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PROFESSIONAL PRACTICE

Demystifying productivity and performance

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Abstract

Purpose – Examines the ways in which the concepts of "productivity" and "performance" are dealt with in the literature, demonstrating that terms used within these fields are often vaguely defined and poorly understood.

Design/methodology/approach – Reviews related performance literature from the past 30 years (of both an academic and a practical nature).

Findings – Clarifies the meaning of five terms (productivity, performance, profitability, efficiency, effectiveness) and shows how they are inter-related.

Research limitations/implications – The creation of a common grammar is not an easy task; one must therefore still accept the fact that people will continue to interpret the terms described in this paper in slightly various ways.

Practical implications – Measurement and improvement regimes are often built without a clear understanding of what is being measured or improved. This can be regarded as simply a pragmatic approach to improvement, or a missed opportunity to fully understand and then optimise important factors relating to competitiveness and success.

Originality/value – The paper creates a terminology that reduces the existing confusion within the field. Certainly, within academia and industry, a shared vocabulary and grammar are helpful in ensuring rigorous and robust development of shared understanding.

Keywords Productivity rate, Performance management, Profit, Process efficiency, Performance appraisal, Semantics

Paper type Literature review

Introduction

The terms productivity and performance are commonly used within academic and commercial circles; they are however rarely adequately defined or explained. Indeed they are often confused and considered to be interchangeable, along with terms such as efficiency, effectiveness and profitability (Sink and Tuttle, 1989; Chew, 1988; Sumanth, 1994; Koss and Lewis, 1993; Thomas and Baron, 1994; Jackson and Petersson, 1999).

Measurement and improvement regimes are often built without a clear understanding of what is being measured or improved. This can be regarded as simply a pragmatic approach to improvement, or a missed opportunity to fully understand – and then optimise – important factors relating to competitiveness and success.

Certainly, within academia, a shared vocabulary and grammar is helpful in ensuring rigorous and robust development of shared understanding.

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Productivity – a multidimensional term

A very early appearance of the term productivity was as used by Quesnay (1766) in the *Journal de l'Agriculture* over two centuries ago. Since then it has been applied in many different circumstances at various levels of aggregation, particularly in relation to economic systems (Tangen, 2002a). It has been argued that productivity represents one of the most important basic variables governing economic production activities (Singh *et al.*, 2000). Grossman (1993), for example, discusses productivity improvement as one of the key competitive advantages of an enterprise in the following way:

> Companies need to realize that gains in productivity are one of their major weapons to achieve cost and quality advantages over their competition.

In spite of the fact that productivity is seen as one of the most vital factors affecting a manufacturing company's competitiveness, many researchers argue that productivity is often relegated to second rank, and neglected or ignored by those who influence production processes (Singh *et al.*, 2000; Sink and Tuttle, 1989; Broman, 2004). One possible reason for this is the lack of common agreement on what the term actually represents. Though the term is widely used, it is often misunderstood, leading to productivity being disregarded or even to contra productive decision making (Tangen, 2002b; Forrester, 1993).

Chew (1988) suggests that even though the concept of productivity has existed for a long time, remarkably many people who make decisions every day about improving plant efficiency do not know how to answer the simple question of what productivity is. Björkman (1991) suggests that decisions on productivity improvement are often based on individual opinions instead of on a shared and commonly held view.

A relatively simple review of the literature suggests that:

- Those who use the term productivity rarely define it.
- There is a lack of awareness of the multiple interpretations of the term, as well as the consequences, to which such discrepancy leads.
- There are both verbal and mathematical definitions and approaches.

This suggests that productivity is a multidimensional term, the meaning of which can vary, depending on the context within which it is used. However, there are common characteristics that tend to be embraced by the term. In industrial engineering, productivity is generally defined as the relation of output (i.e. produced goods) to input (i.e. consumed resources) in the manufacturing transformation process (Sumanth, 1994). However, there are numerous variations on this basic ratio, which is often too "wide" a definition to be useful in practice. Table I shows a number of these variations, created from examining the term from different perspectives (Thomas and Baron, 1994).

