Productivity Implications of Performance Appraisal System (Full Version)

Subramaniam, Viswanatha

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PRODUCTIVITY IMPLICATIONS OF EMPLOYEE PERFORMANCE APPRAISAL SYSTEM (Full Version)

BY : VSR.SUBRAMANIAM
Doctoral Research Scholar, University of Bombay, India (1971-1975).

GUIDE : Dr.P.K.Ghosh, Professor in Humanities,
Jamnalal Bajaj Institute of Management Studies, Bombay, India.

BY : Dr.VSR.Subramaniam B.Sc.,MBA.,Ph.D.,
Post Doctorate in Computer Science (USA).,
Professor – Management Science & Consultant
Email : drvsrs@gmail.com Mobile : 919094321160

drvsrs

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PREFACE BY THE AUTHOR

Science invents new ideas. But it does not provide any idea about the end-use of the innovation. Engineering makes a design to convert the ideas into useful products. But it cannot foresee the methodology to manufacture these products. Technology prepares a process to manufacture these designs into products of utility, and sets the supply quantum. But the products become useful only if it is within the means of the people to buy, utilise and get some expected advantages. This is done by Management, the manpower behind to think, innovate, meet the demand and supply economics, and progress / prosper with Corporate leadership.

The foundation for modern Economics and Management was initiated in 1776 by Adam Smith (1723 - 1790, Edinburgh, UK) through his paper "An Enquiry into the Nature and Causes of the Wealth of the Nation". He postulated the theory that Labour is the only source of national wealth, and investment in productive powers of labour is essential. He emphasised the need to have the division of labour, group work, importance of individual enterprises, and the benefits of free trade. From then, the dimensions of Management expanded towards a methodology to direct and decide the formation of wealth, their distribution and their impact on social welfare.

The prime wing of Manpower management is to sharpen the performance traits of the employees by proper appraisal, and synchronise them with the corporate leadership. The employee trait sharpening tool is "Performance appraisal" and corporate leadership property is reflected in "Productivity". Can these two be directly matched ? This was the objective behind this Doctoral Research work !!

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ABSTRACT

The measure and optimisation of this relationship between the input and output in any organization is the "Productivity". The closed cycle economic concept has confirmed that the manpower is the key contributor to the corporate performance. Hence, high performance manpower in any corporate unit should directly reflect a high productivity end result. The performance of manpower is assessed through a "Manpower performance appraisal system". In 1961 Peter Drucker popularised the Management by Objectives (MBO) method. The MBO is thus a performance oriented system. Hence in this doctoral research work, the Preliminary Hypothesis was coined as "Productivity is directly linked to the Performance Appraisal system" or Productive persons are always good performers. In order to establish the hypothesis, samples were chosen from 4 different type of corporate units, with 10 sectors in each. In order to be realistic, 25 top performing (A – Grade) employees were drawn from each of the sample organisation. They were randomly sampled and normally distributed sectarian survey to provide a least-error probability. The total samples were, 10 organisations X 4 typess X 25 employees = 1,000 top performing employees. The standard criteria and contents of the performance appraisal method was also pre-established. The total production data from January to December 1974 was used, to test the validity of the preliminary hypothesis. From 12 diversified organisations spread over 4 types, Productivity had a positive relation for 300 Performance Appraisal Toppers, subject to the correct and up to date Sector Management Information System (MIS). From 28 diversified organisations spread over 4 types, Productivity had a negative relationship for 700 Performance Appraisal Toppers, because of inadequate Sector Management Information System (MIS). The preliminary hypothesis was hence considered "null".

The hypothesis was revised as "Productivity (Pr) is linked to the Performance Appraisal System (Pa) through the corporate Management Information System (MIS)" or Productive persons are good performers, only with the support of the MIS. Mathematically Pr ≈ (Pa)◄*MIS*, which means that, Productivity is proportional to the Performance appraisal grading, moderated by the sector MIS. The hypothesis was well propagated through multi-fold presentations, media, evaluation and viva voce. The hypothesis utility spreads to 6 different practical management decision orientation. Based on all these, the University of Bombay (India) accepted the thesis, as the first in the subject of Management Studies, under the faculty of arts. Awarded a Doctor of Philosophy (Ph.D) degree, with a Doctoral Merit Certificate for special recognition.

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drvsrs

R & D

This Book should be in the possession for Reference and Implementation guide lines with All World the Government Heads, Ministers and Administrative Heads (Village, District, State, Nation); Private & Public sector Management personnel; Colleges & Universities; Economics & Management Students, Research Scholars, Lecturers and Professors; Social Workers and Public Service personnel; International Development Agencies like Commonwealth, IMF, Regional development Institutions (ADB, CDB, IFC, ICICI etc..), UN and the World Bank.

CONTACT

EMAIL : **drvsrs@drvsrs.com**

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appraisal, commercial, employee, economics, gdp, hypothesis, innovation, mahabharatha, manpower, material, mbo, mis, motivation, performance, production, productivity, prosperity, service, technology, thesis, university of bombay

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ACKNOWLEDGEMENT

The universe is an optimal product mix of Energy and Mass. Energy is a non-visible but felt / experiencing media, containing all the components of everything in the universe. Mass is distinctively felt, visible and manifested with the capability of reproduction, depending upon the capacity mix of the energy ingredients. These 2 interchangeable universal contents (Energy and Mass) are synchronised in a simple harmonic conversion process, programmed for an um-imaginable dimension of infinite time period, so that no species in the universe can exist and observe this cycle. The 2 extremes manifestations are from an only mass to an only energy stage in the universe, in a cyclical process forward and backward. Now we are in a partial conversion process from Energy to Mass (backward) stage (with new matters or masses appearing).

These 2 interchangeable components, cannot be created nor destroyed but convertible from one form to another without any loss or gain, have an imbedded and unknown format of electronic storage, process and retrieval component (from the universally distributed static electric power) called "Knowledge".

At the submission of any new output concept, processed and derived from the utility of this universal input ingredient of knowledge, should be "Acknowledged".

The universal philosophy has identified and sequenced the worldly sources of knowledge as the Mother (Matha), Father (Pitha), Teacher (Guru) and the Universal & eternal power (God or Deyvam). For the motivation and the contributory contents of this Doctoral research book work, I acknowledge the following in the universal sequence :-

1. **My mother (Matha) Late Kadayam Kasthuri Kalyani (KKK). Daughter of a highly accredited rural judge (of British times), born in a village called Kadayam in Tirunelveli district, Tamizh nadu, India. She embedded the need for a self-disciplined life, achievement orientation, passion for research + development in every walk of life and service for the society (It was unfortunate that she died at my age of 11).**
2. **My father (Pitha) Late Viswanathan, Son of a truth establishment oriented Layer and Educationist (of British times), born in a village called Gopala samudram, in Tirunelveli district, Tamizh nadu, India. He was an intelligent agriculturist, artist, astronomer and an innovative cross-thinker. He taught me how to read and understand the matters in the universe including the Zodiac, the methodology to absorb / store the universal power for cross-thinking (think and link unrelated objects or subjects, and establish certain inferences of value to the world, or it is an advanced innovation of infinite dimension).**
3. **My guide (Guru) Dr. Pasun.K.Gosh, a Doctorate holder (from the Manchester Business, UK) was a Professor in humanities at Jamnalal Bajaj Institute of Management Studies, Bombay. He indoctrinated me to the field of research planning, topic selection of value to the world, guidance to plan and progress, periodic updates, inclusion of the latest techno-commercial contents, publish for public enlightenment and feed back.**
4. **It is also an imperative responsibility for me to remember the teachers (Past Gurus) in my native learning locations in India : Chatram High School, Kadayam; Government Arts College, Madras (now Chennai); St.Xaviers college, Palayamkottai as well as IIM, Ahmedabad. They moulded and re-shaped my cumulative thinking force acquired through born-psychology, learned-sociology and gained-philosophy into an emergent-curiosity for invention orientation, in every walk of life.**
5. **The universal power (God or Deyvam) for blessing me always unlucky, destroyed my peace and comfort wherever I go, created enormous social-problems, unforeseen economic-squeezes, unmanageable life-situations, but envious performance-challenges. Also for locating me in almost every alien locations on the earth, with an opportunity to contribute something innovative, with good health & mental balance !! These are the contributory causes for my gained philosophy "Be happy with what you have, than being worried about what you do not have, and others have", and made me to lead a comfortable, satisfied, and peace-intensive life with a quick-cogitative wife and a brilliant-thinking son.**

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CHAPTER – 1 : INTRODUCTION

1.01. PROSPERITY INDEX – GDP.

To start a research project for a doctoral program, it is appropriate to initiate with an introduction of prosperity, a welcome need for all nations and their population. The prime indicator of the prosperity of a nation is the "Gross Domestic Product" or GDP. Gross Domestic Product is the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports.

