied with their on-line classes as they are with traditional ones. Private Institutions may become more involved with on-line presentations as the cost of instituting such a system decreases. Properly trained staff must also be hired to work with students on-line. These staff members must be able to not only understand the content area, but also be highly trained in the use of the computer and Internet. Online education is increasing. E-learning services have evolved since computers were first used in education. There is a trend to move toward blended learning services, where computer-based activities are integrated with practical or classroom-based situations. E-learning is naturally suited to distance learning and flexible learning, but can also be used in conjunction with face-to-face teaching, in which case the term Blended learning is commonly used. Typical Managed Learning Environment with a navigation menu and icons giving access to automated tools and content pages. In higher education especially, the increasing tendency is to create a Virtual Learning Environment (VLE) (which is sometimes combined with a Management Information System (MIS) to create a Managed Learning Environment in which all aspects of a course are handled through a consistent user interface standard throughout the institution. A growing number of physical universities, as well as newer online-only colleges, have begun to offer a select set of academic degree and certificate programs via the Internet at a wide

range of levels and in a wide range of disciplines. While some programs require students to attend some campus classes or orientations, many are delivered completely online. In addition, several universities offer online student support services, such as online advising and registration, e-counselling, online textbook purchase, student governments and student newspapers. E-Learning can also refer to educational web sites such as those offering learning scenarios, worksheets and interactive exercises for children. The term is also used extensively in the business sector where it generally refers to cost-effective online training. Communication technologies used in E-learning Communication technologies are generally categorized as asynchronous or synchronous. Asynchronous activities use technologies such as blogs, wikis, and discussion boards. The idea here is that participants may engage in the exchange of ideas or information without the dependency of other participants involvement at the same time. Electronic mail (Email) is also asynchronous in that mail can be sent or received without having both the participants¡¦ involvement at the same time. Synchronous activities involve the exchange of ideas and information with one or more participants during the same period of time. A face to face discussion is an example of synchronous communications. Synchronous activities occur with all participants joining in at once, as with an online chat session or a virtual classroom or meeting. Virtual classrooms and meetings can often use a mix of communication technologies.

Indeed advances in technology have changed virtually every aspect of our lives. These changes have dramatically impacted how we communicate, manage information, use our time, and complete simple and complex daily tasks. Technology is also reforming how information is accessed and processed. Students are able to access and manage information and interact with others in ways barely thought possible just a few short years ago. Electronically one can visit museums and other countries, participate in lessons taught by teachers conducting research in Antarctica, interact with scientists in space and under the ocean, view original historic documents, and participate first-hand in research with others across town, across the country, or around the world. One can even engage in virtual simulations of surgery to study anatomy or physiology. Almost every day new applications for technology emerge, usually enhancing both life and learning. Not only do advances in technology influence how teaching and learning occur for students, they may also influence how educators learn. Teachers and principals have opportunities, via E-learning, to participate in multiple professional and personal learning experiences. Teachers can exchange ideas with leading experts in their content areas, visit classrooms of exemplary teachers, receive coaching from their mentors via web conferencing, and access online virtual libraries full of instructional resources and research. Most institutes of higher education offer some online courses, and many now offer bachelors, masters, and other specialist¡¦s degree programs online.

Thus it can be rightly asserted that-¢wTechnology brings the world of learning to educators, rather than requiring educators to go to the learning.¡ü This aspect is further elaborated in the following paragraphs, as it¡¦s the right time that institutes realize the growing popularity of E learning as a teaching-learning device.

Technology as a vehicle for staff development:

At the best it is cited that-¡§Not only do advances in technology influence how teaching and learning occur for students, they may influence how educators learn as well.¡¨ The principal tool is through E Learning. E learning includes multiple uses of technology to facilitate learning. The uses range from the simple to more sophisticated. Videotape and audiotape are simpler forms of technology-mediated learning. Computer-based learning such as computer-aided instruction and tutorials represent different forms of E-learning. Internet-based learning such as online courses and web-based videoconferencing represent still other forms of E-learning.

E learning can have great payoffs, but it has to be approached thoughtfully. In order to realize e-learning¡¦s promise, educators, especially those who regard themselves as least technology savvy, must actively participate in technology-related discussions and decisions. I have seen countless educators silence themselves in technology conversations because they didn¡¦t feel qualified to comment. Yet, educators skilled in educating should speak up about the purpose of technology investments¡Xto enhance student learning. Educators, regardless of their comfort or familiarity with technology, need to ask developers of e-learning how their products enhance students¡¦ learning and educators¡¦ ability to serve students.

To date, most staff development is provided in face-to-face settings. Institutes are indeed reluctant to make the transition to other delivery media and structures made possible with technology. They may actively seek more evidence about the impact of e learning before

investing in it. Yet, the challenge posed to them is in staff development to tap the E-learning opportunities., mainly through monitoring, providing more just-in-time professional learning; creating job-embedded learning opportunities; ensuring content-rich learning opportunities; expanding personalized professional development; increasing access to professional learning experiences; and potentially reducing the costs of professional development programs.

Overview: -

Despite the increased demand for ongoing professional learning, education may continue to struggle with external forces shaping its direction unless educators themselves begin to take responsibility for shaping the learning communities within which they work and learn. To do this, it is important that they not only become informed consumers of e-learning products and services, but co-constructors of them. Their learning needs and preferences along with the needs of their students and their schools must become the driving forces in the design of professional e-learning products and services. If educators identify and voice their needs by demanding high quality professional learning related to student learning needs, those who produce such products and services will respond by developing results-driven, needs-based products that meet the market demand.

In business and industry, the trend toward instructor-led, face-to-face training is decreasing, and professional learning is quickly moving to a just-in-time, technology-mediated environment Berge, 2001[1]. Online training in the private sector not only addresses the more traditional information technology skills, but recently has widened its scope to include leadership, collaboration, and management skills, and the development of job-specific knowledge and skills. As the need for learning increases in a rapidly changing knowledge-based e c o n o m y, many businesses are rethinking their approach to workforce development. Online training is projected to increase to 55 percent of all training and development by 2002, up from 21 percent in 1998

Bassi & Van Buren, 1998[2]. Web-based training alone, a form of technology-based training and development, is expected to grow 95 percent, from $197 million in 1997 to $5.5 billion in 2002 Moe, Bailey, & Lau, 1999[3,4]

These changes in business and industry will influence two aspects of education. One is how schools prepare graduates to learn on-the-job. The second is how continuing education for adults, both at their workplace and beyond, will be designed and distributed. Companies such as Qualcomm, Ford Motor Company, Hewlett Packard, U.S. Army Intelligence Center, and the American Red Cross, to name just a few, have increased their use of online training and the numbers grow daily. In a survey of attendees at the Training 2001 Conference & Expo, 78 percent of respondents agreed that e-learning is an essential part of their c o m p a n y ¡¦s blended learning strategy, and over 80 percent expected their organizations to invest in e-learning this year Future Vibes, 2001[5].

One cannot ignore the potential impact E learning will have on the development of both preservice and inservice educators. Integrated seamlessly with high quality face-to-face staff development, E-learning can enhance learning opportunities for adults in schools. Further, educators who act early in this trend can shape the quality and use of E-learning for staff development so that it embodies the characteristics of powerful professional learning that sustains growth over time, builds productive learning communities and, most importantly ¡V improves student learning. Educators now more than ever can take an active role in co-producing knowledge, shaping the structure of their own learning experiences, and influencing producers of e-learning to develop programs, products, and services that are responsive to the needs of educators and their students. Without the active participation of educators themselves, E-learning may not develop to its full potential. Instead of becoming a dynamic tool to construct knowledge, technology may be used only for information and resource management. Perhaps the best way to take advantage of the opportunities available through technology-mediated professional learning is to integrate E-learning into a balanced professional development program that combines formal

face-to-face learning experiences optimally followed by online and one-on-one support, ¢wjust in time¡ü training and development, and collaborative work on those tasks that most directly influence the quality of teaching and learning Doubler, S., Laferriere, T., Lamon, M., Rose, R., Jay, M. Hass, N., Polin, L. and Schlager, M.[8].

Reasons for expansion of E-Learning. „h The call for continued professional learning among educators is increasing The importance of staff development as a key process to improve student achievement is gaining more acceptance worldwide. Schools and institutes are

increasing their professional development opportunities ¡V and especially those that are flexible, convenient, cost effective, and that use the newly installed technology infrastructures. The number of students in post-secondary education enrolled in distance education has increased dramatically. Teachers report and also feel significant lack of training and in their familiarity with using technology.

Need of E learning adoption by the staff/ faculty:

When teachers have access to high quality, results-driven, content-specific staff development, their students¡¦ academic achievement increases Killion, 1999[6]; WestEd, 2000[7]. For example, an investment in professional development produces greater increases in student achievement than comparable investments in reducing class size, increasing salaries, and hiring more experienced teachers. So, the first and foremost is that when the teachers have access to high quality, results-driven, content-specific staff development, their students¡¦ academic achievement will increase leading to their own up gradation. Further the pressure is created as a result of increased demands on educators for accountability and challenging differences in student learning needs that require more and higher quality professional learning for educators. As a result, educators themselves are seeking more opportunities for professional learning and are demanding that these experiences be more closely related to their specific responsibilities and their students¡¦ learning needs. With the increased access to professional learning for educators available through E-learning, it is even more important to ensure that all professional learning supports educators in gaining the knowledge and skills necessary to increase student learning. High quality professional learning on an ongoing basis is one-way institutes can leverage improvement in professional practice and increased student achievement. The most effective and efficient way to achieve this objective is the E learning way. Technology-mediated staff development Vs. Face-to-face: - For this purpose, E-learning is used as the umbrella term for all forms of electronically assisted or technology-mediated learning. Although technology-mediated staff development offers far more diverse learning experiences, its core purpose and function are the same as its face-to-face counterpart. As such, it is a prominent reform intervention, capable of improving learning and teaching. When institutes want to improve student performance, they provide staff development opportunities to enhance educator effectiveness: the pathway to student achievement. The similarities between traditional face-to-face staff development and technology-mediated staff development are significant. They require the same level of support and resources to ensure effectiveness. They use many of the same learning processes, including collaboration, inquiry, dialogue and reflection. And, they both seek the same result ¡V to increase student achievement. The Fig. 1 reflects a comparative analysis of these two staff development methodologies.

Fig: 1-Increased Learning Opportunities

	Current Realities of most face to face Staff development Programs	E-Learning possibilities
Time for Learning	Time for formal staff development such as courses, workshops, seminars etc., is determined by a set schedule	Time for learning is flexible and available to learners (24x7)
Place for learning	Participants and /or consultants travel to designated learning site	Learning occurs anywhere access is available when learning is desired
Opportunities for learning	Opportunities for learning are pre dominantly determined by geographic region.	Learning opportunities are available worldwide.
Design for learning	Most learning occurs in formal structures where one size fits all	The learning experiences is customizable and supports "just –in –time" learning..

Source:- National staff development council(US), May 2005.

Such exponential growth in access to information and learning opportunities may hold promise for the field of staff development. While it is still too soon to know the effectiveness of e-learning initiatives, nonetheless, virtually every day, businesses, program developers, staff developers, community-based agencies, professional associations, and universities are creating new courses, programs, services, seminars, and other forms of technology-mediated learning for educators. Faced with these opportunities, individual educators, schools and institutions, and other agencies are eager to explore the potential of E-learning and avoid whatever pitfalls may exist.

Conclusion: -

The greatest advantage of E learning in the staff development process is that it can be used anytime and anywhere for meeting the diverse teaching ¡Vlearning requirements of the educators. To be successful, E-learning requires specialized resources in addition to those necessary in face-to-face staff development. E learning requires an investment in the technology infrastructure including hardware, connectivity, and the software that supports learning. It also requires ongoing and planned maintenance and upgrading and access to technical support to minimize technical problems, which interrupt learning and decrease learners¡¦ motivation and capacity

to learn. Human resources include faculty with specialized training in designing, teaching, and facilitating E-learning. Sufficient faculty is needed to ensure that students have immediate feedback and support to prevent depersonalization within the e-learning environment.

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PHISHING: THE FASTEST GROWING FRAUD ON THE INTERNET

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Abstract

Phishing is the fastest growing fraud on the Internet. Phishing is recently a popular type of web based attack which implements deceit techniques by means of spoofed E-mails and web sites attempting to fool internet users to obtain their credentials and personal information. Major activities of the phishing across globe specifically in the banking sector. This paper provides an introduction to phishing the reasons for increase in phishing activities, multiple techniques used for phishing. This paper concludes some steps that can be used to detect and avoid phishing schemes.

Keywords: Online Frauds, Phishing Methods, Prevention steps

Introduction

It is derived from word fishing. Phishing is a technique used to gain personal information for purposes of identity theft, using fraudulent e-mail messages that appear to come from legitimate businesses, most commonly banks. The message generally indicates that, due to problems in the institution (bank in this case) such a database updates, problem occurred in server, security/identity theft concerns, the recipient is required to update personal data such as passwords, bank account information, driver's license numbers, social security numbers, Personal Identification Numbers (PIN), and so forth. The e-mails include warning to the users that failure to immediately provide the updated information will result in suspension or termination of the account etc. Phishing emails are distributed using techniques similar to spam including sending millions of emails from compromised computer systems on the Internet. Recently, phishing attacks have become more sophisticated and in some instances don't even require the user to be deceived via email. Techniques known as DNS spoofing and overwriting of the user's host file will send the user to the fraudulent site even when he types the correct URL in his browser. Such advanced phishing attacks are commonly known as "pharming". Over 16,000 unique phishing attacks reported in Nov. 2005, about double the number from 2004.

Phishing Techniques
Cross-Site Scripting Explored

Cross-site scripting is a powerful tool for Web site trust building. The attacker's content is presented to his victims with the correct domain information in the Location bar, and can even take advantage of his target brand's SSL credentials and trust zone designation. For these reasons, the SunTrust case was widely reported as a sea change in the phishing landscape, and many security researchers came to the conclusion that XSS is the next killer phishing technology. However, the vast majority of phishing campaigns make no use of these tricks. The reasons are based largely in the practical application of XSS. To begin with, XSS attacks require XSS vulnerabilities, and these are non-trivial to discover, even for experienced application security auditors and penetration testing experts. This is not to say they do not exist, but they require levels of effort and expertise to properly exploit that are not commonly found in a typical phishing gang.

Furthermore, once an XSS attack is launched, the campaign doesn't tend to have an effective lifespan that's any different from a normal attack. In fact, the use of an XSS error can shorten the detection time for a targeted financial institution. Intrusion prevention systems and URL validation software are both able to detect, prevent, and alert on attempted XSS exploits. When a phisher leverages vulnerability on a bank's site, he has lost the stealth factor inherent in the more traditional phishing attack.

Finally, XSS vulnerabilities, once discovered and known to the victim organization, tend to be fixed rapidly, which, in turn, destroys the repeatability of a phishing campaign. Bank applications tend to be highly customized and particular to a brand, so a phishing campaign that

makes use of an XSS exploit is not only a "one-shot" against a particular brand, but cannot be easily repurposed with another brand's image. It should not be construed that phishers are ignorant of cross-site scripting. To the contrary, evidence indicates that XSS is rapidly becoming a favorite method of compromising third-party bulletin board Web sites running known-vulnerable PHP code. In contrast to finance-related sites, these small BBS's are lightly administered and thus, an XSS compromise may go undetected for weeks. These are attractive features for phishers looking for a more permanent hosting site for their forged login pages. However, the fear that phishers will descend on bank and credit sites armed with clever XSS tricks is largely overrated. XSS vulnerabilities are much more useful for a careful, coordinated attacker; they are not particularly useful for the volume-driven phishing industry.

Distributed Phishing Networks

In this technique attacker use large numbers of fraudulent Web hosts for each set of bait messages. Each server is responsible for collecting only a tiny percentage of victim PIIs, so server takedown only significantly hinders a DPA when applied to thousands of servers within hours of the initial mailing. In the extreme case where each victim is referred to a unique Web page, the benefits of detection vanish. If the user recognizes the bait message as a component of a phishing attack, the link to the fraudulent Web server is not generalizable information since it only collects information for the one victim; disabling the server will not prevent any other potential victims from betraying their PII. While the extreme case may not be economical if large numbers of victims (> 100, 000) are targeted, DPAs that use thousands of servers carry most of the benefits. In this more affordable case, reporting a server eliminates less than 0.1% of the attack's collection capacity. In addition to frustrating server takedown, DPAs limit the utility of current database.

DNS based Phishing:

DNS Based Phishing is also called pharming. It targets numerous users and refers generally to misdirecting the user towards phished targets through misconfiguring the DNS caches or host files of operating systems. Man in the Middle Phishing which is based on the basic "Man in the Middle" attack strategy and aims to interfere between user source and server in order to get the confidential information.

Preset Session Attack:
Preset Session Attack is based on the statelessness of HTTP and HTTPS protocols. To manage the states in a session, Session IDs are used. By web based applications with poor state management systems the user may be allowed to generate a Session ID. Attackers send an E-mail to the victim with a link to his own legitimate bank account containing a predefined Session-ID. As the valid user authenticates itself, the server allows any connection using the same Session-ID, so that the attacker gains access. The types of attacks which apply techniques such as injecting malicious software, DNS manipulations or communication interference between user and server, other than the deceptive phishing attacks, excludes the role of the attacked user almost completely. User's consciousness of phishing hazard or general knowledge in internet issues are factored out in this kind of attacks because due to their implementation through exploiting the security vulnerabilities of the operating systems or legitimate sites. As we mentioned earlier we will be rather dealing with the perceptive kind of phishing attacks as we don't want to exclude the factor "user" out of our concerns but rather study it to some extent.

Prevention
What to Do

- Protect your computer with anti-virus software, spy ware filters, e-mail filters, and firewall programs, and make sure that they are regularly updated.
  - Consider installing a Web browser tool bar to help protect you from known phishing fraud websites. (Check with your browser or e-mail provider for such toolbars.)
- Ensure that your Internet browser is up to date and security patches applied.
- Be suspicious of any e-mail with urgent requests for personal financial information or threats of termination of online accounts.
  - Unless the e-mail is digitally signed, you can't be sure it wasn't forged or "spoofed."
  - Phishers typically ask for information such as usernames, passwords, credit card numbers, social security numbers, etc.
  - Phisher e-mails are typically not personalized, while valid messages from your bank or e-commerce company generally are.

- When contacting your financial institution, use only channels that you know from independent sources are reliable (e.g., information on your bank card, hard-copy correspondence, or monthly account statement), and don't rely on links contained in e-mails, even if the web address appears to be correct.

- Always ensure that you're using a secure website when submitting credit card or other sensitive information via your Web browser.
  - To make sure you're on a secure Web server, check the beginning of the Web address in your browsers address bar - it should be "https://" rather than just "http://."

- Regularly log into your online accounts.
  - Don't leave them for as long as a month before you check each account.

- Regularly check your bank, credit and debit card statements to ensure that all transactions are legitimate.
  - If anything is suspicious, contact your bank and all card issuers.

What Not to Do

- Don't assume that you can correctly identify a website as legitimate just by looking at its general appearance.
- Don't use the links in an e-mail to get to any web page, if you suspect the message might not be authentic.
  - Instead, call the company on the telephone, or log onto the website directly by typing in the Web address in your browser.
- Avoid filling out forms in e-mail messages or pop-up windows that ask for personal financial information.
  - You should only communicate information such as credit card numbers or account information via a secure website or the telephone.

Conclusion

In this paper we have discussed phishing in detail. Applying Digital Signatures in E-mail communication is an effective way to overcome the massive problems caused by absence of sender authentication. Nowadays, all popular E-mail client programs support the digital signature technology. Once the user starts to utilize digital signature technology after creating the key pair and have them certified by a key management server, it's much easier to assess the legitimacy and the identity of the communication partners. However, it is not enough to rule out the possibility that a phisher can also exploit digital signature system through having its own keys and certificates.

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"ASSESSMENT MEASURES OF NUCLEAR POWER GENERATION PLANT UNDER PRE-EMPTIVE REPEAT REPAIR"

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Abstract

The present study discusses important assessment measures of nuclear power generation plant. In this paper we have taken one extra heat exchanger in parallel redundancy to improve overall system's performance. The pre-emptive repeat repair policy has been adopted. The system being non-markovion nature, we have used supplementary variable technique and Laplace Transformation to formulate and solve the mathematical model. Steady state behaviour of the system and a particular case has also been derived for practical point of view. Reliability of the system and mean time to failure of the system have been computed. A numerical example together with its graphical illustration has been appended to high light the important results.

Key words : *Exponential time distribution, M.T.T.F., Reliability, Steady-state behaviour, Pre-emptive repeat repair, Redundancy, etc.*

Introduction

Several authors including [1,2,3,4,5.....] in the field of reliability theory analysed the complex system under different augumentations, assumptions and model formulation by using the supplementary variable and regenerative point technique and Boolean function technique. Singh I.P. etal (1996) studied the reliability analysis of stream generating system in

a thermal power plant and optimized the availability of the system by taking constant failure and repair rates. Chatterjee A. etal (2004) discussed enhancement of reliability and economy of a thermal power generating system. S. Mukender and Chander S. (2005) analysed stochastically a system of two reliability models of non-identical units – one unit an electric transformer and other generator in priority. Recently Bier V.M. etal (2007) discussed the methodology for identifying the optimal strategy of a power transmission system.Recently Singh.T.P.&Satyavati(2007)discussed the assessment measures of Nuclear power generation plant under Head of line repair and derived the availability &M.T.T.F.of the system .This paper is an extension of our previous work with a difference that we have adopted pre-emptive repeat repair policy.

In the present paper we have obtained some important assessment measures of nuclear power generation plant. The transition state diagram in system configuration has been shown in fig. 1. In this nuclear power generation plant, there are four main subsystems A, B,C and D, connected in series. Subsystem A is reactor vessel where we create energy by fissioning the atom. This energy goes to subsystem B, through coolent, which is a heat exchanger. Subsystem B converts the energy into steam. This steam can be used to rotate turbine (the subsystem C). This turbine is connected with generator, the subsystem D and this generates the electric power. We have adopted pre-emptive repeat repair policy i.e. the repairs of subsystems A,C and D preempt over repair of subsystem B. In this model, we have taken one extra heat exchanger in parallel redundancy to improve overall system's performance.

Since the system is of Non-Markovion nature, we have used supplementary variables technique for mathematical formulation of the problem. The mathematical model has been solved with the aid of Laplace transforms. Pre-emptive repeat repair policy has been adopted for repair purpose.

All failures follow exponential time distribution, whereas all repaires follow general time distribution. Steady state behaviour of the system and a particular case, when repairs follow exponential time distribution have also been derived for practical utility of the model. Reliability of the system has been computed. One numerical example together with its graphical illustration has been appended to highlight important results of the study.