The verbal definitions aim to explain what the concept of productivity means. They are useful since they can create a "norm", a shared view of what an organisation is striving to achieve. They can also be used when specifying and explaining an organisation's strategic objectives (Björkman, 1991).

Mathematical definitions, on the other hand, can be used as the basis of performance measures, where the major aim is to improve (not to explain) productivity. Since it can be difficult to translate a verbal definition to a mathematical one, mathematical definitions do not always reflect all the characteristics that represent the concept of productivity. Compromises are often made when mathematical definitions are formulated, which in

Definition	Reference
Productivity = faculty to produce	(Littré, 1883)
Productivity is what man can accomplish with material, capital and technology. Productivity is mainly an issue of personal manner. It is an attitude that we must continuously improve ourselves and the things around us	(Japan Productivity Centre, 1958 (from Björkman, 1991))
Productivity = units of output/units of input	(Chew, 1988)
Productivity = actual output/expected resources used	(Sink and Tuttle, 1989)
Productivity = total income/(cost + goal profit)	(Fisher, 1990)
Productivity = value added/input of production factors	(Aspén *et al.*, 1991)
Productivity is defined as the ratio of what is produced to what is required to produce it. Productivity measures the relationship between output such as goods and services produced, and inputs that include labour, capital, material and other resources	(Hill, 1993)
Productivity (output per hour of work) is the central long-run factor determining any population's average of living	(Thurow, 1993)
Productivity = the quality or state of bringing forth, of generating, of causing to exist, of yielding large result or yielding abundantly	(Koss and Lewis, 1993)
Productivity means how much and how well we produce from the resources used. If we produce more or better goods from the same resources, we increase productivity. Or if we produce the same goods from lesser resources, we also increase productivity. By "resources", we mean all human and physical resources, i.e. the people who produce the goods or provide the services, and the assets with which the people can produce the goods or provide the services	(Bernolak, 1997)
Productivity is a comparison of the physical inputs to a factory with the physical outputs from the factory	(Kaplan and Cooper, 1998)
Productivity = efficiency * effectiveness = value adding time/total time	(Jackson and Petersson, 1999)
Productivity = (output/input) * quality = efficiency * utilisation * quality	(Al-Darrab, 2000)
Productivity is the ability to satisfy the market's need for goods and services with a minimum of total resource consumption	(Moseng and Rolstadås, 2001)

Table I.
Examples of definitions of productivity

turn means that they usually only show a part of the "true" meaning of productivity. Broman (2004) suggests that it is necessary to have a clear distinction between a concept and a particular mathematical definition attached to the concept, in order to effectively evaluate the characteristics of the mathematical definition.

(Bernolak (1997) provides a useful verbal explanation of productivity are related to manufacturing:

> Productivity means how much and how well we produce from the resources used. If we produce more or better goods from the same resources, we increase productivity. Or if we produce the same goods from lesser resources, we also increase productivity. By "resources",

> we mean all human and physical resources, i.e. the people who produce the goods or provide the services, and the assets with which the people can produce the goods or provide the services. The resources that people use include the land and buildings, fixed and moving machines and equipment, tools, raw materials, inventories and other current asset.

This definition captures two important characteristic. First, productivity is closely related to the use and availability of resources. In short, this means that a company's productivity is reduced if its resources are not properly used or if there is a lack of them. Second, productivity is also strongly connected to the creation of value. Thus, high productivity is achieved when activities and resources in the manufacturing transformation process add value to the produced goods. An important conclusion is therefore that one must eliminate waste in order to improve productivity: waste can be considered to be the opposite of what productivity symbolizes.

Broman (2004) points out the inherent similarities in many definitions of productivity; the basic content seems to be the same. Ghobadian and Husband (1990), however, suggest that, within the similar definitions, there are three broad categorisations:

(1) The technological concept: the relationship between ratios of output to the inputs used in its production.

