



Historical analysis of performance measurement and management in operations management

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Abstract

Purpose – This paper seeks to take a historic perspective on performance measurement and management (PMM) within operations management (OM) across all sectors (manufacturing, service and public) in order to reflect on and uncover relevant lessons and issues about PMM in OM.

Design/methodology/approach – Drawing from a range of documents and experts, three historic phases were identified which reflected changing aspects of PMM in OM from the early twentieth century until today.

Findings – The analysis shows that most of PMM within OM derives from work study and productivity measurement within manufacturing during the industrial revolution. The general trend shows a movement away from performance measurement towards performance management. The paper illustrates how views of PMM have moved in three directions: the broadening of the unit of analysis; the deepening of performance measures; and the increasing range of performance measures.

Research limitations/implications – The paper concludes by presenting four reflections and challenges including the fact that the drive for productivity still exists and there is a need to continue to develop measures across organisations which are also predictive. Finally, that lessons between private and public sectors regarding PMM are shared.

Originality/value – The paper argues that in order to evaluate the movement in the three directions effectively it is necessary to differentiate between the terms performance measurement, performance reporting and performance management.

Keywords Performance management, Performance measures, Operations management

Paper type Conceptual paper



Introduction

Operations management (OM) is concerned with the management of organisational activities which produce goods and/or deliver the services required by its customers. Slack *et al.* (2005) argue that one of the fundamental models within operations management is the “transformation process” in which a set of inputs are transformed into a set of outputs – typically a mixture of goods and services. The transformation can occur at all levels within an organisation – from a task within a department to operational level across departments and even at strategic level through the supply chain (Slack *et al.*, 2005). The management issues at all these levels are similar, and include capacity, design, managing demand and planning. However, often there is a

need to understand and measure the performance of the process. The two most important aspects of performance are generally considered to be efficiency and effectiveness. Efficiency is based around the notion of output divided by input which focuses measures around the productivity of a process and the utilisation of resources. Effectiveness on the other hand has been based around the notion of the appropriateness of the outputs of the process, which focuses on a broader set of measures. However, as the prime concern of most enterprises has been a desire to ensure that financial (economy) stability and growth is achieved, it is the measurement of efficiency that has dominated operations management since the start of the industrial revolution. As Neely *et al.* (1997) argue, "Traditionally performance measures have been seen as a means of quantifying the efficiency and effectiveness of action ... an integral element of the planning and control cycle." However, they also conclude that "[This is a] somewhat mechanistic view. Performance measures also have a behavioural impact." This has been reflected over the last two decades when there has been a more concerted effort to move to effectiveness where more emphasis has been placed on outcomes and so softer measures such as levels of innovation, motivation and customer retention have come more to the fore.

This paper aims to take an historic perspective on performance measurement and management (PMM) within operations management (OM). The paper will take an historic perspective, using examples from manufacturing, service and public sector, in order to consider the following research questions:

RQ1. How has PMM within operations management evolved and developed?

RQ2. How have the measures and the management of them changed?

RQ3. How can PMM be defined within operations management?

RQ4. Finally, considering an historical analysis can any conclusions be drawn about the future and, importantly, the challenges of PMM in OM?

The paper starts from the premise that most of PMM within OM today appears to be derived from the introduction of work study/productivity measurement within manufacturing during the industrial revolution which has led to a focus on performance measurement. The paper will then discuss how aspects of performance measurement and management have changed over time, reflecting changes in the concerns of operations managers. Finally, the paper will reflect on the historical analysis in order to respond to the research questions. This paper aims to give a view and reflection of performance measurement and management from the perspective of operations management in order to draw lessons particularly relevant to that field.

The history of PMM in OM

As Voss (1995) notes: "OM is very much an applied discipline ... [with] a symbiotic relationship with industry". It is often difficult to discern whether OM theory leads or lags industrial practice, particularly with regard to PMM. To fully appreciate the OM perspective on PMM requires an historical analysis of OM theory and practice.

An emergent approach was taken to developing the historical analysis. Both a literature review and discussion with "experts" were carried out in order to identify distinct periods of performance measurement and management in operations

management, Criteria included changes in definitions as well as greater use of particular terminology, techniques and tools. Evaluation of key texts also took place (e.g. Neely, 1999; Slack *et al.*, 2005; Neely *et al.*, 1997; Johnston and Clark, 2005) in order to position the analysis. The purpose of the analysis was to produce a conceptual framework by which critical reflection could take place in order to develop some observations and possible future research agendas of PMM particularly relevant to operations management. The analysis differed from previous pieces of work (i.e. Neely, 1999) in that it considered PMM from one particular perspective and discipline – operations management.

