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The theory and practice of performance measurement

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ABSTRACT

This paper builds on principles and techniques developed in measurement science, as currently understood in physical sciences and engineering, to improve the theory and practice of performance measurement. To do so, it firstly discusses three fundamental positions on measurement, characterized as metaphysical, anti-metaphysical and relativistic. Subsequently, it lays the foundations of a pragmatic epistemology of measurement in both physical and social sciences. Finally, these insights are integrated through the examination of possible advances in both the theory and practice of performance measurement in organizations.

1. Introduction

Performance is a notion that permeates contemporary societies, as it is used to assess the quality of individual and collective efforts (Corvellec, 1997). In management research, performance is often perceived as encapsulating the unitary purpose of organizations (March and Sutton, 1997). Indeed, organizations are required to 'perform' and to communicate their achievements to key stakeholders. As a consequence, organizational functions and processes are increasingly demanded to demonstrate their contribution to performance.

The need to establish links between planning, decision, action and results has generated substantial interest in the measurement of organizational performance. Scholars from management accounting and other areas of management research have examined a wide range of issues related to the design, implementation, use and review of performance measurement systems (see, for example, Chenhall and Langfieldsmith, 1998; Goold and Quinn, 1990; Hall, 2008; Henri, 2006; Ittner et al., 2003; Neely, 1999). In management practice, organizations have invested considerable amounts of resources to measure and demonstrate their performance (Hood et al., 2000; Micheli and Manzoni, 2010). However, there is no conclusive evidence over the benefits and shortcomings of introducing performance measurement systems in either private or public sector organizations (Griffith and Neely, 2009; Malina et al., 2007; Power, 2004; Townley et al., 2003).

This paper argues that both research and practice in performance measurement (PM) suffer from an underdeveloped conceptualization of the notion of performance measurability, and of the derived measurement processes. While the study of PM has often led to the critique or support of specific frameworks, such as the Balanced Scorecard (Kaplan and Norton, 1992, 2008), in physical sciences and engineering the very concept of measurement has been extensively debated also at a foundational level. Indeed, in this paper we argue that the current characterization of the concept in purely functional terms (Joint Committee for Guides in Metrology, 2008a) allows its application also to non-physical properties without any reductionist or physicalist implications and, as such, it could inform studies in management research.

By examining PM epistemology, we aim at advancing both the theory and the practice of management in two major ways. First, we draw on fundamental debates on

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measurement science made in physical sciences and engineering to provide more robust theoretical bases to the study of PM. Through the presentation of epistemological analyses on measurement, we re-examine key properties of measurement (e.g., objectivity, accuracy and precision). Moreover, we argue on the implications of adopting a criterion of adequacy, as opposed to a criterion of truth, and of a model-based view, as opposed to a truth-based view, for characterizing measurement and its results. Second, we explain and help address several issues that have emerged in PM related studies. Indeed, the epistemological position we propose offers a relevant perspective on the links between PM and strategy; on the roles of PM in organizations; and on the possibility of developing dynamic PM systems.

We start by providing an overview of current debates on the theory and practice of PM. We then introduce some epistemological analyses on measurement in the physical and social sciences. Subsequently, we present an outline of a conceptual history of measurement, as mainly developed in physical sciences and engineering, by comparing three main paradigms: metaphysical, anti-metaphysical, and relativistic. This discussion leads to the examination of PM as a fundamentally epistemic and pragmatic act, rather than as the determination of the 'true value' of organizational performance. We conclude by discussing several implications of this standpoint for measurement of performance in organizations.

2. Performance measurement: benefits, limitations and shortcomings

Studies in performance measurement have often focused on procedures and tools that could improve the efficiency and the effectiveness of organizations (Franco-Santos et al., 2007; Kaplan and Norton, 1992). Research has shown that, through appropriate measurement and management of performance, organizations can benefit in the following areas:

- formulation, implementation and review of organizational strategy (Ahn, 2001; Chenhall, 2005; Euske et al., 1993; Govindarajan and Gupta, 1985; Veliyath, 1992);
- communication of the results achieved to stakeholders, and strengthening of brand and reputation (Atkinson et al., 1997; McKevitt and Lawton, 1996; Neely et al., 2002; Smith, 1995a);
- motivation of employees at all levels, creation of a performance improvement culture, and fostering of organizational learning (Gittell, 2000; Henri, 2006; Malina and Selto, 2001; Roos and Roos, 1997).

Several empirical studies have shown how PM can be generally productive and help improve organizational performance (Cavalluzzo and Ittner, 2004; Davis and Albright, 2004; Ittner et al., 2003; Poister, 2003). However, despite considerable resources invested (Neely et al., 2006), PM related initiatives can often fail to deliver on their promises (Neely and Bourne, 2000). Furthermore, if done poorly, they can be not only ineffective, but harmful and indeed destructive (Perera et al., 1997; Royal Statistical Society, 2005). Therefore, it is crucial to understand under which specific conditions performance measurement and management practices can actually deliver improved performance.

So-called 'alternative approaches' have looked at PM, considering it more as a social practice rather than as a technical process (Covaleski et al., 1996). In this context, the need for deeper reflections on the conceptual and operative conditions required for the measurement of performance has been advocated (Chua and Degeling, 1993). Indeed, a number of scholars have remarked that PM is often regarded as the objective evaluation of reality by academics and practitioners (Morgan, 1988; Power, 1997). The customary use of adages such as 'if you cannot measure it, you cannot manage it' and 'what gets measured gets done' (Garvin, 1993; Johnson and Kaplan, 1987; Kaplan and Norton, 1992; Osborne and Gaebler, 1992; Peters and Waterman, 1982) sometimes expresses not only the acknowledged importance of PM in organizations, but also, and far more generally and critically, a (usually unjustified) belief on the epistemic role of measurement. These praising sentences have two major implications: first, they suggest that behaviors and action follow measurement, whereas this is not necessarily the case in organizations (Kennerley and Mason, 2008; Pollitt, 2006; Smith, 1995b). Second, they assume that all the key properties of measurement (e.g., objectivity, accuracy, and precision) are unproblematic and can be taken for granted.

