Title: Measuring Productivity of the Creative Process

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Abstract: This report discusses the meaning and measurement processes for productivity, the reasons for measurement, and its business and social implications. The methods for measuring productivity in a creative environment such as Design Engineering of R&D are explored and a list of suggested measurement techniques derived from literature search, interviews and case studies are presented.

MEASURING PRODUCTIVITY OF THE CREATIVE PROCESS

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EXECUTIVE SUMMARY

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Measuring Productivity of the Creative Process

The subject of productivity has achieved significant stature in today's global business climate. While it is relatively easy to measure productivity in a manufacturing environment where the activities are repetitive, it is generally agreed that it is much more difficult to do in a creative environment full of abstract and intangible activity.

In this paper, the authors present a discussion of the meaning of productivity, the reasons for its measurement, and its business and social implications. Through a literature search, interviews, and case studies, it was concluded that in order for the measurement to be effective, it should be performed on an ongoing basis, with trend analysis becoming possible after a few years' data has been collected. It was also concluded that while numerical measures of creative productivity are possible, the temptation to combine several measures into one definitive index should be resisted; the measures are more useful if considered as a group. Additionally, the authors concluded that it is important for the creative people being evaluated to be involved in the selection of their own measures of productivity. The Nominal Group Technique, which is a method of involving the workers in this process, is discussed.

A list of possible measures of productivity which could aid managers in starting a measurement program is presented. This information is augmented by an appended list of possible measures from one of the literature sources.

MEASURING PRODUCTIVITY OF THE CREATIVE PROCESS

TABLE OF CONTENTS

SECTION	TITLE	PAGE
I.	ABSTRACT	1
II.	INTRODUCTION	2
III.	DISCUSSION	6
IV.	LITERATURE RESEARCH	9
V.	INTERVIEWS	11
VI.	CASE STUDIES	14
	A. HYSTER COMPANY	14
	B. FREIGHTLINER	18
	C. HUGHES AIRCRAFT COMPANY	20
	D. SOUTHERN COMPANY	23
	E. NGT (HYPOTHETICAL CASE STUDY)	24
VII.	CONCLUSIONS	29
VIII.	RECOMMENDATIONS	32
IX.	SUMMARY	33
X.	BIBLIOGRAPHY	34
APPENDIX		38

I. ABSTRACT

A study was made in which methods for measuring productivity in a creative environment such as Design Engineering or Research and Development were explored. The reasons for measuring this productivity and its consequences are examined. A list of suggested measurement techniques derived from a literature search, interviews, and case studies is presented.

II. INTRODUCTION

The topic of productivity is far from obscure. To the contrary, it is of concern to almost all areas of business, and there is abundant literature on the subject. There is no question that productivity, and specifically the methods used to measure it, are a source of controversy among those that study and write about it. But, while the controversy continues, it is important to recognize the value of "convincing people to get on with the task... and not getting into lengthy discourses over the validity of measurement tools".[3]

At the heart of the matter is the desire to improve, enhance, or increase productivity; in general, to seek optimum operating efficiency, in which productivity plays a major role. This occurs for a variety of reasons, not the least of which involves the simple will to survive in business. High productivity has come to have a positive connotation, whereas low productivity is regarded negatively. This probably comes from the simplest definition of productivity, namely output divided by input.[14] Logic dictates that if this quotient can be made larger by increasing the numerator, decreasing the denominator, or some combination of the two, the overall health of a business should improve, assuming all other factors remain the same. (This also assumes that if the numerator increases, there exists a demand for the additional product produced.[14]) While output divided by input

is the most elementary definition of productivity, many other definitions (perhaps sub-definitions would be a better term) find favor in various realms of business. Dovring[15] tends to differentiate between physical and economic measures of productivity. Physical measures of productivity deal with the quantification of tangible items such as output per worker (labor productivity) or output per machine (process productivity). Physical productivity is concerned with the production process itself, and as such provides valuable measures. It does not, however, provide any indication regarding the usefulness of the process. For example, it may be possible to devise an extremely efficient process for the production of slide rules, but slide rules aren't in high demand these days. Also, since labor is becoming a smaller and smaller part of the overall cost of doing business in many industries, a simple labor productivity analysis usually provides an incomplete picture.[5] Therefore, a complementary definition of productivity involves the measurement of economic parameters, such as value added during the production process and the opportunity costs of engaging in that production. In order for a productivity analysis to be useful, the manager must consider both the physical and economic definitions of the word.