1) **GDP is a measurement of production and income of a country. Countries with higher GDP have a higher level of human development. Hence, GDP is part of the human development index.**
2) **GDP is important because the domestic production and income have a positive relationship with a better domestic quality of life.**
3) **In general, higher GDP is associated with better health, education and overall increased happiness.**

(Source : "Importance of GDP - Some interesting correlations" in the "Principles of Macroeconomics" By Dr. Fidel Gonzalez, Department of Economics and International Business, Sam Houston State University, USA).

The prime contributor to the GDP is the domestic corporate Production and Services. This converts the input resources into output product or services, through scientific planning and control, within the frame work of the corporate objectives and policies. The measure and optimisation of the relationship between the output and input is the Productivity.

1.02. PROSPERITY THROUGH PRODUCTIVITY.

GDP is an aggregate of the domestic products and services (outputs). It is the result arising through the coversion of input resources. Higher the quantum ratio of output / input, then more the quantum GDP. The quantum ratio of output to input is the productivity. Hence, higher the productivity growth, greater the GDP. Hence, the naton gains a greater Per capita GDP (when divided by the population).

Industrialised countries usually have a fairly high productivity level, and therefore have a high per capita GDP and standard of living. Developing nations have a lower productivity level because they don't have a large supply of latest equipment, tools and technology. This results in lack of employment infrastructure. Hence, the educated and experienced professionals and workers migrate to alien coutries, where there is a market, incentive and monetory return for their talents and skills. The resident workers (left over) are not that productive and quality conscious, because of their freedom and fundamental rights to protect their employment and income. These nations do not have a lot of goods to sell, trade or export, and their citizens have a fairly low standard of living. (Source : http://danika.wordpress.com/)

1.02A. PRODUCTIVITY – EARLY VERSIONS.

Productivity, from 1940s (during the 2nd World war - 1939 to 1945), was considered as a domain of the Engineering faculty to analyse the relationships of the output that can be produced in a specified period of time. It was related to the concept of efficiency, which is the amount of output produced relative to the amount of resources (time, work and money) that go into the production. Improved productivity benefits a business, by lowering the cost and increasing the leverage to compete better in the market, and to make profits.

World labour and manufacturing organisations standardised the concept of Productivity as the ratio between the Physical output (Products) to the Physical input (Labour, material, power etc…). More output quantum with less input quantum, provides a higher and favourable Productivity index.

1.02B. PRODUCTIVITY MOTIVATORS.

More productivity index has a direct impact on lowering the Cost per unit of the Output product, and indirectly improves the profit per unit of that product at a constant price. This universally assist the continued existence and growth of the corporate organisations. A change in the methodology, and/or technology, automation and computerisation (which minimise the tasks that must be performed by an employees) considerably improve the productivity. Recently, less obvious techniques are being employed that involve ergonomic design and worker comfort.

It was found that a comfortable employee, can produce more than a counterpart who struggles throughout the day. In fact, some studies claim that measures such as raising workplace temperature (in cold counties) can have a drastic effect on office productivity. Experiments done by the Japanese Shiseido corporation also suggested that productivity could be increased by means of perfuming or deodorising the air conditioning system of the workplaces.

Till 1960, the productivity motivators were constrained to the methodology, performance and profitability of individual corporate sectors. During this period, both the Eastern and Western nations were competing to prove their techno-commercial superiority. This, drastically increased aggregate supply of various goods. They deployed various productivity optimisation techniques to get more output with a possibly less input. But Japan, by their innovative management strategies, emerged as a leader to flood the international market with low priced and high quality goods, posing a threat to both the Eastern and western allies,

This inducted an increase in the aggregate demand for these goods in the international market, covering the neutral, developing and under developed nations. In turn, the situation motivated large scale production, cost reduction and productivity optimisation approaches among the developed nations.

The result was an increase in the employment situation in both the Eastern and Western nations, as well as they attracted a large scale immigration of labour from the developing and under developed world. As an offspring, the international inflation remained stable.

1.02C. PRODUCTIVITY TAKE-OFF.

After 1960s, there was an economic expansion in the United States, leading to a massive increase in worker productivity and globalisation (complex series of economic, social, technological, cultural and political changes with increasing interdependence, integration and interaction between people and companies in alien locations). Key forces shaping this decade were the a global recession, due to the shift in the manufacturing process, the product delivery to remote locations, popularisation of 3rd generation computers and the invention of e-communications. The productivity in this period assumed a new dimension of a small physical output creating a large value, while a large physical output creating only a smaller value. As a result, everything which were big or maxi prior to 1960s, started assuming the dimension of mini. (Automobile, Camera, Computers, Mobile, TV etc…)

It was a take-off period for a Globalised productivity. Increases in productivity also started influencing the society more broadly, by improving living standards, creating more income, and generating economic growth. Because of this, there were drastic changes in patterns of social behaviour, resulting from new communication technologies and changed/broadened male-female and social relationships. This situation closed the gap between the Productivity and the management of manpower.

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CHAPTER – 2 : CLOSED CYCLE ECONOMICS

A comparative review of the productive activities that control the Productivity flow in a Capitalist set-up as in *Figure-1*, and in a Communist set-up as in *Figure-2*, These two schematics infer the presence of a common economic cycle. It is in a pre-set pattern with seven steps as shown in *Figure-3*.

1. **The first step is the demand for goods and services from individual households for consumables, and capital items from corporate sectors. These needs are converted into deliverable outputs by the Research and Development activity, with a Social intensive approach.**
2. **The second step is to locate and augment the sources for basic materials from infrastructure units, through proper input management decisions.**
3. **The third step is to plan for the raw and semi-finished materials, control them through proper inventory systems, and process them with Productivity intensive approach.**
4. **The fourth step is the Engineering and Technological conversion process through appropriate machinery, infrastructure and parts, utilising the operating and maintenance manpower, with optimum Productive efforts.**
5. **The result is the fifth step is the finished product or services, transported and delivered by the handling manpower. The handling and warehousing operations are made Productive through quantifiable Operations Research Models.**
6. **The products and services in the sixth step reach the users, after proper packing through the forwarding media and marketing channels, at socially acceptable quality and economically viable prices.**
7. **The last and seventh step in the cycle is the consumption of materials and services, distributed and accounted by the financial and personnel manpower. These operations are managed and optimised through Cost-benefit and Management Information systems, guided by the appropriate Output management decisions.**

This consumption in turn, links the cycle back to the demand generation in Step - 1.

The Closed Cycle Economics in Figure-3, highlight the fact that Manpower serves as a direct intangible input, as well as it controls and monitors the input Materials, Techno-commercial systems, and the throughput Production process. Also, Manpower as Consumers, play the role of demand generator, and as a cost adder to the goods by its work contribution. Manpower plays a dual role in the Socio-economic process. Hence, the prime component in the productivity cycle is the "Manpower".

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CHAPTER 3 : PRODUCTIVITY AND MANPOWER LINK.

The closed cycle economic concept has concluded that manpower is the key contributor to the corporate performance, irrespective of the politico-financial methodology. The innovations in the world originates from the thinking ability of the manpower. Hence, high performance manpower in any corporate unit should directly reflect a high productivity setup. The performance of manpower is assessed through a "Manpower performance appraisal system"

3.01. MANPOWER PERFORMANCE APPRAISAL

Appraisal of performance is widely used in the society. Parents evaluate their children, Teachers evaluate their students and Employers evaluate their employees and workers. Formal evaluation of employees was initiated for the first time during thee First World War (1914 – 1918). Motivated by the thoughts of Walter Dill Scot (1869 to 1955. Applied psychologist, USA), the US Army adopted a "Man to Man" rating system to evaluate the military personnel. During 1920 to 1930 hourly paid workers were evaluated in USA, under the title "Merit Rating System". The formal performance appraisal system came into existence in corporate organisations during early 1950's. This was used for Technical, Professional, and Managerial personnel in addition to the employees and workers. Since then there were dramatic improvement and innovation to the formal "Employee Appraisal" system.

Performance Appraisal is an objective system to judge the ability of an individual employee to perform his tasks. A good performance appraisal system should focus on the individual and his development, besides helping him to achieve the desired performance. This means that while the results are important the organisation should also examine and prepare its human capital to achieve this result. This holds true even for new inductees.

According to Flippo (An expert in Personnel Management), "Performance appraisal is the systematic, periodic and impartial rating of an employee's excellence in matters pertaining to the present job and the potential for a better job". It is the process of obtaining, recording and analysing the information about the relative worth of the employees.

3.02. OBJECTIVES OF PERFORMANCE APPRAISAL

Almost all organisations practice performance appraisal in one form or another to achieve certain objectives. These objectives may vary from organisation to organisation or even within the same organisation from time to time. It has been found that there are two primary objectives behind the use of this methodology. One is to use it as an evaluation system and second, to use it as a feedback system.

The aim of the evaluation system is to identify the performance gap. This means that it helps determine the gap between the actual performance of the employee and that required or desired by the organisation.

The aim of the feedback system is to inform the employee about the quality of his work or performance. This is an interactive process by which the employee can also speak about his problems to his superior.