Assumptions :

- All failures follow exponential time distribution

whereas all repairs follow general time distribution.

- Initially, all the subsystems are operable.
- Repairs are perfect and after repair system works like new.
- Failures are S-independent.
- On failure of one unit of subsystem B, whole system works in reduced efficiency state.

Notations :

f_i : failure rate of the ith subsystem.

$r_i(j)\Delta$: first order probability that i_{th} failure will be repaired in the time interval $(j, j+\Delta)$ conditioned that it was not repaired upto the time j.

Po(t) : Probability that at time t, whole system is operable.

$P_i(j,t)\Delta$: Probability that at time t, system suffers with failure of i^{th} subsystem and elapsed repair time lies in the interval $(j, j+\Delta)$.

$P_B(j,t)\Delta$: Probability that at time t, system suffers with failure of i^{th} subsystem while subsystem B_1 has already failed. The elapsed repair time lies in the time interval $(j, j+\Delta)$.

Si(j) :

FORMULATION OF MATHEMATICAL MODEL:

Probability considerations and limiting procedure yield the following set of difference-differential equations, governing the behaviour of considered model:

$$\left[\frac{d}{dt}+f_A+f_{B_1}+f_C+f_D\right]P_0(t)=\int_0^\infty P_A(x,t)r_A(x)dx+\int_0^\infty P_{B_1}(y,t)r_{B_1}(y)dy$$

$$+\int_0^\infty P_C(m,t)r_C(m)dm+\int_0^\infty P_D(n,t)r_D(n)dn$$

$$+\int_0^\infty P_B(z,t)r_B(z)dz \quad \text{.....(1)}$$

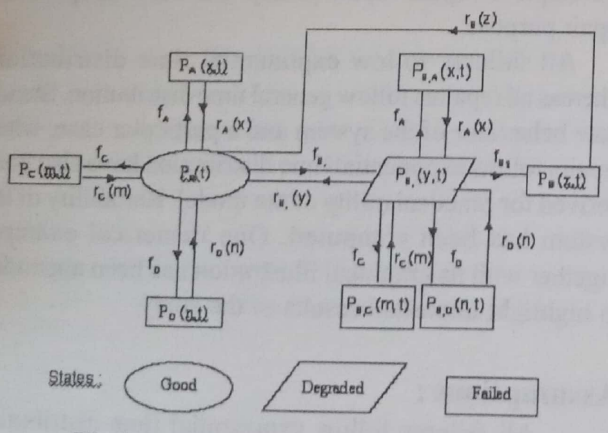


Fig 1.1 State – Transition Diagram

$$\left[\frac{\partial}{\partial x}+\frac{\partial}{\partial t}+r_A(x)\right]P_A(x,t)=0 \quad (2)$$

$$\left[\frac{\partial}{\partial m}+\frac{\partial}{\partial t}+r_C(m)\right]P_C(m,t)=0 \quad (3)$$

$$\left[\frac{\partial}{\partial n}+\frac{\partial}{\partial t}+r_D(n)\right]P_D(n,t)=0 \quad (4)$$

$$\left[\frac{\partial}{\partial y}+\frac{\partial}{\partial t}+f_A+f_{B_2}+f_C+f_D+r_{B_1}(y)\right]P_{B_1}(y,t)=0 \quad (5)$$

$$\left[\frac{\partial}{\partial x}+\frac{\partial}{\partial t}+r_A(x)\right]P_{B_1A}(x,t)=0 \quad (6)$$

$$\left[\frac{\partial}{\partial m}+\frac{\partial}{\partial t}+r_C(m)\right]P_{B_1C}(m,t)=0 \quad (7)$$

$$\left[\frac{\partial}{\partial n}+\frac{\partial}{\partial t}+r_D(n)\right]P_{B_1D}(n,t)=0 \quad (8)$$

$$\left[\frac{\partial}{\partial z}+\frac{\partial}{\partial t}+r_B(z)\right]P_B(z,t)=0 \quad (9)$$

Boundary conditions are :

$$P_A(0,t)=f_AP_0(t) \quad (10)$$

$$P_C(0,t)=f_CP_0(t) \quad (11)$$

$$P_D(0,t)=f_DP_0(t) \quad (12)$$

$$P_{B_1}(0,t)=f_{B_1}P_0(t)+\int_0^\infty P_{B_1A}(x,t)r_A(x)dx+\int_0^\infty P_{B_1C}(m,t)r_C(m)dm$$

$$+\int_0^\infty P_{B_1D}(n,t)r_D(n)dn \quad (13)$$

$$P_{B_1A}(0,t)=f_AP_{B_1}(t) \quad (14)$$

$$P_{B_1C}(0,t)=f_CP_{B_1}(t) \quad (15)$$

$$P_{B_1D}(0,t)=f_DP_{B_1}(t) \quad (16)$$

$$P_B(0,t)=f_{B_2}P_{B_1}(t) \quad (17)$$

Initial conditions are :

$P_0(0)=1$, otherwise zero. ...(18)

SOLUTION OF THE MODEL :

Taking Laplace transforms of equations (1) through (17) subjected to initial conditions (18), we have

$$\left[s+f_A+f_{B_1}+f_C+f_D\right]\overline{P}_0(s)=1+\int_0^\infty \overline{P}_A(x,s)r_A(x)dx+\int_0^\infty \overline{P}_{B_1}(y,s)r_{B_1}(y)dy$$

$$+\int_0^\infty \overline{P}_C(m,s)r_C(m)dm+\int_0^\infty \overline{P}_D(n,s)r_D(n)dn$$

$$+\int_0^\infty \overline{P}_B(z,s)r_B(z)dz \qquad -(19)$$

$$\left[\frac{\partial}{\partial x}+s+r_A(x)\right]\overline{P}_A(x,s)=0 \qquad .....(20)$$

$$\left[\frac{\partial}{\partial m}+s+r_C(m)\right]\overline{P}_C(m,s)=0 \qquad .....(21)$$

$$\left[\frac{\partial}{\partial n}+s+r_D(n)\right]\overline{P}_D(n,s)=0 \qquad .....(22)$$

$$\left[\frac{\partial}{\partial y}+s+f_A+f_{B2}+f_C+f_D+r_{B_1}(y)\right]\overline{P}_{B_1}(y,s)=0 \qquad (23)$$

$$\left[\frac{\partial}{\partial x}+s+r_A(x)\right]\overline{P}_{B_1A}(x,s)=0 \qquad ....(24)$$

$$\left[\frac{\partial}{\partial m}+s+r_C(m)\right]\overline{P}_{B_1C}(m,s)=0 \qquad .....(25)$$

$$\left[\frac{\partial}{\partial n}+s+r_D(n)\right]\overline{P}_{B_1D}(n,s)=0 \qquad .....(26)$$

$$\left[\frac{\partial}{\partial z}+s+r_B(z)\right]\overline{P}_B(z,s)=0 \qquad ....(27)$$

$$\overline{P}_A(0,s)=f_A\overline{P}_0(s) \qquad ...(28)$$

$$\overline{P}_C(0,s)=f_C\overline{P}_0(s) \qquad ...(29)$$

$$\overline{P}_D(0,s)=f_D\overline{P}_0(s) \qquad ....(30)$$

$$\overline{P}_{B_1}(0,s)=f_{B_1}\overline{P}_0(s)+\int_0^\infty \overline{P}_{B_1A}(x,s)r_A(x)dx+\int_0^\infty \overline{P}_{B_1C}(m,s)r_C(m)dm$$

$$+\int_0^\infty \overline{P}_{B_1D}(n,s)r_D(n)dn \qquad ....(31)$$

$$\overline{P}_{B_1A}(0,s)=f_A\overline{P}_{B_1}(s) \qquad ....(32)$$

$$\overline{P}_{B_1C}(0,s)=f_C\overline{P}_{B_1}(s) \qquad ...(33)$$

$$\overline{P}_{B_1D}(0,s)=f_D\overline{P}_{B_1}(s) \qquad (34)$$

$$\overline{P}_B(0,s)=f_{B_2}\overline{P}_{B_1}(s) \qquad (35)$$

Now integrating (20) by using boundary condition (28), we get

$$\overline{P}_A(x,s)=f_A\overline{P}_0(s)\exp.\{-sx-\int r_A(x)dx\}$$

$$\Rightarrow \overline{P}_A(s)=f_A\overline{P}_0(s)D_A(s) \qquad (36)$$

Similarly, integrating (21) and (22) subjected to (29) and (30), respectively, we have

$$\overline{P}_C(s)=f_C\overline{P}_0(s)D_C(s) \qquad ....(37)$$

and $$\overline{P}_D(s)=f_D\overline{P}_0(s)D_D(s) \qquad ....(38)$$

Again, integrating equation (24) by using (32), we obtain

$$\overline{P}_{B_1A}(x,s)=f_A\overline{P}_{B_1}(s)\exp.\{-sx-\int r_A(x)dx\}$$

$$\Rightarrow \overline{P}_{B_1A}(s)=f_A\overline{P}_{B_1}(s)D_A(s) \qquad ...(39)$$

Similarly integrating (25) and (26) subjected to equations (33) and (34), respectively, we can obtain :

$$\overline{P}_{B_1C}(s)=f_C\overline{P}_{B_1}(s)D_C(s) \qquad ....(40)$$

$$\overline{P}_{B_1D}(s)=f_D\overline{P}_{B_1}(s)D_D(s) \qquad ....(41)$$

Integrating (27) by using (35), we get

$$\overline{P}_B(z,s)=f_{B_2}\overline{P}_{B_1}(s)\exp.\{-sz-\int r_B(z)dz\}$$

$$\Rightarrow \overline{P}_B(s)=f_{B_2}\overline{P}_{B_1}(s)D_B(s) \qquad ...(42)$$

Now, integrating (23) by using relevant relations, we have

$$\overline{P}_{B_1}(s)=A(s)\overline{P}_0(s) \qquad ....(43)$$

In last, simplifying equation (19) subjected to relevant relations, we have

$$\overline{P}_0(s)=\frac{1}{B(s)}$$

Thus, finally we have the following Laplace transforms of various transitions-state probabilities

$$\overline{P}_0(s)=\frac{1}{B(s)} \quad (44)$$

$$\overline{P}_A(s)=\frac{f_A D_A(s)}{B(s)} \quad (45)$$

$$\overline{P}_C(s)=\frac{f_C D_C(s)}{B(s)} \quad (46)$$

$$\overline{P}_D(s)=\frac{f_D D_D(s)}{B(s)} \quad (47)$$

$$\overline{P}_{B_1}(s)=\frac{A(s)}{B(s)} \quad (48)$$

$$\overline{P}_{B_1A}(s)=\frac{f_A A(s) D_A(s)}{B(s)} \quad (49)$$

$$\overline{P}_{B_1C}(s)=\frac{f_C A(s) D_C(s)}{B(s)} \quad (50)$$

$$\overline{P}_{B_1D}(s)=\frac{f_D A(s) D_D(s)}{B(s)} \quad (51)$$

$$\overline{P}_B(s)=\frac{f_{B_2} A(s) D_B(s)}{B(s)} \quad (52)$$

where

$$A(s)=\frac{f_{B_1} D_{B_1}(s+f_A+f_{B_2}+f_C+f_D)}{1-[f_A\overline{S}_A(s)+f_C\overline{S}_C(s)+f_D\overline{S}_D(s)]D_{B_1}(s+f_A+f_{B_2}+f_C+f_D)} \quad (53)$$

$$B(s)=s+f_A+f_{B_1}+f_C+f_D-f_A\overline{S}_A(s)-f_C\overline{S}_C(s)-f_D\overline{S}_D(s)$$
$$-[f_{B_1}+A(s)\{f_A\overline{S}_A(s)+f_C\overline{S}_C(s)+f_D\overline{S}_D(s)\}]\overline{S}_B(s+f_A+f_{B_2}+f_C+f_D)$$
$$-f_{B_2}A(s)\overline{S}_B(s) \quad (54)$$

It is worth noticing that

$$\text{Sum of equations (44) through (52)}=\frac{1}{s} \quad (55)$$

STEADY-STATE BEHAVIOUR OF THE SYSTEM :

By using final value theorem in Laplace transforms, we have the following steady – state probabilities from equations (44) through (52) :

$$P_o=\frac{1}{B'(O)} \quad (56)$$

$$P_A=\frac{f_A M_A}{B'(O)} \quad (57)$$

$$P_C=\frac{f_C M_C}{B'(O)} \quad (58)$$

$$P_D=\frac{f_D M_D}{B'(O)} \quad (59)$$

$$P_{B_1}=\frac{A(O)}{B'(O)} \quad (60)$$

$$P_{B_1A}=\frac{f_A A(O) M_A}{B'(O)} \quad (61)$$

$$P_{B_1C}=\frac{f_C A(O) M_C}{B'(O)} \quad (62)$$

$$P_{B_1D}=\frac{f_D A(O) M_D}{B'(O)} \quad (63)$$

$$P_B=\frac{f_{B_2} A(O) M_B}{B'(O)} \quad (64)$$

$$\text{Where } A(O)=\frac{f_{B_1} D_{B_1}(f_A+f_{B_2}+f_C+f_D)}{1-[f_A+f_C+f_D]D_{B_1}(f_A+f_{B_2}+f_C+f_D)} \quad (65)$$

$$B'(O)=\left[\frac{d}{ds}B(s)\right]_{s=O} \quad (66)$$

$$M_i=-\overline{S}_i'(O),\forall i \quad (67)$$

A PARTICULAR CASE

When repairs follow exponential time distribution :

Setting $\overline{S}_i(j)=r_i/j+r_i, \forall i \text{ and } j$ in equations (44) through (52), we have the following Laplace transforms of various transition-state probabilities, in this case :

$$\overline{P}_O(s)=\frac{1}{C(s)} \quad (68)$$

$$\overline{P}_A(s)=\frac{f_A}{C(s)}.\frac{1}{s+r_A} \quad (69)$$

$$\overline{P}_C(s)=\frac{f_C}{C(s)}\cdot\frac{1}{s+r_c} \quad (70)$$

$$\overline{P}_D(s)=\frac{f_D}{C(s)}\cdot\frac{1}{s+r_D} \quad (71)$$

$$\overline{P}_{B_1}(s)=\frac{E(s)}{C(s)} \quad (72)$$

$$\overline{P}_{B_1A}(s)=\frac{f_A E(s)}{C(s).(s+r_A)} \quad (73)$$

$$\overline{P}_{B_1C}(s)=\frac{f_C E(s)}{C(s).(s+r_C)} \quad (74)$$

$$\overline{P}_{B_1D}(s)=\frac{f_D E(s)}{C(s).(s+r_D)} \quad (75)$$

$$\overline{P}_B(s)=\frac{f_{B_2} E(s)}{C(s).(s+r_B)} \quad (76)$$

Where

$$E(s)=\frac{f_{B_1}}{s\left[1+\frac{f_A}{s+r_A}+\frac{f_C}{s+r_c}+\frac{f_D}{s+r_D}\right]+f_{B_2}+r_{B_1}} \quad ..(77)$$

$$and\ C(s)=s\left[1+\frac{f_A}{s+r_A}+\frac{f_C}{s+r_c}+\frac{f_D}{s+r_D}\right]+f_{B_1}-\frac{f_{B_2}E(S)r_B}{s+r_B}$$

$$-\left[f_{B_1}+E(s)\left\{\frac{f_A r_A}{s+r_A}+\frac{f_c r_c}{s+r_c}+\frac{f_D r_D}{s+r_D}\right\}\right]\frac{r_{B_1}}{s+f_A+f_{B_2}+f_c+f_D+r_{B_1}} \quad ....(78)$$

RELIABILITY AND M.T.T.F. EVALUATION

We have, for the considered model

$$\overline{R}(s)=\frac{1}{s+f_A+f_{B_1}+f_C+f_D}$$

Taking inverse Laplace transform, we get

$$R(t)=\exp.\left\{-\left(f_A+f_{B_1}+f_C+f_D\right)t\right\} \quad (79)$$

Also, mean time to failure of the system is given by

$$M.T.T.F.=\int_0^\infty R(t)\,dt \quad (79)$$

$$=\frac{1}{f_A+f_{B_1}+f_C+f_D} \quad (80)$$

NUMERICAL COMPUTATION:

For a numerical computation, let us consider the values

$f_A=0.001,\ f_{B_1}=0.002,\ f_{B_2}=0.004,\ f_C=0.0025,\ f_D=0.003$ *and* $t=0,1,2,---$.

By using these values in equations (79) and (80), one can compute the table – 1.1, 1.2 and 1.3. Corresponding graphs have been shown in fig. 1.2, 1.3 and 1.4, respectively.

t	R(t)
0	1
1	0.991536
2	0.983144
3	0.974822
4	0.966572
5	0.958390
6	0.950279
7	0.942236
8	0.934260
9	0.926353
10	0.918512

Table 1.1

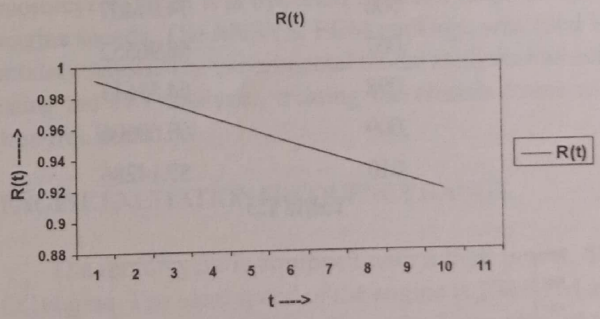
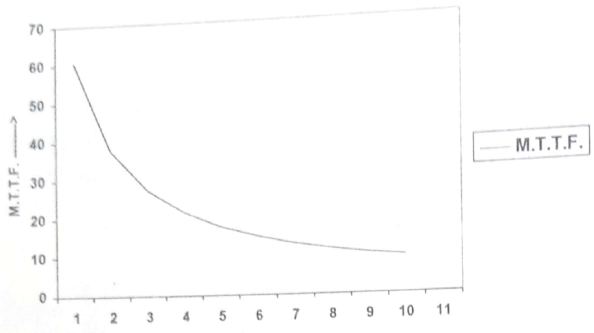


Fig- 1.2

f_{B_1}	M.T.T.F.
.01	60.60606
.02	37.73585
.03	27.39726
.04	21.50538
.05	17.69912
.06	15.03759
.07	13.0719
.08	11.56069

.09	10.36269
.10	9.389671

Table 1.2

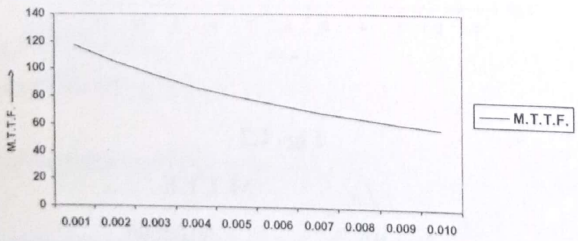


f_{B_1} - - >

Fig- 1.3

f_A	M.T.T.F.
.001	117.6471
.002	105.2632
.003	95.2381
.004	86.95652
.005	80.0000
.006	74.07407
.007	68.96552
.008	64.51613
.009	60.60606
.010	57.14286

Table 1.3



f_A - - >

Fig- 1.4

RESULTS AND DISCUSSION

On studying table 1.1 we find that reliability of system decreases as we make increase in time. Examination of Table 1.2 reveals that M.T.T.F. of the system decreases fastly in the beginning as we make increase in the value of failure rate f_{B_1} but for a higher value of f_{B_1} M.T.T.F. decreases constantly.

Analysis of table 1.3 yields that M.T.T.F. of system decreases approximately in a constant manner as we make increase in the failure rate f_A.

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MODEL ANALYSIS OF MOTORCYCLE CHASSIS FRAME BY FINITE ELEMENT METHOD

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Abstract

Modal Analysis is a well-defined technique, which defines the inherent dynamic properties of the structure. Modal analysis gives the modal parameters especially natural frequencies, mode shapes & damping values of the structure. The paper describes the methodology of using Finite Element Method (FEM) to analyze the motor-cycle chassis vibrations which are induced by engine excitation. It is an attempt to conduct modal analysis of motor-cycle chassis frame. The chassis is fabricated for high power, three-cylinder and 800cc country ride vehicle. Modal analysis of chassis is done by finite element method using ANSYS software by subjecting the chassis to one unit excitation force & observing the response at various locations of the chassis & further analyzing it for modal analysis. The method involves the FE modeling with shell elements & modal analysis with frequency sweep up to 1200 Hz. The paper aims to compare the excitation frequencies at various speeds of the engine with the natural frequencies at various modes of the chassis frame, there by predicting any possibility of resonance. It also gives the mode shapes at various frequencies of the chassis frame. The natural frequencies obtained for the chassis frame were above the range of excitation frequencies, thereby eliminating any possibility of resonance & mode shapes observed give the dynamic behavior of the chassis at different frequencies.

INTRODUCTION

In this world of global competition, in the two wheeler scenario, the ride comfort quality offered by the two wheeler plays an important role in attracting the potential buyers. The comfort is significantly affected by noise and vibration which is experienced by the rider during the travel. These vibrations are caused by road roughness, mass unbalance etc. and are transmitted to the occupants through the seat floor, handle bar, foot rests means in totality through the frame skeleton of motorcycle chassis. Hence to isolate these vibrations, the understanding of the dynamic behavior of the frame chassis is essential. Modal analysis can be used as a means for visualizing, and thereby increasing our understanding of the motions which occurs when the structure or system vibrates. The modal analysis of motorcycle chassis frame plays a vital role in determining the modal parameters like natural frequencies, mode shapes and damping values of the structure, which would define the dynamic behavior of the structure. In this paper an attempt is made to design and manufacture a chassis frame for 800 cc country ride motorcycle. To begin with, the modal analysis of chassis frame was undertaken for the study. The paper describes the methodology to analyze the motorcycle chassis vibration, treating the chassis frame as a free- free beam. The method involves the Finite Element modal analysis, validation of Finite Element model by Experimental dynamic modal analysis results. The paper also aims to compare the natural frequencies of chassis with engine excitation frequencies to check the possibility of resonance in motorcycle, when it is operated between ideal and peak engine speeds. The ANSYS, FEM package, was used for modal analysis. The experimental modal analysis was done using the FFT analyzer, treating the chassis frame as a free-free beam.

ENGINE EXCITATION FREQUENCY RANGE

The motorcycle is equipped with a high power, 800 CC engine. The ideal speed of the engine is 700 RPM and the peak speed is 2500 RPM. From the given ideal speed and peak speed the range of excitation frequency lies between 11.66 Hz to 41.66 Hz.

