

Canadian International Journal of Science and Technology

CIJSSE

**With Support from Canadian Research
Centre for Humanities and Science**

www.tcsse.org

socialscience@crchs.info

Toronto, Canada

About The Journal

The Canadian Research Centre for Humanities and Science encourages Undergraduate students and Post-Graduates Students of Colleges and Universities to submit their papers for publication in the Canadian International Journal of Social Science and Education. In addition, The CRCHS will give letter of acceptance for all papers accepted for publication and a Certificate of publication.

Frequency of Publication

The Canadian International Journal of Science and technology is published twice per year, in January and June.

Chief-In-Editor

Dr.Samah Khalil

Associate Professor at Ontario College for Research & Development

Prof. Dr Tijana Mandić

Religious and Psychological Studies, FDU, Serbia

Gloria Esteban de la Rosa,

Professor at the University of Jaen, Spain

Ahmed Ali (PhD)

Associate Professor of Translation

Dept. of Arabic and Translation Studies

American University of Sharjah

International Editorial Committee

Dr Marcel Heerink

Associate professor

Windesheim University of Applied Sciences

The Netherlands

Dr Ahmad Aizan Zulkefle

Solar Energy Research Institute, Universiti Kebangsaan Malaysia, Malaysia

Dr Maslan Zainon

2Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah
Jaya, Malaysia

Zaihasraf Zakaria

3Department of Electrical, Electronic and Systems Engineering, Faculty of Engineering
and Built Environment, The National University of Malaysia, Malaysia.

Dr Zabihollah zadeh

MahabGhodss Consulting Engineering Company, Tehran, Iran

Dr MasoudYamin pour

hahidChamran University of Ahwaz, Ahwaz, Iran

Dr S Algoul,

University of Tripoli, Libya

Dr Abdalla Hanashi,

University of Zawia, Libya

Dr M S Alam,

University of Dhaka, Bangladsh

Dr M A Hossain,

University of Northubria

Dr M A A Majumder,

University of Bradford

Jayam Naga Sateesh

Department of Chemistry, PRRM College of Pharmacy, Kadapa, Andhra Pradesh, India

Gopireddy Venkata Subba Reddy

Department of Chemistry, Jawaharlal Nehru Technological University Anantapur
College of Engineering, Pulivendula, Andhra Pradesh, India

K.N.Jayaveera

Department of Chemistry, Jawaharlal Nehru Technological University Anantapur,
Anantapur, Andhra Pradesh, India

Hossam M Moussa

Associated professor AL-faraby collage for dentistry and nursing ryidh, Saudia Arabia

Faleh T. AL-Hojhouj

Associated professor AL-faraby collage for dentistry and nursing ryidh, Saudia Arabia

Essam Elkhatat

Associated professor AL-faraby collage for dentistry and nursing ryidh, Saudia Arabia

Jose AntonioSilveira

Federal University of Sao Carlos, Brazil

Conrado Planas

Federal University of Sao Carlos, Brazil

CHITTINENI ARUNA

Research Scholar, Acharya Nagarjuna University, Assistant Professor, Department of
CSE, KKR & KSR Institute of Technology and Sciences, Guntur, Andhra Pradesh, India

R. SIVA RAM PRASAD

Research Guide, Department of CSE and Head, Department of IBS, Acharya Nagarjuna
University, Guntur, Andhra Pradesh, India.

HUANG Zhanbin

School of Chemical and Environmental Engineering, China University of Mining and Technology, China

Dr. Habib ur Rahman

Sarhad University of Science and Information Technology,
University Town, Pakistan

Hong Thi Nguyen, Wendy Warren and Heather Fehring

School of Education, RMIT University, Melbourne, Australia

Mohammed Saleh Altayar

Al Imam Mohammad Ibn Saud Islamic University (IMSIU), Saudi Arabia

T. Ramana

Research Scholar, JNTUA University, Anantapuramu, A.P, India

V. Ganesh

Associate Professor, Department of Electrical and Electronics Engineering, JNTUA University, Anantapuramu, A.P, India

S. Siva Nagaraju

Professor, Department of Electrical and Electronics Engineering, JNTUK University, Kakinada, A.P, India

Table of Content

| | |
|---|------------|
| Logistic modelling of supply process synchronization in converging material flows..... | 7 |
| Trianthema portulacastrum Linn. As New Source for Organic Manure Preparation and It's Effect on Growth of Fodder Maize..... | 24 |
| Applying Different Mobility Models to Evaluate the Performance of Improving Dynamic Probabilistic Flooding in Ad Hoc Networks Based on Simulation..... | 32 |
| Power Savings using hybrid model of DVFS and Max-Min in Cloud Computing..... | 42 |
| Awareness of using flowers and ornamental plants and its impact on improving the internal environment of the housing..... | 52 |
| Assessment of Nursing Students' Attitude toward Learning Communication Skills at King Saud bin Abdul-Aziz | 74 |
| Effect of the Hydraulic Retention Time and Temperature on the efficiency of Up-flow Anaerobic Filter Reactor treating Rural Domestic Sewage..... | 92 |
| Innovation and Technology: Ford Motor Company defines restructure through technological advancement..... | 101 |
| The status and Socioeconomic value of Cherry laurel (Prunus laurocerasus L.): Advancement for the future..... | 105 |
| Engineer Job Satisfaction in Bangkok, Thailand..... | 113 |
| OPTIMIZATION OF ELECTROCOAGULATION PARAMETERS FOR PRE-TREATMENT OF INDUSTRIAL METAL CUTTING WASTEWATER..... | 120 |
| BARRIERS IN CONDUCTING RESEARCH AMONG NURSE EDUCATORS IN ILIGAN CITY..... | 128 |
| A Modified Compact Fork-Shaped Slotted Wideband Antenna for C and X-band Applications..... | 138 |
| Smart CCTV Surveillance System for Hospitals..... | 147 |
| Synbiotic Dietary Pattern used as a Predictor for Bifidobacterium and Lactic acid Bacteria in Breastfeeding..... | 153 |
| APPLICATION OF LINEAR PROGRAMMING MODEL AND SENSITIVITY ANALYSIS IN MULTI-PRODUCT MULTI-DESTINATION SYSTEM..... | 168 |

Logistic modelling of supply process synchronization in converging material flows

Jonas Mayer*, Hans Wiesinger and Peter Nyhuis

Institute of Production Systems and Logistics, Leibniz Universität Hannover, Garbsen, Germany

Leibniz Universität Hannover, Institute of Production Systems and Logistics, An der Universität 2, 30823 Garbsen, Germany.

This work was supported by the German Research Foundation under Grant [NY 4/58-1].

In the competitive environment of today's growing globalisation, industry enterprises must master the coordination of a continually increasing number of material flows. In particular, aligning the material flows that meet at so-called convergence points in assembly processes, requires significant effort. In this context, the converging material flows describe the situation in which n parts from different supply processes flow into one product. Respective orders can only be executed in accordance with the assembly schedule when all of the supply processes deliver the components for an assembly order on-time. Synchronizing the material supply at these convergence points poses a particular challenge when planning and controlling supply processes. Here, the degree to which supply processes deliver goods simultaneously describes their synchrony. Greater synchrony between supply processes improves logistic performance and decreases logistic costs. In order to realize a quantitative tool for designing, planning and controlling supply processes, this paper introduces a logistic model which mathematically describes an inventory system's synchrony in relation to other supply processes at a convergence point.

Keywords: synchronization, assembly process, supply process, convergence point

1. Introduction

In the competitive environment of today's growing globalisation, industry enterprises must master the coordination of a continually increasing number of material flows. In particular, aligning the material flows that meet at so-called convergence points in assembly processes, requires significant effort [1]. Converging material flows describe the situation in which n parts from different supply processes flow into one product. Respective orders can only be executed according to the assembly schedule when all of the supply processes deliver the components for an assembly order on-time. Delays in any one of the individual supply processes results in the entire order being delayed at the convergence point [2].

WIP at convergence points is differentiated as either complete or disrupted [1]. When all components required to process a job are available at the convergence point, the assembly order

is complete. The sum of the value of all the components in the completed assembly orders corresponds to the complete WIP. In contrast, the disrupted WIP represents the value based sum of all components not yet allocated to assembly orders. Lateness in supply processes causes materials to be supplied either before or after the actual planned due date. Disrupted WIP results when supply processes are not aligned and thus supply processes which are dependent on the planned output date or delayed supply processes cannot be pulled forward or deferred. Coordinating the timing of supply processes at convergence points is especially challenging.

The following example serves to clarify the underlying problematic: An assembly order requiring six components in order to be processed, is served by two supply processes SP_1 and SP_2 , each of which provide three of the necessary components. If SP_1 supplies the components 5 days before the actual planned due date (lateness = 5 SCD) without being synchronized with SP_2 , the components from SP_1 have to be stored in the interim until the three missing components are supplied by SP_2 (see Fig. 1a). It may be possible to synchronize SP_2 with SP_1 by specifically controlling SP_2 through prioritizing the necessary material supply. The degree to which they can be synchronized is dependent on SP_2 's restrictions, for example, the actual utilization or availability of materials etc. (see Fig. 1b). As a result, in consideration of SP_2 's logistical restrictions, the assembly order can be completed early and is available for further processing on the assembly system. This reduces disrupted WIP at the convergence point and increases complete WIP. This example demonstrates how carefully synchronizing supply processes can support enterprises in optimizing supply situations at convergence points by reducing disrupted WIP while simultaneously increasing complete WIP.

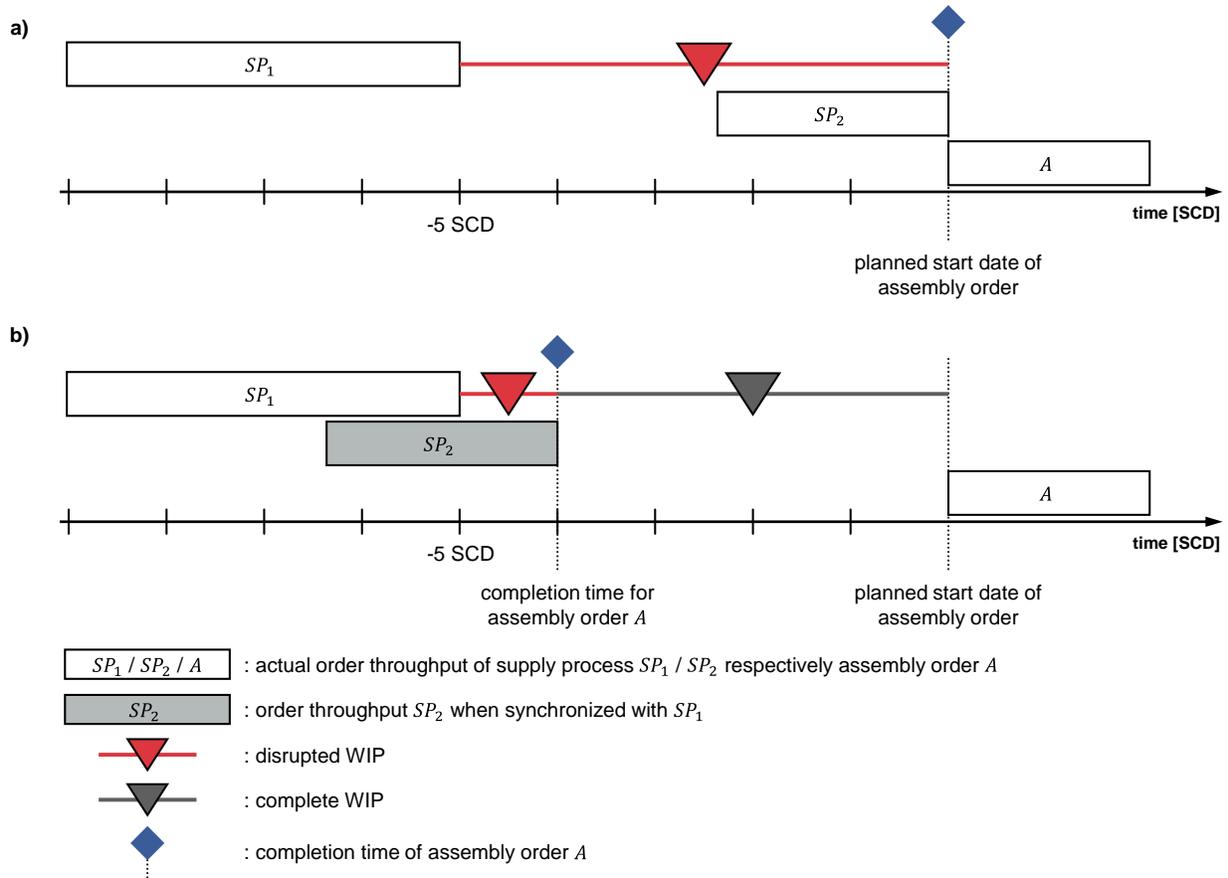


Figure 1: Comparison of Supply Situations with and without Synchronized Supply Processes

Supply processes that provide components from warehouses at convergence points can be used in two ways to synchronize supply processes:

1. By prematurely calling up components from the warehouse, the stored stock can be used to offset early provisions from other supply processes.
2. The warehouse can be used as a temporary buffer when other supply processes are delayed. The inventory system's provision is then delayed depending on other supply processes and the corresponding order quantity is available for other assembly orders.

The logistic model introduced in this paper mathematically models the synchronization of a warehouse with random supply processes at a convergence point. Applying the model supports enterprises in aligning supply processes at a convergence point, ensuring greater synchrony between the supply processes and thus identifying optimization potential in regard to disrupted WIP.

2. The Supply Diagram – An Impact Model for Convergence Points

The supply diagram describes the interactions between supply processes as well as the resulting supply situation at convergence points [1]. Two curves are differentiated in the supply diagram, the input curve and the completion curve (see Fig. 2). The input curve takes into account all the

delivery times of the subcomponents required for assembly orders or completions within the corresponding observation period. The lateness distributions of the specific supply processes serve as the basis for generating the input curves. A lateness distribution is generated for each of the supply processes by standardizing the supply time points in relation to the requirement date for the individual supply orders. These distributions then reflect the supply behaviour of the individual supply processes. Additionally, the supply time points are weighted based on the value of the components delivered, so that the value weighted input frequency f_{SP} of a supply

process can be determined. Mathematically the input curve of a convergence point with n supply processes results from the sum of input values per supply process j as a function of the supply

process specific lateness L_i [1]:

$$F_{in}(L_i) = \sum_{i=L_{min}}^{L_{max}} \sum_{j=1}^n f_{SP,j}(L_i) \quad (1)$$

Based on the input curve, the total value of the deliveries that have entered the analysed convergence point within a specific lateness range can be quantified.

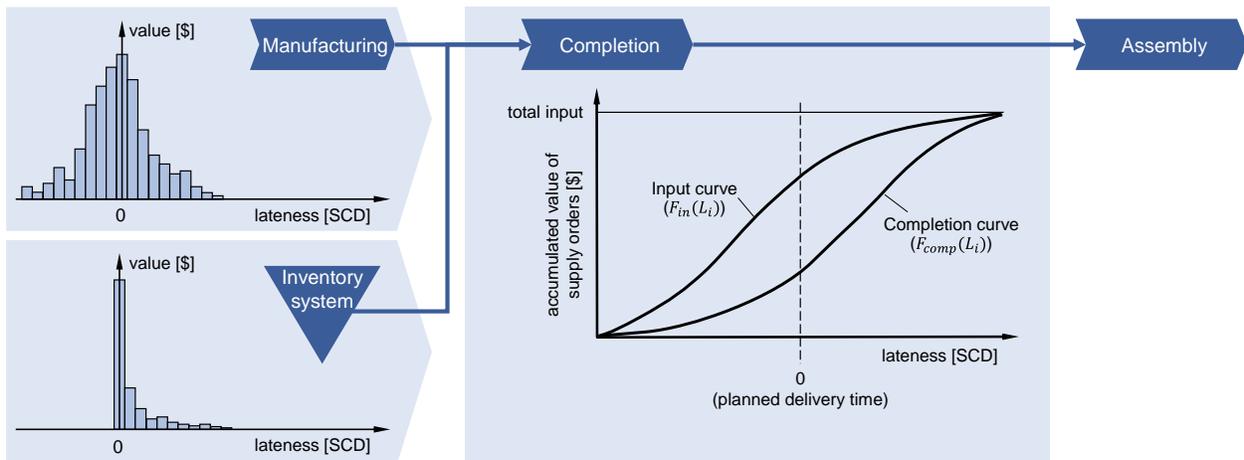


Figure 2: Sample Supply Diagram for Two Supply (based on [1])

The completed orders are depicted in the completion curve. The completion curve only includes the delivery time of the last supplied component for each of the assembly orders. In accordance with the input curve, the delivery time points are standardized in relation to the requirement dates and weighted based on the total value, so that the completions can also be quantitatively represented in the form of a lateness histogram. Given that the supply processes are randomly distributed for the individual assembly orders, the completion curve can be derived mathematically by exponentiating the probability of the order input with the mean number of

components c_m delivered by the supply processes (with $\sum P_x$ as the total value delivered by the supply processes) [1]:

$$F_{comp}(L_i) = \sum P_x \cdot \left(\frac{F_{in}(L_i)}{\sum P_x} \right)^{c_m} \quad (2)$$

The WIP at convergence points is differentiated as either disrupted or complete. The level of complete WIP results from the integral of the completion curve as a function of the lateness L_i

and is calculated as [1]:

$$WIP_{comp} = \frac{\sum P_x}{ObsP} \cdot \int_{L_{min}}^{L_{max}} F_{comp}(L) dL \quad (3)$$

where $ObsP$ corresponds to the observation period.

From a mathematical perspective, the disrupted WIP can be interpreted as the difference between the total WIP that has entered the convergence point and the complete WIP [3]:

$$WIP_{dis} = \frac{\sum P_x}{ObsP} \cdot \left(\int_{L_{min}}^{L_{max}} F_{in}(L) dL - \int_{L_{min}}^{L_{max}} F_{comp}(L) dL \right) \quad (4)$$

In addition to determining the level of distorted WIP at a convergence point, information regarding the due date alignment of supply processes can be derived from the supply diagram's input and completion curve trends [3]. The simultaneity of a provision describes the quality of the temporal alignment between the processes (see Fig. 3). A high degree of simultaneity requires a minimal temporal offset between delivering the first component of an order and the last component. This is the case when the horizontal distance between the input curve and completion curve in the supply diagram is minimal. Furthermore, based on the supply diagram, it can be derived that supply processes that deliver simultaneously, reduce disrupted WIP. Since synchronized supply processes deliver the individual components almost simultaneously at a convergence point, both the input curve and resulting completion curve change.

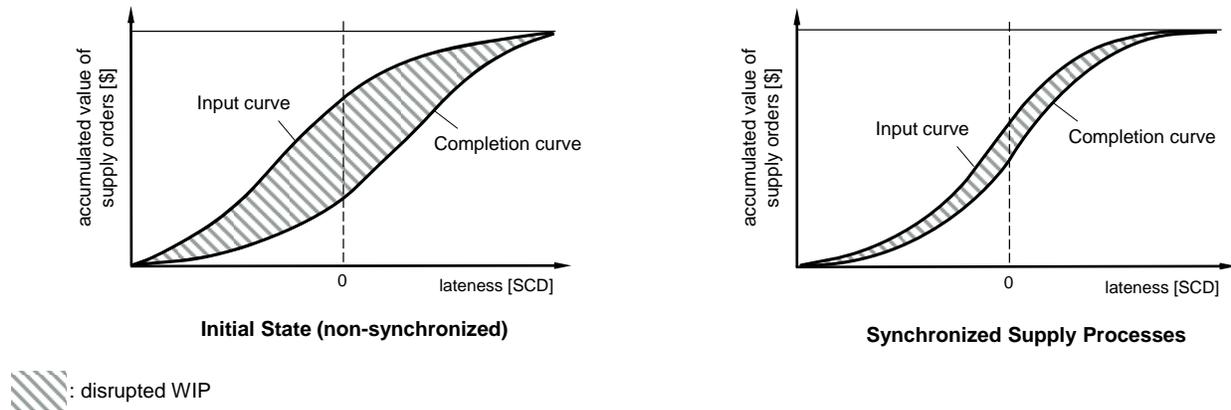


Figure 3: Impact of Synchronized Supply Processes on Input/Completion Curves and Disrupted WIP (based on [4])

Understanding the interactions between the lateness distributions of supply processes and the input/completion curve trends makes it possible to use a model to depict measures for improving the lateness values of supply processes and to determine the potential for optimizing the specific supply processes [3]. Additionally, based on supply diagrams, weak points in the converging supply processes can be identified. The supply diagram, thus represents a key tool in designing and controlling assembly and completion areas.

As long as components for completing assembly orders at a convergence point are served from a warehouse, it is practical from a logistics perspective to couple the provision from the warehouse with the other supply processes and thus optimally use available inventories. Accordingly, a component is served from the warehouse once the last of the non-stocked components belonging to an assembly order is delivered, so that the inventory system provision immediately leads to the completion of the corresponding assembly order. Since the supply diagram is grounded on the lateness distributions of the individual supply processes, we quantitatively describe lateness distributions in inventory systems in Section 3. Based on this model and the supply diagram's calculation logic, we then derive a model which depicts the synchrony between inventory system supply processes and other necessary supply processes (see Section 4). After validating the developed model using simulations (see Section 5), we then examine the logistical impact of synchronizing supply processes in dependence on the inventory system lateness distribution in Section 6.

3. Mathematically Describing Lateness Distributions in Inventory Systems

The mathematical derivation of the model for describing the inventory system output lateness distributions determines frequency values for discrete lateness classes and is grounded on two key basepoints $L = 0$ and $L = TA_{max}$ (see [5]). Lateness class $L = 0$ includes all orders that can

be directly served without any delivery delay. Since these orders can be served on-time and in

the correct quantity, the class $L = 0$ corresponds to the mean service level $SERL_w$ of an inventory system. The service level operating curve is used as the underlying model for determining the service level and with that the frequency of the lateness class 0 as a function of a mean stock. Based on the parameters SL_0 (mean lot stock, that just meets the demand to ensure no delivery delay assuming that there are no process disruptions in the inventory systems)

$$SL_0 = \frac{X_{in,m} - X_{out,m}}{2} \quad (5)$$

where $X_{in,m}$ corresponds to the mean input quantity and $X_{out,m}$ represents the mean output quantity, and SL_1 (stock level required to attain a service level of 100 % when accounting for plan deviations)

$$SL_1 = \frac{X_{in,m} - X_{out,m}}{2} + \sqrt{(L_{max}^+ \cdot DR_m)^2 + ((DR_{max} - DR_m) \cdot T_{resp})^2}, \quad (6)$$

(with L_{max}^+ : maximum positive inventory system input lateness, DR_m : mean demand rate, DR_{max} : maximum demand rate and T_{resp} : replenishment time) the service level operating curve

can be mathematically modelled, depicting the general behaviour of an inventory system [6]:

$$SL_m(t) = SL_0 \cdot (1 - \sqrt[1-C]{1-t^C})^2 + (SL_1 - SL_0) \cdot t \quad \text{with } t \in [0; 1] \text{ and } C \in [0; 0,5] \quad (7)$$

$$SERL_w(t) = 1 - \sqrt[1-C]{1-t^C} \quad \text{with } t \in [0; 1] \text{ and } C \in [0; 0,5] \quad (8)$$

After determining the relevant parameters for establishing SL_1 , empirically deriving the C-value and subsequently developing the service level operating curve, the service level is calculated as a function of the mean stock, thus defining the frequency of lateness class $L = 0$ [5].

The maximum possible lateness class is determined along with its frequency as the second basepoint. Lateness class L_{max} provides the percentage of all orders which can be supplied from an inventory system with a mean stock SL_m and maximum delivery delay $DELD_{max}$. The extent of the maximum delivery delay is dependent on the size of the selected mean stock $SL_{ideal,m}$ and safety stock $SL_{b,m}$, which can be calculated as follows [5]:

$$SL_{ideal,m}(SERL_w) = SL_0 \cdot SERL_w^2 \quad (9)$$

$$SL_{b,m}(SERL_w) = (SL_1 - SL_0) \cdot \sqrt[3]{1 - (1 - SERL_w)^c} \quad (10)$$

Variables which influence the maximum delivery delay can be subdivided into three components: lot stock dependent maximum delivery delay $DELD_{max}(SL_{ideal,m})$, lateness dependent maximum delivery delay $DELD_{max}(L^+_{max}, SL_{b,m})$ and maximum delivery delay as a function of demand rate fluctuations $DELD_{max}(DR_{max}, SL_{b,m})$ (see Fig. 4).

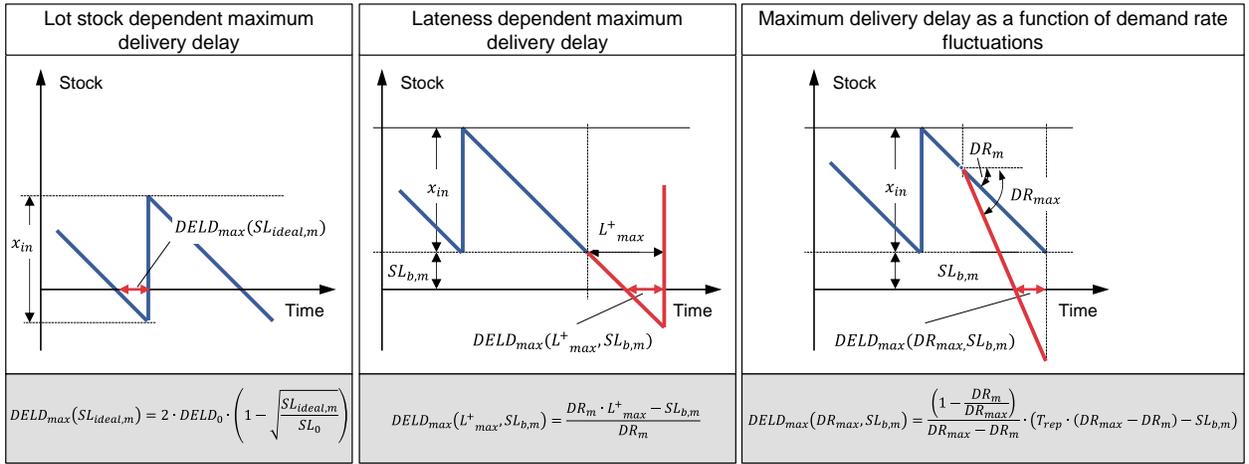


Figure 4: Deriving the Function for the Maximum Delivery Delay $DELD_{max,total}(SL_{ideal,m}, SL_{b,m})$ (based on [5])

Overall, we can formulate the following functional relation of the maximum total delivery delay as a function of $SL_{ideal,m}$ and $SL_{b,m}$ $DELD_{max,total}(SL_{ideal,m}, SL_{b,m})$ [5]:

$$DELD_{max,total}(SL_{ideal,m}, SL_{b,m}) =$$

$$DELD_{max}(SL_{ideal,m}) + \sqrt{DELD_{max}(L^+_{max}, SL_{b,m})^2 + DELD_{max}(DR_{max}, SL_{b,m})^2} \quad (11)$$

The output lateness distribution of an inventory system results from [5]:

$$SC(L_k) = SERL_w + (1 - SERL_w) \cdot \left(1 - \sqrt[2 \cdot C]{1 - \left(\frac{L_k}{L_{max,inv}} \right)^{2 \cdot C}} \right) \quad \text{with } SC(L_0) = SERL_w$$

(12)

where, the maximum lateness corresponds to the maximum total delivery delay with $DELD_{max,total}(SL_{ideal,m}, SL_{b,m})$ defined as [5]:

$$L_{max,inv} = DELD_{max,total}(SL_{ideal,m}, SL_{b,m}) \quad (13)$$

Equation 12 describes the summation function for the frequencies of the individual lateness classes. In order to be able to derive a lateness distribution from this function, the probabilities of the individual classes have to be calculated. Since Equation 12 is a sum function, the frequencies of the respective lateness classes can be found by forming the difference (see Fig. 5) [5]:

$$f_{inv}(L_k) = SC(L_k) - SC(L_{k-1}) \quad \text{with } SC(L_0) = SERL_w \quad \text{and } k \in [1; L_{max,inv}] \quad (14)$$

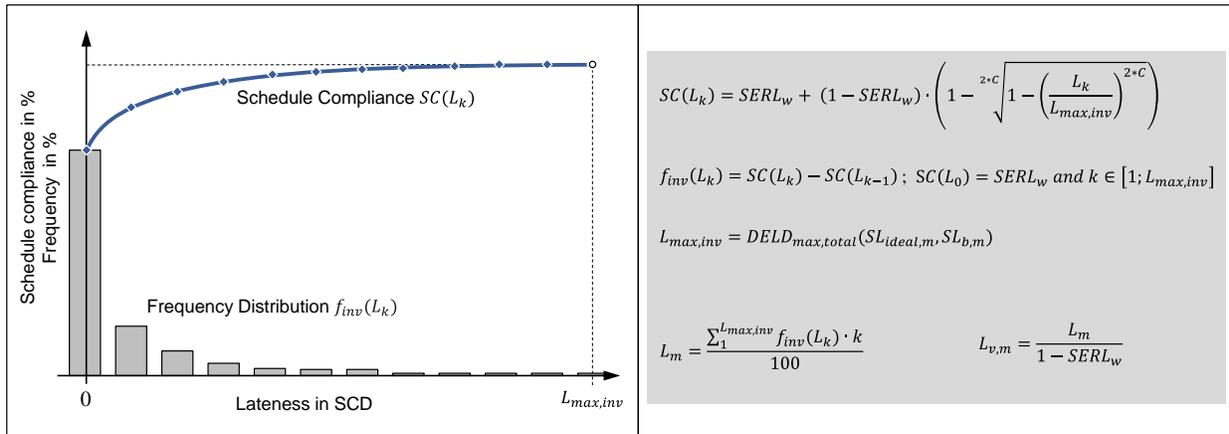


Figure 5: Modelling the Lateness Distribution for Inventory Systems (based on [5])

Based on the individual probabilities for each of the lateness classes, a discrete lateness distribution of an inventory system can be determined. This modelling is based on the assumption that the inventory systems do not demonstrate any negative lateness (i.e., that the earliest the inventory system delivers is at the planned date and not before).

4. Mathematically Modelling Synchronization between Inventory Systems and Supply Processes at Convergence Points

In order to be able to model the impact of synchronizing inventory systems with other supply processes, the influence of deviations from the planned output in an inventory system has to first

be analysed. Pulling or deferring orders can cause the demand rate RD_{min} and/or RD_{max} to change, which in turn can be reflected in changes to $DELD_{max,total}(SL_{i,m}, SL_{b,m})$ and SL_1 . Assuming that the times at which orders are pulled or deferred are randomly distributed, RD_{min} and/or RD_{max} do not change on average. The probability that an order is added during the replenishment time is:

$$p_{add} = \frac{T_{rep}}{ObsP} \quad (15)$$

The probability that an order is cancelled during the replenishment time is

$$p_{canc} = \frac{T_{rep}}{ObsP} \quad (16)$$

Therefore, the probability that the demand rate increases within the replenishment time is identical to the probability that the demand rate decreases within the replenishment time. Consequently, RD_{min} and/or RD_{max} do not change as a result of pulling or deferring orders.

Therefore, the conditions for applying Equations 5 to 14 for quantitatively describing the service level operating curve and inventory system output lateness are also given when consciously pulling or deferring orders from an inventory system. Correspondingly, the basic lateness distribution according to Figure 5 does not change.

In the underlying definition of the problem, the object being investigated is the synchronization between the supply process inventory system and other supply processes. According to the problem definition, materials should be provided from an inventory system only when it then results in a complete assembly order. There is thus a synchronization between the inventory system's supply process and the other supply processes. Generating a completion curve without accounting for the inventory system's supply process, reflects the proportion of orders that has to be pulled or deferred from an inventory system by a lateness i in relation to the planned output date, so that the different processes are fully synchronized at a convergence point. To do so, Equations 1 and 2 are calculated without the inputs from the inventory system's supply process, thus generating a completion curve $F_{comp,rsd}(L_{i,v})$ that is reduced by the inventory system's

supply process. Here, the index v is added to L_i in order to be able to distinguish the lateness value of the supply processes without accounting for the inventory system from the lateness value of the inventory system. In this step, the variable c_m is determined without the proportion of components that are served on average from the inventory system. Based on the completion curve thus generated, the value weighted lateness frequencies of the completions can be derived:

$$f_{comp,red}(L_{i,v}) = F_{comp,red}(L_{i,v}) - F_{comp,red}(L_{i-1,v}) \quad (17)$$

In this context $F_{comp,red}(L_{i,v})$ indicates the total value of assembly orders completed without explicitly taking into account the inventory system's supply process with lateness L_k . The inventory system's supply process is fully synchronized with the other supply processes when the inventory supply process is able to provide the components it is responsible for 100% of the respective $L_{i,v}$. The proportion of the total inventory output that is called up from an inventory system with a planned lateness $L_{i,v}$ from the originally scheduled output date in order to synchronize the supply processes can be described by the frequency $f_{comp,red,rel}(L_{i,v})$, which is derived from the supply diagram's completion curve:

$$f_{comp,red,rel}(L_{i,v}) = \frac{f_{comp,red}(L_{i,v})}{\sum_{i=L_{min}}^{L_{max}} f_{comp,red}(L_{i,v})} \quad (18)$$

Consequently, to completely synchronize the supply processes it is necessary to shift the warehouse requisition by $L_{i,v}$ in the amount of $f_{comp,red,rel}$. Mathematically modelling the lateness behaviour of an inventory system demonstrates that its output lateness distribution results as a function of the selected WIP level and ensuing service level (see Section 3). This basic inventory system's lateness distribution means it is not possible to completely synchronize the processes as a function of the service level $SERL_w$. In order to be able to generate the actual

inventory system's output lateness distribution when pulling or deferring inventory orders, the inventory system's basic lateness distribution has to be transformed as a function of the degree of pulling or deferring orders. Despite pulling or deferring orders from an inventory system, Equations 5 to 14 remain applicable. Therefore, an inventory system's output lateness distribution $f_{inv,fcomp,red,rel}(L_{k,synch})$ can be calculated using Equation 14 for every

$f_{comp,red,rel}(L_{i,v})$. The lateness values of the inventory system's output lateness distribution that

it is to be generated for $f_{comp,red,rel}(L_{i,v})$, correspond to the basic distribution of the inventory system's output distribution according to Equation 14, corrected by the number of days pulled or deferred from the planned output dates:

$$f_{inv,fcomp,red,rel}(L_k + L_{i,v}), \quad (19)$$

whereby $L_{i,v}$ describes the pulling or deferring of inventory orders in SCD for $f_{comp,red,rel}(L_{i,v})$.

Generating a mixture distribution results in a total lateness distribution for the inventory system's output, standardized to the total frequency 1. Statistically, a mixture distribution corresponds to the weighting of the individual distributions (see [7]) and can be calculated as:

$$f_{inv,total}(L_{k,synch}) = \sum_{i=L_{min}}^{L_{max}} \sum_{k=1}^{L_{max,inv}} f_{comp,red,rel}(L_{i,v}) \cdot f_{inv,f_{comp,red,rel}}(L_k + L_{i,v}) \quad (20)$$

It is thus possible to generate a lateness distribution for an inventory system's supply process, which is dependent on the inventory side's restrictions (mean WIP and resulting basic distribution of the inventory system's lateness according to Equation 14). The logistic modelling also accounts for the synchrony between the inventory system's supply process and other supply processes, since the frequencies of the completion curve – which is generated based on the supply processes without the inventory process – represents the measure for pulling or deferring orders from the inventory supply process, in order to be able to completely synchronize the supply processes. By subsequently integrating the newly generated inventory system's lateness distribution $f_{inv,total}(L_{k,synch})$ into the calculation of the supply diagram according to Equations

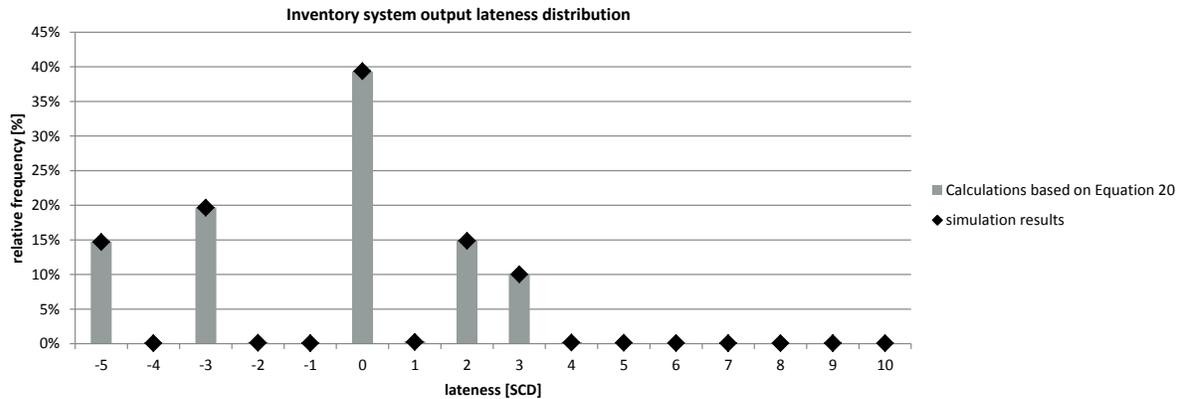
1 and 2, it is possible to then evaluate the influence of pulling or deferring stock orders.

5. Validating the Developed Model Using Simulations

The developed modelling of pulling or deferring orders from an inventory system according to Equation 20 was validated using simulations. The applied simulation model emulates an inventory system that supplies one article. As input variables, the mean input lot size, replenishment time, mean demand rate and initial stock have to be defined. Plan deviations, lateness and demand rate fluctuations are represented in the simulation model by normal distributions. The mean stock within a single simulation run can be modified by varying the reorder point as a function of the replenishment time and mean demand rate. Pulling or deferring stock orders can be parameterized by allocating random due date shifts to stock orders. The proportions of stock orders that should be offset on average by the parameterized due date shift can be adjusted in the simulation model through weighting factors. Here, the assumption is made that the supply processes' lateness behaviour does not change over time and thus the due date shifts $f_{comp,red,rel}(L_{i,v})$ are on average constant.

Figure 6 depicts an example of the conducted model validation. In the upper part of the figure, the parameters underlying the simulation and model calculations are summarized. The results of the simulation and model based calculations are compared in the lower parts of the figure. On average, the deviation between the simulation and model results was 0.056%, which emphasizes the high quality of the model's representation. The quality of the model's depiction was confirmed for different parameter sets using a partial factorial experimental design.

| simulation / calculation parameters | | | | | |
|--------------------------------------|----------|--|----------|------------------------|------|
| mean input lot size ($X_{in,m}$) | 3000 pcs | maximum positive inventory system input lateness (L_{max}^+) | 7 SCD | $f_{comp,red,rel}(-5)$ | 15 % |
| mean output lot size ($X_{out,m}$) | 250 pcs | maximum demand rate (DR_{max}) | 265 pcs | $f_{comp,red,rel}(-3)$ | 20 % |
| replenishment time (T_{rep}) | 20 SCD | Maximum delivery delay ($DELD_{max,total}$) | 4.17 SCD | $f_{comp,red,rel}(0)$ | 40 % |
| mean demand rate (DR_m) | 250 pcs | C-value | 0.34 | $f_{comp,red,rel}(2)$ | 15 % |
| service level ($SERL_m$) | 98.17 % | | | $f_{comp,red,rel}(3)$ | 10 % |



| | | | | | | | | | | | | | | | | |
|-------------------------|-------|------|-------|------|------|-------|------|-------|-------|------|------|-------|-------|-------|-------|-------|
| simulation results [%] | 14.69 | 0.08 | 19.65 | 0.13 | 0.07 | 39.38 | 0.24 | 14.87 | 10.01 | 0.17 | 0.13 | 0.11 | 0.08 | 0.09 | 0.08 | 0.06 |
| calculation results [%] | 14.73 | 0.12 | 19.7 | 0.21 | 0.11 | 39.34 | 0.37 | 14.91 | 10.06 | 0.22 | 0.13 | 0.006 | 0.004 | 0.001 | 0.001 | 0.001 |

Figure 6: Validation of Calculation Results based on Equation 20

6. Applying the Developed Model for Describing Synchrony between Supply Processes at Convergence Points

Using an example, we will now discuss the possibility of applying the developed modelling according to Equation 20 for describing the synchrony between supply processes at convergence points. In the example being considered, components are provided for the assembly through two supply processes: manufacturing (M) and inventory (I). Via a second simulation model, which quantifies the lateness situation of the supply processes, the supply situation at the convergence point preceding the assembly can be described. Figure 7 depicts the initial situation of the example.

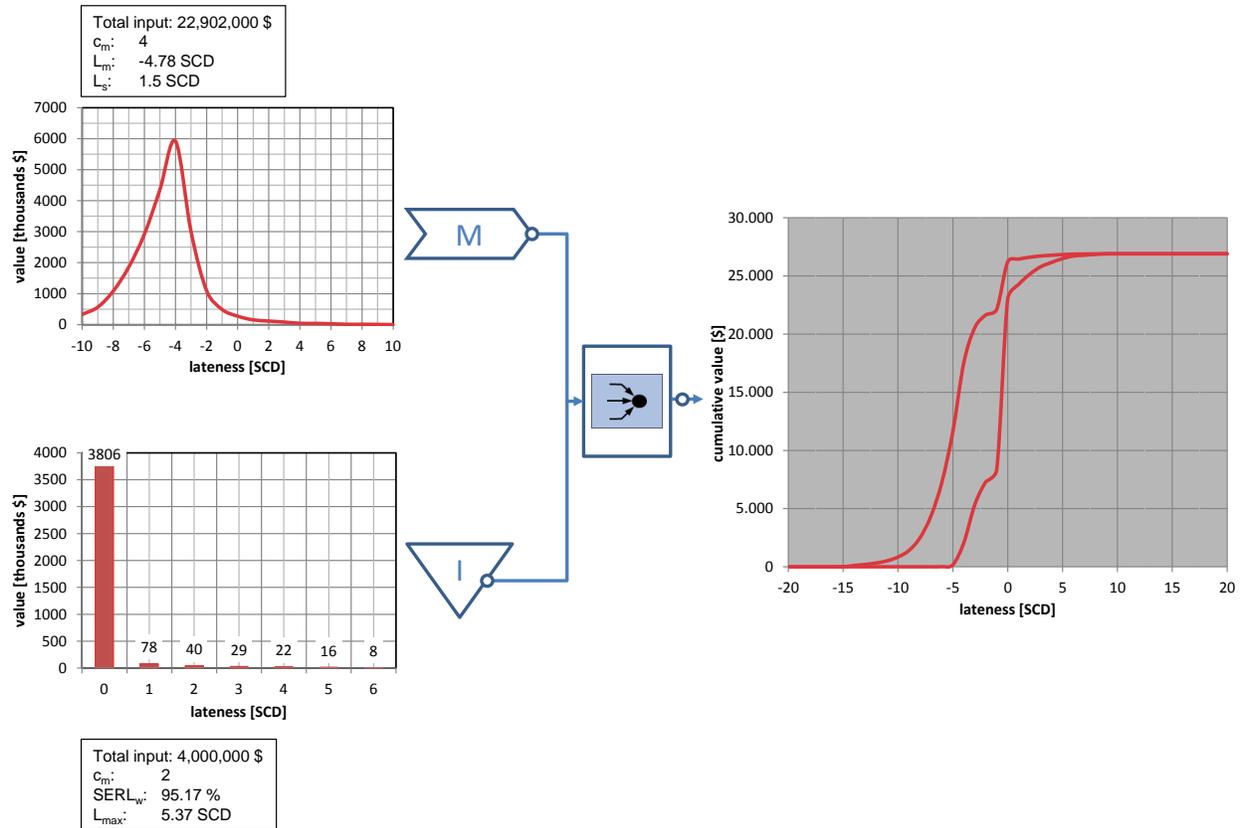


Figure 7: Supply Processes' Lateness Distributions and Resulting Supply Diagram

Next, based on the manufacturing supply process' lateness distribution, the relative lateness frequency of the completion function $f_{comp,red,rel}(L_{i,v})$ is determined for the manufacturing supply process according to Equation 18 (see Fig. 8 – upper part). The lateness distribution of the inventory system's supply process when synchronized with the manufacturing supply process can be derived by calculating $f_{inv,f_{comp,red,rel}}(L_k + L_{i,v})$ (see Equation 19) for the specified $f_{comp,red,rel}(L_{i,v})$ and subsequent quantification of $f_{inv,total}(L_{k,synch})$ (see Equation 20 and Figure 8 – lower part). The basic distribution of the inventory system's output lateness, which is required for calculating $f_{inv,total}(L_{k,synch})$ corresponds to the inventory system's output lateness distribution depicted in Figure 7 for a service level of $SERL_w = 95.17\%$. In this example, the deviation of the model based calculation according to Equation 20 from the simulation results is 0.067%.

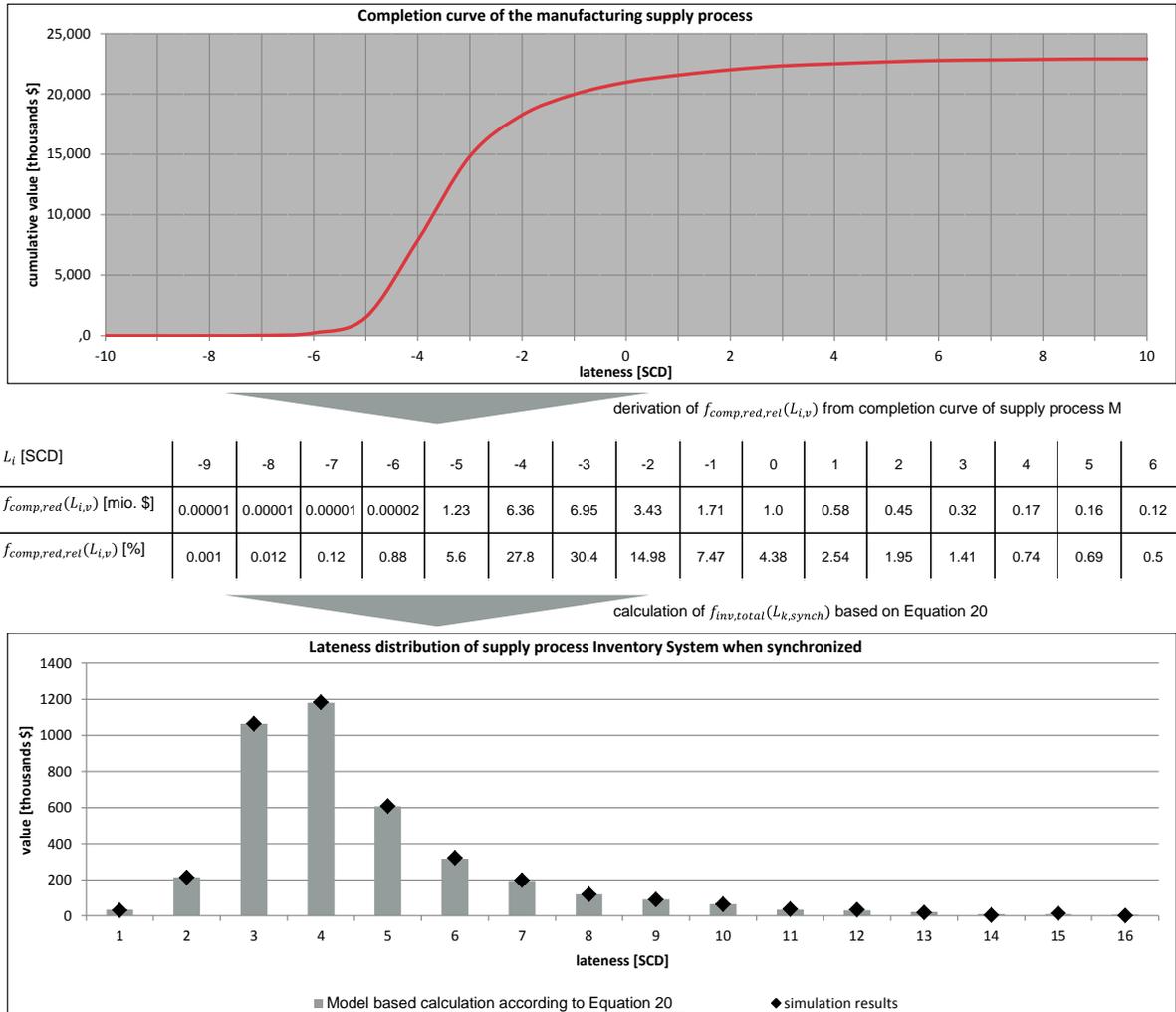


Figure 8: Calculating the Inventory Systems Output Lateness when Synchronized with the Manufacturing Supply Process

In order to demonstrate the logistical impact of synchronized supply processes at convergence points, the inventory system's lateness distribution required for a synchronization is then integrated in the quantification of the supply situation, by recalculating the supply diagram (see Fig. 9). It can be derived from the adjusted supply diagram that the impact of synchronizing the supply processes on the supply situation is generally positive. As postulated in Section 1, the synchronization is reflected in the changed input and completion curve trends. At the same time, there is a smaller horizontal distance between the curves than in the initial state. Compared to the initial state, by synchronizing the supply processes the disrupted WIP can be reduced by \$36,000 and the complete WIP increased by \$64,000. These results emphasize the logistical potential of synchrony at convergence points.

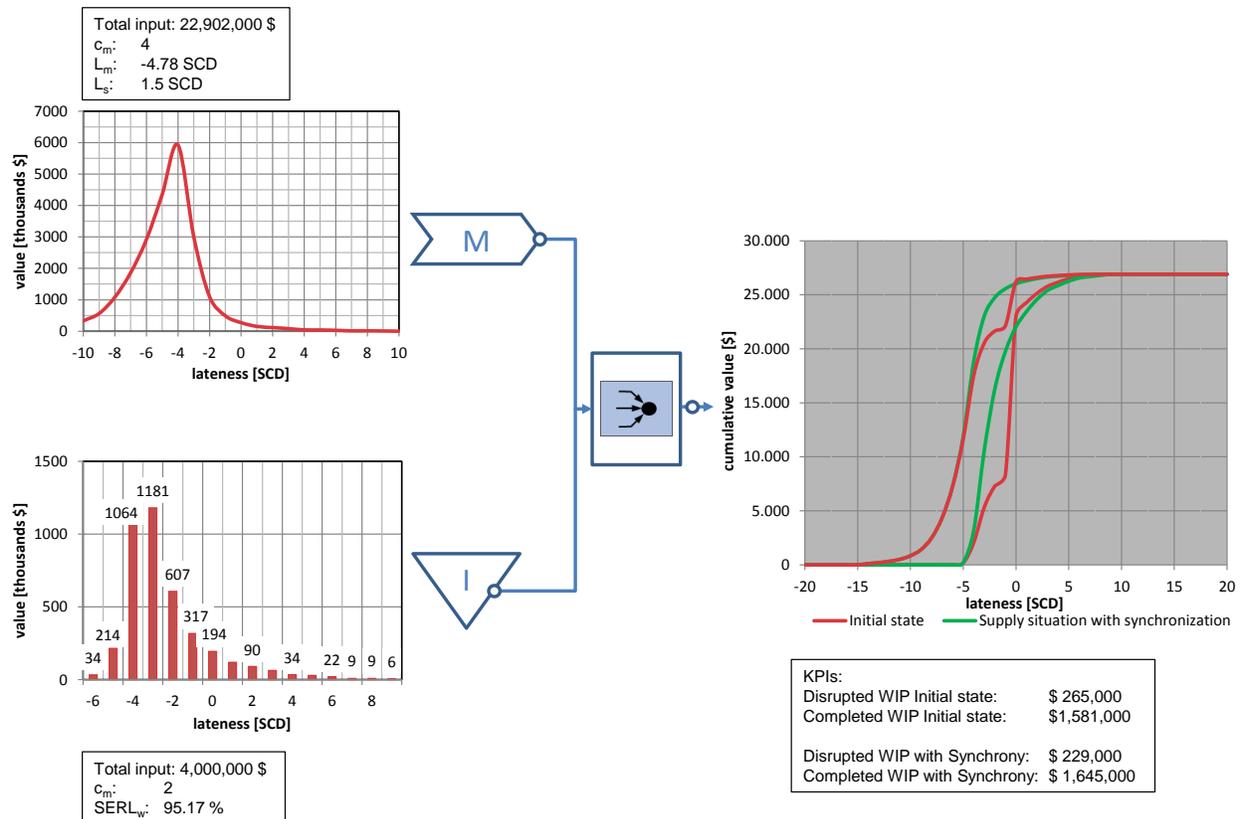


Figure 9: Changed Supply Situation when Synchronizing Supply Processes

7. Conclusion

Based on the development of a model for depicting synchrony between supply processes, a quantitative tool was created, which allows the realizable synchrony between inventory system supply processes and other supply processes at convergence points to be calculated. Through applying the logistical model summarized in Equation 20 and integrating the modelling of an inventory system's output lateness (see Section 3), the expected lateness of the inventory system's supply process when synchronized with other supply processes can be quantified. In this context, both the inventorial influences on the warehouses' lateness behaviour as well as the extent of pulling and deferring stock orders are taken into account in the modelling. By subsequently integrating this re-calculated inventory output lateness distribution into the model's supply diagram, the logistic potential of synchronizing supply processes can be quantified.