It was concluded that over the last 100 years three distinctive time periods can be identified. However, the dates assigned to these periods need to be seen as indicative rather than definitive. The transitions from one era to the next should be considered as evolutionary and gradual rather than revolutionary and abrupt. The three periods are:

- (1) *The early twentieth century* – during which the foundations of OM as a discipline were laid, based on the emerging ideas of scientific management. This helped establish “the dominant management paradigm . . . [that] the role of the operations function [is] . . . to manufacture as efficiently as possible. Hence the question that operations managers wanted their measurement systems to help them answer was how efficient are we” (Neely and Austin, 2000).
- (2) *The post-Second World War years up to the mid 1980s* – which saw a gradual shift in OM from considering performance purely in terms of cost and efficiency to one which also encompassed other performance concerns especially quality, flexibility, timeliness, innovation, etc.
- (3) *The mid-1980s to date* – during which a growing dissatisfaction with existing performance measurement systems has led to what Neely (1999) has termed a “performance measurement revolution”, from which OM has not been immune.

These three periods will now be examined in more detail.

Early twentieth century

The origins of OM lie in the factories of the industrial revolution that enabled large scale manufacture for the first time. As the economist Adam Smith (1776) had predicted, the application of the principle of the specialisation of labour allied to the adoption of large scale machinery enabling goods to be produced at rates previously unimaginable using individual craft based approaches. However, one of the true founding fathers of OM (and arguably its most important influential), was Frederick Taylor. Taylor believed that it was management’s responsibility to devise the best method of performing work. In the first decade of the twentieth century he developed the concept of scientific management (Taylor, 1911). This was based on the analysis of existing work methods through observation and measurement. From this, an improved method could be developed and implemented, and its results monitored through ongoing performance measurement. Taylor’s ideas were advanced by many others including Frank and Lillian Gilbreth, who developed the concept of time and motion studies, which required the measurement of every single movement undertaken by a worker in the course of their work. This newly developed discipline which came to be known as work study, incorporated the study of work methods and the measurement of work.

The focus of scientific management was primarily on increasing the efficiency of individual workers. Taylor further stressed the importance of the individual worker by advocating the payment of individually based financial incentives to those workers who could increase their output as a result of the application of scientific management. This in turn required the measurement of the performance of individuals, especially their output. Thus, the emphasis of PM in scientific management was at the micro-level within each operation, focussing on the work and the output of individual workers. For more macro-level measures of performance, operations managers seemed mostly to look to financial figures supplied by management accountants (although, they were more likely to be termed “cost accountants” at that time). Performance measurement was conceived primarily in terms of the volume and cost, and hence productivity. In an era of labour intensive mass manufacture this made a lot of sense. These ideas came to dominate OM theory and practice well into the second half of the twentieth century. Their application made a significant contribution to the success of western, and especially US, industry in this period.

Despite its widespread adoption in large tracts of industry, what became known as Taylorism was not without its critics (These are well catalogued and vigorously rebutted by Locke, 1982). Many of these criticisms originate from the human relations movement, which had its origins in the Hawthorne experiments of Elton Mayo (Roethlisberger and Dickson, 1939), and the theories of Maslow (1954), McGregor (1960) and Herzberg (1966). This argued that worker motivation was best achieved by humanising the workplace. From a PMM perspective these criticisms seem to centre on the impact of scientific management’s concentration on the measurement of the work and the resultant performance of the individual. The human relations movement argued that the social factors of work were at least as important as the technical ones emphasised in scientific management. The performance measures of scientific management usually failed to reflect this. Such criticisms led to the start of the trend to broaden the unit of analysis of work measurement from the individual to the work group.

Post-Second World War to mid-1980s

In many respects, the immediate post war years were a golden age for quantification in management as the newly developed techniques of management science (also known as operations research) allied to the computational powers of the first commercially available computers were added to the practices of scientific management.