FEM APPLICATION TO THE MOTORCYCLE CHASSIS

Modal analysis of the motorcycle frame was carried out using 'ANSYS' FEM package. The entire FEM analysis procedure was completed in following steps.

Model Preparation - The motorcycle frame is the assemblage of main stem tube, steering tube, chassis back tubes, handle bar, steering column, foot rests engine brackets seat mount assembly, etc. Among these parts

only main stem tube of chassis is undertaken for the study. The tubular sections and the plate sections of the main frame of the motorcycle were modelled by using Shell- 93, three nodded plate element having six degrees of freedom at each node. The structural material properties were provided to the model by giving its elasticity, poisson's ratio and thickness as per the software configuration. Figure 1 shows the whole FEM model of the motorcycle skeleton with boundary conditions.

Boundary Conditions - The particular analysis was carried out to predict and analyse the vibrations induced in the chassis frame. The suspension and shock absorber elements (road tyre interactions) were not considered. Hence the suspension end and shock absorber end were fixed by applying zero displacement at concerned nodes. A concentrated load, equal to weight of three cylinder engine, for 800 cc motorcycle was applied at appropriate node, as shown if figure 1. The load was applied using MPC184 element, a general class of multipoint elements that implements kinematic constraints using lagrange multipliers, at suitable node. MPC184 element was also used at the centre of handle bar to fix it at that appropriate node. These boundary conditions are used for modal analysis.

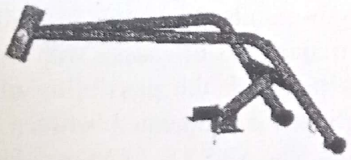

Figure 1: Finite Element model of Motorcycle Frame.

Finite Element Modal Analysis Solution - After the geometric model formulation, modal analysis was carried out for the given boundary conditions, treating the chassis main frame as a free- free beam. Among the different algorithms available on ANSYS for Modal analysis, of which Block Lanczos method was used to extract the natural frequencies and mode shapes of the motorcycle frame. The number of mode shapes required to expand, for the study of dynamic behavior, were generally the lower mode shapes of the structure. Figure 2 represents typical mode shapes of the chassis frame at 106.572, 189.866, 378.651 and 644.32 Hz. From the results of Modal analysis it was observed that the handle bar, seat mount and rear swing mount have elastic modes of vibration at all frequencies upto 250 Hz, indicating that the vibration levels are high at these locations.

The natural frequencies obtained from modal analysis of motorcycle chassis frame by FEM are given in Table 1. Some of the first modes were of very low frequency due to rigid body motions of the chassis and the unsprung masses. These were followed by the suspension modes showing bouncing and pitching of the whole body. Then in higher frequency range, the modes of elastic deflection of the chassis and the steering column were obtained

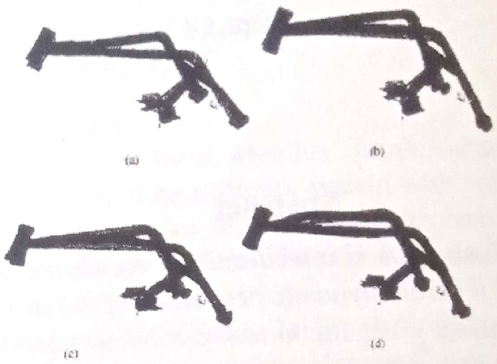

Figure 2: Selected Mode shapes of Motorcycle Frame at, (a) 106.572, (b) 189.866, (c) 378.651 and (d) 644.32 Hz.

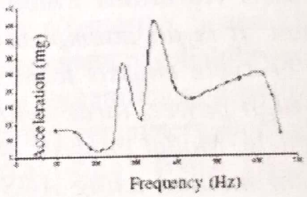

Figure 3: FRF of Finite Element Modal Analysis

Figure 3 shows the average FRF of the structure for the finite element modal analysis. The FRF gives the natural frequencies at the peaks with corresponding amplitudes. The frequency sweep was obtained between 97 Hz to 657 Hz.

Table 1 & figure 3 shows that the peak frequencies obtained by FEM are higher than that of engine excitation frequencies thereby eliminating any possibility of resonance in chassis frame.

Table 1. Natural frequencies of the motorcycle frame by FEM.

Mode No.	Natural Frequency in 'Hz'	Nature of the Mode Shape
1	106.572	Whole body bouncing
2	189.866	Whole body pitching
3	235.610	Cantilever bending of front chassis
4	318.800	Bending of steering columi
5	378.651	Twisting of full chassis
6	437.980	Overall bounce and role about suspension
7	520.510	Overall twisting of frame
8	566.070	Longitudinal Bending of whole chassis.
9	610.36	Cantilever bending of full chassis
10	644.32	Twisting of steering column

RESULTS AND DISCUSSION

Successful attempt has been made to predict the vibrations induced in motorcycle chassis frame by using FE modal analysis. The results of FEA gave the behavior of the chassis at different positions. As the chassis undertaken for the study was made robust, to mount 800 cc engine hence the range of natural frequencies observed by FEM technique was quiet above than that of engine excitation frequency range, thereby eliminating any possibility of resonance.

After studying the mode shapes at different frequencies it was observed that overall twisting for chassis was found. The present study was an attempt to find out modal parameters like natural frequencies, mode shapes and amplitude of vibrations of chassis of a country ride motorcycle mounted with 800 cc engine. As it was a first step towards design and analysis of a frame of country ride motorcycle, hence the modal analysis was done in primary stage of design treating the chassis as a free-free beam. In future the same work can be extended for modal analysis of chassis frame, treating it as a grounded beam. The structure can be excited to dynamic harmonic forces and the responses at handle bar, footrest and seat mount locations can be observed. Same responses can be obtained using finite element method and further they can be correlated with each other.

Acceleration (mg)Frequency (Hz)

CONCLUSIONS

From the results and discussion we come to the conclusion that the FE Modal analysis is very useful tool to find out the vibration sources correctly and reduce the overall vibration level. From the comparison of engine excitation frequencies with the FE Modal analysis, it was found that there was no possibility of any resonance in the chassis frame. The finite element vibration analysis not only predicts the natural frequencies of chassis but also shows the scope for structural modification to be carried out to minimize the vibration level of the motorcycle. Finally the results obtained from the present study can be further used to design the total suspension at front and rear wheel of the country ride, 800 cc motorcycle.

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BICRITERIA : IN GENERAL n × m FLOW SHOP SCHEDULING WITH TRANSPORTATION TIME

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Abstract

The paper deals with n jobs m machines flow shop when machines are taken on rent under pre-defined rental policy, the transportation time of each job from one machine to other is given. The objective of the paper is:— for a given sequence, to obtain the earliest times at which machines should be taken on rent so that overall rental cost is least and total elapsed time is as minimum as possible. The paper provides simple, direct and efficient algorithm to find the earliest time at which 2nd, 3rd, 4th ——, mth machines should be taken on rent.

Keywords:- Bicriteria, Flow- time, Rental policy, Transportation time, Make span etc.

Introduction:-

Johnson [1954] developed a polynomial time algorithm to minimize make span in two and restrictive 3- stage flow shop. Minimization of make span implies minimization of the idle time of the last machine whereas minimization of total flow time implies minimization of the idle time of the jobs. The algorithm which minimizes one criteria does not take into account the effect of other criteria. Recently, Bagga & Narain [2005], Singh T.P., Vij Indira etal [2006] & Narain L [2006] in their studies discussed various types of scheduling models under specified rental policy with the objective of minimizing rental cost as a measure of performance. Narain L [2006] studied a bicriteria problem to obtain a sequence which gives minimum possible rental cost while minimizing total elapsed time using Branch and Bound technique to obtain optimal algorithm.

The present study deals with general n×m flow shop scheduling when machine are taken on rent under pre-defined rental policy, the first machine will be taken on rent in the starting of processing the jobs, second, third,.....m^{th} machines should be taken on rent whenever it is required in order to satisfy the optimal criteria. The transportation time of jobs from one machine to other is given. The objective of the study is:- for a given sequence to obtain the earliest times at which machines should be hired so that total rental cost is least and total elapsed time is as minimum as possible.

The total rental cost of machines = $\sum_{J=1}^{m} \sum_{i=1}^{n} [A_{ij} + I_{ij} + t_{i,j-1}] \times C_j$

Where A_{ij} is the processing time of i^{th} job on machine j, I_{ij} is the idle time of machine j for i^{th} job, $t_{i,j-1}$ is transportation time for i^{th} job to $(j-1)^{th}$ machine and C_j is rental cost per unit time of machine j. Here we find the processing times A_{ij}, rental costs C_j and transportation time $t_{i,j-1}$ are constants, therefore, only factor remains to reduce idle times I_{ij}. Hence, total rental cost of machines is least if $I_{ij}=0$ for i=1,2,3.. n, j=1,2,3..m.

Hence for any sequence, the least total rental cost =

$$\sum_{J=1}^{m} \sum_{i=1}^{n} [A_{ij} + t_{i,j-1}] \times C_j$$

The paper provide simple, direct and efficient algorithm based on some theorems under the pre-defined rental policy to find the earliest time at which 2^{nd}, 3^{rd}.. m^{th} machine should be taken on rent, so that total rental cost is least and total elapsed time is as minimum as possible. The algorithm is illustrated through a numerical example.

Formulation & Notations :

Let n jobs require processing on machines M_1, M_2 … M_m in the order M_1 M_2 M_3 ..M_m.

M_j = Machine j, j=1, 2 …m
A_{ij} = The processing time of job i on machine M_j
Z_{ij} = The completion time of i^{th} job on M_j when all the machines are taken on rent at same time.
t_{ij} = Transportation time of i^{th} job to carry on j^{th} machine.
I_{ij} = The idle time of M_j for i^{th} job.
C_j = Rental cost per unit time of machine M_j
H_j = The earliest time at which machine M_j should be taken on rent so that total idle time of M_j is zero.
Z'_{ij} = The completion time of i^{th} job on machine M_j when M_j is taken on rent at time H_j. i=1,2….n, j=1,2…..m.

We refer

$Z_{(i,j)}$ = Max $[Z_{i-1,j}, Z_{i,j-1}] + A_{i,j} + t_{i,j-1}$ for $j \geq 2$

$Z_{(k,1)} = \sum_{i=1}^{k} A_{i,1}$

$I_{k,1}=0$

$I_{k,2} = \text{Max}\,[Z_{k-1,1}, Z_{k-1,2}]$ for $j \geq 2$

Theorem 1:

To show the time at which machine M_r should be taken on rent (or started processing jobs) to have zero idle time on M_r is given by $H_r = \max_{1 \leq k \leq n} \{y_k\}$, r=2,3…m

Where $y_k = Z'_{(k,r-1)} - \sum_{i=1}^{k-1} A_{i,r} - \sum t_{i,r}$ for $k > 1$

$Y_1 = Z'_{1,r-1}$

Proof:

In order to prove the theorem, we apply mathematical induction technique. If machine M_r starts processing jobs at time H_r then idle time of M_r is zero.

For $r=2, H_2 = \max_{1 \leq k \leq n} \{Y_k\}$

Let $Y_q = \max_{1 \leq k \leq n} \{Y_k\}$

$\therefore Y_q \geq Y_k$ for k=1,2.....n

For $k=1, y_q \geq y_1$

i.e $H_2 \geq Y_1$

i.e $H_2 \geq Z'_{(1,1)}$

i.e $Z'_{(1,1)} \leq H_2$ (1)

(1) $\Rightarrow$ If machine M_2 is taken on rent at time H_2, then it will start processing on the first job without waiting. Therefore, idle time of machine M_2 for 1st job is zero when it starts processing jobs at time H_2

For k=2,3.....n

$Y_q \geq Y_k$

$$Y_q + \sum_{i=1}^{k-1} A_{(i,2)} \geq y_k + \sum_{i=1}^{k-1} A_{i,2} + \sum t_{i,1}$$

i.e, $$H_2 + \sum_{i=1}^{k-1} A_{i,2} \geq Z'_{k,1} - \sum_{i=1}^{k-1} A_{i,2} + \sum_{i=1}^{k-1} A_{i,2} + \sum_{i=1}^{k-1} t_{i,1}$$

i.e $Z'_{(k-1,2)} \geq Z'_{(k,1)}$ for k=2,3....n.

i.e $Z'_{(k,1)} \leq Z'_{(k-1,2)}$ (2).

$I'_{(k,2)} = \max\,[Z'_{(k,1)} - Z'_{(k-1,2)}, 0]$

From (2), $I'_{(k,2)} = 0$ for k=2,3.....n.

$\therefore$ Result holds for r = 2

Let it is true for r = w

For r=w+1, $H_{w+1} = \max_{1 \leq k \leq n} \{y_k\}$

Let $Y_t = \max\{y_k\}$

$\therefore Y_t \geq y_k$ for k=1,2....n.

For k=1, $y_t \geq y_1$

i.e. $H_{w+1} \geq y_1$

i.e $H_{(W+1)} \geq Z'_{(w,1)}$

i.e $Z'_{(w,1)} \leq H_{w+1}$ (3)

Equation (3) implies that if machine M_{w+1} is taken on rent at time H_{w+1}, then it will start processing the first job without waiting. Therefore, idle time of machine M_{w+1} for 1st job is zero when it starts processing jobs at time H_{w+1}.

For K=2,3,.....n.

$Y_t \geq y_k$

$$\text{i.e } Y_t + \sum_{i=1}^{k-1} A_{(i,w+1)} + \sum t_{i,w} \geq y_k + \sum_{i=1}^{k-1} A_{i,w+1} + \sum t_{i,w}$$

$$\text{i.e } H_{w+1} + \sum_{i=1}^{k-1} A_{(i,w+1)} + \sum t_{i,w} \geq Z'_{k,w} - \sum_{i=1}^{k-1} A_{i,w+1} - \sum t_{i,w} + \sum_{i=1}^{k-1} A_{i,w+1} + \sum t_{i,w}$$

i.e $Z'_{k-1,w+1} \geq Z'_{k,w}$ for k=2,3,.....n

i.e $Z'_{k,w} \leq Z'_{k-1,w+1}$

$I'_{(k,w+1)} = \max[Z'_{(k,w)} - Z'_{k-1,w+1}, 0]$ (4)

From equation (4), $I'_{(k,w+1)} = 0$ for k=2,3.....n

$\therefore$ Result holds for r=w+1 also

Hence by mathematical induction technique, the theorem holds $\forall r$, where r=2,3,….m

Theorem2:

There will be idle time on machine M_r if it is taken on rent at time

$H_r < \max_{1 \leq k \leq n} \{y_k\}$; r=2,3…m

Where $Y_k = Z'_{(k,r-1)} - \sum_{i=1}^{k-1} A_{i,r} - \sum t_{i,r-1}$ for $k > 1$

$Y_1 = Z'_{(1,r-1)}$

Proof: Apply mathematical induction technique we can prove the theorem

for r=2; let $Y_q = \max_{1 \leq k \leq n} \{y_k\}$

$H_2 < \max_{1 \leq k \leq n} \{y_k\}$

$\therefore H_2 < y_q$

Here, arise two cases

Case I For q=1, $H_2 < Y_1$

i.e $H_2 < Z'_{(1,1)}$

i.e $Z'_{(1,1)} > H_2$ (5)

Machine M_2 will remain idle for time $\geq Z'_{(1,1)} - H_2$

From equation (5) $Z'_{(1,1)} - H_2 > 0$

Therefore, idle time of machine M_2 for 1st job will be greater than zero when it is taken on rent at time $H_2 < y_1$

Case II $q>1$; $H_2 < y_q$

$$\text{i.e } H_2 + \sum_{i=1}^{q-1} A_{i,2} + \sum t_{i,1} < Y_q + \sum_{i=1}^{q-1} A_{i,2} + \sum t_{i,1}$$

$$\text{i.e } Z'_{(q-1,2)} < Z'_{(q,1)} - \sum_{i=1}^{q-1} A_{i,2} - \sum t_{i,1} + \sum_{i=1}^{q-1} A_{i,2} + \sum t_{i,1}$$

$$\text{i.e } Z'_{q-1,2} < Z'_{q,1}$$
$$\text{i.e } Z'_{q,1} > Z'_{q-1,2} \qquad (6)$$

$$\Rightarrow I'_{q,2} \geq \max [Z'_{q,1} - Z'_{q-1,2,0}]$$
$$(6) \Rightarrow I'_{q,2} \geq Z'_{q,1} - Z'_{q-1,2} > 0$$

$\therefore$ Idle time of machine M_2 for q^{th} job will be greater than zero when it is taken on rent at time $H_2 < \max_{1 \leq k \leq n} \{y_k\}$

$\therefore$ result holds for r=2

Let result hold for r=w

For r=w+1

$$H_{w+1} < \max_{1 \leq k \leq n} \{y_k\}$$

Let $Y_t = \max_{1 \leq k \leq n} \{y_k\}$

$\therefore H_{w+1} < Y_t$

Now, there arise two cases

Case I:- t=1

$$H_{w+1} < Y_1 \text{ i.e } H_{W+1} < Z'_{(1,w)}$$

$$\text{i.e } Z'_{(1,w)} > H_{W+1} \qquad (7)$$

Machine M_{w+1} will remain idle for time $= Z'_{(1,w)} - H_{w+1}$

$(7) \Rightarrow Z'_{(1,w)} - H_{w+1} > 0$

$\Rightarrow$ idle time of machine M_{w+1} for 1st job will be greater then zero when it is taken on rent at time $H_{w+1} < Y_1$

Case II:- t>1

$$H_{w+1} < y_t$$

$$\text{i.e } H_{w+1} + \sum_{i=1}^{t-1} A_{(i,w+1)} + \sum t_{i,w} < Y_t + \sum_{i=1}^{t-1} A_{(i,w+1)} + \sum t_{(i,w)}$$

$$\text{i.e. } Z'_{(t-1,w+1)} < Z'_{(t,w)}$$
$$\text{i.e } Z'_{(t,w)} > Z'_{(t-1,w+1)} \qquad (8)$$
$$\therefore I'_{(t,w+1)} \geq \max[Z'_{(t,w)} - Z'_{(t-1,\,w+1),0}]$$

$$(8) \Rightarrow I'_{(t,w+1)} \geq Z'_{(t,w)} - Z'_{(t-1,\,w+1)} > 0$$

$\therefore$ idle time of machine M_{w+1} for i^{th} job will be greater than 0 when it is taken on rent at time $H_{w+1} < \max_{1 \leq k \leq n} \{y_k\}$

$\therefore$ result hold for r=w+1

By mathematical induction technique result holds for $\forall r$

Where r=2,3….m.

Conclusion & discussion

From theorems 1 & 2 we conclude that the earliest time at which machine M_r should start processing jobs continuously without idle interval is :-

$$H_r = \max_{i \leq k \leq n} \{y_k\}$$

$$= \max_{i \leq k \leq n} \{Z'_{(k,r-1)} - \sum A_{i,r}\} - \sum t_{i,r-1}$$

$$= \max_{i \leq k \leq n} [H_{r-1} + \sum_{i=1}^{k} A_{i,r-1} + \sum t_{(i,r-2)} + \sum_{i=1}^{k-1} A_{i,r} - \sum t_{i,r-1}$$

$$= H_{r-1} + \max_{i \leq k \leq n} [\sum_{i=1}^{k} A_{i,r-1} + \sum t_{i,r-2} - \sum_{i=1}^{k-1} A_{i,r}] - \sum t_{i,r-1}$$

$$= H_{r-1} + K_r \qquad (9)$$

Where $k_r = \max_{i \leq k \leq n} [\sum_{i=1}^{k} A_{(I,r-1)} + \sum_{i=1}^{k-1} A_{i,r}]$

K_r is the idle time of machine M_r for machine pair (M_{r-1}, M_r) as a two machine flow shop sequencing problem. Total elapsed time when all the machines process jobs continuously without idle interval is :

$$Z'(n,m) = H_m + \sum_{i=1}^{n} A_{i,m} + \sum t_{i,\,m-1} \qquad \text{——————} (10)$$

(10) $\Rightarrow$ total elapsed time will be minimum when H_m will be minimum.

Based on the above theorem we derive the following algorithm which provides the earliest times at which machines M_2 M_3 ….. M_m should be taken on rent so that total rental cost is minimum.

Algorithm

Step 1 :- consider s be any sequence.

Step 2: For machine pair (M_j, M_{j+1}) compute

$k_{j+1} = Z_{n,j+1} - \sum_{i=1}^{n} A_{i,j+1} - \sum t_{i,j}$, $1 \leq j \leq m-1$, as a two machine flow shop sequencing problem.

Step 3: The rental times H_j are given by

$H_j = H_{j-1} + k_j$ (j=3,4,……..m-1)

$H_2 = k_2$ & $H_1 = 0$

Illustration

Consider 5 jobs 4 machines problem with processing time and transportation time (in hours) given in table. Jobs are

processed in a given sequence s=1,2,3,4,5. Rental cost of machines M_1, M_2, M_3, M_4 is 10,20,30,40 units per hours respectively. Our objective is to make rental cost as minimum as possible and total elapsed time also minimum.

Jobs	Machine							
M_1	t_1	M_2	t_2	M_3	t_3	M_4		
1	6	1	3	1	2	2	8	
2	5	2	1	3	6	2	4	
3	4	2	4	1	4	1	5	
4	9	1	1	2	5	1	4	
5	3	1	3	1	4	1	3	

Solution- Reduced problem will be

Jobs	M_1	$M'_2=M_2+t_1$	$M'_3=M_3+t_2$	$M'_4=M_4+t_3$
1	6	4	3	10
2	5	3	9	6
3	4	6	5	6
4	9	2	7	5
5	3	4	5	4

for pair of machines (M_1, M'_2)

Jobs	M_1	M'_2
1	0-6	6-10
2	6-11	11-14
3	11-15	15-21
4	15-24	24-26
5	24-27	27-31

$Z_{5,2}$=31 Hours
K_2=31-12-7=12 Hours

For pair of machines (M'_2, M'_3)

Jobs	M'_2	M'_3
1	0-4	4-7
2	4-7	7-16
3	7-13	16-21
4	13-15	21-28
5	15-19	28-33

$Z_{5,3}$=33 Hours, K_3= 33-21–8 = 4 hours
For pair of machines (M'_3, M'_4)

Jobs	M'_3	M'_4
1	0-3	3-13
2	3-12	13-19
3	12-17	19-25
4	17-24	25-30
5	24-29	30-34

$Z_{5,4}$= 34 Hours
K_4= 34-24-7= 3 hours
H_1= 0, $H_j=H_{j-1}+k_j$ J=2,3,4
$H_2=H_1+K_2$=12 hours
$H_3=H_2+K_3$=12+4= 16 hours
$H_4=H_3+K_4$=16+3=19 hours

Conclusion

To minimize overall rental cost M_1 should be taken on rent in the starting of processing jobs, M_2 should be hired after 12 hours of processing of first job on M_1, M_3 after 16 hours and M_4 after 19 hours of processing of first of first machine.

