DOES PRODUCTIVITY SCIENCE JUSTIFY USE OF THE WORD 'SCIENCE'?

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Abstract

Productivity Science is a term in fairly general usage to describe the principles and practises of productivity development and improvement. This paper examines the use of the word 'science' in this term to try and justify the use of the term 'productivity science' to describe such practices and activities.

Does Productivity Science justify use of the word 'science'?

WCPS proudly incorporates the term 'productivity science into its name., aiming to bring together people and organisations around the globe that promote, support and practice the development and improvement of productivity. Improving productivity is the only sustainable means of improving human wealth and well-being (Kim, Loayza, and Balcazar). WCPS firmly believes that such wealth and well-being is a key underpinning of world peace.

In the 2000s, WCPS clarified its definition of productivity to stress that development must address social and environmental factors in addition to established economic factors. The resulting multi-factor productivity model is described as SEE (social, environmental and economic) productivity.

Productivity improvement is recognised as a major underpinning of economic development. but is this recognition of its importance sufficient to justify the use of the word 'science'? This paper explores this issue by looking at the practice of productivity measurement and development, comparing it to the processes of investigation in what is generally referred to as 'scientific method'.

What is science?

Science can be defined as the pursuit of knowledge and understanding of the natural and social world using a systematic methodology based on collecting evidence to prove theories/conjectures resulting from observation of natural phenomena.

The various processes and activities characteristic of science are collectively known as the 'scientific method and represent the 'how' of science - the means by which science is carried. These are activities such as systematic observation and experimentation, inductive and deductive reasoning, and the formation and testing of hypotheses and theories. (Hepburn and Andersen).

Further thought on the nature of 'science' leads to the clarification of 'the systematic method' referred to above.
A common or generic process can be usefully summarised as:

- Select a problem or phenomenon to be investigated
- Observe instances of the phenomenon, recording input, contextual and environmental factors along with outcomes of the phenomenon
- Construct a hypothesis which explains the observed outcomes and relates the associated factors
- Carry out a series of experiments under varying conditions (different values of the input, contextual and

environmental factors) so that observed behaviours and outcomes of the phenomenon can be replicated - and record the conditions under which this replication takes place

- Analyse experimental data and draw conclusions
- Decide whether the hypothesis has been proved.

Scientists do use the scientific method, but they do not always do so as laid out in this exact process. They may modify the process by skipping steps, jumping backwards and forwards between steps, or repeating a number of the steps because they are dealing with imperfect real-world conditions or because they have existing, partial knowledge of the situation under review.

But they will use the core of the methodology by using observations, experiments, and data analysis to support or reject their theory of how a phenomenon works.

While conducting experiments is considered the best way to test hypotheses, sometimes this is not possible (for example in astronomy or when investigating certain phenomena relating to animal or human life) and the theory/hypothesis must be judged by observations alone.

One of the more recent 'sciences' is that of 'management science'. This term emerged with the application of science (principally data science) to management problems via approaches such as operational research, systems analysis and management information systems. Rather than applying to the whole field of 'management', the term 'management science' is possibly best reserved for the application of such techniques to managerial problem-solving and decision - making. Much of the work done and reported as management science employs mathematical techniques such as modelling & simulation, statistics and calculus.

Management more generally can benefit from both these scientific techniques and approaches based on creativity and inspiration. Many inventions and innovations have come from inspirational moments, but these, themselves, are often based on the hard work of science being applied to investigate a particular situation or problem. This is presumably the basis of Thomas Edison's famous quote:, "Genius is 1% inspiration and 99% perspiration", meaning that the brainwave moment tends to follow thorough preparation and investigation.

Management can thus be considered as both a science and art form.

This mirrors progress in the behavioural sciences where over several decades psychologists have tended to converge on dual-process theories of behaviour that propose that rapid, intuitive and non-conscious cognitive processes sit alongside deliberative, reflective and self-aware ones. (Lieberman, 2007)

If the above represents the scientific method - and therefore the basis of 'science' - then 'productivity science' should broadly follow such a methodology.

There are numerous systematic approaches or methodologies that have grown up around productivity development. - Business Process Re-Engineering, Balanced Scorecard, Lean, Kaizen, Kata, Six Sigma, TRIZ and so on. Some of these are, or include, specifically science-based approaches: data envelope analysis (DEA), queuing theory, workforce planning, multi-variable analysis, six sigma etc.