However, a number of changes in the working environment led to a gradual rejection of the dominant efficiency and cost focus of PMM in OM. As discussed, there was a gradual increase in the influence of human relations movement at the expense of Taylorism. During the 1950s and the 1960s, scientific management came to be seen as a manifestation of an autocratic management style that seemed increasingly outmoded in a new democratic era. In an era of low unemployment, there was a concern to improve the quality of working life to attract and retain sufficient numbers of high calibre staff. Fuelled by the theories of the human relations school, it was perceived that performance would improve if workers were given a greater say in how they performed their work. This would eventually lead to experiments with self-managed teams, quality circles and other attempts at group based participation. Workers were given more autonomy in determining how they carried out their tasks. The worst

excesses of specialisation were increasingly frowned on and job enrichment and job enlargement became the order of the day.

With this rise in the acceptance of motivation theories there was the backlash against work measurement approaches and the efficacy of performance related pay schemes was increasingly challenged. Where financial incentives schemes were retained, these tended to become group rather than individually based. This all led to a reduction of the influence and practice of work study and measurement. OM's concern for performance measurement at the micro-level gradually disappeared. Operations managers now wanted measures that would reflect their concern for the performance of the team rather than that of the individual.

As the 1960s gave way to the 1970s, questions began to be asked about the wisdom of concentrating solely on performance measurement. The previously unassailable position of US style management practice was increasingly challenged as manufacturers across the world were forced to face up to fierce competition from Japanese companies. It became apparent to consumers that Japanese manufactured goods had both appreciably fewer defects than those of their western counterparts as well as often a much greater product variety. To the thinking of western operations managers such approaches should have led to higher cost. Improved quality must have involved increased spending on quality activities. The introduction of greater variety should have negated some of the benefits of mass manufacture. Yet, Japanese goods were usually competitively priced. Western operations managers were therefore forced to reconsider their practices, including their approach to PMM.

Some called for better measures of efficiency so that they could assess why some factories, notably Japanese ones, were more productive than others. Hayes and Clark (1986) concluded that what was required was "a dependable metric for identifying and measuring such differences and a framework for thinking about how to improve performance". They advocated the use of total factor productivity, calculated by "dividing output by labour materials, capital and energy costs, at constant prices". They bemoaned operations managers' "pre-occupation with labour costs ... even though direct labour now accounts for less than 15% of total costs in most manufacturing companies".

However, others challenged the dominant mindset that cost should be the main concern of operations managers. Skinner's (1974) view was that a:

... major cause of companies getting into trouble with manufacturing is the tendency for many managers to accept simplistic notions in evaluating performance of their manufacturing facilities ... the general tendency in many companies is to evaluate manufacturing primarily on the basis of cost and efficiency. There are many more criteria to judge performance.

This was inherent in the Japanese approach to OM. As Hayes and Abernathy (1980) argued, much of Japan's economic success seemed to be due to their pursuit of both efficiency and effectiveness. Western OM had almost certainly been guilty of concentrating on the former at the expense of the later.

New measures were required to reflect the new found concern for effectiveness. The natural starting point for this was quality – something that consumers were clearly concerned about and something that the Japanese excelled at. Initially, the focus was on eliminating defects and achieving conformance. Western operations managers turned to the application of statistics to solve their need for quality measures. Ironically, such

statistical techniques were based on the work of a number of Americans – most notably Shewhart (1980) Deming (1982) and Juran (Juran and Gryna, 1980) – who had been largely ignored by their compatriots, but whose ideas had been enthusiastically taken up in post war Japan. Such measures were initially aimed at improving effectiveness by reducing the number of product defect experienced by customers. However, their use would lead to a growing realisation that improved process quality could also improve efficiency much more successfully than the traditional accountancy based measures that operations managers often had to rely on.

The advent of total quality management (TQM) increased OM's concern to improve effectiveness and responsiveness. This, therefore, saw the introduction of customer-based measures. This linked well to the requirements of the increasingly important service operations sector for measures of customer satisfaction. In services, a level of high quality was seen as synonymous with a high level of customer satisfaction.

The lessons learnt from the Japanese experience, led to an increased understanding of the importance of the role of operations in achieving customer satisfaction and hence in the strategic success of the company. As Neely and Austin (2000) put it, in the 1980s there was:

... a growing recognition that operations had a strategic role to play. Suddenly managers were interested in understanding whether the operation they managed was achieving appropriate levels of performance.

