CHAPTER – IV

KNOWLEDGE WORKER PRODUCTIVITY MEASUREMENT

4.1 Introduction

While productivity has been studied for decades and knowledge work has always existed, it is only recently that researchers have tried to measure knowledge worker productivity. One basic way of defining productivity is "output divided by input" (O/I). If Company X uses Rs.100 of input to produce Rs.100 of output, their productivity ratio is 1. If in the above example the ratio of outputs to inputs was measured at a later date and was found to be Rs.200/Rs.100, the new ratio would be 2. The change in productivity would be (2-1)/1 or 100 percent.

4.2 Productivity and Business Objectives

Many people would define a business in terms of making profits, but such a definition is too narrow. In a broader sense, the first valid business purpose is to create a customer (Drucker 1974). Drucker says every business must satisfy its customers or it will fail.

It is the customer who determines the existence of a business. It is the customer alone whose willingness to pay for a good or service converts economic resources into wealth, things into goods. A business converts economic resources into something else. At this level, productivity is the balance between all production factors that will give the greatest return for the least effort (Drucker 1974).

The customer buys utility (Jury 1992), and productivity associates outputs with inputs. Productivity, at the organization level, may be considered a measure of how well the company satisfies the customers' utility. Therefore, productivity measurement shows how well a company is doing.

Knowledge work is the area that offers the greatest opportunities to increase productivity (Drucker 1974). In the past, the production line received a lot of attention because it was relatively easy to analyze and measure. On the other hand, management does not clearly understand what goes on in white-collar work areas, or how to match white-collar personnel needs to future business needs (Strassman 1985, Shackney 1989).

4.3 Defining Productivity

A large number of concepts consider productivity as an output-input relationship relevant mostly to a production system, implying that an organization works as a physical system with variables and their inter-relationships amenable to precise definitions. Similarly, factorial productivity measures connected with input factors such as labor, capital, etc

Sardana and Vrat (1987) say those who measure productivity should have three objectives: (i) to identify potential improvements; (ii) to decide how to reallocate resources; and (iii) to determine how well previously established goals have been met. The findings based on these objectives show the observer how the measured organization is doing as a whole.

Productivity can be separated into two factors: (i) performance and (ii) financial (Moore 1978). Performance productivity is based on the number of outputs produced. For example, if Company A produces 100 units in one week and 120 units in the next week, its performance productivity has increased by 20 percent. By contrast, financial productivity focuses on the
value of the output. If Company A had produced 100 units in both weeks, but raised the price from Rs.1.00 per unit to Rs.1.20 per unit in the second week, its financial productivity would have increased by 20 percent with no increase in output.

Sink (1984) states that Productivity, as mentioned, is strictly a relationship between resources that come into an organizational system over a given period of time and outputs generated with those resources over the same period of time. It is most simply Output divided by Input.

4.4 Productivity and Knowledge Work

Knowledge work is all work whose output is mainly intangible, whose input is not clearly definable, and that allows a high degree of individual discretion in the task. This difference in work content requires different approaches to productivity evaluation.

There is a great need to evaluate the productivity of knowledge work and the need grows greater each year. Under the old classification of work, in which there were essentially only two categories, white-collar workers represented two-thirds of the workforce in the early 1980s, with the managerial and professional subgroups representing one-quarter of the workforce. Yet, productivity in knowledge work has shown little improvement over the past decades (Davis 1990).

4.5 Problems in Measuring Knowledge Work

Evaluating productivity is never more difficult than when evaluating knowledge work. Consequently, this type of productivity evaluation is poorly understood (Drucker 1974; Salemme 1986). Planning and work measurement in the knowledge worker areas is not conducted as scientifically as it has been in other areas (Magliola-Zoch 1984). There are several reasons why knowledge work is so hard to evaluate.

A related problem is that individual productivity increases do not transfer to the productivity of higher levels of organization (Rittenhouse 1992). The change in the productivity of one worker may not affect anyone else. This makes it seem as if measuring the productivity of knowledge workers will not change anything. Both Rittenhouse (1992) and Sassone (1991) correctly point out that the work group is the proper level at which to evaluate knowledge worker productivity.