Comparison of total rental cost & total elapsed time.

The least renal cost = $\sum_{j=1}^{m}\sum_{i=1}^{n}(A_{i,j}-H_j)\times C_j$

=27×10+(31-12)×20+(37-16)×30+(41-19)×40
=270+380+630+880=2160

Whereas without making idle time zero the least rental cost is given by

$\sum_{j=1}^{m}\sum_{i=1}^{n}(A_{i,j}+t_{i,j-1})\times C_j$

=27×10+(12+7)×20+(21+8)×30+(24+7)×40
=270+380+870+1240
= 2760 units which is much greater.

Jobs	M_1	M_2	M_3	M_4
1	0-6	7-10	11-13	15-23
2	6-11	13-14	17-23	25-29
3	11-15	17-21	23-27	29-34
4	15-24	25-26	28-33	34-38
5	24-27	28-31	33-37	38-41

for a given sequence s=1,2,3,4,5 the total elapsed time based on our theorems and algorithm= 27+(31-12)+(37-16)+(41-19) = 89 hours

where as total elapsed time by not considering our algorithm is given by

= 27+(31-7)+(37-11)+(41-15)
= 103 hours which is greater

Hence our objective to minimize total rental cost and to minimize total elapsed time is obtained.

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FUZZY LOGIC : AN APPLICATION TO FACULTY PERFORMANCE ANALYSIS

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Abstract

The performance analysis of an employee of an organization is an important aspect for growth and development of organization. There is a need for certain algorithm, tools, techniques etc which can provide precise and accurate information for the performance analysis. This paper presents an improved method for performance analysis of faculty members which has given us more precise and accurate result than the existing one.

This analysis is divided into three parts i.e. input fuzzification, rule evaluation and defuzzification. All the steps have been tested on various faculty members and the experimental results have demonstrated a fast, robust, and reliable analysis simulation. The inputs for this analysis are Feedback from students, Self-development effort and proficiency in teaching for a faculty. Output is obtained in term of overall performance of the faculty. The proposed performance analysis technique is simulated using fuzzyTECH 5.7 developed by Inform Software Corporation.

Key words : *Fuzzy Logic (FL), Crisp, Faculty Performance Analysis (FPA), Fuzzification and Defuzzification.*

I. INTRODUCTION

Fuzzy Logic control systems Figure (1) have been reported in wide range of applications that include industrial processes, transportation system, robotics and consumer products. The concepts of fuzzy logic (FL) was conceived by Lotfi Zadeh, a professor at University of California at Berkley, and presented as a way of processing data by allowing partial set membership rather than crisp set membership or non membership.

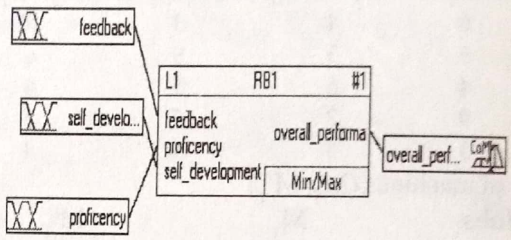


Figure (1) Structure of the Fuzzy Logic System

Professor Zadeh reasoned that people do not require precise, numerical information input, and yet they are capable of highly adoptive control. Fuzzy logic is a problem solving control system methodology that lends itself to implementation in system ranging from simple, small, embedded microcontrollers to large network, multi channel PC or work station based data acquisition and control systems. It can be implemented by hardware, software or a combination of both. Fuzzy logic provides a simple way to arrive at a definite conclusion based upon vague, ambiguous, imprecise, noisy or missing input information. A fuzzy logic based faculty performance analysis is devised on the basis of three basic factors of a faculty:

(i) Feedback
(ii) Self Development effort
(iii) Proficiency in teaching.

Each factor is allotted with 20 marks and on the basis of it overall performance of a faculty member is analyzed using fuzzy logic.

II. PROPOSED FUZZY MODEL

In order to design FL system we must describe the operation of system linguistically. Steps in designing FL system in this case are appended below:

(i) Identify the inputs and outputs using linguistic variables.

(ii) Assign membership function to the variables (fuzzification).
In our case study we have three input parameters and one output parameter. Membership functions are selected from the list of factors affecting the overall performance of a faculty at teaching institutions.
(iii) Build a rule base.
(iv) Generate crisp control action (defuzzification).

Fuzzification: - For this analysis we have taken three input parameters which are appended below:

Feedback: This factor is dependent on various aspects, however in this performance analysis we have considered the following four aspects:

(a) Presentation/Communication Skill.
(b) Course content and coverage.
(c) Motivation Skill.
(d) Punctuality and regularity.

Each aspect is assigned with 5 marks with a total of 20 marks.

Self Development Effort: This factor is collection of :

(a) Publications (Paper/articles/book /manual).
(b) Research and development/ Industrial projects.
(c) Participation (Seminar/ Conferences/Workshop etc).
(d) Research guidance.

Self Development Effort is having total marks of 20 with 5 marks each.

Proficiency in teaching: This factor includes:

(a) Handouts and lecture notes.
(b) Use of teaching aids.
(c) Participation in lab development work.
(d) Effective teaching skill

Total 20 marks are assigned for this factor and each aspect is assigned with 5 marks.

The Input parameters are fuzzified using the pre-defined membership functions shown in figure (2), figure (3) and figure (4). For three input parameters we have chosen four possibilities in each case.

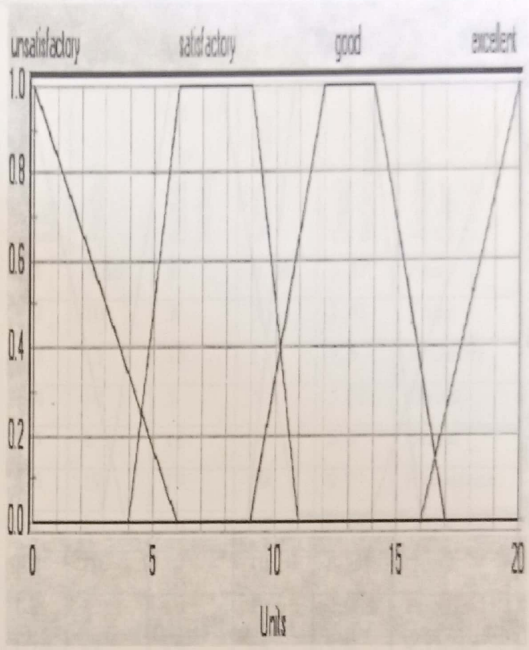


Figure (2) Membership function for input parameter "feedback".

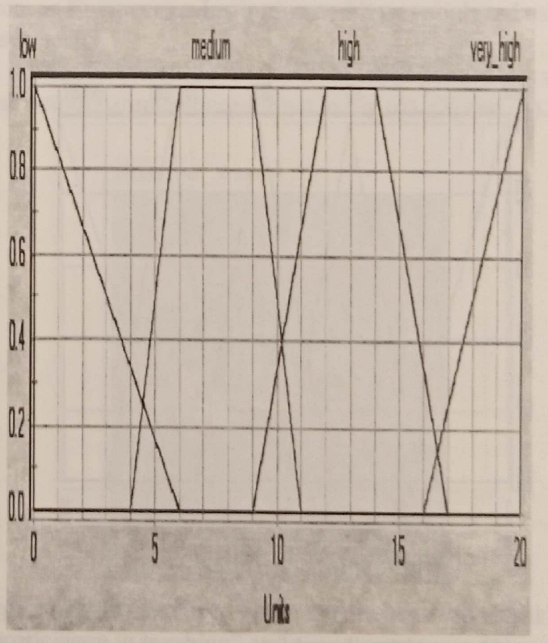


Figure (3) Membership function for input parameter "Proficiency in teaching".

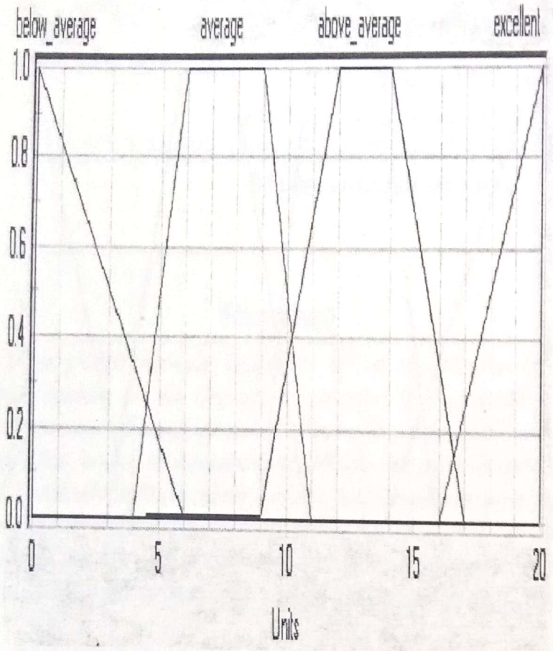
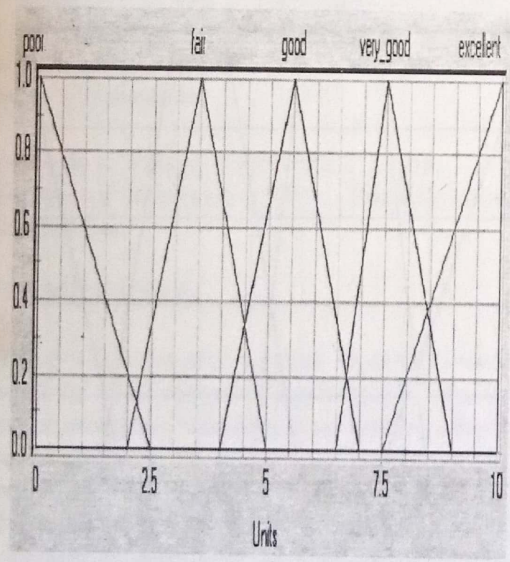


Figure (4) Membership function for input parameter "Self Development".

Similarly the output parameter "overall performance" is also fuzzified as shown in figure (5).



Figure(5) Membership function for output parameter "Overall Performance".

The output parameter is divided into five categories:

(i) Poor
(ii) Fair
(iii) Good
(iv) Very Good
(v) Excellent

Rule Evaluation: These fuzzified input values are used to evaluate rules for obtaining overall performance of faculty member. These rules are shown in Table (1). Here for the simulation we have fired 64 rules to find out the performance analysis of faculty members.

Rules for fuzzy system

	IF		THEN
feedback	proficiency	Self development	Overall performance
unsatisfactory	low	below_average	poor
unsatisfactory	low	Average	poor
unsatisfactory	low	above_average	fair
unsatisfactory	low	Excellent	fair
unsatisfactory	medium	below_average	poor
unsatisfactory	medium	average	fair
unsatisfactory	medium	above_average	fair
unsatisfactory	medium	excellent	good
unsatisfactory	high	below_average	fair
unsatisfactory	high	average	fair
unsatisfactory	high	above_average	good
unsatisfactory	high	excellent	good
unsatisfactory	very_high	below_average	fair
unsatisfactory	very_high	average	good
unsatisfactory	very_high	above_average	good
unsatisfactory	very_high	excellent	very_good
satisfactory	low	below_average	poor
satisfactory	low	average	fair
satisfactory	low	above_average	fair
satisfactory	low	excellent	good
satisfactory	medium	below_average	fair
satisfactory	medium	average	fair
satisfactory	medium	above_average	good
satisfactory	medium	excellent	good
satisfactory	high	below_average	fair
satisfactory	high	average	good
satisfactory	high	above_average	good
satisfactory	high	excellent	very_good
satisfactory	very_high	below_average	good
satisfactory	very_high	average	good
satisfactory	very_high	above_average	very_good
satisfactory	very_high	excellent	very_good
good	low	below_average	fair
good	low	average	fair

good	low	above_average	good
good	low	excellent	good
good	medium	below_average	fair
good	medium	average	good
good	medium	above_average	good
good	medium	excellent	very_good
good	high	below_average	good
good	high	average	good
good	high	above_average	very_good
good	high	excellent	very_good
good	very_high	below_average	good
good	very_high	average	very_good
good	very_high	above_average	very_good
good	very_high	excellent	excellent
excellent	low	below_average	fair
excellent	low	average	good
excellent	low	above_average	good
excellent	low	excellent	very_good
excellent	medium	below_average	good
excellent	medium	average	good
excellent	medium	above_average	very_good
excellent	medium	excellent	very_good
excellent	high	below_average	good
excellent	high	average	very_good
excellent	high	above_average	very_good
excellent	high	excellent	excellent
excellent	very_high	below_average	very_good
excellent	very_high	average	very_good
excellent	very_high	above_average	excellent
excellent	very_high	excellent	excellent

Table (1) Showing Rules for fuzzy system

Defuzzification: In this step we calculate the crisp value of the fuzzy system. There are various methods for the method of calculation crisp values; here we have used the minimum – maximum defuzzification method for simulation of results.

III. SIMULATION RESULTS

This analysis simulation was programmed using Inform Software Corporation's fuzzyTECH 5.7.Every inputs were divided into four sets. The simulation results use 64 rules.

The summary of results is shown in Table (2). In this table we have taken inputs for 10 faculty members and their corresponding output is evaluated using fuzzy logic system. For example if a faculty member is having a feedback of 10, proficiency in teaching is 3 and self development effort is 3, then the overall performance of faculty member using fuzzy logic is derived out to be 1.4190 which is categorized into poor category of faculty.

Summary of results

S.No	Feedback	Proficiency in teaching	Self Dev effort	Overall performance	Analyzed Output
1	4.66	8	8.46	3.57	Fair
2	10	3	3	1.41	Poor
3	15	15	15	7.5	V Good
4	18	5	5	5.02	Good
5	3	18	5	5.0	Good
6	19	19	19	9.9	Excellent
7	5	10	18	6.29	Good
8	10	12	10	6.29	Good
9	1	1	1	0.005	Poor
10	12	15	15	7.5	V Good

Table (2) Showing Summary of results

The sample for only 10 faculty members was collected from an Engineering Institution and it was analyzed using fuzzy logic.

The surface curve for the three input parameters and one output parameter are shown in Fig (6), (7) and (8).

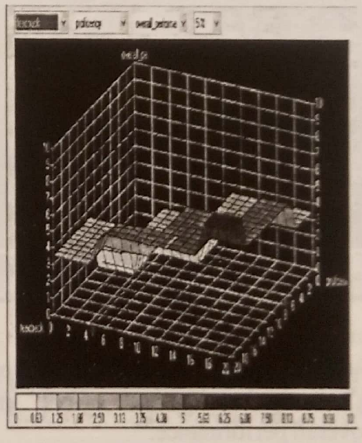


Figure (6) Surface curve for input parameter "feedback", "proficiency in teaching" and output parameter "overall performance".

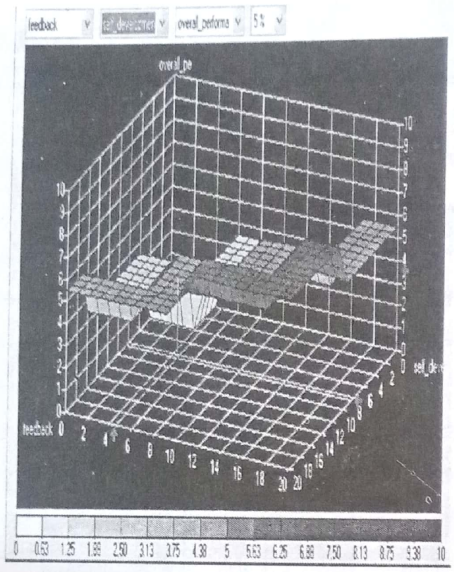


Figure (7) Surface curve for input parameter "feedback", "self development effort" and output parameter "overall performance".

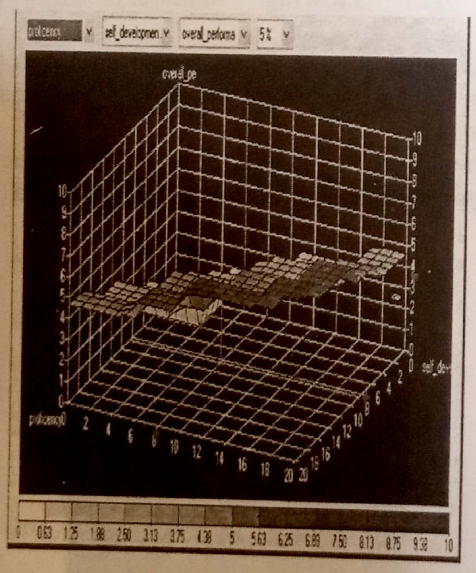


Figure (8) Surface curve for input parameter "proficiency in teaching", "self development effort" and output parameter "overall performance."

III. CONCLUSION

Fuzzy logic is a problem solving control system methodology that lends itself to implementation in system ranging from simple, small, embedded microcontrollers to large network, multi channel PC or work station based data acquisition and control systems. In this paper, overall performance analysis of only 10 faculty members of an Engineering Institution is taken as sample. It can further be extended as per the requirement of the organization. This method provides an easy and precise method for accurately defining the overall performance of a faculty member. These methods can also be extended for finding the performance of students in teaching institutions and in industries for performance evaluation of employee.

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"Biserial Queue Network with Multi-input source Assuming Service Rate to be Nonlinear"

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Abstract:

The paper deals a bitandem queue model in which multi-input source from a simultaneous arrival occurs to both queues arranged in biseries. The arrival rate is linear and follow poisson stream. The service parameters are supposed to be directly proportional to the respective queue number. Assuming the first channel service rate is linear while the second channel service rate to be non-linear, the transient behavior of the system is discussed.

Key words : Poisson stream, Multiinput, Bitendem, Non linear, Mean Queue Size etc.

Introduction:

Jackson (1954) studied the time dependent behavior of a system with two queues in series and obtained the steady state solution. O' Brien (1954) analysed the transient solution of queue model in which the service parameters $\mu n1$ and $\mu n2$ depends upon their queue length $n1$ and $n2$. The biserial queue system introduced by Maggu (1977) in "The Theory of Queues" corresponds to a practical situation to arrise in a production concern. Later on this idea was developed by various researches under different modification and augmentations. Singh T.P. (1986, 2005) studied two queues in biseries with multiinput source in which the service parameters depend upon respective queue length. H. Noor Mohammad et al (1983) studied a queue model in which growth rate considered to be non linear. Singh, T.P. (1994) studied a special class of birth death model in which the departure rate are supposed to be non-linear.

The present queue model is further an extension of the study made by Singh T.P. in a wider sense. Here we assume the 1st channel service rate is linear while the 2nd channel rate is non linear. The analytical behavior of this model discussed with additional assumption of the multiinput source and the service parameters depend upon respective queue lengths.

The practical situation can be observed in a civil or a nursing home where there are two or three wards via general ward and emergency ward. The patient arriving in general ward are treating in normal i.e. the service are done in linear fashion while in emergency ward service are done in linear fashion *i.e.* depending the rush of patients or the seriousness of cases. We find the practical situation in animals. Animals it the deer/pigeon/ chickens in some particular place. Exceeds certain density the deer/ pigeon / chickens start dying in a non linear fashion while there birth in linear way.

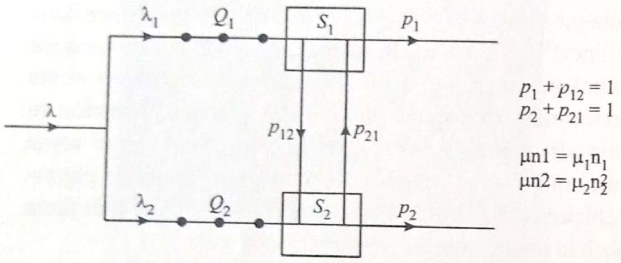
The Problem:

Consider a queue system comprised of two service channels S_1 and S_2 in biseries. The customers demanding service, arrive in Poisson process at the mean rate λ_1 and λ_2 Customers with rate λ_1 join a queue Q_1 infront of S_1 and those with rate λ_2 join a queue Q_2 infront of S_2 . An assumption of multi-input source in this problem states that at a mean rate λ is a simultaneous arrival in the system occurs according to which one arrival joins queue Q_1 before S_1 and other customer joins Q_2 before S_2 at the same moment.

In n_1 and n_2 are the queue numbers at any time t in Q_1 and Q_2 then μn_1 and μn_2^2 are the service parameters at S_1 and S_2 respectively defined by $\mu n_1 = \mu_1 n_1$ and $\mu n_2 = \mu_2 n_2^2$ where μ_1 and μ_2 are constant of proportionality.