An effective performance appraisal system should emphasis individual objectives, organisational objectives and also mutual objectives. From the viewpoint of individual objective the performance appraisal should talk about

a) What task the individual is expected to do?
b) How well the individual has done the task?
c) How can his performance be further improved?
d) The reward for doing well.

From the organisational view point a performance appraisal should generate manpower information, improve efficiency and effectiveness serve as a mechanism of control and provide a rational compensation structure. In short the appraisal system establishes and upholds the principle of accountability in the absence of which organisation failure is the only possible outcome. It strengthens the area of mutual goals between the employee and employer, for growth, development, harmony, effectiveness and profitability.

3.03. METHODS OF PERFORMANCE APPRAISAL

In order to achieve the objectives, a variety of performance appraisal methods have been developed. The choice of method depends on organisational ethos, its objectives, size, product and technology.

The most traditional method is the Confidential Report method where the supervisor makes an evaluation of his subordinate on the basis of certain characteristics like loyalty, intelligence, conduct, character etc. In some other methods like Graphic Rating scale and the Ranking Methods though the process is simple it is plagued with subjectivity. In the Critical Incidents method a balance sheet of on-job-behavior for each employee is generated which can then be used at the end of the year to see how well the employee has performed.

In 1961 Peter Drucker (1909 to 2005, Austria/USA) popularised the Management by Objectives (MBO) method. In this method the subordinate in consultation with the supervisor prepares short term objectives followed by specific actions that he has to carry out. The goals are finally set and are action oriented. The goals set should be specific, measurable, achievable, review able and time bound and most importantly it should be aligned with the goal of the organisation. At the end of a specified time period, the activities are jointly reviewed by both the subordinate and his supervisor. Depending on the performance of the subordinate, the goals are modified or redesigned for the next period of time.

The MBO is thus a performance oriented system. A well thought out MBO system provides multiple benefits. It establishes a link between the performance of the individual and the organisation.

It is easy to implement because those who carry out the plan also participates in setting it up. Each employee becomes aware of the task he has to perform. This leads to better utilization of capacity and talent. It promotes better communication and information sharing. It provides guidelines for self evaluation as well as evaluation by the superior against set tasks and goals. It facilitates guidance and counseling.

But most organisations engage in a retrospective performance appraisal. In this process some objectives that were agreed upon in the beginning of the year are dragged out and the appraisee and the manager discuss and debate about how well each of these objectives was achieved.

This procedure has many flaws. It does not address the basic human needs in the motivation process. Feedback should be as immediate as possible, it should focus on actual things and the individual involved should be given the opportunity to correct his behavior. But the traditional procedure is too late. It is difficult to remember events a month old let alone events that had occurred over ten months ago.

3.04. PERFORMANCE APPRAISAL AND PERFORMANCE MANAGEMENT

Many people mistake performance appraisal for performance management. Actually, performance management is a much bigger system, and is much more valuable to managers and companies (and employees) than performance appraisal. The essential components or parts of an effective performance management system include:

- **Performance Planning (includes employee goal setting / objective setting)**
- **Ongoing Performance Communication**
- **Data Gathering, Observation and Documentation**
- **Performance Appraisal Meetings**
- **Performance Diagnosis and Coaching**

Performance Management is an ongoing process of measuring and adjusting performance continually focusing on behaviors throughout the year. It is a continuous process not an event.

It is not the same as performance appraisal, which is an assessment of the employee's performance by both the employee and his superior jointly, with the purpose of allocating a score that may be used for both development and salary or promotion purposes.

Performance Management includes Performance Appraisal as one of its elements. Performance Management should became part of day to day workplace behavior. Some organisations have adopted an online Performance Management system. Going online with performance management puts ownership of the process in the hands of the individual as opposed to the traditional manager driven system. It allows direct communication between the individual and the manager via online journals at times convenient to both. It links performance with the individual's learning and development plans and also to the organisational goals, values and competencies.

In fact performance appraisal is the least important component of a performance management system. To quote Robert Bacal (Eminent Educator and Trainer of Management Teachers) '*If all you do is appraisal -- if you don't do planning and have ongoing communication, collect data, and diagnose problems, you are wasting your time*.' If all you do is performance appraisal, you will almost be guaranteed that morale will suffer, performance problems will increase, and the manager's job will become much harder.

3.05. PERFORMANCE APPRAISAL - MODERN TRENDS

A growing number of front running organisations like Ford, Microsoft and Sun Microsystems, have adopted a performance appraisal model in which best-to-worst ranking methods are used to identify poor performers. The identified poor performers are then given a time period during which they have to show an improvement in their performance. In cases where the employee fails to improve his performance he is asked to leave the organisation gracefully and a severance package is offered to him. If the employee refuses to leave then his service is terminated and no compensation is offered. This system is called "rank and yank strategy". Advocates of this system feel that it continually motivates employees to better their performance since nobody would like to be included in the poor performance band. But the flip side of this strategy is that employees become too competitive and team spirit is not nurtured.

Effective organisations are not build merely on investment and returns, but more on the quality of the workforce, its commitment to the organisational goals and investments made to attract train and retain superior human capital. An integrated Performance Management system is essential to get the best out of its people. Employee performance is linked to company performance. This helps in achieving the organisational goal and creates a performance culture in the company. Invention, creativity, diversity of perspectives is fostered. Employees act as one company one brand.

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CHAPTER 4 : PRELIMINARY HYPOTHESIS.

So far, it has been established that the primary contributing link for Productivity is the manpower. Manpower Performance is appraisal system identifies the best and worst performers. Hence the Best manpower (Performance Grade-A) in an organisation should be highly Productive .

Hence the Preliminary Hypothesis is "Productivity is directly linked to the Performance Appraisal system" or Productive persons are always good performers.

It was decided to test this hypothesis by drawing manpower samples from different type of representative corporate organisations.

4.01. SAMPLE ORGANISATIONS.

In order to establish the hypothesis, samples from a diversified corporate types is chosen as below. They should be randomly sampled and normally distributed sectarian survey to provide a least-error probability.

1. **Commercial firms – Dealing in financial, accounting and audit services. {Auditors, Banks, Share brokers etc…}**
2. **Service oriented firms – Providing services of any nature {Travel fleets & agents, Hospitality, Insurance etc.…}**

3. **Material intensive firms – Manufacturing and converting raw materials into finished products {Production of Automobiles, Engineering goods, Refrigeration, Tools etc..}**
4. **Technology oriented firms – Providing technical products and maintenance (Fabrication of special products, Repair and servicing technical products etc..)**

4.02. PERFORMANCE APPRAISAL CONTENTS AND CRITERIA.

Organisations in each of the above types should have at least the following criteria in their performance appraisal method.

a) **Work performance in terms of quality, quantity and costs.**
b) **Job knowledge.**
c) **Knowledge about the organisational policies, procedures and rules.**
d) **Character and Behavior.**
e) **Relationship with superiors, colleagues and subordinates.**
f) **Main strengths and weaknesses.**
g) **Overall suitability of the employee for the current position.**
h) **Potentiality for Promotion.**
i) **Training and development needs.**

4.03. SAMPLE AND SIZE.

The period of data – January to December 1974.

A total of 10 organisations shall be selected in each sample type of organisation categorised as above in 4.01. This leads to a total of 40 organisations.

In order to be realistic, 25 top performing (A – Grade) employees will be drawn from each of the sample organisations, during the 1 year period (January to December 1974).

The total samples, then will be 10 organisations X 4 types x 25 employees = 1,000 samples.

4.04. PRODUCTIVITY AND PERFORMANCE APPRAISAL CORRELATION METHODOLOGY.

For each of the 25 "A" grade performing employees, selected from each organisation, their productivity ratings will be worked by the ratio of Output to the Input quantum, for the 1 year period from January to December 1974. The work item and the units selected will be exclusive and representative for the types of organisations as per classification in 4.01 above,

No	ORGANISATION TYPES	UNIT	INPUT	OUTPUT
1	Commercial	Numbers	Customers in	Customers disposed
2	Service oriented	Numbers	Customers in	Customers disposed
3	Material intensive	Kgs/Tons/Pieces	Materials	Output production
4	Technology intensive	Kgs/Tons/Pieces	Materials	Output production

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CHAPTER 5 : DATA ANALYSIS

The productivity data for the 250 employees in each category of corporate organisations were collected and tabulated in Figures 4 to 7. There were significant observations. Productivity index of the selected employees range from 2.5 to 0.69 through the measure of quantum output to input. The criteria is to test the preliminary hypothesis "Productivity is directly linked to the Performance Appraisal system" or Productive persons are always good performers.

5.01 GENERAL OBSERVATION.

In Performance Appraisal System contents in "4.02(a) Work performance in terms of quality, quantity and costs", were taken for what is completed and not for what should have been completed, which is considered as a measure of interest to the Planning and Control department.

Also, it in not feasible to get and analyse the daily production data for each employee to assess their productive ability, for sake of Performance Appraisal.

The sample to test the preliminary hypothesis that "the productive persons are always good performers" with a total of 1,000 best performing employees from 4 representative categories of organisations and within each category a mix of 10 sector combinations.