There was a widespread view that the traditional performance measures of OM were inadequate. Neely *et al.* (1995) characterise these shortcomings as:

- encouraging short-termism;
- lacking strategic focus;
- encouraging local optimisation;
- encouraging managers to minimise variance from standard rather than seek continuous improvement; and
- failing to provide information on what customers want and what their competitors are doing.

In short, there was a recognition that OM was experiencing what Neely and Austin (2000) term “the first measurement crisis - measurement myopia ... [caused by] measuring the wrong things”. The new found concern for quality had required measures with which operations managers could track their performance. As will be discussed next, quality measures were not the only new measures that operations managers would need to concern themselves with. Many others would follow, as operations managers sought to find the “right things” to measure. This would lead to yet more broadening of the unit of analysis of measurement and to a deepening of, and an increasing range of performance measures in OM.

Mid-1980s to present day

The late 1980s and early 1990s saw the rise of business process re-engineering (BPR) which had main principles based on a consideration of organisations in terms of processes – looking across organisations horizontally rather than functionally and on creating an environment which allowed “breakthrough” or “step-change”

improvements. BPR focused on those processes that crossed departmental boundaries, which enabled operations to be seen as more clearly linked with other departments (e.g. Marketing). This promoted a more strategic consideration of operations and gave rise to operations being assessed against objectives beyond cost and quality, including speed, flexibility and dependability (Slack *et al.*, 2005).

The majority of OM text books today clearly present the process view, suggesting that operations needs to compete across all the factors important to a particular organisation. The importance of linking operations objectives beyond cost and quality, has led to many of the performance measures within OM being adopted by service organisations and even the public sector. The notion of “delivery” has been taken beyond a product to “service delivery”. Consequently, the need to measure the effectiveness of the delivery has become important.

Both TQM and BPR allowed the focus of OM to move from merely “producing”, towards also “improving”. This was reflected in performance measures that were becoming wider and deeper. As Bourne *et al.* (2000) note:

... in the late 1980s and early 1990s, this dissatisfaction [with traditional backward looking accounting based performance measurement systems] led to the development of “balanced” or “multi-dimensional” performance measurement frameworks. These new frameworks placed emphasis on non-financial, external and forward looking performance measures. These frameworks have been dominated by one particular model “The balanced scorecard” (BSC).

The BSC was first presented by Kaplan and Norton in 1992 as an improved approach to performance management beyond standard financial metrics. Since then, it has grown from being a tool for organising measures to being a device for controlling the implementation of strategy. It has become one of the preferred strategic performance management tools of many prominent public and private sector organisations (Radnor and Lovell, 2003). If designed and implemented correctly, reported benefits include the improved articulation and communication of strategy, improved organisational control and strategic and operational process alignment (Kaplan and Norton, 1992, 2000).

Since its introduction, the BSC has evolved in terms of its design characteristics, design processes and usage patterns. Cobbold and Lawrie (2002) identify three “generations” of scorecards:

- (1) *First generation.* Originally Kaplan and Norton (1992) organised measures into clusters called perspectives. These four perspectives (financial, customer, internal processes and learning and development) represented, it was argued, the set of measures required by any organisation.
- (2) *Second generation.* The focus of the BSC moved towards the choice of objectives which could then be used to inform the choice of measures. The objectives were related through cause and effect relationships, documented in the form of a “Strategy map” organised across four or more perspectives (Kaplan and Norton, 2000).
- (3) *Third generation.* The idea of a destination statement (a long term plan) which informed the choice of the short and medium term objectives was introduced. These measurable strategic objectives are then organised into activities and outcomes linked through causal relationships.

The BSC approach has been adopted by a wide range of organisations from manufacturing (BP, Motorola, Ford), to service (Vodafone, Marriot Hotels, British Airways) and the public sector (the UK's National Health Service, local government and social services). It could even be argued that the approach has led to PMM becoming an industry in itself, with some organisations measuring literally hundreds of things at any one time. Performance measurement itself is costing companies vast amounts of money, time and energy.

In particular, an exponential rise seems to have occurred within the public sector where the development of performance measurement was not really felt until the 1980s. In the 1980s and 1990s the analysis of public sector reform in the UK focused on "New public management" (NPM). There are many different definitions of NPM, which tend to overlap (Pollitt, 2003). Pollitt (2001) defines NPM, among other things, as:

- A shift in focus of management systems and management effort from inputs and processes to outputs and outcomes.
- A shift towards more measurement, manifesting itself in performance indicators and standards.
- A much wider use of market or market-like mechanisms for the delivery of public services.