Thus far, the definitions of productivity have dealt primarily with efficiency, which describes how well something gets done. Another definition makes use of the concept of

effectiveness, and questions whether or not the desired results are being produced. It doesn't make much sense to improve the efficiency of a process that is not producing the desired results; rather, it is best in this case to redefine the objectives of the activity. This has obvious connections with the economic definition of productivity discussed earlier, in that it is false economy to optimize an unwanted or unneeded activity.

Another source[15] makes a distinction between labor productivity and capital productivity, which is a valuable way of separating the efficiency of a labor force from that of capital goods.

In addition to defining what productivity is (in terms of his or her own sphere of business), the manager must also recognize what productivity is not. It is not, for example, simply the measure of the output of a factory or the number of drawings generated by an engineering department. Such measures address only the numerator of the productivity quotient. Productivity is also not represented by expressions of the denominator such as number of man-hours or pounds of raw material used. The entire quotient must be considered in order for the productivity equation to be valid.[17] It is also important to note that productivity measurement is not a panacea; the mere act of measuring productivity will not guarantee a successful business.

Productivity measurement is not the ultimate objective; it is only one of many tools that a manager must have at his or her disposal for the purpose of optimizing the performance of their organization.

Again, despite disagreements about the definition of productivity and the methods by which it is measured, the important thing is to get on with the job. In the extremely competitive global economy which exists today, businesses can not afford to do otherwise.[10] This is not to suggest that productivity measurement should be conducted in a haphazard or nonchalant fashion. Rather, the method should be chosen carefully, with an eye toward customizing it to the organization. Within the creative organization, such as a design engineering or research and development group, this task becomes difficult, primarily because the definition of productivity is clouded by the intangibility of the input and output commodities.

It is this difficult task that the authors choose to address herein. The objective of this research was to determine historical and present-day schools of thought about the measurement of productivity in a creative environment. Literature search and interviews with engineering managers and members of academia in the Portland area were conducted. It became apparent during the research that the concept of productivity measurement had been dismissed by many technical

managers as too difficult or nebulous a subject to be useful. The output goal, therefore, was a set of simple guidelines that a technical manager could employ to begin the task of productivity analysis. The authors believe that they have succeeded in this regard.

III. DISCUSSION

Some of the daily tasks in the creative environment are repetitive and therefore relatively easy to measure, but chances are that the bulk of the activity will be in the creation of work packets which vary from project to project.[18] This tends to lessen the precision of traditional output/input measures for productivity, and suggest that creative activities may be more appropriately measured in terms consisting of quality as well as quantity. As a result, it may be necessary to abandon the simplest definition of productivity in favor of a more complex one which better serves the needs of the organization. However, this is only one of the challenges facing the person trying to make objective measurements. The manager must also consider the social, political, and economic ramifications of his or her actions. While technical managers are coming under increased pressure from upper management to examine productivity,[19] this same upper management realizes that the measurement activity itself takes time and resources, and represents an opportunity cost to the company. This would suggest that a simple method of measure would find favor in many

organizations, provided that the information derived from it had some value. Some suggest that creative white-collar workers are more reluctant to have their productivity evaluated than their blue-collar counterparts, because they perceive the measurement as a sign of distrust by management.[18] Still others feel that productivity measurement will expose their inadequacies to management and to their peers, with embarrassing results.[19] This would suggest that either the workers should be involved in the selection of the productivity parameters to be measured, or possibly that they should not be told at all that their productivity is being measured. In any event, the psychological impact of the measurement process must be taken into account, lest it appear to be just another intrusion into the lives of the workers, with no real value.