(2) The engineering concept: the relationship between the actual and the potential output of a process.

(3) The economist concept: the efficiency of resource allocation.

Implications

A common mistake is to equate productivity with production – the amount of a product or service produced (Stainer, 1997; Bernolak, 1996). This would suggest that increased production represents increased productivity. This is not necessarily true. Productivity is a relative concept: it cannot be said to increase or decrease unless a comparison is made, either of variations from a "standard" at a certain point in time (which can be based on, for example, a competitor or another department) or of changes over time. Moreover, as stated by Misterek *et al.* (1992), improvements in productivity can basically be caused by five different relationships:

(1) Output increases faster than input; the increase in input is proportionately less than the increase in output (managed growth).

(2) More output from the same input (working smarter).

(3) More output with a reduction in input (the ideal?).

(4) Same output with fewer inputs (greater efficiency).

(5) Output decreases, but input decreases more; the decrease in input is proportionately greater than the decrease in input (managed decline).

Most transformation processes within a company are fed with several types of input (e.g. labour, capital, material and energy) and emit more than one output (e.g. product A, product B) – see Figure 1. This complicates the calculation of productivity (Kurosawa, 1991).

Broman refers to the commensurability problem, recognizing that each variable in the process is not measurable against the same standard or in the same units (Broman,

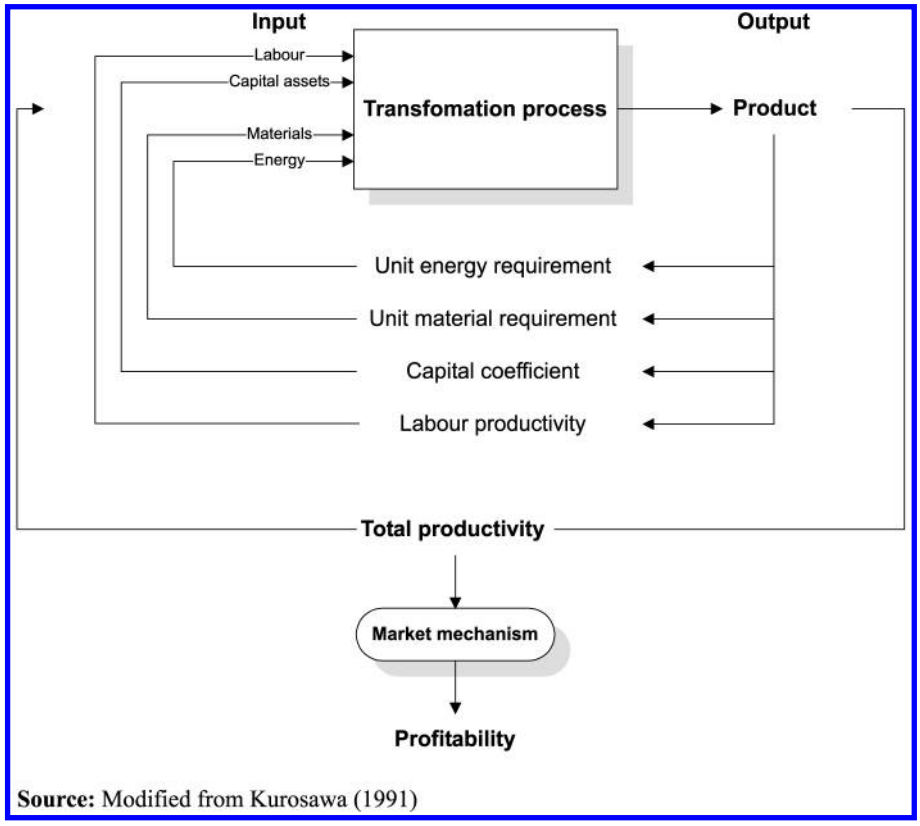

Figure 1.
Transformation process and productivity model

2004). Finding an appropriate way to solve the commensurability problem has resulted in various types of productivity measures and ways to aggregate inputs and outputs by use of weightings.