5.02. POSITIVE RESPONSE TO THE PRELIMINARY HYPOTHESIS.

There is a positive support to the preliminary hypothesis from 300 employees from 12 diversified organisations, spread over 4 types. But they are all conditional. (Support – Figures 4 to 7)

Type	Sector	Numbers	Employees	Remarks
Commercial	Banks	2	50	All commercial Information is up to date
Service Type	Insurance	1	25	All client information is up to date
	Air lines	1	25	All travel information is up to date
	Star Hotel	1	25	All guest and room details are up to date
Material Intensive	Auto moblie	2	50	All production & Stock information are up to date
	Electric Motors	1	25	
	Cutting Tools	1	25	
Technology oriented	Boiler Fabrication	2	50	All process information are up to date
	Electrical Stamping	1	25	
Total		12	300	30 % Conditional

INFERENCE : Productivity is positive for Performance Appraisal Toppers, subject to the correct and up to date Sector Management Information System (MIS).

5.03. NEGATIVE RESPONSE TO THE PRELIMINARY HYPOTHESIS.

There is a negative response to the preliminary hypothesis from 700 employees from 28 diversified organisations, spread over 4 types. But they are all due to loop holes in the Management Information System. (Support – Figures 4 to 7)

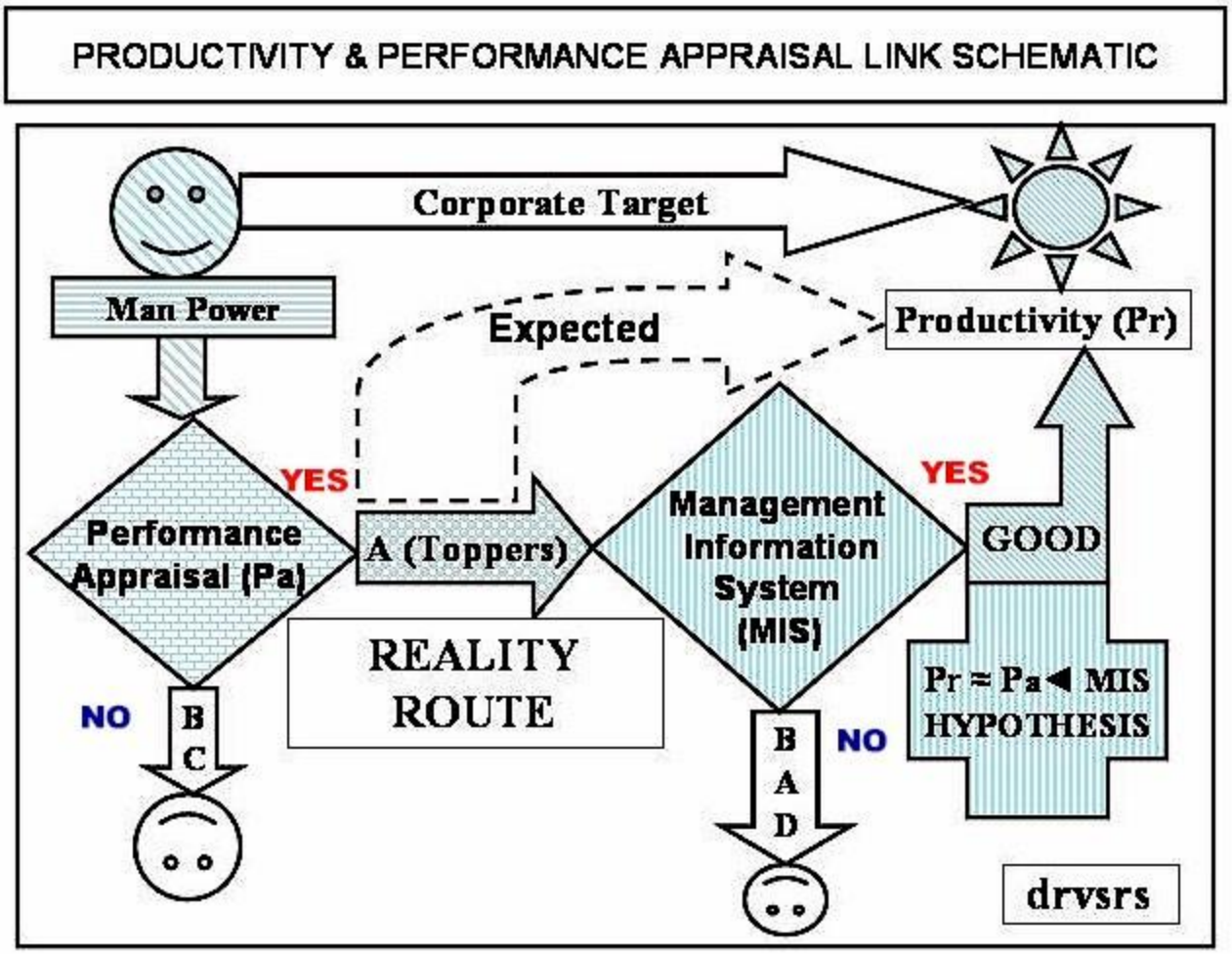
Type	Sector	Number	Employees	Remarks
Commercial	Auditors	3	75	Work support data inadequate
	Share Brokers	5	125	
Service Oriented	Insurance	2	50	Premia data Incomplete
	Airlines	2	50	Fare & charges incomplete
	Star Hotel	3	75	Hospitality Data incomplete
Material Intensive	Automobile	1	25	Stock outs of materials
	Electric Motors	2	50	In-process & Stock data incomplete
	Cutting Tools	3	75	Stock and Material quality inadequate
Technology oriented	Boiler Fabrication	1	25	Drawing data incomplete
	Electrical Stamping	2	50	Machine Schedule incomplete
	Customer Order Fabrication	4	100	Specifications & Fabrication data incomplete
Total		28	700	70% on Information Conditions

INFERENCE : Productivity is negative for Performance Appraisal Toppers, because of inadequate Sector Management Information System (MIS)

5.04. HYPOTHESIS REVISION.

The preliminary hypothesis "Productivity is directly linked to the Performance Appraisal system" or Productive persons are always good performers, is null. This is because of the conditional constraints posed by the sector wise Management Information System accuracy. The revised hypothesis based on the survey and analysis is :-

- **"Productivity (Pr) is linked to the Performance Appraisal System (Pa) through the corporate Management Information System (MIS) " or Productive persons are good performers, only with the support of the MIS**
- **Mathematically Pr ≈ (Pa)◄*MIS*, which means that Productivity is proportional to the Performance appraisal grading moderated by the Sector MIS.**



Diagrammatically it is shown as below :-

The revised hypothesis was re-tested in each of the 4 organisation types. The result was positively supported. It was already supported by the previous 1,000 employees (from 4 types of firms, 10 sectors and 250 employees from each) which enunciated this revised hypothesis. The final hypothesis summary schematic is in Figure – 8.

5.05. HYPOTHESIS PROPAGATION

Between the period 1971 to 1975, the following standards were followed before the submission to the University :-

A) 7 Publications. B) 5 Seminar Presentations.
C) 3 Open Discussion sessions, with Question/Answer & Review.
D) 2 Faculty Colloquium.
E) Randomly sampled / Normally distributed sectarian survey to provide the results with least-error probability.
F) Post-test of the hypothesis in 4 representative sectors.
G) Evaluation by the University / Local Management Experts and a Professor in Management from a Foreign accredited University (Manchester Business School, UK).
H) Expert Group Viva Voce (Examination and Review).

5.06. HYPOTHESIS UTILITY.

It is necessary to evaluate any new management hypothesis in terms of its utility to the world corporate sectors.

A) This hypothesis has added an important management guideline that Performance appraisal, Productivity and Management Information System (MIS) should be viewed as a package unit, to lead the company into a leadership status.
B) Personnel managers should pin point the best performer's job locations and arrange to install or sharpen the existing MIS modules.
C) MIS design should have the vital ingredients applicable to each sector, for the best performers to be productive personnel.
D) The employees, when their performances are being appraised, should highlight the adequacy / inadequacy of the MIS system, which they depend upon during their on the job performance.
E) This hypothesis is universally applicable to all corporate units in the world, irrespective of their location, sector and productive goals / policies.
F) This is the first and unique attempt to correlate a Tangible (quantitative) output measure (Productivity) to an Intangible (non-quantitative) judgment (performance), of an input resource (manpower).

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CHAPTER 6 : UNIVERSITY ACCEPTANCE AND DEGREE AWARD.

Based on all the above, the University of Bombay (India) accepted the thesis as the first in the subject of management studies, under the faculty of Arts. Issued a Ph.D degree with a Doctoral Merit Certificate of special Recognition (Figure – 9).