Acknowledgements

This work was supported by the German Research Foundation [NY 4/58-1].

References:

- [1] [1] Nyhuis, P.; Beck, S.; Schmidt, M. (2013) Model-based logistic controlling of converging material flows. CIRP Annals - Manufacturing Technology 62 (1), 431–434
- [2] [2] Schmidt, M. (2011): Modellierung logistischer Prozesse der Montage. Garbsen: PZH, Produktionstechnisches Zentrum. (Berichte aus dem IFA, 2011, 1)
- [3] [3] Beck, S. (2013): Modellgestütztes Logistikcontrolling konvergierender Materialflüsse. Garbsen: PZH Produktionstechnisches Zentrum (Berichte aus dem IFA, 2013,3)
- [4] [4] Fastabend, H. (1997): Kennliniengestützte Synchronisation von Fertigungs- und Montageprozessen, Dissertation Leibniz Universität Hannover, Düsseldorf: Fortschritt-Berichte VDI
- [5] [5] Nyhuis, P.; Mayer, J. (2017): Logistic Modelling of Lateness Distributions in Inventory Systems. In: Production Engineering – Research and Development, submitted on 29th of January 2017
- [6] [6] Lutz, S.; Lödding, H.; Wiendahl, H.-P. (2003) Logistics-oriented inventory analysis. International Journal of Production Economics 85 (2), 217–231

- [7] [7] Seidel, Wilfried (2010), "Mixture models", in Lovric, M., International Encyclopedia of Statistical Science, Heidelberg: Springer, pp. 827–829

***Trianthema portulacastrum* Linn. As New Source for Organic Manure Preparation and It's Effect on Growth of Fodder Maize**

Naikwade Pratap Vyankatrao

**ASP College Devrukh, Maharashtra, India
School of life sciences, Arizona State University, Tempe, USA**

Abstract

Trianthema portulacastrum Linn. commonly known as Desert Horse purslane, it is a creeping, much branched, annual herb. This plant is an invasive weed in irrigated areas of nearly all states of India and other parts of world. The aim of present investigation was to study the influence of different manures prepared from *Trianthema* on growth of maize. A field experiment was carried out in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, India to prepare different manures from *Trianthema* and evaluate the performance of various manures viz. NADEP compost (AC), Bangalore pit compost (BC), *Trianthema* vermicompost (TV), dry leaf manure (DLM) and garden leaf vermicompost (GLV) on growth of fodder maize. It was compared with chemical fertilizer treatment and Control. Growth analysis was carried out periodically. The application of *Trianthema* vermicompost was more effective followed by dry leaf manure. Results are statistically significant when compared to chemical fertilizer treatment and control. Manures prepared from *Trianthema* are the best, active and cheapest source of plant nutrients. It will not only be useful for weed control, but will also promote use of manures to replace chemical fertilization to the deteriorating agricultural lands.

Key Words- compost, dry leaf manure, vermicompost, weed.

INTRODUCTION

A weed in a general sense is a plant that is considered by the user of the term to be a nuisance and normally applied to unwanted plants in human-made settings. *Trianthema portulacastrum* belongs to family aizoaceae and commonly called *Wasu* in local language Marathi has been reported in the many states of India and considered as a number one problematic terrestrial weed by virtue of its infestation in various agricultural and vegetable crops such as mustard, maize, potato, onion, cotton, soybean, pearl millet and sugarcane, especially during the rainy seasons [1]. It causes significant reduction in maize yields. Balyan and Bhan [2] reported 32% losses in maize grain yield due to unweeded *Trianthema*. It also affects the quality of maize grain as it reduces protein in maize crop [3]. Under irrigated low-land ecosystem, *Trianthema portulacastrum* was found to interfere in sweet potato cultivation seriously [4]. This weed is causing seivour losses in India and other parts of world also [5][6]. Systemic survey has not been conducted on control of this weed around the world [7]. It is currently controlled mechanically and treatment with pre and post emergence herbicides. Nevertheless best method of management of this weed is composting.

The continued use of chemical fertilizers causes health and environmental hazards such as ground and surface water pollution by nitrate leaching [8]. Composting has been recognized as a low cost and environmentally sound process for treatment of many organic wastes [9]. A process related to composting which can improve the beneficial utilization of organic wastes is vermicomposting. It is a non-thermophilic process by which organic materials are converted by

earthworms and microorganisms into rich soil amendments with greatly increased microbial activity and nutrient availability. Vermicomposts are products derived from the accelerated biological degradation of organic wastes by earthworms and microorganisms. Earthworms consume and fragment the organic wastes into finer particles by passing them through a grinding gizzard and derive their nourishment from microorganisms that grow upon them [10].

Maheswarappa [11] reported increased amounts organic carbon, improvements in pH, decreased bulk density, improved soil porosities and water-holding capacities, increased microbial populations and dehydrogenase activity of soils in response to vermicompost treatments. Compost has a high nutritional value, with high concentrations of especially nitrogen, phosphorus and potassium, while the contamination by heavy metals and other toxic substances are very low [12]. Several examples in the literature show that compost and vermicompost are able to enhance the growth of a wide range of plant species further what can be expected because of the supply of nutrients [13][14].

Nutrient and weed management are leading production related challenges in organic farming systems [15]. The nutrient level and physical quality of soil is at alarming low level due to excess use of chemical fertilizers [16][17]. Weeds are causing great competition to crop plants and resulting in higher losses in yield. So nutrient and weed management can be done by use of weed for preparation of organic manure. Earlier references about use of *Trianthema* for preparation of organic manure are not found. In order to utilize the huge amount wasteland weed *Trianthema* as valuable resource for vermicompost, a study was conducted to investigate the influence on maize yield and nutrient uptake.

METHODOLOGY

A field experiment was carried out in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. The fresh vegetation of *Trianthema* was collected from University campus, brought to laboratory and chopped into small pieces (2 - 3 cm) by iron cutter. Equal amount (13333 kg/ha) of weed vegetation was used for the preparation of NADEP compost (AC), Bangalore pit compost (BC), *Trianthema* vermicompost (TV) and dry leaf manure (DLM). Equal amount of leaf litter was used for the preparation of Garden leaf vermicompost (GLV). The process of composting was done as described by Stoffella and Kahn [18]. The fresh vegetation of *Trianthema portulacastrum* Linn. was collected from nearby area and chopped into small pieces (2-3 cm) by iron cutter. Equal amounts of weed vegetation was used for the preparation of compost (TC), vermicompost (TV), dry powder TDP. The process for preparation of organic manures was followed as described by Naikwade [19].

The fresh vegetation of *Trianthema* was spread on the hygienic floor and subsequently sprayed with 5 % urea and single super phosphate and another lot of litter was also sprayed with 5 % dung slurry to enhance the composting process. These pretreated materials were arranged alternately along with well-composted inoculum and soil on each layer in pits. Each pit used for composting and vermicomposting was 105 x 75 x 90 cm (l x w x h). Water is essential for bacterial activity in the composting process (the nutrients for the microorganisms must be dissolved in water before they can be assimilated) [20]. So sufficient water was sprinkled in order to maintain the optimal moisture (50 - 70 %) over the material. The pits were enclosed with dung mud paste to prevent loss of moisture or heat and allowed to decompose. The trenches were

watered whenever the dampness was less than 50 %. In composting, one of the main factors that can be most influenced by technology and around which system designs are developed is the provision of oxygen to the composting mass. So after one month intervals, turning the whole material upside down was employed for providing oxygen and achieving uniform homogenous decomposition of the organic wastes. The pits were again irrigated and closed by dung-mud mixture. Finally, amorphous, dark brown, well-fermented composts were obtained.

For preparation of vermicompost after partial decomposition of vegetation in compost pit, main species of earthworm *Eudrilus eugeniae* Kinberg (90 individuals per pit) were released. After 30 days a good quality vermicompost was obtained. For preparation of dry leaf powder fresh above ground biomass of *Trianthema* was dried in poly house, after drying converted into dry powder. The uniformly mixed samples (100gm) of each treatment were collected immediately from the pits for nutrients analyses. N120:P80:K40 kg/ha is the recommended dose for maize

Experiment was laid out in a randomized block design (RBD) with seven treatments as *Trianthema* NADEP compost (AC), *Trianthema* Bangalore compost (BC), *Trianthema* vermicompost (TV), *Trianthema* dry leaf manure (DLM), garden leaf vermicompost (GLV), Chemical fertilizer alone (FER) and absolute control (CO) with four replicates each. The fodder maize (*Zea mays* L.) var. 'African Tall' (Mahalaxmi) produced by Mahendra Hybrid Seeds Co. Ltd., Jalna was cultivated at a rate of 100 kg/ha. A plot with the size 9 m² and nine rows spaced 30 cm apart was adopted to keep the uniform population density. The mineral fertilizers N, P₂O₅ and K₂O (120:80:40 kg/ha) were applied through urea, single super phosphate and muriate of potash to chemical fertilizer treatment only.

ANALYSIS:

Growth analyses -

The growth analysis of fodder maize was noted at 68 as plant height, diameter, number of leaves per plant, plant fresh weight, 4th upper leaf length, its width and weight and leaf area per plant was determined by gravimetric method [21].

Chemical analyses -

The chemical analysis of organic manures was carried out before application. The chemical analyses were done by adopting standard analytical methods. Ash values were obtained by burning the moisture-free samples in a muffle furnace at 600°C for 2 hours and calcium (Ca) content was analyzed by titrating the acid soluble ash solution against 0.01 N KMnO₄ solution using methyl red as indicator [22]. Nitrogen (N) was estimated by micro-Kjeldahl method after digesting the sample with Conc. H₂SO₄ [23]. The amount of phosphorus was measured following Fiske and Subba Rau [24] as described by Oser [25]. Potassium (K) Content was determined on a flame photometer (model Mediflame- 127) as suggested by Jackson [26].

Statistical analysis -

All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant difference (C.D., p = 0.05) which allowed determination of significance between different applications [27].

RESULTS AND DISCUSSION

Chemical Analysis of organic Amendment:

All manures were prepared from fresh equal amount of *Trianthema* weed i.e. 13333 kg/ha. The dry matter and nitrogen Content was found more in the treatment of GLV (Table 1). The percent of calcium, phosphorus and potassium was found maximum in the treatment of BC, DLM and TV respectively. The total ash and carbon percentage was found more in the order as TV. The C/N ratio was highest in BC and lowest in DLM.

Table 1. Analysis of *Trianthema* composts produced by different methods

| Treat ments | Fresh | DM | | N | | % | | | | | C:N |
|----------------|----------------------------------|-------|---------------------|------|------------------|------|------|------|-------|------|-------|
| | weight (kg ha ⁻¹) | | | kg | | Ca | P | K | C | N | |
| | | % | kg ha ⁻¹ | % | ha ⁻¹ | | | | | | |
| AC | 6667 | 68.38 | 4559 | 0.71 | 32 | 2.79 | 0.09 | 0.13 | 24.52 | 0.71 | 34.63 |
| BC | 7222 | 67.40 | 4868 | 0.67 | 32 | 2.97 | 0.10 | 0.11 | 24.78 | 0.67 | 37.19 |
| TV | 5833 | 64.29 | 3750 | 0.92 | 34 | 2.63 | 0.13 | 0.14 | 27.68 | 0.92 | 30.21 |
| DLM | 13333 | 10.73 | 1431 | 2.0 | 29 | 1.00 | 0.24 | 0.11 | 8.05 | 2.0 | 4.03 |
| GLV | 7778 | 68.33 | 5315 | 0.83 | 44 | 2.87 | 0.09 | 0.08 | 26.98 | 1.00 | 32.39 |

Growth analyses -

First Growth Analysis (68 DAS)

First growth analysis of maize crop was done at 68 DAS (Table 2). The tallest plant was obtained in TV treated plots followed in order by DLM, GLV, AC, BC and FER over CON plots where soil available nutrients were not adequate to meet the crop demand. The diameter of stem, number of leaves, length and leaf area of 4th upper leaf of fodder maize was found highest in TV treatment. The fresh weight of root, stem, leaves, weight of 4th upper leaf and ultimately for total fresh weight of plant was maximum in TV treatment followed in order by DLM, GLV, AC, BC and FER while it was minimum in CON treatment.

Table 2. Growth analysis of maize plant (Age of plant: 68 DAS)

| Treat ment | Plant height (cm) | Diame ter (cm) | No of leave s /plant | Plant fresh weight(g) | | | | 4th upper leaf | | Leaf area (cm ²)/ plant | |
|---------------|-------------------------|----------------------|-------------------------------|-----------------------|--------|--------|--------|--------------------|-------------------|--|---------------|
| | | | | Root | Stem | Leaves | Total | Lengt h (cm) | Widt h (cm) | | |
| | | | | | | | | | | | Weight (g) |
| AC | 164.68 | 1.24 | 7.75 | 4.37 | 93.57 | 33.06 | 131.00 | 67.95 | 7.03 | 5.71 | 399.15 |
| BC | 162.45 | 1.23 | 9.25 | 4.29 | 90.00 | 32.83 | 127.13 | 75.45 | 6.38 | 5.68 | 401.86 |
| TV | 173.68 | 1.38 | 9.75 | 5.35 | 107.47 | 42.47 | 155.29 | 76.75 | 6.48 | 6.70 | 480.86 |
| DLM | 168.05 | 1.27 | 9.50 | 4.94 | 100.29 | 36.34 | 141.57 | 75.15 | 5.00 | 6.20 | 446.65 |
| GLV | 167.35 | 1.34 | 9.75 | 4.64 | 97.07 | 35.58 | 137.28 | 73.13 | 6.25 | 6.02 | 429.98 |

| | | | | | | | | | | | |
|-----------|--------------|-------------|-------------|-------------|--------------|-------------|--------------|-------------|-------------|-------------|--------------|
| FER | 149.23 | 1.18 | 7.00 | 3.99 | 84.48 | 27.61 | 116.08 | 73.95 | 5.65 | 5.55 | 377.28 |
| CON | 92.83 | 1.02 | 6.75 | 2.73 | 53.43 | 16.29 | 72.45 | 60.58 | 4.73 | 3.01 | 213.12 |
| SE | 10.59 | 0.04 | 0.50 | 0.32 | 6.62 | 3.12 | 10.02 | 2.16 | 0.32 | 0.45 | 32.59 |
| CD | 25.94 | 0.11 | 1.23 | 0.77 | 16.21 | 7.65 | 24.56 | 5.29 | 0.77 | 1.10 | 79.84 |

All types of organic manures prepared from *Trianthema* resulted in increased growth, chlorophyll content and nutrients of fodder maize. The contents of organic manures prepared in this experiment are comparable to earlier studies [28]. These nutrients are released slowly as per requirement of crops resulting in higher yield [29]. Patra *et al.* [30] proved that organic manure contains high content of nitrogen and phosphorus and a slow and sustainable availability of the nutrients can occur in various crops. Same results were obtained in mint [31]. Earlier there are results of increased maize yield by application of organic manure [32].

Arancon et al [33] reported significantly increased growth and yields of field tomatoes (*Lycopersicon esculentum*) and peppers (*Capsicum annuum grossum*) when vermicomposts, produced commercially from cattle manure, food waste or recycled paper, were applied to field plots at rates of 20 t/ha and 10 t/ha in 1999 and at rates of 10 t/ha and 5 t/ha in 2000 compared with those receiving equivalent amounts of inorganic fertilizer. Fallah, [34] carried out an experiment and concluded that organic composts such as sewage and city waste compost and cow waste increase the yield and yield components of corn, so that there was a significant increase in leaf area index, plant height and 1000-seed weight and seed yield. The marketable tomato yields in the vermicompost (plus fertilizers) plots were consistently and significantly greater than those from inorganic-fertilizer only treated plots. There were significant increases in shoot weights, leaf areas and marketable fruit yields of pepper plants grown in plots that were treated with vermicomposts compared to those of plants grown in inorganic fertilizers. Leaf areas, numbers of strawberry suckers, numbers of flowers, shoot weights, and marketable fruit yields of strawberries all increased significantly in response to supplemented vermicompost applications compared to those from strawberries that received inorganic fertilizers only [35].

Vermicompost contains most nutrients in plant-available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium [36]. Vermicompost has been shown to have high levels of total and available nitrogen, phosphorous, potassium (NPK) and micro nutrients, microbial and enzyme activities and growth regulators [37] [38] and continuous and adequate use with proper management can increase soil organic carbon, soil water retention and transmission and improvement in other physical properties of soil like bulk density, penetration resistance and aggregation as well as beneficial effect on the growth of a variety of plants [39].

The improved performance of fodder maize as a result of added *Trianthema* manure is due to the supply of nutrient elements to the plants. Organic manures are not only sources of major nutrients, but they also provide other micronutrients and plant growth-promoting molecules, which together lead to better crop yields [40] [41]. The involvement of other macro and micro nutrients in the metabolic processes of plants including maize had been reported in previous research [42]. It means that *Trianthema* manures provide macro and micro nutrients resulting in improved crop growth as compared to chemical fertilizer, reducing the total input cost for the production.

CONCLUSION

It is concluded on the basis of results that biomass of the weed *Trianthema portulacastrum* can be efficiently used to prepare manures for organic farming. This use of *Trianthema* will not only be useful for weed control, but will also promote use of manures to replace chemical fertilization to the deteriorating agricultural lands. *Trianthema* vermicompost showed best results. Drying of *Trianthema* leaves and use of it as dry leaf manure proved effective for increasing crop production. Preparation and use of manures is the unique solution providing control of noxious weeds outcome in the best valuable nutrient resource for the crops. The author recommends vermicompost, compost and dry leaf manure prepared from *Trianthema* as the best, active and cheapest source of plant nutrients working with high efficiency as compared to fertilizer treatment. Training and awareness programmes must be arranged by government, NGOs, institutes to farmers for preparation and use of organic manures from *Trianthema* as it's long term use can help in agricultural sustainability.

REFERENCES:

- [1] Simmons, E.G. "Gibbago- a new phaeodictyoconidial genus of hyphomycetes," *Mycotaxon*, vol. 27, no.1, pp. 107-111, 1986.
- [2] Balyan R.S. and V.M. Bhan, "Competing ability of maize, pearl millet, mung bean and cowpea with carpet weed under different weed management practices," *Crop Research Hisar*, vol.2, pp. 147-53, 1989.
- [3] Friesen, G. L.H. Shebeski and A.D. Robinson, "Economic losses caused by weed competition in Manitoba grain fields, Effect of weed competition on the protein content of cereal crops," *Canadian J. Plant Sci.*, vol. 40, pp. 652-658, 1960.
- [4] Roy S. Chowdhury, K. Kannan and H.N. Verma, "Crop interference and weed growth in sweet potato (*Ipomoea batatas*L.) field under different irrigation regimes," *Journal of Root Crops*, vol. 29, pp. 1-7, 2003.
- [5] Brar L. S. and U. S. Walia, "Bioefficacy of herbicides against *Trianthema portulacastrum* in toria (*Brassica campestris subsp. oleifera* var. toria)," *Ind. J. Agron.*, vol. 40, pp. 647-650, 1995.
- [6] Qureshi Huma, Arshad Muhammad, Yamin Bibi, "Invasive flora of Pakistan: a critical analysis," *International Journal of Biosciences* vol. 4, no. 1, pp. 407-424, 2014.
- [7] Aneja, K.R. "Biotechnology for the production and enhancement of mycoherbicide potential," In J Singh and KR Aneja eds. *From Ethnomycology to Fungal Biotechnology*. Kluwer Academic/Plenum Publishers, Netherlands/UK, 1999, pp. 91-114.
- [8] Pimentel D.. Green Revolution and chemical hazards. *Sci Total Environ* 188: 86-98. 1996
- [9] Hoitink, H.A.J. Proceedings Review: International Symposium on composting research. *Compost Science and Utilization*. Spring, 37. 1993.
- [10] Norman Q. Arancon and Clive A. Edwards Effects of Vermicomposts on Plant Growth, International Symposium Workshop on Vermi Technologies for Developing Countries (ISWVT 2005), Los Banos, Philippines. 2005.
- [11] Mahewarappa HP, Nanjappa HV and Hegde MR. Influence of organic manures on yield of arrowroot, soil physico-chemical and biological properties when grown as intercrop in coconut garden. *Annals of Agricultural Research*. 20: 318-323, 1999.
- [12] Asghar HN, Ishaq M, Zahir ZA, Khalid M and Arshad M. Response of radish to integrated use of nitrogen fertilizer and recycled organic waste. *Pak J Bot* 38: 691-700, 2006.

- [13] Edwards CA and Burrows I. The potential of earthworm composts as plant growth media. Pp. 211-220 In: Earthworms in Environmental and Waste Management. C. A. Edwards and Neuhauser. (Eds.). SPB Academic Publ. B.v., The Netherlands, 1988.
- [14] Grigatti M, Giorgonni Me and Ciavatta C. Compost-based growing media: influence on growth and nutrient use of bedding plants. *Bioresource Technol* 98, 3526-3534. 2007.
- [15] Kleinhenz M.D. and J. Cardina, "Compost application effects on weed populations and crop yield and quality in three early manuring, organically managed potato cultivars," *XXVI International Horticultural Congress: Potatoes, Healthy Food for Humanity: International Developments in Breeding, Production, Protection and Utilization*, ISHS Acta Horticulturae, pp 619, 2000.
- [16] Naikwade, P.V. S.T. Sankpal and B.B. Jadhav, "Management of waste by composting, vermicomposting and its use for improvement of growth, yield and quality of fodder maize," *ARPJ Journal of Science and Technology*, vol. 2, no. 5, pp. 184-194, 2012.
- [17] Naikwade, P.V. U. P. Mogle and B.B. Jadhav, "Effect of *Ipomoea* weed manures on quality of fodder crop maize," *Research journal of agricultural science*, vol. 2 no.4, pp. 927-930, 2011.
- [18] Stoffella P.J. and B.A. Kahn, *Compost utilization in horticultural cropping systems*. Lewis publishers, Florida. 2001.
- [19] Naikwade P. V. Ph.D. thesis Studies on some biotechnological aspects of food preservation and nutrient sources of crop plants submitted to Dr. Babasaheb Ambedkar Marathwada university Aurangabad (MS), India. 2010.
- [20] Fricke, C. and Vogtmann Quality of source separated compost: Research results from Germany. *Biocycle*, 34, 64-70, 1993.
- [21] Mungikar, A. M. *Sci. and Cult.*, vol. 25, pp.166-167, 1986.
- [22] A. O. A. C., *Official Methods of Analytical Chemistry*. Association of Official Analytical Chemists, Washington, DC. 16th Ed., 1995.
- [23] Bailey, R.L. *Techniques in Protein Chemistry*, Elsevier Publishing Co., Amsterdam. II Ed., 1967.
- [24] Fiske C.H. and Y. Subba Rau, "The calorimetric method for the estimation of phosphorus," *J. Biol. Chem.* Vol. 66, pp. 375, 1972.
- [25] Oser, B.L. *Hawk's Physiological Chemistry*, Tata McGraw Hill Publishing Co. Ltd., New Delhi, XIV Ed., 1979.
- [26] Jackson, M.L. *Soil Chemical Analysis*, Prentice Hall of India Pvt. Ltd., New Delhi, 1973.
- [27] Mungikar, A.M. *An Introduction to Biometry*. Sarawati Printing Press, Aurangabad, 1997.
- [28] Naikwade, P.V. "Waste Management by composting and its effect on growth of *Trigonella*," *Journal of aquatic biology and Fisheries*, vol. 2, pp. 476-483, 2014.
- [29] Naikwade, P.V. "Response of fodder maize to the application of various organic manures prepared from *Ipomoea muricata* weed," *Journal of Organics*, vol. 1, no.1, pp.31-38, 2014.
- [30] Patra, D.D. M. Anwar and S. Chand, "Integrated Nutrient Management and Waste Recycling for Restoring Soil Fertility and Productivity in Japanese and Mustard Sequence in Uttar Pradesh, India," *Agriculture Ecosystem and Environment*, vol. 80, pp. 267-275. 2000.
- [31] Chand, S. M. Anwar and D.D. Patra, "Influence of Combined Application of Farmyard Manure (FYM) and Inorganic Fertilizer on Herb, Essential Oil Yield and Nutrient Accumulation in Menthol Mint (*Mentha arvensis*)," *Journal of Medicinal and Aromatic Plant Sciences*, vol. 23, pp. 29-33, 2001.
- [32] Adekayode F.O. and M.R. Olojugba, "The utilization of wood ash as manure to reduce the use of mineral fertilizer for improved performance of maize (*Zea mays* L.) as measured in the

- chlorophyll content and grain yield,” *Journal of Soil Science and Environmental Management*, vol. 3, pp. 40-45, 2010.
- [33] Arancon, N.Q., Edwards, C.A., Bierman, P., Metzger, J., Lee, S., Welch, C. Applications of vermicomposts to tomatoes and peppers grown in the field and strawberries grown under high plastic tunnels. Proceedings of the International Earthworm Symposium, Cardiff Wales. September 2002.
- [34] Fallah A, Ghalavand VM and Khajepour R. Effects of blending method of livestock compost with soil and mixing it with chemical compost on yield and parts of yield of seed corn in Khorramabad, Lorestan, agricultural and natural resources science magazine, number 40, p 233-242, 2006.
- [35] Arancon, N.Q., Edwards CA, Atiyeh RM, Metzger JD, Effects of vermicomposts produced from food waste on greenhouse peppers. *Bioresource Technology*, 93: 139-144, 2004.
- [36] Orozco FH, Cegarra J, Trvjillo LM and Roig A. Vermicomposting of coffee pulp using the earthworm *Eisenia foetida*: effects on C and N contents and the availability of nutrients. *Biology and Fertility of Soil*, 22: 162-166. 1996.
- [37] Parthasarathi K and Ranganathan LS. Longevity of microbial and enzyme activities and their influence on NPK content in pressmud vermicasts. *Europ. J. Soil Biol.*, 35 (3): 107-113, 1999.
- [38] Chaoui I, Zibiliske M and Ohno T. Effects of earthworm casts and compost on soil microbial activity and plant nutrient availability. *Soil Biology and Biochemistry* 35: 295-302. 2003.
- [39] Atiyeh RM, Lee S, Edwards CA, Arancon NQ and Metzger JD. The influence of humic acids derived from earthworms- processed organic wastes on plant growth. *Bioresource Technology* 84: 7-14, 2002.
- [40] Naikwade, P.V. U.P. Mogle and B.B. Jadhav, “Improving Total chlorophyll, ascorbic acid and β -carotene in spinach by applying weed manures,” *Bioscience discovery*, vol. 2, no.2, pp. 251-255.2011.
- [41] Mader, P. A. Fliebach, D. Dubois, L. Gunst, P. Fried and U. Niggli, “Soil fertility and biodiversity in organic farming,” *Science* vol. 296, pp. 1694–1697, 2002.
- [42] Kogbe J.O. and J.A. Adediran, “Influence of nitrogen, phosphorus and potassium application on the yield of maize in the savannah zone of Nigeria” *Afr. J. Biotechnol.* Vol. 2, pp. 345-349, 2003.

Applying Different Mobility Models to Evaluate the Performance of Improving Dynamic Probabilistic Flooding in Ad Hoc Networks Based on Simulation

Abdalla M. Hanashi,
University of Zawia, Zawia, Libya
Elmabruk Laias
Omar Al-Mukhtar University, Derna, Libya
S. Algoul
Tripoli University, Tripoli, Libya

Abstract-Broadcasting is a basic data propagation technique, which has a number of applications such as route discovery and address resolution. While data broadcasting has many gains, it introduces some problems known as broadcast storm problems, which causing a lot of contention, collision and redundant retransmission. In this paper our objective is to reduce the number of rebroadcast. A good probabilistic broadcast protocol can achieve high save rebroadcast. In this paper, we propose a probabilistic approach that calculates the rebroadcast probability according to the number of neighbour's nodes when nodes move according to different mobility modes and compare it with simple flooding, adjusted probabilistic flooding and dynamic probabilistic flooding schemes. Simulation results show our improved approach performs better than simple flooding, adjusted probabilistic flooding and dynamic probabilistic flooding.

Keywords

Flooding, Broadcasting, Collisions, AODV

1. Introduction

Ad hoc networks are a set of wireless mobile nodes which communicate with each another without relying on any pre-existing routing infrastructure for communication, but instead communicate either directly or with the help of other intermediate nodes in the network. The disseminated, wireless and self-configuring character of ad hoc networks make them appropriate for a wide variety of applications. Ad hoc networks are helpful in many situations where unprepared communication facilities are required, such as disaster relief missions and battlefield communication facilities [1, 2]. Other applications of MANETs are in data acquisition in hostile territories, virtual classrooms, and temporary local area networks.

Broadcasting is a general and basic operation in ad hoc networks whereby a source node transmits a packet so that each node in a network receives a copy of this packet. Broadcasting is also a common operation in many distributed computing applications and can be used for service or resource discovery in unstructured environments [1,8]. For example, in Ad Hoc On-demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR) [12], Zone Routing Protocol (ZRP) [11], in the network a route request is broadcasted. Every node remains the broadcast ID and the name of the node from which the message has been received. As soon as the correspondent is reached, it replies with a unicast (point-to-point) message and then each intermediate mobile node is capable to establish the return route.

Flooding is commonly used for broadcasting. Each node, that receives a broadcast message for the first time, rebroadcasts it to its neighbours [6]. The only 'optimisation' applied to this technique is that nodes remember broadcast messages received and do not rebroadcast if they receive repeated copies of the same message [11]. This approach offers the advantage to be reliable, but produces a high overhead in the network. The probability of multiple requests at the same time for medium access is very high and the number of collisions dramatically increases, which causes a lot of dropped packets, such a scenario has often been referred to as the "broadcast storm problem" [5, 6, 7].

A number of researchers have identified this problem by showing how serious it is through analyses and simulations [6]. A probabilistic approach for flooding has been suggested in [8, 9, 10] as a means of reducing redundant rebroadcasts and alleviating the broadcast storm problem. In the probabilistic scheme, when receiving a broadcast message for the first time, a node rebroadcasts the message with a pre-determined probability p ; every node has the same probability to rebroadcast the message. When the probability is 100%, this scheme reduces to simple flooding. The studies of [5] have shown that probabilistic broadcasts incur significantly lower overhead compared to blind flooding while maintaining a high degree of propagation for the broadcast messages.

In this paper, we propose probabilistic broadcast approach that can efficiently reduce broadcast redundancy in mobile wireless networks where the forwarding probability p is dynamically adjusted by the local topology information. Topology information is obtained by proactive exchange of "HELLO" packets between neighbours. Four significant matrices to measure network performance, saved rebroadcasts, collision, relays and reachability are used under random waypoint mobility model [13].

We evaluate our proposed approach against the simple AODV, adjusted probabilistic flooding [4,7] and dynamic probabilistic flooding [14] by implementing them in a modified version of the AODV protocol. The simulation results show that broadcast redundancy can be significantly reduced through the proposed approach.

The rest of this paper is configured as follows: Section 2 introduces the background and related work of broadcasting in MANETs. In section 3, we present the proposed dynamic probabilistic approach. The parameters used in the experiments and the performance results and analyses of the behaviors of the broadcasting algorithm are presented in Section 4. Section 5 concludes the paper and suggestions for the future work.

2. Background

Flooding is one of the earliest broadcast mechanisms in wired and wireless networks. Upon receiving the message for the first time, each node in the network rebroadcasts a message to its neighbours. While flooding is simple and easy to implement, it can affect the performance of a network, and may lead to a serious problem, often known as the broadcast storm problem [2, 6] which is exemplified by large number of redundant rebroadcast packets, collision and network bandwidth contention. Ni et al [2] have

studied the flooding protocol experimentally and analytically.

Their results have indicated that rebroadcast could provide at most 61% additional coverage and only 41% additional coverage in average over that already covered by the previous broadcast attempt. Consequently, they have concluded that retransmits are very costly and should be used with warning.

There are five proposed flooding schemes [6] in MANETs called probabilistic, counter-based, distance-based, location-based [2] and cluster-based [2, 6]. In the probabilistic scheme, when receiving a broadcast message for the first time, a host rebroadcasts the message with a fixed probability P . The counter-based scheme inhibits the rebroadcast if the message has already been received for more than C times. In the distance-based scheme a node rebroadcasts the message only if the distance between the sender and the receiver is larger than a threshold D .

The location-based scheme rebroadcasts the message if the additional coverage due to the new emission is larger than a bound A . Finally, the cluster-based scheme uses a cluster selection algorithm to create the clusters, and then the rebroadcast is done by head clusters and gateways. The authors conclude by the efficiency of the location-based scheme [2], but these additional area coverage protocols need a positioning system.

Zhang and Dharma [3] have also described a dynamic probabilistic scheme, which uses a combination of probabilistic and counter-based schemes. The value of a packet counter does not necessarily correspond to the exact number of neighbours from the current host, since some of its neighbours may have suppressed their rebroadcasts according to their local rebroadcast probability. On the other hand, the decision to rebroadcast is made after a random delay, which increases latency.

Bani Yassein et al. [4,7] have proposed fixed pair of adjusted probabilistic broadcasting scheme where the forwarding probability p is adjusted by the local topology information. Topology information is obtained by proactive exchange of "HELLO" packets between neighbours to construct a 1-hop neighbour list at every host. Hanashi, A. M. et al. [14] have proposed a probabilistic approach that dynamically calculates the rebroadcast probability according to the number of neighbour's nodes distributed in the ad hoc network for routing request packets (RREQs).

Here, we propose a new probabilistic broadcast approach that can efficiently reduce broadcast redundancy in mobile wireless networks where the forwarding probability p is dynamically adjusted by the local topology information. Topology information is achieved by proactive exchange of "HELLO" messages between neighbours. We explain the details of our approach in the following section.

3. Dynamic Probabilistic Flooding Algorithm

The probabilistic scheme [2] is one of the alternative scheme to simple flooding that's objective is to reduce redundancy through rebroadcast moment control in an attempt to

alleviate the broadcast storm problem. In this scheme, when receiving a broadcast message for the first time, a node rebroadcasts the message with a pre-determined probability p so that every node has the same probability to rebroadcast the message, regardless of its number of neighbours.

In dense area, multiple hosts share similar transmission ranges. Therefore, these probabilities control the number of rebroadcasts and thus might save network resources without affecting delivery ratios. Note that in sparse area there is much less shared coverage; thus some hosts will not receive all the broadcast packets unless the probability parameter is high.

Our enhanced algorithm is a combination of the dynamic probabilistic [14] and knowledge based approaches. It dynamically adjusts the re-broadcast probability P at every mobile node according to the value of the local number of neighbours. We calculate the average number of neighbours for the selection of the value of P by using equation 1 [4,7]. Let A be the area of an ad hoc network, N be the number of mobile nodes in the network. The average number of neighbour can be obtained as shown below.

$$\overline{nbr} = (N - 1) \times 0.8 \times \frac{\pi r^2}{A}$$

Enhanced probabilistic broadcasting algorithm

This algorithm relays the packet (pkt) for i th node with probability P .

Input Parameters:

$pkt(i)$: Packet to relay by i th node.

$p(i)$: Rebroadcast probability of packet (pkt) of i th node.

$RN(i)$: Random Number for i th node to compare with the rebroadcast probability p .

$S_{nbr}(i)$: Number of neighbour nodes of i th node.

\overline{nbr} : Average number of neighbour (threshold value).

Output Parameters:

$Discpkt(i)$: Packet (pkt) will be discarding by the i th node, if it is already in its list.

$Rbdpkt(i)$: Packet (pkt) will be rebroadcast by i th node, if probability p is high.

$Drpkt(i)$: Packet (pkt) will be dropped by i th node, if probability p is low.

Upon receiving a packet (pkt) at i th node

if packet (pkt) received for the 1st time **then**

if $S_{nbr}(i) < \overline{nbr}$ **then**

i th node has a low degree:

$$P := \prod_{i=0}^{S_{nbr}(i)} P * P_{\max}$$

if $p < p_{\min}$ **then**

```

    P = Pmin
  end if
return (P)
else
ith node has a high degree:
drop the ZSpacket ( Drpkt(i) )
  end if
end if
Generate a random number RN over [0, 1].
Relay the packet ( Rbdpkt(i) ) when (P > RN(i))
  else
    Drpkt(i)
  end if
end if
Where Pmax= 0.9 and Pmin=0.4

```

4. Mobility Models

Appropriate mobility models that can accurately capture the properties of real-world mobility patterns are required for effective and reliable performance evaluation of the MANETs. Due to the different types of movement patterns of mobile users, and how their location, velocity and acceleration change over time, different mobility models should be used to emulate the movement pattern of targeted real life applications. In our study, three different mobility models are considered including Random Waypoint (RWP), Manhattan Grid and Reference Point Group Mobility (RPGM) models.

The RWP mobility model proposed by Johnson and Maltz [13] is the most popular mobility model used in the performance and analysis of the MANETs due to its simplicity. The two main key parameters of the RWP models are V_{max} and T_{pause} where V_{max} the maximum velocity for every mobile station and T_{pause} is the pause time. A mobile station in the RWP model selects a random destination and a random speed between $[0, V_{max}]$, and then moves towards the selected destination at the selected speed. Upon reaching the destination, the mobile station stops for some pause time T_{pause} , and the repeats the process by selecting a new destination, speed and resuming the movement. Figure 1 shows a movement trace of a mobile station using a RWP mobility model.

Unlike RWP mobility, Manhattan mobility model uses a grid road topology as shown in Figure 2. Initially, the wireless stations are placed randomly of the edge of the graph. Then the wireless stations move towards a randomly chosen destinations employing a

probabilistic approach in the selection of stations movements with probability $\frac{1}{2}$ to keep moving in the same direction and $\frac{1}{4}$ to turn left or right.

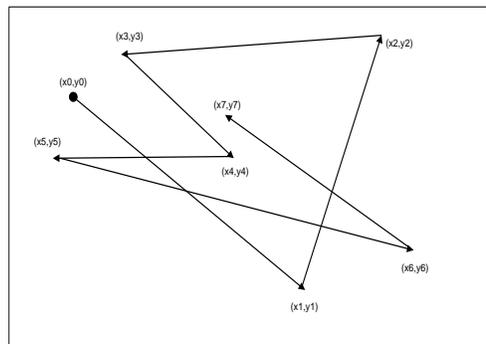


Fig.1. An example of mobile station movement in RWP model.

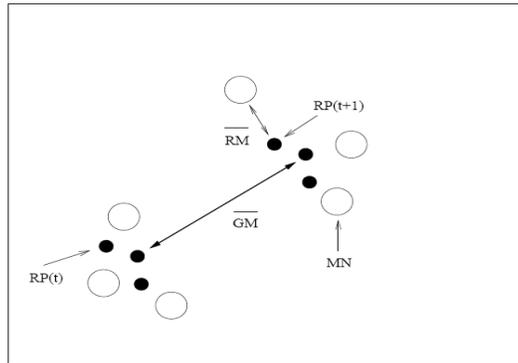


Fig. 2. Example of mobile station movement in Manhattan mobility model.

In addition to RWP and Manhattan mobility models, the Reference Point Group Mobility (RPGM) model is proposed in [17]. In this model, each group has a number of wireless station members and a center, which is either a logical center or a group leader. This model represents the random motion of a group of mobile nodes (MNs) as well as the random motion of every individual MN within the group. The group leader movement determines the mobility behaviors of all other members in the group. The group leader is used to calculate group motion via a group movement vector, \overline{GM} . The movement of the group centre completely characterizes the movement of its corresponding group of MNs, including their direction and speed. Individual MNs randomly move about their own predefined reference points, whose movements rely on the group movement. As the individual reference points move from time t to $t+1$, their locations are updated according to the group's logical centre. Once the updated reference points, $RP(t+1)$, are calculated, they are combined with a random motion vector, \overline{RM} , to represent the random motion of each MN about its individual reference point. Figure3 shows an example of node movement in Reference Point Group Mobility Model. One of the real applications which RPGM model can represent it accurately is the mobility behaviors of soldiers moving together in a group.

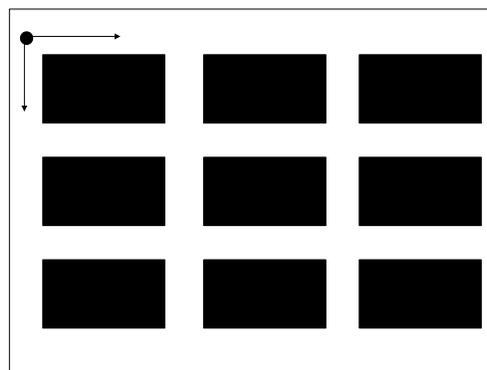


Fig.3 An example of node movement in RPGM Mobility Model

5. Performance Analyses

We evaluate the performance of the enhanced dynamic probabilistic broadcasting algorithm. We compare the proposed algorithm with the simple AODV, adjusted probabilistic flooding [4,7] and dynamic probabilistic flooding algorithm [14]. The metrics for comparison include average saved rebroadcast, average number of routing request rebroadcasts, and the average number of collisions.

5.1 Simulation Setup

The GloMoSim network simulator (version 2.03) [9] has been adopted to conduct extensive experiments to evaluate behavior of the proposed probabilistic flooding algorithm. In our simulation, we use a 1000m X 1000m area with 100 mobile nodes. The network bandwidth is 2Mbps and the MAC layer protocol is IEEE 802.11 [3]. Other simulation parameters are shown in Table I.

Table 1. Simulation Parameters

| Simulation Parameter | Value |
|----------------------|----------------|
| Simulator | GloMoSim v2.03 |
| Network Range | 1000m×1000m |
| Transmission Range | 250m |
| Mobile Nodes | 100 |
| Traffic Generator | CBR |
| Band Width | 2Mbps |
| Packet size | 512Bytes |
| Packet Rate | 10 pps |
| Simulation time | 900s |

We analysis the performance of the broadcasting approaches in the situation of a higher-level application, namely, the AODV routing protocol [8,10,11] that is included GloMoSim package. The original AODV protocol uses simple (Blind) flooding to transmit routing requests. We have implemented three AODV variations: one using adjusted probabilistic flooding [4, 7] method called AD-AODV (AODV + fixed pair probability), the second one based on dynamically calculating the rebroadcast probability for each node [14], called P-AODV (AODV + dynamic probability) and the third one is our enhanced dynamic algorithm (EDP-AODV)The main idea behind the proposed approach is to reduce the rebroadcasting number in the route discovery phase, thus reducing the network traffic and decrease the probability of channel contention and packet collision.

While our algorithm is founded on a probabilistic approach, it does not fit every scenario, as there is a small chance that the route requests cannot reach the destination. It is necessary to re-generate the route request if the prior route request failed to arrive at the destination. We study the performance of the broadcast approaches in these scenarios.

5.2 Saved Rebroadcast (SRB)

In our algorithm, saved rebroadcast is the ratio of the number of route request packets rebroadcasted over total number of route request packets received, excluding those expired by time to live.

As attempt to investigate the performance of our algorithm, after we introduce mobility, more route requests are generated and some of them may fail to reach their destinations. Such failures cause another round of transmission of route request packets. Figure4 shows the number of relays of our algorithm, P-AODV, AD-AODV and Blind AODV under RWP model. As shown in figure, the proposed algorithm has lower relays numbers than P-AODV, AD-AODV and Blind AODV.

In Figure5, we compare Relays for Manhattan mobility model. The figure shows our algorithm incurs lower number of relays. As a result, for rout request, our scheme can definitely perform better than P-AODV, AD-AODV and Blind AODV in these scenarios.

Figure6 shows the performance with RPGM mobility model. Due to increasing the number of connections in the network with mobility, more route requests fail to reach the destinations. In these cases, more route requests are generated. The figure implies that our dynamic probabilistic approach can achieve less route request than P-AODV, AD-AODV and Blind AODV in this mobility model too. Figure7 shows the number of relays for our algorithm under RWP, RPGM and MG mobility model. The figure indicates that enhanced algorithm under MG mobility model incur lower number of relays than RWP and RPG mobility models.

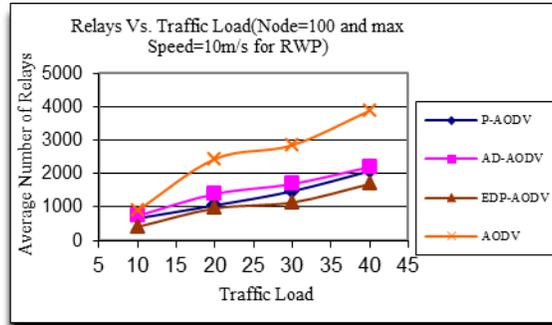


Fig4. Relays comparison between our proposed dynamic probabilistic, adjusted probabilistic flooding, dynamic probabilistic flooding and Blind AODV for the RWP mobility model.

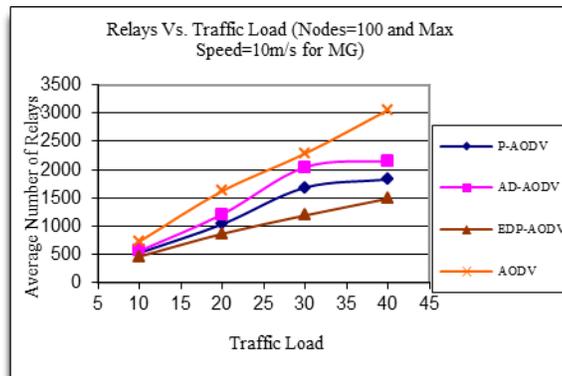


Fig.5. Relays comparison between our proposed dynamic probabilistic, adjusted probabilistic flooding, dynamic probabilistic flooding and Blind AODV for the Manhattan mobility model.

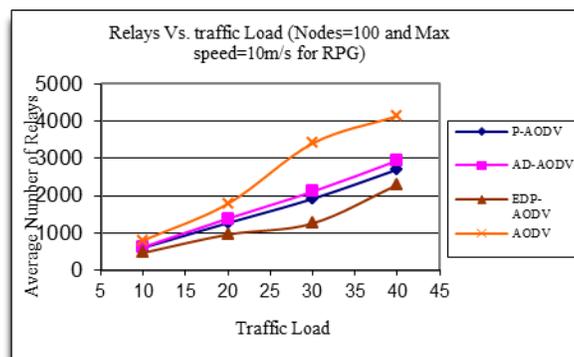


Fig.6. Relays comparison between our proposed dynamic probabilistic, adjusted probabilistic flooding, dynamic probabilistic flooding and Blind AODV for the RPGM model.

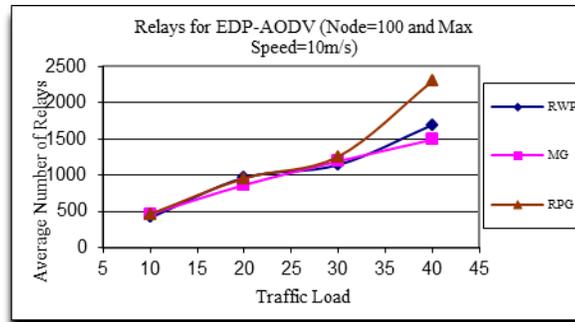


Fig.7. Comparison of Relays for our proposed probabilistic under RWP, MG and RPGM mobility model.

6. Conclusion

This paper has evaluated the performance of enhanced probabilistic flooding on the AODV protocol where nodes move according to different mobility models, which traditional uses simple flooding, in order to increase the saved rebroadcast of rout requests. This proposed algorithm decides the rebroadcast probability by taking into account the network density. In order to improve the saved rebroadcasts, the rebroadcast probability of low density nodes is increased while that of high density of mobile nodes is decreased. Compared with P-AODV, AD-AODV and Blind AODV, our simulation results have shown that the proposed probabilistic flooding algorithm outperforms the P-AODV, AD-AODV and Blind AODV in terms of number of relays, even under conditions of different number of source-destination pair's connections and different mobility models.

For future work it would be interesting to evaluate the Performance of dynamic probabilistic flooding on the Dynamic Source Routing (DSR) with different mobility models representing more realistic scenarios. We also plan to make an analytic model for our proposed algorithm in order to compare it with simulation results.

6. References

- [1] Rajiv, G., P. Srinivasan, et al . Minimizing broadcast latency and redundancy in ad hoc networks, Proceedings of the 4th ACM international symposium on Mobile ad hoc networking and computing, Annapolis, Maryland, USA, 2003, pp.222-232.
- [2] Y.-C. Tseng, S.-Y. Ni, Y.-S. Chen, and J.-P. Sheu. The broadcast storm problem in a mobile ad hoc network. *Wireless Networks*, 8(2/3), 2002, pp.153–167.
- [3] Q. Zhang and D. Agrawal. Dynamic probabilistic broadcasting in manets. *Journal of Parallel Distributed Computing*, 65: 2005, pp. 220–233.
- [4] Yassein, M. B., M. O. Khaoua, et al. (2006). Improving route discovery in on-demand routing protocols using local topology information in MANETs. Proceedings of the ACM international workshop on Performance monitoring, measurement, and evaluation of heterogeneous wireless and wired networks. Terromolinos, Spain, ACM Press, pp. 95-99.
- [5] Stefan, P., B. Mahesh, et al. (2006). MISTRAL: efficient flooding in mobile ad-hoc networks. Proceedings of the seventh ACM international symposium on Mobile ad hoc networking and computing. Florence, Italy, ACM Press, pp 1-12.
- [6] B. Williams, T. Camp, Comparison of broadcasting techniques for mobile ad hoc networks. *Proc. ACM Symposium on Mobile Ad Hoc Networking & Computing (MOBIHOC 2002)*, 2002, pp.194–205.
- [7] L. M. M. M. Bani-Yassein, M. Ould-Khaoua and S. Papanastasiou. Performance analysis of adjusted probabilistic broadcasting in mobile ad hoc networks. *International Journal of Wireless Information Networks*, , March 2006. Springer Netherlands, pages 1–14.

- [8] C.E. Perkins, E.M. Royer, Ad-hoc on-demand distance vector routing, in: Proceedings of the 1999 Second IEEE Workshop on Mobile Computing Systems and Applications, IEEE Computer Society, New York, February 1999, pp. 90–100.
- [9] X. Zeng, R. Bagrodia, M. Gerla, GloMoSim: a library for parallel simulation of large-scale wireless networks, in: Proceedings of the 1998 12th Workshop on Parallel and Distributed Simulations. PADS '98, May 26–29, Banff, Alb., Canada, 1998, pp. 154–161.
- [10] Y. Sasson, D. Cavin, A. Schiper, Probabilistic broadcast for flooding in wireless mobile ad hoc networks, *Proc. IEEE Wireless Communications & Networking Conference (WCNC 2003)*, March 2003, pp. 1124–1130.
- [11] Y. Sasson, D. Cavin, A. Schiper, Probabilistic broadcast for flooding in wireless mobile ad hoc networks, EPFL Technical Report IC/2002/54, Swiss Federal Institute of Technology (EPFL), 2002.
- [12] D.B. Johnson, D.A. Maltz, Dynamic source routing in ad hoc wireless networks, in: T. Imielinski, H. Korth (Eds.), *Mobile Computing*, Academic Publishers, New York, 1996, pp. 153–181
- [13] Jaehyun Kim; Woojin Han; Woohyuk Choi; Yunil Hwang; Taehwan Kim; Joowook Jang; Jaeyong Um; JunChae Lim, "Performance analysis on mobility of ad-hoc network for inter-vehicle communication," *Computer and Information Science, 2005. Fourth Annual ACIS International Conference on*, vol., no., pp. 528–533, 2005
- [14] Hanashi A. M, A.Siddique, et al. "Performance evaluation of dynamic probabilistic flooding under different mobility models in MANETs", *Proceedings of the IEEE International Conference on Parallel and Distributed Systems*, Vol. 2, Dec. 2007, pp. 1–6.

Power Savings using hybrid model of DVFS and Max-Min in Cloud Computing

Prabhjot Kaur Bhullar
Guru Kashi University, Punjab, India

Abstract

In cloud computing, load balancing is necessary to distribute the dynamic local workload across all the nodes. It helps to achieve reliability which depends on the way it handles the load by ensuring an efficient and fair allocation of every computing resource. Cloud load balancing helps to improve the overall cloud performance by minimizing resource consumption and avoids bottlenecks. Many load balancing schemes have been presented, but no one reduces the heat dissipation which decreases the reliability of hardware. This paper presents, algorithm which combines the Max-Min scheduling algorithm with DVFS (Dynamic Voltage Scaling Technique) which provide ability of slowing down CPU clock speeds. Further, this paper also provides the experimental results with the implementation of the proposed algorithm.

Keywords: Load balancing, DVFS, Max-Min, Virtual Machine (VM).