The complexity of knowledge work arises from several factors. It is not routine, involves much independent judgment, and requires several people to work together. Furthermore, a considerable amount of knowledge is required to do the work. The non routine nature of knowledge work means that it is very difficult to lay down a norm. There is no obvious average to observe and record, so any measure will be somewhat inaccurate. The degree of independent judgment involved in knowledge work means that the "norm" may vary from individual to individual.

Productivity measures applied to knowledge workers often concentrate on the countable results of the work rather than the work itself, which is information (Wilson 1988; Salamme 1986). The work is so complex that an artificial indicator is evaluated rather than the actual work. Often, the indicator is chosen because it is easily quantified. This approach ignores potentially important aspects of the output, such as quality (Rittenhouse 92). The value of the output, which includes its quality, is very important in knowledge work. This value is the primary output.
4.6 Measuring Productivity

In knowledge work the majority of the cost of producing the output is due to the knowledge work itself rather than materials or equipment. The work produced is a consequence of the efforts of the knowledge worker. The following discussion focuses on ways of measuring or evaluating the knowledge worker's efforts.

4.6.1 Performance Measures

Performance measures typically fall under three major categories:

(i) Factor of production indicators,
(ii) Outcome indicators, and
(iii) Work process indicators.

Most measures are quantitative, but selected effective measures such as customer satisfaction may be qualitative.

4.6.2 Factor of Production Performance Measures

Factor of production performance indicators typically describe the relationship of resources to output.

Input measures : These describe the resources-time and worker-used for a program.

Output measures : These describe the goods or services produced.

Efficiency : The relationship of outputs to inputs.

Effectiveness : Output as it conforms to specified characteristics.

4.6.3 Outcome Measures

Outcome Measures : These measures assess the effect of output against specified objective standards.

Impact measures : How the outcome affects the organization.

4.6.4 Work Process Measures

Indicators of the way work gets done in producing output at a given level of resources, efficiency, and effectiveness.

Cost-effectiveness : Measures the change in the relationship of resources to output, or some other measurement.

Efficiency review : A process where the overall work process is analyzed. The inputs, outputs, and workflows are identified and studied. The result is an analysis of the existing process versus a standardized model of the process. This analysis is used to make recommendations for improvements and enhancements. Many methods are employed in performing these analyses.

Flow Charting : A graphical mapping of the activities of the work process. It is often used in conjunction with other techniques to produce a complete analysis of a work area.
Cost-Based Activity Modeling System: Cost-based activity modeling charts work processes and sub processes; identifies and eliminates non-value tasks; identifies costs of remaining tasks and focuses on process changes, including identification of automation opportunities, to accomplish necessary tasks at reduced costs.

Theory of Constraints: Focuses on maximizing throughput, reducing inventory, and reducing turnaround time.

Macro Management Analysis Reviews: Typically uses economic analysis techniques to analyze the work process.

Benchmarking: Compares performance indicators of some part of an organization to indicators of another similar part of the organization, or to a similar entity outside of the organization.

Statistical Process Control: Statistical techniques used to evaluate the performance of a process.

Status of Conditions Indicators: Indirect measures of the work environment. They can include rates of absenteeism, accidents, and turnover. They give an indirect indication of the conditions of a work area that may affect efficiency and effectiveness.

Organizational Assessment Tools: Tools used to determine and evaluate an organization's culture and environment. The outcome is an analysis of an organization's potential.

Innovation: The rate of the introduction of innovation into the work process.

Quality: The measurement and assignment of cost to the level of quality in the work process.

Bridges (1992) gives one fundamental reason for measuring productivity: "Some type of benchmark (standard, average, mean) should be determined, if none exists. How can you be sure of how much is being saved if you do not have a baseline?" Peter Drucker (1974) has put it in a more general way: "Without productivity objectives, a business does not have direction. Without productivity measurement, it does not have control."

Measurement requires collecting data. Sink (1985) categorizes three basic ways to collect data about a given phenomenon or organizational system: (i) inquiry, (ii) observation, and (iii) collecting system data or documentation. This data gathering is the essential part of measurement. It is the process by which productivity benchmarks are established. In the simplest form, the outputs are evaluated against the inputs.