NOTE : The University of Bombay (now known University of Mumbai) is one of the oldest and premier Universities in India. It was established in 1857 consequent upon "Wood's Education Dispatch" {Right Honourable Sir Charles Wood (1800 to 1885), 1st Viscount Halifax of the British Empire, sent a plan for University system in India, modeled after London University, to Lord Dalhousie, the then Governor General of India}. Based on that, it is one amongst the first three Universities established in India. As a sequel to the change in the name of the city from Bombay to Mumbai, the name of the University has been changed from "University of Bombay" to "University of Mumbai", vide notification issued by the Government of Maharashtra and published in the Government Gazette dated 4th September, 1996. (SEE AT : http://www.mu.ac.in/)

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CHAPTER 7 : SUMMARY AND CONCLUSION

Enthusiastically started research work should be concluded with a note of invigoration to the receivers and audience. This last and final chapter is made to propagate that sprightliness with a summary of the work and a memorable conclusion.

7.01. THESIS SUMMARY

Aggregate corporate production and services contribute to the Gross Domestic product (GDP) of any nation. Higher the GDP, better the living standards and happiness of the people. The contributor to GDP is the domestic production, which again is optimised by "Productivity". The contributors for productivity are the domestic manpower.

Appraise the manpower, select the toppers, provide incentives and direct them to be more productive, looks as a feasible management concept. In order to test this concept that "Top performers are always the top Productive people, and there should be a one to one relationship", this thesis was formulated.

But testing the productivity grade of 1,000 top performers in diversified types and sectors of corporate organizations concluded that it is <u>not</u> "directly true". The Productivity and Performance of the employees are <u>linked</u> and <u>moderated</u> through the corporate sector Management Information system (MIS), was the finding and conclusion. This universally applicable concept was recognised by the University of Bombay, India and the first Ph.D degree was awarded to the author, in the subject of management studies (under the faculty of arts), with a special merit certificate.

7.02 CONCLUSION

Research and Development is a continuing process, elevating the researchers as well as the listeners through the steps of "Wisdom"

- **The <u>First</u> level of Wisdom is to be Calm and Quiet than to speak about anything.**
- **The <u>Second</u> level of Wisdom is to talk - and talk about Factual Information to any Group.**
- **The <u>Third</u> level of Wisdom is to extract the Pleasing facts among the exposed information, and present them effectively.**
- **The <u>Fourth</u> level of Wisdom is to Motivate the Group to utilise these Pleasing Facts for Productive purposes and lead them towards Prosperity.**
- **From : MAHABHARATHA Smrithi. Udyoga Parvam (Chapter on Professions), Verse 83. The great Indian Epic dated about 5,000 BC.**

This doctoral research was initiated with the objective to link the Productivity and Employee Performance Appraisal system in corporate organizations in the world. That followed the above constructive and sequential guidelines and motivated the world audience to "Utilise the Pleasing Facts of the initiated hypothesis for Productive purposes and lead the world towards Prosperity.

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- **Many books, journal articles and publications from the Library and Mayo hall collections of the University of Bombay, India**

FIGURE – 1
CORPORATE MANAGEMENT DECISION CYCLE
CAPITALIST SETUP

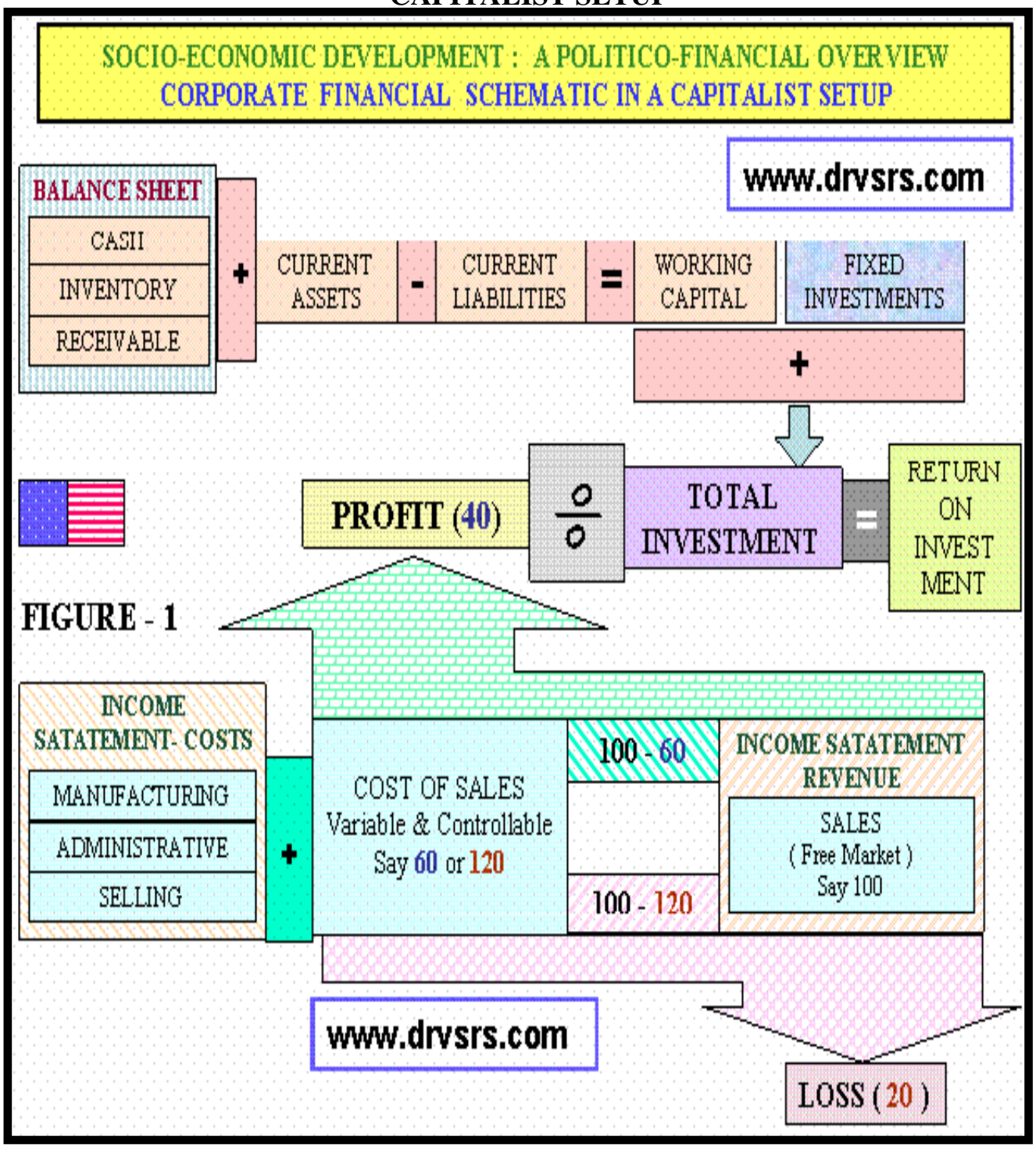
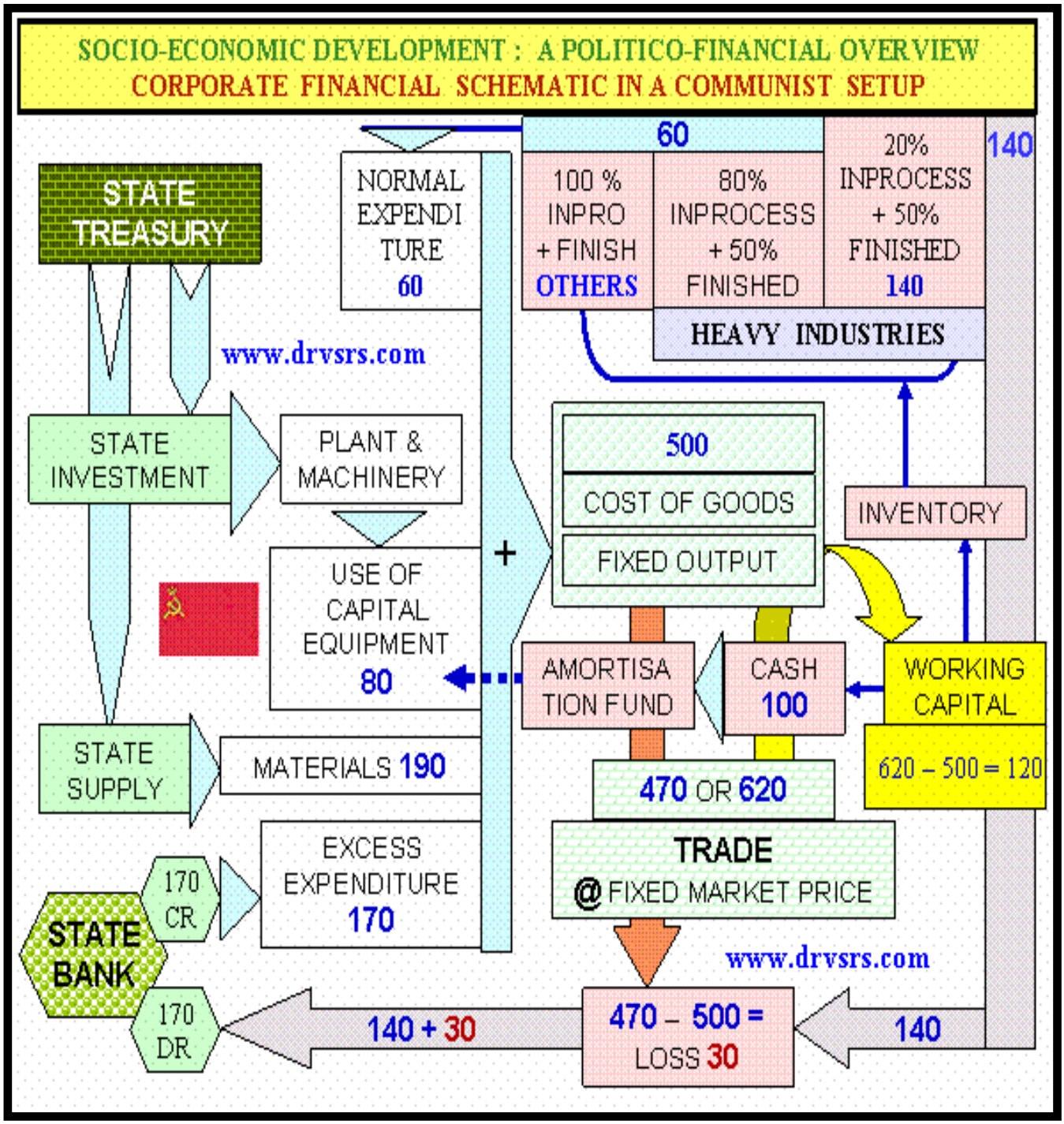