However, probably we should first take a look at what is the first pairing of the words 'science' and 'management'. This is the use of the term 'scientific management' by Frederick Winslow Taylor in the early part of the 20th century.

Taylor suggested that managers should systematically examine what their workers do and codify an agreed working method, rather than allowing each man to use 'rule of thumb' and personal preference to determine how he completes a

task.
This agreed method could then be used as the basis of training any new workers.

The result is that each worker can then be given a clear task with an agreed working method and a target for completion - or throughput - based on this method. In return, the manager can prepare a production plan based on the same data and could, in some circumstances, offer incentives in the form of bonus payments for output over the agreed target. (Taneja, Pryor and Toombs, 2011)

The most comprehensive of these productivity improvement approaches do, indeed, share elements with the scientific method They tend to use various scientific research-based principles, strategies, and analytical methods including mathematical modelling, statistics and numerical algorithms with the aim of improving the ability of an organisation to take rational and accurate management decisions by arriving at optimal or near optimal solutions to complex problems.

Sometimes it can be argued that the methodology itself has been created following adoption of the scientific method by the developers of the methodology and the end user is 'piggybacking' on the work of these developers (and their science) when they apply the methodology to a specific situation.

This is certainly true of TRIZ. TRIZ was developed by the Soviet inventor Genrich Altshuller and his colleagues and uses the acronym TRIZ which, when the Russian words are translated into English results in "The Theory of Inventive Problem Solving". TRIZ is not, though, a theory: it is a collection of tools and techniques.

Altshuller and his team looked in detail at hundreds of patents filed within Russia and eventually came to the conclusion that many of the inventions listed were solving variants of a limited number of problems. Thus what is needed is a common set of 'solutions' that can be redeployed to the whole variety of problem types. The team also noticed that many problems contain inherent contradictions, such as "We need this part to be longer, but we also need it to be heavier." The TRIZ database includes inventions and innovations that address such contradictions. (Altshuller, 1999)

Again, the users of TRIZ are building on the work of previous scientists and inventors, and of course on the work of Altshuller and his team who analysed the patent data and codified sets of general problems and sets of general solutions which can be applied to these problems.

TRIZ is very useful at the 'creativity stage' of problem solving when we are looking at new idea and innovations trying to answer the question, "How else could we achieve our desired end result?"

Examining a range of these productivity improvement methodologies and tools shows that
there is certainly sufficient correspondence between these various methodologies and the scientific method to justify the use of the term 'productivity science' to cover systematic and comprehensive productivity improvement/development approaches.

The implications of the fact that systematic, comprehensive productivity improvement methodologies are based on, or align with, scientific method are that those seeking to improve organisational or national productivity should adopt a structured and systematic approach. The collection and analysis of performance data to guide and to evaluate the success of productivity improvement initiatives and programmes ensures that any long-term programme of improvement (and the nature of its application to specific situations) can be refined and improved on the basis of real-world and recent evidence.

Principles to underpin the application of productivity science to specific productivity development initiatives
Consideration of the above, together with the fundamental commitment to addressing all of social, environmental and

economic productivity leads WCPS to recommend that those interested in pursuing productivity development as part of an economic development strategy should develop a strategy for productivity development which:

- Recognises particular, local cultural and social factors which might influence the effectiveness of the strategy
- Recognises the current state of infrastructure elements which might reduce the potential for higher productivity
- Uses transparent communication media and methods to ensure that those likely to be affected by the project are \ fully informed of the reasons for the project and the process that will be adopted in its execution
- Predicts the effects of productivity interventions using predictive modelling and the identification of causal relationships
- Adopts measures of performance which incorporate social, environmental and economic factors
- Creates targets for improvement, based on processes such as sector benchmarking which can be recognised as achievable by key players in target sectors/communities
- Recognises the importance of adopting productivity improvement approaches and methodologies which align with scientific method
- Ensures that productivity gains should be shared by the various communities involved in the situation under review/investigation - and by wider society

Adoption of these principles - along with a long-term view - is more likely to lead to outcomes which meet declared aims and objectives and which will be regarded as 'success' by all key stakeholders.

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