1 INTRODUCTION

Cloud computing is a model for delivering online services through which resources are retrieved from a centralized pool of resources at large scale. Clouds use virtualization technology in distributed data centers to allocate resources to customers on demand. The typical feature of cloud computing is its flexibility. The term cloud refers to as Internet or Network. Cloud Computing is a practical approach to manipulating, accessing, configuring the applications online. The key challenge is efficient use of underlying hardware. The main entities involved in cloud computing are the cloud user, the cloud broker and the cloud service provider. The cloud broker can schedule the resources according the demand of cloud user. Due the growth of high speed networks over the last decades, there is continuous rise in demand of large scale datacenters which consolidate thousands of servers with other infrastructure such as storage, cooling and network systems. Many internet companies such as Google, eBay, Yahoo and Amazon are operating such huge datacenters around the world.



Fig. 1. Cloud computing deployment model

Clouds are essentially virtualized datacenters and offered applications as services on a subscription basis. They require high energy for its operation. Typical, a datacenter with 1000 racks need 10 Megawatt of power to operate which results in higher operational cost. In April

2007, Gartner estimated that the Information and Communication Technologies (ICT) industry generates about 2% of the total global carbon dioxide emissions, which raises the global temperature by 2°C. So, energy consumption and carbon emission by Cloud datacenters has become a key environmental concern. Here the green cloud computing came into existence the word green means “eco-friendly”. The key role of this computing is to make the use of computer as energy efficient as possible with minimal impact on environment. Some simple techniques provide basic energy management for servers in Cloud environments, i.e. using Dynamic Voltage/ Frequency Scaling(DVFS) ; turning on and off servers, putting them to sleep to adjust servers power states. DVFS adjusts CPU power according to the workload by lowering down clock speed and supply voltage during frequency-insensitive application phases, large reductions in power can be achieved with modest performance loss. Another approach for improving energy efficiency is to adopt load balancing to get better resource allocation and reduce infrastructure energy consumption through live migration.

1.1 Some Load Balancing Existing Algorithms

Load balancing is one of the paramount tasks which enhance the performance of a cloud and to attain optimal resource utilization, through sharing loads across datacenter infrastructures in order to achieve a well-organized throughput, avoiding congestion, shortened response time, quick response time etc. Load may comprise of amount of memory used, CPU load, delay load, network load the aim of load balancing methods is to distribute the load among different nodes so that no node gets overwhelmed. Some benefits of load balancing in cloud computing are to ensure that;

- Available of resources on demand.
- Resources are effectively utilized under condition of high or low load.
- Energy is saved in case of low load
- Save processing time
- Reduce Cost
- Ensure better communication across network nodes.
- Overcome resources wastages.

Distribute workload of multiple network links to achieve minimum response time and maximum throughput and to avoid overloading. We uses different algorithms to distribute the load.

1.1.1 Round Robin Algorithm (RR): In this datacenter controller uses the concept of time quantum or slices it assigns the requests to a list of VMs on a rotating basis. The resources of the service provider are provided on the basis of the time quantum. The first request is allocated to a VM randomly from the group and then the datacenter controller assigns the subsequent requests in a circular order. Once the VM is assigned the request, the VM is moved in circular motion to the end of the list. In Round Robin Scheduling if time quantum is very large then Round Robin Scheduling Algorithm is same as the FCFS Scheduling and if the time quantum is extremely too small then Round Robin Scheduling is called as Processor so time quantum play an important role in RR algorithm.

1.1.2 Throttled Load Balancer (TLB): In this algorithm the load balancer maintains the record of each state (busy or ideal) in an index table of virtual machines. First the client or server makes a request to data center to find a suitable virtual machine to perform the recommended job. The data center queries the load balancer for allocation of the VM. The load balancer check the index table from top until the first available VM is found,

if the VM is found, the load data center communicates the request to the VM identified by the id. Further, if appropriate VM is not found, the load balancer returns -1 to the data center. When the VM completed the allocated task, a request is acknowledged to data center, which is apprised to load balancer to de-allocate the same VM whose id is already communicated. The total execution time is estimated in three phases. In the first phase the formation of the virtual machines and scheduler will be idle waiting to schedule the jobs in the queue ,in second phase once jobs are allocated, the virtual machines in the cloud will start processing, and finally in the third phase the destruction of the virtual machines. The throughput of the model can be estimated as the total number of jobs executed within a required time span without considering the any destruction time. This algorithm will improve the performance by providing the resources on-demand, by reducing the rejection in the number of jobs submitted and resulting in increased number of job executions.

1.1.3 Active Monitoring Load Balancer (AMLB): The AMLB maintains information about each VMs and also the number of requests currently allocated to which VM. When a request is to allocate a new VM arrives, first it identifies the least loaded VM. If there are more than one loaded VM, then the first identified is selected. Active VmLoadBalancer returns VM id to datacenter controller. The datacenter controller sends the request to the VM identified by that id. This algorithm is quite similar with Weighted Round Robin Algorithm of cloud computing in order to achieve better response time and processing time.

2 Related Work

Anton and Buyya [1] have proposed novel approach called as Markov chain model to overcome limitations of statistics or heuristic based approaches to identify and mitigate overloading problems in datacenters. They heuristically adapt the algorithm for the non-stationary workloads using the Multisize Sliding Window workload estimation technique.

DVS systems for real-time jobs was first given by Yao [2] who considered a set of aperiodic jobs on an ideal processor. An ideal processor can operate at any speed in a pre-defined section, and a non-ideal processor has discrete speeds with negligible or non-negligible speed transition overheads.

Jejurikar [3] exploit a combined shutdown and slowdown approach to minimize energy consumption. The handoff strategy depends on a critical speed, in which executing any task at any speed less than the critical speed would consume more energy than that at the critical speed.

Pinheiro [4] called the technique Load Concentration (LC). The basic idea behind LC is to dynamically distribute the load to a server cluster so that, under light load, some hardware resources can be idled and put in low-power modes, or can be turned off.

Elnozahy [5] proposed coordinating voltage scaling (CVS) and independent voltage scaling (IVS). In CVS, nodes coordinate their voltage and frequency settings to optimize the overall energy consumption. In IVS, each node makes its own independent decision about what voltage and frequency to use, depending on the load it is receiving. But, CVS come to be expensive as it increases implementation complexity.

Generally, a load-balancing algorithm generally is divided into two types, static and dynamic. The static load-balancing algorithm includes Opportunistic Load Balancing (OLB) and Round Robin (RR). The dynamic load balancing algorithm includes Minimum Execution Time (MET), Min-Min, and Minimum Completion Time (MCT) and Max-Min algorithms. The limitation of these algorithms are that they cannot guarantee the stability of the load balancing due to the differences of each computing node and task.

3 Proposed Work

The work presented in this paper proposes a load balancing technique that is power efficient. In this proposed algorithm load is balanced at each node with Max-Min technique as well as DVFS is also combined with the Max-min for the proper utilization of power. The goal of this algorithm is to maintain availability to compute nodes while reducing the total power consumed by the cloud.

Tasks will be categorized into 3 classes depending upon the nature of their work.

Class A: It includes all those tasks that involve normal processing

Class B: This class contains all those tasks that involve input/ output processing and hence require more CPU than Class A

Class C: This class contains the multimedia jobs and these tasks require very high CPU than any other classes.

Resources (Virtual Machines) can operate in 3 modes:

1. Low Mode/ Basic Mode: The virtual machine will operate in low frequency mode and lesser amount of voltage will be supplied
2. Medium Mode: Medium frequency + medium voltage is supplied
3. High Mode: High frequency + higher amount of voltage is supplied.
 - a. All the tasks will be sorted according to their maximum execution length.
 - b. Expected Completion time of a task on a resource can be calculated through the following relation:

$$CT(I, j) = ET(I, j) + r(j)$$

Where $ET(I, j)$ is the expected execution time of task $t(i)$ on machine $m(j)$ and $r(j)$ is the ready time of $m(j)$ i.e. the time when $m(j)$ becomes ready to execute $t(i)$.

- c. Now we will find minimum expected completion time of each task in MT (Meta task table) and the resource that will obtain it.
- d. Now the tasks (cloudlets) will be assigned to the appropriate Virtual Machines (dynamic load balancing)

- e. Depending upon the class of the task assigned to the virtual machine, the resource will operate.

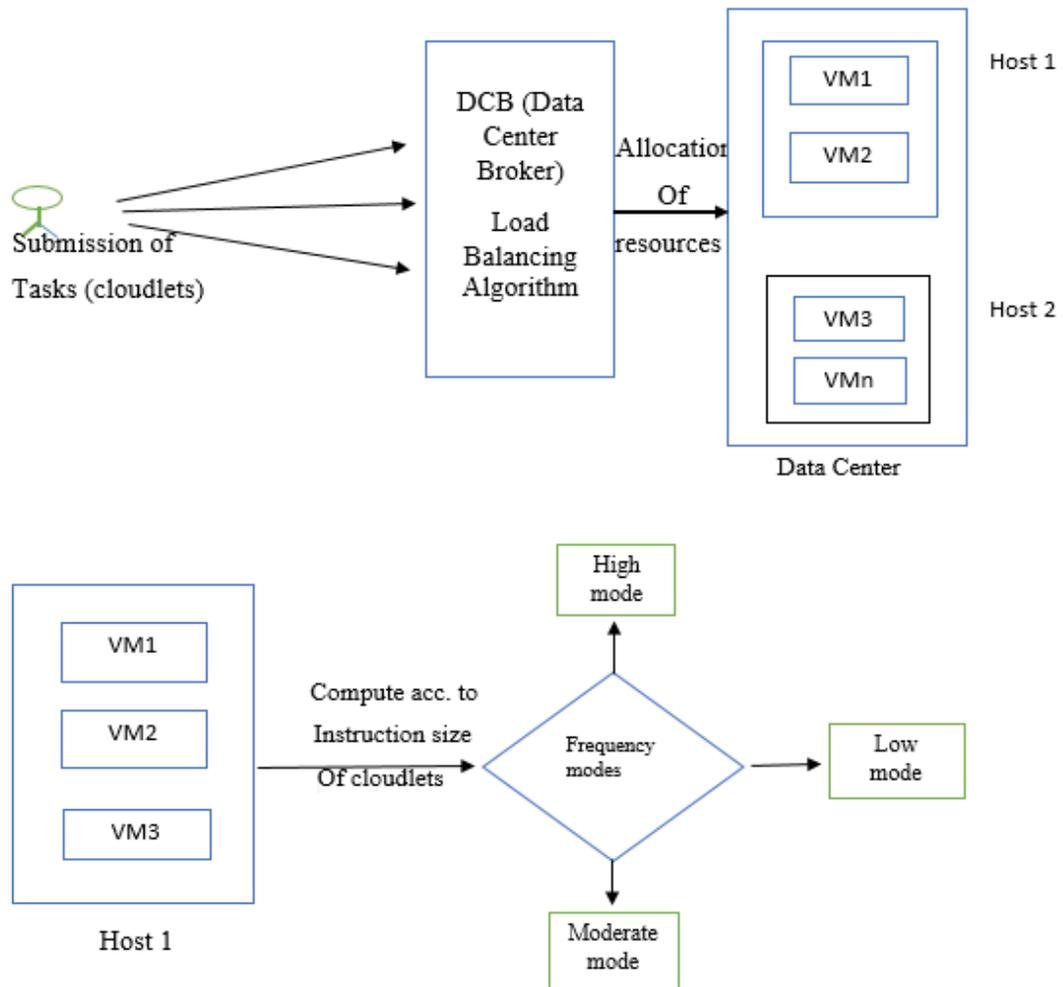


Fig. 2. Flow Chat of Proposed Model

4 Experimental Evolution

CloudSim [10], a simulation tool for cloud computing is used to model and simulate task scheduling in the large-scale cloud computing. The virtual nodes, energy consumption, computing resource are modeled with CloudSim to evaluate the efficiency of load balancing for the proposed Max-Min task-scheduling along with DVFS. In this proposed algorithm, there is comparison of energy consumed without using DVFS or with using DVFS. In results we analyze that after using DVFS there is energy conservation near about 30% of energy will be conserved by using this algorithm.

A. Experimental Data

1. *Turnaround Time (TAT)*: Time required for a particular process to complete, from submission time to completion time.

2. *Waiting Time (WT)*: How much time processes spend in ready queue waiting their turn to get on the CPU.
3. *Response Time*: The time taken in an interactive program from the issuance of a command to commence of a respond to that command.
4. *Throughput*: Number of processes completed per unit time

B. Experimental Results

I. TABLE

| No. of Cloudlets | TAT | Avg. TAT | Execution Time | Avg. Exec. Time | Avg. Waiting Time | Throughput |
|------------------|----------|----------|----------------|-----------------|-------------------|------------|
| 100 | 1.717E8 | 1717000 | 1.0E7 | 100000 | 1617000 | 100000 |
| 250 | 1.0542E9 | 4216800 | 2.5E7 | 100000 | 4116800 | 100000 |
| 500 | 4.1917E9 | 8383400 | 5.0E7 | 100000 | 8283400 | 100000 |
| 750 | 9.4125E9 | 1.255E7 | 7.5E7 | 100000 | 1.245E7 | 100000 |

In Table I as increases the number of tasks or jobs currently running in the VM (cloudlets) than their execution time also increases but the average execution time or throughput remains the same.

II. TABLE

| No. of Cloudlets | Without DVFS Power in W | With DVFS Power in W | Difference | %age improvement |
|------------------|-------------------------|----------------------|------------|------------------|
| 100 | 78439 | 54916 | 23523 | 28.9% |
| 1000 | 770551 | 539470 | 231081 | 29.9% |
| 10000 | 7691668 | 5385014 | 2306654 | 30% |
| 100000 | 76902841 | 53840456 | 23062885 | 29.9% |

In Table II, there is comparison of energy by using DVFS or without DVFS. As shown in table there is approximately 30% of energy conservation by using DVFS. As the no. of cloudlet increases the difference will also increases.

$$\% \text{age of conservation energy} = \text{Difference} / \text{without DVFS} * 100$$

The below Bar Chart, shows comparison in the power consumption by using DVFS or without DVFS. It clearly shows that by using DVFS waiting time decreases that means power consumption also decreases as result energy is conserved. As more the waiting time machine will turn on for more time which consuming more energy. So DVFS can help in maintaining the frequency according to the workload on machine. If there is less workload than run machine on low medium of frequency and if workload is more run machine on higher medium of frequency.

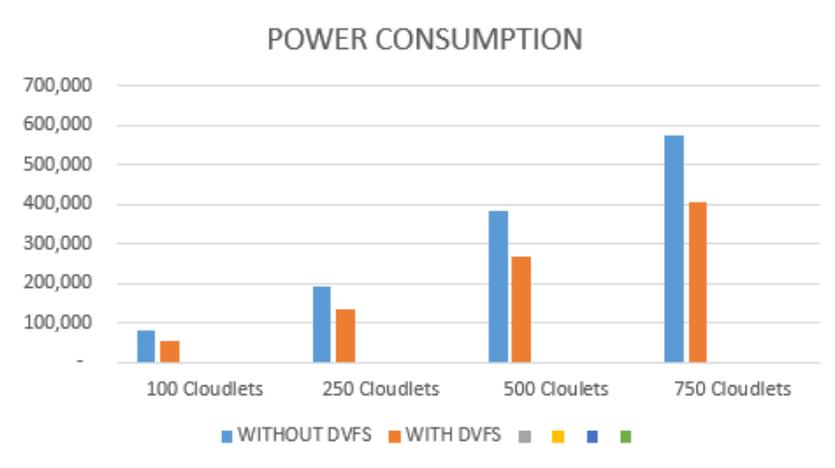


Fig. 3 Comparison with DVFS or without DVFS

In the below bar chat number of hosts is changes it shows as the no. of hosts are increases energy consumption also increases as in above chat no. of cloudlets are changes. This chat shows the energy consumption using DVFS and Without DVFS. This also shows that new proposed algorithm is valid and clearly provides the efficient results.

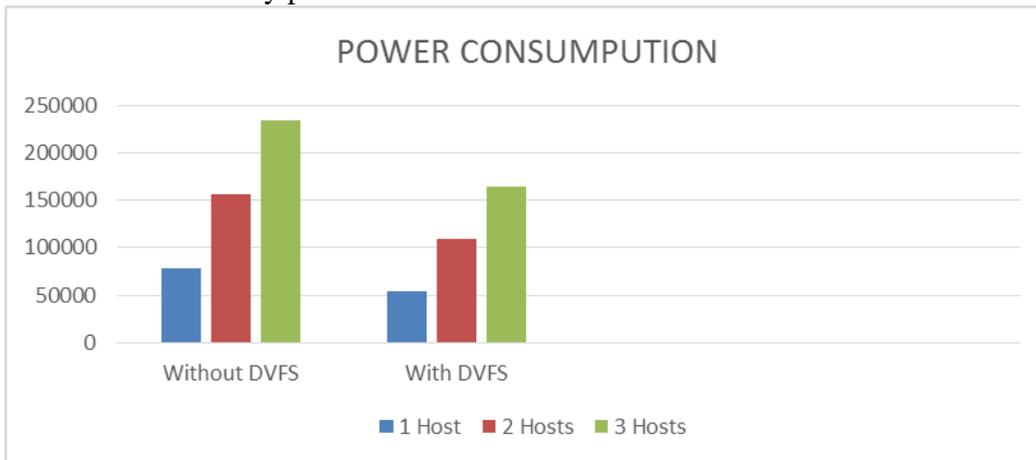


Fig. 4. Comparison when no. of Host are changes

III TABLE

| No. of Cloudlets | Max-Min algorithm | With DMEELB | Difference | % age improvement |
|------------------|-------------------|-------------|------------|-------------------|
| 200 | 154571 | 108217 | 46354 | 29.9% |
| 300 | 230703 | 161518 | 69185 | 29.9% |

| | | | | |
|-----|--------|--------|--------|-------|
| 400 | 309143 | 216434 | 92709 | 29.9% |
| 500 | 385275 | 269735 | 115540 | 29.9% |

The above table and below bar chart shows the energy improvement by comparing proposed technique i.e. EELBF with Max-Min scheduling algorithm. It clearly shows that in DMEELB power consumption is less as compare to Max-Min algorithm.

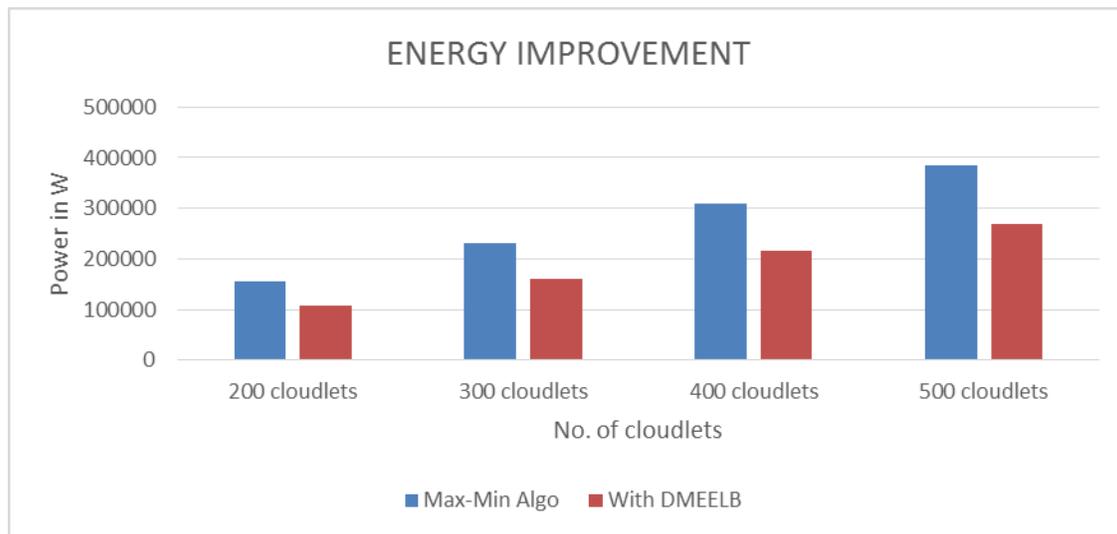


Fig. 5. Comparison of Max-Min algorithm with proposed algorithm

5. Conclusion

Energy conservation is important tasks in cloud computing as number of online services like online gaming, search, online video streaming and social networks have exploded. This led to the construction of large scale of data centers which consumes considerable amount of energy. This paper proposed a new power conservation load balancing algorithm in which there is a combination of Max-Min scheduling with the DVFS. This proposed work can save nearly 30% of power. The future must have an approach for a low energy use data centers using cloud computing that are powered with renewable energy that are based on intelligent network of agents which keep track of demand and supply of both sources of power and consumer of power from various distributed regions.

REFERENCES

1. Anton Beloglazov and Raj Kumar Buyya, Managing Overloaded Hosts for Dynamic Consolidation of Virtual Machines in Cloud Data Centers Under Quality of Service Constraints, IEEE Transactions on Parallel and Distributed Systems, Vol. 24, No. 7, July 2013, pages 1366 -1379.
2. Yao F, Demers A, Shenker S (1995) A scheduling model for reduced CPU energy. In: Proceedings of the 36th annual symposium on foundations of computer Science (FOCS'95), Milwaukee, Wisconsin, pp. 374-382.
3. Jejurikar R, Pereira C, Gupta RK (2004) Leakage aware dynamic voltage scaling for real-time embedded systems. In: Proceedings of the 41st design automation conference (DAC'04), San Diego, USA, pp 275-280.

4. Pinheiro E, Bianchini R, Carrera EV et al (2001) Load balancing and unbalancing for power and performance in cluster-based systems. In: Proceedings of the international workshop on compilers and operating systems for low power.
5. Elnozahy EN, Kistler M, Rajamony R (2002) Energy-efficient server clusters. In: Proceedings of the 2nd workshop on power-aware computing systems, pp 179–197.
6. Chen JJ, Hsu HR, Chuang KH et al (2004) Multiprocessor energy-efficient scheduling with task migration considerations. In: 16th Euro Micro conference on real-time systems (ECRTS'04), pp 101–108.
7. Chen JJ, Hsu HR, Kuo TW (2006) Leakage-aware energy-efficient scheduling of real-time tasks in multiprocessor systems. In: 12th IEEE real-time and embedded technology and applications symposium (RTAS'06), pp 408–417.
8. Bhaskar Prasad Rimal, Eunmi Choi and Ian Lumb, A Taxonomy and Survey of Cloud Computing Systems, Fifth International Joint Conference on INC, IMS and IDC 2009.
9. Jasmin James and Dr. Bhupendra Verma, Efficient Vm Load Balancing Algorithm for a Cloud Computing Environment, Jasmin James et al. / International Journal on Computer Science and Engineering (IJCSSE) ISSN: 0975-3397 Vol. 4 No. 09 Sep 2012.
10. Shu -Ching Wang, Kuo-Qin Yan, Wen-Pin Liao and ShunSheng Wang, Towards a Load Balancing in a Three-level Cloud Computing Network, 978-1-4244-5539-3/10 ©2010 IEEE.
11. Nidhi Jain Kansal and Inderveer Chana, “Cloud Load Balancing Techniques: A Step Towards Green Computing, IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 1, No 1, January 2012.
12. Qi Zhang, Lu Cheng and Raouf Boothbay, Cloud computing: state-of-the-art and research challenges, J Internet Serv Appl (2010) 1: 7–18
13. Y. Abulafia and A. Kornfeld. Estimation of FMAX and ISB in microprocessors. IEEE Transactions on VLSI Systems, 13(10), Oct 2006.
14. L. Barroso, K. Gharachorloo, R. McNamara, A. Nowatzyk, S. Qadeer, B. Sano, S. Smith, R. Stets, and B. Verghese. Piranha: a scalable architecture based on single-chip multiprocessing. In ISCA '00: Proceedings of the 27th annual International Symposium on Computer Architecture, 2000.
15. K. Bowman, S. Duvall, and J. Meindl. Impact of die-todie and within-die parameter fluctuations on the maximum clock frequency distribution for gigascale integration. IEEE Journal of Solid-State Circuits, 37(2), Feb 2002.
16. R. P. Mahowald, Worldwide Software As A Service 2010–2014 Forecast: Software Will Never Be Same ,In, IDC, 2010
17. P. Barham, B. Dragovic, K. Fraser, S. Hand, T. Harris, A. Ho, R. Neugebauer, I. Pratt, A. Warfield, Xen and the art of virtualization, in: Proceedings of the 19th ACM Symposium on Operating Systems Principles, SOSP 2003, Bolton Landing, NY, USA, 2003, p. 177.
18. Rich Lee, Bingchiang Jeng ”Load Balancing Tactics In Cloud” International Conference On Cyber Enabled Distributed Computing And Knowledge Discovery, 2011
19. K.D. Devine, E.G. Boman , R.T. Hepahy, B.A.Hendrickson, J.D. Teresco, J. Faik,J.E. Flaherty, L.G. Gervasio,” New Challenges In Dynamic Load Balancing, Applied Numerical Mathematics,52(2005)133-152.

20. Mishra , Ratan , Jaiswal, Anant,P“Ant Colony Optimization: A Solution Of Load Balancing In Cloud”,April 2012, International Journal Of Web & Semantic Technology;Apr2012, Vol. 3 Issue 2, P33
21. Eddy Caron , Luis Rodero-Merino “Auto-Scaling , Load Balancing And Monitoring In Commercial And Open-Source Clouds “ Research Report ,January2012

Awareness of using flowers and ornamental plants and its impact on improving the internal environment of the housing

Dr. WIJDAN ABDULRAHMAN AL OWDA
Associate Professor of Housing and Home Management

College of Art and Design. Princess Norah bint Abdul Rahman University

Summary of the study

The research aims to study the Awareness of using flowers and ornamental plants and its impact on improving the internal environment of the housing through the study of different themes of awareness using flowers, ornamental plants represented in awareness of (types of flowers and plants, using of flowers and natural plant, using of flowers and industrial plants, methods of care of flowers and plants), as well as the study of the internal environment of housing in terms of (Aesthetic and Psychological), also aims to identify the awareness of using flowers and ornamental plants and its impact on the internal environment of the housing according to the educational level of the housewife and monthly income of the family and to identify the similarities and differences between working and non-working women in the awareness of using flowers and ornamental plants and its impact on the internal environment of the housing.

Research has been applied to 250 of the working and non-working women in the city of Riyadh, the study tools included form of the preliminary data of the family which serve the objectives of the study including: education level of the housewife, seeking of the housewife for work, the monthly income of the family, and a questionnaire for internal environment of the housing. One of the most important results of the study is the presence of a positive correlative relationship between using of flowers, ornamental plants and improvement of the internal environment of the housing at a significance level 0.01, as well as the presence of statistically significant difference between the study sample in using of flowers and ornamental plants, according to the educational level of the housewife at the level of 0.001, also there is statistically significant difference between the study sample in improving the internal environment of the housing, according to the educational level the housewife at the level of 0.01, and the presence of statistically significant difference between the study sample in using of flowers and ornamental plants, according to the monthly income of the family at the level of 0.001, also it is clear the presence statistically significant difference between the study sample in improving the internal environment of the housing, according the monthly income of the family at the level of 0.01, and there are statistically significant differences between working and non- working housewives in using of flowers, ornamental plants and improvement of the internal environment of the housing at significance level of 0.001 in favor of the working housewives.

Introduction and research problem

flowers are signs of beauty and divine creativity which human contemplates its beauty and enjoy their perfume, not only that, but also give a sense of comfort, tranquility and sends spiritual joy and pleasure also it considered as a language to communicate with others, so it became necessary for the human to take care of these flowers and look after its beauty and tenderness for a longest period as possible so he can satisfy his desires and achieve greater material and moral benefit (Asrar, 2008).

Scientific studies and research have shown that the efficiency of the individual production and performance of work assigned to him increased by 20% in the case of Beautifying his office with plants where the beauty of these plants raise his sense of vigor and vitality and thereby increased the amount of work produced, further the presence of greenery and nature breaks the rigidity of the walls, desks and chairs thus eliminate the boredom and provides a comfortable atmosphere and fresh air (Khalil, 2004).

the acquisition of living plants and their use in cosmetic aspects within houses is no longer just a hobby but has become a key factor in human life and living and the internal decoration plants has constitute a vivid element of the decor that add beauty and vitality to interior spaces where placed, as these plants reflect these engineering lines and rigid view of the internal architectural installations and add nature and greenery to them in addition to improving the atmosphere in the internal environment through air refreshment and increase the oxygen content and the reduction of air pollutants (Abu Dahab, 1998).

Plants of internal decoration has also social importance for the individual and the community as it works to create a comfortable atmosphere, sends calm in the soul, soothes the nerves and spread joy in the hearts of viewers. So we find that the use of plants in the decorations and aesthetic operations is no longer a luxury or some sort of luxuries at the present time however it became necessary for people who are able to acquire and take care of them and providing appropriate environmental conditions needed for their growth (Al Zoom and Moussa, 2008). It is possible to use artificial plants that look at first like a real to suit those who has no interest in the natural plants (Ashour 0.2011) .

a variety of plants differ in the nature of growth and flowers and leaves are used to make decorations in various interior places and can thus implement appropriate decoration in the right place, these plants are used in ornamentation and decoration in accordance with the principles of unity, balance, diversity, interdependence and compatibility with home furniture, the size of the rooms , corridor and halls taking into account the color harmony and consistency with the overall style of the house and selection of the appropriate place for each of them (Al Manea et al., 1998).

The interior ornamental plants are divided into non-flowering indoor ornamental plants and these plant are acquired to the beauty of their foliar part specially leaves, and Flowering indoor plants such as those with fine odor and without odor and these plants acquired to the beauty of flowers in addition to the foliar part (Mazahrah and Hamouda, 2003).

There are decoration principles which must be considered when decorating flowers and plants, namely: shall add beauty and splendor to the place, not obscure other beautiful views, to obscure views undesirable for vision, shall not be inconsistent or incompatible with other beauty components or pieces of furniture, not impede movement or traffic in the place, do not cause any damage or dirtiness of the place, which appropriate laying of impermeable pots under their vessels own (Al Masri, 2004).

Harvested flowers are used to decorate the sitting areas, dining tables, corridors and different areas in the house so there must be a harmony between their shapes and colors which requires taste and slender sense (Hessayon,1996)

Flowers decoration means use of common technical methods by arranging them individually or jointly with any other plants, taking into account the general principles of decoration which includes six components namely the decoration line, shape, color, scale, rhythm or repetition, focus (Al Masri, 2004).

Modern schools are significantly depends on the engineering bases like heights, areas, volumes, symmetry and asymmetry and appropriate background, there are basic designs of flower decoration the Coordinator may consider as the basis to form the main structure of the decoration, and then adds glimpses of his art and private taste (Alqiei and Saadawi, 1996).

The names of the decorations are: the Vertical Decoration In form of S or beauty line (Hogarth Decoration), Crescent Decoration, Radiating Decoration, Symmetrical Decoration, Asymmetrical Decoration, Horizontal Decoration, Round Decoration, Floating Decoration, Free Decoration (Badr, 2000)

Some flower has a warm nature colors, such as yellow, orange and red which is glamorous and attractive, some has cold quiet nature such as green, blue, violet, and the graduation between these colors should not be a surprise, but it must be gradual so that adjacent colors can be complementary to each other as is the case between the Red and green, or between yellow and orange, or between light blue, and so on (Brinton, 1991).

Among the things that are to be taken into account when making decoration is the balance between flowers and different plant parts including the size of flowers used so that emerging small flowers to be laterally while large flowers with a dark color should be in the center or at the edge of the pot (Al Masri, 2004).

Decoration pots should be in suitable size, their color harmonizes the color of the decorated flowers, selection of simple shapes, with shape and size suitable to the quantity and sizes of flowers to be decorated for the place on which they will be placed in, the quality of the pot and its compatibility with the environmental conditions (Hessayon, 1991).

People's tastes vary from time to another and from one place to another so, decoration shall consider the updates specifically the entire world is open to each other, which in turn is reflected on the basis of decoration in our culture (Khalifa, 1985)

The acquisition of living plants and their use cosmetic aspects in inside homes is no longer just a hobby but has become a key factor in human life (Al Sayfi, 1998)

The different images for beautifying buildings with plants can be summarized as follows (Bader, 20)

Pot Plants, Plant BOXES, Hanging Baskets, Shelf, Decorated lath walls, Dish Gardens, Class Gardens, Plant Fountains, Wall Gardens, Window Gardens, Balcony or Terrace Gardens.

To maintain flowers and plants, provision of the factors that help keep them alive and beauty, should be taken into account which is limited to the provision of a suitable environmental factors for the growth as well as to carry out the necessary service and maintenance, which can be summarized as follows (Abu DeJain, 2004):

Environmental Factors: soil, light, Temperature, humidity, Ventilation or Aeration, Pollution.

Care: Irrigation or watering, Fertilization, Repotting, Soil Aeration, Supporting , Forming , removing of Dry Infected Branches and Leaves , Leaves, Leaves Cleaning , Pests Control, Moving the Plants

The flower decoration throughout the house is considered as a core elements for the decor as it give warm and refreshing, break the routine and stereotypes and to show the spectacular view of plant we put in its background an adequate lighting (Ashour 0.2011).

The Spanish Arabic gardens are characterized by the introduction of glass balconies and windows overlooking the garden and the distribution of pots planted with shadow plant in the corridors and interior rooms, Arabs in Spain, were the first to use lighting to show the beauty of the park and enjoy the day and night as the Arabs are unique in the selection of trees, flowers and plants, and this is what distinguishes the Arab design (Al Jabali, 1990).

Also, the presence of natural plants around the house for beautifying considered as a civilized appearance and standard for cultural and material upgrade, as well as instilling good behaviors in the hearts of young and make them familiar with the discipline, cleanliness and sociability and to pay attention to people around them (Alqiei & Al Manea, 1413).

So the study focused on examining the use of flowers and ornamental plants and its impact on improving the internal environment of the housing to raise awareness of the types of flowers and plants and bases of their use, arrangement and rearing them and to achieve the inner beauty of the house, provide psychological comfort and happiness of family members and the civilized and cultural progress of the community.

Hence, the current study examines the nature of the relationship between using of flowers, ornamental plants and improvement the internal environment of the housing by answering the following questions:

1. What is the nature of the relationship between using of flowers, ornamental plants and improvement of the internal environment of the housing?
2. What nature of difference between the study sample in using of flowers, ornamental plants and improvement of the internal environment of the housing depending on the level of education of the housewife.
3. What is the nature of difference between the study sample in using of flowers, ornamental plants and improvement of the internal environment of the housing depending on the monthly income of the family?
4. What are the differences between working and non-working housewives using of flowers, ornamental plants and improvement of the internal environment of the housing.

Objectives of the Study:

The current study aimed to achieve the following:

1. Determine the relationship between using flowers and ornamental plants in its four themes (pro forma basis, material basis, moral, religious basis, social and cultural basis) and to improvement of the internal environment of housing in its two themes (sensory material satisfaction, moral satisfaction).

2. Recognize the difference between the study sample in using flowers, ornamental plants and improvement of the internal environment of housing depending on the level of education of the housewife.
3. Recognize the difference between the study sample in using flowers, ornamental plants and improvement of the internal environment of the housing depending on the monthly income of the family.
4. Identify similarities and differences between working and non- working housewives in using flowers and ornamental plants in its themes and improvement of the internal environment of housing in its two themes.

Importance of the study:

As the central region in the Kingdom of Saudi Arabia is characterized by dry nature, lack of diversity of vegetation and dependence on the import of many types of flowers and plants from other agricultural areas in the Kingdom also dependence on imports from abroad, the thing which impact on low use of flowers and plants by community members, and thus lack of awareness of their all kinds, their use and rearing of them, which in turn led to a lack of many homes to enjoy and refresh the spirit and beauty of nature, so the research goal is to raise awareness of the types of flowers and plants and principles of their use, arrangement and rearing them and to achieve the inner beauty of the house, provide psychological comfort and happiness of family members and the civilized and cultural progress of the community.

Research method:

First, the study hypotheses:

Due to lack of studies related to the subject matter of the current study, which the two researchers were able to achieve, hypotheses were drafted in zero form, as follows:

1. There is no statistically significant correlative relationship between using flowers and ornamental plants in its four themes (types of flowers and plants, using of flowers and natural plant, using flowers and industrial plants, methods of care of flowers and plants) and improvement of the internal environment of housing in its two themes.
- 2- There is no statistically significant difference between the study sample in using of flowers, ornamental plants and improvement of the internal environment of the housing depending on the education level of the housewife.
- 3- There is no statistically significant difference between the study sample in using of flowers, ornamental plants and improvement of the internal environment of the housing depending on the monthly income of the family.
4. There are no statistically significant differences between working women and non-working housewives in using of flowers and ornamental plants in its four themes and improvement of the internal environment of housing in its two themes.

Second: Tools of the study:

A set of tools were used include the following:

1. Preliminary data form of the family: include the preliminary data of the family which serve the objectives of the current study and determines the social and economic characteristics of the housewife include: education level of the housewives (primary, intermediate, secondary, university, postgraduate), family income (less than 3000, 3000 to less than 5,000 riyals, from 5,000 to less than 8,000 riyals, from 8000 to less than 12,000 riyals, from 12,000 to less than 16,000 riyals, 16,000 riyals and more).

2. The use of flowers and ornamental plants: the questionnaire has been prepared in its initial form and included four themes: the types of flowers and plants, uses of flowers and natural plants, uses of flowers industrial and plants, methods of flowers and plants care), to realize the veracity of the scale content it has been introduced in its initial form to a group of arbitrators who specialize in the field of housing and home management in some colleges in Riyadh, Medina and Mecca who are seven arbitrators, and asked them to issue their judgment on it in terms of suitability of each phrase of the questionnaire to the theme of, and determine the validity of the phrase correctness, determine the direction of each phrase, in addition to any amendments or comments on the phrases, the percentage of arbitrators agreement on the questionnaire phrases was calculated where the frequencies of percentage of agreement on most of the phrases was more than 85%. According to the opinions of the arbitrators five phrases were deleted (by one phrase from the first, second and third theme and two phrases from the fourth theme), where the frequencies of percentage of agreement on it was less than 85%, where the drafting of some phrases was amended, according to the opinions of the arbitrators. Thus, the questionnaire underwent sincerity of content, as the researcher calculated the stability of scale in using of flowers and ornamental plants in two methods:

- **First method:** using Alpha-Cronbach equation to calculate the reliability coefficient to determine the value of the internal consistency of the questionnaire where the alpha coefficient was calculated for each phrase separately and for the questionnaire as a whole, and the value of the alpha coefficient of the questionnaire as a whole (the use of flowers and ornamental plants) was 0.933, which is a high value confirming the consistency of the questionnaire.

- **Second method:** Using Half-Split test of the questionnaire on the basis of dividing it into odd phrases and other even and then by calculating the value of the correlation coefficient between the two divisions by Spearman-Brown method and the value of the correlation coefficient was 0.948, which is a high value for this type of consistency and it indicates the internal consistency of the questionnaire phrases,

Based on the foregoing the questionnaire in its final form included 100 approximate predicative phrase distributed among the four themes so that the number of types of flowers and plants phrases 25 phrases, the number of uses of flowers and natural plant 25 phrases, the number of uses of flowers and industrial plant 25 phrases, the number of methods to take care of flowers and plants 25 phrases. responses determine to the questionnaire phrases one degree for three choices and on connected scale (3,2, 1) and thus the highest score obtained by the family in the scale is 300 degrees and the less degrees is 100 degrees, and thus questionnaire degrees could be divided into three levels, namely:

Low level of awareness: those with less than 150 degrees with a percentage of less than 50%

The average level of awareness: those with 150 degrees until less than 225 degrees with a percentage of up to 50% until less than 75%.

A high level of awareness: those with 225 degrees or more with a percentage of 75% and more.

3. Improvement of the internal environment of housing: the preparation of the questionnaire in the initial form included two themes: the Aesthetic and Psychological point of view, to realize the veracity of the scale content it has been introduced in its initial form to a group of arbitrators who specialize in the field of housing and home management in some colleges in Riyadh, Medina and Mecca who are seven arbitrators, and asked them to issue their judgment on it in terms of suitability of each phrase of the questionnaire to the theme of, and determine the validity of the phrase correctness, determine the direction of each phrase, in addition to any amendments or comments on the phrases, the percentage of arbitrators agreement on the questionnaire phrases was calculated where the frequencies of percentage of agreement on most of the phrases was more than 85%., drafting of some phrases was amended, according to the opinions of the arbitrators. Thus, the questionnaire underwent sincerity of content, further, the researcher calculates the stability of a measure of the improvement of the internal environment of the housing in two methods:

- **First method:** using Alpha-Cronbach equation to calculate the reliability coefficient to determine the value of the internal consistency of the questionnaire where the alpha coefficient was calculated for each phrase separately and for the questionnaire as a whole, and the value of the alpha coefficient of the questionnaire as a whole (the use of flowers and ornamental plants) was 0.959, which is a high value confirming the consistency of the questionnaire to measure improvement of the internal environment of the housing.

- **Second method:** Using Half-Split test of the questionnaire on the basis of dividing it into odd phrases and other even and then by calculating the value of the correlation coefficient between the two divisions by Spearman-Brown method and the value of the correlation coefficient was 0.959, which is a high value for this type of consistency and it indicates the internal consistency of the questionnaire phrases,

Based on the foregoing the questionnaire in its final form included 100 approximate predicative phrase distributed among the four themes so that the number of types of flowers and plants phrases 25 phrases, the number of uses of flowers and natural plant 25 phrases, the number of uses of flowers and industrial plant 25 phrases, the number of methods to take care of flowers and plants 25 phrases. responses determine to the questionnaire phrases one degree for three choices and on connected scale (3,2, 1) and thus the highest score obtained by the family in the scale is 300 degrees and the less degrees is 100 degrees, and thus questionnaire degrees could be divided into three levels, namely:

Low level of awareness: those with less than 150 degrees with a percentage of less than 50%

The average level of awareness: those with 150 degrees until less than 225 degrees with a percentage of up to 50% until less than 75%.

A high level of awareness: those with 225 degrees or more with a percentage of 75% and more.

Third: study sample

The study sample included 250 Saudi housewife, it has been selected by psoriasis manner among families inhabiting the city of Riyadh in its five regions (north, south, central, east and west) with different socio-economic levels.

Fourth: Study Approach

This study followed the descriptive analytical approach, and is intended to describe and interpret the phenomenon of the study as it found actually and expressed qualitatively and quantitatively and the relationships between variables defines using statistical methods, and then extract conclusions (Al Tayeb et al., 2000).

Fifth: procedures of application of study tools on the sample

Study tools have been applied to the sample by filling data from housewives through personal interview directly with them, field application took 3 months.

Sixth: The statistical treatment

The data were analyzed and conducting statistical treatments using Statistical Package for Social Sciences Program (SPSS.) to extract the results and the following are some statistical methods to disclose the relationship between the variables of the study and test the validity of hypotheses: -

1. Calculation of frequencies, percentages, averages and standard deviations for each variables of the study (level of education of housewives - monthly income of the family, seeking of the housewife for work).
2. Alpha - Cronbach's coefficient, Half-split, calculation of correlation coefficient by Gitman and Spearman - Brown two equations to calculate the reliability of study tools.
3. The correlation coefficients matrix between each of the use of flowers and ornamental plants with its four themes and improvement of the internal environment of the housing with its two themes, analysis of variance (ANOVA) in one direction to see the significance of differences between the average degrees of families the study sample in using flowers and ornamental plants with its four themes and improvement of the internal environment of the housing with its two themes according to the level of education of housewife - the monthly income of the family, and in the case of a differences Tukey test is applied to know the significance of differences between the average degrees.
- 4- T-test to know the significance of differences between the mean scores of working and non-working housewives in using flowers and ornamental plants with its four themes and improvement of the internal environment of the housing with its two themes,

The results of the field study

First, a description of the preliminary study sample

Below is a description of the study sample, which consisted of 250 Saudi housewives who were selected from different social and economic levels:

Table (1) the relative distribution of the sample according to the level of education of the housewife

| Education Level | Frequency | Percentage |
|------------------------|------------------|-------------------|
| Elementary | 0 | 0 % |
| Intermediate | 2 | 0.8 % |
| Secondary | 26 | 10.4 % |
| University | 192 | 76.8 % |
| Postgraduate | 30 | 12.0 % |
| Total | 250 | 100 % |

The results in the table (1) indicate high educational level housewife as most of the sample member hold a university education level and above by 76.8% for the university education level and 12% of the level of higher education, while the secondary education level accounts for only 10.4% and not more than the 0.8% for the intermediate educational level of.

Table (1) the relative distribution of the sample according to seeking work by housewife

| Seeking work by housewife | No's | Percentage |
|----------------------------------|-------------|-------------------|
| Working | 135 | 54.0 5 |
| Non-working | 115 | 46.0 % |
| Total | 250 | 100 5 |

Table (2) shows that the higher percentage among housewives are working at 54 % against 46 % non-working.

| | | | | | | | | |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------|
| | | | | | plants | | | ment of housing |
| Types of flowers & plants | - | | | | | | | |
| Use of flowers and natural plants | ** 0.654 | - | | | | | | |
| Use of flowers and industrial plants | ** 0.579 | ** 0.624 | - | | | | | |
| Methods of care of flowers and plants | ** 0.529 | ** 0.599 | ** 0.756 | - | | | | |
| Total themes of use of flowers and ornamental plants | ** 0.809 | ** 0.841 | ** 0.871 | ** 0.853 | | | | |
| Aesthetic aspect | ** 0.489 | ** 0.467 | ** 0.551 | ** 0.639 | ** 0.627 | - | | |
| Psychological aspect | ** 0.547 | ** 0.519 | ** 0.679 | ** 0.704 | ** 0.724 | ** 0.807 | - | |
| Total themes of improvement of internal environment of housing | ** 0.532 | ** 0.514 | ** 0.635 | ** 0.698 | ** 0.701 | ** 0.957 | ** 0.927 | - |

* Significant at 0.05

** Significant at 0.01

*** Significant at 0.001

The following is shown from the study of the correlative relationship:

The presence of statistically significant correlative relationship between the themes of the types of flowers and plants and between the total themes of improvement the internal environment of housing where the value of the correlation coefficient (0.532) and is a function value at the level of significance (0.01) This means that the higher the theme of the types of

flowers and plants the higher the level of improvement of internal environment of housing with its different themes.

The presence of statistically significant positive correlative relationship between the use of flower and natural plants and the total themes of improvement of internal environment of housing where the value of the correlation coefficient was (0.514) and is a function value at the level of significance (0.01) This means that the higher the theme of the use of flowers and natural plants the higher the level of improvement of internal environment of housing with its different themes.

The presence of statistically significant positive correlative relationship between the use of flowers and industrial plants and the total themes of improvement of internal environment of housing where the value of the correlation coefficient was (0.635) and is a function value at the level of significance (0.01) This means that the higher the theme of the use of flowers and industrial plants the higher the level of improvement of internal environment of housing with its different themes.

The presence of statistically significant positive correlative relationship between the methods of flowers and plants Care and the total themes of marital satisfaction where the value of the correlation coefficient (0.698) and is a function value at the level of significance (0.01) This means that the higher the theme of methods of flowers and plants Care the higher the level of improvement of internal environment of housing with its different themes.

The presence of statistically significant positive correlative relationship between the use of flower and ornamental plants and the total themes of improvement of internal environment of housing where the value of the correlation coefficient was (0.701) and is a function value at the level of significance (0.01) This means that the higher the theme of the use of flowers and ornamental plants its different themes the higher the level of improvement of internal environment of housing with its different themes.

The presence of statistically significant positive correlative relationship between the Aesthetic aspect theme and the total themes of improvement of internal environment of housing where the value of the correlation coefficient was (0.957) and is a function value at the level of significance (0.01) This means that the higher the theme of Aesthetic aspect the higher the level of improvement of internal environment of housing with its different themes.

The presence of statistically significant positive correlative relationship between the Psychological aspect theme and the total themes of improvement of internal environment of housing where the value of the correlation coefficient was (0.927) and is a function value at the level of significance (0.01) This means that the higher the theme of Psychological aspect the higher the level of improvement of internal environment of housing with its different themes.

After the previous presentation of the results of the first hypothesis it is clear that there is a positive correlative relationship between the use of flowers and ornamental plants, and improvement of internal environment of housing at level of significance 0.01 and thus realized the non-validity of the first hypothesis.

2. The results of the second hypothesis

The second hypothesis states that "There is no statistically significant difference between the study sample in using of flowers, ornamental plants in its different themes and improvement of the internal environment of housing in its two themes depending on the education level of the housewife" To validate the hypothesis statistically we used analysis of variance method in one direction, and the table (5) and (6) illustrates this.

Table (5) analysis of variance in one direction for the questionnaire of the use of a flowers and ornamental plants using of flowers, ornamental plants in its different themes depending on the level of education of the housewife n = 250

| Theme | Variance source | Total squares | Freedom degrees | Variance | F value | Significance level |
|--------------------------------------|-----------------|---------------|-----------------|----------|---------|---------------------------------|
| Types of flowers & plants | Inter-groups | 626.51 | 3 | 208.14 | 3.86 | 0.01 (significant at 0.01) |
| | Intra-groups | 13320.83 | 246 | 54.15 | | |
| | Total | 13947.34 | 249 | | | |
| Use of flowers and natural plants | Inter-groups | 610.73 | 3 | 203.58 | 3.36 | 0.02 (significant at 0.05) |
| | Intra-groups | 14869.97 | 246 | 60.45 | | |
| | Total | 15480.70 | 249 | | | |
| Use of flowers and industrial plants | Inter-groups | 1012.14 | 3 | 337.38 | 5.29 | 0.002 (significant at 0.001) |
| | Intra-groups | 15702.26 | 246 | 63.83 | | |
| | Total | 16714.40 | 249 | | | |
| Methods of flowers and plants care | Inter-groups | 764.22 | 3 | 254.74 | 5.24 | 0.002 (significant at 0.01) |
| | Intra-groups | 11963.87 | 246 | 48.63 | | |
| | Total | 12628.10 | 249 | | | |
| Total Themes | Inter-groups | 1150.45 | 3 | 3834.82 | 5.99 | 0.001 (significant at 0.001) |
| | Intra-groups | 157592.81 | 246 | 640.62 | | |
| | Total | 169097.26 | 249 | | | |

From table (5) the following is shown:

- Presence of statistically significant difference between the study sample in the theme of types of flowers and plants, and the educational level of the housewife where the calculated value of (F) was (3.86) which is functional at significance level (0.01).
- Presence of statistically significant difference between the study sample in the theme of use of flowers and natural plants, and the educational level of the housewife where the calculated value of (F) was (3.36) which is functional at significance level (0.05).
- Presence of statistically significant difference between the study sample in the theme of use of flowers and industrial plants, and the educational level of the housewife where the calculated value of (F) was (5.29) which is functional at significance level (0.01).
- Presence of statistically significant difference between the study sample in the theme of care of flowers and plants, and the educational level of the housewife where the calculated value of (F) was (5.24) which is not functional at significance level (0.01).

- Presence of statistically significant difference between the study sample in the theme of use of flowers and ornamental plants, and the educational level of the housewife where the calculated value of (F) was (5.99) which is functional at significance level (0.001).

When applying Tukey test it was found that the average degrees of the study sample is graduated from 197.67 for the elementary education level until reach 225.29 for the university education level which means the presence of statistically significant differences in the total themes of the use of flowers and ornamental plants at significance level (0.001) in favor of the housewives with university education level.

From the foregoing there is statistically significant difference between the study sample in the use of flowers and ornamental plants in its different theme, and the educational level of the housewife.

Table (6) analysis of variance in one direction for the questionnaire of improvement of internal environment of housing in its different themes depending on the level of education of the housewife n = 250

| Theme | Variance source | Total squares | Freedom degrees | Variance | F value | Significance level |
|----------------------|-----------------|---------------|-----------------|----------|---------|--------------------------------|
| Aesthetic aspect | Inter-groups | 2028.44 | 3 | 676.15 | 3.79 | 0.01 (significant at 0.01) |
| | Intra-groups | 43922.94 | 246 | 178.55 | | |
| | Total | 45951.38 | 249 | | | |
| Psychological Aspect | Inter-groups | 4097.57 | 3 | 1365.86 | 4.44 | 0.005 (significant at 0.01) |
| | Intra-groups | 75693.41 | 246 | 307.70 | | |
| | Total | 79790.98 | 249 | | | |
| Total Themes | Inter-groups | 11608.14 | 3 | 3869.38 | 4.48 | 0.004 (significant at 0.01) |
| | Intra-groups | 212114.57 | 246 | 862.25 | | |
| | Total | 223722.70 | 249 | | | |

From table (6) the following is shown:

- Presence of statistically significant difference between the study sample in the theme of Aesthetic aspect, and the educational level of the housewife where the calculated value of (F) was (3.79) which is not functional at significance level (0.01).
- Presence of statistically significant difference between the study sample in the theme of Psychological aspect, and the educational level of the housewife where the calculated value of (F) was (4.44) which is functional at significance level (0.01).
- Presence of statistically significant difference between the study sample in the total themes of improvement of the internal environment of housing, and the educational level of the housewife where the calculated value of (F) was (4.48) which is functional at significance level (0.01).

When applying Tukey test it was found that the average degrees of the study sample is graduated from 168.41 for the intermediate education level until reach 177.14 for the university education level which means the presence of statistically significant differences in the total themes of improvement of the internal environment of housing at significance level (0.01) in favor of the housewives with university education level.