FIGURE – 2
CORPORATE MANAGEMENT DECISION CYCLE
COMMUNIST SETUP



Source : Collected and Schematised by the Author DR.VSRS on an R & D tour to USSR in 1984 May

FIGURE – 3
THREE DIMENSIONAL CLOSED CYCLE ECONOMICS

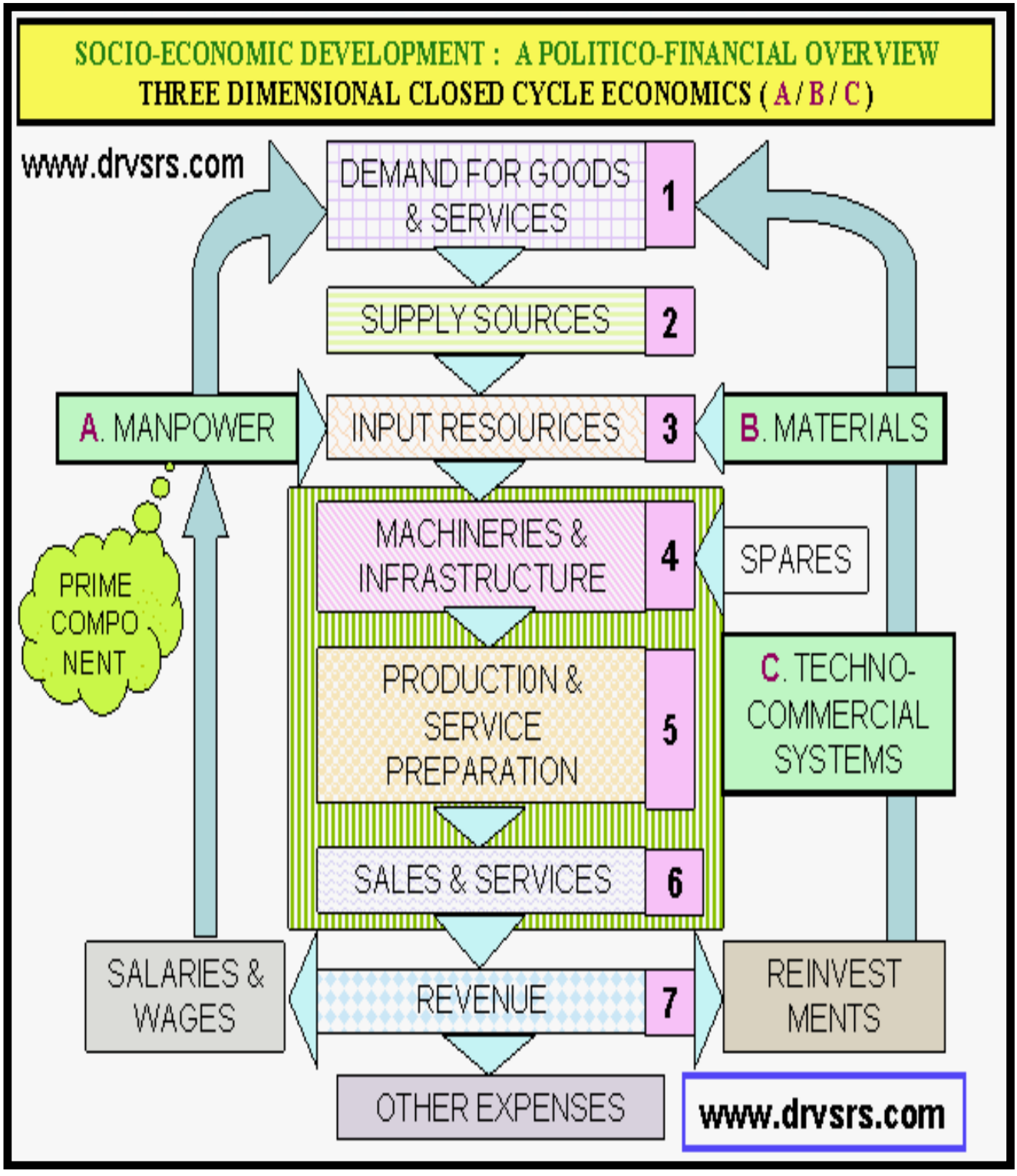


FIGURE – 4
HYPOTHESIS INFERENCES FROM 1O COMMERCIAL FIRMS
250 EMPLOYEES (Performance Appraisal Grade - A)

Type	Firms	Employees	Productivity		Reasons
			Grade	Comment	
Banks	2	50	1.00	All Disposed	All A/C holders information updated & On-line
Auditors	3	50	0.95	5% Balance	Client's data incomplete
		25	0.85	15% Balance	Tax policy not updated
Share Brokers	5	75	0.75	15% Balance	Scrip values not updated
		50	0.70	30% Balance	Client's address not updated
Total	10	250	Employee's reasons were recorded		

- **Observation – In Performance Appraisal System, (a) Work performance in terms of quality, quantity and costs, were taken for what is completed and not for what should have been completed, which was considered as a measure of interest to the Planning and Control department.**
- **50/250 = 20% employees are in favour of the hypothesis**
- **Inference : Performance Appraisal System is not directly related to the Employee productivity. But it is linked through the in-house accounting and financial Information systems.**

FIGURE – 5

HYPOTHESIS INFERENCES FROM 1O SERVICE ORIENTED FIRMS 250 EMPLOYEES (Performance Appraisal Grade - A)

Type	Firms	Employees	Productivity		Reasons
			Grade	Comment	
Insurance	1	25	1.00	All Disposed	All customer information updated & On-line
	2	50	0.80	20% Pending	Paid premia & allotment schedule not updated.
Airlines	1	25	1.00	All Disposed	All travel information updated & On-line
	2	25	0.72	28% Balance	Air fare for the season not updated
		25	0.85	15% Balance	Airport landing charges are not final
Star Hotel	1	25	1.00	All Disposed	All guest / room information updated & On-line
	2	50	0.69	31% Not disposed	Maintenance completion & reservation priority are not clear
	1	25	0.90	10% Not disposed	Reservation & Check in name differences
Total	10	250	Employee's reasons were recorded		

- **Observation – In Performance Appraisal System, (a) Work performance in terms of quality, quantity and costs, were taken for what is completed and not for what should have been completed, which was considered as a measure of interest to the Planning and Control department.**
- **75/250 = 30% employees are in favour of the hypothesis.**
- **Inference : Performance Appraisal System is not directly related to the Employee productivity. But it is linked through the in-house Customer, Work, Priority schedule Information systems.**

FIGURE - 6
HYPOTHESIS INFERENCES FROM 1O MATERIAL INTENSIVE FIRMS
250 EMPLOYEES (Performance Appraisal Grade - A)

Type	Firms	Employees	Productivity		Reasons
			Grade	Comment	
Automoble	1	25	1.00	Total production	All Materials information updated & On-line
	1	25	2.50	Efficient Work	Purchase, Stock data is up to date
	1	25	0.80	20% Pending	Stock out & Power cuts
Electric Motors	1	25	1.00	Assembled as per plan	All Materials information updated & On-line
	1	25	0.64	36% to be assembled	Confusion in in-process stock
	1	25	0.74	26% to be assembled	Armature coil wire short
Cutting Tools	1	25	1.00	All completed	All stock information updated & On-line
	2	50	0.75	25% Tools waiting	Carbide tip and High speed steel stock problem
	1	25	0.93	7% Rework	Material hardness was more
Total	10	250	Employee's reasons were recorded		