Some of these measures relate to a subset of inputs – partial productivity; others attempt to consider all inputs – total productivity (see Craig and Harris, 1973; Grossman, 1993; Sumanth, 1994; Hannula, 1999).

Additionally, even though the concept of productivity – for manufacturing organisations – relates to physical phenomena (the outputs from the manufacturing process), productivity is variously expressed in monetary or physical units. Gold (1980) suggests that it is impossible to measure the "physical efficiency" of a manufacturing process (or any other economic process), since there is no physical common nominator for combining different kinds of inputs.

Finally, the meaning of productivity varies depending of what context it is placed in. For example, a strategic perspective of productivity amongst senior managers will usually differ from the more operational view of productivity among operators of an assembly line. This reasoning indicates that productivity must be seen from a different point of view at each level and that the means for achieving high productivity may be level specific. One categorisation of the different levels in a company is:

- the individual machine or manufacturing system;
- the manufacturing function, for example assembly;
- the manufacturing process for a single product or group of related products;
- the factory; and
- the company's entire factory system (Gerwin, 1987).

Profitability

Perhaps the reason why companies tend to ignore the importance of productivity is that they often link productivity and profitability as one issue. There is no sense in denying that productivity and profitability are interdependent, but they do not always go hand in hand (West, 1999). Generally speaking, the term profitability is the overriding goal for the success and growth of any business; it can be defined as the ratio between revenue and cost (i.e. profit/assets). However, the profitability ratio mainly addresses the needs of shareholders (as the primary interest group) and many researchers therefore claim that an excessive use of monetary ratios can have disadvantages. For example, it can induce short-termism and discourage a perspective on customer views (see Ghalayini *et al.*, 1997; Jagdev *et al.*, 1997; Kaplan and Cooper, 1998). Grünberg (2004) states that profitability does not have a direct impact when it comes to improvement purposes, since it is a result of, rather than a contributor to, the actions and processes in operations.

A significant issue is that profitability can change for reasons that have little to do with productivity; for instance, cost or price inflation (Bernolak, 1996) and other external conditions that may bear no relationship to the efficient use of resources (Stainer, 1997). This has in turn made researchers argue that productivity is a more suitable measure to monitor manufacturing excellence in the long run rather than profitability, since profits are influenced by many factors over the short term (Miller, 1984).

Increased productivity does not necessarily lead to increased profitability in the short term but the effect of increased productivity is more likely to be realised in terms of long-term profitability (Tangen, 2002a).

Miller (1984) was one of the first to discuss this in detail. He explained how profitability could be separated from productivity by the price recovery, defined as a ratio of unit prices related to unit costs (see Figure 2). The "profitability = productivity + price recovery" procedure can be structured in several ways (see Miller, 1984; Wollf, 1990; Edgren, 1996), but in simplified terms it means that productivity is defined as output quantities per input quantities. Profitability on the other hand, is defined as output quantities times output unit price per input quantities times unit costs (Bernolak, 1997). Organisations should combine productivity and profitability ratios, so that the true reasons for increased profits can become clearer.

Performance

According to Thomas and Baron (1994), many people who claim to be discussing productivity are actually looking at the more general issue of performance. Even though productivity is a multidimensional term, one has to remember that it is a fairly specific concept related to the ratio between output and input. Performance, on the