4.6.5 Productivity Measurement Techniques

Many measurement techniques and packages are available. Mundel (1989) presents a computer software package that evaluates productivity. Direct adjustments for quality by the package are excluded, but quality indicators may be implicit because the package considers only good output. The program does not consider raw materials, because the end product is knowledge. In this and other computer programs, simple O/I algorithms are used to calculate productivity. The programs facilitate the calculation of productivity at the organization level. Mundel presents eight levels of work units, starting from the lowest-motion-up to the highest-results achieved because of outputs.

Sassone (1991) presents a technique that is relatively simple to implement. He classifies work by the lowest level of employee who could reasonably do it. Work is then recorded for each
participant by the type he or she is doing. This record is then analyzed and compiled in a 
matrix format that shows the amount of effort expended by each type of employee, and 
whether employees are working at, above, or below their level. This information can indicate 
the mix of workers is needed in a work group. It can be used to explore the consequences of 
common assumptions, such as whether cutting support staff will actually reduce costs.

Sink (1985) presents several techniques of evaluating productivity. His three main 
methodologies are Multi-Factor Productivity Measurement Model (MFPMM), Normative 
Productivity Measurement Methodology (NPMM), and Multi-Criteria Performance/ 
Productivity Measurement Technique (MCP/PMT).

MFPMM is a computerized methodology for measuring productivity, based strictly on O/I. 
NPMM uses structured group processes to formulate appropriate productivity measures for 
knowledge workers. It uses the group technique to establish consensus about what the 
productivity measures are and how they should be measured. MCP/PMT is designed to allow 
the user to evaluate the various productivity measures and decide which are the most 
important. It also allows the user to aggregate dissimilar productivity measures.

A number of other researchers use the group technique. Bernard (1986) discusses project 
teams and stresses maximizing their diversity, warning that it cannot be assumed that the 
manager knows what is going on. Thor (1990) talks about Normative Group Techniques 
(NGT), what they do, and how to use them. He strongly recommends the participatory 
approach of NGT for knowledge workers. The groups should be planned to get the most out 
of the available personnel. To avoid partisanship, each group should have a facilitator who is 
familiar with the technique but is relatively unknown by the group.

Kristakis (1984) describes a methodology that depends on estimation. The manager lists the 
types of work processes performed in the group, then breaks them down into detailed 
operations. He or she identifies who does what and estimates how long each process takes. 
This is a very simple technique, but it may not be accurate because it relies on the judgments 
of only one person.

Anthony (1984) discusses the use of time diaries, estimates, work sampling, and direct 
observation. He used these techniques on professional and technical staff. The data were 
analyzed by computer, then reviewed to eliminate insignificant tasks. Anthony concluded; 
"Although many people think that professional activities are non routine and non repetitive, 
we have found that if the scale of reference is expanded, they reoccur on a predictable basis."

Overby (1984) discusses work sampling at predetermined periods rather than at random times 
during the day.

4.6.6 Productivity Measurement Issues

A common theme among researchers is that knowledge worker's productivity can be 
measured (Bernard 1986; Sink 1984; Anthony 1984; Magliola-Zoch 1984). These writers 
offer several suggestions to make measurement simpler and acceptable to the workers. First, 
the workers must participate in the establishment and evaluation of the measures of 
productivity. The more they are involved, the less likely they will feel threatened. Second, 
any process that seems too complex to measure is likely to have less complex sub processes, 
which are more practical to measure. Third, always use the best measure for the job, even if 
some different measures must be pursued for different processes. Fourth, do not expect 
absolute accuracy, but try for the best that is economical. Finally, regardless of the 
shortcomings, measuring is better than not measuring.
4.6.7 Unified Concept of Productivity Management

In discussing productivity, the terms "measurement," "evaluation," "performance," and "improvement" are used in different ways by different authors. The strictest interpretation of productivity is outputs divided by inputs (O/I). A number of people use this interpretation because it is easily defined, calculated, and implemented. "Performance" is a broader term than "productivity." It includes factors that are not easily quantified, such as quality, customer satisfaction, and worker morale. The inclusion of these terms, makes the calculation more difficult. However, these terms more fully describe what actually occurs in production. The difficulty in applying productivity measures frequently can be attributed to an overlapping of these two subjects.