3. The results of the third hypothesis

The third hypothesis states that "There is no statistically significant difference between the study sample in using of flowers, ornamental plants in its different themes and improvement of the internal environment of housing in its two themes depending on the monthly income of the family" To validate the hypothesis statistically we used analysis of variance method in one direction, and the table (7) and (8) illustrates this.

Table (7) analysis of variance in one direction for the questionnaire of the use of a flowers and ornamental plants using of flowers, ornamental plants in its different themes depending on the monthly income of the family

n = 250

| Theme | Variance source | Total squares | Freedom degrees | Variance | F value | Significance level |
|--------------------------------------|-----------------|---------------|-----------------|----------|---------|---------------------------------|
| Types of flowers & plants | Inter-groups | 696.96 | 5 | 139.39 | 2.12 | 0.06 (not significant) |
| | Intra-groups | 16017.44 | 244 | 65.65 | | |
| | Total | 16714.40 | 249 | | | |
| Use of flowers and natural plants | Inter-groups | 1433.48 | 5 | 286.70 | 4.98 | 0.000 (significant at 0.001) |
| | Intra-groups | 14047.22 | 244 | 57.57 | | |
| | Total | 15480.70 | 249 | | | |
| Use of flowers and industrial plants | Inter-groups | 1571.22 | 5 | 214.24 | 6.87 | 0.000 (significant at 0.001) |
| | Intra-groups | 11156.88 | 244 | 45.73 | | |
| | Total | 12628.10 | 249 | | | |
| Methods of flowers and plants care | Inter-groups | 1178.59 | 5 | 235.72 | 4.50 | 0.001 (significant at 0.001) |
| | Intra-groups | 12768.76 | 244 | 52.33 | | |
| | Total | 13947.34 | 249 | | | |
| Total Themes | Inter-groups | 17996.70 | 5 | 3599.34 | 5.81 | 0.000 (significant at 0.001) |
| | Intra-groups | 151100.57 | 244 | 619.27 | | |
| | Total | 169097.26 | 249 | | | |

From table (7) the following is shown:

- There is no statistically significant difference between the study sample in the theme of types of flowers and plants, and the monthly income of the family where the calculated value of (F) was (2.12) which is not statistically significant.

- Presence of statistically significant difference between the study sample in the theme of use of flowers and natural plants, and the monthly income of the family where the calculated value of (F) was (4.98) which is functional at significance level (0.001).
- Presence of statistically significant difference between the study sample in the theme of use of flowers and industrial plants, and the monthly income of the family where the calculated value of (F) was (6.87) which is functional at significance level (0.001).
- Presence of statistically significant difference between the study sample in the theme of care of flowers and plants, and the monthly income of the family where the calculated value of (F) was (450) which is not functional at significance level (0.001).
- Presence of statistically significant difference between the study sample in the total themes of use of flowers and ornamental plants, the monthly income of the family where the calculated value of (F) was (5.81) which is functional at significance level (0.001).

When applying Tukey test it was found that the average degrees of the study sample is graduated from 201.63 for those with income from 3000 to less than 5000 Riyals until reach 225.00 for those with income from 12000 to less than 16000 Riyals which means the presence of statistically significant differences in the themes of the use of flowers and ornamental plants at significance level (0.001) in favor of the income from 12000 to less than 16000 Riyals.

From the foregoing there is statistically significant difference between the study sample in the use of flowers and ornamental plants in its different theme, according to the income.

Table (8) analysis of variance in one direction for the questionnaire of improvement of internal environment of housing in its different themes among study sample depending on monthly income of the family n = 250

| Theme | Variance source | Total squares | Freedom degrees | Variance | F value | Significance level |
|----------------------|-----------------|---------------|-----------------|----------|---------|---------------------------|
| Aesthetic aspect | Inter-groups | 1354.82 | 5 | 270.96 | 1.48 | 0.20 (not significant) |
| | Intra-groups | 44596.56 | 244 | 182.77 | | |
| | Total | 45951.38 | 249 | | | |
| Psychological Aspect | Inter-groups | 2286.59 | 5 | 457.32 | 1.44 | 0.21 (not significant) |
| | Intra-groups | 77504.38 | 244 | 317.64 | | |
| | Total | 79790.98 | 249 | | | |
| Total Themes | Inter-groups | 6416.72 | 5 | 1283.34 | 1.44 | 0.21 (not significant) |
| | Intra-groups | | 244 | 890.60 | | |
| | Total | | 249 | | | |

From table (8) the following is shown:

- There is no statistically significant difference between the study sample in the theme of Aesthetic aspect, and the income where the calculated value of (F) was (1.48) which is not statistically significant.
- There is no statistically significant difference between the study sample in the theme of Psychological aspect, and the income where the calculated value of (F) was (1.44) which is not statistically significant.
- There is no f statistically significant difference between the study sample in the total themes of improvement of the internal environment of housing, and the according to income
- From the foregoing there is statistically significant difference between the study sample in the use of flowers and ornamental plants in its different theme, according to the income. While there is no statistically significant difference between the study sample in the total themes of improvement of the internal environment of housing, according to income, so the correctness of the third hypothesis is partially realized.

4. The results of the fourth hypothesis

The fourth hypothesis states that "There are no statistically significant differences sample in using of flowers, ornamental plants in its different themes and improvement of the internal environment of the housing in its different themes" To validate the hypothesis statistically we the value (T) to show the differences significance between the average degrees of working and non-working housewives, and the tables (9) and (10) illustrates this.

Table (9) differences significance between the average degrees of working and non-working housewives in using of flowers, ornamental plants in its different themes

| Theme | Working n =134 | | Non-working n =116 | | Differences between averages | Value of T | Significance level |
|--------------------------------------|----------------|------|--------------------|------|------------------------------|------------|--------------------------------|
| | M | J | M | J | | | |
| Types of flowers & plants | 56.48 | 7.30 | 53.13 | 8.18 | 3.35 | 3.45 | 0.001 (significant at 0.001) |
| Use of flowers and natural plants | 57.05 | 6.37 | 53.88 | 8.30 | 3.17 | 3.43 | 0. .001 (significant at 0.001) |
| Use of flowers and industrial plants | 56.97 | 7.35 | 53.55 | 8.51 | 4.42 | 4.39 | 0.000 (significant at 0.001) |
| Methods of flowers and | 55.82 | 7.05 | 52.53 | 6.88 | 3.29 | 3.70 | 0.001 (significant at |

| | | | | | | | |
|--------------|--------|-------|--------|-------|-------|------|------------------------------------|
| plants care | | | | | | | 0.001) |
| Total Themes | 227.32 | 23.07 | 213.09 | 31.87 | 14.23 | 4.46 | 0.000 (significant at 0.001) |

From table (9) the following is shown:

- The average degrees of working exceed the average degrees of non- working in the total of the first theme (types of flowers and plants) by 4.40 which is a significant value at the level of significance (0.001), and this means that there are statistically significant differences between the average degrees of working and non- working in the Pro forma basis theme.
- The average degrees of working exceed the average degrees of non- working in the total of the second theme (use of flowers and natural plants) by 3.70 which is a significant value at the level of significance (0.001), and this means that there are statistically significant differences between the average degrees of working and non- working in the material basis theme.
- The average degrees of working exceed the average degrees of non- working in the total of the third theme (use of flowers and industrial plants) by 3.18 which is a significant value at the level of significance (0.001), and this means that there are statistically significant differences between the average degrees of working and non- working in the religious and moral theme.
- The average degrees of working exceed the average degrees of non- working in the total of the fourth theme (flowers and plants Care methods) by 3.37 which is a significant value at the level of significance (0.01), and this means that there are statistically significant differences between the average degrees of working and non- working in the socio-cultural basis theme.
- The average degrees of working exceed the average degrees of non- working in the total of the four theme by 14.23 which is a significant value at the level of significance (0.001), and this means that there are statistically significant differences between the average degrees of working and non- working in the total themes of the use flowers and ornamental plants.

Table (10) differences significance between working and non-working housewives in improvement of the internal environment in its different themes

| Theme | Working n =134 | | Non-working n =116 | | Differences between averages | Value of T | Significance level |
|------------------|----------------|-------|--------------------|-------|------------------------------|------------|-----------------------------------|
| | M | J | M | J | | | |
| Aesthetic Aspect | 89.40 | 12.98 | 84.53 | 13.85 | 4.87 | 2.87 | 0.004 (significant at 0.01) |
| Psychological | 90.39 | 18.41 | 82.95 | 16.49 | 7.44 | 3.34 | 0. .001 |

| | | | | | | | |
|--------------|--------|-------|--------|-------|-------|------|------------------------------|
| Aspect | | | | | | | (significant at 0.001) |
| Total Themes | 179.78 | 29.62 | 167.47 | 29.14 | 12.31 | 3.30 | 0.001 (significant at 0.001) |

From table (10) the following is shown:

- The average degrees of working exceed the average degrees of non- working in the total of the first theme (Aesthetic Aspect) by 4.87 which is significant at the level of significance (0.01), and this means that there are statistically significant differences between the average degrees of working and non- working in the Pro forma basis theme.
- The average degrees of working exceed the average degrees of non- working in the total of the second theme (Psychological Aspect) by 7.44 which is significant at the level of significance (0.001).
- The average degrees of working exceed the average degrees of non- working in the total themes of improvement of the internal environment of housing by 12.31 which is a significant value at the level of significance (0.001), and this means that there are statistically significant differences between the average degrees of working and non- working in the total themes of improvement of the internal environment of housing.

After the foregoing presentation for the results of the eighth Hypothesis we conclude that there is statistically significant difference between the working and non- working housewives in the use of flowers and ornamental plants in its different theme, and the improvement of the internal environment of housing in favor of the working housewives, thus the correctness of the fourth hypothesis cannot be realized.

Summary of the most important result of this study

The result of this study revealed the following:

- 1-The presence of a positive correlative relationship between using of flowers, ornamental plants and improvement of the internal environment of the housing at a significance level 0.01
- 2-The presence of statistically significant difference between the study sample in using of flowers, ornamental plants in its different themes depending on the education level of the housewife at a significance level 0.001 and presence statistically significant difference between the study sample in the total themes of improvement of the internal environment of the housing at a significance level 0.01.
- 3-The presence of statistically significant difference between the study sample in using of flowers, ornamental plants in its different themes depending on the level of income at a significance level 0.001 while there is no statistically significant difference between the study sample in improvement of the internal environment of the housing in its different themes depending on the level of income.

4-There is statistically significant difference between the working and non- working housewives in the use of flowers and ornamental plants in its different theme, and the improvement of the internal environment of housing in its different theme in favor of the working housewives.

Study Recommendations

Based on the results of the current study, the researcher recommends the following: -

1. Holding extension courses and programs to raise awareness of the use of flowers and ornamental plants in terms of types and their uses and methods of coordination and taking care of him.
2. Emphasize the role of the interior designer in consumer awareness of the impact of flowers and ornamental plants on the general beauty of the house decor and its role in providing comfort and enjoyment of the housing
3. Attention of the authorities concerned with housing by creating the spirit of nature in modern designs taking into account the suitability of climatic conditions and the easiness of taking care of it to ensure its continuity.
4. The expansion in establishment of nurseries and greenhouses and the provision of modern types of flowers and plants with aesthetic character and scents to upgrade the public taste and give more enjoyment and beauty.
5. Conduct a study of prices for flowers and plants so that the consumer can obtain them easily and smoothly.
6. Establishment of centers that supervise the use of flowers and plants in the house and develop the use and care of them.

References List

- 1- Abu Dijain, Ibrahim Mubarak (1424 H) : collection and assessment of the most important ornamental plants and their landscape uses in the public park in Riyadh, "Master, Faculty of Agriculture, King Saud University, Riyadh.
- 2- Asrar. Abdulwase Abdul Ghafoor (1428): Harvested flowers and methods of care, King Fahd Library, Riyadh.
- 3- AL Shafei. Shaima Atef (2006): "furnishing the living area and its relationship to the psychological needs of the housewife and internal relations in the family," PhD thesis, College of Home Economics, University of Menoufiya.
- 4- AL Zagat. Moeen Fahd & Tajuddin, Salah Saad & Alshababni. Osama (1413): The most important desert garden plants guide, Desert Studies Center, King Saud University, Riyadh.

- 5- AL Zoom. Ibtisam and AL Moosa. Samia (2008): the inner and outer Aesthetic of the housing – Swimming pool-Gardens- complementary, Al Rushod library, Riyadh.
- 6- AL Ssayfi. Ihab Bismarck (1419): "Aesthetic and structural bases of design," Master, Department of Architecture, King Saud University, Riyadh.
- 7- AL Tayeb. Mohammed Abdul Zahir & AL Deraini. Hussein & Badran. Shibil & AL Beblawy. Hussein & Abu Tahoun. Adli (2000): Research Approaches on Educational and Psychological science, Angelo library, Cairo, Egypt.
- 8- AL Adawi, the Jamal Moosa (2010): Domestic Garden, Dijla home, Baghdad.
- 9- Alqiei. Tariq & Saadawi. Faisal (1996): ornamental Plants and interior decoration, Dar AL Meraikh Publishing, Riyadh.
- 10- AL Manea. Fahad and AL Khirib. Suleiman and Saadawi. Faisal and Muhammad. Salah (1419): internal landscaping plants and diseases, King Fahad Library, Riyadh.
- 11- Ashour. Aisha Ahmed (2011): interior design and its psychological impact, Dar Alhadarah for publication and distribution, King Fahad Library, Riyadh.
- 12- Agricultural Extension Center (1990): implanting, ornamental plants and landscaping, King Saud University Press, Faculty of Agriculture, King Saud University.
- 13- Agricultural Extension Center (1996): the creation and maintenance of home gardens, King Saud University, Riyadh.
- 14- AL Masri. Jawad Radi (2004): ornamental plants and landscaping, AL Shorouq House, Amman.
- 15- Badr. Mustafa (2000): flowers landscaping and beautify buildings, AL Ma'aref facility, Alexandria.
- 16- Brinton, Dianna,1991.The Complete guide to flower arranging Mere Hurst, London.
- 17- Badahdah ‘A.M. & Tiemann. ‘K.A. (2005). Mate selection criteria among Muslims living in America. Evolution and Human Behavior.
- 18- Hessayon,D.G.1996.The new Rose expert. Expert books.
- 19- Hessayon,D.G.1991.The Howse plant Expert pbi publication
- 20- Khalifa. Sayed Faraj (1985): Oranmental flowers and bulbs, in the Kingdom of Saudi Arabia, Princess Nora Bint Abdul Rahman University, Riyadh.

- 21- Khalil. Heba Farouk (2004): the effectiveness of Extension program toward furnishing and beautify the living area and its relationship to the family consensus, Master, Faculty of Specific Education, Suez Canal University.
- 22- Mazahrah. Ayman & Hammouda. Fadwa (2003): Domestic agriculture and home garden, first edition, Dar Al Manahej for Publishing and Distribution, Amman, Jordan.

Assessment of Nursing Students' Attitude toward Learning Communication Skills at King Saud bin Abdul-Aziz University for Health Science - College of nursing Riyadh (CON-R)

Eman S.M Miligi PHD, MN SC, Faculty of Nursing, Nursing Administration Department, Cairo University King Saud Bin Abdul-Aziz University for Health Science College of Nursing –Riyadh

Second others : Miaad A. Al Horaim, Mariam W.Al anazi, Ghada M. Alateeg : Nursing graduate

Abstract:

Objectives: The aim of this study is to assess the attitudes of nursing students toward learning communication skills across the two years of nursing study. Also to identify factors that may influence attitudes toward learning communication skills, such as age, level of study, GPA, exposure//non- exposure to formal training in communication skills.

Methodology: A Descriptive Cross- Sectional design is utilized to assess the attitudes of nursing students towards learning communication skills. The participants of the study were all the students enrolled in the undergraduate bachelor course from the pre-professional (N 66) and professional program (120). On the other hand, the survey questionnaire consisted of 25- items skills attitude communication scale where in each item is represented by a 5-point Likert scale ranging from 1(strongly disagree)to 5(strongly agree) Likewise, included also were negative and positive statements wherein all negative items were reversely coded for analysis. Henceforth, all higher scores in the items indicated more positive attitudes toward

learning communication skills.

Results: The study findings indicated that the mean scores of the participants were 21+ 1.507 and the mean scores of their GPA were 3.280+ .5587. This data revealed

that there was significant positive correlation between the level of study and their attitude toward learning communication skills ($r=.795$ $p = .000$) Moreover there was a significant positive correlation between GPA and their attitude ($r =.472$ $p=.000$).

However, there was limited positive relationship between their age and their attitude toward learning communication skills ($.196$ $p= .015$). With regard to the total communication scores the findings revealed that the students enrolled in the pre-professional program got on 84.6+ 1.13 while the students enrolled in professional program had 86.91+ 1.13.

Conclusion: It can be deduced from the finding of the study that students in professional program have positive attitude toward learning communication skills than the students in the pre professional program.

Key words: Attitude- nursing students- learning- communication skills.

Introduction

Communication skills are vital in nursing profession. It is important in dealing with people of different personalities, advanced communication skills courses are being offered only in the second- two years of professional nursing education but never in the first-second year of pre professional program. Tantamount to this to further cite its importance, one of the learning outcome identified in the nursing program at King Saud Bin Abdul-Aziz University for health science is that, “students

should be able to effectively communicate with individuals, families, groups and communities” .With this development, it is indeed significant to assess the attitude of nursing students towards learning communication skills in relation to their age, GPA and level of study. In another perspective, communication is essential in building trust and rapport to determine and recognize patient needs Moreover, Fakhr, (2011) stated that the nursing process is a scientific model in the nursing practice which is achieved through endorsement, interpersonal environment and specific skills of verbal communication. In the hospital, nurses are considered coordinator because they act as the primary contacts person who serves as link between the patient and member of the health team .Likewise, the power of effective nursing care depends on good communication skills. In the light of the above, previous researches made by Cegala & Broz,(2002) as well as Humpris & Kaney (2001) supported the findings that good communication skills are helpful to the relationship between the patients and their health care providers as it links to effective health outcome. On the other hand, all employers preserve that graduates should practice in some topics as listening and speaking (Mayes, Weldey, & Icenogle, 1997).Furthermore, a lot of researches about communication skills in training suggested that effective communication skills improve the relationship between the nurse and the patient and are related to positive health outcomes.

In the same line, more effective health care organizations ,effective health care delivery provider and patient satisfaction with lower incidents of malpractice

have been attached to effective communication skills. Moreover, the American Association of Colleges of Nursing (AACN) stated that the communication skills is one of nursing competencies that must be acquired over the course of nursing academic program, AACN (February 2007) and Kaufman (2001) provided evidences that the students' attitudes toward communication skills are affected by taking courses that emphasize communication skills in training. . Moreover, Maria, et al (2012) reported in their study that the students who were exposed to in the newly developed training who take communication skills as a course exhibit an increase in their skills. Likewise, it was also showed that students who in the intervention group had a higher scores in the competencies which assess the self-following practicing than the other student who in the comparison group. On the contrary, Communication skill education is extensively debated. As Kerby and Romine (2009) suggested inserting communication courses in the curriculum is required by the employers. Also Du-Babcock (2006) mentioned that applying communication skills in the future is dependent on learning communication application materials not just theory and models. Murranka and Lynch (1999) proved earlier that a communication course based on competency and concentrated on skills applications is highly beneficial in Nursing and Midwifery courses. It is further stated that all nurses must demonstrate the competency of communication and interpersonal skills with other health care discipline to deliver patient centered care. Infact, the Saudi Commission of Health Specialties Nursing Scientific Board (2014) documented the Nursing Competencies for Bachelor Degree Graduate. One of the

nursing competencies included is” interpersonal communication and collaboration for improving patient health outcomes by demonstrating effective communication techniques including negotiation, team work, collaborative strategies and conflict resolution to produce positive professional working environment”. Accordingly, the purpose of this study is to assess the attitudes of nursing students toward learning communication skills. Also to identify factors that may influence attitudes toward learning communication skills, such as age, level of study, GPA exposure/non-exposure to formal training in communication skills.

Objectives of the study

The objectives of the current study were to:

- 1- Measure the nursing student`s attitude toward learning communication skills.
- 2- Investigate the correlation between the socio demographic factors on the nursing students and their attitude toward learning communication skills.

Subjects and methods:

Research design: A Descriptive Cross- Sectional design was utilized to identify the attitudes of nursing students towards learning communication skills.

Setting: This study was carried out in the College Of Nursing Riyadh (CON-R) – King Saud Bin Abdul-Aziz University for Health Sciences (KSAU-HS).

Subjects of the study: A non-probability convenience sample was used in the study. All the students enrolled are in the undergraduate bachelor of nursing program and are from the first level to the eighth level. The purposive sample was

chosen so that the students enrolled in the first two years were not exposed to the communication courses. On the contrary, students in the last two years were taught communication as a lecture or as a subject over the two years. Thereby, we can measure the students' attitudes before and after taking this course. Corollary to their rights, students were informed that participation is voluntary, informed of their right to withdraw from the study at any time, and assured that all their information's are kept anonymous as agreed in the informed consent signed by them.

Instruments of data collection: Data were collected using the:

- 1- Demographic information about age of the students, semester of study and GPA.
- 2- The communication skills attitude scale (CSAS) originally developed by
- 3- Rees and colleagues (2002). The CSAS has been used in subsequent studies by Rees and other researchers Anvik T, et,al (2007) each item is accompanied by a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), All negative CSAS items were reverse coded for analysis, so that higher scores on all items indicated more positive attitudes toward communication skills training. A pilot study was conducted to test the feasibility and applicability of the tool. The pilot study was carried out on fifteen subjects and the results of the pilot study were used in refining the questionnaire form. Relevant comments were obtained from the subjects, and on the basis of their comments, the following changes were

made to the CSAS:

Modifications

- Item 2; Original - I can't see the point in learning communication skills.
- Modified - I don't see that I need to learn communication skills.
- Item 3; original - Nobody is going to fail their medical degree for having poor communication skills.
- Modified - Nobody is going to fail their nursing degree for having poor communication skills.
- Item 8; Original - I can't be bothered to turn up to sessions on communication skills.
- Modified - It's too much to attend classes on communication skills.
- Item 11; Omitted - Communication skills training states the obvious and then complicates it.
- Item 20; Original - I find it hard to admit to having some problems with my communication skills.
- Modified - My ability to pass exams will get me through nursing school rather than my ability to communicate.

Procedures

After obtaining the official approval to conduct the study, the questionnaire will be distributed to the students during regular class periods during the academic year 2014-2015. The students received

written instructions that specified the purpose of the study and explain the procedure to be followed in responding to the items .Students were asked to return the survey to the class instructor who in turn returned it to the researchers. The questionnaire takes approximately 15 minutes to complete.

Ethical issues:

Informed written consent was obtained from the students who agreed to participate in the study. It was clearly stated that students’ participation is voluntary and confidential and students were assured about their right to withdraw from the study at any time.

Results of study:

Findings of the current study are presented in three sections: demographic characteristics of the subjects, nursing student’s attitude towards learning communication skills and finally the correlation between these demographic characteristics and their attitude toward learning communication skills

Table 1: Descriptive Statistics

| | <i>Mean</i> | <i>Std. Deviation</i> |
|---------------------|---------------|-----------------------|
| age in years | 20.31 | 1.507 |
| student GPA | 3.280 | .6421 |
| Mean score | 3.7533 | .55874 |

This table shows the mean age of the subject 20.31 years the means GPA is 3.28 Table 2 Scores of communication skills attitude scale (range 1-5) No 186

| | mean | Standard deviation |
|---|------|--------------------|
| 1. In order to be a good nurse I must have good communication skills | 4.53 | 1.149 |
| 2. I don't see that I need to learn communication skills | 1.72 | 1.135 |
| 3. Nobody is going to fail their nursing degree for having poor communication skills | 2.70 | 1.221 |
| 4. Developing my communication skills is just as important as developing my knowledge of nursing. | 3.96 | 1.212 |
| 5. Learning communication skills has helped or will help me respect patients. | 4.25 | 1.125 |
| 6. I haven't got time to learn communication skills | 2.37 | 1.124 |
| 7. Learning communication skills is interesting | 4.02 | 1.173 |
| 8. It's too much to attend classes on communication skills. | 2.85 | 1.134 |
| 9. Learning communication skills has helped or will help facilitate my team working skills. | 4.35 | 0.954 |
| 10. Learning communication skills has or will improve my ability to communicate with patients. | 4.35 | 1.031 |
| 11. Learning communication skills is fun. | 3.81 | 1.114 |
| 12. Learning communication skills is too easy. | 3.36 | 1.112 |
| 13. I find it difficult to trust information about | 2.89 | 1.239 |

| | | |
|---|------|-------|
| | 4.11 | 1.053 |
| 14. Learning communication skills has helped or will help me recognize patients' rights regarding confidentiality and | | |
| 15. Communication skills teaching would have a better image if it sounded more like a science subject. | 3.44 | 1.32 |
| 16. When applying for nursing, I thought it was a really good idea to learn communication skills. | 3.97 | 1.192 |
| 17. I don't need good communication skills to be a nurse | 1.97 | 1.29 |

| | | |
|---|-------------|--------------|
| 18. I don't like to show that I have problems in communication skills. | 2.89 | 1.189 |
| 19. I think it's really useful learning communication skills on the nursing degree. | 4.09 | 1.185 |
| 20. My ability to pass exams will get me through nursing | 3.25 | 1.227 |
| 21. Learning communication skills is applicable to learning | 3.79 | 1.074 |
| 22. I find it difficult to take communication skills learning seriously. | 2.60 | 1.127 |
| 23. Learning communication skills is important because my ability to communicate is a lifelong skill.. | 4.09 | 1.141 |
| 24. Communication skills learning should be left to psychology students, not nursing student. | 2.08 | 1.377 |
| 25. Learning communication skills has helped or will help me respect my colleagues | 4.24 | 1.153 |

Table-2 shows that the items means scores for student`s attitude towards learning communication skills, the highest mean scores range between (4.53) and (4.09) in relation to the items: In order to be a good nurse I must have good communication skills, Learning communication skills has helped or will help me respect patients, Learning communication skills is interesting, Learning communication skills has helped or will help facilitate my team working skills, Learning communication skills has or will improve my ability to communicate with patients, . Learning communication skills has helped or

will help me recognize patients' rights regarding confidentiality and informed consent, I think it's really useful learning communication skills on the nursing degree and finally , Learning communication skills has helped or will help me respect my colleagues.

They have moderately mean score ranged between (3.96) and (2.60) in relation to the items: Developing my communication skills is just as important as developing my knowledge of nursing, Nobody is going to fail their nursing degree for having poor communication skills, It's too much to attend classes on communication skills, Learning communication skills is fun, Learning communication skills is too easy, I find it difficult to trust information about communication skills given to me by non-clinical lecturers, Communication skills teaching would have a better image if it sounded more like a science subject, When applying for nursing, I thought it was a really good idea to learn communication skills, My ability to pass exams will get me through nursing school rather than my ability to communicate, Learning communication skills is applicable to learning Nursing and finally . I find it difficult to take communication skills learning seriously.as well as they have lowest means score which ranged between (1.72) and (1.97) which is relation to I don't see that I need to learn

communication skills and . I don't need good communication skills to be a nurse.

Table3- Correlation between the demographic data and student`s attitude toward communication

| | <i>Communication</i> | |
|-----------------------|----------------------|-------------|
| | <i>r</i> | <i>p</i> |
| Level of studv | .795** | .000 |
| Age | .196* | .015 |
| GPA | .472** | .000 |

**** . Correlation is significant at the 0.01 level (2-tailed).**

***. Correlation is significant at the 0.05 level (2-tailed).**

Table 3 reveals that there is strong positive correlation between the level of study and their attitude towards learning communication skills and moderate correlation between the GPA and their attitude and finally there is mild correlation between theage their attitude toward learning communication skills.

Table 4 - Compare of means between professional and paraprofessional regarding the attitude toward learning communication skills

| MEAN&SD | Professiona (156) | Pre- f (126) | All student (126) |
|--------------------|------------------------------|-----------------------------|------------------------------|
| | 84.6 ±11.25 | 86.911 ±1.33 | 86.11 ±1.32 |

Table -4 highlights that the students enrolled in the pre-professional program have low score than the students in the professional program.

Data Analysis

Data were coded for entry and analysis using SPSS statistical software package version 18. Data were presented using descriptive statistics were used to identify the personal characteristics of the total sample students. The association of the dependent variables with the independent variables (GPA and year level) was determined. Correlation -test, means and Standard deviation were used with $p < 0.05$. SPSS version 18 was used for the statistical analysis.

Results:

The study findings indicated that the mean age of the participants was $21 + 1.507$ and the mean scores of their GPA was $3.280 + .5587$. The study revealed that the students enrolled in the professional program got high scores ($86.91 + 1.13$) than the students enrolled in pre- professional program had ($84.6 + 1.13$). Also there was a strong significant positive correlation between level of study and their attitude toward learning communication skills ($r = .795$ $p = .000$). Moreover there was a moderate significant positive correlation between GPA and their attitude ($r = .472$ $p = .000$) finally mild correlation between their age and their attitude toward learning ($r = .196$ $p = .015$) communication skills.

Discussion

This study aims to assess the attitudes of nursing students toward learning

communication skills.

All the respondents are female .Majority of them are ranged between 19- 21 years of age with the GPA mean score of 3.28. Corollary to these respondents, 35.4% of them are enrolled in the pre-professional program and the remaining 64% in the professional program with the possible mean scores for each item that varies from 1 to 5. The study also revealed that highest means score which range between 5 to 4 and dominates some of the important items that has a relationship to nursing profession such as “In order to be a good nurse I must have good communication skills and Learning a communication skill has or will improve my ability to communicate with patients” I think it’s really useful learning communication skills on the nursing degree. However, in the mindset of the researchers the results can be attributed to the significance of communication skills in relation to the nursing Profession and gender in as much as all the respondents are female. Likewise, female loves to communicate and therefore, would like the subject communication. Along this vein, Faze.(2011) that cited that female students had more positive attitude toward communication skills training than male students.

On the contrary, the study further revealed that some items got moderate mean score which ranged between 3.96 to 2.70 such as follows” it’s too much to attend classes on communication skills , I find it difficult to take communication skills

learning seriously and the Communication skills learning should be left to psychology students, not nursing student.

Relative to these moderate scores negative findings to communication, the researcher found out that some respondents perceived that learning communication skills is a priority to the nursing profession but moderately convince about the importance of communication in nurse patient interaction. Henceforth, the researchers think that those students exposed to the communication as a subject but they did not practice.

Other findings revealed that some items had low mean scores that ranged between 1.72 to 2.08 such as follows as in survey “I don’t need good communication skills to be a nurse”. “I haven’t got time to learn communication skills”.

“Communication skills learning should be left to psychology students, not nursing student”. Henceforth, it can be gleaned from these results that most respondents were not convinced about the valuable contribution of communication in the delivery of quality patient care and not realized with the importance of communication to be a good nurse and they can learn and gain communicationskills by experience therefore they gave a low marks to such cited items. On another venue, the study revealed that some students enrolled in the first two years had low scores than the students enrolled in the last two years, this result

could be attributed that these students in the first two years are not exposed to the clinical experience and therefore has no experience in dealing with patient and did not know the value of nurse patient interaction towards quality nursing care. In the light of these cited issue, Neupane ,M. S. (2012). He explained that the students in \ second year group had positive attitude toward communication skills more than first year attitude, that showed there were significant difference between the two group .Hence forth, the researcher believes that the students in the professional program should be more exposed to the clinical experience which offer opportunities to interact with the patients and health care providers so that they could be fully convinced about the importance and implications of learning good communication skills in relation to safe and quality patient care.. In the same line, Fazel,I. (2 011) said that the there are significant difference between students in basic science and pathophysiology course and the students in clinical sciences with regards to their attitudes toward learning communication skills which in contrary to Wright(2006) who reported that the attitude of fourth year students did not differ than first years in their attitudes toward communication skills, Also Marambe,K.N,(2012) who added that most Junior students had more positive attitudes than senior students. These former cited findings are inconsistent to Rees and Garrud (2001), who cited that older and advanced students have more positive

attitude toward learning communication skills training. Finally, this study revealed that there is a mild correlation between the subject's age and their attitude toward learning communication the finding is supported by Rees and Sheard (2002) who cited that younger students have more positive attitudes toward communication skills learning. Likewise, Kevin et al (2006) emphasized that there is no difference between younger or older age of the students in their attitude toward communication skills learning.

Conclusion / Recommendations

The students in professional program perceived the importance of learning communication skills in relation to be a good nurse than the students in the pre professional program.

References

- [1] Rees C, Sheard C, Davies S.(2002) The development of a scale to measure medical students' attitudes towards communication skills learning: the Communication Skills Attitude Scale (CSAS). *Med Educ*;36(2):141-7.
- [2] Anvik T, Gude T, Grimstad H, Baerheim A, Fasmer OB, Hjortdahl P, Vaglum P.(2007) Assessing medical students' attitudes towards learning communication skills: which components of attitudes do we measure? *BMC Med Educ*;7:4
- [3] Du-Babcock, B. (2006). Teaching business communication: Past, present, and future. *Journal of Business Communication*, 43 (3), 253-264.

- [4] Kirby, D. & Romine, J. (2009). Develop oral presentation skills through accounting curriculum design and course-embedded assessment. *Journal of Education for Business*, 85, 172-179.
- [5] Murranka, P. A. & Lynch, D. (1999). Developing a competency-based fundamentals of management communication course. *Business Communication Quarterly*, 62 (3), 9- 23.
- [6] Mayes, J. D., Weldy, T. G., & Icenogle, M. L. (1997). A managerial perspective: Oral communication competency is most important for business students in the workplace. *Journal of Business Communication*, 34(1), 67-80.
- [7] AACN. (February 2007). White Paper on the Education and Role of the Clinical Nurse Leader™
- [8] Maria C et al. (2012) Enhancing medical students' communication skills: development and evaluation of an undergraduate training program.. *BMC Medical Education*, (12), 12-16
- [9] Kevin B. et,al (2006) Medical Student Attitudes Toward Communication Skills Training and Knowledge of Appropriate Provider-Patient Communication: A Comparison of First-Year and Fourth-Year Medical Students. *Med Educ* , Available from <http://www.med-ed-online.org>
- [10] Lambrini. k and Losnna.V(2014) communication in Nursing : *Journal of a academy of medical science of Bosnia and Herzegovina*, 26,v 65-67
- [11] Raya A. Nursing of man as a unique person *Nosileftiki*. 2006;45(1):19–24.
- [12] Fakhr-Movahedi A, Salsali M, Negarandeh R, Rahnavard Z. Exploring contextual factors of the nurse-patient relationship: A qualitative study. *Koomesh*. 2011;13(1):23–34.
- [13] Raya A. Ed.6th. Athens: 2005. *Basic Nursing*.
- [14] Kevin B. et al Medical Student Attitudes toward Communication Skills Training and Knowledge of Appropriate Provider-Patient Communication: A Comparison of First-Year and Fourth-Year Medical Students” *Med Educ Online* [serial online] 11:18(2006) Available from <http://www.med-ed-online.org>.

Effect of the Hydraulic Retention Time and Temperature on the efficiency of Up-flow Anaerobic Filter Reactor treating Rural Domestic Sewage

John Leju Celestino LADU^{1,2}, Xi-wu LÜ^{1*}, Zhong Zhao PING¹

¹Southeast University, Nanjing 210096, P. R. China

²University of Juba, Juba 82, South Sudan

Abstract

Application of up-flow anaerobic filter (UAF) reactor for the treatment of rural domestic sewage nowadays is extensively documented as efficient and cost-effective process reactor and importantly for organic matter and nutrients removal. The influent for this experimental study was collected from a sewage manhole at Southeast University campus in Wuxi, China. The reactors were operated continuously for 28 days as the start-up period until it acclimatized. Two rounds of experimental operations were conducted in a laboratory scale. The first round was during summer season at mesophilic condition and the second one during winter at psychrophilic temperature. The UAF reactor system was composed of two columns made of polyvinyl chloride (PVC), with a total capacity of 200 L. The two UAF reactors were connected in a series with an internal diameter of 0.2 m and a height of 2 m. The columns was filled with non-woven fabric filter material with a length of 2.5 m, width of 50 mm, surface area of 150 m²/m³, porosity of 97% and an effective volume of 90 L for each column. In the course of the experimental operations, the effect of hydraulic retention time (1, 2, 3 and 4 days) and temperature (31.6°C, 32.95°C, 33.7°C, 16.4°C and 10.2°C) on organic matter and nutrients removal were assessed. Accordingly, the optimum hydraulic retention time (HRT) and temperature observed in UAF was three days and 33.7°C with the maximum average chemical oxygen demand (COD) and total nitrogen (TN) removal of 91% and 65% respectively. The results of the experiments revealed high efficiency when the reactor's HRT and temperature increases. The study concludes that, the UAF treatment of various biomass substrates from the rural domestic sewage gives a number of advantages for the management of rural domestic sewage.

Key words: up-flow anaerobic filter; sewage, acclimatized; organic matter; nutrients

1. Introduction

Despite the fact that rural domestic sewage is considered to be a pollutant, it can be exploit as useful resource for water, manure and energy [1, 2, 3]. Organic matter and nutrients input to our environment has increased tremendously in the recent few decades. Several studies have shown that an overabundance of organic matter and nutrient compounds is overwhelming ecosystems in several parts of the world. Organic matter and nutrients, when present in excessive amounts, can pollute the water environment and consequently cause eutrophication which is detrimental and will directly or indirectly cause algal bloom and on the other hand cause toxicity to organisms, including humans.

Recently, rural domestic sewage treatment has been studied either by application of anaerobic filter (UAF) reactors [4, 5], aerobic filter [6], or application of high-rate aerobic systems, such as

rotating biological contactor and fluidised bed [7], or by application of low-rate systems, such as slow sand filter [8] and vertical flow constructed wetlands [2].

In this study, application of anaerobic filter (UAF) reactor was assessed for the treatment performance of organic matter and nutrient removal. Treatment of rural domestic sewage by anaerobic filter reactor is widely recognized as a mature and cost-effective process for the management of rural domestic sewage and importantly for organic matter removal, nutrient removal and bio-gas production, which is an alternative valuable renewable primary source of energy. The up-flow anaerobic filter is on the other hand one of the earlier design and operational characteristics are well defined [9]. In engineering terms, it is not as complex as a fluidised bed reactor and in biological terms it does not require the formation of a granular sludge, a prerequisite for the upflow sludge blanket digester [10].

The anaerobic filter (UAF) process has gained popularity and has been applied in various rural domestic wastewater treatment schemes since it was first developed by Young and McCarty (1969). An AF reactor is chiefly a column or tower packed with support filter material for the growth of biomass.

2. Materials and methods

2.1 Experimental Raw Materials

The types of wastewater used for this study was rural domestic sewage. The influent was collected from a sewage manhole at the campus of Taihu Lake Environmental Engineering Research Center of Southeast University, Wuxi, China, and then pumped into a storage tank as influent to the UAF system. The UAF reactors were inoculated with sludge obtained from a municipal sewage treatment plant in Wuxi. The reactors were operated continuously for 28 days (four weeks) as the start-up period until the performance was acclimatized. The effluent samples of every reactor were collected at the sampling ports of the reactors in separate bottles every three days interval and stored in a refrigerator at 5°C before experimental tests in the laboratory. The pH value and temperature were recorded daily. The composition of the raw domestic sewage used in this study is shown in Table 1.

Table 1 Composition of study raw domestic sewage

| Item | COD concentration (mg/L) | TN concentration (mg/L) | pH value |
|---------|-----------------------------|----------------------------|----------|
| Minimum | 59.0 | 14.6 | 7.2 |
| Maximum | 285.6 | 38.1 | 7.8 |
| Average | 167.4 | 25.4 | 7.5 |

2.2 Experimental setup

The experimental system was comprised of a regulating tank (influent tank), submersible pumps, and a UAF bioreactor system. The UAF reactor system was composed of two columns made of polyvinyl chloride (PVC), with a total capacity of 200 L. The two columns were typically operated as an anaerobic zone. The UAF reactors were connected in a series. The two anaerobic columns had an internal diameter of 0.2 m and a height of 2 m. The columns was filled with non-woven fabric filter material with a length of 2.5 m, width of 50 mm, surface area of 150 m²/m³, and porosity of 97%. The UAF reactors had an effective volume of 90 L for each column. The influents were pumped from the same feed tank to the bottom of the columns with the help of a

pump (BT100-2J). Sampling ports were located at different heights to help in extraction of samples for experimental tests and analysis.

The flow rates were 200 L/d, 100 L/d, 66 L/d, and 50 L/d corresponding to HRTs of one day, two days, three days and four days, respectively. The first three months of the experimental operation were conducted with HRTs of one, two, and three days and run at mesophilic conditions (high temperature operations).

After assessing the response of the reactor performance to those experimental factors and conditions in the first round of operations (mesophilic condition), the reactor was then operated with HRTs of three and four days and operated at psychrophilic conditions (low temperature operations).

2.3 Estimation of parameters

2.3.1 Volumetric hydraulic load

The amount of wastewater applied daily to the reactor, per unit of volume, is termed the volumetric hydraulic load (L , $\text{m}^3/(\text{m}^3 \cdot \text{d})$) [11]:

$$L = \frac{Q}{V} \quad (1)$$

where Q is the flow rate (m^3/d), and V is the total volume of the reactor (m^3). The hydraulic retention time (τ), given in days, is expressed as

$$\tau = \frac{1}{L} \quad (2)$$

which gives

$$\tau = \frac{V}{Q} \quad (3)$$

2.3.2 Volumetric organic load

The volumetric organic load (VOL) is the amount of organic matter applied daily to the reactor, per unit of volume [11]:

$$L_o = \frac{QS_i}{V} \quad (4)$$

where L_o is the volumetric organic load for COD ($\text{kg}/(\text{m}^3 \cdot \text{d})$), and S_i is the influent substrate concentration (kg/m^3).

For domestic wastewater characterized by low organic matter concentrations, the VOL value to be applied usually ranges from 2.5 to 3.5 $\text{kg}/(\text{m}^3 \cdot \text{d})$ [12].

2.3.3 Removal efficiency of reactor

The removal of COD in the UAF system refers to the difference between the influent concentration (C_{inf}) of COD and the effluent concentration (C_{eff}) of COD. Thus, the removal rate (R_r) of COD is expressed by the following equation:

$$R_r = \frac{C_{\text{inf}} - C_{\text{eff}}}{C_{\text{inf}}} \times 100\% \quad (5)$$

This equation can also be used to calculate the efficiency of the reactors in regards to other nutrients.

2.4 Analytical procedures

The experimental test was carried for a period of five months. All the analyses were carried out in accordance with the Chinese standard methods in Determination of Municipal Sludge in Wastewater Treatment Plant (CJ/T 221—2005). The samples were filtered through a 0.45- μm membrane filter before experimental analysis. The influent and effluent COD and TN concentrations were measured according to the standard methods recommended by the U.S. Environmental Protection Agency [13]. Temperature and pH values were measured with a dissolved oxygen meter and pH meter, respectively. The flow rate was controlled by a valve and incessantly regulated with the help of a pump.

3 Results and discussion

3.1 COD removal

The average concentrations of COD in the influent and effluent of the UAF system were, in the first round of experimental operations, 192.2 mg/L and 31.6 mg/L and in the second round of experimental operations were 113.7 mg/L and 45.5 mg/L, respectively. The average removal rate of COD from the first and second round of experimental operations was 82% and 63% respectively. The results provided in Tables 2 and 3 show the effects of the HRT, OLR and temperature on the removal of COD.

Table 2 Average Influent and effluent COD concentrations and removal efficiencies in first round of experimental operations

| Temperature (°C) | HRT (d) | OLR for COD (kg/(m ³ ·d)) | C_{inf} (mg/L) | C_{eff} (mg/L) | Removal efficiency (%) |
|------------------|---------|--------------------------------------|-------------------------|-------------------------|------------------------|
| 31.6 | 1 | 0.16 | 157.8 | 43.2 | 72 |
| 32.5 | 2 | 0.10 | 192.5 | 31.6 | 83 |
| 33.7 | 3 | 0.08 | 226.4 | 20.1 | 91 |

Table 3 Average influent and effluent COD concentrations and removal efficiencies in second round of experimental operations

| Temperature °C | HRT (d) | OLR for COD (kg/(m ³ ·d)) | C_{inf} (mg/L) | C_{eff} (mg/L) | Removal efficiency (%) |
|----------------|---------|--------------------------------------|-------------------------|-------------------------|------------------------|
| 16.4 | 3 | 0.04 | 126.1 | 45.3 | 64 |
| 10.2 | 4 | 0.03 | 113.7 | 43.4 | 61 |

The COD removal efficiency throughout the treatment process in the first round of experimental operations were 72%, 83% and 91% under the conditions of HRTs of one days, two days, and three days; OLRs for COD of 0.16, 0.10 and 0.08 kg/(m³·d); temperatures range of 31.6°C, 32.5°C and 33.7°C, and. In the second round of experimental operations were 64% and 61% under the conditions of HRTs of three days and four days; OLRs for COD of 0.04 and 0.03 kg/(m³·d); temperatures of 16.4°C and 10.2°C respectively.

The experimental results showed that HRT, temperature and OLR have a significant influence on

COD removal. In the first round of experimental operations, increasing HRTs from one to two days, and then to three days reduces OLR and thus improves the removal efficiency, resulting in average COD removal rates of 72%, 83% and 91%, respectively. This revealed that COD removal efficiency became less efficient and more variable with the HRT reduction and this was found to be dependent also on the influent concentrations of COD. A low HRT caused pre-acidification, resulting in accumulation of COD as (VFA), which did not subsequently convert to methane, resulting in an accumulation of VFA.

This result agrees with the trend observed by [14], who showed that little change occurred in COD removal efficiency when an ABR was operated at constant OLR ($4.8 \text{ kg COD}\cdot\text{m}^{-3}\cdot\text{d}^{-1}$) with decreasing HRT (20 - 6.6 h). They concluded that, at low OLRs, there is enough biomass to metabolise the feed, and, even when the substrate concentration decreases with decreasing HRT, the mass transfer into the flocs is sufficient to remove most of the substrate. This result also agrees with the trend observed by [15], who revealed the removal efficiency of 81% of COD when the HRT was increase from 3 hours to 4 hours. However, other authors [16, 17] which used in their experiments similar conditions to this study reported results comparable to our observations. A study by [18] revealed that, as the HRT decreased from 10.38 d to 2.5 d, the COD removal efficiencies decreased slightly from 94% to 92 % in an ABR treating nitrobenzene. In the second round of experimental operations, an increase in HRT and temperature led to improved efficiency of the reactor (Table 3). The maximum COD removal rate obtained was 65%, which corresponds to an influent COD of 126.1 mg/L at a HRT of three days and temperature of 16.4°C. Increase in HRT when the temperature is low has no impacts on the reactor performance. The removal efficiency obtained coincided with the study conducted by [19], which achieved a COD removal efficiency of 74% when treating municipal wastewater at temperatures between 18 °C and 28 °C. Bodik et al. [16] studied the performance of an up-flow anaerobic treating domestic wastewater, obtaining organic matter removal efficiency between 46 - 90 % at a lower temperature ranging from 9 - 23 °C. At temperatures higher than 20 °C and HRT in the range of 6 - 10 h, removal efficiencies from 65 % to 80 % for COD have been obtained by [20 & 21].

Comparison of the two rounds of experimental operations shows that the COD removal efficiency of the anaerobic reactor increased with an increase in HRT and temperature, and decreased with an increase in OLR. This agreed with the findings of [22], who reported a COD removal rate of 65% at high temperatures in a UASB reactor, which decreased to a removal rate of 55% when the temperature was reduced to between 13 °C and 17 °C. Also Bodik et al. [16] studied the performance of an upflow anaerobic treating domestic wastewater, obtaining organic matter removal efficiency between 46 - 90 %.

3.2 TN removal

The results in Tables 4 and 5 illustrate the effects of the HRT, nitrogen volumetric loading rate (VLR), and temperature on the removal efficiency of total nitrogen (TN) in the UAF reactor. The average TN concentrations in the influent and effluent in the first round of experimental operations were 33.3 and 14.0 mg/L, respectively, and the average TN concentrations in the influent and effluent in the second round of experimental operations were 29.2 mg/L and 17.6 mg/L, respectively. These results indicate insignificant TN removal with regard to the operating conditions. This may be attributed to the low sludge production in the UAF reactor, as reported by [19].

Table 4 Average influent and effluent TN concentrations and removal efficiencies in first round of experimental operations

| Temperature (°C) | HRT (d) | Nitrogen VLR for TN (kg/(m ³ ·d)) | C _{inf} (mg/L) | C _{eff} (mg/L) | Removal efficiency (%) |
|------------------|---------|--|-------------------------|-------------------------|------------------------|
| 31.6 | 1 | 0.03 | 32.4 | 15.5 | 52 |
| 32.5 | 2 | 0.02 | 32.7 | 14.4 | 56 |
| 33.7 | 3 | 0.01 | 34.9 | 12.2 | 65 |

Table 5 Average influent and effluent TN concentrations and removal efficiencies in second round of experimental operations

| Temperature (°C) | HRT (d) | Nitrogen VLR for TN (kg/(m ³ ·d)) | C _{inf} (mg/L) | C _{eff} (mg/L) | Removal efficiency (%) |
|------------------|---------|--|-------------------------|-------------------------|------------------------|
| 16.4 | 3 | 0.01 | 30.8 | 16.5 | 46 |
| 10.2 | 4 | 0.007 | 27.5 | 18.6 | 34 |

The TN removal efficiency throughout the treatment process in the first round of experimental operations were 52%, 56% and 65% under the conditions of HRTs of one day, two days and three days; VLRs of 0.03, 0.02 and 0.01 kg/(m³·d); temperatures range of 31.6°C, 32.5°C and 33.7°C and in the second round of experimental operations 46% and 34% under the conditions of HRTs of three days, and four days; VLRs for TN of 0.01 and 0.007 kg/(m³·d); temperatures range of 16.4°C and 10.2°C respectively.

The results revealed that increase in HRT and temperature enhances the nitrification process. However, there was no significant difference in the removal efficiency of the UAF reactor at different nitrogen VLRs. It can be seen that, the higher the amount of nitrogen compounds and increase temperature in the influent is, the higher the removal efficiency is.

The first experimental operation conditions with high effluent temperature showed an average TN removal efficiency of 58%, while the operation conditions with low temperature revealed an average TN removal efficiency of 40%. Slight effects of nitrogen VLRs were observed.

3.3 Variation of pH values

The pH value fluctuations in the influent and effluent of the UAF reactor were monitored over time and the average pH values in the influent and effluent were 7.5 and 7.7, respectively, during the first round of experimental operations, and 7.5 and 7.6, respectively, during the second round of experimental operations (Tables 6 and 7).

Table 6 Influent and effluent pH values in first round of experimental operations

| Temperature (°C) | HRT (d) | Influent pH value | Effluent pH value |
|------------------|---------|-------------------|-------------------|
| 31.6 | 1 | 7.2 | 7.4 |

| | | | |
|------|---|-----|-----|
| 32.5 | 2 | 7.7 | 7.6 |
| 33.7 | 3 | 7.5 | 7.7 |

Table 7 Influent and effluent pH values in second round of experimental operations

| Temperature (°C) | HRT (d) | Influent pH value | Effluent pH value |
|------------------|---------|-------------------|-------------------|
| 16.4 | 3 | 7.5 | 7.6 |
| 10.2 | 4 | 7.4 | 7.5 |

Monitoring of pH value in the anaerobic reactor is crucial and can be helpful in detecting abnormalities of a system. According to [23], the methane-producing microorganisms have optimum growth in the pH range between 6.6 and 7.6, although stability may be attained in the formation of methane over a wider pH range (6.0 – 8.0). pH values below 6.0 and above 8.3 should be avoided, as they can inhibit the methane-forming microorganism [12].

In this study, the pH value of the treated domestic wastewater (effluent) was in the range of 7.5 to 7.7, indicating satisfactory conditions of the reactor. According to the literature [24], pH values less than 6.8 or greater than 8.3 will cause souring of the reactor in the process of anaerobic digestion. The average pH value of the influent wastewater for the two experimental operations was 7.5, which is typical for wastewater with a mean pH value of 7.8, slightly higher than what reported by [25]. Several researchers have studied the effect of pH on the anaerobic treatment process [26, 27, 28] but there does not exist ample information about the influence of pH on AF's efficiency in treating rural domestic waste. Generally, the pH throughout the UAF effluent remained stable despite an increase in HRTs.

4. Conclusions

The UAF reactor, experimented in this study, revealed an efficient anaerobic process for rural domestic sewage at optimum HRT of 3 days and temperature of 33.7 °C. Average removal efficiencies of COD in the first round of experimental operations amount to 72%, 83% and 91% at an HRT of 1, 2 and 3 days (at mesophilic temperature) respectively and in the second round of experimental operations amount to 64% and 61% respectively at an HRT of 3 and 4 days (at psychrophilic temperature).

Average removal efficiencies of TN in the first round of experimental operations amount to 52%, 56% and 65% at an HRT of 1, 2 and 3 days, respectively and in the second round of experimental operations amount to 46% and 34% respectively at an HRT of 3 and 4 days.