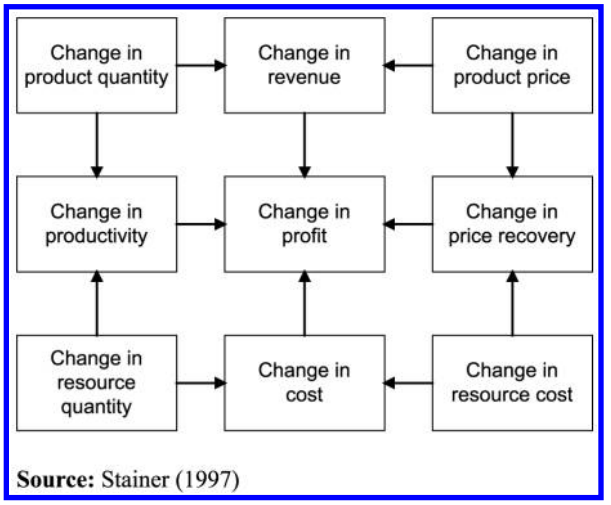

Figure 2.
Productivity, profit and price recovery

other hand, is an even broader term that covers both overall economic and operational aspects. It includes almost any objective of competition and manufacturing excellence whether it is related to cost, flexibility, speed, dependability or quality (Figure 3). Furthermore, performance can be described as an umbrella term for all concepts that considers the success of a company and its activities. Nevertheless, the types of performance that a particular company strives to fulfil are very case specific. Slack *et al.* (2001) offer the following description of high-performance operations that most companies aim to accomplish:

- High-quality operations do not waste time or effort having to re-do things, nor are their internal customers inconvenienced by flawed service.
- Fast operations reduce the level of in-process inventory between micro operations, as well as reducing administrative overhead.
- Dependable operations can be relied on to deliver exactly as planned. This eliminates wasteful disruption and allows the other micro operations to operate efficiently.
- Flexible operations adapt to changing circumstances quickly and without disrupting the rest of the operation. Flexible micro operations can also change over between tasks quickly and without wasting time and capacity.
- Low cost operations lead to higher profits as well as allowing the company to sell their products to a competitive price.

In turn, this has led to performance objectives, especially those relating to quality, being seen as a part of the concept of productivity by some researchers (see for example Al-Darrab, 2000). However, the concept of quality is often used in a very wide context, relating to both processes and products as well as including both tangible and intangible factors. Improvements in quality, other than the fact that no-fault products add to output levels, ought not to be included in the concept of productivity. Quality and productivity often come hand in hand, but they are two separate concepts.