To complete the model probalities p_1 and p_{12} have been introduced at S_1 to show that after completion of phase service at S_1 a customers at this counter departs from the service system or goes through S_2 for completion

of final phase service at S_2 where $p_1 + p_2 = 1$. Similarly p_2 and p_{21} have been introduced probablities at S_2 to show that after completion of phase service a customer at the counter S_2 departs from the service system completely or goes through S_1 for completion of final partial phase at S_1 where $p_2 + p_{21} = 1$



Define $P_{n1,n2}(t)$ probability that at array time t there are n_1, n_2 customers in queues $Q1$ and Q_2 in from of S_1 and S_2 respectively waiting for service (including a unit in service) in each case $(n_1, n_2 \geq 0)$

Connecting the various stale probabilities at $t + \delta t$ with those at t, and then taking $\delta t \to 0$ the differential difference equation governing the model can be stated as :

$$P'_{n_1,n_2}(t) = -(\lambda_1 + \lambda_2 + \lambda + \mu_1 n_1 + \mu_2 n_2^2)P_{n_1,n_2}(t) + \lambda_1 P_{n_1-1,n_2}(t) + \lambda_2 P_{n_1,n_2-1}(t) + \lambda P_{n_1-1,n_2-1}(t)$$
$$+ \mu_1(n_1+1)p_1 P_{n_1+1,n_2}(t) + \mu_1(n_1+1)p_{12}P_{n_1+1,n_2-1}(t) + \mu_2(n_2+1)p_2 P_{n_1,n_2+1}(t)$$
$$+ \mu_2(n_2+1)p_{21}P_{n_1-1,n_2+1}(t) \quad (1)$$

$$P'_{0,n_2}(t) = -(\lambda_1 + \lambda_2 + \lambda + \mu_2 n^2)P_{0,n2}(t) + \lambda_2 P_{0,n2-1}(t) + \mu_1(n_1+1)p_1 P_{n1+1,n2}(t) + \mu_1 p_{12} P_{1,n2-1}(t)$$
$$+ \mu_2(n_2+1)p_2 P_{n_2+1}^2(t) \quad (2)$$

$$P'_{n_1,0}(t) = -(\lambda_1 + \lambda_2 + \lambda + \mu_1 n_1)P_{n_1,0}(t) + \lambda_1 P_{n_1-1,0}(t) + \mu_1(n_1+1)p_1 P_{n_1+1,0}(t) + \mu_1 p_2 P_{n_1,0}(t)$$
$$+ \mu_2 p_{21} P_{n_1-1,1}(t) \quad (3)$$

$$P'_{0,0}(t) = -(\lambda_1 + \lambda_2 + \lambda)P_{0,0}(t) + \mu_1 p_1 P_{1,0}(t) + \mu_2 p_2 P_{0,1}(t) \quad (4)$$

To solve eq. (1) to (4) define generating functions as:

$$F(x,y,t) = \sum_{n_1=0}^{\infty}\sum_{n_2=0}^{\infty} P_{n_1,n_2}(t)x^{n_1}y^{n_2} \quad (5)$$

Also define the p.g.f as:

$$F_{n_2}(x,t) = \sum_{n1=0}^{\infty} P_{n_1,n_2}(t)x^{n_1} \quad (6)$$

Eq. (5) with the help of eq. (6) as:

$$F(x,y,t) = \sum_{n_2=0}^{\infty} F_{n_2}(x,t)y^{n_2} \quad (7)$$

Multiply eq. (1) and eq. (3) by x^{n1} and summing each over n_1 from 0 to ∞ using eq. (2) and eq. (4) with the help of eq. (6), we get,

$$\frac{\partial}{\partial t}F_{n_2}(x,t) = -(\lambda_1 + \lambda_2 + \lambda + \mu_2 n_2^2)F_{n_2}(x,t) + \lambda_1 x F_{n_2}(x,t) + \lambda_2 F_{n_2-1}(x,t) + \lambda P_{n_1-1,n_2-1}(t)$$
$$+ \mu_1 p_1 \frac{\partial}{\partial x}F_{n_2}(x,t) + \mu_1 p_{12}\frac{\partial}{\partial x}F_{n_2-1}(x,t) + \mu_2(n_2+1)p_2 F_{n_2+1}(x,t)$$
$$+ \mu_2(n_2+1)p_{21}F_{n_2+1}(x,t) - \mu_1 x\frac{\partial}{\partial x}F_{n_2}(x,t) \quad (8)$$

$$\frac{\partial}{\partial t}F_0(x,t) = -(\lambda_1 + \lambda_2 + \lambda)F_0(x,t) + \mu_1 p_1\frac{\partial}{\partial x}F_0(x,t) - \mu_1 x\frac{\partial}{\partial x}F_0(x,t) + \mu_2 p_2 F_1(x,t)$$
$$+ \mu_2(p_{21}xF_1(x,t) \quad (9)$$

Multiply eq. (8) by y^{n2} and summing $n_2 = 0$ to ∞ using eq. (9) and eq. (7), we get,

$$\frac{\partial}{\partial y}F(x,y,t) = -(\lambda_1 + \lambda_2 + \lambda)F(x,y,t) - \mu_1 x\frac{\partial}{\partial x}F(x,y,t) + \mu_1 p_1\frac{\partial}{\partial x}F(x,y,t)$$
$$+ \mu_2 p_2\frac{\partial}{\partial x}F(x,y,t) + \mu_2 p_{21}x\frac{\partial}{\partial y}F(x,y,t) + \mu_2 y\frac{\partial}{\partial y}F(x,y,t)$$
$$+ \mu_1 p_{12}y\frac{\partial}{\partial y}F(x,y,t) + \lambda_1 xF(x,y,t) + \lambda xyF(x,y,t) - \mu_2 y^2\frac{\partial^2}{\partial y^2}F(x,y,t)$$
$$+ \mu_2 p_2 y\frac{\partial^2}{\partial y^2}F(x,y,t) + \mu_2 p_{21}yx\frac{\partial^2}{\partial y^2}F(x,y,t) + \lambda_2 yF(x,y,t) \quad (10)$$

Now,

$$\frac{\partial F}{\partial t} = \frac{\partial^2 F}{\partial y^2}(-\mu_2 y^2 + \mu_2 p_2 y + \mu_2 p_{21}xy) + \frac{\partial F}{\partial y}(\mu_2 p_{21}x + \mu_2 p_2 + \mu_2 y)$$
$$+ \frac{\partial F}{\partial x}(-\mu_1 x + \mu_1 p_1 + \mu_1 p_{12}xy) + F[\lambda(xy-1) + \lambda_1(x-1) + \lambda_2(y-1)]$$

As $t \to \infty, \frac{\partial F}{\partial t} \to 0, F(x,y,t) \to F$, we have,

$$\frac{\partial^2 F}{\partial y^2}(\mu_2 y^2 - \mu_2 p_2 y - \mu_2 p_{21}xy) + \frac{\partial F}{\partial y}(-\mu_2 p_{21}x - \mu_2 p_2 + \mu_2 y)$$
$$+ \frac{\partial F}{\partial x}(\mu_1 x - \mu_1 p_1 - \mu_1 p_{12}y) + F[\lambda(1-xy) + \lambda_1(1-x) + \lambda_2(1-y)] = 0 \quad (11)$$

Divide the solution of eq. (11) into two parts, we have Ist Part:

Taking $x \to 1$ and $F(1, y) = L(y)$ in eq. (11)

$$y\frac{d^2L}{dy^2} + \frac{dL}{dy} - \rho_1 L = 0 \text{ , where } \rho_1 = \frac{\lambda_2 + \lambda}{\mu_2}$$

Let $$L(y) = \sum_{k=0}^{\infty} A_k y^k$$

$$\frac{dL}{dy} = \sum_{k=0}^{\infty} A_k k y^{k-1}$$

$$\frac{d^2L}{dy^2} = \sum_{k=0}^{\infty} A_k k(k-1) y^{k-2}$$

$$\sum_{k=0}^{\infty} [yk(k-1)A_k y^{k-2} + A_k k y^{k-1}] - \rho_1 \sum_{k=0}^{\infty} A_k y^k = 0$$

$$\sum_{k=0}^{\infty} (k^2 A_k y^{k-1}) - \rho_1 \sum_{k=0}^{\infty} A_k y^k = 0$$

$$\sum_{k=1}^{\infty} (k^2 A_k - \rho_1 A_{k-1}) y^{k-1} = 0$$

Equating to zero the coefficient of y^{k-1}, we get,

$$k^2 A_k - \rho_1 A_{k-1} = 0$$

$$A_k = \frac{\rho A_{k-1}}{k^2}$$

Therefore, the solution is:

$$L(y) = \sum_{k=0}^{\infty} A_k y^k$$

$$= \sum_{k=1}^{\infty} \frac{\rho_1 A_{k-1}}{k^2} y^k$$

$$= \frac{\rho_1 A_0 y}{1^2} + \frac{\rho_1 A_1 y^2}{2^2} + \frac{\rho_1 A_2 y^2}{3^2} + \ldots$$

$$= \frac{\rho_1 A_0 y}{1^2} + \frac{(\rho_1)^2 A_0 y^2}{1^2 \cdot 2^2} + \frac{(\rho_1)^3 A_0 y^3}{1^2 \cdot 2^2 \cdot 3^2} + \ldots$$

$$= \frac{\rho_1 A_0 y}{(1!)^2} + \frac{(\rho_1)^2 A_0 y^2}{(2!)^2} + \frac{(\rho_1)^3 A_0 y^2}{(3!)^2} + \ldots$$

$$L(y) = A_0 \sum_{k=1}^{\infty} \frac{(\rho_1 y)^k}{(k!)^2}$$

As $L(y) \to 1$, we have

$$A_0 = \frac{1}{\sum_{k=1}^{\infty} \frac{(\rho_1 y)^k}{(k!)^2}}$$

$$L(y) = \frac{\sum_{k=1}^{\infty} \frac{(\rho_1 y)^k}{(k!)^2}}{\sum_{k=1}^{\infty} \frac{(\rho_1)^k}{(k!)^2}}$$

2nd Part :

Again taking $y \to 1$ in eq. (11), $F(x,1) = M(x)$ we get,

$$\mu_1 (x - p_1 - p_{12}) \frac{\partial F}{\partial x} + [\lambda_1 (1-x) + \lambda(1-x)] M = 0$$

$$\mu_1 \frac{\partial M}{\partial x} - \lambda_1 M = 0$$

$$\frac{\partial M}{\partial x} - \rho_2 M = 0 \text{ , where } \rho_2 = \left(\frac{\lambda_1 + \lambda}{\mu_1}\right)$$

Therefore the solution is $M(x) = Be^{\rho_2 x}$

As $x \to 1$ $\quad M(1) = 1 = Be^{\rho_2}$

$$B = e^{-\rho_2}$$

$$M(x) = e^{\rho_2 x} e^{-\rho_2} = e^{\rho_2 (x-1)}$$

The complete solution of eq. (11) can be written as

$$F(x, y) = L(y) M(x)$$

$$= \frac{\sum_{k=1}^{\infty} \frac{(\rho_1 y)^k}{(k!)^2}}{\sum_{k=1}^{\infty} \frac{(\rho_1)^k}{(k!)^2}} \cdot e^{\rho_2 (x-1)}$$

To find Mean Queue Length:

$$LQ_1 = \left(\frac{\partial F}{\partial x}\right)_{x=y=1}$$

$$= \left| \frac{\sum_{k=1}^{\infty} \frac{(\rho_1 y)^k}{(k!)^2}}{\sum_{k=}^{\infty} \frac{(\rho_1)^k}{(k!)^2}} \cdot \rho_2 e^{\rho_2 (x-1)} \right|_{x=y=1}$$

$$= \rho_2$$

$$LQ_2 = \left(\frac{\partial F}{\partial y}\right)_{x=y=1}$$

$$= \left| \frac{\sum_{k=1}^{\infty} \frac{k y^{k-1} (\rho_1)^k}{(k!)^2}}{\sum_{k=1}^{\infty} \frac{(\rho_1)^2}{(k!)^2}} \cdot e^{\rho_2 (x-1)} \right|_{x=y=1}$$

$$= \frac{\sum_{k=1}^{\infty} \frac{k(\rho_1)^k}{(k!)^2}}{\sum_{k=1}^{\infty} \frac{(\rho_1)^k}{(k!)^2}}$$

$$L = LQ_1 + LQ_2$$

$$= \rho_2 + \frac{\sum_{k=1}^{\infty} \frac{k(\rho_1)^k}{(k!)^2}}{\sum_{k=1}^{\infty} \frac{(\rho_1)^k}{(k!)^2}}$$

Other parameters such as variance busy period distribution etc. can be calculated.

Concluded Remark:

(i) If $\lambda_1 = 0$ and no multi-input source is considered i.e. only the second channel exist then the result coincide with the result obtained by T.P. Singh (1994).

(ii) If input pattern is taken as food grain in human life system of a country and output pattern is considered the population growth rate in a most natural homogenous environmental condition. The above model after certain modification can follow the "Malthus Theory of Population Circle" used in economic thoughts.

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IMPLEMENTATION OF "BIOMETRIC IDENTIFICATION BASED ELECTRONIC GATE CONTROLLER" USING VHDL

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Abstract

An attack on Indian parliament, a number of bomb blasts and 9/11 Sep attacks have put up a threat on our security systems. There is a need of improved security systems which is implemented on the basis of Biometric Information. This research paper is on the design methodology and implementation of an electronic gate controller based on biometric identification of the thumb expression. The key element of the Biometric Identification Based Electronic Gate Controller system is a "Biometric Information Center"[BIC], which is implemented in FPGA using VHDL. The implemented "Biometric Information Center" contains requisite information for controlling an Electronic Gate Controller which will "Open" or "Close" the gate for entry of authorized employees in an office/premises/ organization.

For implementation of the proposed system we have used Field Programmable Gate Array FPGA which is programmed according to our requirements by using VHDL. The VHDL models are simulated, synthesized and finally implemented on FPGA's.

Key words: Biometric, FPGA, VHDL, Biometric Information Center .

I. INTRODUCTION

"Biometric Identification Based Electronic Gate Controller" has a wide range of applications that include identification of authorized person/employee, strict vigilance at high security zone, etc. A "Biometric Identification Based Electronic Gate Controller" is designed with an aim of 'OPENING' the electronic gate of premises when a person belongs to that particular office/ premises/organization and wants to enter.

In this research paper we have implemented "Biometric Information Center" which is a key element required for "Biometric Identification Based Electronic Gate Controller".

For the implementation of 'Biometric Information Center (BIC)' we have used VHDL and BIC is implemented in FPGA. VHDL is one of the most accepted and widely used languages for describing digital system. VHDL has been approved by IEEE as a standard language for designing hardware. VHDL stands for Very High Speed Integrated Circuits Hardware Description Language.

In 1987 standard version of VHDL "IEEE Std 1076-1987" was launched for industrial use.

In 1993 language was upgraded with new features and upgraded version "IEEE Std 1076-1993" was launched.

Subsequently, many computers – aided engineering companies put lot of efforts into developing tools based on VHDL. At this point of time VHDL is supported by nearly all design automation tools and is widely used in the design cycle for Simulation, Synthesis and Testing.

The most important part of VHDL is its technology independency.

II. BIOMETRIC IDENTIFICATION BASED ELECTRONIC GATE CONTROLLER: WORKING PRINCIPLE

1. Overview - A schematic diagram of a Biometric Identification Based Electronic Gate Controller is shown in figure (1).

This controller is designed for the biometric identification of eight persons and according to their identity electronic gate will be 'OPEN' or 'CLOSE'. This controller can further be expanded to the identification of any number of persons.

Various blocks of Biometric Identification Based Electronic Gate Controller are as follows:

(i) Thumb Pad – Thumb pad is used to load or match the thumb impression of a person who wishes to enter in premises. According to the thumb impression an analog signal is generated.

(ii) Analog to Digital Converter (A/D) – The analog signal generated by the thumb impression is converted into equivalent four bit digital signal by an Analog to Digital Converter (A/D).

(iii) Biometric Information Center (BIC) – Biometric Information Center contains a collection of all the thumb impression of those persons who are allowed to enter the premises.

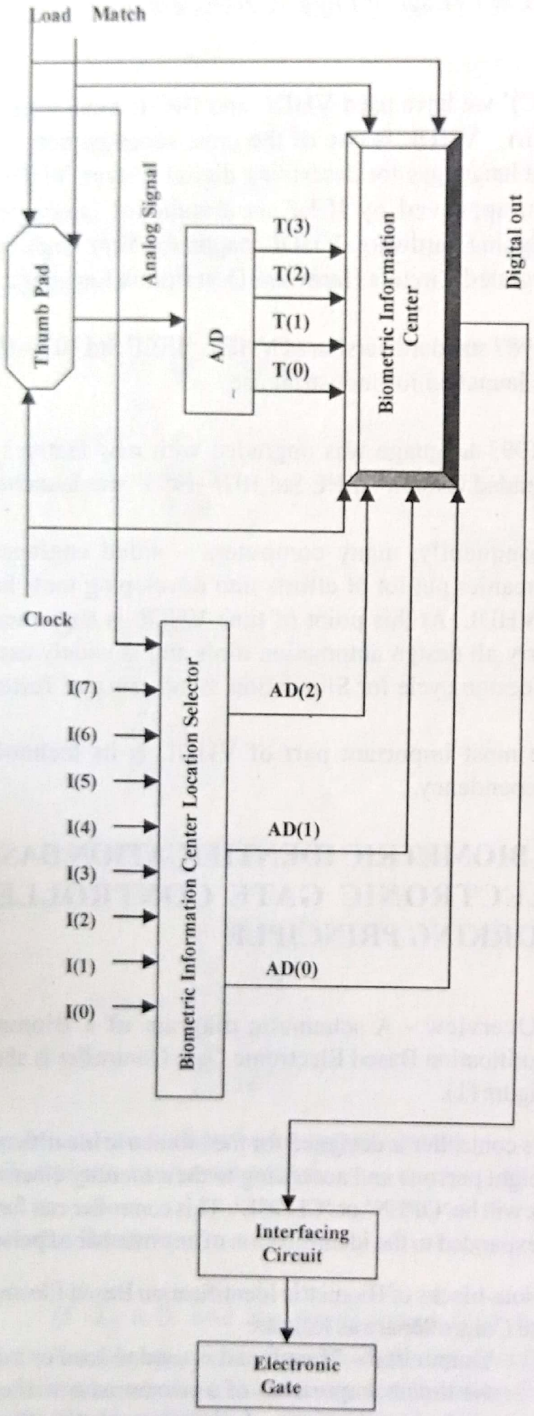

Fig. 1. Various Blocks Of Biometric Identification Based Electronic Gate Controller

The thumb impression of the person who wishes to enter in premises will be matched with the thumb impressions stored in BIC, if it matches with the existing thumb impressions then 'HIGH' output from BIC will be generated.

(iv) Biometric Information Center Location Selector (BICL) – This block is used to load the thumb impression of a person who is allowed to enter in the premises. 'Biometric Information Center Location Selector' is activated by using 'Load' input. The thumb impression of a person is loaded in Biometric Information Center at appropriate location depending upon the input condition on inputs I(7) to I(0). This block is working as 8 to 3 encoder.

(v) Interfacing Circuit – It is an electronic circuit used to interface the output of the Biometric Information Center and electronic gate.

(vi) Electronic Gate – An electronic gate will be 'OPEN' or 'CLOSE' depending upon the output of the Biometric Information Center.

2. Operation - Biometric Identification Based Electronic Gate Controller is used to allow authorized person to enter in a premises through electronic gate.

(i)Loading Operation – The load operation is to be performed to load the thumb impression of people who are allowed to enter the premises. **When Load = '0' and Match = '1' Load operation is to be performed.**

Thump pad will generate an analog signal which is converted into four bit digital signal by an analog to digital converter [T(3), T(2), T(1) and T(0)]. This four bit digital signal will be stored in Biometric Information Center (BIC). The appropriate location where digital signal will be stored is decided by the output of Biometric Information Center Location Selector (BICL). Depending upon the signals on I(7) to I(0) three bit binary code will be generated [A(2), A(1) and A(0)], and these three bits serves as the address lines to indicate the location to store the signal generated by A/D converter.

(ii) Matching Operation – A person who wants to enter the premises is to put his thumb impression on Thumb Pad. The thumb pad is provided with sensor which generates the analog signal. Accordingly the analog signal is converted into equivalent four bit digital signal by an analog to digital (ADC) converter. **When Load = '1' and Match = '0' Match operation is to be performed.**

The digital signal generated by A/D converter is now

matched with the thumb expressions loaded in BIC (eight thumb expressions are loaded in BIC in proposed system). If match found then BIC will generate a 'HIGH' otherwise 'LOW' will be generated by BIC.

The output of BIC is then feed to Interfacing Circuit which is used to interface the output of BIC to Electronic Gate. 'HIGH' output of BIC is utilized to operate electronic circuitry of Electronic Gate and 'OPEN' it so the person can enter in the premises.

For a thumb impression if no match is found in the BIC then output of BIC will 'LOW' and Electronic Gate will remain 'CLOSE' to deny the unauthorized person to enter in the office/premises/organisation.

III. IMPLEMENTATION OF BIOMETRIC IDENTIFICATION CENTER (BIC)

In this section, various steps involved for implementing a Biometric Information Center (BIC) are discussed. This BIC performs loading and matching of eight persons thumb impression in form of four bit digital data. The output of BIC is 'HIGH' if thumb impression match found otherwise output of BIC is 'LOW'. In other words it can be said that output of BIC remains "LOW" and goes "HIGH" only when thumb impression matches with that of stored one. The transition of BIC output signal from low to high triggers output circuitry and devices to "OPEN" the entry gate. Thus only authorized entrants are allowed to cross the gate and enter to office/premises/organization. The Block diagram of Biometric Information Center is shown in figure (2).

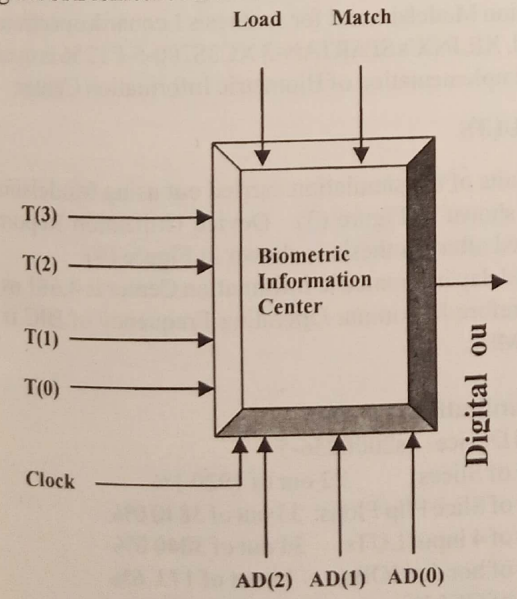

Fig. 2. Block Diagram Of Biometric Information Center

Step-1 VHDL Model of BIU

There are many ways for writing VHDL Model viz. Behavior Model (it explains the functionality of the circuit) and Structure Model (it explains how the components are interconnected to each others).

Behavior Model of the Biometric Information Center is developed at ECAD lab of BRCM CET Bahal. The code for implementation of Biometric Information Centre (BIC) is written in VHDL and experiment is carried out on XILINX's SPARTAN-3 XC3S200-5-FT256. The Program Code is available with the authors.

Step-2 Simulation of BIU

After writing the VHDL Model of required BIU the simulation is carried out. The functionality of the truth BIU is verified from the waveform generated by the simulation tool. The simulation tool used for the simulation is Modelsim-SE VHDL. Simulated waveform of BIU which is obtained after experiment is shown in Figure (3).

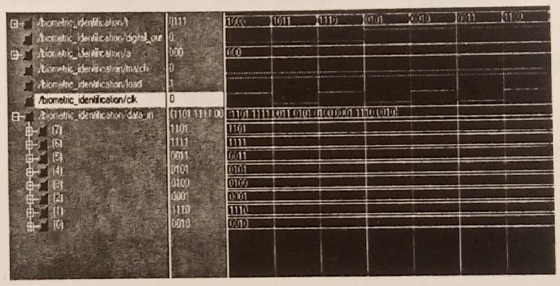

Figure (3) Simulated Waveform of Biometric Information Center

Step-3 Synthesis of BIU

LeonardoSpectrum VHDL Tool is used for the purpose of synthesis. RTL (Register Transfer Logic) schematic generated after synthesis is shown in Figure (4) and Figure (5).