Results obtained from this current work and from previous studies showed that up-flow anaerobic filter system operated at a longer HRT and at mesophilic temperature provides high removal efficiencies for COD and TN removal than for those operated at short HRTs and at psychrophilic temperatures.

Acknowledgment

This work was supported by the National Natural Science Foundation of China (Grant No. 51078074) and the Key Project of the Chinese Ministry of Education (Grant No. 308010).

References

- [1] Otterpohl, R., Albold, A., Oldenburg, M., 1999. Source control in urban sanitation and waste management: ten systems with reuse of resources. *Water Sci. Technol.* 39 (5), 153–160.
- [2] Otterpohl, R., Braun, U., Oldenburg, M., 2003. Innovative technologies for decentralized water, wastewater and biowaste management in urban and peri-urban areas. *Water Sci. Technol.* 48 (11/12), 23–32.
- [3] Elmitwalli, T.A., van Lier, J., Zeeman, G., Lettinga, G., 2003. Treatment of domestic sewage at low temperature in a twoanaerobic step system followed by a trickling filter. *Water Sci. Technol.* 48 (11/12), 199–206.
- [4] Ladu, J. L. C., and Lu, X., 2014. Effects of hydraulic retention time, temperature, and effluent recycling on efficiency of anaerobic filter in treating rural domestic wastewater. *Water Science and Engineering*, 2014, 7(2): 168-182 doi:10.3882/j.issn.1674-2370.2014.02.005.
- [5] Manariotis, I. D., and Grigoropoulos, S. G. 2006. Anaerobic filter treatment of municipal wastewater: biosolids behavior. *Journal of Environmental Engineering*, 132(1), 23-31.
- [6] Jefferson, B., Laine, A.L., Judd, S.J., Stephenson, T., 2000. Membrane bioreactors and their role in wastewater reuse. *Water Sci. Tech.* 41 (1), 197–204.
- [7] Nolde, E., 1999. Greywater reuse systems for toilet flushing in multi-storey building-over ten years experience in Berlin. *Urban Water* 1, 275–284.
- [8] Jefferson, B., Laine, A., Parsons, S., Stephenson, T., Judd, S., 1999. Technologies for domestic wastewater recycling. *Urban Water* 1, 285–292.
- [9] Henze, M., Harremoes, P., 1983. Anaerobic treatment of wastewater in fixed film reactors – a literature review. *Water Sci. Technol.* 15, 1–101.
- [10] Ahn, J.-H., Forster, C.F., 2000a. Kinetic analyses of the operation of mesophilic and thermophilic anaerobic filters treating a simulated starch wastewater. *Process Biochem.* 36, 19–23.
- [11] Martina, U. 2008. Effect of Hydraulic Loading Variation on a Pilot Scale UASB Reactor Treating Domestic Wastewater at Vapi CETP. *M. E. Dissertation. Sweden: Lund University.*
- [12] Chernicharo, C. A. L. 2007. Anaerobic Reactors, Biological Wastewater Treatment Series (Volume 4). London: IWA Publishing.
- [13] Clescerl, L. S., Arnold, E. G., and Eaton, A. D. 1998. Standard Methods for the Examination of Water and Wastewater. 20th ed. Washington: American Public Health Association
- [14] Nachaiyasit, S., Stuckey, D. C., The effect of shock loads on an anaerobic baffled reactor (ABR), 2. Step and transient hydraulic shocks at constant feed strength. *Water Research*, 31, (11), 2747- 2755 (1997).
- [15] Elmitwalli, T.A., Zeeman, G., Oahn, K.L.T., Lettinga, G., 2002b. Treatment of domestic sewage in a two-step system anaerobic filter/anaerobic hybrid reactor at low temperature. *Water Res.* 36 (9), 2225–2232.
- [16] Bodik, L., Herdova, B., and Kratochvil, K. 2000. The application of anaerobic filter for municipal wastewater treatment. *Proceedings of the 20th International Conference of the*

Slovak Society of Chemical Engineering, 54(3), 159-164.

- [17] Manariotis, I. D., and Grigoropoulos, S. G. 2006. Anaerobic filter treatment of municipal wastewater: biosolids behavior. *Journal of Environmental Engineering*, 132(1), 23-31. [doi:10.1061/(ASCE)0733- 9372(2006)132:1(23)]
- [18] Kuscü, O. S., Sponza, D. T., Effects of nitrobenzene concentration and hydraulic retention time on the treatment of nitrobenzene in sequential anaerobic baffled reactor (ABR)/continuously stirred tank reactor (CSTR) system. *Bioresource Technology*, 100, (7), 2162-2170 (2009).
- [19] Barbosa, R. A., and Sant'Anna, G. L. 1989. Treatment of raw domestic sewage in an UASB reactor. *Water Research*, 23(12), 1483-1490. [doi:10.1016/0043-1354(89)90112-7]
- [20] Wiegant W.M. (2001) Experience and potential of anaerobic treatment in tropical regions. *Water Science and Technology* 44 (8): 107–113
- [21] Foresti, E. 2001. Perspectives on anaerobic treatment in developing countries. *Water Science and Technology*, 44(8), 141-148.
- [22] Lettinga, G., Roersma, R., Grin, P., de Zeeuw, W., Hulshof Pol, L., van Velsen, L., Hovma, S., and Zeeman, G. 1981. Anaerobic treatment of sewage and low strength wastewater. *Proceedings of the Second International Symposium on Anaerobic Digestion*, 271-291. Travemunde: Elsevier Biomedical Press.
- [23] Rittmann, B. E., McCarty, P. L., Environmental biotechnology: principles and applications. *McGraw-Hill International Edition, New York (2001)*.
- [24] Stronach, S. M., Rudd, T., and Lester, J. N. 1986. Anaerobic Digestion Process in the Industrial Wastewater Treatment. *Berlin: Springer-Verlag*.
- [25] Chuan, W. S. 2007. Performance of Upflow Anaerobic Sludge Blanket Reactor Treating Municipal Wastewater at Different Retention Times. *M. E. Dissertation, Kent Ridge: National University of Singapore*.
- [26] Yu, H. Q., Hu, Z. H., Hong, T. Q., and Gu, G. W. 2002. Performance of an anaerobic filter treating soybean processing wastewater with and without effluent recycle. *Process Biochemistry*, 38(4), 507-513.
- [27] Paulo, P. L., Villa, G., Van Lier, J. B., and Lettinga, G. 2003. The anaerobic conversion of methanol under thermophilic conditions: pH and bicarbonate dependence. *Journal of Bioscience and Bioengineering*, 96(3), 213-218.
- [28] Hu, Z. H., Yu, H. Q., and Zhu, R. F. 2005. Influence of particle size and pH on anaerobic degradation of cellulose by ruminal microbes. *International Biodeterioration and Biodegradation*, 55(3), 233-238.

Innovation and Technology: Ford Motor Company defines restructure through technological advancement

Introduction

Alan Mulally, President and CEO of Ford Motor Company announced on June 7, 2011 that Ford would be taking aggressive steps to increase sales by 50% in less than four years. Part of their ambitious plan is that the company will be selling more small cars than trucks and is expanding their lines internationally in China and India. Ford is the only company out of the big three automakers to not accept an auto bailout from the government. Innovation can come in different forms, but innovation for Ford came from the leadership and creativity of Mulally, who unlike the other two heads of the Big Three automakers has both an engineering and business degree.

Two years prior to the economic crisis Ford hired Mulally, who at the time was serving as the executive vice president of The Boeing Company, and later promoted to president and chief executive officer of Boeing Corp. and Boeing Commercial Airplanes. Since bringing in Mulally, Ford has now been profitable for two years. Some of the success is attributed to the company focusing on three factors that help individuals decide to purchase car, 1) economy, 2) price, and 3) quality. On their website, Ford (2011) clearly names five factors that they believe will help them expand their domestic as well as international base, 1) technology, 2) quality, 3) design, 4) safety, and 5) environment.

Innovation and entrepreneurship as defined by theorist Peter Drucker (1998) is the means by which the entrepreneur either creates new wealth producing resources or endows existing resources with enhanced potential for creating wealth. Ford in this case study has taken existing knowledge and resources and enhanced its potential for domestic and global growth. Their strategy lies in their technological and strategic innovativeness to advance the organization as the long-term global position leader.

Strategic Innovation and Growth

Firms are looking for new ways to enhance their competitive positioning in increasingly globalized and competitive markets, thus innovation is generally considered a key factor to firms' success in the current competitive settings (Roseira, et al, 2010). The industry of emerging countries settles continuously new goals in industrial process organization and productive management so in this competitive environment companies have to look with renovated interest towards the chances offered by innovative industrial techniques (Cominotti & Gentili, 2008). To do so, it must innovate; it must use new knowledge to offer new products that customers want (Afuah, 1997).

For example, Ford utilized an approach previously employed by Toyota's product development plan called, lean product development. Lean product development as defined by Teresko (2007) utilizes some principles such as: 1) establish customer-defined value to separate value-added from waste, 2) front-load the product development process to explore thoroughly alternative solutions while there is maximum design space, 3) create a level product development process flow and 4) utilize rigorous standardization to reduce variation, and create flexibility and predictable outcomes.

Principles and methods based on this systems model of lean product development were applied with great success at Ford Motor Company helping to bring to market a record number

of products that helped fuel a rebuilding of the company to financial success and award winning world-class product quality (Liker & Morgan, 2011). He decided to channel as much of this money as possible into new product development. Mulally realized that if Ford were to succeed it would need to be led by great new product, with every product being a winner.

Technological Innovation

Economic performance is not just determined by new knowledge creation but also by the ability and the willingness of innovative entrepreneurs to develop new products and processes based on new knowledge (Audretsch, Bonte and Keilbach, 2008). Ford's leadership position comes from their uses of different types of technological innovation that helps them create and develop cars that are efficient, affordable and attractive. Technological breakthrough comes from the entrepreneur creating products that also service millions of individuals on a continuous basis.

Technological innovation and entrepreneurship state Mondal (2011) comes from the introduction of a new method of production: This refers to changing technological relationship or the existing production function, thus in order to lower the per unit cost of production, an entrepreneur may introduce a new method of production or substitute new and cheaper inputs in place of existing inputs. If an entrepreneur is successful in doing this, she or he will ensure the maximum profit from the sale of a new product (Mondal, 2011).

Lenfle & Midler (2009) discuss product-related (PRS) as services that are closely associated with goods in products. Developing innovative product-related services (PRS) is therefore a major concern for firms in a wide range of industries. As the authors observed, this is the likely explanation for the relative lack of proven methods for the development of new services. Utilizing innovation for the use of design in the development for more efficient automobiles enables the car not just to run better, but perform at an optimum level versus the competition.

That competition comes from international carmakers such as Toyota who have largely controlled most of the market. However, Ford has list design, as one of their largest features that they believe will help them sell more cars. The design includes, small cars which will be mostly sold in China and India because the company sees a need for smaller, less pricer, more efficient automobiles.

Similarly, Triebswetter & Wackerbauer (2008) view technological innovation as more towards integrated environmental innovation and competitiveness. They state that end-of-pipe technologies have been introduced as a way to over both superior environmentally and economically efficient automobiles. This helps with preventing pollution while savings costs on the maintenance and management of the automobile. Studies of environmental innovation over the last ten years have found that regulation is the most important stimulus for innovation and other incentives such as cost reductions, effects of supply chain pressure are also important (Triebswetter & Wackerbauer, 2008). Germany has been identified as a leader in environmental innovation technologies and continued to penetrate the market since 2003.

Pricing Strategic-Innovation

Isaksen & Kalsaas (2009) discuss that since there is a rise in globalization this leads to price competition, which in particular challenges firms in high-cost countries, thus firms may

respond to this challenge in two ways, the first response includes lowering the production cost by introducing, among other things, more lean production methods inside firms and along the value chain. The other is building unique learning systems within an organization and building additional knowledge to help differentiate your products and services from the competitors. Firms compete on producing unique products for specific customers building their innovation activity to achieve a competitive advantage.

One of the most important factors according to Ford is pricing as their chief factor driving the demand for their product in the United States and globally. Ford has adjusted their price structure largely due to the economic slowdown in the United States that has led to other countries as well. The company recognizes the need to adjust the price due to rising gas cost, once the consumer purchases the automobile in part to make sure they will be able to keep it. Car repossession affects not only one automaker but trickles down to others as well. Smaller cars have great fuel efficiency and saves cost on the monthly payments as well. Pricing is what has largely helped Ford maintain and gain growth in a competitive international industry.

References:

- Afuah, A. (1997). Is Ford 2000 the right strategy for innovation? A management theory perspective. *Strategic Change*, 6(6), 345-355. Retrieved from EBSCOhost.
- Cominotti, R., & Gentili, E. (2008). Near net shape technology: An innovative opportunity for the automotive industry. *Robotics and computer-integrated manufacturing*. Vol.24(6).
- Drucker, P. (1998). *The discipline of innovation*. Harvard business Review 1998.
- Ford (2011). Annual Report. <http://corporate.ford.com/>.
- Isaksen, A., & Kalsaas, B. (2009). Suppliers and strategies for upgrading in global production networks: The case of a supplier to the global automotive industry in a high-cost location. *European Planning Studies*, 17(4), 569-585.
- Lenfle, S., & Midler, C. (2009). The launch of innovative product-related services: Lessons from automotive telematics. *Research Policy*, 38(1), 156-169.
- Liker, J. K., & Morgan, J. (2011). Lean Product Development as a System: A Case Study of Body and Stamping Development at Ford. *Engineering Management Journal*, 23(1), 16-28. Retrieved from EBSCOhost.
- Mondal, W.. (2011). Entrepreneurship In U.S. Auto Industry: Ford Stays Ahead. *Journal of Business Case Studies*, 7(1), 31-37. Retrieved June 21, 2011, from ABI/INFORM Global.
- Roseira, C., Brito, C., Garrett, A., & Henneberg, S. C. (2010). Innovation-based nets as collective actors: A heterarchization case study from the automotive industry. *Working Papers (FEP) -- Universidade do Porto*, (292), 1-35. Retrieved from EBSCOhost.

Teresko, J. (2007). The 13 Principles Of Lean Product Development from creating a level product development flow to adapting technologies to fit your people. Industry Week.

Triebswetter, U., & Wackerbauer, J. (2008). Integrated environmental product innovation and impacts on company competitiveness: a case study of the automotive industry in the region of munich. *European Environment: The Journal of European Environmental Policy* (Wiley), 18(1), 30-44.

The status and Socioeconomic value of Cherry laurel (*Prunus laurocerasus* L.):

Advancement for the future

Melekber SULUSOGLU DURUL^{1,2}

¹Kocaeli University, Arslanbey Agricultural Vocational School, TR-41285, Kocaeli/Turkey.

²Kocaeli University, Graduate School of Natural and Applied Sciences, Department of Horticulture, TR-41380, Kocaeli/Turkey.

Corresponding author e-mail: meleksl@kocaeli.edu.tr, melekber_s@yahoo.com

Abstract:

Cherry laurel (*Prunus laurocerasus* L.) is an evergreen shrub or small tree that can grow up to 6 m high; its fruit is native to the regions bordering the Black Sea in Southwestern Asia and Southeastern Europe. It is widely spread in the northern part of Turkey and very common in the Marmara region. There are many cultivars with differing characteristics in Turkey and these, as sources of germplasm, provide rich parental material for crossing. The major utilization of the crop is as fresh fruits and it is known as “taflan” or “karayemis” in Turkey. The fruit is traditionally known for its rich medicinal properties against diabetes and kidney stones. It is an integral part of the life of the people of the Black sea region where it is known as “laz kirazi”. Cherry laurel tree is generally grown as a border tree, such as around the house, gardens, or as a roadside tree. However, a few ‘monitored’ fruit-gardens of cherry laurel have been recently planted at the fruit research center. The fruits are evaluated locally for direct consumption in the local bazaars even though its other uses include as dried fruit and jam and brine preparation. Despite the fact that the cherry laurel plant is propagated vegetatively by suckers, the species has retained considerable genetic diversity in the production region. Fruit characteristics have been reported in many studies, including pomological, chemical, and nutritional values, and these studies have helped the selection of superior types from various natural populations. Importantly, such observations continue in the ‘monitored’ orchards. The tree is highly resistant to drought, arduous soil conditions, as well as biotic and abiotic stress conditions. As the impact of climate change is one of the most important issues of the last century, such minor fruits are predicted to become more popular in the future, mainly due to their resistance to strenuous conditions. In this paper, we discuss available studies on cherry laurel, including breeding study evaluations, social and economic value predictions, health properties, and other functional uses such as ornamentation. We propose that, in future, it can be grown in small-scale conventional farms.

Keywords: Cherry laurel, fruit, socio-economic evaluation, breeding

1. Introduction

Cherry laurel is grown in a wide area covering the regions of the Black Sea from Southwestern Asia to Southeastern Europe. It is also grown in North America as an ornamental plant. There are many cultivars with different characteristics. Historically, the species was first

described by the French researcher, P. Belan in 1546, in Northeastern Turkey. It is an evergreen shrub or small tree that can grow up to 6 m in height; the leaves are dark green and 5–15 cm in length and 4–10 cm in breadth (Kolayli et al. 2003). The seeds of cherry laurel are easily spread by birds, which has led to concerns regarding increasing its potential. The fruit is a small cherry that turns red to black when ripe. Most types ripen between the second half of July and August, but some types mature at the end of August to early September (Sulusoglu 2011) (Figure 1).

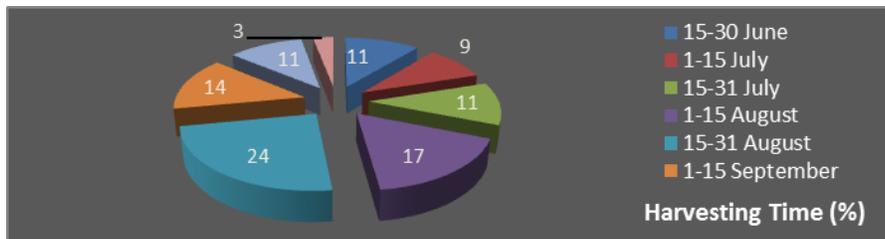


Figure 1. Harvesting time of cherry laurel fruit

Cherry laurel trees have very attractive flowers and are, therefore, a good ornamental plant. Flower buds appear in February and start to open between March and the end of April; this can take until June in some late blooming types (Figure 2). The tree and fruit are native to Turkey, among other countries, and they are an important source of nutritious natural food and income for the rural population. The fruits of cherry laurel are not eaten as food before ripening because they are astringent and some are, possibly, poisonous. Some wild forms with very little fruit flesh, are very astringent and bitter, are not edible even after ripening, and become red-dark purple-black colored (Figure 3).



Figure 2. Leaves, buds and flowers of cherry laurel

2. Ecological Requirements:

The plant grows naturally in light, medium, or heavy clay soils. It has better pest resistance than most other species in the genus *Prunus* (Frohne and Pfander, 1984). It is suitable to the clay-loam soil texture found in the Black Sea Region and the temperate climate in which winters are not very cold and summers are warm-hot with rare spring frosts. The cherry laurel tree can grow in different kinds of soil, from acidic to dry climate soil without any specific preference. It is also pH tolerant, grows well in the sun or in deep shade, is salt-spray tolerant, and can withstand heavy pruning (Posta 2009).



Figure 3. Cherry laurel fruits (unmature fruits, mature fruits, Kiraz type and black type)

3. Cherry laurel cultivars and characteristics

Known cultivars of Cherry laurel are listed in Table 1 in (Anonymous 2017a,b,c; Huxley 1992). In Turkey, some common names for these cultivars are Su, Vavul, Yabani, Ağustos-İstavrit, Orak, Ayran, and Kiraz. Vavul is more fleshy but has less fruits per branch; Kiraz matures in mid-June, but is tasty and slightly sour; Orak matures in mid-July and is very delicious; Su matures in mid-June and has a bitter taste (İslam 2002, Bostan 2001, Sulusoglu 2016) (Figure 3).

4. Status and Socioeconomic value of Cherry laurel

Fruits are astringent before maturity but become sweet and reasonably pleasant when fully ripe. Cultivated plants have bigger, sweeter tasting fruit, and are marketed locally for table consumption. While it is mostly consumed as fresh fruit in local markets, the cherry laurel fruits are also used in making jam, pickle, and cake. It is also consumed as dried fruit and has gained popularity in the recent years (Sulusoglu 2011). Although it has other uses, the preparation of brine with onion in oil is very common and it is used for cooking food during winter.

The fruits and seeds of this tree have been used as traditional medicines against diabetes, stomachaches, cancer, skin problems, cholesterol, hemorrhoids, and for decreasing blood pressure. Fresh leaves are used in herbal medicine for their antispasmodic, narcotic, and sedative properties. It is also a good diet fruit that gives satiety but is associated with the formation of

kidney stones when eaten with the stone. However, powder from the fruit stone is considered beneficial for bronchitis. The fruits also positively affect the blood acid-base balance and fresh leaves are used to prepare 'laurocerasus water', in pharmacies, for antispasmodic and breathing diseases (Sulusoglu 2016). Cherry laurel fruits are considered significant sources of phenolic compounds and anthocyanins (Grieve, 1984; Kolaylı et al., 2003). As it is generally cultivated like a border tree, they are rarely present in closed orchards; both of these have resulted in insufficient culture treatments and low productivity. As the Cherry laurel is a decorative plant when it is in full bloom, it is used in parks and gardens as an ornamental plant, and its foliage is also used as cut greenery in floristry (Sulusoglu 2016).

Table 1. Name of the cherry laurel types-cultivars and characteristics

| Name of cultivar and types | Characteristics | References and Place |
|----------------------------|--|-------------------------|
| Kiraz | Kiraz' cherry laurel is a table cultivar and one of the important varieties grown in Trabzon province of Turkey. | İslam, 2002, Turkey |
| Su | Very juicy and has an attractive color of skin and flesh. | Bostan 2001, Turkey |
| Mount Vernon | Slow-growing, compact dwarf to 90 cm, wide spreading, dense, leaves similar to species | USA, Anonymous 2017(a) |
| Otto Luyken | Popular form, compact, spreading to 1.8–3 m wide and 1.5 m tall, erect stems, narrow, glossy dark green leaves, abundant flowers | Huxley, 1992 |
| Schipkaensis | Several forms have this name. Moderate growing to 1.2–1.8 m tall and 1.8–2.4 m wide. | USA (Anonymous 2017(b)) |
| Nana | A dwarf cherry laurel, slow growing to 1.2–1.6 m tall and wide, spreading, glossy dark green leaves similar to species. | USA, Anonymous 2017(c) |
| Marbled Dragon | Slow growing, leaves marbled gray or white, variable and unstable | USA, Anonymous 2017(b) |
| Magnolia | A very large-growing form, this selection bears large foliage that resembles <i>Magnolia grandiflora</i> and is lustrous dark green. The plant may be grown to a tree. | Huxley, 1992 |

Cherry laurel grows naturally, does not require pesticide application, and is resistant to high humidity or arid conditions (Sulusoglu 2011). The uses of cherry laurel fruits are a result of traditional habits rather than economics, mainly because of varietal heterogeneity and the lack of selection and identification of genotypes. Traditionally, in the Black sea region, almost every house has one tree in its garden, and because of this popularity, it is said that, if there is a cherry laurel tree somewhere, the owner is probably from the Black sea region.

5. Breeding Studies

The Cherry laurel fruit is steadily gaining commercial popularity in the United States, Europe, and Turkey (Foley and Raulston 1994; Sulusoglu 2011), even though it is traditionally

cultivated in Turkey. Such minor fruits are of economic importance for the local people, forest villagers, and for the future human generations, as they are resistant to a range of biotic and abiotic stressors, have limited needs, require minimal care, and yet produce nutritionally healthy fruits.

Studies on breeding of this species have focused on the selection of superior cultivars with maximum resistance to disease, environmental adaptability, and molecular mapping of these cultivars. Unfortunately, breeding programs to obtain cultivars with high fruit quality have rarely been attempted (Islam and Odabas, 1996; Islam and Vardal, 2009). Due to its increasing market value, the demand for the fruit by producers and the processing industry has increased and presents an impetus to develop commercial cultivars.

Studies have been conducted to select superior cultivars from different regions in Turkey. Trees with different ages at different locations and under various growing conditions were identified and some of their pomological and chemical traits were determined. The first such study in literature was by Özbek (1952) in the Giresun forest area. Özbek (1952) traveled in the Black Sea Region and investigated tree and fruit characteristics of this species, and subsequent investigators have used these characteristics in the Trabzon, Rize, Ordu, Samsun, Sakarya, and Kocaeli cities of Turkey (İslam 1996; Islam and Odabas 1996; Islam and Vardal 2009; Beyhan 2010; Sulusoglu 2011; Macit and Demirsoy 2012).

Pomological studies indicate that genotypes selected as ‘promising’ could indeed improve the cultivation of this fruit. Based on the results of phenological and pomological analyses, some genotypes were identified as potential sources of raw material for breeding programs. However, adaptation studies, which form the second phase of the selection procedure, need to be organized in the potential areas of cultivation.

Genetic characterization of the different types and their molecular studies constitute other important steps in the breeding process. The taxonomic classification within the genus *Prunus*, which is mainly based on fruit morphology, remains controversial. The subgenera *Padus* and *Laurocerasus*, in which the Cherry laurel is placed, is more isolated within the genus *Prucultivars*, with same characteristics, but assigned different names, resulting in too many types and genotypes in the selection studies (Aradhya et al. 2004). A few genetic-molecular analyses among cherry laurel genotypes have been reported (Hajyzadeh et al 2013; Sandalli et al, 2005; Lee and Wen, 2001; Bortiri et al, 2001).

Biological characteristics such as pollen germination and viability, ideal fertilizer selection, fruit set, and the effects of pollinators on fruit quality are very important, and such characteristics have been investigated for cherry laurel (Sulusoglu and Cavusoglu 2014a, Sulusoglu and Cavusoglu 2014b). In these studies, various cherry laurel genotypes were investigated that showed satisfactory in vitro pollen viability and germination. The initial number of fruit set was very high and did not differ based on the pollen source. On the other hand, there were significant differences among the genotypes and pollinators during final fruit set. These results provide preliminary information on the biological characteristics of cherry laurel for use in breeding programs. A continuation of such studies should focus on utilization of new pollinators, fruit set in different combinations of cross-pollination, and the dynamics of pollen tube growth in the pistil.

6. Propagation Studies:

The propagation of the selected genotypes using cuttings (Riberio et al. 2010; Yazici et al. 2009; Posta 2009; Sulusoglu and Cavusoglu 2010) or in vitro studies have been successfully conducted in this species. Economical mass propagation of cherry laurel is an important step for the commercial production of saplings. The semi-hardwood cuttings of sixteen cherry laurel types, selected considering their pomological properties (Sulusoglu, 2011), were reported to root successfully using IBA(Indole-3 butyric acid) , and thus, superior rooting genotypes were identified for use in commercial orchards (Sulusoglu and Cavusoglu 2010).

In vitro proliferation could provide an alternative and rapid means of producing cherry laurel saplings (Ponchia, 1991; Kalinina and Brown 2007; Sulusoglu and Cavusoglu 2013) and one study used embryo culture of cherry laurel for breeding. In this study, large differences among the types were found and cold stratification played an important role in the growth of embryos (Sulusoglu 2012). This protocol could be useful in future breeding programs for cherry laurel.

7. Conclusion

Cherry laurel is a part of the daily life of people in the Black Sea region and is a traditional fruit with a promising future. Appropriate breeding steps can identify and improve genotypes to meet production quality standards. Molecular studies could support the selection of superior genotypes before cultivation and conservation of plant material. Selected genotypes will serve as the source of new cultivars for the Cherry laurel, and certificated saplings of the new

cultivars can be used to populate new plantation areas. Finally, creating awareness through social networks can increase recognition of cherry laurel in other countries as well.

8. References

- Anononyous 2017a. <http://davesgarden.com/guides/pf/go/132046/#b>
- Anonymou 2017b. <http://www.hort.uconn.edu/plants/detail.php?pid=352>
- Anonymou 2017c http://plants.westwoodgardens.com/12170002/Plant/7350/Dwarf_Cherry_Laurel
- Beyhan O (2010). A study selection of promising native cherry laurel (*Prunus laurocerasus* L.) genotypes from Sakarya, Turkey. *The J. of Animal and Plant Science* 20(4): 231-233.
- Bortiri E, Oh SH, Jiang J, Baggett S, Granger A, Weeks C, Buckingham M, Potter D and Parfitt DE (2001). Phylogeny and systematics of *Prunus* (Rosaceae) as determined by sequence analysis of ITS and the chloroplast trnL-trnF spacer DNA, *Syst. Bot.* 26 (4):797-807.
- Frohne D, Pfander J (1984). A colour Atlas of poisonous plants. Worfe ISBN 0723408394.
- Foley TJr, Raulston C (1994). *Prunus laurocerasus* evaluations in the NCSU Arboretum. *JC Raulstan Arboretum*, Friends of the Arboretum Newsletter, N. 25. In Proceedings of the SNA Res. Workers Conf. 39, 364-368. Retrieved from <http://jcra.ncsu.edu/publications/newsletters/ncsuarboretum-newsletters/newsletter-25-1995-02.php>.
- Grieve A (1984). *Modern Herbal*. Penguin ISBN:0140464409.
- Hajyzadeh M, Cavusoglu A, Sulusoglu M and Unver T (2013). DNA SSR fingerprinting analysis among cherry laurel (*Prunus laurocerasus* L.) types. *J. of Food, Agriculture & Environment* 11(2):630-638.
- Huxley A (1992). *New RHS Dictionary of Gardening*. Macmillan [ISBN 0-333-47494-5](https://www.rhs.org.uk/Books/9780230474945).
- İslam A (1996). Improvement by selection of cherry laurel (*Prunus laurocerasus* L.) grown in Vakfikebir and its surroundings. *Yuzuncu Yıl University, The Journal of Agricultural Faculty (Turkey)* 6(4):147-158.
- İslam A, Odabas F (1996). Improvement by selection of cherry-laurel (*Prunus laurocerasus* L.) grown in Vakfikebir and its surroundings-I. *Yuzuncu Yıl University, J. Agric. Fac. (Turkey)*, 6(4): 147-158.
- İslam A (2002). 'Kiraz' Cherry Laurel. *New Zealand J. Crop and Horti. Sci.* 30(4):301-302
- İslam A, Vardal E (2009). Pomological characteristics of cherry laurel (*Prunus laurocerasus* L.) Grown in Rize. *Proc.1st IS on Pomogranate. Acta Hort.*, 818: 133-136.
- Kalinina A, Brown D (2007). Micropropagation of ornamental *prunus* spp. and GF305 peach, a *prunus* viral indicator. *Plant Cell Rep* 26(7):927-935.
- Kolaylı S, Küçük M, Duran C, Candan F, Dinçer B (2003). Chemical and antioxidant properties of *Laurocerasus officinalis* Roem (Cherry laurel) fruit grown in the Blacksea Region. *J. Agric. Food Chem.*, 51(25): 7489-7494

- Lee S, Wen J (2001). A phylogenetic analysis of *Prunus* and the Amygdaloideae (Rosaceae) using ITS sequences of nuclear ribosomal DNA. *Am. J. of Bot.* 88(1):150-160.
- Macit I, Demirsoy H (2012). New promising cherry laurel (*Prunus laurocerasus* L.) genotypes in Turkey. *Bulgarian Journal of Agricultural Science* 18(1):77-82.
- Özbek S (1952). Karayemiş (*Prunus laurocerasus* L.) A.Ü. Ziraat Fakültesi Yıllığı, 4, p.8
- Ponchia G (1991). Research on in vitro propagation of *Prunus laurocerasus* cv. Otto Luyken. *Acta Horticulturae* 300:177-180.
- Posta DS (2009). Vegetative planting material producing at the *Prunus laurocerasus* L. *Bulletin UASVM Horticulture* 661(1-2):204-208.
- Riberio MM, Collado LM and Antunes MA (2010) The influence of indole-3-butyric-acid in *Prunus laurocerasus* vegetative propagation. *Acta Hort. (ISHS)* 885:277-283
- Sandallı C, Beris F S, Canakci S, Demirbag Z and Beldüz AO (2005). RAPD analysis of three cultivars and a wild form in *Prunus laurocerasus* (Rosaceae). *Biol. Brat.* 60(1):83-87.
- Sulusoglu M, Cavusoglu A (2010). Vegetative propagation of Cherry laurel (*Prunus laurocerasus* L.) using semi-hardwood cuttings. *African Journal of Agricultural Research* 5(23): 3196-3202
- Sulusoglu M (2011). The cherry laurel (*Prunus laurocerasus* L.) tree selection. *African Journal of Agricultural Research* 6(15): 3574-3582.
- Sulusoglu (2012). Development of embryo culture protocol for cherry laurel (*Prunus laurocerasus* L.)”, *J. of Food Agriculture & Environment* 10 (3&4), 347-352.
- Sulusoglu M, Cavusoglu A (2013). Micropropagation of cherry laurel *Prunus laurocerasus* L. *J. of Food, Agriculture & Environment* 11 (1): 576-579.
- Sulusoglu M, Cavusoglu A (2014a). In Vitro Pollen Viability and Pollen Germination in Cherry Laurel (*Prunus laurocerasus* L.). *Hindawi Publishing Corporation Scientific World Journal Volume 2014, Article ID 657123, 7 pages, <http://dx.doi.org/10.1155/2014/657123>.*
- Sulusoglu M, Cavusoglu A. (2014b). Pollination Biology of Cherry Laurel and Pollenizer Effects on Fruit Set and Fruit Characteristics. *YYÜ TAR BİL DERG (YYU J AGR SCI)*, 24(3): 280- 289.
- Sulusoglu (2016). Socio-economic importance of cherry laurel (*Prunus laurocerasus* L.) in Turkey. WG4, European cherries: competitiveness, markets and rural development, 25-26.02.2016 (<https://www.bordeaux.inra.fr/cherry/page6-1-21.html>)
- Yazici K, Dal B, Gozlekci S, Kaynak L, Ersoy N (2009). Effects of cutting type and duration time on rooting of three cherry laurel (*Prunus laurocerasus* L.) genotypes. *Acta Hort. (ISHS)* 818:199-204.

Engineer Job Satisfaction in Bangkok, Thailand

Opal Suwunnamek and Poramate Asawaruangpipop

King Mongkut's Institute of Technology Ladkrabang, Thailand

Abstract

This study is aimed to explore and to compare engineers' personal characteristics toward satisfaction levels on their jobs in Bangkok, using percentage, mean, S.D. T-test and 1-Way ANOVA. From 370 respondents, it was found that, age and engineering branches of the respondents toward satisfaction levels had a statistical significance of group differences at 0.05, while gender, marital status, and education had no statistical significance.

Keywords: Engineer, Job satisfaction, Bangkok

Introduction

Human resources are very important and valuable for any organization. Qualified, efficient and ethical employees can better the organization. Therefore, employee retention is necessary for the success of any organization (B.L.Das and M. Baruah, 2013). It is aimed to achieve organizational goals and objectives, to reduce turnover ratio, and to motivate capable employees to be in, as viewed in many researchers such as Maertz and Campion (1998), Heneman and Judge (2003), and Gberebie (2010).

In Thailand, industrial sector in the country has faced the problem of employee retention. According to Towers Watson Thailand, in 2013, resignation in the industrial sector was found the highest, comparing with the last 4 years prior, especially for engineering position (Towers Watson Thailand, 2014)⁵. The research conducted by Koonya (2004)⁶ informed that production process in the assembling line of many factories in Thailand has been controlled by engineer. Engineer Resignation, then, caused negative effect on production process and the total work. In addition, Thepsiri (2004)⁷ studied factors relating engineer resignation in Thailand's auto industry. It was found that resignation of engineers, who had technical and managerial skills, brought about unavoidably negative influences to the organization. Engineer resignation is an organization cost and burden.

Bangkok is chosen as it is the area that applicants for engineering position applied most, according to information from Jobs ThinkNet Ltd., the site to find jobs in Thailand.

Engineer job satisfaction has been related with organizational success, meanwhile it is also related to employee consideration of quitting and intention to resign. This paper attempts to explore personal characteristics and satisfaction levels of engineers in Bangkok. In addition,

classification of engineer personal characteristics on gender, age, marital status, education, and engineering branches towards job satisfaction was examined.

Literature review

Definition of job satisfaction is about an attitude, perceptions and evaluations that individuals have about their jobs or job experiences (Mortimor & Lorence, 1989, Apollis 2010, and Bhuian and Menguc 2002). There are many papers explaining that turnover and absence from work have been resulted from job dissatisfaction directly and indirectly (Pienaar et al. 2007, Moore, 2002, Netemeyer, et al 1990 and Brown & Peterson 1993). If job satisfaction increases, employee's intention to stay with an organization will be more strengthened, more collaboration, while reducing resignation probability (Price & Mueller 1981).

Methodology

There were 370 respondents of engineers in private enterprises located in Bangkok, Thailand. Convenience sampling method was conducted. Questionnaire on job satisfaction was adjusted from Minnesota Satisfaction Questionnaire (MSQ). Each item was rated on a 5-point Likert scale where 1 "least satisfied", 2 "less satisfied", 3 "can't decide", 4 "satisfied" and 5 "very satisfied" (Weiss et al., 1967). Level of job satisfaction was based on the range of average scores from 1.00 to 5.00 point scale. "Low" level score was ranged from 1.81-2.60, "Moderate" level score was ranged from 2.61 to 3.40, "High" level score was ranged from 3.41 to 4.20, and "Highest" level score was ranged from 4.21 to 5.00. Cronbach's alpha coefficient was conducted to measure content validity. It was found acceptable at 0.865. Descriptive analysis and analysis of variance (ANOVA) was applied to examine significant difference between the personal characteristics and job satisfaction.

Results

Personal characteristics

Of the 370 respondents, the result of the personal information, namely, gender, age, marital status, education, engineering branches, and firm nationality, was shown in Table 1.

Table 1 Personal information of the respondents

| Personal information | No. of persons (N = 370) | % |
|----------------------|--------------------------|------|
| gender | | |
| male | 265 | 71.6 |
| female | 105 | 28.4 |
| Education | | |

| | | |
|--|-----|------|
| Bachelor | 267 | 72.2 |
| Higher than bachelor | 103 | 27.8 |
| Marital status | | |
| single | 273 | 73.8 |
| married | 97 | 26.2 |
| Age (years of age) | | |
| 20-29 | 207 | 55.9 |
| 30-39 | 128 | 34.6 |
| 40-49 | 30 | 8.1 |
| 50-59 | 5 | 1.4 |
| Engineering field | | |
| Industrial | 82 | 21.9 |
| Civil | 79 | 21.4 |
| Machinery | 60 | 15.7 |
| Electrical | 49 | 13.5 |
| Computer | 32 | 8.6 |
| Others(agricultural, telecom, mechatronics, control, instrument) | 68 | 18.9 |
| Total | 370 | 100 |

Job satisfaction of the respondents

Level of job satisfaction was examined. Mean and standard deviation were presented in Table 2.

Table 2 Mean (\bar{X}), standard deviation (S.D.), and ranking of job satisfaction level

| Dimensions | Job satisfaction level | | | | | \bar{X} | SD | ranking |
|---|------------------------|------------|--------------|----------------|-----------------|-----------|-------|---------|
| | Very satisfied | Satisfied | Can't decide | Less satisfied | Least satisfied | | | |
| Freedom of decision at work | 56 (15.1) | 160 (43.2) | 122 (33) | 30 (8.1) | 2 (0.5) | 3.64 | 0.854 | High |
| Communications at work | 55 (14.9) | 150 (40.5) | 131 (35.4) | 31 (8.4) | 3 (0.8) | 3.60 | 0.869 | High |
| Environment at work | 54 (14.6) | 143 (38.6) | 128 (34.6) | 31 (8.4) | 14 (3.8) | 3.52 | 0.969 | High |
| Being a part of this job | 41 (11.1) | 151 (40.8) | 139 (37.6) | 32 (8.6) | 7 (1.9) | 3.51 | 0.872 | High |
| Superior-subordinate relationship at work | 52 (14.1) | 139 (37.6) | 121 (32.7) | 46 (12.4) | 12 (3.2) | 3.47 | 0.988 | High |
| Stability at work | 43 (11.6) | 136 (36.8) | 136 (36.8) | 41 (11.1) | 14 (3.8) | 3.41 | 0.962 | High |

| | | | | | | | | |
|----------------------------|-----------|------------|------------|-----------|----------|------|-------|----------|
| Job advancement | 38 (10.3) | 124 (33.5) | 141 (38.1) | 52 (14.1) | 15 (4.1) | 3.32 | 0.974 | Moderate |
| Work load and compensation | 34 (9.2) | 130 (35.1) | 125 (33.8) | 58 (15.7) | 23 (6.2) | 3.25 | 1.031 | Moderate |
| Total (N= 370) | | | | | | 3.47 | 0.94 | |

*() %

The relationship between personal characteristics and job satisfaction

Gender and job satisfaction

The finding in Table 3 showed that there was no difference found (by T-test) between the level of satisfaction of male and female respondents ($p = 0.654 > 0.05$). However, in this study, female engineers were more satisfied with their job than the male engineers.

Table 3 Descriptive statistics and ANOVA results between job satisfaction and gender

| Gender | Job satisfaction level (Mean) | p-value |
|------------------|-------------------------------|---------|
| Male (n = 265) | 3.4382 | 0.654 |
| Female (n = 105) | 3.5345 | |

Remark: the Mean difference was significant at the $p < 0.05$

Age and job satisfaction

The finding in Table 4 showed that there was statistically significant difference between the level of satisfaction and age ($p = 0.001 < 0.05$). In this study, it was found that the level of job satisfaction went higher when the age of the respondents rose. Especially of the age group between 50 and 59 years of age, they were more satisfied than other age groups.

Table 4 Descriptive statistics and ANOVA results between job satisfaction and age

| Job satisfaction level | Years of age | | | | P-value |
|------------------------|--------------|---------|---------|---------|---------|
| | 20 - 29 | 30 -39 | 40 - 49 | 50 – 59 | |
| | n = 207 | n = 128 | n = 30 | n = 5 | |
| Mean | 3.3502 | 3.5635 | 3.7333 | 4.1250 | 0.001* |

When comparing treatment group mean by Fisher's Least Significant Difference (LSD) in Table 5, it was found that the age group between 20 and 29 years of age had statistically significant difference compared with other age groups. However, for other pair groups, it was found no significant difference of job satisfaction.

Table 5 LSD differences between means of age groups

| Age group | Mean | group | 1 | 2 | 3 | 4 |
|-----------|--------|-------|---|-----------|----------|-----------|
| 20 - 29 | 3.3502 | 1 | - | -0.21324* | -3.8309* | -0.77476* |
| 30 - 39 | 3.5635 | 2 | | - | -0.16986 | -5.6152 |
| 40 - 49 | 3.7333 | 3 | | | - | -0.39167 |
| 50 - 59 | 4.1250 | 4 | | | | - |

* p-value < 0.05

Marital status and job satisfaction

The finding in Table 6 showed no statistically significant difference between the single and the married was found (by T-test) for job satisfaction ($p = 0.223 > 0.05$). However, in this study, married respondents were more satisfied with their job than the single respondents.

Table 6 Descriptive statistics and ANOVA results of job satisfaction and marital status

| Marital status | Job satisfaction level (Mean) | p-value |
|------------------|-------------------------------|---------|
| Married (n = 97) | 3.7719 | 0.223 |
| Single (n = 273) | 3.3567 | |

Education and job satisfaction

The finding in Table 7 showed no statistically significant difference between bachelor and higher than bachelor was found (by T-test) for job satisfaction ($p = 0.828 > 0.05$). However, in this study, “higher than bachelor” degree respondents were more satisfied with their job than the bachelor degree respondents.

Table 7 Descriptive statistics and ANOVA results of job satisfaction and education

| Education | Job satisfaction level (Mean) | p-value |
|--------------------------------|-------------------------------|---------|
| Bachelor (n = 267) | 3.4059 | 0.828 |
| Higher than bachelor (n = 103) | 3.6201 | |

Engineering branches and job satisfaction

The finding in Table 8 showed that there was statistically significant difference between the level of satisfaction and engineering branches ($p = 0.01 < 0.05$). In this study, it was found that respondents in civil and other engineering branches such as mechatronics, instrumentation, telecommunication and agricultural branches had a moderate level of job satisfaction, while mechanical, electrical, industrial, and computer branches had a high level of job satisfaction.

Table 8 Descriptive statistics and ANOVA results between job satisfaction and engineering branches

| Job satisfaction level | Engineering branches | | | | | | P-value |
|------------------------|----------------------|----------------------|----------------------|----------------------|--------------------|------------------|---------|
| | civil n = 79 | mechanical n = 60 | electrical n = 49 | industrial n = 82 | computer n = 32 | others n = 68 | |
| Mean | 3.2880 | 3.4521 | 3.5663 | 3.5137 | 3.8242 | 3.3842 | 0.01* |

* p-value < 0.05

When comparing treatment group mean by Fisher’s Least Significant Difference (LSD) in Table 9, it was found that the computer branch had statistically significant difference compared with mechanical, industrial, civil and “others” branches. In addition, the civil branch, which showing the lowest mean score of job satisfaction level, had statistically significant difference compared with Electrical, industrial, and computer branches.

Table 9 LSD differences between means of engineering branches

| Branches | Mean | group | 1 | 2 | 3 | 4 | 5 | 6 |
|----------|------|-------|---|---|---|---|---|---|
|----------|------|-------|---|---|---|---|---|---|

| | | | | | | | | |
|------------|--------|---|---|----------|-----------|-----------|-----------|-----------|
| Civil | 3.2870 | 1 | - | -0.16411 | -0.27835* | -0.22574* | -0.53624* | -0.09622 |
| Mechanical | 3.4619 | 2 | | - | -0.11424 | -0.06164 | -0.37214* | 0.06789 |
| Electrical | 3.5663 | 3 | | | - | 0.05261 | -0.25789 | 0.18214 |
| Industrial | 3.5137 | 4 | | | | - | -0.31050* | 0.12953 |
| Computer | 3.8199 | 5 | | | | | - | -0.44003* |
| Others | 3.3692 | 6 | | | | | | - |

* p-value < 0.05

Conclusion

The contribution of personal characteristics and job satisfaction of engineers in Bangkok, Thailand in this paper may clarify the phenomenon of employees that it should be taken into account for any enterprises. This paper attempted to explore job satisfaction level and personal characteristics of engineer respondents. It was found that there were “high” level of satisfaction for freedom of decision at work, communications at work, environments at work, being a part of this job, superior-subordinate relationship at work, and stability at work. However, it is expected that findings in this study may be useful for private enterprises that have young engineers, as well as those who have civil engineers. They should take more concerns on, especially, work load and compensation as well as job advancement if they want to retain them.

Acknowledgement

The authors would like to thank Faculty of Administration and Management, King Mongkut’s Institute of Technology Ladkrabang, Thailand, for the research funding.

References

- Appollis, V.P. 2010. The relationship between intention to quit, psychological capital and job satisfaction in the tourism industry in the Western Cape, Cape Town:WCU. (Dissertation)
- Bhuiyan, S.N. & Menguc, B. 2002. Evaluation of job characteristics: Organizational commitment and job satisfaction in an expatriate guest worker sales setting. *Journal of Personal Selling and Sales Management*, 22:1-12.
- Bidisha L.D.and Baruah M. 2013. Employee Retention: A Review of Literature. “IOSR Journal of Business and Management (IOSR-JBM). Vol.14, Issue 2(Nov.-Dec. 2013). 8-16.
- Brown, S.P. & Peterson, R.A. 1993. Antecedents and consequences of salesperson job satisfaction: meta analysis and assessment of causal effects. *Journal of Marketing Research*, 30(1):63-77.
- Gberville D.E.. 2010. Strategies for employee recruitment, retention and performance: Dimension of the Federal Civil Service of Nigeria. “African Journal of Business Management”, Vol 4(8), 1447-1456, 18 July, 2010.
- Heneman H.G. and Judge T.A.. 2003. *Staffing Organization* (4th Ed). Boston. Mc-Graw-Hill, Irwin.
- Koonya K. 2004. A study of engineer resignation of Bangkok Spring Industrial Co.,Ltd.

- Independence study submitted for the master degree of Master of Public Administration, graduate school of public administration, Burapa university.(In Thai)
- Maertz, C.P. Jr. and Campion M.A.. 1998. 25 Years of Voluntary Turnover Research: A review and Critique. *International Review of Industrial and Organizational Psychology*. Vol. 13,49-81.
- Moore.J.E. 2002. One road to turnover: an examination of work exhaustion in technology professionals. *Management Information Systems (MIS) Quarterly*. 24(1):141-168.
- Mortimer, J.T. & Lorence, J. 1989. Satisfaction and involvement: disentangling a deceptively simple relationship. *Social Psychology Quarterly*, 52 (4).249-265.
- Netemeyer. R.G.. Johnston, M.W. & Burton, S. 1990. Analysis of role conflict and role ambiguity in a structural equation framework. *Journal of Applied Psychology*, 75(2):148-157.
- Pienaar, J., Sieberhagen, C.F. & Mostert, K. 2007. Investigating turnover intentions by role overload, job satisfaction and social support moderation. *SA Journal of Industrial Psychology*. 33(2):62-67.
- Price, J.L. & Mueller, C.W. 1981. A causal model of turnover for nurses. *Academy of Management Journal*, 24 (3):543-565.
- Thepsiri S. 2004. Factors affecting engineer's job resignation level in automotive industry. Thesis submitted for the Master of Science program, graduate school, King Mongkut's Institute of Technology Ladkrabang, Bangkok.
- Towers Watson's Thailand. 2014. Towers Watson's Thailand 2014 Q1 Flash Survey, HR Trends and Challenging Issues for General Industry [online].Access on March 4, 2017. In Thai.
<https://www.towerswatson.com/en/Press/2014/03/Salary-increase-of-6-in-2014-for-Thailand-general-industry>
- Weiss, D.J., Dawis, R.V. England, G.W. and Lofquist, L.H. 1967. Manual for the Minnesota Satisfaction Questionnaire. Vol 22. Minnesota Studies in Vocational Rehabilitation, Minneapolis: University of Minnesota, Industrial Relations Center.

OPTIMIZATION OF ELECTROCOAGULATION PARAMETERS FOR PRE-TREATMENT OF INDUSTRIAL METAL CUTTING WASTEWATER

Umran TEZCAN UN^{1,*}, Ayse GUL¹, S. Eren OCAL²

¹ Anadolu University Department of Environmental Engineering, Turkey

² Anadolu University Department of Chemical Engineering, Turkey

Abstract

Metal cutting fluids are liquid used in machines in the form of emulsified oil for cutting, cooling and lubrication operations. Metal cutting wastewater is one of those wastewaters with high COD value and need to be treated well before being discharged. In this study, electrocoagulation as a pre-treatment step for treating an industrial metal cutting wastewater was experimentally investigated. Optimum values of operating parameters such as pH, current density and supporting electrolyte concentration with initial COD value of 180000 mg/L has been studied. The system made of iron gave optimum removal of 84.72% at pH 7, current density 30 mA/cm² and 0.4M of NaCl electrolyte concentration respectively.

Key Words: Cutting oil wastewater, iron electrode, electrocoagulation,

1. Introduction

Cutting oils are fluids used to reduce friction and heat between processing metals, to wash residual metals and to suppress the growth of microorganisms on the surface of metals in the metal cutting industries. Cutting oil in general contains oil, water and additives. They generally have high COD values and if discharged into rivers, it may affect water qualities and also lead to diseases such as respiratory disease, skin disease, cancer and others [1]. As water discharge limitations are getting stringent, industries face huge technical challenges in treating these metal cutting wasters in order to meet the regulations.

Many treatment techniques were developed in the last two decades in order to meet environmental regulations demand like sorption [2], membrane techniques [3], biotreatment [4] etc. But, no single technique was found efficient to treat metal cutting wastewater to dischargeable limits. Hence integration of various wastewater treatment techniques is required [5].

Electrocoagulation is one of the promised techniques to treat metal cutting wastewaters with high COD values [6]. Electrocoagulation involves in situ generation of positive metal ions which result in the formation of metal hydroxides by reacting with the negatively charged hydroxyl ions in the wastewater. These metal hydroxides either react or decrease the Vander wall forces between the colloidal particles leading to the formation of flocs with sufficient weight to settle down in the treatment reactors. The resulting sludge can be then separated through filtration. The treated fluid can then be discharged directly into the environment or can be used as an influent to other advance treatment methods [5]. Reactions occurring with iron electrodes are described in our earlier publications [7].

In this study, experimental investigation of electrocoagulation treatment as a pre-treatment step for treating the industrial metal cutting wastewater with initial COD of 180000 mg/L has been carried out. The effects of pH, current density and supporting electrolyte concentration on COD removal efficiency were determined using unique designed electrode.