- **Observation – In Performance Appraisal System, (a) Work performance in terms of quality, quantity and costs, were taken for what is completed and not for what should have been completed, which was considered as a measure of interest to the Production Planning and Control department.**
- **100/250 = 40% employees are in favour of the hypothesis.**
- **Inference : Performance Appraisal System is not directly related to the Employee productivity. But it is linked through the in-house Materials Information systems.**

FIGURE - 7

HYPOTHESIS INFERENCES FROM 1O TECHNOLOGY INTENSIVE FIRMS. 250 EMPLOYEES (Performance Appraisal Grade - A)

Type	Firms	Employees	Productivity		Reasons
			Grade	Comment	
Boiler	2	50	1.00	Total Fabrication	All fabrication information updated & On-line
	1	25	0.75	25% Work pending	CAD Drawing not modified
Electrical Stampings	1	25	1.00	Fabricated as per plan	All process information updated & On-line
	2	50	0.73	23% Pending	Machine sequence schedule upset
Customer Order Fabrication	1	25	0.93	7% Wait	Specifications change. Not updated
	1	25	0.75	25% Not clear	3 Customer has similar fabrication in different metals. To be clarified
	2	50	0.81	19% Tools waiting	Carbide tip and High speed steel stock
Total	10	250	Employee's reasons were recorded		

- **Observation – In Performance Appraisal System, (a) Work performance in terms of quality, quantity and costs, were taken for what is completed and not for what should have been completed, which was considered as a measure of interest to the Production Planning and Control department.**
- **75/250 = 30% employees are in favour of the hypothesis.**
- **Inference : Performance Appraisal System is not directly related to the Employee productivity. But it is linked through the in-house Technical Information systems.**

FIGURE – 8. HPOTHESIS SUMMARY SCHEMATIC MANPOWER PERFORMANCE APPRAISAL & PRODUCTIVITY CORRELATION SCHEMATIC

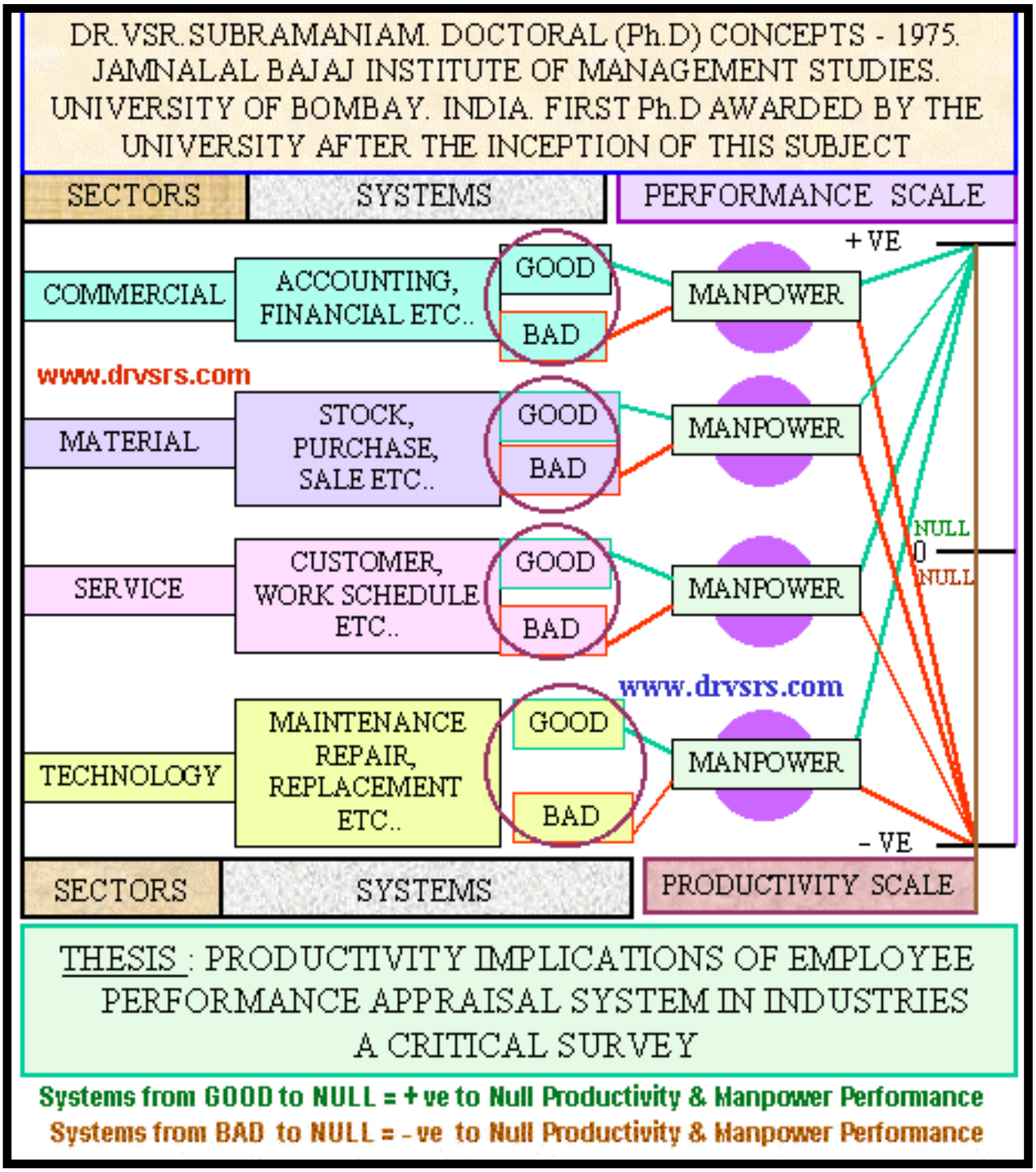


FIGURE – 9.

DOCTORAL MRIT CERTIFICATE UNIVERSITY OF BOMBAY

University of Bombay

No.Th./ 24 of 1976

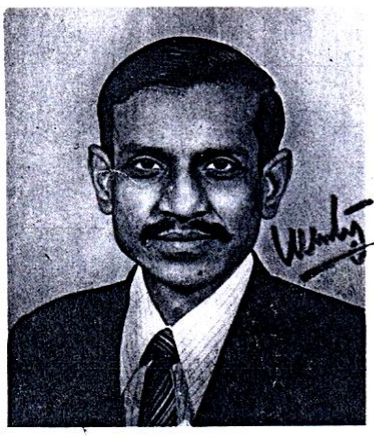
Bombay- 400 032,

1st Jan 1976

This is to certify that the thesis entitled " Productivity Implications of Employee Performance Appraisal System in Indian Industries ; A Critical Survey ", submitted by Shri V. Sankara Rama Subramaniam has been accepted for the Ph.D. degree in Management Studies, in the Faculty of Arts, of this University.

Shri Subramaniam has worked under the guidance of Dr. P. K. Ghosh of the Jamnalal Bajaj Institute of Management Studies, Bombay. The thesis submitted by Shri Subramaniam is the first thesis accepted for the Ph.D. degree of this University in the subject of Management Studies.

The said degree was conferred on him at the Annual Convocation held on 19th December, 1975.



T. V. Chidambaram

University Registrar.

10. AUTHOR'S NOTE ON RESEARCH MOTIVATION

Source : Author's Web Page - http://www.drvsrs.com/motivation.htm

Research and Development are not a speciality job. We cannot lead a satisfied life without these. It could be to find a way to a new place or to get a daily needed product, when we shift our residence to a new locality etc… One should feel happy about such searches, keeping in mind the end result. This positive thinking is the motivation. In day to day life, people get self-motivated in both Constructive and Destructive directions.

Always be a Constructive Self-Motivator. An individual can self motivate himself / herself by simply changing his/her way of thinking with the following easy frames of mind. In order to understand, remember and apply the motivational methodologies the rule of BESTPEDAL is formatted, by coining the first letter of each of these functions.

The first 4 aspects or the BEST corresponds to the Self disciplines of the individual. The next 5 aspects or the PEDAL corresponds to the behaviour and modality of the individual with reference to the environments and others with whom they come across. If this is Positive, then the individual is a Constructive Self-motivator. It is represented by BEST + PEDAL. If this is Negative, then the individual is a Destructive Self-motivator. It is represented by BEST – PEDAL.