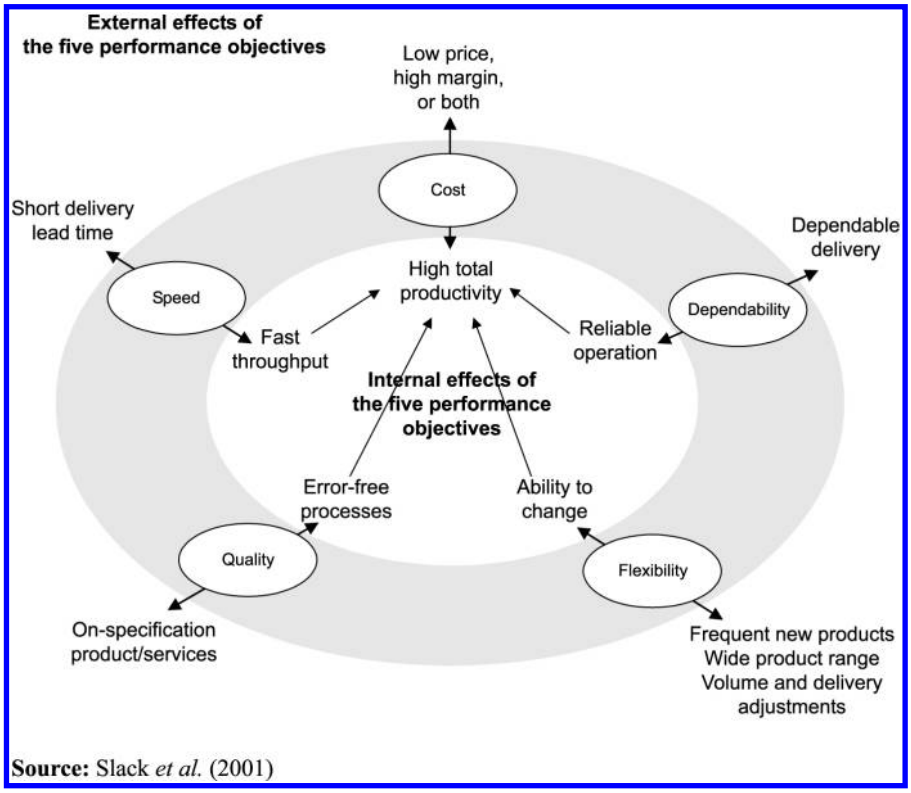

Figure 3.
Performance objectives

Efficiency and effectiveness

The terms effectiveness and efficiency further complicate the terminology within this field. These terms are frequently confused with each other. However, as stated by Sink and Tuttle (1989) effectiveness is usually in simple words described as "doing the right things", while efficiency means "doing things right". Several examples of other definitions are given in Table II. Nevertheless, most researchers concur that efficiency is strongly connected to the utilisation of resources and mainly affects the denominator (inputs) of the productivity ratio. In detail, efficiency is commonly defined as the minimum resource level that is theoretically required to run the desired operations in a given system compared to how much resources that are actually used (see Figure 4). Further, the efficiency ratio is rather simple to measure, whether it is based on time, money or other units. In addition, efficiency is very similar to the concept that is referred to as utilisation rate (i.e. degree of utilisation), which means how much equipment or a process is used in practice compared to its maximum.

Effectiveness, on the other hand, is a more diffuse term and in most cases very difficult to quantify. It is often linked to the creation of value for the customer and mainly influences the numerator (outputs) of the productivity ratio. A good, simple description of effectiveness is "the ability to reach a desired objective" or "the degree to which desired results are achieved". Such definitions lead to an interesting concept: there are usually no limits as to how effective an organisation can be.

Definitions of efficiency	Definitions of effectiveness	Reference
Efficiency is an input and transformation process question, defined as the ratio between resources expected to be consumed and actually consumed	Effectiveness, which involves doing the right things, at the right time, with the right quality etc., can be defined as the ratio between actual output and expected output	(Sink and Tuttle, 1989)
Efficiency is used for passive or operational activity, which is usually defined technically so that the system and its behaviour are foreseeable in advance	Effectiveness is basically used in active or innovative activity performed by a risk taker and based on a rather broad perspective	(Kurosawa, 1991)
Efficiency is the ratio of actual output attained to standard output expected, and reflects how well the resources are utilised to accomplish the result	Effectiveness is the degree of accomplishment of objectives, and shows how well a set of results is accomplished	(Sumanth, 1994)
Efficiency is a measure of how economically the firm's resources are utilised when providing the given level of customer satisfaction	Effectiveness refers to the extent to which the customer requirements are met	(Neely *et al.*, 1995)
Efficiency means how much cost is expended compared with the minimum cost level that is theoretically required to run the desired operations in a given system	Effectiveness in manufacturing can be viewed as to what extent the cost is used to create revenues	(Jackson, 2000)
Efficiency = ideal system dependent time/total time	Effectiveness = value added time/ideal system dependent time	(Jackson, 2000)