2. Materials and Methods

The metal cutting wastewater was obtained from a metal working industry in Eskisehir, Turkey. The wastewater received had a pH of 8.63 and initial COD of 180000mg/L. The pH was measured using SevenGo pH meter and the COD values were evaluated by Hach Lange COD analysis kit with a measurable range of 0-60000 mg/L. The initial COD was evaluated by diluting the wastewater four times using distilled water. The pH values were adjusted using 0.1M NaOH solution or 0.1M H₂SO₄ solutions. All the chemicals used were of analytical grade.

A cylinder, made of iron, with diameter of 11cm and height of 10 cm was used as electrochemical reactor. The reactor capacity was 950 mL and in experiment 600 mL of sample

was used per batch. Rushton type turbine (RT), made of iron, with a disc of diameter 4 cm and 8 attached blades of height 2.5 cm, width 1.5 cm and a thickness of 0.5cm was used as sacrificial anode. The effective area of RT blade was 120 cm². The overall experimental setup was as shown in Figure 1. A DC power was supplied to the setup by using Statron® power supply with operating range of 0-45V and 0-50A.

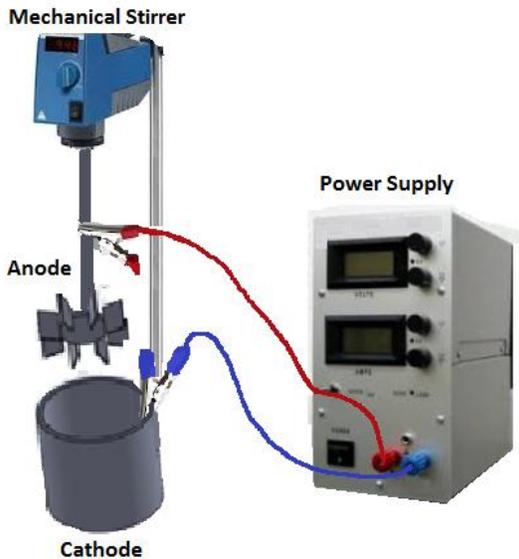


Figure 1: Experimental set-up

3. Results and Discussion

3.1. Effect of pH

Initial pH of wastewater has a profound effect on the electrocoagulation treatment of metal cutting wastewater [8]. In general, in the electrocoagulation process with sacrificing iron electrode the formation of metal hydroxides like $\text{Fe}(\text{H}_2\text{O})_6^{3+}$, $\text{Fe}(\text{H}_2\text{O})_5(\text{OH})_2^+$, $\text{Fe}(\text{H}_2\text{O})_4(\text{OH})_2^+$, $\text{Fe}_2(\text{H}_2\text{O})_8(\text{OH})_2^{4+}$ and $\text{Fe}_2(\text{H}_2\text{O})_6(\text{OH})_4^{4+}$ in is highly effected by pH [9]. Hence a study of effect of pH on the overall process is desired.

In this study, apart from original pH of 8.63, the effect of initial pH values was studied for 240 minutes at current density of 20 mA/cm², 0.2 M of NaCl electrolyte concentration and pH values of 3, 5 and 7 respectively. The highest removal was found at a pH value of 7 after 150 minutes,

which is conjunction with the published literature, Kobya et al. [10], for iron electrode. The effect of various pH values in our study are as shown in Figure 2. Further studies were carried at pH 7 for a time of 150 minutes.

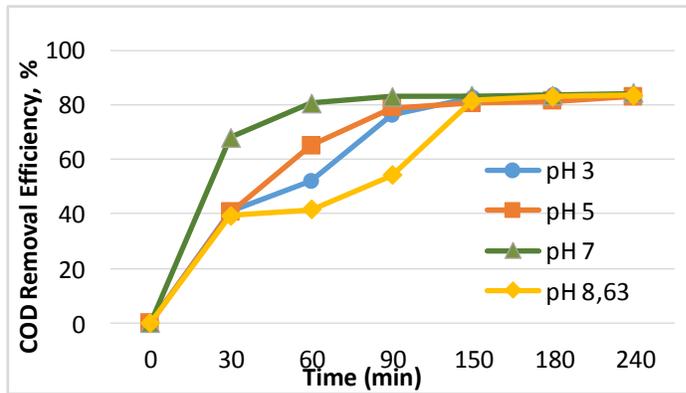


Figure 2: Effect of pH on the COD removal

efficiency



(a)

(b)

Figure 3: The photographs of raw wastewater (a) and treated wastewaters (b)

3.2. Effect of current density

Current density is one of the most important parameters that will have impact on both, the performance of electrocoagulation process and the cost of operation [11]. Hence an optimum selection of current density value is required for any kind of further investigations, especially for scale up of reactor configurations. In this study current density effect on the removal efficiency of electrocoagulation process was investigated at 20, 30 and 40 mA/cm² at a pH of 7 and 0.2 M electrolyte concentration. The effect of current density on the removal efficiency and energy

consumption are as shown in Figure 4 and 5. From the Figure 4 it can be clearly seen that there isn't any significant difference in the overall removal efficiency at current densities of 30 mA/cm² and 40 mA/cm². But at the same time the electrical energy consumption, as shown in Fig. 5, at 30 mA/cm² was 100.8 kWh/m³ and at 40mA/cm² it was found to be 145.2 kWh/m³. Hence in order to have least energy consumption current density of 30 mA/cm² was chosen as optimum value for further investigations.

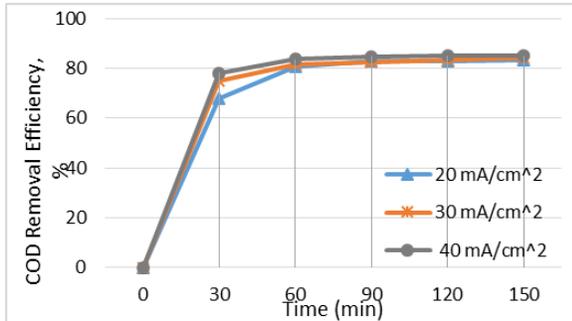


Figure 4: Effect of current density on COD removal efficiency

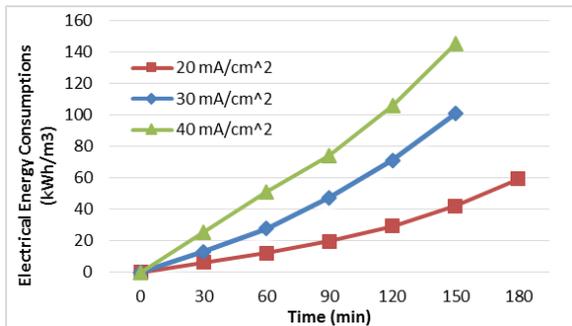


Figure 5: Effect of current density on electrical energy consumption

3.3. Effect of electrolyte concentration

Addition of electrolyte increases the ion activity and hence leads for effective removal of pollutants by electrocoagulation technique [12]. In this study the effect of electrolyte concentration was studied at 0.2, 0.4 and 0.6M at pH of 7 and current density of 30 mA/cm² respectively. The effect of electrolyte concentration on the overall removal efficiency is as

shown in the Figure 6 and 7. From Figure 6 and 7 it can be clearly seen that increase in electrolyte concentration was not found to have any great impact on the overall removal efficiency but at the same time the energy consumption was found decreasing on increase of electrolyte concentration from 0.2 to 0.4 and remaining same when increased to 0.6M. Hence 0.4M can be chosen as optimum value for treating this industrial metal cutting wastewater.

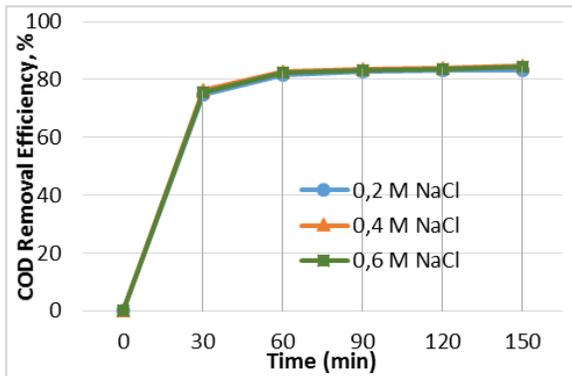


Figure 6: Effect of NaCl concentration on COD removal efficiency

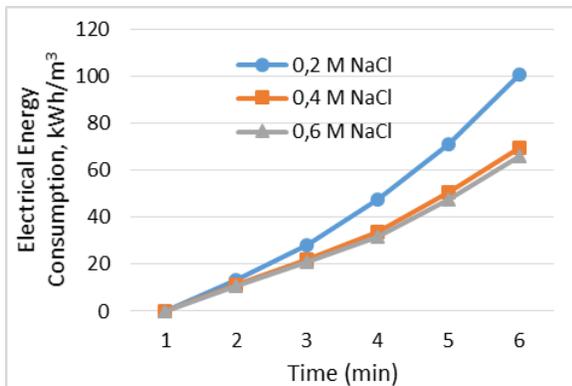


Figure 7: Effect of NaCl concentration on electrical energy consumption

4. Conclusion

Electrocoagulation treatment of metal cutting wastewater was investigated. Optimum values operating parameters like pH, current density and supporting electrolyte concentration was

evaluated and found to be 7, 30 mA/cm² and 0.4 M respectively. Increase in electrolyte concentration was found ineffective in increasing the overall removal efficiency. The overall removal efficiency at optimum parameters for a metal cutting wastewater with initial COD of 180000 was 84.72% which results in a wastewater with COD of 27500mg/L. Advance treatment techniques can be used for further reduction of this discharge. Hence it can be concluded that electrocoagulation treatment can be an effective pre-treatment process for treating industrial metal cutting wastewater.

Acknowledgement: This study was supported by the Research Fund of Anadolu University, Turkey. Project No: 1505F292.

5. References:

1. D.C. Seo, H.J. Lee, H.N. Hwang, M.R. Park, N.W. Kwak, I.J. Cho, J.S. Cho, J.Y. Seo, W.H. Joo, K.H. Park and J.S. Heo, 2007. Treatment of non-biodegradable cutting oil wastewater by ultrasonication-Fenton oxidation process. *Water Science & Technology*, 55(1–2), 251–259.
2. A.M.A. Pintor , V.J.P. Vilar, C.M.S. Botelho, R.A.R. Boaventura, 2016. Oil and grease removal from wastewaters: Sorption treatment as an alternative to state-of-the-art technologies. A critical review. *Chemical Engineering Journal* 297, 229–255.
3. S.S. Hosseinia, E. Bringasb, N.R. Tanc, I. O.M. Ghahramania, M.A.A. Shahmirzadiaa, 2016. Recent progress in development of high performance polymeric membranes and materials for metal plating wastewater treatment: A review. *Journal of Water Process Engineering* 9, 78–110.
4. B.R. Kim, J.F. Zemla, S.G. Anderson, D.P. Stroup, D.N. Rai, 1992. Anaerobic Removal of COD in Metal-Cutting-Fluid Wastewater. *Water Environment Research* Vol. 64, No. 3, 216-222.
5. K. Bensadok, S. Benammara, F. Lopicque , G. Nezzal, 2008. Electrocoagulation of cutting oil emulsions using aluminium plate electrodes. *Journal of Hazardous Materials* 152, 423–430.
6. V. Kuokkanen, T. Kuokkanen, J. Rämö, U. Lassi, 2013. Recent Applications of Electrocoagulation in Treatment of Water and Wastewater—A Review. *Green and Sustainable Chemistry*, 3, 89-121.
7. U. Tezcan Un, E. Aytac, 2013, Electrocoagulation in a packed bed reactor-complete treatment of color and cod from real textile wastewater, *Journal of Environmental Management*, 123, 113–119.
8. X. Xu , X. Zhu, 2004. Treatment of refractory oily wastewater by electro-coagulation process. *Chemosphere* 56, 889–894.

9. R. R. Babu, N. S. Bhadrinarayana, K. M. Meera Sheriffa Begum, N. Anantharaman, 2007. Treatment of tannery wastewater by electrocoagulation. *Journal of the University of Chemical Technology and Metallurgy*, 42, 201-206.
10. M. Kobya , C. Ciftci , M. Bayramoglu , M.T. Sensoy , 2008. Study on the treatment of waste metal cutting fluids using electrocoagulation. *Separation and Purification Technology* 60, 285–291.
11. J.R.P. da Silva, F. Mercon, L. F. da Silva, A. A. Cerqueira, P. B. Ximango, M. R. da C. Marques, 2015. Evaluation of electrocoagulation as pre-treatment of oil emulsions, followed by reverse osmosis. *Journal of Water Process Engineering* 8, 126–135.
12. C. Jimenez Izquierdo, P. Canizares, M.A. Rodrigo, J.P. Leclerc, G. Valentin, F. Lapique, 2010. Effect of the nature of the supporting electrolyte on the treatment of soluble oils by electrocoagulation. *Desalination* 255, 15–20.

BARRIERS IN CONDUCTING RESEARCH AMONG NURSE EDUCATORS IN ILAGAN CITY

Beaven Andrew A. Atienza

**Mindanao State University – Iligan Institute of Technology College of Nursing,
Andres Bonifacio Avenue, Tibanga, Iligan City, 9200 Philippines**

ABSTRACT

All disciplines including nursing depend on scientific investigation to enrich the pool of knowledge and deepen the context as well as to improve their practice. Nursing emerged as a profession when it started to use theoretical knowledge derived from research. This study aimed to determine the barriers that account for low research output among nurse educators in Iligan City. This study used a descriptive-correlational and triangulation procedure. 133 respondents from 5 selected nursing school participated in the study. The statistical tools used were frequencies, percentages, weighted mean, Pearson Product-Moment Coefficient of Correlation and Chi-square. The top 5 barriers that led to the low research output of the respondents were nurse educator's lack of time, organization's lack of time allotment for research conduction, lack of personal funds, being an additional burden to their work load and lack of collaboration between researchers and clinicians. It is interesting to note that lack of mentorship was significantly link to decrease research production. The top 2 greatest barriers in research conduction involve time. This implies that there is a compelling need for nurse educators to be de-loaded in order to do research. Allocating ample time for research studies and starting/strengthening mentorship program might significantly increase research productivity.

Keywords: Barriers, Research, Nurse Educators

INTRODUCTION:

Research in nursing has progressed much to the extent that most members of the nursing profession are motivated to base their practice on result of researches instead of traditional practice. In this regards, the goal of nursing science is "To provide a body of abstract knowledge growing out of a scientific research and logical analysis and capable of being translated to nursing practice" (Burns & Grove, 2005).

Research serves the need of nurses in helping solve today's problems in sustaining life in the face of technological change that threaten life. Nurses must have access to and understanding of patient's feeling when contemplating on the nursing care techniques to alleviate the health problems of man.

The nurse educator's role is essential to the ongoing development of the profession and the ability of the discipline to meet society's needs for quality nursing care.

However, it is sad to note that some nursing schools seem to be not sensitive to the needs of the profession in the area of research.

It is not a new idea that educators need to engage in research. Though there is a seemingly common acceptance of the idea, the actual output of researches in Philippine schools is limited. The Philippines lag behind among Southeast Asia in number of research output. An Institute for Scientific Information publication comparison from the Philippines in all disciplines and its neighboring countries from 2002 to 2007 show the following (from highest to lowest): Korea- 78804, Taiwan-47981, Singapore-17288, Thailand-9188, Malaysia-5088, Indonesia- 2297, Philippines- 2283 and Vietnam-2207. The number of Institute for Scientific Information (ISI) publications from the Philippines is almost similar to that of Indonesia and Vietnam while Malaysia, Thailand and Singapore are very far ahead.

The research outputs from the Philippines are mainly in agriculture, followed far behind by publications on environment and in earth science. The current research productivity among the colleges and universities in the Philippines is only .7% (12 out of 1741 HEI's). In fact, publication was not developed in 8 out of 78 (10.2%) zonal HEI's in our country (Duyanen, 2011).

Research is an important tool for the continual development of a relevant body of knowledge in nursing. It is incumbent upon nursing schools that they must strengthen and widen their horizon to nursing research. It is only through conducting researches can we be able to base specific nursing actions and decisions on evidence indicating that the actions are clinically appropriate, cost-effective, and result in positive outcomes for the clients. Moreover, it has been found out that nurses who incorporate high-quality research evidence into their clinical decisions and advice are being professionally accountable to their clients as well as reinforcing the identity of nursing as a profession (Polit, 2004).

Research findings determine how nurses deliver care, educate each other, and manage their practice. When nursing practice is evidence-based, patients are more likely to receive nursing care that is safe and effective, promotes comfort and facilitates the best outcomes. Research findings help determine how nurses deliver care, educate each other and manage their practice.

However based on self- reports, nurse educators in Iligan were not involved in research activities because of a lot of factors which is the focus of this study. Being aware that research is an important aspect of any institution in order to improve, the researcher has attempted to find out some barriers encountered by nurse in conducting research.

MATERIALS AND METHODS:

This study follows a descriptive-correlational and triangulation procedure. The respondents of the study are composed of nurse educators working in selected nursing schools in Iligan City. All are registered nurses and currently working either as a full time or part-time faculty. The respondents are either a clinical or classroom instructor. A

total of 133 nurse educators participated in the study. No sampling method was used since all nursing faculty participated on the study.

The research questionnaire was divided into two (2) parts: The Participant Demographic Sheet and the two sets of Barrier Scale. The Participant Demographic Sheet were administered to gather information regarding the respondent's demographic data such as age, gender, marital status, highest educational attainment, employment status, number of years of experience, number of teaching units, and number of research(es) conducted. Part II and part III was originally called as the Barrier Scale created by Funk et al (1991). It was originally a 29-item questionnaire that would identify the barriers why nurses do not conduct research and does not utilized the outcomes of various nursing researches.

The questionnaire had been modified to answer the main objective of the study which was to identify the barriers to nurse educators' inability to conducting researches. Some items related to research utilization have been deleted since it does not apply to the study. However, additional questions were added which was taken from a research conducted by Sabzwari, et.al (2009). My Adviser along with three (3) other experts closely examined the paper and validated the items.

The statistical tools used were frequencies, percentages, weighted mean, Pearson Product-Moment Coefficient of Correlation and Chi-square.

RESULTS AND DISCUSSION:

Table 1: Mean Ratings of the Respondents' Perception on the Barriers in Conducting Research on the Characteristics of Nurse Educators in terms of Values, Skills and Awareness

| Characteristics of Nurse Educators | | Mean | SD | Interpretation |
|---|---|-------------|------------|------------------------|
| A. Values | | | | |
| 1. | I am not interested to conduct research. | 1.71 | .91 | Sometimes Agree |
| 2. | Research has little benefit for self. | 1.48 | .84 | Disagree |
| 3. | I feel the benefits of research will be minimal | 1.47 | .84 | Disagree |
| 4. | I see little value in conducting research | 1.39 | .77 | Disagree |
| 5. | I'm not willing to change/try new ideas. | 1.02 | .19 | Disagree |
| Average | | 1.41 | .71 | Disagree |
| B. Skills | | | | |
| 1. | I think conducting research is time-consuming. | 2.77 | .64 | Agree |
| 2. | I don't have enough money to conduct research | 2.70 | .70 | Agree |
| 3. | I lack research training. | 2.27 | .93 | Sometimes Agree |
| 4. | I do not feel capable of conducting research. | 1.55 | .82 | Disagree |
| 5. | I am isolated from knowledgeable colleagues with whom to discuss the research | 1.19 | .54 | Disagree |
| Average | | 2.10 | .73 | Sometimes Agree |
| C. Awareness | | | | |
| 1. | Conducting research is an additional burden to my workload. | 2.50 | .79 | Agree |
| 2. | Conducting research is not exciting. | 1.83 | .94 | Sometimes Agree |
| 3. | I am afraid of being misunderstood and misinterpreted | 1.43 | .89 | Disagree |
| 4. | I am afraid of being identified (confidentiality). | 1.43 | .76 | Disagree |
| 5. | There is no documented need to conduct research. | 1.05 | .31 | Disagree |
| Average | | 1.64 | .74 | Disagree |

Disagree 1-1.67 Sometimes Agree 1.68-2.34 Agree 2.35-3.00

Table 1 revealed the descriptive statistics for the characteristics of the nurse educators in terms of values, skills and awareness. For values, the over-all mean is 1.41 which means that most of the respondents disagreed that the nurse educators' values were barriers in conducting research. From the above results one can infer that most nurse faculty saw the importance in doing research. In the interview questions many of the respondents admitted that they know the value and the benefits of doing research, but they just don't have time to do it.

For skills, the over-all mean which is 2.10 signifies that they were not skillful enough to conduct research. The highest mean of 2.77 means that the respondents pointed out

that lack of time was the most significant factor that hindered them to conduct research. 122 out of 133 nurse educators accounting to 91.7% cited that having no time is the greatest barrier in conducting research. 38% of the respondents had 28-34 teachings units while 59% of them are carrying 21-27 units. According to a respondent, “preparing power point presentation for lecture while preparing for and having duty on the hospitals consumes most of my time. Aside from that, I still have to study about my report and exams for master’s classes”. In the study entitled “Barriers to research Conduction” by Sae-Sia et al (2008), 78% of the respondents reported that having no time to conduct research was a barrier in conducting research. Smith (1986) & Miller et al., (1997) surmised that nursing's poor research performance is due to insufficient time for nurses to participate in research activities. Lack of money had the second highest mean (2.70) and lack of training ranked the third with a mean of 2.27. This means that nurse educators need financial support to conduct research and attend trainings. During the interview many nurse educators responded “not all of us were given the opportunity to attend seminars and trainings about research”.

Lastly, in terms of awareness, the over-all mean of 1.64 implies that most of the respondents disagreed that lack of awareness was a hindrance to conduct research. This goes to show that they were aware of the need to conduct research. However, majority of them consider it as an additional burden to their workload. 107 out of 133 respondents (80.5%), which was the second highest percentage, answered that de-loading of teaching units can motivate them to conduct research. A respondent said that due to her busy schedule, she will be ineffective or incompetent as a nurse educator if conducting research will be added to her workload since she cannot concentrate anymore to her lectures and duties. In a study by Funk et.al (1991) about barriers in research conduction, 80% of the respondents rated “workload too heavy to pursue” as great or moderate barrier. Most of the nursing schools require clinical instructors to work 8 hours a day, 5 days a week and sometimes they go on duty on the weekends. With this hectic schedule, nurse educators find it hard to engage in research activities.

Table 2 Mean Ratings of the Respondents’ Perception on the Barriers in Conducting Research on the Characteristics of the Organization as to setting, mentorship and limitations

| Characteristics of the Organization | Mean | SD | Interpretation |
|---|-------------|-----------|-----------------------|
| A. Setting | | | |
| 1. There is lack of collaboration between researchers and clinicians. | 2.34 | .89 | Sometimes Agree |
| 2. There are no financial incentives for published researches | 1.85 | .95 | Sometimes Agree |
| 3. The facilities are inadequate to conduct research. | 1.80 | .91 | Sometimes Agree |
| 4. Administration does not support research because of various factors (e.g., lack of funds). | 1.69 | .91 | Sometimes Agree |
| 5. There are no appropriate rewards (tenure and promotion) given. | 1.49 | .81 | Disagree |

| | | | |
|--|-------------|------------|------------------------|
| 6. Superiors/Colleagues have no confidence in my ability to conduct research | 1.45 | .69 | Disagree |
| Average | 1.77 | .86 | Sometimes Agree |
| B. Mentorship | | | |
| 1. There is lack of mentorship. | 2.18 | .92 | Sometimes Agree |
| 2. There are no available consultants to help critique. | 1.90 | .89 | Sometimes Agree |
| 3. There is lack of encouragement to conduct research | 1.60 | .89 | Disagree |
| 4. Colleagues are not supportive of research. | 1.52 | .82 | Disagree |
| Average | 1.8 | .88 | Sometimes Agree |
| C. Limitations | | | |
| 1. There is insufficient time to do research. | 2.72 | .67 | Agree |
| 2. There is lack of training and seminars. | 2.22 | .92 | Sometimes Agree |
| 3. Accessible resources are inadequate to conduct research. | 1.91 | .94 | Sometimes Agree |
| 4. Research articles are not readily available. | 1.70 | .91 | Sometimes Agree |
| 5. There is lack of empowerment to make changes. | 1.67 | .88 | Disagree |
| Average | 2.04 | .86 | Sometimes Agree |

Disagree 1-1.67 Sometimes Agree 1.68-2.34 Agree 2.35-3.00

Table 2 shows the descriptive statistics on the characteristics of the organization as to setting, mentorship and limitations. As to setting, the over-all mean is 1.77, which means that the respondents sometimes agreed that there were problems on the organization's setting which hindered them to conduct research. Moreover, most the respondents perceived that there was lack of collaboration between researchers and clinicians. Variability of nurse's duty schedule can possibly affect their collaboration. Some nurses go on duty in the afternoon (3-11pm). Other nurses are scheduled to duty in the NOC shift (11pm-7am) while some nurse educators are having their lecture from 8am to 5 pm. Lack of financial incentives for published research discourages them to engaged in research. In the interview the nurse educators identified lack of financial incentive as the 4th greatest barrier. During the interview the respondent said "conducting research is not worth the time, money and effort we spend because we can't receive cash rewards". Unattractive salary package and lack of incentives (e.g. in publications) for our researchers-results in brain-drain contributing to less and less people engaged in research (Largo, 2011).

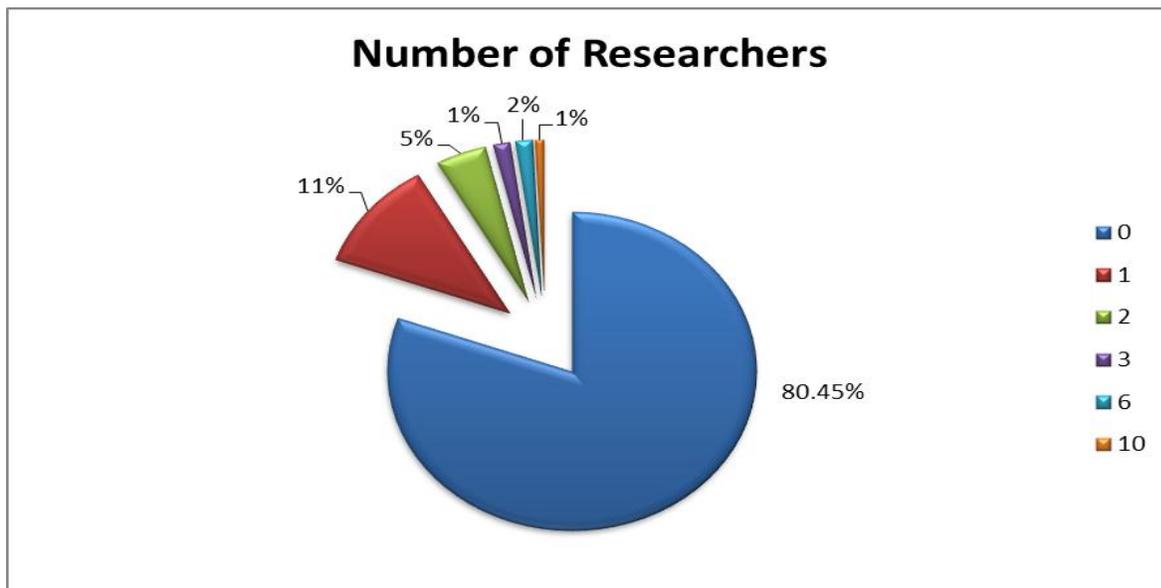
The respondents rated lack of administrative support as the second biggest barrier in terms of setting. With their hectic activities and the numerous concerns administrators need to attend, giving financial support for research can't always be a priority. There are more urgent needs that should be address first such as purchasing lab equipment for return demonstration, etc. In the study about barriers in research conduction by funk et

al (1991), majority of the respondents cited lack of administrative support as a barrier in conducting research. (Mason, 2007) concluded that a large proportion of educational institutions and administrators do not adequately support nursing research.

As to mentorship of the organization, the over-all mean which is 1.8 signifies that lack of mentorship would somehow affect their interest to conduct research. Majority of them agreed that they lack competent consultants to mentor and help critique their research work. A respondent said “we are not motivated to do research because we don’t have enough mentors to guide or edit our researches. We are ashamed of our output”. Weak leaders and lack of dedicated and well-trained research mentors (who are not publishing) - only result to weak researchers (Largo, 2011)

Lastly, as to limitations, the over-all mean of 2.04 implies that there were limitations in the organization in terms of conducting research. Most of them agreed that their time was insufficient to do research and there was lack of training and seminars for research development According to a respondent, “after working in the school or hospital we still continue to check a number of projects, quizzes, exams, etc in the house. It’s difficult for us to conduct research with our busy schedule.” In the study by Funk et al (1991) regarding barriers in research conduction, administrators view lack of time as a substantial barrier in doing research. A research conducted by Hommelstad and Ruland (2004) investigated why Norwegian nurses’ prefers not to get involve in research. They found out that the greatest barriers they perceived were insufficient time for research activities and lack of support from leaders.

Figure 1 Percentage Distribution of Number of Researchers



As shown in Figure1 the larger population of the respondents (80.45%) had not conducted any research at all. On the other hand, about 11% of them had done at least one research output. 2% of the nurse educators have 6 research output while 1% of them was able to produce 10 researches. As reflected in this figure most of the clinical instructors were not conducting research but there were few who had high output. This means that there were respondents who were productive in their research output. This signifies that there were some nurse faculties who were experienced and competent to help mentor the novice researchers.

Table 3: Relationship between the Respondent's Perception on the Barriers in Conducting Research and number of Research Output

| Barrier/s | Chi-square | P-value | Remarks |
|---|------------|---------|-----------------|
| Characteristics of Nurse Educators | | | |
| Values | 3.246 | .518 | Not Significant |
| Skills | 4.093 | .394 | Not Significant |
| Awareness | 6.402 | .171 | Not Significant |
| Characteristics of Organization | | | |
| Setting | 3.389 | .495 | Not Significant |
| Mentorship | 9.926 | .042* | Significant |
| Limitations | 3.091 | .543 | Not Significant |

* Significant at .05 level

According to Table 3 there was a significant relationship between the organization's mentorship (such as lack of mentorship, lack of consultants to help critique, etc) and the level of research output. This suggests that the respondent's view to the organization's barrier as a hindrance to research conduction had influenced their level of research output.

CONCLUSION:

Our study findings suggest that nurse educators see the need and value of research. However there are considerable obstacles that need to be addressed in order to increase research productivity. The biggest obstacles include lack of time, training, funds and collaboration between clinicians and researchers. It is noteworthy that lack of mentorship was significantly associated with low research output. It is recommended that service training programs be conducted to enhance the nurses' competence in doing research. Sufficient funds must be allocated for research. An experienced faculty can be encourage to mentor and help critique the novice researchers. Collaboration between clinicians can be done by providing a schedule where all faculties are available to discuss about nursing research. Regular small-group roundtable discussion on research among peers can be helpful. A Faculty Development Plan can be devise which would facilitate the nurse educators' need for professional development not only by attending various trainings and seminars but also to make researches which would uplift the nursing profession. De-loading a faculty who are undergoing research is also favorable. We can also convert teaching load to "Research Load" to make research comparable to teaching in terms of compensation package. Increasing collaboration

with research institutions-link with foreign institutions can help imbibe new ideas, write joint research proposals with partners - for capability building. Improving the mentoring system can increase the nurse educators' confidence to do research. Lastly, getting to know some funding source like CHED, DOST, USAID, AUS aid, GTZ, Ford Foundation, Sumitomo foundation, in-house funding, etc. can aid in increasing research productivity.

BIBLIOGRAPHY

WEBSITES

1. Arévalo, M. et. al. (2006, June). Fertility awareness-based methods of family planning: predictors of correct use. <http://www.guttmacher.org>. Retrieved on February 23, 2013 from pubs/journals/3209406.html
2. Orbeta, A. (2006). Poverty, fertility preferences, and family planning practices in the Philippines. *Philippine journal of development*. <http://dirp4.pids.gov.ph>. Retrieved on June 16, 2012 from ris/pjd/pidspjd06-poverty.pdf
3. Indongo, I. (2007, April). Contraceptive use among young women in Namibia: Determinants and policy implications. <http://upetd.up.ac.za>. Retrieved on June 15, 2012 from thesis/available/etd-01252008.../00front.pdf
4. Nakibonepa, C. and Maniple, E. (2008). Factors related to the uptake of natural family planning by clients of Catholic Health Units in Masaka Diocese, Uganda. <http://www.bioline.org.br>. Retrieved on February 22, 2013 from [pdf?hp08016](http://www.bioline.org.br/pdf?hp08016)
5. Akintade, O. (2010). Awareness, use and barriers to family planning services among female students at the National University of Lesotho, Roma, Lesotho. <http://ul.netd.ac.za>. Retrieved on February 27, 2013 from bitstream/10386/215/1/Akintade'sMPHprojectfinal%5B1%5D.pdf
6. Mahamed, F. et. Al (2012, March). Impact of family planning health education on the knowledge and attitude among Yasoujian women. www.ccsenet.org. Retrieved on June 15, 2012 from [gjhs](http://www.ccsenet.org/gjhs)

Online Database (Journal)

1. Hooper, D. (2010). Attitudes, awareness, compliance and preferences among hormonal contraception users: A global, cross-sectional, self-administered online survey. *Clinical drug investigation*, 30 (11): 749-763. Retrieved from Research database.

Unpublished Materials:

1. Ryerson, W. (2007). Unmet need: lack of access or lack of cultural and informational support. Vermont, USA.

2. Mugisha J.F. and Reynolds H. (2008). Provider perspectives on barriers to family planning quality in Uganda: A qualitative study. Kampala, Uganda.

3. Adeleye, O.A. et.al. (2010). Barriers and knowledge of benefits regarding family planning methods among women attending antenatal clinics in a Southern Nigerian community. Benin City, Nigeria.

4. Chan, C.M. et.al. (2011). Barriers to therapeutic regimen adherence of type II diabetes mellitus patients in Iligan City. Iligan City. Undergraduate Thesis. MSU-Iligan Institute of Technology, Iligan City.

5. Acedo, S et. al. (2012). A descriptive survey on the barriers of family planning among Badjaos in Barangay Tambacan, Iligan City. Iligan City. Undergraduate Thesis. MSU-Iligan Institute of Technology, Iligan City.

A Modified Compact Fork-Shaped Slotted Wideband Antenna for C and X-band Applications

Jagtar Singh Sivia

Professor, Yadawindra College of Engineering
Punjabi University GKC Talwandi Sabo,
Bathinda, Punjab, India 151302

Manpreet Kaur

Assistant Professor, Yadawindra College of
Engineering Punjabi University GKC Talwandi
Sabo, Bathinda, Punjab, India 151302

Abstract- The paper focuses on the design of a Modified Compact Fork-Shaped Slotted Wideband Antenna (MCFSSWA) having defected ground plane that provides high gain, wide band and good radiation characteristics. The proposed antenna is designed at 8.248GHz and operates at two different frequency bands, namely, C-band and X-band. The material used for the designing of MFSSMA is low cost FR-4 epoxy whose value of relative permittivity is 4.4, loss tangent value is 0.02 and 1.6mm as thickness. It has a small size antenna of $20.6 \times 22.6\text{mm}^2$ and is analyzed that gives suitable results. The MFSSMA is fed using microstrip line and defected ground plane helps in providing high bandwidth. MFSSMA shows two resonant peaks at frequencies of 6.5 GHz and 10.9 GHz and provide a gain of 7.28dB and 7.52dB at respective resonant peaks. The proposed MFSSMA, the return losses are below -10dB at the frequency range of 5.9GHz to 12.5GHz. It provides a bandwidth of 6.6GHz. This antenna also has good radiation characteristics. It has a maximum gain of 12.98dB at 5GHz. The effect of changing the radius of circle in the ground on the antenna performance is also examined in this paper. The simulations of this wideband antenna are performed by employing HFSS software. The whole design of this small size antenna with simulation results are discussed in this paper.

Keywords- Microstrip antenna, wideband, radiation pattern, fork-shaped, return loss.

I. INTRODUCTION

Now days, the wireless communication systems are growing very quickly, therefore there is a huge requirement for the wideband /multiband antennas. In microstrip antenna, there is a very thin patch which is separated by metallic ground. In between these two, there is a dielectric substrate material. The microstrip antennas have large number of applications in several fields and are generally used because they exhibits very distinctive characteristics such as minute size, low manufacturing cost, low mass and volume [1]. However, there are some major drawbacks of

microstrip antenna which includes limited bandwidth, low directive gain and less power handling capability [2-3]. Today, the requirement of the modern world is for small size, wideband microstrip antennas which are useful for several types of communications which includes mobile communication devices, radar and satellite communication systems [4]. For the design evolution of microstrip antennas, the real contemplations are limiting its size and large bandwidth. Several techniques were developed by many researchers that are related with the enhancement of bandwidth and gain of microstrip antennas which includes stacked patches, by etching slots of different shapes, by the use of proper impedance matching networks, by using capacitive feeding and feed modification [5-8]. In [9] a wide-slot antenna employing a fork-shape stub is described for the purpose of enhancing the bandwidth. The bandwidth achieved was 1.1 GHz with gain lies in the range of 3.5-5 dBi. A 48.64×57.23 fork-shaped multiband monopole antenna along with defected ground configuration is described in [10] which is fed by microstrip line. The designed antenna works at these three different range of frequencies 1.21-1.29 GHz, 3.65-3.94 GHz and 5.0-5.20 GHz. Also, it is shown that the results with DGS are better than without DGS. In [11], a fork shaped microstrip slot patch antenna is presented that works at 2.45 GHz and microstrip line feed mechanism is employed. This antenna provides return loss ≤ -10 dB and operates at multiple frequencies. A slotted triangular-shaped antenna that operates at C- and X-band applications has been proposed in [12]. In research paper [13], slot antenna geometry of fractal shape is described that helps in aiding the bandwidth of antenna. The paper [14] is focused on designing of broadband antenna that works in X-band.

This paper emphasis on the designing of a Modified Compact Fork-Shaped Slotted Wideband Antenna (MCFSSWA) having partial ground plane that has applications for C and X bands. The simulations of proposed small size antenna are done by employing HFSS software. In this proposed work, the simulation results of different parameters such as return loss, VSWR, 3D polar plots at resonant frequencies, peak gain and 2D radiation patterns are presented. There are four sections in this paper through which the whole paper can be explained-Section 2 explains the geometrical configurations of fork-shaped wideband antenna. Section 3 explains about the simulation results of different parameters and at last Section 4 summarizes this research work.

II DESIGN STRATEGY

The design and geometry of the proposed fork-shaped slotted antenna using partial ground plane is illustrated in Fig.1. The designed small size antennas have dimensions of 20.6mm x 22.6 mm. The commercial available FR4 material is used to design the MCFSSWA whose relative permittivity value is 4.4, 0.02 loss tangent value and 1.6mm thickness. The dimensions of thin patch depends on these parameters called as resonant frequency (f_r), dielectric constant (ϵ_r) and substrate thickness (h). The patch is excited by a microstrip line, which is placed close to it. Four arms are etched on the patch that forms a fork-shaped structure. The microstrip line is characterized by two geometrical parameters L_f and W_f where L_f is feedline length and W_f is feedline width. The fork-shaped slotted patch is represented by length (L_p) and width (W_p).

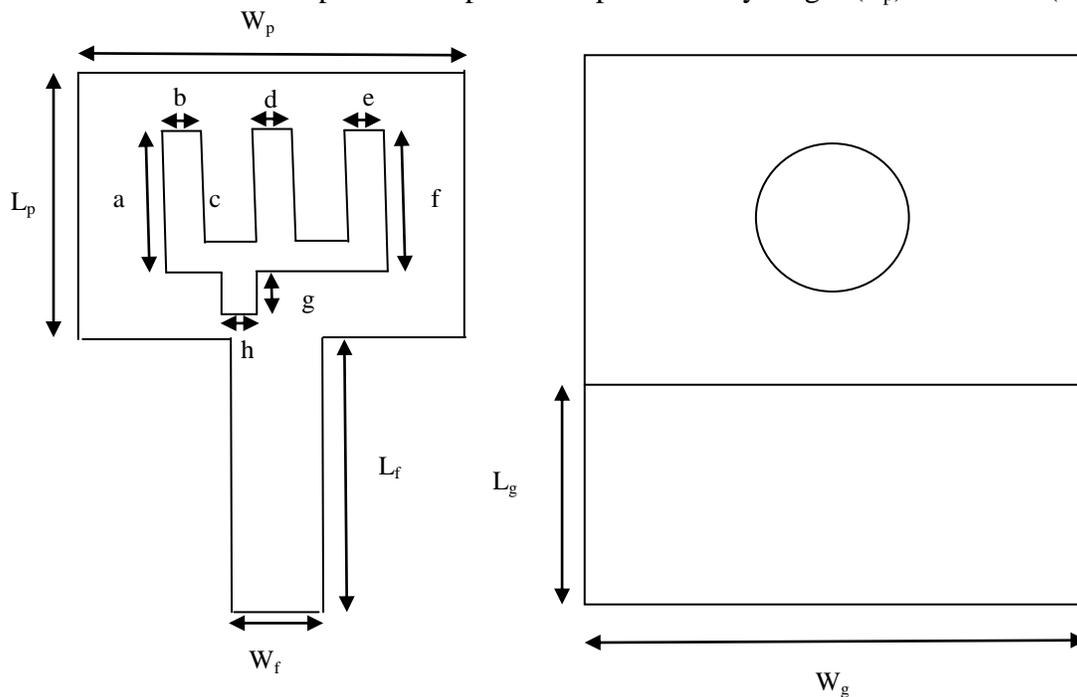


Fig.1 Schematic of the proposed MCFSSWA (a) Upper view (b) Lower view

Table 1 Optimized design parameters of proposed MCFSSWA geometry

| Geometric Parameters | Units in mm |
|----------------------|-------------|
| L_s | 20.6 |
| W_s | 22.6 |
| L_f | 10 |
| W_f | 3 |
| L_g | 8 |
| W_h | 22.6 |
| a | 4.5 |
| b | 1 |
| c | 4.5 |
| d | 1 |

| | |
|---|-----|
| e | 1 |
| f | 4.5 |
| g | 3 |
| h | 1 |

In this geometry, partial ground plane is integrated with a circle so that the antenna achieves better outcomes. Hence, due to this modification in ground, important parameters such as return loss and bandwidth changes. To obtain better impedance matching, a 50Ω microstrip line is used. Fig. 1(a) shows the upper view of proposed wideband antenna and Fig. 1(b) shows the lower view of the proposed wideband antenna. Table 1. summarizes the optimized parameters of proposed MCFSSWA geometry.

III RESULTS AND DISCUSSIONS

The simulation of the MCFSSWA is done by employing HFSS software. The simulations results of several desirable parameters which include return loss, VSWR, 3D polar plots, 2D radiation patterns are explored. It is found that better return loss, large bandwidth, good radiation characteristics and $VSWR \leq 2$ are obtained.

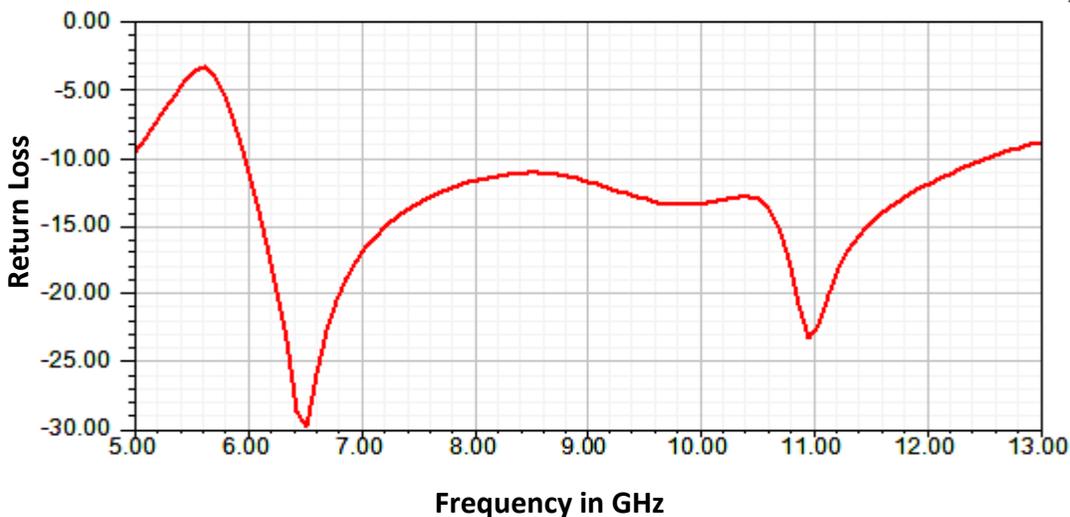


Fig. 2 Reflection coefficient against operating frequency of the proposed MCFSSWA

Fig.2 illustrates the variations of reflection coefficient against operating frequency of the proposed MCFSSWA. The first resonance occurs at a frequency of 6.5GHz with reflection coefficient value of -29dB and the second resonance occurs at a frequency of 10.9GHz with

reflection coefficient value of -23dB. It is observed from Fig.2 that the proposed antenna is a wide band antenna. The calculation for the antenna bandwidth is done by evaluating the difference between the points touching the -10dB line. The calculated value of bandwidth is 6.6GHz which satisfy the requirements of C and X bands.

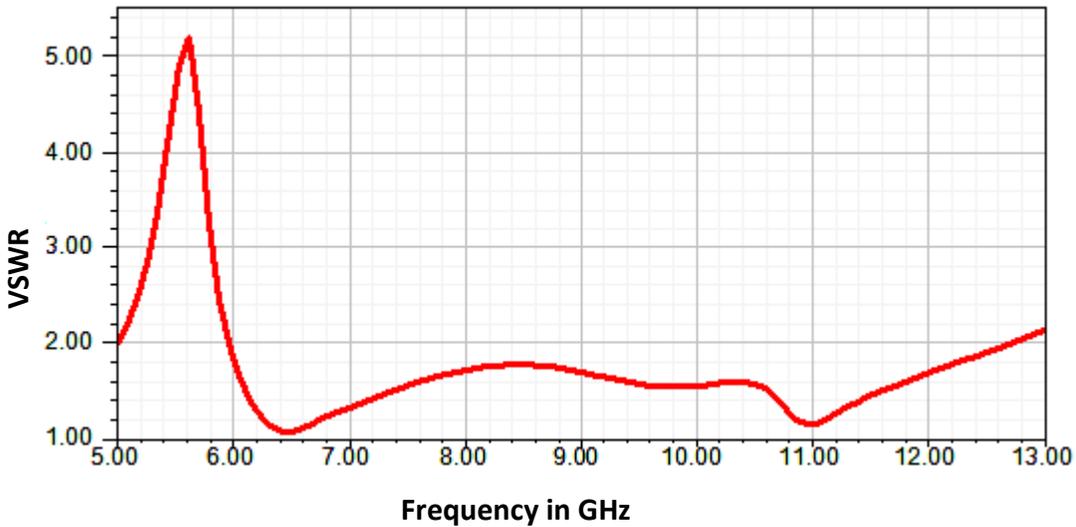


Fig. 3 VSWR against operating frequency of the proposed MCFSSWA

Fig.3 represents variations of VSWR against operating frequency of the proposed MCFSSWA. The VSWR is less than 2 in the range of 5.9 GHz to 12.5 GHz.

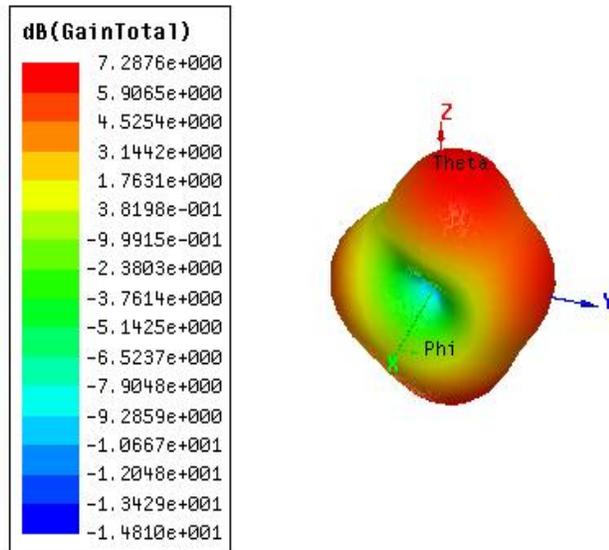


Fig. 4 Three dimensional radiation pattern at 6.5GHz

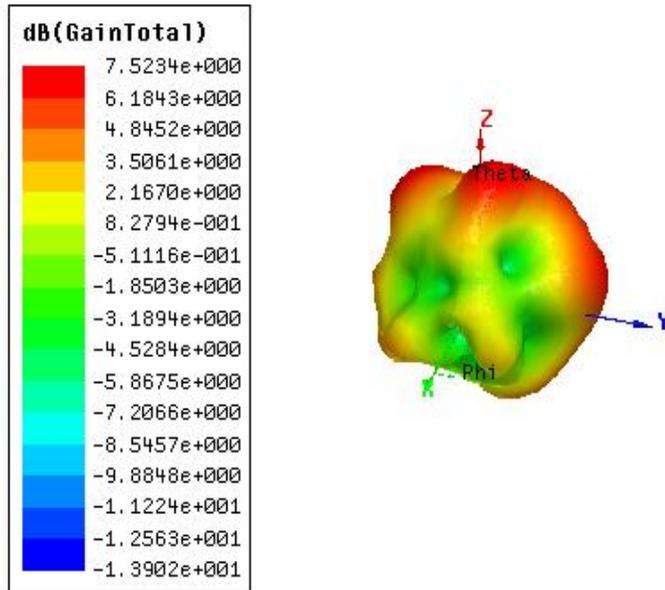


Fig. 5 Three dimensional radiation pattern simulation at 10.9 GHz

Fig. 4 and Fig. 5 illustrate the 3D radiation patterns at 6.5 GHz and 10.9GHz. It provides a gain of 7.28dB at 6.5GHz and 7.52dB at frequency of 10.9GHz

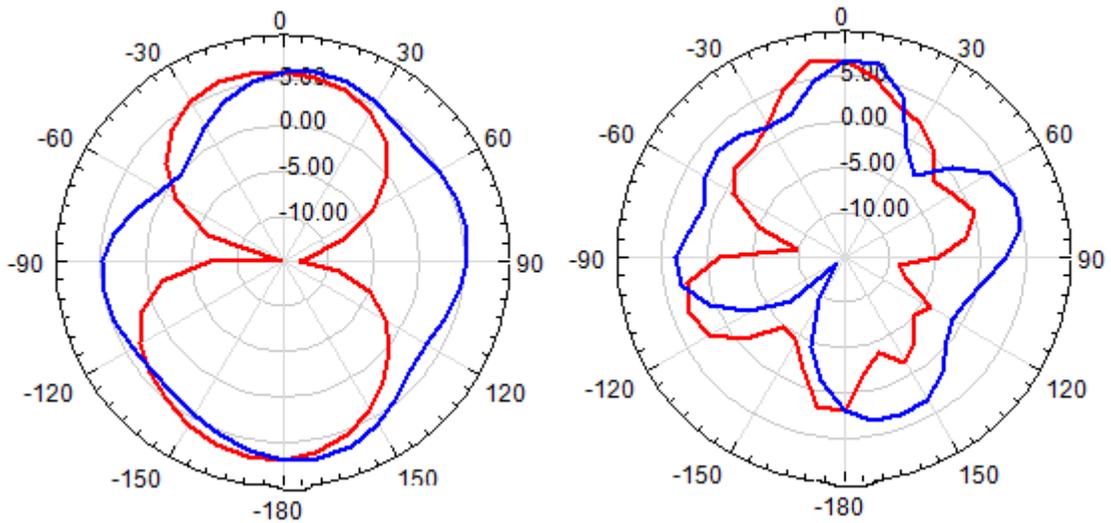


Fig. 6(a) 2-D polar plot at 6.5GHz and **(b)** 10.9GHz in $\phi=0$ and $\phi=90$ planes

Fig. 6(a) and Fig. 6(b) depict 2D patterns and gains at 6.5 GHz and 10.9GHz in $\phi=0$ and $\phi=90$ planes. The proposed antenna shows good radiation characteristics.

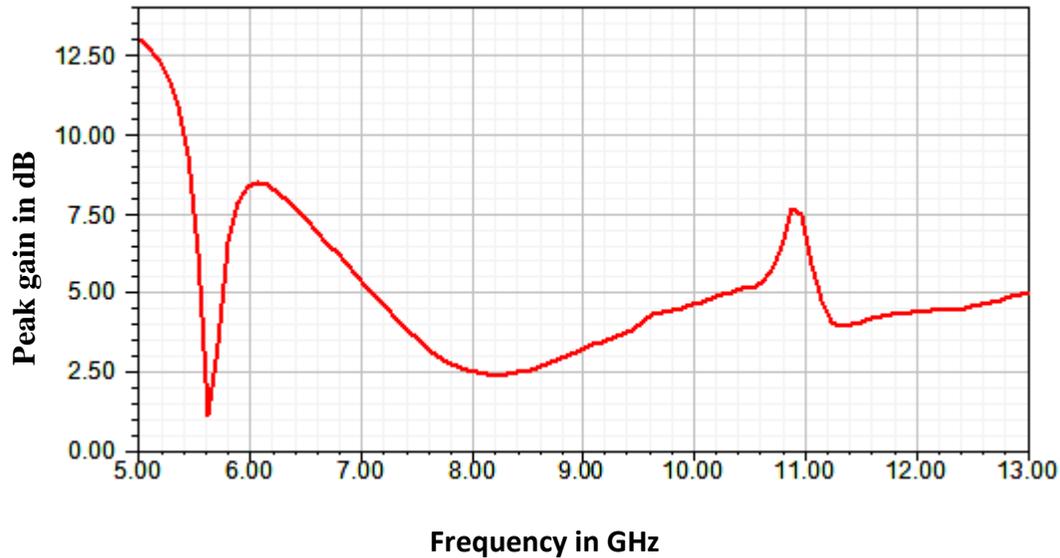


Fig. 7 Gain against operating frequency of the proposed MCFSSWA

Fig. 7 shows the plot of peak gain against operating frequency of the proposed MCFSSWA. In this case, the maximum and minimum gains obtained of the proposed antenna are 12.98dB and 1.14dB at frequencies of 5GHz and 5.622GHz respectively.