It is important to remember that the subject of productivity (especially labor productivity) almost always involves people and their behavior. The psychology of work plays a major role in a productivity measurement program. For example, some studies indicate that the act of measuring productivity has itself resulted in a productivity increase.13 These studies indicate that there is a direct relationship between the amount of employee involvement in the measurement process and the resulting productivity increase. They also show that there is an inverse relationship between employee involvement and their concern over the validity and fairness of the

measurement methods. In other words, the measurement process itself can function as a positive reinforcement, resulting in improved productivity. While this improvement is not an end unto itself and should not be expected in all cases, it is an added bonus for the organization if and when it occurs. There are other bonuses as well. Boyett and Conn[18] claim that when workers are allowed to devise the measures of their own productivity, they become more aware of the purpose of their organization and are able to answer questions such as "Who are we?," "What precisely do we or should we contribute to the company?," and "What exactly are the results expected from our efforts?". This knowledge, which according to Boyett and Conn is (surprisingly) lacking in most white collar groups, can help unite the group toward the achievement of common goals. They also say that an unfortunate possible outcome is that after the role and purpose of the group is defined, some members who disagree with these tenets will leave, either voluntarily or involuntarily.

The manager needs to beware of other things that can occur as a result of the measurement effort. For example, care should be taken to assure that those being evaluated continue to do their entire job. The temptation is to work hardest on the areas of the job in which productivity is being measured. This points out the need for a balanced measure, preferably prepared with the advice and participation of the workers.

In addition, if the purpose of measurement is not explained, its initiation can be viewed as a kind of punishment or negative reinforcement used to squeeze more output from the workers. This can have a detrimental effect on productivity as the workers rebel against the authority that they legitimately feel is out to get them. To allay these fears, the manager needs to emphasize from the beginning that the purpose of the program is not punishment, but rather enhancement of the overall creative process. Obviously, employee involvement is very helpful in this area. If reasonable measures of productivity are devised, preferably by the people being measured and during the time when measurement is initiated, some basic insight into the psychological makeup (value systems, personal goals, perceptions, attitudes, and behaviors) of the group being evaluated is helpful. With this knowledge the manager can tailor the introduction of the program so that it will be accepted with a minimum of suspicion.

IV. LITERATURE RESEARCH

The literature search was conducted primarily with the objective of finding recent accounts of successful methods for measurement of creative productivity, and the problems associated with this activity. While literature on the general subject of productivity is abundant, it is somewhat less so for literature on the subject of measuring productivity in a creative environment. The authors

discovered 14 articles from periodicals and 11 books which provided relevant information on this topic. Many of these works address the subject of "white-collar" productivity, which includes, but is not limited to, creative organizations. (Among the other areas of "white-collar" work cited in the literature were insurance, advertising, sales, purchasing, and MIS.) Much of the literature refers to white-collar groups as "knowledge workers", implying that they are hired primarily for their mental abilities. Most, if not all, of the literature seems to acknowledge the fact that measurement of creative productivity is not easy and requires unconventional methods. Many of the methods discovered center around recurring themes of quality, timeliness, and cost-effectiveness. They are typically categorized in terms of direct vs. indirect and qualitative vs. quantitative.

The literature search also yielded a method for involving the workers in the process of selection of productivity measures. This method is called the Nominal Group Technique, and is discussed in greater depth in a subsequent section of this paper.

VI. INTERVIEWS

Interview with: Dr. Roger G. Nibler
Professor of Business Management
Portland State University

According to Professor Nibler, it is hard to measure creativity itself; we cannot quantify the productivity of creative people, in the form of creativity divided by input. He felt that it would be better not to focus on a small measure such as creativity.

He said that it is difficult to measure creative productivity solely on a quantitative basis. For example, one person may come up with a single idea of great importance, while another person might provide several ideas of lesser value. The two people may be operating at the same productivity level, but a purely quantitative analysis would not show this. In order for creative productivity to be measured accurately, Prof. Nibler felt that qualitative, as well as quantitative measures must be used.