Since New Labour came to power in the UK in May 1997, there has been an acceleration to the restructuring of government and public services begun under the previous Conservative governments (Hartley, 2002). This approach taken by New Labour has been under the banner of "modernisation and improvement" and includes many of the elements of NPM. From the Modernizing Government White Paper came a number of activities including, the development of the Public Services Productivity Panel who produced a raft of White Papers tackling Health, Social Services, Welfare and Criminal Justice (PSPP, 2000). In line with NPM, New Labour has also sought to bring transparency in the performance of public services through the introduction of targets within all major government departments linked to the Spending Review (from local, central government to education, health and community care). These targets then typically get translated by individual bodies and organisations to detailed operational level measures.

Therefore, in response to the NPM and modernisation agendas many services have developed or been subject to various initiatives or frameworks focused around performance measurement. These have included awards, tools and techniques which have been developed or initiated internally (e.g. TQM programmes, Charter Mark, Investors in People (IiP), Balanced Scorecard) but also initiatives and programmes that have been imposed, driven or initiated from central government. In the UK, these initiatives have included, for local government – Best Value and Comprehensive Performance Assessment (CPA), in the Health Service – Star Ratings and, in education – primary school tests and secondary school exam result league tables. All of these approaches lead to published results indicating either performance against a threshold position (e.g. number of stars 1-3) or a position in a league table (e.g. list of good or poor performers).

Fundamentally, performance measurement in the public sector has continued to centre around control, accountability and reporting, based on efficiency (in order to justify to the public "value for money"). Performance management related to

improvement in operations processes and outcomes has been far less prominent – even neglected – in some areas of the public sector. As well as the intrinsic technical complexity of understanding the causal relationships involved in long-term outcomes of public service provision, this “neglect” reflects the political complexity of public agencies working together over long periods to drive real improvement.

Discussion and conclusions

Looking back

Plotting the history of PMM in OM has taken us from Smith and Taylor to Kaplan and Norton through manufacturing, service and public service sector. By considering the first research question – how has PMM within operations management evolved and developed? The three historical periods indicate that PMM in OM has moved from measurement based on efficiency and productivity related to cost to management on a broader more strategic level considering operations from a number of objectives.

The second question asked how have the measures and the management of them has changed? Again reflecting on the three periods of historical analysis presented it is possible to discern three general trends in performance measurement and management:

- (1) The broadening of the unit of analysis. Measures have moved from finite tasks and processes (Taylorism) to taking in ever larger work elements moving towards organisational level and even to outside the organisation along the supply chain from supplier to end-consumer (business process re-engineering).
- (2) The deepening of performance measures in that tools such as the balanced scorecard are linking the operational to the strategic.
- (3) The increasing range of performance measures as focus has shifted from purely from cost and output to cost, quality, flexibility, dependability, speed and outcome or, from efficiency to both efficiency and effectiveness and, from merely measurement to also management.

The third research question considers how can PMM be defined within operations management? Johnston and Clark (2005) note, the purpose of PMM within OM is “communication, motivation, control and improvement”. Moving from measurement to management requires that feedback control be added to the transformational model. This involves comparing measures of outputs with a given target value and taking corrective action if there is a difference between the two. A performance management system is one which provides information on the matters of importance (communication), promotes appropriate behaviour (motivation), provides a mechanism for accountability and control (control), and creates a mechanism for intervention and learning (improvement) (Neely, 1998; Fisher, 1995; Haas and Kleingeld, 1998). The historical analysis has shown that the moving arena of PMM in OM has meant, like in other disciplines, that the notion of what is performance measurement and what is performance management has become very mixed. For many researchers and others engaged in the field, the terms become interchangeable, even though, it will be argued, that it is helpful to consider them as different concepts.

In a paper by Lebas (1995) he describes performance measurement as including measures based on key success factors, measures for detection of deviations, measures to track past achievements, measures to describe the status potential, measures of

output and, measures of input. Whereas performance management: involves training, team work, dialogue, management style, attitudes, shared vision, employee involvement, multi-competence, incentives and rewards (Lebas, 1995, p. 12). Although, he argues that “(although the) processes involved in performance measurement and in performance management are not the same (but) they feed and comfort one another” (Lebas, 1995, p. 12). In other words, performance measurement and management are not separable although distinct should be made between them.