Table II.
Examples of definitions of effectiveness and efficiency

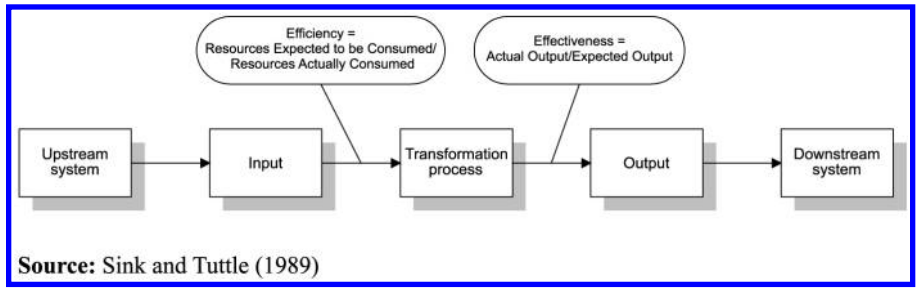

Figure 4.
Efficiency and effectiveness

Jackson (2000) states that a single focus on efficiency does not seem to be a fruitful way to increase productivity. Unfortunately, such single focus is often the case in industry, especially when cost-cutting activities are employed. However, it is the combination of high values of efficiency and effectiveness in the transformation process that leads to

high productivity. Thus, it is possible for an effective system to be inefficient; it is also possible for an efficient system to be ineffective (Tangen, 2002b).

The triple-P model

A schematic view of how common terms within this field might be used is illustrated by the triple-P model (Figure 5). The model is based on the terminology descriptions in the previous sections and explains how they are related to each other. In this way the main differences between the terms are easily captured (also see Tangen, 2002a,b; Grünberg, 2004).

Productivity is the central core of the triple P-model and has a rather straightforward operational definition of productivity as the relation between output quantity (i.e. correctly produced products which fulfil their specifications) and input quantity (i.e. all resources that are consumed in the transformation process). It is here argued that even though it is difficult to measure different quantities by the same standard, the concept of productivity is purely a physical phenomenon and must therefore be defined as one. Profitability is also seen as a relationship between output and input, but it is a monetary relationship in which the influences of price-factors (i.e. price recovery) are included. Performance is the umbrella term of excellence and includes profitability and productivity as well as other non-cost factors such as quality, speed, delivery and flexibility. The two terms effectiveness and efficiency are somewhat cross-functional when it comes to the other three terms. Effectiveness represents the degree to which desired results are achieved; Efficiency represents how well the resources of the transformation process are utilized.

Conclusions

Sink and Tuttle (1989) consider that definitions are important and necessary to reduce confusion, but are most often neglected:

> The field is filled with practitioners with no conceptual models and weak operational definitions; the field is filled with academicians with weak conceptual models and no

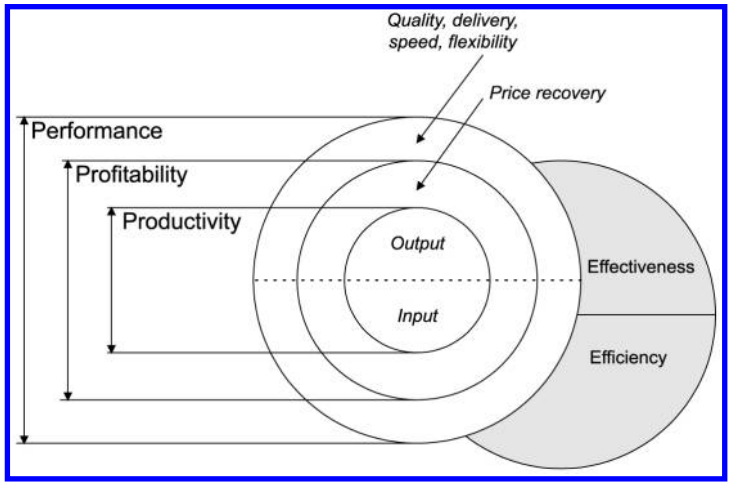

Figure 5.
The triple P-model

operational definitions. The result has been confusion in the literature and in practice with no respect to performance measurement and improvement.

This paper has tried to reduce confusion by explaining the basic meaning of frequently used terms within the field of productivity and performance management. However, one must still accept the fact that people will continue to interpret them in slightly various ways. The creation of a completely common grammar is not an easy task, especially with a range of terms that have been in relatively common usage for some time without such grammar. However, hopefully this paper has illustrated that there is a shared understanding of the basic features that characterize these terms.

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