He suggested that the best way to deal with the complex problem of a combined qualitative-quantitative evaluation is with the use of the Nominal Group Technique, or NGT. Professor Nibler also indicated that multiple measures are required to keep the worker from focusing on only one aspect of his job, which could result in a productivity decrease. The multiple measures should represent not only quantitative

measures, but should include indirect measures such as subjective innovation appraisals.

Interview with: Dr. Alan Cabelly
Professor of Behavioral Science
Portland State University

Dr. Cabelly was not aware of any specific measurement device or tool for creativity. In the development of creativity measurement, he felt that it is important to evaluate a heterogeneous group, if possible (i.e., a sampling of people from throughout the creative organization). This, he felt, would result in a more uniform and reliable sampling. He suggested the use of a personality profile checklist to help the manager determine the psychological makeup of his organization.

Interview with: Dr. Allen Raedels
Professor of Operation Management
Portland State University

According to Professor Raedels, measuring management productivity can be done by direct measure and indirect measure. Creative people can be measured in terms of tasks, objectives, resources they use and the results they obtain in their work.

Professor Raedels felt that measuring creativity itself would

be very hard, but it can be measured in terms of the number of new ideas, dollars spent, etc. It is important to know what management goals are, then measure productivity in that context. Productivity should not be an independent or absolute sort of measure, but should be shaped by the organization in which they are used. He indicated that output measures can vary widely, depending on what we trying to accomplish. At many times we cannot measure directly but must rely upon indirect measurements. For example measures can be based on the number of new ideas generated within work group, or the number of new ideas implemented. Monetary bases, such as resources used versus sales dollars obtained, can also be used. However, Dr. Raedels pointed out that these all are partial measures, and productivity should be measured on a system basis for better results.

Also, Dr. Raedels said that it is important to know how people will respond when they are aware that their productivity is being measured. He felt that people will sometimes work to enhance the productivity figures, while neglecting the rest of their jobs. He indicated that multidimensional productivity measures are a good way of ensuring balanced job performance.

VI. CASE STUDIES

A. HYSTER COMPANY

Case Study

MEASUREMENT OF ENGINEERING PRODUCTIVITY AT HYSTER COMPANY

The information contained in this case study is based on interviews with the following people:

Darrell Cross - Manager, Technical Center
Joe DuBois - Manager, Engine Powered Truck Design
Ron Leptich - Vice President of Engineering
Norm Price - Manager, Electric Truck Design
George Shafer - Manager, Engineering Records

Hyster Company is a worldwide manufacturer of forklift trucks and is based in Portland, Oregon. The Engineering department has approximately 200 employees. The need to develop a means of measuring Engineering Productivity at Hyster Company was requested by the Company President in 1984.

The objective of the program was to initiate action to provide a 10% productivity improvement per year for the subsequent five years. This meant that some means of measuring output had to be developed.

It was determined that the end product of the Engineering department was drawings and lists (bills of material).

Factors causing the most errors were categorized so that corrective action could be taken to improve efficiency. Since an engineering change notice (ECN) is the document that releases drawings and lists, the ECN writer assigned a responsibility code to each item on the ECN. The codes were then accumulated and evaluated monthly by a task team. The ECN writer assigned the code based on a set of guidelines.

The guidelines assigned the value of one unit of engineering output to each new drawing, revised drawing, and deleted drawing. Lists were assigned values in the same way as for drawings. Codes were assigned based on the type of change made.

Line A, which represented engineering output, was totalled. Then line B, the sum total of changes caused by engineering errors, was totalled. The final formula which established the Engineering proficiency percentages was: Engineering proficiency % = $\frac{A-B}{A} \times 100$

An ECN review committee of three to five Engineering personnel was appointed by the Engineering Vice President. The committee met monthly to review the proficiency report and make recommendations to improve productivity/efficiency. Reports were also made to Engineering Management on a monthly basis.

After a period of about two years results had showed that a proficiency increase of nearly 10% had occurred from the base established at the beginning of the program. But, it was also concluded that the measurement program was taking a significant amount of resources so the program was discontinued.