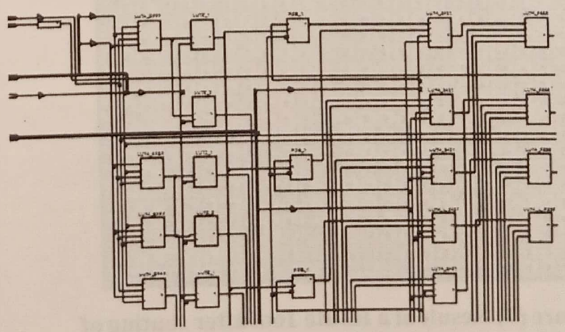

Figure (4) RTL Schematic generated after synthesis of Biometric Information Center

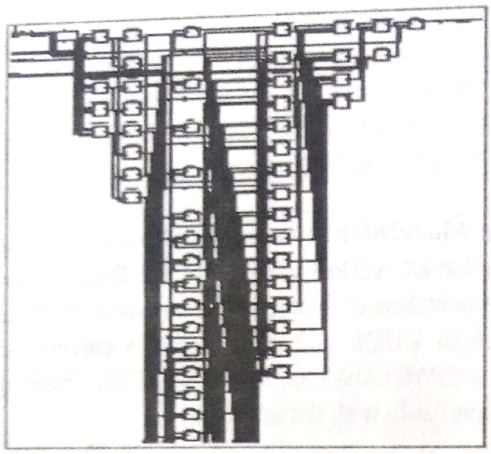

Figure (5) RTL Schematic generated after synthesis of Biometric Information Center

Result of Place Tool is shown in Figure (6) and result of Route Tool is shown in Figure (7).

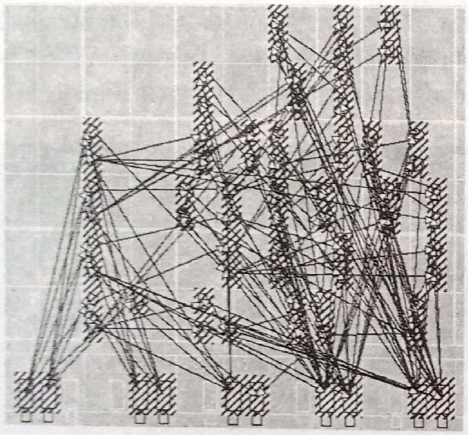

Figure (6) Result of a Place Tool after placement of various logic blocks of Biometric Information Center in XILINX's SPARTAN-3 XC3S200-5-FT256

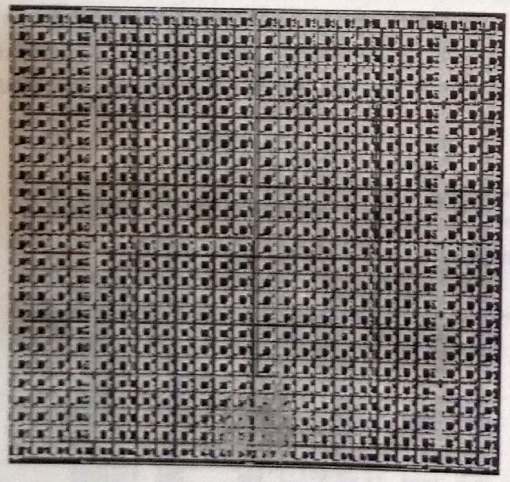

Figure (7) Result of a Route Tool after routing of various logic blocks of Biometric Information Center in XILINX's SPARTAN-3 XC3S200-5-FT256

Step-4 Implementation of BIU

Details of the selected FPGA used for the implementation of BIU are as follows:

Make – XILINX
Family – Spartan – 3
Device – XC3S200
Package – FT256
Speed Grade - 5

Lab set-up for the implementation of Biometric Information Center in XILINX's SPARTAN-3. C3S200-5-FT256 is shown in Figure (8).

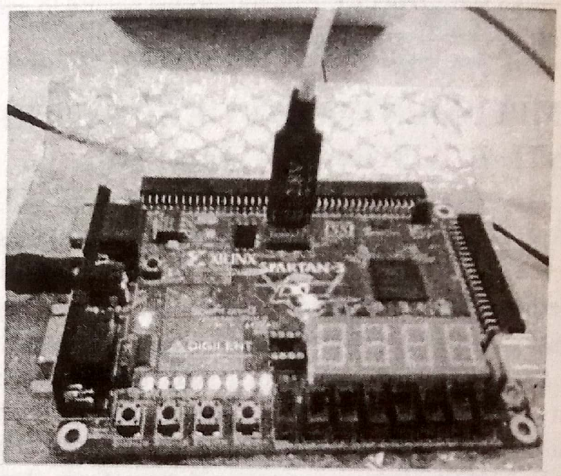

Figure (8) Lab set-up of implementation of Biometric Information Center

IV. LAB ENVIROMENT

Mentor Graphics FPGA Advantage 6.2 is used. For simulation Modelsim and for synthesis Leonardospectrum are used. XILINX's SPARTAN-3 XC3S200-5-FT256 is used for the implementation of Biometric Information Center.

V. RESULTS

The results of the simulation carried out using Modelsim and is shown in Figure (3). Device Utilization Report generated after synthesis is shown in Figure (9).
Critical delay in Biometric Information Center is 4.681 ns and therefore Maximum Operating Frequency of BIC is 213.650MHz.

Device utilization summary:

Selected Device : 3s200ft256-5
Number of Slices: 22 out of 1920 1%
Number of Slice Flip Flops: 33 out of 3840 0%
Number of 4 input LUTs: 34 out of 3840 0%
Number of bonded IOBs: 11 out of 173 6%
Number of GCLKs: 1 out of 8 12%

TIMING REPORT

Timing Summary:
Speed Grade: -5
Minimum period: 4.681ns (Maximum Frequency: 213.650MHz)
Minimum input arrival time before clock: 5.376ns
Maximum output required time after clock: 6.216ns
Maximum combinational path delay: No path found

Figure (9) Device Utilization Report for implementing Bimetric Information Center in XILINX's SPARTAN-3 XC3S200-5-FT256

VII. CONCLUSION

The need of the day is to develop the systems with flexibility in programming. The proposed system can be reconfigured and additional features can be incorporated with increasing need of the end users. Biometric Information Centre developed using Xilinx can be reprogrammed for any number of authorized people who are to enter in the premises of an organization. The developed system can further be improved by incorporating the entire module on a single chip i.e. Application Specific Integrated Chip or FPGA instead. Today's engineers are expected to design a device in a very short span of time due to the time-to-market pressure. If VHDL is used then they are able to model real design, simulate the design, verify the design and finally implement it in FPGA. One more advantage of designing with VHDL is that when in future technology advances then same design can be used because VHDL is a technology independent language.

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Application of Dissolved Gas Analysis to Load Tap Changers

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I. INTRODUCTION

Thermal and electrical faults dissipate energy. If dielectric fluid or solid insulation is in the vicinity of a fault, energy transfer will occur and this will result in non-reversible partial molecular degradation of insulating materials. The existence of irreversibly generated decomposition products is the basis for dissolved gas analysis (DGA)1. These processes are not limited to transformers and can occur in any oil filled electrical equipment. The application of DGA to transformers has been universally accepted as a valuable diagnostic tool. When consideration is taken of the operating parameters of Load Tap Changers and Oil Circuit Breakers, there is no reason why the DGA methodology cannot be applied in a cost-effective preventive maintenance program.

II. APPLICATION OF DGA TO LOAD TAP CHANGERS

Load tap changers (LTCs) often have a higher failure rate than transformers. Accepted diagnostic methods that have been applied to evaluate the condition of LTCs include infra-red scanning (IR) and differential temperature measurements. Infra-red scans and differential temperature methods are not always conclusive and may not detect problems at the initial stages.

Early detection of LTC problems is essential since problems develop rapidly. Contact coking is a major problem. Initial deposition of carbon on LTC contacts leads to increased contact resistance, which in turn leads to increased heating and the buildup of carbon. This process continues at ever accelerating rates.

In Resistive and Reactive designs, arcing occurs in oil filled tap changers whenever they operate. A result of arcing in oil filled equipment is the production of hydrogen and acetylene fault gases. One might conclude that DGA would thus not be applicable to LTCs since fault gases are produced during the normal operation of the LTC. This conclusion, however, is incorrect and is not supported by data now available.

Identification of "key gases" has been used widely as an empirical diagnostic tool for fault characterization in transformers. Acetylene, the key gas for arcing, is routinely found in LTC compartments and will vary with the number of operations. Ethylene, methane and ethane, which are sometimes referred to as the "hot metal gases", are the key gases associated with pyrolysis or overheating. R. Youngblood2 suggested that the presence of high levels of methane, ethane and especially ethylene, would indicate overheating of the LTC contacts. His interpretation has proven to be correct and as a consequence the application of DGA to LTC diagnostics has become an accepted diagnostic procedure. More recent work by Youngblood has revealed that the levels of acetylene and hydrogen should not be ignored since the concentrations of these gases in a "problem" LTC are significantly higher than the levels in a trouble free unit.

Empirical methods for the interpretation of DGA have been used to correlate fault gases found in transformers with specific fault types. The most frequently used empirical methods are the key gas or interpretive method and methods based on the ratios of fault gas concentrations.

The key gas method, based on establishing maximum threshold concentrations for each fault gas, can be applied without modification to the analysis of fault gases formed in LTCs. An essential requirement for utilization of the key gas method is the actual establishment of the threshold or flag points for each of the fault gases. The selection of these values is always based on case history studies, and therefore, threshold fault gas concentration values for LTCs must be empirically determined. The determination of these values, however, is further complicated by variations in mechanical design and breathing characteristics. Free breathing LTCs lose fault gases readily to the atmosphere, while LTCs with desiccant bottles lose fault gases at a slower rate and sealed LTCs tend to accumulate all the fault gases.

Development and application of ratio based interpretation methods require data correlations between gas concentration ratios and known faults. In the case of transformers the applicable ratio methods are generic. In the case of LTCs generic ratios may not be applicable

because mechanical differences, ranging from the design of the reversing, transfer or main dial contacts, to resistive, reactive or vacuum technologies generate varying quantities of key gases during normal operation. The development of suitable ratio methods would also have to consider these variables.

III. LTC CASE HISTORIES

Youngblood3 and Baker4 have tabulated extensive data on gassing levels in both trouble free and problem LTCs. Fault gas levels in both normal and problem units are very dependent on the breathing mechanism of the unit. Case histories for each type of breathing mechanism are documented below. In addition to breathing mechanism variations, design parameters have a significant effect on the "normal" fault gas levels that will be observed in problem free units.

Fault gas levels in problem units will vary based on number of operations, maintenance procedures followed, modifications to the operating parameters of the unit, and the progression of the fault process. The following DGA case studies are presented to illustrate the monitoring of LTC fault processes.

CASE STUDY #1

AC TLH-21 138KVx12KV 50 MVA Free Breather

DATE: FEB. 25 1993

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

02/25/93 AC 018226580301 0 5 1 4 34 71 350

This unit was determined to be operating properly. The low concentrations of hydrogen and acetylene are considered normal for a free breathing unit. The unit was scheduled for annual testing.

DATE: FEB. 25, 1994

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

02/25/94 AC 018226580301 44 1812 576 3143 149 33 645

This unit was in "thermal runaway" when tested. Notice the high level of ethylene, which is the key gas for overheating. This unit was already heavily coked when the DGA test was conducted. The unit was removed from service and repaired. The reversing switch and some moveable dial contacts were replaced.

DATE: FEB. 27, 1995

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

02/27/95 AC 018226580301 55 9 2 11 22 33 440

The unit is operating normally after the repairs were completed. The LTC was placed on a six-month test interval based on of its previous failure history.

CASE STUDY #2

Federal Pacific TC-25 69KVx12KV 20 MVA Desiccant Breather

DATE: MAR. 12, 1992

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

03/12/92 FP 504701 589 60 2 89 144 270 7323

The test indicates a possible early stage of mechanical difficulties. The acetylene and hydrogen levels are high but the ethylene level is less than 1000 ppm. This unit would remain on an annual DGA testing schedule.

DATE: FEB. 1,1993

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

02/01/93 FP 504701 1625 342 70 534 3099 378 1652

With an acetylene level of 1625 ppm and hydrogen level of 3099 ppm, the ethylene level of 534 ppm was still below the 1000 ppm threshold utilized by PSI to take it out of service. The unit was placed on a six-month test interval.

DATE: AUG. 12, 1993

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

08/12/93 FP 504701 1633 53434 55535 253024 2217 1198 8534

By August this unit was in thermal runaway. Ethylene

levels peaked at 253,024 ppm while the acetylene remained stable at 1633 ppm. Hydrogen had decreased to 2217 ppm.

Heating rather than arcing had been occurring at this point. The unit was removed from service and repaired. Replacement parts included a tap shaft board, slip rings and a complete reversing switch assembly. Repairs made to this type of LTC are common due to insufficient contact pressure and too few operations through neutral that results in high contact resistance.

CASE STUDY #3

Westinghouse UTT-A 138KVx69KVx13.8KV Sealed System

DATE: AUG. 31, 1992

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

08/31/92 WES RNP38871 8527 3279 1135 9606 9083 381 4769

Based on the DGA results this unit was immediately removed from service. Serious damage was found on the transfer contacts due to misalignment. Notice higher than normal ratios of acetylene and hydrogen as compared to the other "heating" gases. The transfer contact is primarily tungsten, which will continue to arc instead of coking and heating. Overall gas levels are high since this is a sealed unit.

DATE: DEC. 17, 1993

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

12/17/93 WES RNP38871 501 387 16 375 2883 421 1061

Following the repair of the unit, the levels of gas are typical for a sealed unit. The unit was placed on a six-month test interval.

DATE: MAY 1994

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

05-94 WES RNP38871 451 534 9 313 3800 900 1671

The level of gas shown from this 1994 DGA test was typical for a sealed unit and did not indicate a problem. Individual gas concentrations have slightly changed, but overall the gas levels are remaining stable. This indicated that the repairs were effective.

DATE: AUG. 17, 1995

Date Mfr. Serial Number C2H2 CH4 C2H6 C2H4 H2 CO CO2

08/17/95 WES RNP38871 648 590 52 836 3995 621 5921

The level of gas from this 1995 test is typical of a sealed unit and did not indicate a problem. Individual heat gas levels show small increases or decreases, but overall the gas levels still remain stable. The fifty-percent increase in the acetylene level, however, resulted in the placement of this unit on a six month DGA test cycle.

IV. CONCLUSION

Rates of gas generation in healthy LTCs vary greatly depending on the make, model, and operating parameters. Of the major LTC manufacturers, each of them builds various models with each of the possible breathing configurations. In attempts to improve upon or correct poor designs, modifications over the years have created even greater variability. When combined with other LTC operating variables it is evident that standard DGA threshold values cannot be applied. It is possible, however, to determine ranges of normal gassing levels for each type and apply them generally to a class of units. As multiple tests are taken on similar units, these threshold values can be refined and become more unit-specific.

It is obvious that in addition to the breathing configuration, additional information is required to correctly determine the extent of damage and the best time to take the unit out of service for maintenance. If a unit is removed too early, it will be difficult to find the problem. If the maintenance cycle is too long, extensive damage or a failure may occur. The cost per DGA is minimal compared to the cost of one set of contacts, the cost of unscheduled maintenance, or the ultimate cost of a failure. It has, therefore, become the policy at Cinergy Corp. that each transformer and LTC be tested for dissolved gases three times a year. Any suspect unit, defined as a unit with acetylene above 500 ppm and a significant rate of acetylene generation is put on a monthly test interval until the unit is taken out of service or the condition stabilizes. An indicator of the severity of the problem is then

evaluated on the basis of the ethylene level. The acetylene is therefore the initial flag and ethylene is the indicator of the severity of the problem.

Cinergy Corp. has established the following guidelines for its system based on the three categories of LTC breathing configuration. When the level of acetylene or hydrogen reaches a threshold level of 500 ppm, the unit is placed on a monthly DGA testing schedule. If the ethylene exceeds the maximum value, the unit is removed from service for inspection and/or repair. In the specific case of the vacuum designed LTC, the unit should be removed from service and checked if any of the threshold values in Table I are exceeded. It is important to note that these values can only be used as a general guide. Each LTC has its own set of unique operating characteristics and individualized benchmarks should be set once the service history of a LTC is known.

TABLE I

LTC MONTHLY WATCH CRITERIA

LTC Type	Hydrogen	Acetylene	Ethylene
Free or Dessicant Breather	>1500 ppm	>1000 ppm	>1000 ppm
Sealed	>5000 ppm	>9000 ppm	>1200 ppm
Vacuum	>10 ppm	>5 ppm	>100 ppm

An additional approach to the establishment of LTC breathing configuration threshold or flag points is to apply unit specific thresholds. These values, like those based on an extensive database complied by Mr. Charles Baker (Appendix A), can be used to categorize test results.

From the data collected, Baker established three warning levels for each type of LTC. The gas limits, designated as LT1=Abnormal, LT2=High and LT3=Very High, have been revised over the years as more data became available. They are currently being utilized by South Carolina Electric and Gas. This type of database approach provides unit specific information and is being incorporated into Analytical ChemTech International's (ACTI) existing diagnostic software. As ACTI's LTC database increases, additional unit and operation-specific diagnostics will be developed and provided with DGA reports.

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Enterprise Resource Planning: Business needs and technologies

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Abstract

Enterprise resource planning (ERP) system solutions are currently in high demand by both manufacturing and service organizations because they provide a tightly integrated solution to an organization's information system needs. ERP as a software solution integrating various functional spheres in an organization. Highlights its role in building a customer process, ERP technologies, available systems, viz. database systems, communication protocols and user interface framework. Details organizational preparedness for embarking and evaluating the investment on ERP. Discusses its application, selection criteria for small and medium organizations. Concludes that ERP is the tool for an integrated information system to stay competitive and customer-oriented for all organizations.

Introduction

Information technology-related changes in organizations have always been a central issue to information systems researchers. Managing such change has become increasingly important with rapidly emerging social, economical and technological conditions. As emerging information technologies such as Enterprise Resource Planning Systems (ERP) and Internet-based Information Systems are becoming widespread, such technologies are often seen as enabling complex changes such as global systems integrations and virtual team working.

Many of the world's leading companies consider ERP systems as an essential information systems infrastructure to survive and prosper in today's economy. Deloitte Consulting (Bingi et al., 1999) define an ERP system as a packaged business solution that is designed to automate and integrate business processes, share common data and practices across the enterprise and provide access to information in a real time environment. O'Leary defined ERP system as "computer-based systems designed to process an organization's transactions and facilitate integrated and real-time planning, production, and customer response" (O'Leary, 2000, p.27).

ERP software has been designed to model and automate many of the basic process of a company, from finance to the shop floor with the goal of integrating information across the company and eliminating complex, expensive links between computer system that were never meant to talk to each other.

ERP software is a mirror image of the business processes of an organization such as customer order fulfillment and manufacturing.

The difference between a successful and profitable organization and an average one is the quality of service. The quality comes when companies undergo a "metabolic change" in the way they manage customers and potential prospects. The smart organizations today could anticipate and exceed customer expectations that are evaluated on the basis of quality, time, service, availability and efficiency. The one tool that innovative and progressive organizations have come to increasingly depend on in this endeavor is ERP solutions. ERP has been a software solution integrating the various functional spheres in an organization and a link through the entire supply chain, aimed at adapting best industry and management practices for providing the right product at the right place at the right time at least cost. Over the last decade, there has been a significant shift in business models from hierarchical line-of business- oriented activities to more process driven models that is motivating a re-examination of enterprise applications software. The challenge for ERP systems is to set up and integrate information resources across geographically spread business units to enable optimization across the organization.

The objectives of ERP systems include:

1. Provide support for all variations of best business practices;
2. Enable implementation of these practices with a view towards enhancing productivity;
3. Empower the customer to modify the implemented business processes to suit their needs.

Building a customer process through ERP

To understand how an ERP could help build world-class

customer process, it is essential to examine the following:

1. **The benefits that accrue from a customer centric system include:**

- Loyal customers cost less and buy more year after year. The time lost in recouping the cost of acquiring a new customer is saved.
- Referral revenue, which occurs when the satisfied customer refers his associates to the firm, is increased and subsequently, the longer the relationships with a customer, the more new customers are referred to the firm.
- The premiums by way of loyal customers who would pay more for the products because of satisfaction with the quality delivered and do not want to risk trying another product. Loyal customers will not be tempted to defect by the competitor's discounts and they would not require discounts to stay with the firm.
- The loyal customer also grows into an experienced customer who has learned the product line and processes there by supporting self in a number of transactions when the firm works together that further brings down costs. Organizations can also increase customer inventory by taking the customer reuse in the form of referrals, thereby almost doubling the customers in half the time.

2. What tools, techniques and analyses that an ERP would incorporate, in order to make it customer-centric:

- Data needed to improve customer profitability.
- How do the firms provide the data needed to improve customer profitability?
- On an average, firms lose 50 per cent of their customers in five years. How many leads do the firms pursue to get an order from a new customer? In some industries, recouping the cost of acquiring a new customer takes years. It is no surprise that firms that keep valuable customers are more profitable than those with little repeat business.
- New methods of measuring customer revenue and costs would necessitate a shift from the traditional method of accounting that hides the benefits of loyalty. Activity-based costing could go some way in meeting these requirements. Statistical analysis in terms of quartile rankings of a customer by profitability would supplement total analysis in evaluation of the customer.
- Increase in profits on account of retention of customers. While it is well recognized that retention of customers adds to profits, ERP solutions quantify the increase in profits which may vary by industries.
- Customers need to be classified and analyzed as individuals, not just merely as a member of any class such has high-income groups, urban teens, etc.
- In case of defections of customers, the reasons would have to be analyzed. These could be quantitative (pack size or price), or qualitative (brand positioning, packaging, campaigning).

All the above means the ERP products and suppliers have to be more alert in today's changing scenario to don the mantle of the ERP user and visualize the objectives of ERP from the customer viewpoint.

ERP technologies

Information systems technologies evolved from mainframe-based computing through the client server era to the Internet era. These distinct phases are marked by parallel development in hardware technologies. The client server era began when computing power delivered at desktop machines increased manifold and matched mainframe computing power. These technologies limited the availability of information services to users within an organization. The Internet era has brought in the ability to deliver information around the globe. This is made possible with advancements in communication infrastructure.

With the arrival of the Internet, the biggest challenge facing ERP suppliers is to address the global access issues and deployment of information systems that would cater to intra-organization and extra-organization needs effectively. Over and above these challenges, ERP systems need to leverage these technologies to deliver complete (best business practices), usable (high productivity) and adaptable (easy installation and post-implementation maintenance) business systems.

Existing ERP systems

ERP systems that are currently available belong to the client server era. These systems are built with a clear separation of functional components. The user interface implemented using graphical user interface (GUI) techniques is deployed on client machines. Powerful server machines host the databases and business logic written as server procedures. The databases are built using relational database technology. Business logic is split, depending on the product architecture to be executed on the client, server or both.