- **Belief - Always believe in your self-confidence in doing any thing, and provide a whole-hearted work.**
- **End-Result - Aim at a positive result or a goal to achieve any ambition in your life and work, however small or big it may be. Feel proud, and attain a sense of satisfaction of having made a fair attempt to do anything, whether the end result is successful or a failure.**
- **Success - Take them as a Tool / Application Guide-line for subsequent motivational methods. Do not feel too proud and satisfied. Take it as a favourable approach, because learning is a continuous process in life, without any end.**
- **Targets - Set a target to complete any task, however small or big it may be. This will help to evaluate your ability to achieve or not able to get any results, in a given time frame.**

- **----------**
- **Problems - Consider them as a Challenges. If there are no problems, the purpose of living will become dull.**
- **Expectations - Do not look for immediate results. Provide a fair time for anything to happen. Look for self-satisfaction first, and leave the material and monetary gains as a by-product incentive for the end-result.**
- **Discussions - Grasp points for improving the way of life, actions and self performances better than the existing level.**
- **All Others around - Consider all the people you meet in your life, as potential source for knowledge and contributors for your benefit, irrespective of their age, education, geographical origin, social status etc.. in the society. If they are (positive) good and peace loving, then they are positive contributors. If they are the other way (negative), then take them as the guides to provide information to you, to safe-guard yourself against evils.**
- **Lapses - Digest and be happy with lapses / failures as a lesson for progress and self-improvement. Whatever has happened cannot be reversed. Go forward and do not look back on bad aspects. Do not get frustrated under any circumstances.**

All Self-motivated persons are always an achievers of something for the society in their life. It will be interesting to note that in most of the cases, the motivated personnel's educational career / records, technical attainments, material wealth and family background are insignificant and play a little role in providing a support for their achievement. It is their internal self which alone is responsible.

If the achievement is Constructive then the end is (BEST + PEDAL). The society, the Nation and the World accredit, recognise, acknowledge, respect and honour them.

If the achievement is Destructive then the end is (BEST - PEDAL). The society, the Nation and the World abuse, insult, curses and dis-respects them.

****

11. AUTHOR'S NOTE ON RESEARCH & INNOVATION

Source : Author's Web Page http : //www.drvsrs.com/innovation.htm

Question From Herr Vonhoff, Germany : No more men required for innovation. Computer has come into design. See Autocad. Any thing you give to computer, it will design. It improves better than a man's brain. I am no more an Innovator and I am not needed. Answer : Computer is only a helper to the man for innovation, which consists of :-

- **Achievement - It is a drive or advanced self-motivation in each individual to achieve something superior in life.**
- **Bi-lateral - It benefits the Individual as well as helps others to utilise the value of the innovation.**
- **Cycle Effects - One innovation leads towards another innovation by the same or different individual. The Innovator, even-though envisages the utility of the innovation to some extent, it is subjected to a vicious range of utility by all others.**
- **Expansion - An approach to open the thoughts, expand and update the method of doing anything and elevates Self into a higher plane.**
- **Integration - An integration of the Self into a larger base in the Society.**
- **Satisfaction - An aid to acquire and enjoy a self-satisfaction for having made an idea to work.**
- **Universal - It is applicable to an infinite range of Animate, Inanimate, Celestial and Terrestrial spans. Innovation is not restricted to human beings alone, it is inherent in Animals, Birds and all other species in the universe.**

Every individual by birth has certain innovative aptitude. This starts from a child attempting to open a door by understanding the leverage methods. There are self-development in finding shorter ways to reach a place, swimming, mastery in sports etc.. in adults. But, these are limited to some time, and then fade away. But the type of innovation expressed here are dominant and persist within the interest of an individual continuously, and throughout his / her life time. Innovation is that drive or the feelings and actions in a positive direction to achieve things in a best possible way.

The development of human generations with higher planes and comforts of life, as years advance, are due to the effects of innovation. Innovation always leads to an invention of a Concept, Procedure, Process or Product, through Research and Development.

Practical aspects of any innovation primarily involves a violation of the accepted standards and principles.

- **Fire should be kept away from Gasoline or Petrol. But in an innovation / invention of automobile engine, the same is put into productive use by sparking it under compressed condition.**
- **The principle in a Pressure Cooker is to build steam pressure to enable effective and faster cooking. But to safe-guard from explosion, a hole, with a safety valve through which the excess pressure can escape shall be provided.**
- **When Wright brothers said that man can fly in the air, they were jailed for propagating peculiar ideas against, and in violation of the laws of nature, which has preset that only birds can fly.**

An individual can innovate by simply broadening his/her way of thinking with the following easy frames of mind. In order to understand, remember and apply the innovation methodologies, the rule of STUDIOUS is formatted, by coining the first letter of each of these functions.

It is interesting to note that there are no such innovation like constructive or destructive. Any innovation could be used either way by the end-users, as they prefer to utilise. The innovator will be a happy observer if they are used in constructive / productive methods. But the innovator will be a helpless spectator if they are utilised for un-ethical / destructive operations. The best example is the nuclear power !!

1. **SELECT / STUDY : One should first select a behaviour or material or methods or any other matter of interest of anything, to innovate on any of their aspect. Then a careful study of them on the existing aspects towards improvement should be made.**
2. **TEST : Then test all the current aspects of the selected and studied subject of innovation. This involves the study of both the positive and negative aspects of their formation, function, structure and the end-use.**
3. **UNDERSTAND : As a inference of the testing, understand the logic and necessity of their formation, function and the end-use.**

4. **DEVELOP : After a careful / meaningful / through understanding, list all possible methods of development in order to improve their formation, increase their functions, modify or drastically alter their structure to elongate their utility-span, and make the end-use more multilateral, productive and valuable.**
5. **INGENUITY : Guided by the development analysis and the list of possibilities for innovative dimensions, use the ingenuity to re-model or re-design their formation, function and the end-use. This involves certain calculated risks, combining the utilities of any other un-connected matter / process, drastic deviations from accepted and current methodologies, violation of general beliefs and principles.**
6. **OFF-SPRINGS : As an after-effect of the application of the ingenuity there may be multi-various and vicious range of off-springs. Even others may object to your method of ingenuity and plan drastic actions to curtail and end your efforts and your innovative efforts. The subject of your innovation may mis-behave and get into a mis-directed end-results. These frustrating experiences should be calmly and carefully analysed as a dose for Further comprehensive Testing, Better Understanding, Re-directed Development and Improved Ingenuity. OR Stick to your off-spring results, as an expected result of innovation and do not care for all objections and mis-behaviours. Some times, these off-springs may lead an unexpected direction for an entirely new and never-thought-of innovation.**
7. **UTILITY : Analyse, Comprehend and Summarise the off-springs of your innovation in terms of its utility for you as well as for other individuals, society, nation and the whole world. If you are convinced that there is a valuable utility for your innovation, continue further towards further innovation, or otherwise re-innovate on the same to make it more valuable.**
8. **STANDARDISE : Based on your judgement and envisaged / expected utility always standardise the innovation and provide a lead for further innovation. One should remember that the innovator is not the owner or custodian of the utility of the innovation. Many others may over-innovate on that innovation to utilise it constructively or destructively.**

Scientists are the best examples for Innovators. However, the Industrial revolution during 1800s in England, indoctrinated a motivation for innovation, and originated the concept of mechanisation. That served as a base to invent products and processes for mass production, faster transportation and man-machine interfaces.

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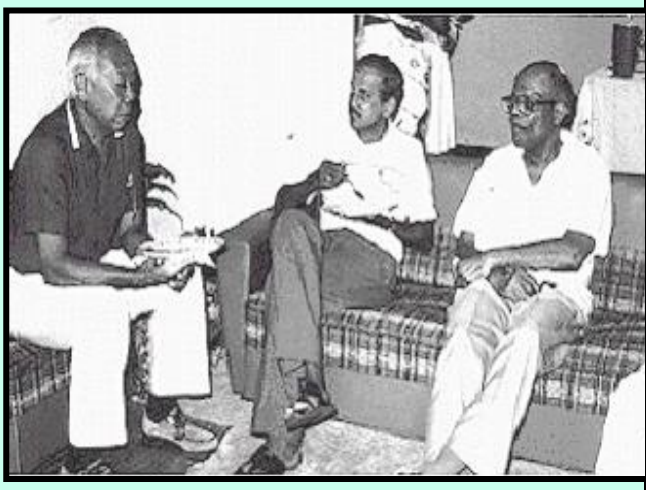
World war 2 (1939-1945) innovated many army/navy/air-force strategies, which found application during post-war period in business, commercial and industrial applications as a methodology known as "operations Research". This indoctrinated the concept of modelling and use of mathematical methods for optimising the productivity / profitability, and minimising costs / losses / wastes etc.. These can be analysed by the concept of STUDIOUS.

12. SPECIAL NOTE

1 2 3	
	
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13. END NOTE – THE AUTHOR

The author is academically a B.Sc., MBA., Ph.D., A Professor in Management Science, with an accredited institution affiliated to Anna University in Tamil Nadu, India. A trained ISO 9001:2000 Quality systems Consultant and Auditor, MIS Consultant and Socio- Economic development acceleration specialist. A "Past "Data Processing Expert" in Commonwealth Fund for Technical Cooperation (CFTC), London and " Consultant Adviser in the Caribbean Development Bank (CDB - A World Bank & UNDP setup), Barbados, West Indies. Author of over 60 publications in Management technique applications.

Over 40 years experience in national and multinational organisations as a Head of Techno-commercial departments. Between 1982 and 1992, he was associated with 5 Nobel Laureates in Economic Science. Created & published new models to accelerate the Socio-Economic Development, by unique application of Algebra and Geometry to the area of Economic Science.

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