However, within many organisations, particularly the public sector the focus is on accountability with emphasis not only on measuring but also on reporting. Speaking with operations managers, particular in the public sector, through other research and teaching, the quote that “literally hundreds of measures are reported internally and externally a month” is frequently repeated. This seems to have led to the development of departments whose role it is to “feed the performance measurement and reporting beast” with little comprehension of the purpose or result in the activity. Interestingly, this vast amount of data and information is often not used by central government or politicians in any meaningful or systematic way (Pollitt, 2004).

Therefore, in considering the definition of PMM in operations management, and perhaps in organisations in general, it may be more useful to consider differentiating not only between measurement and management but also reporting. The following could be considered as possible definitions:

- Performance measurement is quantifying, either quantitatively or qualitatively, the input, output or level of activity of an event or process.
- Performance reporting is providing an account, and often some analysis, of the level of input, activity or output of an event or process usually against some form of target.
- Performance management is action, based on performance measures and reporting, which results in improvements in behaviour, motivation and processes and promotes innovation.

It could be considered, therefore, that performance measurement and reporting is about efficiency, productivity and utilisation. It is a reductionist concept based on the PMM regime which dominated the majority of the twentieth century, whereas performance management builds on performance measurement and is concerned with effectiveness and a broader, more holistic, even qualitative view of operations and the organisation which has risen as a concept and the PMM from the 1980s until today.

Looking forward

Finally, to address the last research question considering the historical analysis what can be concluded about the future and, importantly, the challenges of PMM in OM?

The first point to make is that the drive for productivity has not really disappeared. In a world of increasing global competition, the low wage economies of the developing world and the need for transparency and accountability pose a significant challenge to operations managers in both the manufacturing, service and public service sectors. As Taylor demonstrated so long ago, measurement is the starting point for improving operational performance. The challenge is in measuring the right things and using those measures as the basis for managing performance improvement. More and more

performance measurement and performance reporting, without performance management can be merely counter-productive.

The second challenge follows from this. How should PMM within OM be developed in the future? In particular, can PMM give the link across all functions/ departments of an organisation? The BSC (and similar PMM frameworks) emphasise the importance of taking a multi-perspective on PMM linked to organisational strategy. But, the process perspective provided by the BPR movement highlights the need to link operational activities across the firm and along its supply chain. The challenge then is how to develop a manageable and coherent set of performance measures for an organisation's business processes, rather than a proliferation of unconnected measures for individual operational tasks and activities.

Third, how can the lessons, issues and successes within the private sector help the development of PMM in the public sector particularly in terms of OM? While managing operations in the public sector undoubtedly throws up a new and different set of challenges, there is much to be learnt about PMM from the private sector. Many of the PMM issues that arise in the public sector have been faced before within the private sector. The challenge is to learn how to adapt, not merely adopt, and apply private sector experiences to best effect.

Fourth, there is a need to develop more predictive tools in PMM. Historically, the underlying premise of PMM is based on feed back rather than feed forward. This implies getting things wrong before you can get them right. There is much that could be done to incorporate the lessons of organisational behaviour into PMM. A greater consideration of the "software" rather than just the "hardware" of PMM, using PMM to change behaviours of operations managers not just the systems they manage, would surely yield massive benefits. Exactly how to do this is remains one of the great challenges for PMM in OM.

These four observations illustrate that in terms of OM, PMM will continue to broaden (across departments and supply change), deepen (through the use in the public sector) and extend in range (development of predictive tools). However, operations managers across all the sectors need to remember that PMM is a tool and means and not an end in itself and although understanding effectiveness and efficiency are important the extent at which they are measured, analysed and reported should be balanced with need to manage and deliver improved goods and services.

Future research should aim to investigate the degree to which performance measurement and management now enhances and drives improvement as it broadens, deepens and extends in range. Also questions should be raised regarding the relationship between performance measurement and management and innovation. For example, does PMM support or hinder innovation? Does the drive to hit targets mean the opportunities for creativity and innovation are stifled? Finally, a deeper understanding of the effect of PMM needs to be developed particularly in relation to "gaming" and unintended consequences – which after all are only behaviours or reactions displayed by people in response to the system that they find themselves in. Therefore, rather than focusing on designing the system by which we aim to drive behaviour maybe, more development should focus on designing the system as part of the behaviours.

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