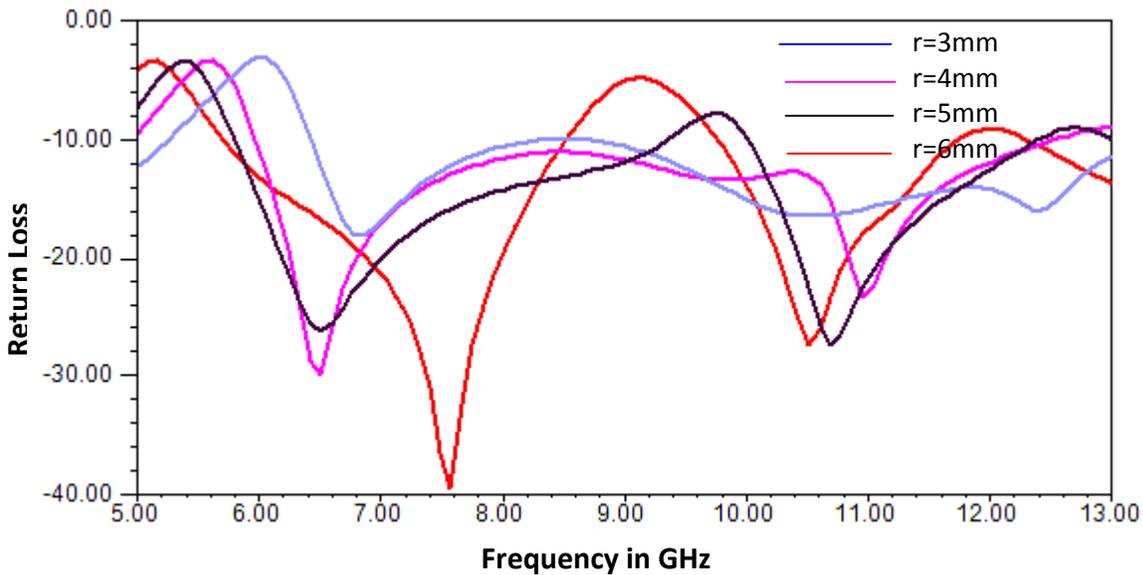


Fig. 8 Return loss v/s frequency of MCFSSWA at different values of radii of circle in ground plane.

Fig. 8 illustrates the variations of reflection coefficient against operating frequency of the proposed MCFSSWA at different values of radius of circle in ground plane. It is evaluated from the plot that as the radius of the circle in the ground plane increases, the impedance bandwidth decreases. It is also examined that with increasing radius of circle, the lower frequency moves to the left. Smaller value of radius shows lesser return loss. Optimum value of radius is obtained 'r' = 6mm for the minimum return loss of -39.5dB, but at this value bandwidth decreases.

IV CONCLUSION

This paper focuses on a Modified Compact Fork-Shaped Slotted Wideband Antenna (MCFSSWA) employing partial ground plane that is applicable for C and X-band applications. The simulations are done using HFSS software. The given antenna design provides a gain of 7.28dB at 6.5GHz and 7.52dB at 10.9GHz. The return losses are ≤ -10 dB in the frequency range of 5.9GHz to 12.5GHz. The bandwidth obtained is 6.6GHz. The radius of circle at ground plane is optimized to get minimum return loss and it is found 6mm for minimum return loss of -39.dB. The antenna also provides good radiation characteristics.

V REFERENCES

1. Lo, Y.T, Solomon, D. and Richards, W.F., "Theory and experiment on microstrip antennas," *IEEE Transactions on Antennas and Propagation*, vol 27, pp 137-145, Mar 1979.
2. Sran, S.S. and Sivia, J. S., "Quad staircase shaped microstrip patch antenna for S, C and X band applications," *Elsevier Journal Procedia Computer Science* 2016, Vol. 85, pp: 443-450.

3. Kaur, M. and Sivia, J.S., "On the design of plus slotted fractal antenna array," Scientific journal of antennas and propagation Vol.04 No.03, 2016.
4. Sidhu, S. K. and Sivia J.S., "Design of a novel fractal antenna for wireless applications," International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), 2016, pp: 244 - 247
5. Mosallaei, H. and Sarabandi, K., "Antenna miniaturization and bandwidth enhancement using a reactive impedance substrate", *IEEE Transactions on Antenna and propagations*, vol52, pp. 2403-2414, Sept 2004.
6. Shekhawat,S., Sekra, P.,Bhatnagar, D.,Saxena, V.K .and Saini, J.S."Stacked Arrangement ofRectangular Microstrip Patches for Circularly Polarized Broadband Performance." *IEEE Antennas and Wireless Propagation Letters*, vol. 9, pp 910-913, 2010.
7. Chattopadhyay, K., Parui S.K., Das, S. and Bhadra C. S.R, "Bandwidth Enhancement of Microstrip Antennas Using Shifted Parasitically Coupled Planar Multiresonators", Applied Electromagnetics Conference (AEMC), IEEE, ISBN 978-1-4244-4819-7, Dec 2009.
8. Matin, M.A., Sharif, B.S. and Tsimenidis, C.C, "Probe fed stacked patched antenna for wideband applications ,” *IEEE Transactions on Antennas and Propagation*, vol 55, pp 2385-2388, Aug 2007.
9. Sze, J.Y. and Wong, K.L., "Bandwidth enhancement of a microstrip line-fed printed wide-slot antenna” *IEEE Trans. on Antennas and Propagation*, vol 49, pp 1020- 1024, July 2001.
10. Kunturkar, G. S. and Zade, P..L.,"Design of Fork-shaped Multiband Monopole antenna using defected ground structure” *International Conference on Communications and Signal Processing (ICCSP)*, pp 0281 – 0285, 2-4 April 2015.
11. Mishra, P.K., Sachdeva, V. and Gupta, S.D. , "Fork shaped antenna for bluetooth application” *International conference on Medical Imaging, m-Health and Emerging Communication Systems (MedCom)*, pp 338-341, 7-8 Nov, 2014.
12. Samsuzzaman, M., Islam, M.T. and Mandeep, J.S., "Parametric analysis of a glass-micro fibre-reinforced PTFE material, multiband, patch-structure antenna for satellite applications,” *Optoelectronics and Advanced Materials—Rapid Communications*, vol. 7, pp. 760–769,2013.
13. Chen, W. L., G. M. Wang, and Zhang, C.X., "Bandwidth enhancement of a microstrip-line fed printed wide slot antenna with a fractal shaped slot” *IEEE Transactions on Antennas Propagation*, Vol. 57, No. 7, 2176-2179, May 2009.
14. Harrabi, A., Razban, T., Mahe, Y.,Osman, L. and Gharsallah, A., "Wideband patch antenna for x-band applications,” in *Proceedings of the Progress in Electromagnetics Research Symposium*, Stockholm, Sweden, Aug 2013.

Smart CCTV Surveillance System for Hospitals
Resheed Almotaeryi, Khan, Faraz , Ahmed Bouridane, Richard Jiang

Northumbria University

Abstract — IN THIS PAPER WE PROPOSE A SYSTEM THAT WOULD MONITOR THE PRESENCE AND LOCATION OF PEOPLE WITHIN THE HOSPITAL AND ALSO TO KEEP TRACK OF HOW MANY PEOPLE HAVE ENTERED OR LEFT A RESTRICTED SECTION OR A SENSITIVE SECTION OF THE HOSPITAL. THIS WOULD GREATLY ASSIST THE SECURITY PERSONNEL IN THEIR MONITORING DUTIES. FURTHERMORE THE SYSTEM WOULD KEEP COUNT OF HOW MANY PEOPLE HAVE ENTERED A RESTRICTED AREA AND HOW MANY HAVE LEFT. IF THE PEOPLE LEAVING EQUAL THE PEOPLE ENTERING THE SYSTEM WOULD NOT ALERT THE USERS BUT IF THIS NUMBER IS UNEQUAL FOR OVER A CERTAIN AMOUNT OF TIME THEN THE OFFICERS CAN BE ALERTED TO GET THEIR ATTENTION. THE SYSTEM ALSO PROPOSES A SMART CCTV SYSTEM ARCHITECTURE COOMPROMISING HUMAN DETECTION AND TRACKING, FACE DETECTION AND TRACKING, INTRUSION DETECTION AND AN ACCESS CONTROL SYSTEM.

Keywords

Smart CCTV, Surveillance System , human detection, access control System .

I. INTRODUCTION

A hospital is a place where urgent and specialized medical care can be sought. The aim of the hospital staff is to treat an unwell person and discharge a healthy person back into the community. Hospitals have always been known to be the building blocks of any society. Since the beginning of recorded history it has been known that for any society to flourish they had to have a system which tented to the sick, injured and elderly or in other words a very crude definition of healthcare. The first recorded hospitals were found in the Byzantine Empire in the late sixth century. [1]. Later on, in Europe many hospitals started emerging in Monasteries [2] . At the time and at the early stage of hospitals healthcare was based on and relied upon the help and knowledge of the elders of extended failies and communities, the reason being that at the time the hospitals did not have much to offer and were seen as a place where a person “went to die”. Due to the lack of knowledge of the human body and also with the emergence of new diseases hopsitals did more harm than good to a sick person. It was during the industrial revolution that the healthcare system made major advancements. The rapid growth of cities and the congestion of current cities greatly increased the spread of diseases. Also the unsafe practices in factories increased injuries and deaths[3]. The increased interest in a “good” healthcare system meant that infection diseases were beginning to be understood, surgeries were being performed with lower mortality rates. The discovery of anaesthesia meant more people were willing to undergo surgery. The advancement in military medical advancements at the end of World War 2 also greatly benefited the healthcare system. Hospitals today are seen in a completely different light when compared to hospitals from the previous century. A hospital now has the image of health and wellness. The fear of hospitals is near to nonexistence and every person of the society is encourage to go to the hospital even for minor symptoms so that any disease might be caught early and treated easily. Even advanced diseases caught at later stages have a high chance of being cured due to advancements in medical science. Hospitals receive patients from three different sources. The first are the patients that come through the emergency department(ED). These patients are in the need of urgent care and are tended to without any loss of time. The second source is the patients that are scheduled to come by physicians either for a regular test or for surgery and the third source are patients that are transfers from

other hospitals. Recently hospitals have been transformed into something more complex and give the feeling of a small commercial complex. Hospitals now include shops and restaurants, banking facilities and almost always a place which can be designated as a community meeting place. All this activity in hospitals warrants a way to monitor and track all these people within the hospital boundaries for security and administration purposes. With all these people passing through the same place every day a surveillance system is definitely needed in place to monitor the patients/visitors and to ensure a safe and trust worthy environment for all. Crime in hospitals is becoming a matter of increasing concern for all hospitals. These crimes can be either common theft or offences against a person. Unfortunately theft from the public places in the hospital and even from sections of the hospital where there is unrestricted access is very common. And this trend is increasing considering how easy it is. The hospitals have countered this by making many of its sections restricted and entry is allowed only to a few authorised people. New hospitals have plans in place that restrict access of entire blocks or floors so that some kind of control can be had over where patients or visitors can roam freely. Recently attacks on members of staff of the hospitals on hospital grounds have also been on the rise. The brunt of this problem is faced by accident and emergency staff in the A&E department. But access to this section cannot be restricted because of the fast nature of treatment needed [4]. Another grave concern faced by hospitals is the abduction of new born infants from the maternity ward. These kidnappers are either staff or visitors. This is a problem faced by many hospitals internationally and is especially an increasing trend in the hospitals of Saudi Arabia. Many hospitals to counter and control these problems have implemented CCTV cameras in all areas (public and restricted) and are monitored at all times from a control room. CCTVs have been a very welcome and favourite addition to hospitals in an attempt to reduce crime, especially in the UK where widespread installation of the cameras has shown clear improvement [4]. It should be realised that the presence of a CCTV camera in itself should not be considered enough for the deterrence of crime but rather it gives the security staff a way to monitor the sensitive areas and to respond accordingly. Along with constant monitoring some areas of the hospital demand constant recording and for the video records to be kept for a certain amount of time, areas such as the maternity wards. Along with the installation of cameras great care must be given to the implementation of the security system. In the current age constant surveillance of the camera feeds is not enough and also at times humans do tend to get distracted and doze off. For this reason some sort of image processing tools must be implemented within the security systems that would aid the security officers in doing their job. In this paper we propose a system that would monitor the presence and location of people within the hospital and also to keep track of how many people have entered or left a restricted section or a sensitive section of the hospital. This would greatly assist the security personnel in their monitoring duties. Furthermore the system would keep count of how many people have entered a restricted area and how many have left. If the people leaving equal the people entering the system would not alert the users but if this number is unequal for over a certain amount of time then the officers can be alerted to get their attention. This would greatly control the presence of trespassers in such sensitive areas. This paper is organized as follows. Section 2 contains the literature review. Section 3 outlines the our proposed method and section 4 concludes with the conclusions of the paper and future work.

II. RELATED WORK

CCTV surveillance systems have generated great interest over the past two decades. It has been proved to be a very effective tool in terms of monitoring and crime deterrence. Worldwide governments are investing more and more money into implementing CCTV systems into their society. For example in UK alone there are 4.2 million CCTV cameras performing surveillance on its citizens that comes to one camera for every 14 people. It was reported that a Briton civilian is likely to be caught on camera over 300 times a day [5]. Systematic reviews of the effectiveness of CCTV once implemented on such wide scale was performed by [6] and then again by [7], it was concluded by the authors that CCTV works best in car parks but not in city centres, also that it helped in reducing vehicle crimes but not violent crimes. CCTV implementation in a place like Saudi Arabia can bring with it along with its benefits some problems. For example CCTV implementation may reduce the crime rate in the monitored area since the offenders will know that they are being watched, also CCTV monitored area may encourage the people to use that area since they would feel safe knowing that they are being watched. But on the other hand CCTV implementation may reduce the vigilance of police and security staff since they would rely more on the CCTV rather than their own natural monitoring. Furthermore CCTV monitored area may discourage people from using it rather than encouraging them as in Saudi Arabia people do not like being watched, especially if they are with their family. So implementation on a wide scale may produce the opposite results. Along with installing CCTV cameras it is important for everyone being watched to know for sure that there will be implications if one is caught stealing or committing a crime on camera. In [8] a police officer showed concern that when the offenders know that even if they are caught on camera and do not see any immediate camera then they (the offenders) along with the public feel that the CCTV system has failed. The same issue is addressed by [9] stating in summary that no public place will be crime free if the offenders know

that they will not get recognised, or if they do get recognised will not get reported, or if they do get reported will not receive any punishment. It is therefore important to set examples and to ascertain that if you are caught on camera the response will be swift and just. Otherwise implementation of this system will benefit no one. This issue was addressed in a recent paper [10] where problems like differential response policies of the police and high camera to operator issues were addressed. The study involved associating a specific camera operator to monitor only a certain number of specific feeds, furthermore two police cars were dedicated to these cameras and were ordered to respond to only incidents detected in the camera feeds. The study showed that it had a positive effect on the crime of that monitored area and that it had shown a meaningful reduction in violent crimes and theft.

III. PROPOSED SYSTEM ARCHITECTURE

The proposed method involves integrating image processing software in the already installed CCTV systems inside the major hospitals of Saudi Arabia. This integration has greatly assisted the security officers monitoring the camera feed and has helped reduce crime and theft on hospital grounds. The software was developed in MatLab and then converted to C++ using the OpenCV computer vision library so that it can be easily implemented in any security system. The proposed software was integrated in all cameras that monitor the sensitive and restricted areas of the hospital. It was also added to the cameras that monitor the entrances and exits of the hospital. The main function of the cameras was to count the number of people entering and leaving an area. For every detected person entering an area a counter was incremented and for every detected person leaving the area the counter was decremented. This was of great help to the security staff as this meant that they did not have to monitor restricted areas at all times and thus their work load was reduced, allowing them to focus their gazes on the more busy and public areas. Under ideal conditions the counter is to stay at 'zero' that is when no one is supposed to be in that area or during night time when the area is closed to all personnel. At all other times the counter should not be above zero for more than a specified amount of time. If the counter stays more than zero for more than the specified time, an alarm is raised in the security room alerting the officers attention to it, so that the officer can assess the situation and take action accordingly. The tracking of people in the public areas also reduced crime related to theft as the tracking of the perpetrators helped the security officer's track and apprehend.

The objectives of the proposed system can be summarised as:

- 1) To develop a system that can be easily integrated with the current CCTV system and their software.
- 2) The system should be able to automatically detect the number of people in the area that is being monitored by the cameras.
- 3) To be able to accurately count the number of people entering and leaving an area.
- 4) To be able to successfully track a person or multiple persons within the area monitored by the camera.

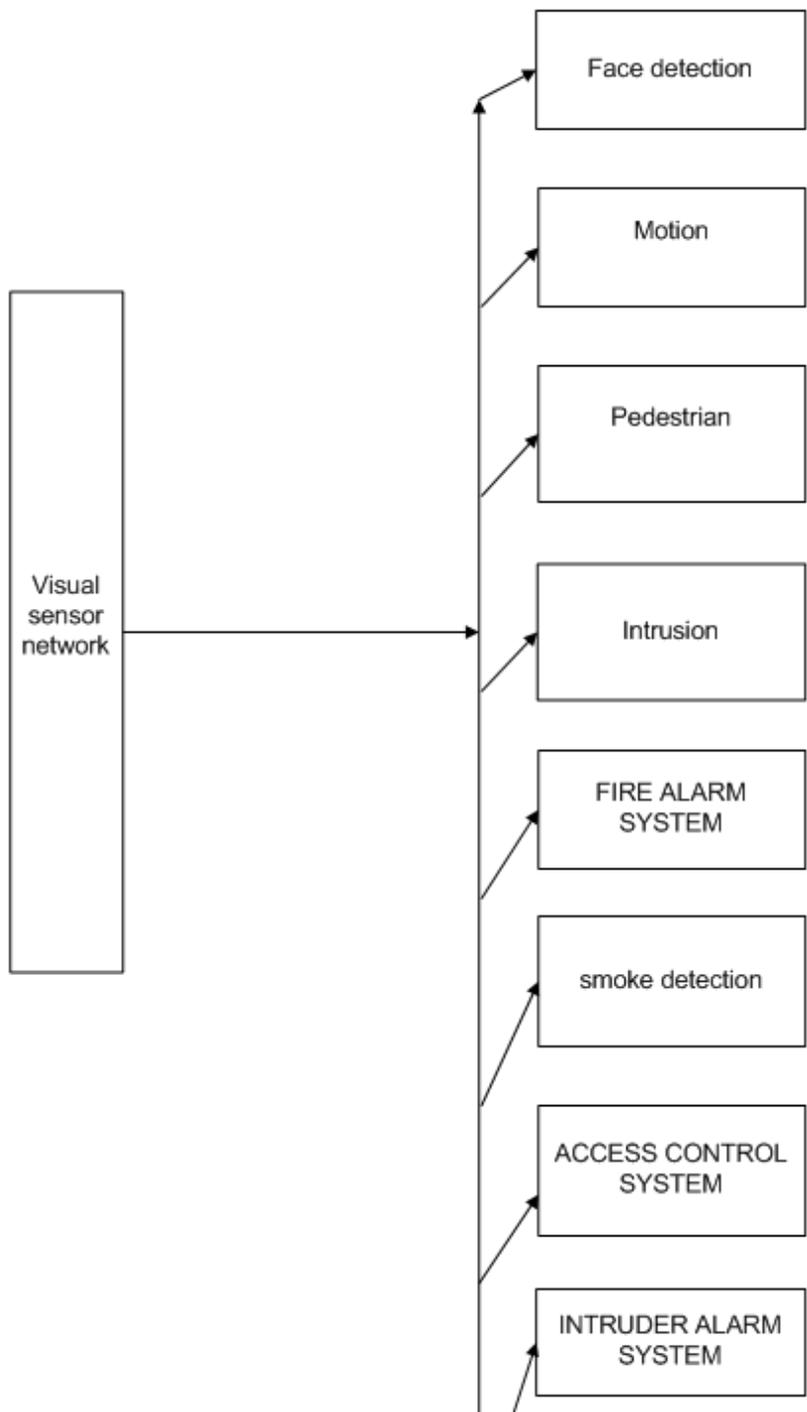


Fig.1. Proposed system architecture

While implementing the system in Saudi hospitals it was observed that results were best achieved when no compression was used on the video feed from the CCTV cameras. Some companies in order to reduce memory usage compress the feeds but this comes at a cost of video quality. And since the researcher aims

to apply image processing tools on the feed a compressed feed was giving poor results. It was observed that of the many popular video formats used by CCTV cameras, .AVI produced the best results and all further work was performed in this .AVI video format. Also that the feed from the CCTV should have a high frame rate. Too low a frame rate produced poor results. It was determined that a frame rate of 15 frames per second showed the best results with the least amount of memory consumption. Furthermore the images acquired from the feed were downsampled. This was done to reduce the processing time and also to reduce the memory consumption. If the images were used in their original size the system would spend too much time processing each frame. With a system that depends on real time results, it was important that speed was given a priority. Lastly as with all image processing software it was very important to maintain a stable, non-fluctuating light source near the CCTV cameras. Variation in light has known to produce problems with almost all image processing software that depend on detection and recognition. Figure 1 shows the complete system architecture. Along with keeping track of patients and visitors the proposed system architecture is capable of advanced tasks such as face detection and tracking, motion detection, pedestrian tracking. The intrusion detection, access control system and intruder alarm system are integrated into the person counting algorithm explained above. The proposed system uses Gaussian Mixture Model (GMM) background modeling to make the task of tracking a moving object possible.

Using GMM modeling the object (in this case a person) is tracked the human silhouette can be extracted. Human silhouette extraction from multiple moving frames has always been a challenge. The proposed system was able to successfully extract the silhouettes using a novel technique using Laplacian fitting. Finally by implementing face detection and tracking the system enables the use of intelligent surveillance. Detecting faces and tracking them has long been a problem because of it being plagued by issues of illumination, pose and occlusion. But our proposed method utilizes a recognition based approach to tracking and is able to successfully recognize and track a subject in a crowd. Thus allowing the security officials to track down their culprit even in crowded areas.

IV. CONCLUSIONS AND FUTURE WORK

With proper planning and utilization of modern tools it is possible to minimize the negative effects of crime and theft in hospitals throughout Saudi Arabia. With proper implementation the time at hospitals for the patients can be one of healing and health rather than fear or stress. The work presented here will benefit all hospitals and in the long run greatly improve the state of security. This will also greatly reduce the money spent by management on security personnel. As with this proposed method not many observers need to monitor the CCTV feeds as most of the tracking and counting task is managed automatically. This system still has a lot of room for improvement, future work would be to implement more recent algorithms to the CCTV feed along with human tracking such as automatic fire detection, weapon detection/concealed weapon detection and RFID tracking along with CCTV tracking.

REFERENCES

- [1] T. Miller, *The Birth of the Hospital in the Byzantine Empire*, ser. *The Birth of the Hospital in the Byzantine Empire*. Johns Hopkins University Press, 1997. [Online]. Available: <http://books.google.co.uk/books?id=S7VtQgAACAAJ>
- [2] R. Porter, *The Greatest Benefit to Mankind: A Medical History of Humanity (The Norton History of Science)*, ser. *The Norton History of Science*. W. W. Norton, 1999. [Online]. Available: <http://books.google.co.uk/books?id=igGdz9g7tmAC>
- [3] M. M and H. J, "The role of the hospital in a changing environment." European Observatory on Health Care Systems, London School of Hygiene and Tropical Medicine, England. martin.mckee@lshtm.ac.uk
- [4] FAU - Healy, J, pp. -.
- [4] T. Cocks, "A brief examination of security and crime prevention in hospitals," in *Technology and Society*, 2003. Crime Prevention, Security and Design. ISTAS/CPTED 2003. Proceedings. 2003 International Symposium on, 2003, pp. 28–32.
- [5] D. Farrington, M. Gill, S. Waples, and J. Argomaniz, "The effects of closed-circuit television on crime: meta-analysis of an english national quasi-experimental multi-site evaluation," vol. 3, no. 1, pp. 21–38, 2007. [Online]. Available: <http://dx.doi.org/10.1007/s11292-007-9024-2>

- [6] B. C. Welsh, D. P. Farrington, and G. Britain, Crime prevention effects of closed circuit television: a systematic review. Citeseer, 2002, vol.252.
- [7] B. Welsh and D. Farrington, Preventing Crime: What Works for Children, Offenders, Victims and Places. Springer, 2006. [Online]. Available: <http://books.google.co.uk/books?id=R6xEopRNwugC>
- [8] J. King, D. K. Mulligan, and S. Raphael, "Citris report: The san Francisco community safety camera program-an evaluation of the effectiveness of san francisco's community safety cameras," Available at SSRN 2183381,pp. -, 2008.
- [9] K. Painter and N. Tilley, Surveillance of public space: CCTV, street lighting and crime prevention. Criminal Justice Press Monsey, 1999,vol. 10.
- [10] E. L. Piza, J. M. Caplan, L. W. Kennedy, and A. M. Gilchrist, "The effects of merging proactive cctv monitoring with directed police patrol: a randomized controlled trial," Journal of Experimental Criminology, pp. 1-27, 2014.

Synbiotic Dietary Pattern used as a Predictor for *Bifidobacterium* and *Lactic acid* Bacteria in Breastfeeding

Marjan Ganjali Dashti^{1,2}, Mansoureh Taghizadeh³, Neda Ganjali Dashti², Freddy Franklin⁴, Nimah Bahreini Esfahani³

¹ Ecobiomaterial Research Laboratory, School of Biological Sciences, Universiti Sains Malaysia, 11800, Penang, Malaysia

² Typhoid and other Enteric Diseases Cluster, Institute for Research in Molecular Medicine (INFORMM), Universiti Sains Malaysia, 11800, Penang, Malaysia

³ Food Security Research Center and Department of Clinical nutrition/Community Nutrition/ Food Science & Technology, School of Nutrition & Food Science, Isfahan University of Medical Sciences, Isfahan, Iran.

⁴ Faculty of Science, Jalan Universiti Bandar Barat, Universiti Tunku Abdul Rahman, 31900, Kampar, Perak, Malaysia

Corresponding author: Nimah Bahreini Esfahani

Mailing address: Food Security Research Center and Department of Clinical nutrition/Community Nutrition/ Food Science & Technology, School of Nutrition & Food Science, Isfahan University of Medical Sciences, Isfahan, Iran.

Tel.: 00989133048537

E-mail: nimahbahreini@yahoo.com

ABSTRACT

Human breast milk which potentially contains probiotic bacteria can be considered as a substantial synbiotic food and provides immunity to the infants against contagious diseases. The aim of this study is to determine dietary patterns and the connection with the presence of feasible bifidobacterium and Lactic acid bacteria (LAB) in breastfeeding. Lactic acid bacteria and bifidobacterium were isolated from healthy mother's milk from a clinic in Isfahan, Iran. An overall of 83 cases within the age range 18–40 years old were hired and interviewed. Nutritional information was evaluated by 165-item semi-quantitative food volume questionnaire. Connection between dietary patterns and breastfeeding were analyzed using Multivariate logistic regression. Synbiotic pattern and Western pattern have been used as the main element usage analysis. Statistic shows that within the variety of food consumption taken by the mothers, 12.83% chose symbiotic pattern while 10.47% opted for western pattern, respectively. The synbiotic dietary pattern enhanced lactic acid bacteria (OR = 0.116; 95% CI = 0.106 – 0.467) although lactic acid bacteria have been reduced in Western dietary pattern (OR = 2.505; 95% CI = 1.251-4.020). Lactobacilli and bifidobacteria showed an increment when synbiotic dietary pattern was practiced while having an opposite effect on lactobacilli and bifobacteria when western dietary pattern were practiced. In conclusion synbiotic dietary pattern is beneficial for the enhancement of lactic acid bacteria and bifidobacterium and can be practiced by mothers

during breast feeding to provide protection to the infants against infection and diseases.

Keywords: Western Dietary Pattern, Breast Feeding, Bifidobacter, Lactobacilus, Microbita

INTRODUCTION

Breastfeeding helps to protect the infant against contagious diseases (Zamora *et al.* 2015). This is achieved through the mixed activity of breast milk elements, such as maternal immune competent cells and immunoglobulins or some of antimicrobial compounds (Jeurink *et al.* 2012). Breast milk also includes prebiotic ingredients, such as so-called bifidogenic factors, that might specifically activate the particular development of a restricted quantity of beneficial microorganisms within the gut (Martín *et al.* 2012; Fernández *et al.* 2013). Synbiotics food associated with probiotics as well as prebiotics which are beneficial to the host through the increase of microflora in the Gastrointestinal (GI) tract (Maldonado *et al.* 2010; Thum *et al.* 2012). Diet plan could affect the actual structure from the gut microflora with the accessibility of numerous substrates intended for bacterial fermentation. Variations in intestine microflora structure among breast-fed as well as formula-fed newborns enhanced protection associated with contamination (Martin *et al.* 2011; Martin *et al.* 2004). In the past, this kind of enhancement has been considered to be due to the larger existence of reporters' effective genera which includes bifidobacteria. Therefore, functional food item components, including prebiotics might impact an excellent alteration within the structure as well as the actions of the intestinal microflora of babies simply by raising optimistic microflora components (Fernández *et al.* 2013). The actual prebiotic strategy is designed to increase resident microorganisms which are therapeutic for human being wellness, e.g. bifidobacteria and lactobacilli. However probiotics depends on the survival of the micro-organisms in the diet (Aguilera, 2012). Both strategies have been used in baby formula feeds to simulate the actual intestine microbiota structure observed throughout breastfeeding. Even though current newborn formulas are created to imitate the human being breast milk, they continue to be completely different from natural biological fluid (Donovan *et al.* 2008). Consequently, variations within the gut microflora among breast-fed already had been frequently observed as well as formula-fed babies (Harmsen *et al.* 2000; Favier *et al.* 2002). Researches on the microbiology associated with breast milk happen to be limited to prospective pathogenic bacteria. Neonates have especial tendency to contagious diseases (Thrall *et al.* 2012). However, there is an insufficient research for the amount of probiotic bacteria present in the mothers breast milk which is important for the immunity of the infant. In the present research, we explored the existence of lactic acid bacteria within breast milk in regards with health of the female, family history, socioeconomic status, physical inactivity and other related components of dietary pattern to breastfeeding. Many researchers have evaluated the relationship between diet plan and lactic acid bacteria; however they mostly concentrated within the consumption of one food or perhaps nutritional requirements (Kralj *et al.* 2002;

Salmerón *et al.* 2015). Even though this kind of analyses is important, they provide insufficient information about the relationship between diet plan and breastfeeding. While individuals take foods which contain a complicated combined nutritional requirements as well as non-nutrients which might be interactive or even synergistic with one another, it is sometimes complicated in order to identify the consequence of one nutritious or perhaps food upon the well-being (Hu, 2002). The majority of the present information upon breastfeeding and also dietary patterns had been obtained through developed nations, along with nearly two-thirds of those researches performed either in the Northern United States or perhaps European countries (Albenberg and Wu 2014). There may be insufficient publicized information about this issue within Iran as a developing country. The goal of this research was to determine dietary patterns and its likely association with lactic acid bacteria with breastfeeding in Isfahan, Iran.

METHODS

Subjects

The actual standard protocol had been authorized by the Ethical Committee of Isfahan University of Medical Sciences, Iran. The nature of the trial was explained to the subjects and permission was obtained from the individual before proceeding. The criteria of participant included: (1) healthy females without having present or even previous actual disorders (2) normal, full-term being pregnant; as well as (3) absence of newborn or perhaps mother's perinatal issues (including mastitis). The actual eighty three healthy breastfeeding females and their particular full term breastfed babies, 18 vaginally delivered and 24 given birth to simply by caesarean section, (in addition to control group, respectively) provided numerous aseptically compiled trial sample of breast milk. Clinic-based case-control research has been performed through September 2013 by means of January 2014 aged 18-40 years old. To reassure the standard of sample selection, the mothers on trial were selected by a group within the medical center, which includes the senior obstetrician as well as the gynecologist, the senior pediatrician, along with a senior microbiologist in addition to a nutritionist.

Sample

Breast milk samples were collected from 40 mothers with newborns (19 males/21 females). The babies aged within 3 days to 12 months complete term and sample was collected through randomized breast feeding. Controls were selected randomly from lactating mothers referred to the same clinic as cases during the same time period. Specific information about individual dietary behavior along type of delivery and early on baby feeding behavior following birth were obtained from a series of dietary questionnaire. In addition, information about time period of breastfeeding and baby feeding routines had been acquired through interview.

Clinical evaluation and exclusion criteria (Subjects and design)

Almost all volunteers had been informed regarding the purpose of an investigation and the procedure. Babies with any kind of malformation, heart failure or hemolytic disease are excluded. Healthy females who hadn't utilized antibiotics in just the prior of two weeks had been included in the research.

Sampling

For sampling, nipple and mammary areola had been cleaned with soap and sterile water, and then Chlorhexidine was applied. The breast milk test had been collected (10-15 ml) in clean and sterile tube using sterile-gloves. The first drops (approximately 1 ml) had been discarded to avoid Chlorhexidine contamination. A swab from the nipple and mammary areola was obtained in order to assess the actual efficiency of the antiseptic treatment. Sterile tubes that contain trial samples were set with dried ice within covered containers and were sent to the laboratory.

Isolation and identification

A volume of 1000 µl of each sample of breast milk was serially diluted (3 times) and 100 µl was transferred to MRS agar plate (Man Rogosa Sharp, Merck). Duplicates plates were prepared with 0.5% glucose (Merck), 0.25% L-cysteine for the isolation of lactic acid bacteria. The agar plates were incubated on 37°C for 48-72 hours, below anaerobic conditions (10% H₂, 10% CO₂ and 80% N₂) in the chamber Mac 500 (mart). Colonies with various morphologies were isolated and then filtered using Gram staining and biochemical test. Isolated sample which belongs to bacilli morphology were oxidase negative, catalase negative and Gram-positive. Positive confirmed samples were retained within MRS broth and 50% glycerol at -80°C.

Dietary assessment

Dietary consumption had been evaluated using a semi-quantitative meals frequency questionnaire which contained 165 meals and beverages (with standard serving sizes) that are commonly used by Iranians. Diet plans associated with respondents depends on consumption in the past year just before breastfeeding (cases) and controls. This kind of FFQ was proven in the past research in order to have a great validity and also reproducibility. The validated meals, recording as well as a set of household size (e.g., glass, tablespoon, teaspoon plate, cup, small dish, and spatula) were used to help respondents to calculate the actual portion dimension and kind of meal items. Respondents had been asked to record the frequency associated with intake of confirmed servings of every daily meal item, every week, month-to-month as well as annually base and information was then transformed into everyday consumption frequency. The actual sizing of each one meals item used will be transformed into grams. Consumption of every meal item within grams was then based on multiplying a portion size of everyday consumption frequency. Intake of seasonal foods (e.g., watermelon, melons, and persimmon) would be taken into consideration depending on the yearly time period of the foodstuffs had been available. Overall energy consumption had been approximated for every meal from the FFQ. Iranian Meals Nutrients Composition (Azar 1980) and USDA Meals Composition Information Food composition table (FCT, 2009) were used as a reference when estimating the energy value of the meals. To recognize dietary patterns, the actual 165 foods had been classified directly into 31 foods groups (Table 1).

Table 1: Food groups used in the dietary pattern analysis

| Food group | Food items |
|-------------------------|--|
| Processed meat | Sausages, hamburger, Pizza |
| Red meat, organ meat | Beef, mutton, ground meat, Visceral meat |
| Fish | Tuna, any type of fish |
| Poultry | Chicken with or without skin, Eggs |
| Butter, margarine | Fried eggs, boiled eggs |
| Low fat dairy products | Low fat milk, Low fat yogurt, ordinary yogurt, |
| High fat dairy products | Whole milk, yogurt (high fat, drained and cream), cream cheese, cream, ice cream |
| Garlic, onion | Garlic, onion |
| Tea, Coffee | Black tea, green tea, Coffee |
| Cruciferous vegetables | Cabbage, cauliflower, Brussels sprouts, kale |
| Fruits | Cantaloupe, watermelon, melon, sloe, apple, apricot, cherry, sour cherry, fig, nectarine, peach, pear, Citrus fruit, date, kiwi, grape, pomegranate, strawberry, banana, grapefruit, plum, persimmon, raisin, mulberry, compotes, other fruits |
| Artificial juice | Lemon juice and packed juice |
| Tomato | Tomato |
| Carrot | Carrot |
| Vegetables | Spinach, lettuce, mixed vegetable, stew vegetables, eggplant, green squash, local vegetables, pepper, mushroom, cucumber, garlic, kinds of cabbage, root vegetables, other vegetables |
| Legumes | Bean, chickpea, split pea, soybean, lentil, other cereals |
| Fried potato | Fried potato |
| Boiled potato | Boiled potato |
| Whole grains | Barbari bread, Sangak bread, Taftoon bread, local bread |
| Refined grains | Lavash bread, baguette, rice, macaroni |
| Snacks | Biscuits, puff, chips |
| Nuts | Almond, walnut, pistachio, Peanut, hazelnut, roasted seeds |
| Sweets and dessert | Cakes, cookies, chocolate, pastry, dry, sweet, honey, jam, halvah |
| Sugar | Sugar, sugar cube, candy, sugar candy |
| Pickles | Pickle, Cucumber Pickle |
| Broth | Broth |
| Solid oil | Solid vegetable oil, animal fat, rump |
| Liquid oil | Liquid oil |
| Olive | Olive and olive oil |
| Mayonnaise | Mayonnaise |
| Soft drink | Carbonated drinks |

Cases and controls had been interviewed through properly trained interviewers utilizing pre-tested questionnaires. Information acquired consists of socio-demographic features, level of physical activity, whether the subjects are under prescription medication as well as dietary intake. Participants were weighed

wearing minimal clothing and without shoes using digital scales. Height had been measured utilizing a SECA body meter. Body mass index (BMI) was assessed as weight (in kilograms) divided to height (in meters) squared according to categorizing based on the World Health Organization's standard with regard to adults. The validated self-report questionnaire was adapted to calculation of physical exercise level of respondents within a metabolic equivalent task (MET) hours/day, based on revealed period allocated to various actions that have been weighed based on high intensity level. Physical exercise had been accomplished according to exercises in the past year (cases) and controls.

Statistical analysis

Considering that the microbial counts within breast-milk had not been typically dispersed, the Mann–Whitney test had been put into use to test out variations in between two categories of baby sex, Mode of delivery (vaginally/ cesarean), region (urban and rural) as well as the lactation period (first3month/ after 3 month). Poisson Regression was adopted to evaluate outcomes of baby sex, Mode associated with delivery, region and lactation period within the bacterial counts. Every healthy female along with breastfeeding had been matched up along with a single healthy female within the control team, simply by age (within 5-year categories). While in dietary pattern evaluation, overall energy consumption outside the range of ± 3 standard deviation of the mean and imperfect meals regularity questionnaire (More than 40% associated with foods weren't assessed) was excluded. The ultimate test intended for statistical evaluation had been 40 cases in addition to 43 controls. Information had been assessed along with Statistical Package deal Software program with regard to Social Science, version 18 (SPSS Inc., Chicago, IL, USA). Kolomogorov-Smirnov test was implemented in order to check out information normality. Dietary patterns had been designed using Principal Component Analysis (PCA) in accordance with the 165 meals items. Sample adequacy as well as inter-correlation of the variables were measured based on the KMO value > 0.647 and Bartlett's test sphericity < 0.05 . Samples outside the range of KMO and Bartlett test values were excluded. Meals groups (e.g. Poultry, egg, boiled potato and fat) along with common function value $< 6\%$ pointed out lower and the inadequate degree of correlation along with other food groups. Scree plot had been evaluated to find out the quantity of factors by having an eigenvalue of > 1.0 , and Varimax rotation had been utilized to evaluate the correlations in between variables as well as factors. Post-rotated factor loadings revealed two dietary patterns identified in the sample which patterns had been labeled according to every meals group obtaining greatest loading up on every pattern. Food groups along with optimistic loadings for every pattern pointed out to the direct relationship with symbiotic or Western diet as well as food groups along with negative loadings demonstrates the inverse relationship with this pattern. The actual factor score for every pattern had been assessed through summing the intake of every simply weighed food group by factor loading. Every individual acquired a factor rating for every revealed pattern. Factor ratings were then identified directly into two groups in accordance with the mean of factor rating. Chi-square (χ^2) test was implemented to evaluate the relationship between factors and focus groups (control). The Independent t-

test was used for evaluating means among two groups. Univariate and multivariate logistic regression were put to use in order to calculate the odds ratio having a 95% confidence interval with regard to breastfeeding of lactic acid bacteria. A p-value <0.05 that is based on a two-sided statistical test was considered as significant.

RESULTS AND DISCUSSION

The mean age of respondents was 29.9 years. There were no significant differences between case and control groups in educational level, occupation, income and physical activity (MET. h/day). Table-2 shows the socio-demographic and lifestyle characteristics of the 40 cases and 43 controls. In addition, cases showed family history of obesity among first (P = 0.002) and second degree relatives (P = 0.001). The mean body mass index (BMI) of the cases was slightly higher than in the control group, but it did not differ statistically. However, the cases demonstrated significantly higher energy intake than the controls (P = 0.024).

Table 2: Characteristics of case and control groups

| Variable | Control (n=43) n (%) | Case (n=40) n (%) | **P- value |
|---|----------------------------|-------------------------|---------------|
| Age (years) | 29.93 ± 10.29 | 29.65 ± 10.36 | - |
| Level of education | - | - | 0.136 |
| No formal education | 6.0 (13.95) | 5.0 (12.5) | |
| Elementary | 15 (34.89) | 9.0 (22.5) | - |
| Junior/Senior high school Diploma/ College/University | 13 (30.23) | 12 (30.0) | |
| Occupation | 9.0 (20.93) | 14 (35.0) | 0.665 |
| Employed/Government | - | - | |
| Employed/Private | 9.0 (20.93) | 13 (32.5) | - |
| Housewife(unemployed) | 11 (25.58) | 8.0 (20.0) | |
| Self-employed | 18 (41.87) | 14 (35.0) | |
| | 5.0 (11.62) | 5.0 (12.5) | |
| | Total household Income | | |
| < \$ 430 | 25 (58.14) | 28 (70.0) | - |
| ≥ \$ 430 | 18 (41.86) | 12 (30.0) | |
| M ± SD | 451.07 ± 275.4 | 423.20 ± 247.7 | 0.121 |
| Family history of obesity in first degree | 2 (4.65) | 4 (10.5) | 0.002 |
| Family history of obesity in second degree | 1 (2.35) | 3 (7.5) | 0.001 |
| Physical activity | | | 0.498 |

| | | | | |
|--------------------------------------|---------------------------------|-------------|-------------|-------|
| | Active | 18 (41.86) | 17 (42.5) | - |
| | Sedentary | 25 (58.14) | 23 (57.5) | - |
| Body mass index (Kg/m ²) | | | | |
| | ≤ 24.9 | 18 (41.9) | 15 (37.5) | - |
| | > 24.9 | 25 (58.1) | 27 (62.5) | - |
| | Mean BMI | 25.58 ± 2.3 | 26.32 ± 2.3 | 0.251 |
| | Energy intake (kcal/d) (M ± SD) | 2054 ± 50.6 | 2211 ± 40.6 | 0.024 |

*Matched variables of the study 1 USD= 9,980.00 Rial Significant difference at p< 0.05 M ± SD: Mean ± Standard deviation.

1 MET: metabolic equivalent task (1MET=energy expenditure of sitting quietly or approximately 1kcal/kg of body weight per hour).

**P-values were estimated using chi-square (χ^2) statistics, independent t-test for the difference between case and control groups.

†Mean age at the interview.

Table 3: Factor loading matrix of food groups for Synbiotic dietary and Western dietary patterns

| Food group | Synbiotic pattern | Western pattern |
|---------------------|-------------------|-----------------|
| Vegetables | 0.765 | - |
| Fruits | 0.678 | - |
| Olives | 0.561 | - |
| liquid oils | 0.552 | - |
| All Fish | 0.425 | - |
| Low fat Dairy | 0.679 | - |
| Carrot | 0.373 | - |
| Nuts | 0.321 | - |
| Whole Grains | 0.471 | - |
| Yogurt Drink | 0.606 | - |
| Sugars | - | 0.676 |
| Red meat | - | 0.550 |
| Pickles | - | 0.378 |
| Refined Grains | - | 0.594 |
| Soft Drink | - | 0.430 |
| Animal butter | - | 0.497 |
| Mayonnaise | - | 0.486 |
| Black tea | 0.340 | - |
| Processed Meat | - | 0.456 |
| Legumes | 0.474 | - |
| Solid Oil | - | 0.239 |
| Sweets and desserts | - | 0.326 |
| Snacks | - | 0.378 |

Total variance 12.83% 10.47%

Absolute factor loading values < 0.20 for both patterns were excluded for simplicity.

From Table 3, the factor analysis showed two dietary patterns and the factor loadings for each dietary pattern. Food groups with exact factor loadings > 0.20 were considered as having a significant contribution to the pattern. These two dietary patterns explained 23.30% of the total variance in food intake. The first pattern with high amount of fresh fruits, vegetables, liquid oil, olive, fish, yoghurt, whole grains, carrot, low-fat dairy products, legumes, tea, and nuts were labeled as Synbiotic dietary pattern. This pattern was significantly related to respondents who had a diploma or higher degree, self-employed, with higher income, and commonly consumes raw or fresh vegetables and fresh fruits. The second pattern which is loaded heavily on sugar, processed and red meat, animal butter, refined cereals, pickles, solid oil, mayonnaise, soft drink, sweets and desserts, and snacks were named as Western dietary pattern. This pattern is associated with high energy intake. The odds ratio and their 95% confidence interval for lactic acid by the mean of dietary pattern scores are presented in Table 4. After adjusting for family history of obesity in first and second-degree relative, energy intake, the Synbiotic dietary pattern was associated with an increased factor of lactic acid bacteria. Those having high Synbiotic dietary pattern had a higher factor of lactic acid bacteria (OR= 0.116, 95% CI=0. 106–0.467). A decreased factor of lactic acid bacteria was associated with a high Western dietary pattern in that those consuming more western foods had the lowest factor of lactic acid bacteria (OR=2.616; 95% CI =1.251–4.020).

Table 4 Odds ratios and 95% confidence intervals for lactic acid by dietary patterns

| Dietary pattern | Controls n (%) | Cases n (%) | Crude OR | 95% CI | *Adjusted OR | 95%CI |
|----------------------------------|----------------|-------------|----------|---------------|--------------|---------------|
| Synbiotic dietary pattern | | | | | | |
| † Low | 28 (65.1) | 13 (32.5) | 1.00 | - | 1.00 | - |
| †† High | 15 (34.9) | 27 (67.5) | 0.306 | 0.155 - 0.548 | 0.116 | 0.106 - 0.467 |
| | P-value | - | <0.001 | - | <0.001 | - |
| Western dietary pattern | | | | | | |
| Low | 17 (39.53) | 29 (72.5) | 1.00 | - | 1.00 | - |
| High | 26 (60.47) | 11 (27.5) | 2.238 | 1.244 - 4.245 | 2.616 | 1.251- 4.020 |
| | P-value | - | 0.002 | - | 0.003 | - |

*Adjusted for family history of obesity in first and second-degree relative, energy intake.

† Respondents with score < 0.20 on a dietary pattern.

†† Respondents with score > 0.20 on a dietary pattern.

Intake of numerous nutrients impacts the structure of the microbial local community as they supplies substrates for microbial metabolism. The particular microbiota may create small molecules which are ingested through the host as

well as impact numerous essential physiological processes. Age as well as social variations contributes to variation in diets which will eventually affect the microbiota in intestinal tract. In this case-control research (Isfahan- Iran), Western dietary pattern (WDP) demonstrated reduction in lactic acid bacteria while the Synbiotic dietary pattern (SDP) have a positive impact on lactic acid bacteria following adjustment of socio-demographic and lifestyle factors. The results declare that the interactions between these types of dietary patterns and enhancement of lactic acid bacteria tend to be dependent of variables of breastfeeding. Intake of specific foods, including solid oil, sweets and sugars which are associated with WDP can be connected with LAB, the mechanism remains to be unknown (Cabrerá-Rubio *et al.* 2012; Tusar *et al.* 2014). Adopting a western dietary pattern where it involves the larger consumption of butter, high-fat dairy foods, sweets and desserts, hydrogenated fats, carbonated drinks, potatoes, pizzas, red and highly processed meats had been positively associated with obesity (Turnbaugh *et al.* 2006; Wu *et al.* 2011). The LAB and dietary pattern connection noticed in the research is consistent with the previous studies. Prudent pattern is described as a very high usage of veggies, fruits, whole grain product, poultry, sea food, and beans. This pattern has been inversely related to an increase of the LAB while the WDP pattern had been related to decrease LAB (Schulz *et al.* 1993; Koropatkin *et al.* 2012; David *et al.* 2014). On the other hand, some research has described a dietary pattern that included highly processed meat or even lower consumption of fresh fruits, veggies, yams, cereal products and high fat milk products reduced the LAB (Claesson *et al.* 2012; Cotillard *et al.* 2013). In our research, fresh fruits, veggies and whole grain products had been associated with the SDP. These kinds of food groups has shown to possess a protecting impact, influence LAB via numerous mechanisms (Schaafsma and Slavin, 2015). Numerous micronutrients have been reported such as mineral deposits, vitamins E, C, A, carotenoids, selenium, flavonoid and fibres, that present the overlap and contrasting mechanisms of activity (Schaafsma and Slavin, 2015). Researchers demonstrated that consumption of milk and dairy products were related to LAB (Favier *et al.* 2002; Blaegova *et al.* 2014). The protecting impact of milk and milk products could be related to the presence of a number of micronutrients including riboflavin, calcium, vitamin B12 and vitamin D. This particular foods group also includes additional protecting ingredients, for example butyric acid, linoleic acid, sphingomyelin and synbiotic which could enhance the LAB (Gauhe *et al.* 1954; Wu *et al.* 2011). The connection between milk products and BF can be affected by fatty deposits content. Whilst excessive fat milk products reduced the factors of LAB (Claesson *et al.* 2012; Le Chatlier *et al.* 2013), reduced fat milk products increases the factors of LAB (Sonnenberg *et al.* 2005; Tap *et al.* 2009). In consistent to this study shows that the higher consumption of low-fat milk products contributed to SDP (Claesson *et al.* 2012; Le Chatlier *et al.* 2013). Non digestible oligosaccharides and fructooligosaccharides tend to be prebiotics. Microflora modulation may appear via diet programs which contain probiotics and prebiotics, and can be applied to utilize within newborn feeds. The primary growth of lactic acid bacteria (LAB) and bifidobacteria within the infant and also the function of breast milk as being a

supply of these kinds of microorganisms required further research. This study demonstrated the growth of those bacteria throughout the initial 3 months of life within 40 cases (vaginally delivered breast-fed full-term babies) and the existence of feasible Bifidobacterium within the corresponding breast-milk trial samples. Results revealed that Enterococcus and Streptococcus was the most separated microorganism from 1 day-old babies while in babies aged 10 days to 90 days showed bifidobacteria as a predominant group. Breast-milk features feasible lactobacilli and bifidobacteria may promote the primary growth of the microbiota within the babies. Results indicated that LAB and bifidobacterial microbiota within breastfed infants and the existence of these kinds of microorganisms in addition to their evolution within breast-milk. Martin and co-workers separated LAB through breast-milk and demonstrated that the same LAB strains obtained in breast-milk can also be located in the fecal material of the corresponding infant. Moreover, the isolation of bifidobacterial strains through breast-milk trial samples obtained 4-7 days following delivery, representing the existence of an active bifidobacteria within human milk (Martin *et al.* 2011; Martin *et al.* 2012).