"Productivity measurement" refers to the way in which productivity is indexed. In the strictest sense, a measurement is a numerical index. Consequently, the same inputs should produce the same outputs—that is, the same index number—each time the output is calculated. The advantage of this is that the index does not depend on who collects the data or when it is collected. "Measurement" also has a meaning by itself. It is the methodology of establishing the amount of work involved in a work function.

"Evaluation," a term used here, is similar to "measurement." Evaluation allows the use of measurements that are not strictly quantitative. Rather than being restricted to measures that are quantifiable, one may use qualitative measures such as "good," "bad," "poor," "superior," "fast," etc. This makes manipulation of the measures difficult, but allows previously unmeasured aspects of work to be measured.

"Productivity improvement" refers to the change sought, noted, or measured in productivity. Productivity improvement can refer to the designed change in an operation to produce a positive change in the measured productivity of that operation. The term can also refer to the change in productivity that results from such a design change.

Bridges (1992) states, "The keystone to implementing productivity improvements is putting everything in measurable terms." Frazelle (1992) says "productivity must be understood before it is effectively measured." Productivity improvement is tied to productivity measurement, which is tied to the measurement of the work.

4.6.8 Barriers to Applying Productivity Measurement

Historically, knowledge work has been exempt from productivity evaluation because of its complex nature and its minor contribution to the total cost. It has long been thought that more could be accomplished in the structured work of the production line and similar jobs. Managers have dismissed productivity measurement in the knowledge work areas because they assume that it is of low importance and that, if productivity cannot be measured with the same accuracy as in a production area, it is a useless measure (Chew 1988).

Productivity measurement systems are often unwelcome to both managers and workers (Sink 1987). A number of authors have written about the need to prepare the work area to be analyzed (Helton 1991; Salamme 1986; Sink 1987). Such preparation ranges from discussion to group participation to self-evaluation. Preparing the area in some manner makes it possible to implement a productivity program. However, a bad program will produce bad results.

Worker expectations are another barrier to implementing productivity measurement in the knowledge work area. This is partly due to the history of productivity and partly due to
human nature. Historically, productivity efforts have produced detailed and highly organized results. The approach has been very structured and well documented. People are highly reluctant to accept anything that is less structured, less well documented, less detailed, and less accurate. Yet that is the nature of knowledge work, so productivity measures of knowledge work are inherently more loosely structured and less accurate than measures of other types of work.

Perhaps the strongest objection to measurement of knowledge worker productivity is that its results are inaccurate (Chew 1988). In addition, productivity measurement is most valuable as a dynamic measure, not as a static measure. This means that as long as measurement inaccuracies are consistently inaccurate, the dynamic measure will be an accurate indicator of the relative change.

4.6.9 Categorizing Work Content

Work must be categorized by its content (Helton 1991; Strassman 1985), and work content is not one-dimensional. The work can be categorised by eight components, as detailed below:

4.6.9.1 Work Component Descriptions

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision making</td>
<td>The application of knowledge in the determination of how to process the work. This application of knowledge differentiates decision making from simple choices such as &quot;stamp&quot; or &quot;do not stamp.&quot;</td>
</tr>
<tr>
<td>Complexity</td>
<td>The difficulty of the job. This component involves the number and difficulty of decisions, and the amount of knowledge needed.</td>
</tr>
<tr>
<td>Knowledge Use</td>
<td>The amount and complexity of information required to do the work.</td>
</tr>
<tr>
<td>Structured</td>
<td>Structure involves constraints on how, when, where, and what is done. Both complex and simple work can be very structured. The assembly-line job is usually fairly simple, but very structured. A legal case can be very complex, but it also is very structured.</td>
</tr>
<tr>
<td>Repetitive</td>
<td>A function done the same way every time, and will always be done the same way. If the job changes each time, then it is not repetitive.</td>
</tr>
<tr>
<td>Volume</td>
<td>The number of times the profiled activity will occur in a given time cycle. This can be expressed in many ways, which will affect the gauge of high-low. To eliminate the relative value of this component, volume will be based on the number of completed actions per year.</td>
</tr>
<tr>
<td>Time per Job</td>
<td>The total time spent completing the job, from start to finish.</td>
</tr>
<tr>
<td>Skilled Activity</td>
<td>The physical difficulty of performing the work. This inversely relates to the mental difficulty or complexity. There are activities that require both skilled physical and mental activity - surgery, for example.</td>
</tr>
</tbody>
</table>

This approach demonstrates that the best way to describe work is by its component content. Using this approach gives a true picture of the work structure, which will allow a match of measurement techniques to the actual work.
4.6.9.2 Categorizing Measures

Simple measures are the most generally applicable, and can be used with any type of work, but they are not the best technique for all types of work. Complex measures apply to fewer types of work, but when they are applicable, they produce better results than simple measures.