During the period that Engineering Proficiency was evaluated there were additions of CAD stations and PCs which contributed indirectly to increasing productivity. Product development time during that period was reduced by one and one half years per project.

There has been no action to reinstate the measurement of Engineering proficiency using the above described program. Instead, management is exploring other ways to obtain productivity measures. Some of these methods are:

1) Development time per typical project. This measure is done over a period of many years and includes a factor for the number of personnel assigned. The inverse of this measure, projects per year, could also be used.

2) Warrantee rate. Tracking this data will give Engineering feedback on the quality of the product.

3) Sales per Engineering headcount. An increase in sales per headcount is one indicator that is useful.

4) Engineering budget divided by company revenue. Yearly comparisons will show long term performance trends.

In the test division, productivity is not being measured today except in a cause and effect sort of way. More attention is paid to acquiring the things or instituting the policies which are thought to enhance productivity. In the past, productivity was measured by dividing the total number of projects by the total number of employees in the test division. The method is no longer used because of the possibility of error and/or distortion in the numbers. The test manager suggested that productivity in a creative environment should only be measured in a broad, general sense. Too many small details tend to distort the results.

In summary, many specific ways of measuring productivity have been used at Hyster Company with limited success. Currently, management uses a number of factors , including items 1 to 4 above to develop an approximation of the productivity of the department.

B. FREIGHTLINER

Case Study

MEASUREMENT OF ENGINEERING PRODUCTIVITY
AT FREIGHTLINER CORPORATION

The information contained in this case study is based on interviews conducted with the following people:
Bob Morrison, Manager, Cab Group
Bob Majors, CAD Manager

Freightliner is a manufacturer of heavy duty trucks. The consensus between the two interviewees is that creative productivity measurement is not really practiced at Freightliner, except in a cursory manner. Although both gentlemen agreed that accurate measurement of productivity in their departments would be useful, neither felt that they had discovered a good way of doing it.

Mr. Majors indicated that due to installation of their CAD system, the productivity in the creation of drawings had increased by a factor of 3 or 4 over the old, hand drawing method. He also speculated that upcoming system improvements would boost productivity another 15 to 20 percent over today's figures. The measure of productivity in this case was based on the number of drawings generated per unit of time, although the estimates were admittedly subjective.

Mr Morrison, who heads up a design group of approximately 28 people, tended to base his assessment of productivity on observations and subjective evaluation, rather than attempts at quantification. He felt, however, that some of the essential statistics for the measurement of productivity were already in place, but had not been used for such a purpose. For example, he felt that tracking the number of projects completed per year, which is a statistic that they have on hand, might be one way of measuring productivity. He agreed that this measure must be carried out over the span of several years, and is based on the assumption that over several years the average project size remains roughly constant. He felt that a parallel measurement might involve the measure of people needed to accomplish a typical project, again measured over a several-year time span. In addition, Mr. Morrison speculated that another useful measure might be the amount of cost reduction dollars per vehicle. He explained that Freightliner encourages cost-reduction suggestions from all areas of the company, and that they have an ongoing program to evaluate the suggestions and implement the best ones.

In summary, it appears that although the managers at Freightliner would like to measure the productivity of their creative employees, this subject has been given neither the priority nor the resources necessary to get the job done.

C. HUGHES AIRCRAFT COMPANY

Case Study

R & D PRODUCTIVITY AT HUGHES AIRCRAFT COMPANY

The Hughes Aircraft study was an extensive investigation into creative productivity, conducted over a 5-year period between 1973 and 1977. The results of this work are extensively summarized in a book entitled R & D Productivity.

While the goal of the study was to identify methods for the optimization of productivity in a research and development group, a significant subset of their report deals with the measurement of creative productivity.

The Hughes authors define productivity as "the ratio of valuable output to input, i.e., the efficiency and effectiveness with which resources - personnel, machines, materials, facilities, capital, and time - are utilized to produce a valuable output." They go on to say that productivity is maximized when all resources, including human ones, are combined in the most efficient way.

The Hughes study indicates that many factors, including personal, job-related, and project-related, interact in varying degrees and are largely responsible for the productivity of an R&D group.