Variation in bacteria is probably due to the difference in food preparation and nutrition availability (Sonnenberg *et al.* 2005). Change in diet in particular group requires time and adaptation and the evaluation of entire samples cannot be measured simply by determination of food sequencing. Tap *et al.* (2009) determined that habitual diet plan has a minimal effect on the entire microbiota user profiles within 17 subjects. Another research revealed the relationship between consumption of fat, proteins, and carbohydrate and the frequency of Bacteroides and Prevotella on microbiotas (enterotypes) within 98 volunteers (Wu *et al.* 2011). Additionally, it seems reasonable to anticipate which variation within the staple diet structure and consumption among various communities and geographical areas may contribute to variations in microbiota composition. Diet plan, host genetics, environmental visibility, and early microbial inoculum cause the variation in the amount of bacteria in each individual so the microbiota cannot be set up completely. Claesson *et al.* (2012) revealed a higher intake of red or even high processed meat reduces the factor of LAB. Interestingly, this study revealed that consumption of legumes in SDP increases the LAB in microbiota. Fung *et al.* (2003) revealed that higher consumption of legumes within the prudent pattern enhanced the factor of LAB whilst Kesse and colleagues did not demonstrate any important relationship in between legumes (Kesse *et al.* 2004). Despite the beneficial connection of legumes and the factor of LAB, food preparation method of legume dishes reduces the advantageous impact of legumes (Duncan *et al.* 2007). Greater portions of solid oil, animal butter and red meat groups is used within WDP while legumes are absent in the WDP. The limitation of this research includes: Firstly, the probability of selection bias is unpreventable in the retrospective case-control studies. The current research minimized this issue by matching the cases and controls through age and energy intake. There is possibility that breastfeeding individuals might recall their own diet plans differently with controls due to their own breastfeeding status. While cases had been chosen only from 6 months of breast feeding and throughout the interview, cases had been requested to report food group consumed prior to breast feeding

to minimize the possibility of cases post-diagnosis. Secondly, this research is unable to evaluate the long term impacts of factors within the existence of LAB. The cohort or even longitudinal research provided a different understanding in the development of LAB factor in breastfeeding and can identify the associations along with socioeconomic, lifestyle behaviors and anthropometry. Thirdly, the various phases of factor analysis utilized in this research included the quantity of factors, Eigenvalue, method of rotation and labelling of factors among the food groups. These interpretations were subjective in accordance with the final decision from the researcher, led through previously revealed methods of analyzing dietary patterns. Ultimately, the sample size with the present research has been relatively small and the research was just performed upon individuals living in Isfahan city. This can restrict the generalization of research results towards the whole Iranian population.

CONCLUSION

The current research recommends Synbiotic dietary plan which is characterized by higher intake of fresh fruits, veggies, liquid oil, olive, carrot, sea food, yogurt, tea drink, whole grains, low-fat dairy products and nuts as a factor to enhance higher lactic acid bacteria in microbiota. Diet plan along with a higher consumption of sugars, processed and red meat, animal butter, refined cereals, pickles, solid oil, sweets and dessert and snacks may reduce the source of lactic acid. The research additionally supported the importance of utilizing a dietary pattern method to investigate element relationships among diet plan and breastfeeding. All of our outcomes point out to which breast-milk consists of feasible lactobacilli and bifidobacteria which may promote the growth and improvement or activity with the microbiota within breastfeeding. This particular diet-BF relationship could be utilized for developing interventions which attempt to promote synbiotic to enhance lactic acid bacteria, especially breastfeeding within the Iranian population.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

ACKNOWLEDGMENT

All authors approved the final version of paper. The authors express their deep appreciation to Food Security Research Center in Isfahan University of Medical Sciences through Fundamental research grant scheme for funding this project. We are thankful to Dr. F Porsina, Dr. M Mirlohi, Dr H. Ghasemian Safaei and F. Madani (M.Sc) which helps us in this project.

REFERENCES

1. Zamora, G., Lutter, C.K., Peña-Rosas, J.P., 2015. Using an equity lens in the implementation of interventions to protect, promote, and support optimal breastfeeding practices. *Journal of Human Lactation* 31:21-5.
2. Jeurink, P.V., Van Berghenhenegouwen, J., Jimenez, E., Knippels, L.M., Fernandez, L., Garssen, J., Knol, J., Rodriguez, J.M., Martin, R., 2012.

- Human milk: a source of more life than we imagine. *Beneficial Microbes* 4:17-30.
3. Martín, V., Maldonado-Barragán, A., Moles, L., Rodríguez-Baños, M., del Campo, R., Fernández, L., Rodríguez, J.M., Jiménez, E., 2012. Sharing of bacterial strains between breast milk and infant feces, *Journal of Human Lactation* 28: 36-44.
 4. Fernández, L., Langa, S., Martín, V., Maldonado, A., Jiménez, E., Martín, R., Rodríguez, J.M., 2013. The human milk microbiota: origin and potential roles in health and disease. *Pharmacological Research* 69:1-0.
 5. Maldonado, J., Lara-Villoslada, F., Sierra, S., Sempere, L., Gómez, M., Rodríguez, J.M., Boza, J., Xaus, J., Olivares, M., 2010. Safety and tolerance of the human milk probiotic strain *Lactobacillus salivarius* CECT5713 in 6-month-old children, *Nutrition* 26:1082-7.
 6. Thum, C., Cookson, A.L., Otter, D.E., McNabb, W.C., Hodgkinson, A.J., Dyer, J., Roy, N.C., 2012. Can nutritional modulation of maternal intestinal microbiota influence the development of the infant gastrointestinal tract? *The Journal of nutrition* 142:1921-8.
 7. Martín, V., Mañes-Lázaro, R., Rodríguez, J.M., Maldonado-Barragán, A., 2011. *Streptococcus lactarius* sp. nov., isolated from breast milk of healthy women. *International Journal of Systematic Evolutionary Microbiology* 61:1048-52.
 8. Martín, R., Langa, S., Reviriego, C., Jiménez, E., Marín, M.L., Olivares, M., Boza, J., Jiménez, J., Fernández, L., Xaus, J., Rodríguez, J.M., 2004. The commensal microflora of human milk: new perspectives for food bacteriotherapy and probiotics. *Trends Food Science and Technology* 15: 121-7.
 9. Aguilera JM. *Edible Structures: The Basic Science of what We Eat*. CRC Press; 2012.
 10. Donovan, S., Gibson, G. and Newburg, D., 2008. Prebiotics in infant nutrition, *Mead Johnson Nutrition* 1-37.
 11. Harmsen, H.J., Wildeboer-Veloo, A.C., Raangs, G.C., Wagendorp, A.A., Klijn, N., Bindels, J.G., Welling, G.W., 2000. Analysis of intestinal flora development in breast-fed and formula-fed infants by using molecular identification and detection methods. *Journal of Pediatric and Gastroenterology Nutrition* 30: 61-7.
 12. Favier, C.F., Vaughan, E.E., De Vos, W.M., Akkermans, A.D., 2002. Molecular monitoring of succession of bacterial communities in human neonates. *Applied Environmental Microbiology* 68:219-26.
 13. Thrall, P.H., Laine, A.L., Ravensdale, M., Nemri, A., Dodds, P.N., Barrett, L.G, Burdon, J.J., 2012. Rapid genetic change underpins antagonistic coevolution in a natural host - pathogen metapopulation. *Ecology Letters* 15:425-35.
 14. Kralj, S., van Geel-Schutten, G.H., Rahaoui, H., Leer, R.J., Faber, E.J., Van Der Maarel, M.J., Dijkhuizen, L., 2002. Molecular characterization of a novel glucosyltransferase from *Lactobacillus reuteri* strain 121 synthesizing a

- unique, highly branched glucan with α -(1 \rightarrow 4) and α -(1 \rightarrow 6) glucosidic bonds. *Applied Environmental Microbiology* 68:4283-91.
15. Salmerón, I., Thomas, K., Pandiella, S.S. 2015. Effect of potentially probiotic lactic acid bacteria on the physicochemical composition and acceptance of fermented cereal beverages, *Journal of Functional Foods* 15:106-15.
 16. Hu, F.B., 2002 Dietary pattern analysis: a new direction in nutritional epidemiology. *Current Opinion Lipidology* 13: 3-9.
 17. Albenberg, L.G. and Wu, G.D., 2014. Diet and the intestinal microbiome: associations, functions, and implications for health and disease. *Gastroenterology* 146:1564-72.
 18. Azar, M., and Sarkisian, E. 1980. Food composition table of Iran: National Nutrition and Food Research Institute. Tehran: Shahid Beheshti University Press Iran. CIT0001.
 19. Food composition table (FCT). Beltsville, MD: Food and Nutrition Information Center, US Department of Agriculture, 2009. (www.nal.usda.gov/fnic/foodcomp, accessed on 20 September 2009).
 20. Cabrera-Rubio, R., Collado, M.C., Laitinen, K., Salminen, S., Isolauri, E., Mira, A., 2012. The human milk microbiome changes over lactation and is shaped by maternal weight and mode of delivery. *American Journal Clinical Nutrition* 96: 544-51.
 21. Tušar, T., Žerdoner, K., Bogovič Matijašič, B., Paveljšek, D., Benedik, E., Bratanič, B., Fidler, N., Rogelj, I., 2014. Cultivable bacteria from milk from Slovenian breastfeeding mothers, *Food Technology Biotechnology* 52:242-7.
 22. Turnbaugh, P.J., Ley, R.E., Mahowald, M.A., Magrini, V., Mardis, E.R., Gordon, J.I., 2006. An obesity-associated gut microbiome with increased capacity for energy harvest. *Nature* 444:1027-31.
 23. Wu, G.D., Chen, J., Hoffmann, C., Bittinger, K., Chen, Y.Y., Keilbaugh, S.A., Bewtra, M., Knights, D., Walters, W.A., Knight, R., Sinha, R., 2011. Linking long-term dietary patterns with gut microbial enterotypes. *Science* 334:105-8.
 24. Schulz, A., Van Amelsvoort, J.M., Beynen, A.C., 1993. Dietary native resistant starch but not retrograded resistant starch raises magnesium and calcium absorption in rats. *The Journal of nutrition* 123:1724-31.
 25. Koropatkin, N.M., Cameron, E.A., Martens, E.C., 2012 . How glycan metabolism shapes the human gut microbiota. *Nature Review Microbiology* 10:323-35.
 26. David, L.A., Maurice, C.F., Carmody, R.N., Gootenberg, D.B., Button, J.E., Wolfe, B.E., Ling, A.V., Devlin, A.S., Varma, Y., Fischbach, M.A., Biddinger, S.B., 2014. Diet rapidly and reproducibly alters the human gut microbiome. *Nature* 505:559-63.
 27. Claesson, M.J., Jeffery, I.B., Conde, S., Power, S.E., O'Connor, E.M., Cusack, S., Harris, H.M., Coakley, M., Lakshminarayanan, B., O'Sullivan, O., Fitzgerald, G.F., 2012. Gut microbiota composition correlates with diet and health in the elderly. *Nature* 488:178-84.
 28. Cotillard, A., Kennedy, S.P., Kong, L.C., Prifti, E., Pons, N., Le Chatelier, E., Almeida, M., Quinquis, B., Levenez, F., Galleron, N., Gougis, S., 2013.

- Dietary intervention impact on gut microbial gene richness. *Nature* 500: 585-8.
29. Schaafsma, G., and Slavin, J.L., 2015. Significance of inulin fructans in the human diet. *Comprehensive Reviews in Food Science and Food Safety* 14:37-47.
 30. Blagoeva, G., Milev, M., Minkova, S., Gotcheva, V., and Angelov, A., 2014. Assessment of Lactic Acid Bacteria and Enterobacteriaceae Counts in Bulgarian Probiotic Products by TEMPO System and ISO Methods. *Journal of Nutrition Health Food Eng* 1: 00029.
 31. Gauhe, A., György, P., Hoover, J.R., Kuhn, R., Rose, C.S., Ruelius, H.W., Zilliken, F. 1954. Bifidus factor. IV. Preparations obtained from human milk, *Archieve Biochemistry Biophysics* 48:214-24.
 32. Le Chatelier, E., Nielsen, T, Qin, J., Prifti, E., Hildebrand, F, Falony, G., Almeida, M., Arumugam, M., Batto, J.M., Kennedy, S., Leonard, P., 2013. Richness of human gut microbiome correlates with metabolic markers. *NAT* 500 : 541-6.
 33. Sonnenburg, J.L., Xu, J., Leip, D.D., Chen, C.H., Westover, B.P., Weatherford, J., Buhler, J.D., Gordon, J.I., 2005. Glycan foraging in vivo by an intestine-adapted bacterial symbiont. *Science* 307:1955-9.
 34. Tap, J., Mondot, S., Levenez, F., Pelletier, E., Caron, C., Furet, J.P., Ugarte, E., Muñoz - Tamayo, R., Paslier, D.L., Nalin, R., Dore, J., 2009. Towards the human intestinal microbiota phylogenetic core, *Environmental Microbiology*11: 2574-84.
 35. Fung, T., Hu, F.B., Fuchs, C., Giovannucci, E., Hunter, D.J., Stampfer, M.J., Colditz, G.A., Willett, W.C., 2003. Major dietary patterns and the risk of colorectal cancer in women, *Achieves in Internal Medicine* 163:309-14.
 36. Kesse, E., Clavel-Chapelon, F., Boutron-Ruault, M.C., 2006 . Dietary patterns and risk of colorectal tumors: a cohort of French women of the National Education System (E3N). *American journal of Epidemiology* 164:1085-93.
 37. Duncan, S.H., Belenguer, A., Holtrop, G., Johnstone, A.M., Flint, H.J., Lobley, G.E., 2007. Reduced dietary intake of carbohydrates by obese subjects results in decreased concentrations of butyrate and butyrate-producing bacteria in feces. *Applied Environmental Microbiology* 73:1073-8.

APPLICATION OF LINEAR PROGRAMMING MODEL AND SENSITIVITY ANALYSIS IN MULTI-PRODUCT MULTI-DESTINATION SYSTEM

**Modestus O. Okwu^{1*}, F. I. Ashiedu², Joachim Gidiagba³
Adedoyin Adesuji⁴**

^{1,2,3}Mechanical Engineering Department, Federal University of Petroleum Resources Effurun,
Warri, Delta State, Nigeria

⁴Petroleum and Gas Engineering Department, University of Port-Harcourt, Rivers State, Nigeria

*mechanicalmodestus@yahoo.com

Abstract. This research explores linear programming (LP) optimization model in multi-product distribution from source to destinations. In doing this, a mathematical model was developed for a source with twelve (12) products allied to ten (10) destinations. From the study, it was noticed that the source distributes products to downstream at a very high cost. A total cost of ₦368,486.00 was incurred on product delivery from source to destinations. From the overall analysis, it was also observed that the LP minimization process would distribute set of products to all destinations at an optimal cost of ₦328,578.00 using TORA application software. Hence, cost of product distribution would be reduced by roughly 10.4%. The study concludes that, the model is highly effective in minimizing distribution expenses for any multi-product distribution system while fulfilling demand at various destinations.

Keywords: optimization, linear programming, single-source, multi-product, multi-destination.

1.0 Introduction

Manufacturing Industries are practically faced with cost engineering optimization which is vital to the existence of firms. Facility design problems are primarily concerned with the optimal ways in which a products produced at different factories or plants can be transported to a number of warehouses or customers. The objective in a transportation problem is to fully satisfy the destination requirements within the operating production capacity constraints at the minimum possible cost. [1] proposed that one of the key problems managers of companies face is the high cost of distributing multiple products to downstream locations. They often rely on their intuition and rule of thumb while making allocation decisions. In that study a mathematical model was developed for minimizing the distribution cost in a multi-product supply chain system. The oil and gas sector was studied to understand the underlying supply chain system. Thus, this study addresses a case of distribution problem faced by a source located in Warri, Nigeria with multiple items to be supplied to various destinations so that product delivered can satisfy retailers' expectation. These challenges earlier mentioned are ever posed on producers of manufacturing industries. Practical applications of this study may arise in different settings as shown: Oil and Gas companies, paint companies, agricultural and pharmaceutical industries where demand of their multiple products is required at various distribution centers. Some specific instances of a single source supplying multiple products to multiple destinations include: Procter and Gamble Nigeria Limited a major distributor of fast moving consumer goods (FMCG) in Nigeria. Their products include pampers, ariel, bonux, vicks, always, Oral-B, duracell, gillette etc. Unilever is another major distributor of FMCGs to multi-destinations in Nigeria. Their products include Omo, Lux, Flora, Rexona, Knorr, Lipton e.t.c. Pipeline & Product Marketing Company (PPMC) distribute gasoline, kerosene, gas oil/diesel, fuel/oil, asphalt etc. to multi-destinations in Nigeria. Their products include PZ Cussons manufacturing

company. The company distribute multiple products reminiscent of premier soap, cussions baby, robb, nunu, zip, haier thermocool, morning fresh to multi-destinations in Nigeria. The concern of this study centers on how single source producing multiple products can optimize cost of shipping these products to various destinations.

1.1 Company Profile. Oyedoh Depot Nig. Ltd is a key distributor of both alcoholic and non-alcoholic drinks in the Warri/Effurun metropolis and has been in existence for the past 15years and currently forms part of the Nigeria Breweries Group. The Depot has two major warehouses both sited at the same location where products are stored. There are three trucks that distribute products to various destinations in Warri/Effurun metropolis.

Major products available at Oyedoh Depot Nigeria Limited include: Star, gulder, harp, Heineken, origin, fayrous, dubic malt, Smirnoff-ice, Goldberg. The study covers the range of products of a firm shipped to various destinations, the unit distribution costs as well as all functional constraints facing a firm. A case scenario of the shipment of the product i to destination j is considered. The aim of the research is to optimize the cost of distribution of products at Oyedo Depot Nigeria Limited. The objectives of the study include: to develop a heuristic model for multi-product multi-destination system, develop solution procedure for the model, collect data from companies and use it to validate the model developed to accomplish low solution cost.

1.2 Product Distribution. Transportation problem (TP) is a significant Linear Programming (LP) model that arises in several contexts and has been greatly acknowledge in literature. TP were the earliest class of linear programs discovered to have totally unimodular matrices and integral extreme points resulting in considerable simplification of the simplex method. The study of the TP's laid the foundation for further theoretical and algorithmic development of the minimal cost network flow problems. [2] looked at transportation models for material distribution as a method to organize the transportation process of a product from various sources to various destinations. [3] optimized cement distribution in the Nigerian cement manufacturing industry. The source of distribution were identified as Gboko, Port-Harcourt and Calabar while destinations were identified as Abakaliki, Onueke, Oha-ozara and Afikpo with a view to determining the shortest route that minimized the cost of cement. Their research showed that transportation model could improve the shipment route at minimal cost. [4] considered distribution as playing a key role within the marketing mix, and the key to success is its successful integration within the mix, ensuring that customers get their products at the right place and at the right time. If the product cannot reach its chosen destination at the appropriate time, then it can erode competitive advantage and customer retention. The purpose of their work is to explore the best distribution strategy and other factors that help the organization meet customer expectations in respect of delivery and service promises the organization might make. The paper was qualitative and empirical data were collected through questionnaire and in-depth interview. SPSS was used in analyzing the data gathered from the sample (105 respondents). The study revealed that the best distribution strategy depends on the target market and the operational environment. It also indicated that the emergence and explosion of the internet and other information communication technologies has greatly affected distribution. [5] noted that one major problem in Nigeria is the persistent scarcity and inequitable distribution of petroleum products even with the establishment of three refineries, many storage depots and pipelines interconnecting them. This is applied to the situation in the downstream petroleum sector in order to determine an efficient and equitable distribution of three blends of petroleum products like premium motor spirit (PMS), dual purpose kerosene (DPK) and Automotive Gasoline Oil (AGO). hey went further to design a model for effective distribution of products considering three refineries and seventeen storage depots. The model was formulated as a linear programming problem with 20 constraints and 51 variables and was solved using LINDO Optimization software using simplex approach. [6] agreed that Linear Programming Problem (LPP) is one of the most potential mathematical tools for efficient allocation of operational resources. Transportation problems (TP) are basic network problems which can be formulated as an LPP. The main objective of TP is to minimize the transportation cost of distributing a product from a number of sources (e.g. factories) to a number of destinations (e.g. ware houses). It is to be mentioned that balanced TP and Unbalanced TP are the types of TP. If the sum of the supplies of all the sources is equal to the sum of the demands of all the destinations, the problem is termed as a balanced transportation problem. Again, if the sum of the supplies of all the sources is not equal to the sum of the demand of all the destinations, the problem is termed as unbalanced transportation problem. They developed a new method of finding an Initial Basic Feasible Solution (IBFS) for both the Balanced TP and Unbalanced TP. [7] solved transportation problem with Vogel's Approximation Method (VAM) which is a special class of Linear Programming Problem. [8] considered VAM to be a better efficient heuristic approach since it often provides an optimal or near optimal solution to the transportation problem. In this research, heuristic for multi-product multi-destination shall be considered.

1.3 Linear and Integer Linear Programming.

A linear programming problem (LP) is a class of the mathematical programming problem, a constrained optimization problem, in which we seek to find a set of values for continuous variables (x_1, x_2, \dots, x_n) that maximizes or minimizes a linear objective function z , while satisfying a set of linear constraints.

An integer linear programming problem (ILP) is a linear programming problem in which at least one of the variables is restricted to integer values. In the past two decades, there has been an increasing use of an alternate term mixed integer programming problem (MIP) for LP's with integer restrictions on some or all of the variables. In this research, the terms ILP and MIP may be used interchangeably. For clarity, we shall use the term pure integer programming problem to emphasize an IP whose variables are all restricted to be integer valued. [9] presented a technique for solving linear integer problems to find out exact optimal solutions using computational resources. These problems belong to a class of NP-hard optimization problems using efficient hybrid methods. [10] presented a unique method of integer linear programme. The ILP framework allows combined decisions of the expert learners in selection and writing of source content through a mixture of objective settings, soft and hard constraints. [8] proposed that wide range of problems can be modeled as Mixed Integer Linear Programming (MIP) problems using standard formulation techniques. However, in some cases the resulting MIP can be either too weak or too large to be effectively solved by state of the art solvers, they review advanced MIP formulation techniques that resulted in stronger and/or smaller formulations for a wide class of problems.

2.0 Materials and Method

The focus includes methods and techniques adopted for this study. This contains problem description, model development, data gathering method and model parametrization.

A multi-product multi-destination system was studied to understand the underlying structural design (Fig. 1). Attempt was made to identify system parameters, variables, limitations, criteria so as to be able to define the problem. This study was done using information from a bottling facility located in Warri, Nigeria. The interactions and flow of products in the system were identified and modeled.

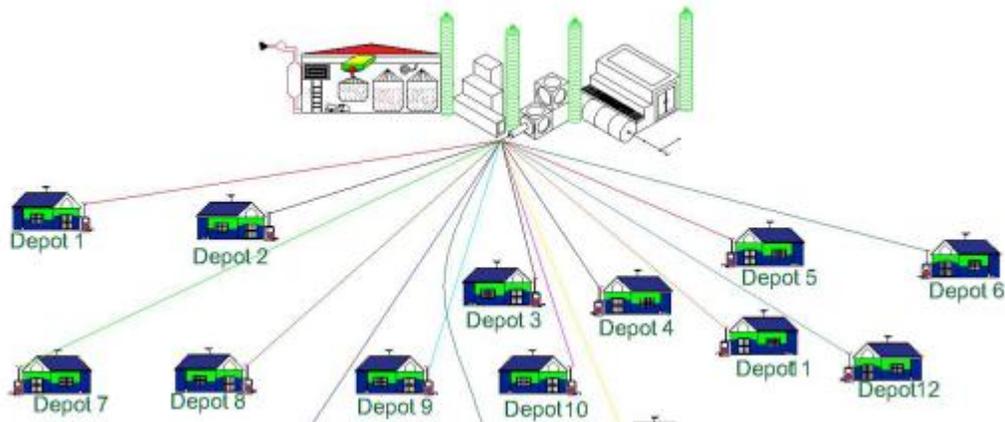


Fig. 1 Underlying Structural Design of the Bottling Plant of Source and Destinations

2.1 Mathematical Formulation.

Suppose a company has a depot and n retail destination and multiple product is to be shipped from the depot to the various destinations. The depot has a given level of supply and each destination has a given level of demand. We are also given the transportation costs between the depot and destination, and these costs are assumed to be linear. More explicitly, the assumptions are:

- The total supply of the product from Depot i is A_i where $i = 1, 2, m$.
- The total demand for the product at outlet j is b_j , where $j = 1, 2, n$.
- The cost of sending one unit of the product from warehouse i to outlet j is equal to C_{ij} , where $i = 1, 2, m$ and $j = 1, 2, n$. The problem of interest is to determine an optimal transportation scheme between the Depot and the destinations, subject to the specified supply and demand constraints.

2.2 The Decision Variables.

A transportation scheme is a complete specification of how many units of the product should be shipped from each warehouse to each outlet. Therefore, the decision variables are:

X_{ij} = the size of the shipment from warehouse i to outlet j , where $i = 1, 2, m$ and $j = 1, 2, \dots, n$. This is a set of $m \times n$ variables. sustain

2.3 Product Distribution Constraint.

The constraints are the conditions that force supply and demand needs to be satisfied. In a Transportation Problem, there is one constraint for each node.

Constraint on availability: This constraint puts a limit on the quantity of any product i that can be sent to the various destinations. Hence, the quantity of product i sent to the various destinations must be less than or equal to the quantity of that product available at the depot. For each product i , the available quantity is A_i . This is shown as system of Eq. (1).

$$\sum_{j=1}^n x_{ij} \leq A \quad (1)$$

Constraint on demand: Considering this constraint, the quantity of product allocated to a destination should be less or equal to the quantity demanded by that destination, In essence, this constraint requires that only what can be paid for by the depots is sent. This implies that not more than the respective depots demand D_{ij} should be sent. This is represented in Eq. (2).

$$X_{ij} \leq D_{ij} \quad (2)$$

Constraint on Company policy: Quantity of products been sent to a destination is affected by a good number of company policies. One of the critical policies is that no depot must be sent zero quantity or there is a minimum quantity that must be sent to a given depot because of the need to keep customer loyalty at every region. This is represented as the system of Eq. (3).

$$X_{ij} \geq b_{ij}D_{ij} \quad (3)$$

Non-negativity constraint: There explains the fact that there is no negative distribution. This is represented as the system of Eq. (4)

$$X_{ij} \geq 0 \quad (4)$$

Objective Function. The objective function of this model is to minimize the total distribution cost. This is represented as system of equation five as shown in Eq. (5)

$$\text{Minimize } C = \sum_{j=1}^n \sum_{i=1}^m C_{ij} X_{ij} \quad (5)$$

Solution Procedure. The procedure for solving the problem for the case at hand (Table 1) is shown clearly below by following the model gotten.

2.4 Bottling Plant Allocation Model

$$\text{Minimize } C = \sum_{j=1}^{10} \sum_{i=1}^{12} C_{ij} X_{ij} \quad (6)$$

Subject to

$$\sum_{j=1}^n X_{ij} \leq A_i \quad \text{for all } i = 1, 2, 3, \dots, m \quad (\text{availability constraint}) \quad (7)$$

$$X_{ij} \leq D_{ij} \quad \begin{cases} i = 1, 2, \dots, 12 \\ j = 1, 2, \dots, 10 \end{cases} \quad (\text{demand constraint}) \quad (8)$$

$$X_{ij} \geq b_j D_{ij} \quad \begin{cases} i = 1, 2, \dots, 12 \\ j = 1, 2, \dots, 10 \end{cases} \quad (\text{policy constraint}) \quad (9)$$

$$X_{ij} \geq 0 \quad \begin{cases} i = 1, 2, \dots, 12 \\ j = 1, 2, \dots, 10 \end{cases} \quad (\text{non-negativity constraint}) \quad (10)$$

3.0 Data Collection.

Oyedoh Depot Nig. Ltd. Is one of the major depot serviced by Nigeria brewery in the Warri/Effurun metropolis. The depot spend so much in the distribution of products around the Warri/Effurun metropolis. The depot distributes twelve (12) major brewery products to ten (10) different destinations around the conurbation. The depot has two major warehouse w_1 and w_2 with capacity of 15,000 and 30,000 crates respectively both located in the same neighborhood. The depot has three (3) major trucks each with capacity of 200 crates which moves around distributing products to customers. This research is intended to minimize the total transportation cost from warehouse to its number of depots around Warri/Effurun neighborhood.

For the purpose of this study, data was collected from Oyedoh Depot Nig Ltd which is a major depot to the Nigeria Brewery in the Warri/Effurun metropolis. The depot sources its products both from Benin and Lagos and its product are usually in crates and cans. The required data includes: List of available products; source of products; demand of each product by customers at various depots; available product at a given point in time; the unit cost of distributing each product to different destinations; company policy towards product demand at different destinations; the study concerns the supply of 12 major brewery products from the depot to ten key destinations geographically located in the Warri/Effurun metropolis.

3.1 Data Source. The data used for the analysis was collected from the logistics manager of Oyedoh Depot Nig Ltd. The data include the cost of transporting brewery products from depot to the various key destinations, quantity demanded of each product by the various destinations and capacities of the two warehouse.

Table 1 Demand Matrix D_{ij}

| Product | Destination | | | | | | | | | | Availability |
|-------------------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|----------|--------------|
| | D_1 | D_2 | D_3 | D_4 | D_5 | D_6 | D_7 | D_8 | D_9 | D_{10} | A_i |
| 1 Star | 800 | 200 | 400 | 400 | 240 | 280 | 400 | 480 | 320 | 320 | 2200 |
| 2 Gulder | 400 | 120 | 160 | 200 | 80 | 120 | 80 | 240 | 120 | 120 | 800 |
| 3 Heineken | 320 | 120 | 120 | 160 | 120 | 200 | 80 | 160 | 160 | 80 | 1500 |
| 4 Goldberg | 1200 | 320 | 480 | 400 | 400 | 320 | 320 | 600 | 320 | 240 | 3200 |
| 5 Fayrous | 200 | 120 | 240 | 160 | 120 | 120 | 80 | 160 | 120 | 200 | 2000 |
| 6 Harp | 200 | 120 | 360 | 80 | 40 | 0 | 80 | 120 | 0 | 120 | 1600 |

| | | | | | | | | | | | |
|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 7 Medium stout | 280 | 120 | 240 | 200 | 80 | 160 | 120 | 160 | 200 | 160 | 1000 |
| 8 Orijin | 160 | 80 | 80 | 120 | 40 | 80 | 120 | 120 | 160 | 40 | 1500 |
| 9 Dubic malt | 120 | 80 | 0 | 40 | 80 | 80 | 120 | 40 | 0 | 80 | 1000 |
| 10 Amstel malt | 320 | 120 | 160 | 80 | 120 | 120 | 160 | 120 | 120 | 160 | 700 |
| 11 Malta guines | 320 | 120 | 80 | 120 | 160 | 160 | 200 | 200 | 160 | 240 | 1100 |
| 12 Smirnoff ice | 80 | 80 | 120 | 80 | 80 | 160 | 120 | 80 | 160 | 120 | 1200 |
| UNIT COST(₦) | 15 | 15 | 12 | 12 | 30 | 35 | 20 | 26 | 30 | 40 | |
| Policy | 0.5 | 0.5 | 0.4 | 0.3 | 0.5 | 0.4 | 0.5 | 0.8 | 0.6 | 0.6 | |

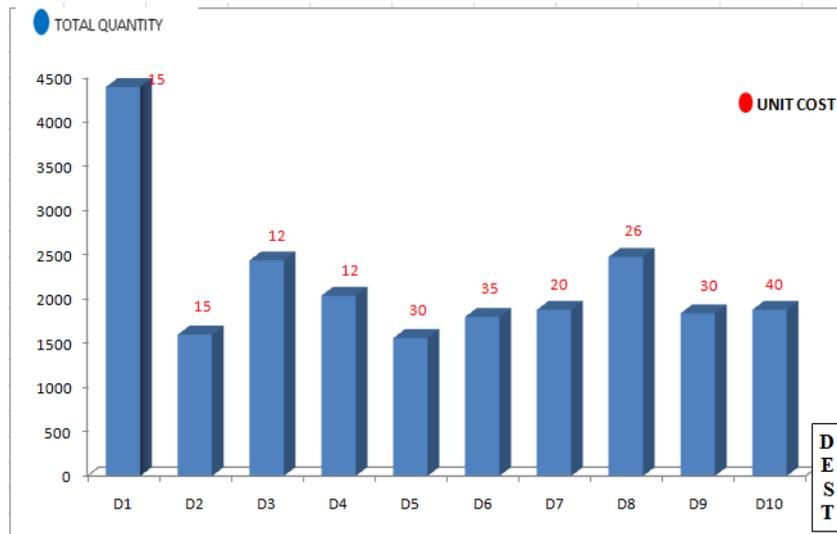


Fig. 2 Total quantity of products demanded at each Destination.

Table 2 Total Products Distributed Using the Model

| Product | Destination | | | | | | | | | | Availability |
|------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|--------------|
| | D ₁ | D ₂ | D ₃ | D ₄ | D ₅ | D ₆ | D ₇ | D ₈ | D ₉ | D ₁₀ | |
| 1 Star | 460 | 150 | 365 | 259 | 72 | 54 | 160 | 300 | 200 | 180 | 2200 |
| 2 Gulder | 200 | 110 | 115 | 125 | 20 | 15 | 18 | 120 | 40 | 37 | 800 |
| 3 Heineken | 280 | 120 | 120 | 140 | 80 | 120 | 50 | 100 | 120 | 60 | 1500 |
| 4 Goldberg | 700 | 240 | 385 | 355 | 260 | 260 | 270 | 440 | 150 | 140 | 3200 |
| 5 Fayrous | 200 | 120 | 240 | 160 | 120 | 120 | 80 | 160 | 120 | 200 | 2000 |
| 6 Harp | 200 | 120 | 360 | 80 | 40 | 0 | 80 | 120 | 0 | 120 | 1600 |
| 7 Medium stout | 185 | 120 | 205 | 155 | 80 | 80 | 50 | 75 | 100 | 30 | 1000 |
| 8 Orijin | 160 | 80 | 80 | 120 | 40 | 80 | 120 | 120 | 160 | 40 | 1500 |
| 9 Dubic malt | 120 | 80 | 0 | 40 | 80 | 80 | 120 | 40 | 0 | 80 | 1000 |
| 10 Amstel malt | 230 | 100 | 95 | 40 | 20 | 50 | 40 | 30 | 45 | 50 | 700 |
| 11 Malta guines | 250 | 120 | 80 | 115 | 80 | 80 | 95 | 70 | 95 | 120 | 1100 |
| 12 Smirnoff ice | 80 | 80 | 120 | 80 | 80 | 160 | 120 | 80 | 160 | 120 | 1200 |

3.2 Solution Technique: Using the TORA Software for Linear programming module the optimal solution obtained is ₦328, 578. This shows that for any set of distribution considering the same decision process, the least cost that could be incurred no matter the redistribution of the products is ₦328,578. Table 2 shows the right quantity of products to be supplied to destinations using the algorithm developed. Analyzing the result obtained from the TORA software, the following conclusion can be drawn: For Destination 1, the best allocation is 460 crate of Star, 200 crate of Gulder, 280 crate of Heineken, 700 crate of Goldberg, 200 carete of Fayrous, 200 crate of Harp, 185 crate of Medium Stout, 160 cartons of Origin, 120 crate of Dubic Malt, 30 crate of Amstel malt, 250 crate of Malta Guinness and 80 crate of Smirnoff Ice. For Destination 2, the best allocation is 150 crate of Star, 110 crate of Gulder, 120 crate of Heineken, 240 crate of Goldberg, 120 crate of Fayrous, 120 crate of Harp, 120 crate of Medium Stout, 80 crate of Origin, 80 crate of Dubic Malt, 100 crate of Amstel Malt, 120 crate of Malta Guinness and 80 crate of Smirnoff Ice.

For Destination 3, the best allocation is 365 crates of Star, 115 crate of Gulder, 120 crate of Heineken, 385 crate of Goldberg, 240 crate of Fayrous, 360 crate of Harp, 205 crate of Medium Stout, 80 crate of Origin, No crate of Dubic Malt to be supplied, 95 crate of Amstel Malt, 80 crate of Malta Guinness, 120 crate of Smirnoff ice.

For Destination 4, the best allocation is 259 crates of Star, 125 crate Gulder, 140 crate of Heineken, 355 crate of Goldberg, 160 crate of Fayrous, 80 crate of Harp, 155 crate of Medium Stout, 120 crate of Origin, 40 crate of Dubic Malt, 40 crate of Amstel Malt, 115 crate of Malta Guinness and 80 crate of Smirnoff ice.

For Destination 5, the best allocation is 72 crate of Star, 20 crate of Gulder, 80 crate of Heineken, 260 crate of Goldberg, 120 crate of fayrous, 40 crate of Harp, no Medium Stout, 40 crate of Origin, 80 crate of Dubic Malt, 20 crate of Amstel Malt, 880 crate of Malta Guinness and 80 crate of Smirnoff Ice.

For Destination 6, the best allocation is 54 crate of Star, 15 crate of Gulder, 120 crate of Heineken, 260 crate of Goldberg, 120 crate of fayrous, 0 crate of Harp, 80 crate of Medium Stout, 80 crate of Origin, 80 crate of Dubic Malt, 50 crate of Amstel Malt, 80 crate of Malta Guinness and 160 crate of Smirnoff Ice.

For Destination 7, the best allocation is 160 crate of Star, 18 crate of Gulder, 50 crate of Heineken, 270 crate of Goldberg, 80 crate of fayrous, 80 crate of Harp, 50 crate of Medium Stout, 120 crate of Origin, 120 crate of Dubic Malt, 40 crate of Amstel Malt, 95 crate of Malta Guinness and 120 crate of Smirnoff Ice.

For Destination 8, the best allocation is 300 crate of Star, crate of Gulder, 100 crate of Heineken, 440 crate of Goldberg, 160 crate of fayrous, 120 crate of Harp, 75 crate of Medium Stout, 120 crate of Origin, 40 crate of Dubic Malt, 30 crate of Amstel Malt, 70 crate of Malta Guinness and 80 crate of Smirnoff Ice.

For destination 9, the best allocation is 200 crate of Star, 40 crate of Gulder, 120 crate of Heineken, 150 crate of Goldberg, 120 crate of fayrous, 0 crate of Harp, 100 crate of Medium Stout, 160 crate of Origin, 0 crate of Dubic Malt, 45 crate of Amstel Malt, 95 crate of Malta Guinness and 160 crate of Smirnoff Ice.

For Destination 10, the best allocation is 180 crate of Star, 37 crate of Gulder, 60 crate of Heineken, 140 crate of Goldberg, 200 crate of fayrous, 120 crate of Harp, 30 crate of Medium Stout, 40 crate of Origin, 80 crate of Dubic Malt, 50 crate of Amstel Malt, 120 crate of Malta Guinness and 120 crate of Smirnoff Ice.

Sensitivity Analysis. The sensitivity report of the distribution process is shown in Fig. 3

| CONSTRAINT | RHS | Slack, Surplus |
|------------|---------|----------------|
| 1 (+) | 2200.00 | 0.00 |
| 2 (+) | 800.00 | 0.00 |
| 3 (+) | 1500.00 | 310.00 |
| 4 (+) | 3200.00 | 0.00 |
| 5 (+) | 2000.00 | 480.00 |
| 6 (+) | 1800.00 | 480.00 |
| 7 (+) | 1000.00 | 0.00 |
| 8 (+) | 1500.00 | 500.00 |
| 9 (+) | 1800.00 | 360.00 |
| 10 (+) | 200.00 | 0.00 |
| 11 (+) | 1100.00 | 0.00 |
| 12 (+) | 1200.00 | 120.00 |
| LB-x1 X11 | 260.00 | 0.00 |
| UB-x1 X11 | 800.00 | 340.00 |
| LB-x2 X12 | 150.00 | 0.00 |
| UB-x2 X12 | 200.00 | 50.00 |
| LB-x3 X13 | 355.00 | 0.00 |
| UB-x3 X13 | 400.00 | 35.00 |
| LB-x4 X14 | 250.00 | 0.00 |
| UB-x4 X14 | 400.00 | 145.00 |
| LB-x5 X15 | 72.00 | 0.00 |
| UB-x5 X15 | 240.00 | 168.00 |
| LB-x6 X16 | 54.00 | 0.00 |

Fig. 3 Sensitivity Report Showing Slack/Surplus of Product.

Table 3 Slack/surplus for quantity of products distributed by the model with respect to quantity of product demanded at the various destination.

| Product | Destinations | | | | | | | | | |
|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| | D ₁ | D ₂ | D ₃ | D ₄ | D ₅ | D ₆ | D ₇ | D ₈ | D ₉ | D ₁₀ |
| 1 STAR | 340 | 50 | 35 | 141 | 168 | 226 | 240 | 180 | 120 | 140 |
| 2 GULDER | 200 | 10 | 45 | 75 | 60 | 105 | 62 | 120 | 80 | 83 |
| 3 HEINEKEN | 40 | 0 | 20 | 40 | 40 | 80 | 30 | 40 | 40 | 20 |
| 4 GOLDBERG | 500 | 80 | 95 | 45 | 140 | 60 | 50 | 160 | 170 | 100 |
| 5 FAYROUS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 HARP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 MEDIUM STOUT | 95 | 0 | 35 | 45 | 0 | 80 | 70 | 85 | 100 | 130 |
| 8 ORIJIN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 DUBIC MALT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 AMSTER MALT | 90 | 20 | 65 | 40 | 100 | 70 | 120 | 90 | 75 | 110 |
| 11 MALTA GUINNESS | 70 | 0 | 0 | 5 | 80 | 80 | 105 | 130 | 65 | 120 |
| 12 SMIRNOFF ICE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Sensitivity analysis shows the slack/surplus of both product demand with respect to product availability and product demand with respect to quantity of product distributed to the various destinations. From table 3, the slack/surplus of product availability with respect to quantity of product distribution is analyzed below.

- For product 1 (Star), 2200 crates was available, 2200 was distributed without slack and surplus.
- For product 2 (Gulder), 800 crates was available, 800 was distributed with no slack, no surplus.
- For product 3 (Heineken), 1500 crates was available, 1190 was distributed with a slack of 310.
- For product 4 (Goldberg), 3200 crates was available, 3200 was distributed without slack and surplus.
- For product 5 (Fayrous), 2000 crates was available, 1520 was distributed with a slack of 480.
- For product 6 (Harp), 1600 crates was available, 1120 was distributed with a slack of 480.
- For product 7 (Medium Stout), 1000 crates was available, 1000 was distributed with no surplus.
- For product 8 (Origin), 1500 crates was available, 1000 was distributed with a slack of 500.
- For product 9 (Dubic Malt), 1000 crates was available, 640 was distributed with a slack of 360.
- For product 10 (Amstel Malt), 700 crates was available, 700 was distributed with no surplus.
- For product 11 (Malta Guinness), 1100 crates was available, 1100 was distributed with no surplus.
- For product 12 (Smirnoff Ice), 1200 crates was available, 1080 was distributed with a slack of 120.

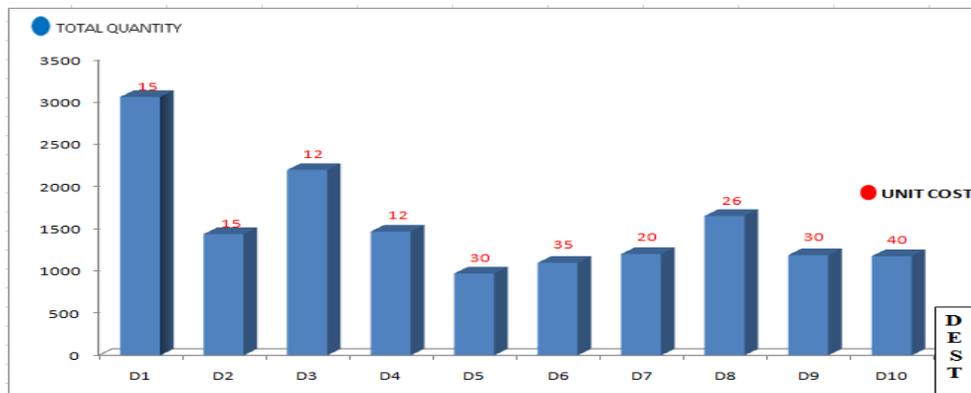


Fig. 4 Unit Cost and Total quantity of products distributed using the Model

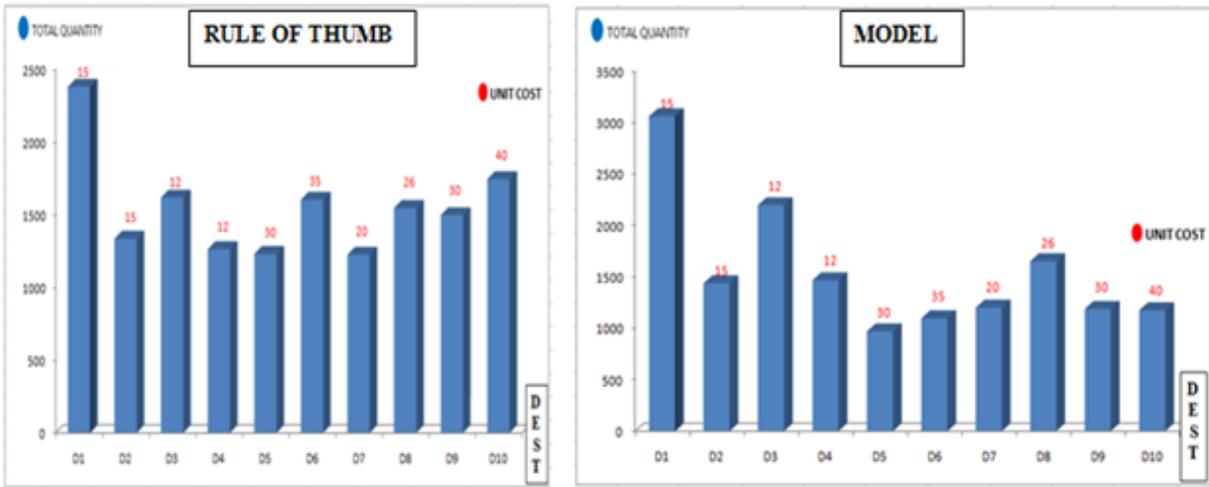


Fig. 5 Comparative analysis of product distribution using rule of thumb and developed model

3.3 Comparison of Product Demanded and Quantity Allocated

There is a variation of the quantity of products demanded at destinations and the quantity of products allocated to these destinations by the depot using rule of thumb. This variation is as a result of the quantity of product available at the source and the company policy.

For Destination 1: Total quantity of product demand at destination 1 is 4400 but 2382 was allocated to them. The sensitivity analysis allocated 3065 products to destination 1 at unit cost of ₦15.

For Destination 2: Total quantity of product demand at destination 2 is 1600 but 1337 was allocated to them. The sensitivity analysis allocated 1440 products to destination 2 at the same unit cost of ₦15.

For Destination 3: Total quantity of product demand at destination 3 is 2440 but 1620 was allocated to them. The sensitivity analysis allocated 2200 products to destination 3 at unit cost of ₦12.

For Destination 4: Total quantity of product demand at destination 4 is 2040 but 1264 was allocated to them. The sensitivity analysis allocated 1469 products to destination 4 at a unit cost of ₦12.

For Destination 5: Total quantity of product demanded at destination 5 is 1560 but 1232 was allocated to them. The sensitivity analysis allocated 972 products to destination 5 at a unit cost of ₦30.

For Destination 6: Total quantity of product demand at destination 6 is 1800 but 1605 was allocated to them. The sensitivity analysis allocated 1099 products to destination 6 at unit cost of ₦35.

For Destination 7: Total quantity of product demand at destination 7 is 1880 but 1227 was allocated to them. The sensitivity analysis allocated 1203 products to destination 7 at a unit cost of ₦20.

For Destination 8: Total quantity of product demand at destination 8 is 2480 but 1548 was allocated to them. The sensitivity analysis allocated 1655 products to destination 8 at unit cost of ₦26.

For Destination 9: Total quantity of product demand at destination 9 is 1840 but 1499 was allocated to them. The sensitivity analysis allocated 1190 products to destination 9 at unit cost of ₦30.

For Destination 10: Total quantity of product demand at destination 10 is 1880 but 1747 was allocated to them. The sensitivity allocated 1177 products to destination 10 at unit cost of ₦40. Thus, the model reduced the quantity allocated to destination ten due to high cost of ₦40.

Table 4 Slack/surplus of products distributed by the model

| Product | Destinations | | | | | | | | | |
|-------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| | D ₁ | D ₂ | D ₃ | D ₄ | D ₅ | D ₆ | D ₇ | D ₈ | D ₉ | D ₁₀ |
| 1 Star | 340 | 50 | 35 | 141 | 168 | 226 | 240 | 180 | 120 | 140 |
| 2 Gulder | 200 | 10 | 45 | 75 | 60 | 105 | 62 | 120 | 80 | 83 |
| 3 Heineken | 40 | 0 | 20 | 40 | 40 | 80 | 30 | 40 | 40 | 20 |
| 4 Goldberg | 500 | 80 | 95 | 45 | 140 | 60 | 50 | 160 | 170 | 100 |
| 5 Fayrous | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 Harp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 Medium stout | 95 | 0 | 35 | 45 | 0 | 80 | 70 | 85 | 100 | 130 |
| 8 Orijin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 Dubic malt | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 Amstel malt | 90 | 20 | 65 | 40 | 100 | 70 | 120 | 90 | 75 | 110 |
| 11 Malta guiness | 70 | 0 | 0 | 5 | 80 | 80 | 105 | 130 | 65 | 120 |
| 12 Smirnoff ice | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 4 represents slack and surplus for source and destinations. This represent demand met at various destinations and quantity of products demand yet to be fulfilled at the various destinations.

4.0 Conclusion and Recommendation

4.1 Conclusion

Distribution cost is an important element of the total cost structure for any Organization. The distribution problem was formulated as a LP model and solved using TORA Software to obtain an optimal solution or near optimal solution. The computational results provided the best possible total distribution cost and the values for the decision variables for optimality. Upon solving the LP problems using the computer software, the optimal solutions provided the valuable information for sensitivity analysis for optimal decisions. The study was done using the data gathered from OYEDOH Depot Nig. Ltd a key distributor to the Nigeria Brewery in Warri, Nigeria. The distribution system of the depot is shown in Table 4 with the depot incurring a total distribution cost of ₦368, 486 without meeting demand at some destinations. Through the use of the developed LP model, all destinations received the exact or a fraction of their demand at an optimal cost of ₦328, 578. This is 10.4% reduction in cost. This implies that a total sum of ₦39,908 would have been saved by the Depot using the model. This would also create time utility by ensuring that products are delivered at the right time.

Conclusively, the distribution model is recommended for effective allocation in a multi-product multi-destination system.

4.2 Recommendations

Based on the results and findings of this study, it is recommended that management of Oyedoh Depot Nig. Limited seek the application of mathematical theories into their operations as a necessary tool in decision making, not only in the area logistics but also in administration.

It is recommended that researchers adopt alternative methods like the use of meta-heuristic techniques in solving distribution problem of this kind.

References

- [1] Okwu, M. O. and Opara, I.O. Optimization modelling for multi-objective supply chains. A Case Study of the Oil and Gas Sector. *International Journal of Science and Technology* Vol.1 (3), (2000) 54-65.
- [2] Lambang, B. S. ,Hanafi, A. , Iskandar, B. , and Suriati, A. M. Transportation model to minimize distribution cost of construction material. *Australian Journal of Basic and Applied Sciences*, 9(23) (2015) 13-21.
- [3] Nwekpa, K. C. and Ewans, C. Optimizing cement distribution in the Nigerian cement manufacturing industry. The case of cement distribution from selected firms to markets in Ebonyi State. *International Journal of Research in Business Management*, Vol. 3, Issue 2 (2015) 35-46
- [4] Asiamah, Y., Alfred O., Solomon B. and Samuel, O. M. Effective distribution management, a pre-requisite for retail operations: a case of puku trading. *European Journal of Business and Innovation Research* Vol. 1, No. 3 (2013) 28-44
- [5] Eke, M.N. and Enibe, S.O. Optimal scheduling of petroleum products distribution in Nigeria. *Nigerian Journal of Technology*, vol. 26 (2010)
- [6] Mollah, M. A., Abu, S. M., Shirin, S. S. and Sharif, U. An effective modification to solve transportation problems: a cost minimization approach. *Annals of Pure and Applied Mathematics* Vol. 6, No. 2, (2014) 199-206
- [7] Hakim, M. A. An Alternative method to find initial basic feasible solution of a transportation problem. *Annals of Pure and Applied Mathematics* Vol. 1, No. 2 (2012) 203-209
- [8] Juman, Z.S., Hoque, M.A., and Buhari, M.I. A sensitivity analysis and an implementation of the well-known vogel's approximation method for solving unbalanced transportation problem, *Malaysian Journal Of Science* 32 (1) (2013) 66-72
- [9] Krasimira, G. and Vassil, G. Linear integer programming methods and approaches A Survey. *Bulgarian academy of sciences cybernetics and information technologies*, volume 11 (1) 2011.
- [10] Kristian, W. and Mirella, L. Multiple aspect summarization using integer linear programming. *Proceedings of the 2012 Joint Conference on Empirical Methods in Natural Language Processing and Computational Natural Language Learning*. (2012) 233–243