With suitable communication infrastructure, these systems could be deployed in a distributed process which may span across multiple geographical locations. As an example, a purchase request could be raised at a plant location to be processed by a purchase department located miles away from the plant.

The technologies deployed have allowed the ERP suppliers to meet the requisite objectives. Relational database systems have enabled the vendors to put in the necessary flexibility in terms of business logic and data structures to support parallel business practice implementations. GUIs support the usability aspect of business systems by providing intuitive and consistent user interface. Object-oriented development practice employed in building GUIs has enabled the suppliers to provide for easy customization and extension of interface components to accommodate additional data entry. These technologies in general have allowed the users to architect the system in such a way that installation, customization and extensions are possible in shorter timeframes.

The technology areas that apply to ERP systems are:

1. Database systems;
2. Communication protocols; and
3. User interface framework.

Database systems: The current database systems are based on relational database management systems (RDBMS) technology. These database systems support querying using standard query language known as structured query language (SQL). Business logic which specifies the set of actions that need to be performed (such as check stock situation and update inventory) is written using SQL and is invoked when the user performs an action. These database systems support access of multiple distributed data sources and allow synchronizing of data manipulation across these sources.

ERP systems built on this technology would support organizations with the need to set up distributed systems with less dependence on a central information resource location. Use of standard query language would enable organizations to perform post-implementation maintenance with confidence since the systems in place are not tied to proprietary languages. The skill needed to do this activity would not be at a premium in the marketplace. Scalability issues are addressed, since sizing of hardware may be done to cater to the business process activities performed at a specific location. Addition of new location(s) would not lead to disruption at other locations.

Communication protocols: The clients and servers in an ERP are connected on a communication backbone. The protocols employed standardize the way data exchange takes place across the network. Database systems employed at servers and the processes on the client use this protocol to send and receive data over the network. Database protocols are specific to the database management systems employed. Since, database systems employ common relation technology, the data exchange is based on a common open data base connectivity standards. Most of the ERP systems use this to integrate client software with the business logic procedures present on the server. Since communication protocols are standardized, organizations could leverage advances in communication infrastructure without worrying about the information systems that are supported.

User interface framework: User interface component of an ERP generally follows GUI approach. Use of GUI based user interface enhances the usability of ERP systems. GUI standards are derived to provide the best application ergonomics with proper design. Interface elements applied in a consistent manner greatly improves usability and helps in user training.

The operating systems environment at the client (such as Windows NT and Windows Xp) provides the graphical user environment. User interface for ERP products conforms to the standards recommended by the operating system vendors. This ensures minimum discomfort for users when they move from a standard desktop application (such as MS Word and MS Excel) to the business system application.

Organizational preparedness for embarking on ERP

1. Infrastructure resources planning: The objective is to ensure that adequate infrastructure is planned for in a way that it becomes reliably available well in time (both for the pre-implementation and the post- implementation stages). Hardware and networking infrastructure is something quite basic and required even for non-ERP applications. Moreover, network standards are generic, common for all ERPs and therefore could be planned and put in place in advance. As far as ERP is concerned, a reliable LAN, with adequate bandwidth, must be in place well in time because ERP implementation is tough and it should not have to contend with the teething problems of networking.

2. Local area network: The network trend today is for a centralized server location even on a wide spread campus.

Category 5 UTP structured cabling with fiber optic for the campus and switched Ethernet or fast Ethernet would be adequate for any ERP and would also support other applications.

3 Servers: These would depend on the ERP selected and could be ordered only after the ERP has been selected. However, it is better to plan for a lower end server that would be available for training and modeling. This could be made available from the time the decision for the ERP is made, because most organizations take a long time in deciding about which ERP package to deploy, but from then onwards, the number of days taken get counted. Adequate server/network, even during the training/ modeling phase, must be available.

4 PCs: If the PCs that were bought were the latest configuration, they would be quite adequate for most ERPs.

5 Training facilities: Adequate training center must be planned for. Temporary centers with makeshift facilities could be counter productive.

6 Human resources planning: What makes ERP difficult to implement is that it could succeed only through teamwork and the team size spans across the entire organization.

7 Education about ERP: If people have to have the right attitude, they must understand what ERP is and also what it is not. Across the organization, ERP education should be carried out. This could be about ERP principles in generic items and case studies to point out what attitudes and principles have succeeded at other places and what have been the stumbling blocks.

8 Commitment to release the right people: If ERP is recognized as a difficult but necessary project, then the best people must be released for it on a full-time basis. Those who could not be spared are the ones who would be required on the ERP team. Adequate advance planning is often necessary to be able to release the best people. There must be commitment for these at all levels.

9 Top management's commitment: Making ERP as one of the top projects for the company for that year and to link assessment of the company head and other people with the progress of ERP implementation. The top management must also have the willingness to allow for a mindset change by accepting that a lot of learning has to be done at all levels, including themselves. This attitude would open up forums, like the exchange of ideas with people who have already done it and videos of successful implementation.

10 Commitment to implement "Vanilla version": 80 per cent of the benefits come out of integration, geographical transparency of the data, actionable information to people who are front ending the customers, etc., but only 10-20 per cent of the customization needs come from these areas. A total of 80 per cent come from areas that are handling statutory requirements. There should be a clear policy to implement the ERP in the "vanilla" form (without customization) and only six months after the implementation to review. This way, 80 per cent of the benefits would be achieved that much faster. Overall company morale also would be high if the implementation is completed at quick speed, even if it is not necessarily the optimal implementation. Making everybody understand this is a very crucial preparatory job.

11 Ability and willingness to consider an ongoing site as a Greenfield site: Implementing an ERP on a Greenfield site is always much easier than an existing site, because at an existing site, unlearning and retraining are major steps. Also, migration of past into the new system is not required. Coupled with this is the fact that it is not easy to spare people from their current jobs to take on the new task. However, if a company is willing to consider an ongoing site, almost as a Greenfield site, and focus on learning and implementing only the new procedures, the implementation could be speeded up considerably. In the interest of speed, even migration of old data can be kept to the minimum to begin with.

12 Reasonably well working manual systems: Similar to the manual systems followed for materials management like stores procedures, discipline of doing work through documentation is also a necessary prerequisite. An audit should be carried out to find the current status and correction action, and training carried out to make the current systems give an acceptable correspondence between the physical stock and book stock.

13 Strategic decision on centralized vs. decentralized implementation: Most organizations have more than one manufacturing location and all organizations have branch offices. The broad decision one needs to make is whether each location would have servers or would they be only centrally located. It would be worthwhile to go for centralization of IT resources.

14 Major reasons for centralization: The overall

centralized costs are found to be two to three times lower compared to the decentralized ones. Cost of consolidating is dramatically reduced. Larger the server platforms, lower the costs per user. The operating system and RDBMS are much lower (only add-on client software is required at remote sites). Costs of providing for redundancy and fault tolerance are considerably reduced. The manageability and IT expertise required are reduced many fold. The availability of data at one place results in a more complete empowerment of people through a complete view of all information, absolutely online. Premises rent for server rooms are reduced/eliminated, more significant in major cities. Power conditioning needs and the need for standby power are considerably reduced. The implementation of software is far easier. Introduction of total standardization is easily possible. The need for consolidation and reconciliation is totally eliminated.

Evaluating investment on ERP

Recent trends in the business are forcing manufacturing enterprises to face the new phenomenon in the business environment with the help of IT. Manufacturing enterprises are contemplating to go in for an ERP package. Most of the manufacturing enterprises, irrespective of their size, are in a fix, in the selection of an ERP package.

Any ERP package whether it is developed by a system department in an organization or bought as a ready-made package from the market needs a substantial capital investment. There are four options available for acquiring or developing any ERP solutions, viz.: developing an own ERP package; enhancing the capabilities in the existing application software; buying a ready-made ERP package from the market; and engaging the services of a software company to develop a software package.

1 Developing an own ERP package: Only possible where the organization has qualified software professionals with practical experience. Generally, software professionals are not familiar with the business functions and business practices. So the services of functional specialists are required to guide the software professionals in the development of application software. The various stages of software development life-cycle, i.e. study, finalization of specifications, design, coding, testing and implementation, have to be meticulously assessed. Much effort is required to work out the above activities.

2 Enhancing the capabilities in the existing system: The existing non-integrated computerized business functions would be assessed for integration. Also, changes that need to be carried out would be ascertained from this exercise.

3 Buying a ready-made package: A readymade package that has all the features required by a manufacturing enterprise requires some amount of customization for effective use. If the product is of international repute, a business process reengineering (BPR) exercise needs to be carried out, because these products have been developed keeping in view of the business practices followed in their countries. The cost of customization has to be obtained from the suppliers.

4 Engaging a software company: It is essential to know the profiles of the software professionals who are going to be associated with the development of an ERP package, to suit the requirements of the user company. Some companies may have software developed for one of their clients, which in turn could be used with or without changes.

Hardware and system software:

Depending on the requirements of the application software, the cost of element of hardware, system software and networking has to be ascertained. The services of professionals may be sought for this exercise.
Generally, two options available, viz.:

1. Enhancing the existing hardware (servers and nodes), replacing the existing system software and networking; and
2. Buying a new hardware (servers and nodes), buying new system software and networking.

ERP for small and medium organizations

A major problem faced by Indian enterprises today is the lack of integration of data among different functions like finance, production, material and sales. This could be attributed to the fact that individual departments over a period of time to perform departmental tasks on installed PCs and no serious attempt was made to integrate them. It is common to find companies having computers in stores, but not connected to the finance department. As a result, finance would enter data again in their financial accounting system and a host of people would be spending their time trying to reconcile the statement from the two departments.

Implication of lack of integration: In the early days when the enterprises were small, organizations had a customer focus. As they grew, the enterprises created different functions to manage the system more efficiently. Unknowingly, this created barriers among different functions and led to problems like:

1. The CEO has to struggle hard through many review meetings to ascertain the true status of key performance factors.

2. Department heads have become less sensitive to the enterprise-wide impact of what they do in their individual departments. For example, a production manager who is judged on increased equipment utilization does not bother about its adverse implication on inventory turnovers or work-in-progress build up.

3. Despite major investment in IT, people do not get the information they really need that, in turn, leads to the poor quality of managerial decisions.

Ultimately, all these affect the organization's financial hygiene and general health.

ERP is needed by all: Many multinationals restrict their business with only those companies that operate the same ERP software as the multinational firm. It is a fact that ERP is for big firms and smaller firms have to adjust their business model and approach according to the practices and software adopted by the big firms. The main problem is that there is no seamless interaction between the packages.

Once purchased, has one to stick with it for a lifetime and make the best use of it. As per the statistics, big firms have to incur an implementation cost that is 15 times the product cost and takes over a year for implementation.

According to the International Data Corporation, India is expected to make distinct gains from the projected growth in ERP software applications market. The packaged application market in India and China totaled around US $78 million. The estimated compound annual growth rate of the ERP software market would be 29.5 per cent from 1998 to 2002. The growth rate is attributed to continued industrialization, further implementation and migration to client server architectures and the increasing technology adoption and greater availability of ERP applications for small & medium enterprises (SMEs).

The cost of ERP solutions available in the Indian market ranges from Rs 1.5 lakh per user at the high end, to Rs 15,000 per user at the lower end. The customization and implementation costs have to be added. The total time required for a successful implementation would take anything from 12 to 24 months. One problem faced by Indian organizations is the mass exodus of trained IT professionals. The acutely affected ones are the SMEs, most of which are left with single manpower in ERP departments. This makes it necessary for such enterprises to go for an ERP product that attempts an in-house development.

A misnomer that has gained acceptance in the recent past is that ERPs are meant for large organizations. This statement is partly true. The ERPs marketed are expensive and smaller organizations cannot afford them.

However, this does not mean that the SMEs do not need an ERP. In fact there is a greater need for information integration in SMEs that lack the money power and business resilience of large enterprises. The need of the hour is to provide micro ERPs, i.e. near ERP capabilities build into a product and sold at an affordable price, including implementation.

The available ERP solutions include SAP, PeopleSoft, Oracle, Baan, JBA Systems, Ramco, etc., meant for the higher end market. The middle end products include SSA, BPCS, JD Edwards, Inertia Movers, etc., and offer good functionality and could be implemented faster. The low end products like QAD, MFG, PRD, etc., could be implemented very fast, but offer limited functionality.

Criteria for selection

SMEs should look for and demand that they get a software package that meets the following criteria:

*1. **Affordability:*** Attractive prices, including implementation support.

2. Domain knowledge of suppliers': It is important that the software developer or supplier knows the industry and is willing to implement the software for the industry. If the industry is a manufacturing enterprise, procure the software from people who have the experience in manufacturing industries.

3. Local support: Low end software packages developed abroad and sold in India are not likely to be adequately supported with regard to implementation. For effective implementation, such packages would need more support from suppliers both in terms of IT expertise and domain knowledge.

4. Technically upgradeable: Ensure that the suppliers undertake to upgrade the products to make best use of technologies that are likely to become available in the

Future. With the advent of Internet, Intranet, EDIs, the ability to upgrade is important. Obviously, no supplier would do it free. But a contract that binds the supplier to do it for an annual cost of say, 15 percent of the software, is indeed worthwhile.

5. Uses latest technology: It is useful to choose a product that is designed based on object-oriented technology and GUI. These are easy to implement, user-friendly and amenable to modifications in future.

Conclusion

The waves of change brought by ERPs have begun to be felt and appreciated by organizations worldwide. Customer-focused applications and analysis have begun moving from theory to implementation by creative, innovative and motivated organizations because they have Realized that in today's environment measuring customer

Profitability and organizing to retain customers provide a tremendous and unbeatable strategic advantage.

Suppliers who are offering ERP systems on client-server technologies are now looking at the impact of Internet-based technologies. During this initial phase, ERP products would be "Internet-enabled" in at least a portion of the systems offered. With the opening up of the economy, SMEs have found the going rather tough indeed. Since they do not have the robustness associated with large companies, SMEs have to tap the power of IT and an integrated information system to stay competitive and customer oriented. ERP is the answer for their survival.

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Prospects of Sugar Industry :India and World

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ABSTRACT

It is universally acknowledged that India is the homeland of sugarcane and sugar. There are references of sugarcane cultivation, its crushing and preparation of Gur in Atharva Veda as well as Kautaliya's Arthasastra. The scribes of Alexander the Great, who came to India in 327 BC recorded that inhabitants chewed a marvelous reed, which produced a kind of honey without the help of bees. The Indian religious offerings contain five 'Amrits' (elixirs) like milk, curd, ghee (clarified butter), honey and sugar - which indicates how important sugar is not only as an item of consumption but as an item which influences the Indian way of life. It is understood that sugar was initially made in India during fourth and sixth centuries by cutting sugarcane into pieces, crushing the pieces by weight to extract the juice and then boiling it to crystalise. These crystals were called 'Sarkara' meaning gravel in Sanskrit. The word sugar is a derivative of 'Sarkara'. The larger lumps were called Khand from which the English word 'Candy' is derived. Around 600 AD the Chinese Emperor, Tsai Hang sent an emissary to Bihar - where sugarcane was cultivated for making sugar - to learn the art of making sugar. Therefore it is from India that the art of making sugar went to Persia and subsequently to the world over.

Although sugarcane was being grown in India from time immemorial and sugar produced in lumps during fourth century, there was no sugar industry in India. It is said that the French People at Aska in Orissa established the first sugar plant in India in 1824. Not much is known about this factory except that Late James Fredrick Vivian Minchin maintained it and that it stopped its operation around 1940. However, the first vacuum pan process sugar plant was set up at Saran in Marhowrah in Bihar in 1904.

Key Words: Sugar, sugar cane, Candy, Sugar Industry, sickness

In 1950-51, incentives were given for higher sugar production by the food and agriculture ministry. As a result, at the end of the first five-year plan i.e., in 1955-56 a record production of 18.92 lakh tones was achieved from 143 units. Sugar production is varied between 19 to 20 lakh tones till 1958-59. In 1959-60, the government provided further incentives to cane growers in terms of a higher cane price and to factories in the form of an excise rebate. Sugar output reached 30.30 lakh tones from 174 units in 1960-61. The output further rose to 35.41 lakh tones and the number of units to 200 by 1965-66.

Sugar outputs in 1966-67 were however reduced to 21.54 lakh tones only due to drought conditions and reduction in cane acreage. Owing to a fear of further decline in sugar production, the government partially decontrolled the sale of sugar with effect from 1st October 1967. This resulted in an increased sugar output of 37.58 lakh tones in 1968-69 from 205 units. The government again decontrolled the sale of sugar from 25th May 1971 because of a large surplus stock of 1969-70 production. The decrease in sugar production in 1970-71 and 1971-72 however created acute shortage and resulted in increased sugar prices. The sugar Producers contributed voluntarily 60% of their production for public distribution at the rate of Rs. 150.00 per quintal and 3.5% of production for export. This situation however lasted only for six months i.e., from 1st January 1972 to 30th June 1972. The government re imposed partial control on 1st July 1972 and this policy has continued since then. The sugar output in 1973-74 was 39.48 lakh tones produced by 229 units.

It was estimated by the Planning Commission that about 55 lakh tones of sugar would be needed for domestic consumption and about 5 lakh tones for export. Therefore, the sugar production target was fixed at 60 lakh tones by the end of the fifth five year plan. Licenses for 62 new sugar factories and the expansion of 32 existing units were issued. The sugar output rose to 47.92 lakh tones in 1974-75. This record sugar production was due to higher cane prices paid to the cane growers and the excise duty concessions on increased production to factories. The sugar production however declined to 42.61 lakh tones in 1975-76 due to severe drought conditions in Tamil Nadu and lower production in Uttar Pradesh and Andhra Pradesh. The production in 1976-77 was 48.40 lakh tones. The addition in number of mills was at its peak during seventies when nearly 100 mills were added between 1970 and 1980 to increase the number of operating units to 300.

The general policy of partial control and dual pricing for sugar continued during 1993-94 and 1994-95 sugar seasons. The ratio of levy and free sale sugar was 40:60 during these seasons. Production of sugar during the season 1994-95 was about 146.43 lakh tomes as against 98.24 lakh tomes during 1993-94. The carry-over stock of sugar at the beginning of 1994-95 season was 21.93 lakh tomes as compared to 31.13 lakh tomes in 1993-94 season. The general policy of partial control and dual pricing for sugar continued during 1993-94 and 1994-95 sugar seasons. The ratio of levy and free sale sugar was 40:60 during these seasons. Production of sugar during the season 1994-95 was about 146.43 lakh tomes as against 98.24 lakh tomes during 1993-94. The carry-over stock of sugar at the beginning of 1994-95 seasons was 21.93 lakh times as compared to 31.13 lakh tomes in 1993-94 season. The quantum of levy sugar allocation to State Governments was revised upwards to 3.32 lakh tomes from February, 1987 and was further slightly revised to 3.33 lakh tomes from May, 1990 as against 3.13 lakh tonnes allotted earlier. Further the Government allowed 5% ad-hoc increase in the monthly levy allocation from August 1991 to March 1994. Keeping in view the larger availability of levy sugar in 1994-95, 5% adhoc increase in the monthly levy allocation was restored from September 1995. From January 1996, monthly levy allocations were made on the basis of 1991 census figures. An additional quantity of about I lakh tonnes of levy sugar was also released for distribution through Public Distribution system for festivals. The releases of free sale sugar for sale in the open market were 78.35 lakh tonnes during 1994-95 as compared to 71.65 lakh tomes during 1993-94 seasons. The production of sugarcane reached an all-time record level of 254.00 million tonnes during 1991-92, the sixth year in succession. However, the production of sugarcane at 228.03 declined during 1992-93. During 1993-94 at 229.7 million tomes, the production has shown some recovery. It has shown, again a record production of 271.23 million tonnes during 1994-95 and is, likely to be of the order of 267.38 million tonnes during 1995-96.

The Government has taken the steps for decontrol of the sugar industry. Accordingly, the compulsory levy obligation of the sugar factories was reduced from 40% to 30% w.e.f. January 1, 2000. With effect from February 1, 2001, the compulsory levy obligation has been further reduced to 15%. The levy obligation now stands at 10% of the production w.e.f. March 1, 2002.

In order to safeguard the interests of sugarcane growers, the producers of sugar and the general public, to stabilize the open market price of sugar and to obviate intervention in the 'regulated release' mechanism, the Essential Commodities Act, 1955 was amended in June 2003. 'The Essential Commodities (Amendment) Act, 2003,' incorporates the provisions of Clause 4 & 5 of the Sugar (Control) Order, 1966 in the Essential Commodities Act, 1955 through insertion of Clause 3D & 3E. As per this amended Act, no producer, importer or exporter of sugar shall sell or otherwise dispose of or deliver any kind of sugar except under and in accordance with the direction issued by the Government.

In May 2001 the Central Government issued a notification under the Forward Contracts (Regulation) Act, 1952 allowing futures/forward trading in sugar. The future trading in sugar has already been commenced in four Exchanges viz. M/s E-Sugar India Ltd, Mumbai (w.e.f. 25-07-2003), National Commodity & Derivatives Exchange Ltd., Mumbai (w.e.f. 27-07-2004), Multi Commodity Exchange Ltd., Mumbai (w.e.f. 7-02-2005) and National Multi Commodity Exchange Ltd., Ahmedabad (w.e.f. 6-02-2003). One more Exchange viz. M/s E-Commodities Ltd. New Delhi is likely to commence future trading in sugar shortly. The application for final recognition of another Exchange viz., M/s Universal Exchange Ltd., Hyderabad is under consideration.

The Central Government had announced two packages of special assistance to the State Governments to help them in clearing sugarcane price arrears in respect of 2002-03 sugar season. Ministry of Agriculture had allocated Rs. 678.06 crores for one time assistance to the Governments of U.P., Uttaranchal, Punjab, Haryana and Bihar to help clearance of sugarcane price arrears in respect of 2002-03 sugar season by private sugar factories in those States. States of Uttaranchal and Bihar have availed the assistance to the tune of Rs. 45.54 crores and Rs. 18.85 crores respectively. Since the Ministry of Agriculture has not made any budgetary provision for the above assistance during the financial year 2004-05 the scheme has since lapsed. The number of operating sugar mills in the country has increased from 29 in sugar year (SY) 1930-31 to 584 by SY2006-07 (sugar year = October 1st to September 30th). The average capacity of the sugar mills in the industry has considerably moved up from just 644 ton per day in SY1930-31 to 2656 ton per day SY2006-07. But still the growth in the Indian sugar industry was driven by horizontal growth (increase in number of units) compared to the vertical growth witnessed in other countries (increase in average capacity).