The conclusions and recommendations of the Hughes study are summarized as follows:

Conclusions of the Hughes Study

1. Managers should adopt a long-term approach to the evaluation of creative productivity. Their definition of long-term indicates that several years are necessary to develop accurate trend indicators.
2. No single parameter will provide an accurate measure of productivity. A family of indicators is a much more reliable source of data.
3. The parameters chosen will vary, depending upon the organization. The decision of which parameters to evaluate must take into account the characteristics of the organization and the nature of the work being done.
4. The distinction between quantitative and qualitative productivity measurement is discussed. The conclusion is that quantitative measurements are best used in places where the work is highly structured, simple, and repetitive, whereas qualitative measurements are best used where the work is abstract, complex, and creative. In reality, most "knowledge-based" work environments involve a mixture of repetitive and abstract duties; therefore, the productivity measures should correspondingly represent a mixture of qualitative and quantitative properties.

Recommendations of the Hughes study

1. Typical parameters may include: Performance of finished project vs. original requirements, actual cost per project vs. planned cost per project, and subjective indicators of customer satisfaction.
2. The techniques used to evaluate the above parameters can be classified as follows:
   a. Work Sampling - Subjective evaluation of the work being done, through observation and informal discussion with the workers in their work area.
   b. Productivity Ratios and Trends - Numerical representation of quantifiable parameters, and long-term monitoring of these numbers so that trends can be discovered.
   c. Patterns of Performance - Somewhat related to item b above. This method consists of looking at a group's record of success in meeting such objectives as technical specifications, cost, and schedule.

The Hughes study produced some valuable lists, called Productivity Indicators and Productivity Profiles. The Productivity Indicators are lists of suggested parameters for the manager to consider when measuring productivity. The list is divided into qualitative and quantitative parameters, and is reproduced in the appendix of this report for the convenience of the reader.

The Productivity Profiles is another interesting list compiled by the Hughes study. In this list, characteristics are given which may help to identify a productive individual, manager, or organization.

D. SOUTHERN COMPANY

Case Study

THE SOUTHERN COMPANY

Information for this case study was taken from Productivity Plus by John Belcher of the American Productivity Center.[17]

The Southern Company, an electric utility holding company in the southeast United States, was committed to the idea of productivity measurement in their Engineering Division. As a first step, they defined productivity as follows: "Productivity is the relationship of how well an organization utilizes and converts its resources (manpower, material, equipment, capital, and energy) through some type of production process into company outputs (tangible items or services)." In addition, the engineer in charge of the project submitted that the measures might fall into one of the following categories: Effectiveness, Efficiency, Quality, Quantity, and Timeliness. With these categories in mind, departmental managers were asked to develop realistic productivity measures to be submitted to the division head for approval.

Southern's implementation technique invited a lot of employee involvement. A room was reserved for the express purpose of displaying all the productivity charts (approximately 100 in all), and employees were encouraged to visit the room at any time to examine them.

According to Belcher, a friendly spirit of competition developed among employees as they sought to improve their statistics. Although Belcher does not say whether productivity gains were realized solely as a result of the implementation of the measurement process (the measurement program was the initial step of an overall productivity improvement effort), it seems likely that this occurred. Belcher points to the Southern case as a prime example of how effective the measurement of creative productivity can be, provided that it is done correctly, using realistic measures and the involvement of the workers.

E. NGT APPLICATION

Case Study: Design and Development of a Productivity System

In their book Productivity Management, Sink and Scott describe a hypothetical case study in which an engineering supervisor sought to measure productivity in her department through a "normative" approach.

Despite the costs of the program and the risks that the measurement approach might not initially yield high quality

results, she decided to implement the program, using the following steps excerpted from Sink and Scott's book.

1. Hold productivity basics seminar with engineers (one day, outside consultant).
2. Make informal assessment of response to the subject with individual engineers.
3. Present proposal to engineers for development of productivity measurement system.
4. If accepted, run NGT session to develop consensus list of productivity measures, ratios, and/or indexes.
5. Review results and discuss next steps with group.
6. Integrate and operationalize results with current control system.