The following techniques, starts with the most complex and ends with the simplest. The groupings are based on the complexity of setting up the analysis and conducting the evaluation.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Complex setup, Complex implementation</td>
<td>Predetermined time-motion studies, Stop-watch studies, Logging</td>
</tr>
<tr>
<td>2.</td>
<td>Complex setup, Simple implementation</td>
<td>Self-logging, Sampling, Counting</td>
</tr>
<tr>
<td>3.</td>
<td>Simpler setup, Moderate implementation</td>
<td>Committee, Estimation</td>
</tr>
</tbody>
</table>

The more complex techniques require more expertise to design and implement. The techniques in Category 1 usually require extensive preparation. The work has to be analyzed and described. Data must be gathered on frequencies and volumes. A measurement plan has to be devised—one that fairly represents the work being evaluated. The implementation for Category 1 usually requires an analyst with a high level of expertise in the techniques being used. Techniques in Category 2 can be simpler to implement because setup involves simple measures designed to be performed by those involved in the normal workflow. But the preparation in Category 2 is difficult: the work must be understood so valid measures can be designed.

Category 3 is simpler to set up because the process is a continuous one, and much of the setup difficulty in Categories 1 and 2 can be spread over time. Implementation is only moderately complex because it is a continuation of the initial setup process.

Highly repetitive work, for example, is best measured by techniques based on norms, such as time-motion studies. Non repetitive work is not suitable for such techniques. The time required per job is another component that directly affects the methodology used. If each job takes a long time, it does not make sense to time the work on a stopwatch. A work log is more applicable in such a situation. The higher the volume of the work, the more cost-effective any measurement technique will be. Techniques that are costly—those requiring a lot of effort and expertise—are best applied to high-volume work. Work with a high level of decision making or complexity are poor candidates for stopwatch or time-motion techniques. These require a less structured technique.

4.6.10 Conclusion

It appears clear that work should be evaluated by its own content, not on the basis of the old white collar/blue collar model. The approach to measurement has been shown to fall into several categories, and each category can be associated with the various elements of work content. Therefore, it is clear that any measurement techniques used to evaluate a work group should match the content of the work being performed there. In some units, each different type of work being performed may require different types of measurements (Thor 1987;
How to measure and what to measure is a complex decision. Taking a single measure is not necessarily the best solution. The best way to measure depends on the cost, effort, and need. Lower levels in an organization require more detail than higher levels in the same organization (Rittenhouse 1992). At a departmental or work group level, detail is needed, but cost and available resources may dictate the use of a less-than-perfect measurement mix.

The total productivity measure is usually synthetic. It is derived from the other productivity measures and has no direct relationship to any specific activity. This type of measure is most often used at higher organizational levels to reduce the complexity and proliferation of productivity measures to be analyzed. At the higher levels in an organization, productivity is not directly related to any single workgroup, and there is frequently no need to explain why productivity changed from the previous measurement. Lower levels of the organization can also use a total productivity measure, but it will simply indicate how well the group is performing from period to period without providing insight into why.

Extensive review of the literature indicates that the possibility of measuring the productivity of knowledge work environments is acknowledged, but practical implementation lags far behind. The causes of this lag are based on the perception that knowledge work is unmeasurable and of little significance. It has been shown that knowledge work is by far the area where measurement offers the greatest potential benefits. It is more difficult to measure knowledge worker productivity than it is to measure blue-collar worker productivity. This does not mean that knowledge work cannot be measured, but that more innovative measurement techniques are needed.

Categorizing work by its content components—decision making, complexity, knowledge use, structure, repetition, volume, time, and skill level—facilitates understanding the work and how to best measure it. Picking a measurement technique appropriate to work content is only part of the job. Cost and accuracy must also be factored into the decision.