The over all picture of the growth of sugar industry from 1930-31 to 2006-07 is given in Table no. 1.1as follows:

Table No. 1.1 Growth of Sugar Factories and Sugar Production

Sl. No.	Years	No. of Sugar Industries	Sugar Production
1	1930-31	30	100000 tonnes
2	1931-32	32	159000 tonnes
3	1932-33	57	295000 tonnes
4	1933-34	112	461000 tonnes
5	1934-35	130	587000 tonnes
6	1935-36	137	947000 tonnes
7	1936-37	129	1105000 tonnes
8	1937-38	131	929000 tonnes
9	1938-39	132	653000 tonnes
10	1939-40	138	1227000 tonnes
11	1940-41	140	1063000 tonnes
12	1941-42	141	763000 tonnes
13	1942-43	141	1068000 tonnes
14	1943-44	145	1220000 tonnes
15	1944-45	136	957000 tonnes
16	1945-46	136	938000 tonnes
17	1946-47	135	916000 tonnes
18	1947-48	134	1092000 tonnes
19	1948-49	139	1024000 tonnes
20	1949-50	139	994000 tonnes
21	1950-51	139	1134000 tonnes
22	1951-52	140	1521000 tonnes
23	1952-53	134	1318000 tonnes
24	1953-54	139	1017000 tonnes
25	1954-55	136	1616000 tonnes
26	1955-56	143	1892000 tonnes
27	1956-57	147	2062000 tonnes
28	1957-58	158	2010000 tonnes
29	1958-59	164	1950000 tonnes
30	1959-60	168	2461000 tonnes
31	1960-61	174	3030000 tonnes
32	1961-62	180	2730000 tonnes
33	1962-63	186	2132000 tonnes
34	1963-64	195	2573000 tonnes
35	1964-65	200	3232000 tonnes
36	1965-66	200	3541000 tonnes
37	1966-67	200	2154000 tonnes
38	1967-68	200	2249000 tonnes
39	1968-69	205	3558000 tonnes
40	1969-70	214	4262000 tonnes
41	1970-71	216	3737000 tonnes
42	1971-72	221	3108000 tonnes
43	1972-73	229	3873000 tonnes
44	1973-74	229	3948000 tonnes
45	1974-75	247	4792000 tonnes
46	1975-76	253	4261000 tonnes
47	1976-77	271	4840000 tonnes
48	1977-78	287	6461000 tonnes
49	1978-79	299	5841000 tonnes

50	1979-80	300	3858000 tonnes
51	1980-81	315	5150000 tonnes
52	1981-82	320	8437000 tonnes
53	1982-83	321	8229000 tonnes
54	1983-84	326	5917000 tonnes
55	1984-85	339	6144000 tonnes
56	1985-86	342	7016000 tonnes
57	1986-87	354	8502000 tonnes
58	1987-88	357	9110000 tonnes
59	1988-89	365	8752000 tonnes
60	1989-90	377	10990000 tonnes
61	1990-91	385	12047000 tonnes
62	1991-92	392	13405000 tonnes
63	1992-93	393	10609000 tonnes
64	1993-94	394	9833000 tonnes
65	1994-95	408	14643000 tonnes
66	1995-96	416	16452000 tonnes
67	1996-97	412	12905000 tonnes
68	1997-98	453	12844000 tonnes
69	1998-99	484	15452000 tonnes
70	1999-2000	498	18193000 tonnes
71	2000-2001	506	18510000 tonnes
72	2001-2002	523	18498000 tonnes
73	2002-2003	539	20132000 tonnes
74	2003-2004	547	13958000 tonnes
75	2004-2005	566	13000000 tonnes
76	2005-2006	572	19321000 tonnes
77	2006-2007	584	22700000 tonnes

Source: Sugar Directorate

1.1 Global Sugar Scenario:

Sugar is produced in 110 countries. The leading sugarcane producing countries are Brazil, India, Australia, Thailand, China and Cuba. Sugar is extracted from two different raw materials, sugarcane and beet. Both produce identical refined sugar. Sugarcane is grown in semi-tropical regions, and accounts for around two-thirds of world production. Beet is grown in temperate climates, and accounts for the balance one third of world production. The Russian Federation, Ukraine and Europe account for around 80 per cent of total beet sugar production. In addition to weather conditions, diseases, insects, and quality of soil, international trade agreements and domestic price support programs affect production of sugarcane and beet.

Table no.1.2- The Global Sugar Scenario in the calendar year 2006 is as under

10 Largest Cane Sugar Producers
(million ton, raw value)

1	Brazil	26.2
2	India	23.5
3	China	6.9
4	Thailand	6.2
5	Mexico	4.8
6	Australia	4.4
7	Cuba	4.1
8	USA	3.7
9	South Africa	2.7
10	Pakistan	2.6

Source: F.O.Licht

Table no.1.3– Sugar consumers in the world

10 Largest Sugar Consumers
(million ton, raw value)

1	India	16.5
2	EU	14.1
3	Brazil	9.7
4	USA	9.0

5	China	8.6
6	Russian Fed.	5.7
7	Mexico	4.6
8	Indonesia	3.4
9	Pakistan	3.3
10	Japan	2.4

Source: F.O.Licht

India is among the largest producers of sugar in the world and ranks as the largest growing global market for the product. India has 20% of the total sugar mills in the world and accounts for about 15% of the global production.

India has maintained its position as the 2nd largest sugar producing country in the world, having a share of over 15 percent of the world's sugar production. The production of sugar in India, from 1996-97 to 2006-07 sugar season (October – September) vis-à-vis the global production of sugar has been as follows:

Table no.1.4- Production of Sugar in India vis-a-vis the Global Production (000' tons raw value)

Sugar Season	Global production	India's Production	India's production as % to Global Sugar Production
1996-97	123.8	14.0	11.3
1997-98	127.0	14.0	11.0
1998-99	133.4	16.9	12.7
1999-00	136.2	19.8	14.5
2000-01	130.0	20.1	15.5
2001-02	135.2	20.0	14.8
2002-03	143.0	21.6	15.1
2003-04	145.0	14.0	9.65
2004-05	150.2	13.5	8.9
2005-06	157.5	20.0	12.7
2006-07	160.0	23.0	14.4

Source: F.O.Licht

1.2.1Sugar Consumption: India is also the largest consumer of sugar in the world. India's consumption of sugar, year-wise from 1996 to 2007 as compared to the Global consumption of sugar has been as follows:

Table no.1.5- Consumption of Sugar in India Vis-à-vis World Sugar Consumption

Sugar Season	Global production	India's Production	India's production as % to Global Sugar Production
1996-97	120.9	15.0	12.4
1997-98	123.1	16.0	13.0
1998-99	125.00	16.3	13.2
1999-00	127.8	16.7	13.1
2000-01	130.8	17.4	13.3
2001-02	133.0	17.9	13.4
2002-03	136.1	18.5	13.6
2003-04	138.1	19.0	13.9
2004-05	140.2	19.7	14.2
2005-06	142.3	20.1	14.3
2006-07	145.0	20.9	14.6

Source: F.O.Licht

1.2.2Per Capita Consumption: Apart from white sugar India also consumes alternate sweeteners jaggery and khandsari which are produced in large quantities, representing about 35% of the total sweeteners production in the country. Taking into account all the three sweeteners i.e. white sugar, jaggery, and khandsari, on a per capita basis, India's consumption stands at a reasonably high figure. This would be evident from data of per capita consumption of sugar in various countries.

Table no.1.6-Per Capita Consumption of Sugar in Various Countries
(Qty. in kgs)

Region	1996	1997	1999	2000	2001
EU	38.9	38.9	36.9	39.9	37.5
USA	32.8	32.8	33.4	32.9	32.6
Japan	20.5	19.6	19.2	20.1	19.0
India					
(Total Sweeteners)					
(Sugar + Gur & Khandsari)	26.6				
(14.5 + 12.1)	26.4				
(14.5 + 11.9)	24.9				
(14.9 + 10.0)	25.6				
(15.6 + 10.0)	25.8				
(15.8 + 10.0)					
Asian Average	13.6	3.3	13.2	13.6	13.8
World Average	20.6	20.6	20.4	20.6	20.7

The production is expected to increase in Brazil, China and Australia whereas, it is expected to fall in India in sugar season 2004-05 as compared to the previous season.
In the new season the market will be shaped by developments in two sugar giants – Brazil the world's largest sugar producer and exporter and India the world's largest sugar consumer

1.3Importance of Sugar Industry in National Economy:

Sugar industry is the largest agro-based industry located in the rural India. About 59 million sugarcane farmers, their dependents and a large mass of agricultural labourer are involved in sugarcane cultivation, harvesting and ancillary activities, constituting 7.5% of the rural

population besides, about 0.7 million skilled and semi-skilled workers, mostly from the rural areas are engaged in the sugar industry. The sugar industry in India has been a focal point for socio-economic development in the rural areas by mobilizing rural resources, generating employment & higher income, transport and communication facilities. Further, many sugar factories have established schools, colleges, medical centers and hospitals for the benefit of the rural population. Some of the sugar factories have also diversified into byproduct based industries and have invested and put up distilleries, organic chemical plants, paper and board factories and cogeneration plants. The industry generates its own replenishable biomass and uses it as fuel without depending on fossil fuel. The sugar industry's contribution to the Indian economy is, therefore, enormous.

There are 584 installed sugar mills in the country with a production capacity of 230 lakh MTs of sugar. These mills are located in 18 states of the country. About 60% of these mills are in the cooperative sector, 35% in the private sector and rest in the public sector. The minimum price of raw material, namely sugarcane, is statutorily fixed by the Central Government on the basis of the recommendation made by Commission for Agricultural Costs & Prices (CACP). Sale of sugar produced by the mills is regulated by the Central Government through monthly fixation of quota. 90% of the sugar produced is allowed to be sold by mills as free sale quota (free in regard to price and movement) and 10% is allowed to be sold as levy to State Governments or their nominees at predetermined prices. The sale of sugar produced in 4-5 months of the sugar season is staggered over a period of a year

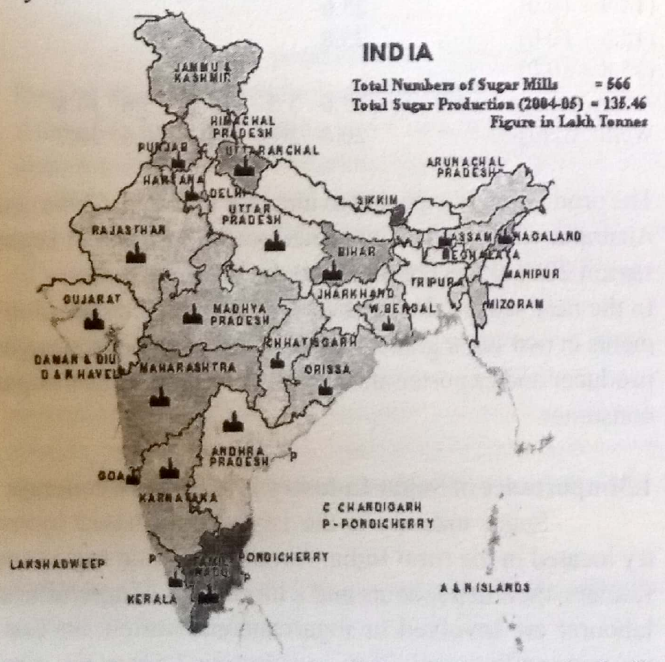

Fig. 1.2 Sugar Industry in different location in India

The foregoing details illustrate the importance of sugar industry to the nation in terms of its role in domestic production, consumption, employment and export. Financial position of the industry has however been deteriorating during the recent years and a large number of units are in a 'sick' state.

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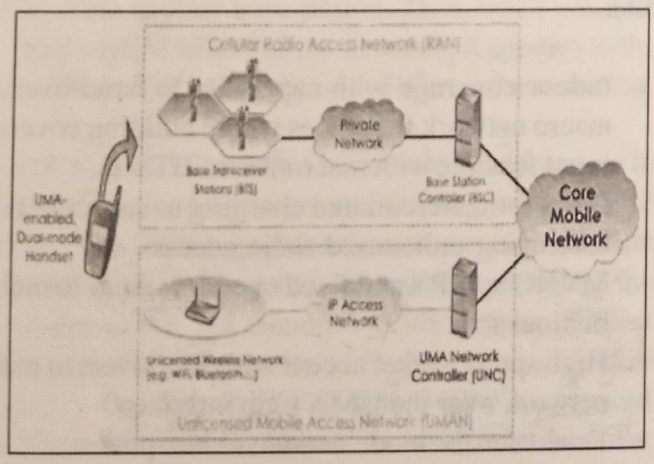
Abstract:-

Unlicensed Mobile Access (UMA) technology provides access to GSM and GPRS mobile services over unlicensed spectrum technologies, including Bluetooth and 802.11.by deploying UMA technology service providers can enable subscribers to roam and handover between cellular networks and public and private unlicensed wireless networks using dual mode mobile handsets. This paper is an attempt to describe the fixed mobile convergence solution using Unlicensed Mobile Access (UMA). The document describes elements for UMA access, convergence solution and the evolution towards the IP based Network.

1. INTRODUCTION

UMA TECHNOLOGY :- UMA technology offers an alternative to the cellular radio access network (RAN), which uses the Global System for Mobile Communications (GSM) and General Packet Radio Service/Enhanced Data rates for Global Evolution (GPRS/EDGE) core circuit, data Subscribers receive a consistent user experience for their mobile voice and data services as they transition between networks.

How UMA Technology Works



1. A mobile subscriber with a UMA-enabled, dual-mode handset moves within range of an unlicensed wireless network to which the handset is allowed to connect.
2. Upon connecting, the handset contacts the UMA Network Controller (UNC) over the broadband IP access network to be authenticated and authorized to access GSM voice and GPRS data services via the unlicensed wireless network.
3. If approved, the subscriber's current location information stored in the core network is updated, and from that point on all mobile voice and data traffic is routed to the handset via the Unlicensed Mobile Access Network (UMAN) rather than the cellular radio access network (RAN).
4. **ROAMING**: When a UMA-enabled subscriber moves outside the range of an unlicensed wireless network to which they are connected, the UNC and handset facilitate roaming back to the licensed outdoor network. This roaming process is completely transparent to the subscriber.
5. **HANDOVER**: If a subscriber is on an active GSM voice call or GPRS data session when they come within range (or out of range) of an unlicensed wireless network, that voice call or data session can automatically handover between access networks with no discernable service interruption. Handovers are completely transparent to the subscriber.

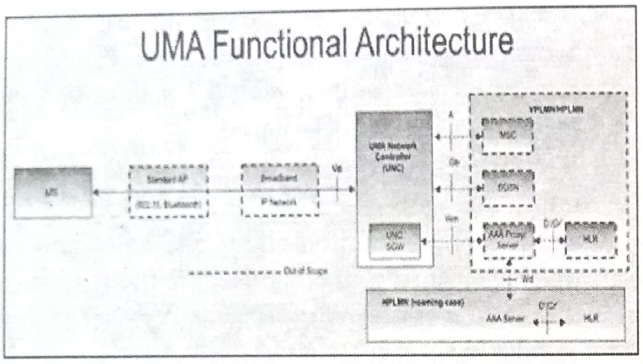
UMA Technology

Unlicensed Mobile Access (UMA) technology enables access to GSM and GPRS mobile services over unlicensed spectrum, including Bluetooth™ and WiFi™. Highlights of UMA Technology:

- Seamless delivery of mobile voice and data services over unlicensed wireless networks.
- Provides the same mobile identity on Cellular RAN and unlicensed wireless networks.
- Seamless transitions (roaming and handover) between Cellular RAN and unlicensed wireless networks.
- Preserves investment in existing/future mobile core network infrastructure
- Independent of underlying unlicensed spectrum technology (e.g. WiFi™, Bluetooth™)
- Transparent to existing, standard CPE devices (e.g. access points, routers and modems)

- Utilizes standard "always on" broadband IP access networks (e.g. DSL, Cable, T1/E1, Broadband Wireless, FTTH…)
- Security equivalent to current GSM mobile networks
- No impact to operations of Cellular RAN (e.g. spectrum engineering, cell planning,…)

- **UMA Technology Architecture**



UMA Technology Operation

UMA technology provides alternative access to GSM and GPRS core network services via IP-based broadband connections. In order to deliver a seamless user experience, the specifications define a new network element (the UMA Network Controller, UNC) and associated protocols that provide for the secure transport of GSM/GPRS signalling and user plane traffic over IP. The UNC interfaces into the core network via existing 3GPP specified A/Gb interfaces.

UMA Interoperability

An open test specification is under development that can be used to facilitate interoperability testing between implementations. The test specification will be available through this web site. Companies planning to implement products based on the UMA specifications should seek bilateral compliancy testing agreements directly with other vendors.

In principle, the UMA specifications ensure interoperability similar to any other industry specifications, but the specifications may include options and parameters that have to be agreed bilaterally with other vendors. The UMA participating companies do not guarantee interoperability and the specifications may be upgraded without notice.

Challenges in Unlicensed Mobile Access (UMA)

Evolution of telecom network from early analog. Networks to digital circuit switched network has already taken place.

The next major trend in network evolution will be the change from circuit switched networks with centralized control towards packet switched next generation network with distributed control separated from media connectivity is UMA.

The change to next generation networks (NGN) will be Evolutionary, using network elements from the legacy network and gradually introducing new network elements that deliver new and converged services. The next generation packet voice networks will serve multiple end user terminal types,legacy terminal as well as advanced terminals supporting both voice and data applications.

A phased approach will spread the investment over different technology and service cycles. In addition, more reliability in the network during the transition period and continuous delivery of service quality, with gradual integration of new services into a single IP platform, allows the formation of truly converged applications. Unlicensed Mobile Access technology enables intermediate solutions on the way towards ultimate packet switched next generation network. UMA utilizes unlicensed Radio technologies, broadband access to customer premises and current 2G/GSM circuit and packet switched core network capabilities in order to realize Voice over IP (VoIP) and packet based services solutions. Integration of UMA technology with bearer independent circuit switched core network – i.e. MSC Server system – provides the operator with machinery that combines globally widely deployed GSM voice and messaging services as well as with cost efficient transmission techniques. UMA will provides an access to GPRS core and therefore it can be used as one access method to IMS based services too.

ADVANTAGES OF UNLICENSED MOBILE ACCESS (UMA):

?? Indoor coverage with capability to hand-overs to macro network for places where building coverage is not feasible with macro/micro BTS's
?? Basis for differentiated charging to subscribers by leveraging unlicensed radio access
?? MVNO's, ISP's and fixed operators entry to mobile business
?? High speed packet access with handovers to macro network over the UMA's Gb interface
?? Dual transfer mode service at hotspots

Specifications:

In order to promote the widespread adoption of UMA

technology, a number of leading companies within the wireless industry will have to jointly develop a set of open specifications. These specifications should be made available through the Web site, and may be used by vendors and carriers of wireless communications systems and applications to develop and deploy interoperable solutions.

In addition to developing and maintaining the initial Specifications, the participating companies are actively working with the 3GPP standards organization to use the specifications as the basis for the development of a formal standard.

GAN:

Generic Access Network (GAN), also known as Unlicensed Mobile Access (UMA), is a telecommunication system allowing seamless roaming and handover between local area networks and wide area networks using a dual-mode mobile phone. It lets mobile operators deliver voice, data and IP Multimedia Subsystem/Session Initiation Protocol(IMS/SIP) type applications to mobile phones. Its ultimate goal is the convergence of mobile, fixed and Internet telephony (Fixed Mobile Convergence).

The local network may be based on private unlicensed spectrum technologies like Bluetooth or 802.11, while the wide network is alternatively GSM/GPRS or UMTS mobile services. On the cellular network, the mobile handset communicates over the air with a base station, through a base station controller, to servers in the core network of the carrier. Under the GAN system, when the handset detects a LAN, it establishes a secure IP connection through a gateway to a server called a GAN Controller (GANC) on the carrier's network. The GANC translates the signals coming from the handset to make it appear to be coming from another base station. Thus, when a mobile moves from a GSM to an 802.11 network, it appears to the core network as if it is simply on a different base station.

The system was initially called UMA and then renamed to GAN. It was developed by a group of operator and vendor companies. The initial specifications were published on 2nd September 2004. The companies then contributed the specifications to the 3rd Generation Partnership Project (3GPP) as part of 3GPP work item "Generic Access to A/Gb interfaces". On 8th April 2005, 3GPP approved specifications for Generic Access to A/Gb interfaces for 3GPP Release 6. TS 43.318 and TS 44.318 and renamed the system to GAN. But the term GAN is little known outside the 3GPP community, and the term UMA is more common in marketing.

Advantages of GAN:

For carriers: Instead of erecting expensive base stations to cover every nook and cranny of a neighborhood, GAN allows carriers to add coverage using low cost 802.11 access points. When at home, subscribers have very good coverage.

In addition, GAN relieves congestion on the GSM or UMTS spectrum by removing common types of calls and routing them to the operator via the relatively low cost Internet

GAN makes sense for network operators that also offer internet services. Operators can leverage sales of one to promote the other, and can bill both to each customer.

Some other operators also run networks of 802.11 hotspots, such as T-Mobile. They will be able to leverage these hotspots to create more capacity and better coverage in many populous areas. Subscribers, not the network, pay directly for much of the costs associated with the service. They pay for a connection to the Internet, effectively paying the expensive part of the cost of routing calls from their location.

For subscribers:

Subscribers do not rely on their operator's ability to roll out towers and coverage, allowing them to fix some types of coverage black spot themselves (such as in the home or office.)

GAN is currently the only commercial technology available that combines GSM and 802.11 into a service that uses a single number, a single handset, single set of services and a single phone directory for all calls.

Disadvantages

Handsets must support 802.11 network access which requires additional space, power and complexity and may affect the size, weight and battery performance of the phone.

GAN is designed around connecting directly to an existing 2/2.5G GSM network. As such it is only suitable for network operators who have an existing GSM network. For operators such as '3' in the UK this is not the case. To address the issue a development called EGAN is under way in 3GPP.

Increasingly, consumers take advantage of unlimited or

otherwise high-volume data tarrifs to make VoIP calls via SIP, as with Skype. GAN will mean that this type of usage is more likely to be charged on a per-minute or unit basis as with voice calls, which may increase the cost of mobile calls made over IP.

Conclusion

An Open test specification is under development that can be used to facilitate interoperability testing between implementations. The test specifications will be available

Through web site. Companies planning to implement products. based on the UMA specifications should seek bilateral compliancy testing agreements directly with other vendors. In principle, the UMA specifications ensure interoperability similar to any other industry specifications, but the specifications may include options and parameters that have to be agreed bilaterally with other vendors. The UMA participating companies do not guarantee interoperability and the specifications may be upgraded without notice.

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