According to Sink and Scott, the above technique can be very successful in the measurement and control of productivity. It makes use of a group participation concept called the Nominal Group Technique, which is discussed here.

Nominal Group Technique (NGT)

NGT is a "carefully designed, structured, group process that involves carefully selected participants in some activities as independent individuals, rather than in the usual interactive mode of conventional groups."[13] It is useful for situations where individual judgements must be tapped and combined to arrive at decisions which may not be reached by one person. The groups are provided with a carefully

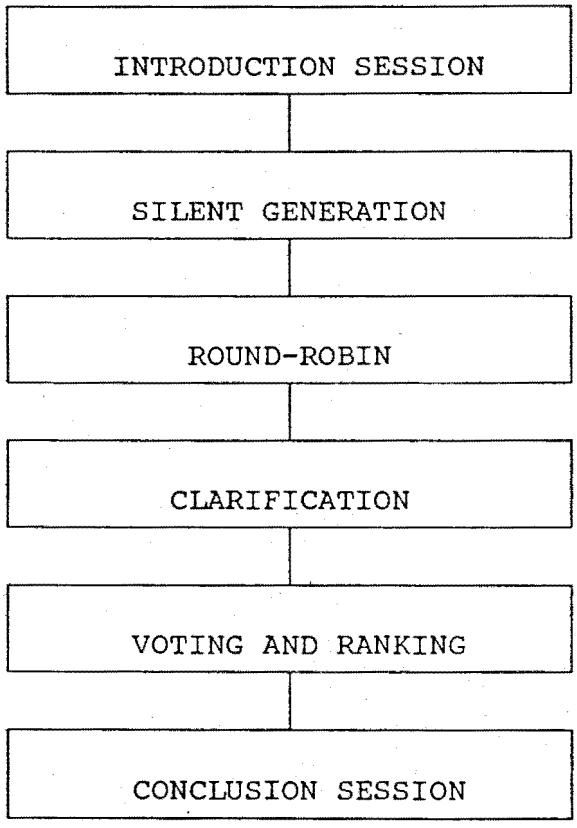
designed "task statement" to delimit and define the group's task. In the case of productivity measurement, they are asked to "identify and list either measures, ratios, and/or indexes of productivity" for the organization.

NGT consists of four phases, plus introduction and conclusion sessions. The participants are usually from the departments throughout the organization including the department to be measured, and the session is controlled by a process consultant or a facilitator and an assistant.

In the introduction, the facilitator introduces the participants to the process, tries to make them familiar and feel ease with what will be done during the process. The facilitator usually gives a brief discussion of the purpose and importance of the process, the steps, how to use the results, and the steps to follow. He then reads and clarifies the task statement, which is the task of the participants during the structured group session.

The first phase is "silent generation", which usually takes from 10 to 15 minutes. The group members are instructed to write their responses to the task statement. This phase focuses attention on the specific task, and frees the participants from distractions, and gives them chance to think through their ideas rather than simply to react to others' comments.

NOMINAL GROUP TECHNIQUE PHASES



The second phase is the "round-robin phase", in which the facilitator calls on participants one-by-one to state one of the responses they have written. There is no need to stop generating ideas, any additional ideas generated during this phase should be added to the "silent generation" lists. A participant may only suggest one idea at a time, and either the facilitator or the assistant records the idea.

The third phase is "clarification"; after all the ideas have been recorded, the facilitator goes over every idea to make sure that all participants understand them . Any participant may offer clarification, suggest combination, modification, deletion, etc. The facilitator moves quickly from one measure to the next, and the underlying logic behind idea may be brought out.

The fourth phase is "voting and ranking", which provides the participants with a chance to select the most important ideas and to rank those ideas. This permits participants to express their individual evaluations of the items free of social pressure. After this process, tabulation of the votes takes place. The tabulation process involves sorting ideas from the original list and recording the ranking given to each.

The session closes with a brief discussion of the results of the voting process where the facilitator emphasizes those

items which have strong consensus. The facilitator may comment on the future steps or discuss future action.

NGT provides a high degree of acceptance, a strong sense of group involvement, a feeling of group accomplishment, and a high level of interest for future steps in the activity being examined. Although participants may not individually agree to the result, usually they will support the final result as the achievement of their group.

VII. CONCLUSIONS

This study has examined measuring the productivity of the creative process. Productivity is one of seven criteria making up performance, the others being effectiveness, efficiency, quality, quality of worklife, innovation, and profitability. To be successful, a manager must measure, evaluate, control, and plan using all these criteria. Productivity is one of the more critical components in measuring the performance of the creative process. The challenge for the manager is to determine what measures to use when integrating it into his organization's overall planning.

Measuring productivity of the creative process is an achievable but difficult task. If a manager succeeds he will have an effective and essential productivity indicator. With the development of this tool, organizations that are seeking

to improve performance are able to judge their progress.

The case studies included in this report show that many companies have made attempts at measuring productivity with varying degrees of success.

Hyster Company - Hyster's approach to measuring creative productivity was that of measuring engineering proficiency. Drawing and list output were categorized and graded. This is an example of a partial measure. They have ceased to use this measure and are now trying to use a combination of indicators in a very low-key approach.

Freightliner - measuring productivity of creative employees is not currently done. It would be of interest to them if they felt that there were a good way of doing it.

Hughes Aircraft Company - An extensive five-year investigation produced a common-sense approach, as well as numerous innovative measurement techniques.

Southern Company - Southern implemented a successful program in which employee involvement fostered a healthy spirit of competition.

The types of techniques implemented at these companies are all different. Many of the companies that were contacted had

thought about measurement but had not taken any action. Some companies used partial productivity measures while another had a very comprehensive plan.

The more successful techniques have the following characteristics:

1. Long running plan and strategy.
2. Participation of many people.
3. The use of more that just a single indicator to measure.
4. Realization of the need for continuous improvement.
5. Involvement of those being measured in developing the measures.
6. Managers and workers both understand the measure and what it does.
7. When the primary goal of the measure is to influence. behavior "the simpler the better" is the rule.[4]
8. Seek the measure that promises the greatest impact, not the measure boasting the greatest technical elegance or greatest accuracy.[4]
9. Avoid the temptation to combine the productivity measures into one number. It discourages examination of the individual measures and probably doesn't mean much anyway.

VIII. RECOMMENDATIONS

The following is a list of specific measurement alternatives both quantitative and qualitative which can be used to customize a program to the specific need. Each measure should be used independently with no attempt at trying to combine several measures to get one "number". The relevancy of each alternative must be determined by the manager.

1. Number of Engineering change notices.
2. Warrantee rate.
3. Development time per project and number of personnel.
4. Sales per Engineering headcount.
5. Number of part numbers managed per Engineering employee.
6. Engineering budget divided by company revenue.
7. Amount of existing product per Engineering headcount expressed in terms of models in complete line.
8. Dollars of cost reduction per product.
9. Cost reduction per Engineering budget.
10. Projects per year.
11. Projects per employee.
12. Hughes list of qualitative and quantitative indicators in the appendix.
13. The degree of application of current and new technology to the job.
14. Performance compared to others doing similar work.
15. Product performance through its lifecycle.

The authors suggest that three or four of the above measurements be chosen, then monitored over time. Also, use the Nominal Group Technique (as presented in the case study section of this report) to determine the most suitable measures. The real value of the measurement of creative productivity lies in the analysis of the long-term trends derived from these measurements.

IX. SUMMARY

The determination of a measure of productivity of the creative process requires that data be gathered over a long period of time. Correct evaluation can take several years or more. Quantitative measurement can be done if the work is highly structured or repetitive whereas creative, abstract, and non-repetitive work is best evaluated through qualitative measures. Depending on the task to be done there will be both quantitative as well as qualitative factors to be considered to gain a true representation of productivity. In deciding which factor to apply when measuring creative productivity it must be understood that the productivity of each organization or individual is unique and therefore each requires their specifically tailored set of measures.

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