A basic aim of this paper is to argue the underpinnings of such a position and to challenge the widespread, albeit often implicit, view that PM could enable organizations to determine the 'true value' of their performance. To this goal, we analyze the epistemological bases of PM, a topic about which, interestingly, little has been written. To do so, we build on debates on measurement in physics and engineering, where key aspects of the measurement process have been extensively discussed. Moreover, we address the fundamental question of what type of measurement (or evaluation) could be undertaken in social sciences.

3. Differences between sciences: epistemological preliminaries

While this paper is not aimed at investigating the complex topic of the (possible) methodological characterization of different scientific disciplines, it is important to consider the implications that different modes of explanation and theorization have on the theory and practice of PM. Indeed, important differences between sciences can be recognized in the process of theorization, in the way theories are applied, and how such a use is deemed to affect the behavior of theorized systems (Ghoshal and Moran, 1996). The application of management theories, unlike theories in sciences of inorganic or organic matter, generally has a significant impact on the object they relate to, e.g., the ways in which organizations function. As organizations are adaptive systems, in the social sciences theories tend to be self-fulfilling, whereas in physical sciences they clearly do not (Gergen, 1973). Consequently, the more a theory is based on strong assumptions on human self-interest and opportunism, as is the case of agency theory, the more it will induce exactly those types of behaviors expected from the theory itself (Ghoshal and Moran, 1996). On the other hand, despite the existence of significantly different explanation modes, processes of theorization and epistemic roles of the human agent, management scholars have adopted the "'scientific' approach of trying to discover patterns and laws, and have replaced all notions of human intentionality with a firm belief in causal determinism for explaining all aspects of corporate performance" (Ghoshal, 2005, p. 77). Such a concept of 'scientific' approach is clearly referring to 'hard' sciences, as arose and progressively developed from the Galilean–Newtonian interpretation of the role of experiments in knowledge acquisition and conceptualization. In fact, despite the nature of activity studied by social sciences, management often adopts modes of explanation and theorization that are derived from sciences such as physics or biology. As Ghoshal (2005, p. 79) notes, "management theories at present are overwhelmingly causal or functional in their modes of explanation". In this regard, in his Nobel Memorial Lecture, Friedrich von Hayek stated that economics, like other social sciences, is subject to the so-called 'physics envy', which leads researchers to draw inappropriate conclusions and to forcefully adopt methodologies and methods drawn from physical sciences (von Hayek, 1989). Von Hayek referred to this issue as 'scientistic error'.

Reflections on the differences between sciences have relevant implications on the epistemology of PM. A realist view of epistemology assumes that the external world can be accessed objectively and observations can be reported by means of a subject-neutral and theory-neutral language. It also supports the formulation of general laws for 'closed systems', where environmental influences can be controlled, or even completely eliminated (Tsoukas, 1989). A subjectivist, and, more generally, a non-objectivist, view denies the possibility of such an epistemological foundation, emphasizing that the critical role of human agents has to be stated and considered, possibly with reference to the interactions with an independent external reality, which can constrain or facilitate human action (Johnson and Duberley, 2000).

Social sciences entail operative interventions in social life and value judgments by investigators (Bhaskar, 1978): hence, instead of being primarily aimed at providing 'true descriptions' of the external world, their theories can be considered "a form of insight, i.e., a way of looking at the world, and not a form of knowledge of how the world is" (Bohm, 1980, p. 4). The polysemy of the fundamental concept of explanation is a meaningful indicator in this regard: while in physical sciences to explain mainly means to exhibit a law from which the explanandum can be derived by deduction – the so-called *nomological* explanation – in social sciences to explain mainly means to identify a goal able to justify the explanandum as a consequence – the so-called *teleological* explanation (Nagel, 1961).[1]

The adoption of an epistemological stance, such as the one advocated by Bohm, has relevant implications for the measurement of organizational performance. First of all, PM will have to be regarded as a form of insight, rather than the (actual or potential) 'true knowledge' of how organizations perform. Second, our understanding of organizational performance will be limited. These implications, in turn, could have substantial repercussions on the design, implementation and use of PM systems. Since these claims call into question the very concept and possibility of measuring performance, the following section discusses the epistemology, and in some degree the ontology, of measurement in more depth. To do so, recent developments in measurement science, as currently understood in physical sciences and engineering, are analyzed and subsequently implications for PM are discussed.

4. The epistemology of measurement

Management scholars have emphasized how, according to the positivist paradigm, which maintains an objectivist epistemological perspective, many studies in management are based on the following assumptions:

- "Variables other than the ones whose variation we would like to observe are perfectly controlled for.[2]
- The empirical scales measure the constructs completely.
- There is no cognitive disagreement among social agents about the definition of the situation.
- Social agents have an ability to reflect, that is, they can think about their own thinking and that of others" (Numagami, 1998, pp. 4–5).

Interestingly, these assumptions are aligned with traditional principles in physical science, for which measurement is "a process of empirical, objective assignment of symbols to attributes of objects and events of the real world, in such a way as to represent them, or to describe them" (Finkelstein, 2003, p. 41). On the other hand, we argue that, not only are the assumptions outlined by Numagami examples of 'physics envy' and 'scientistic error', but also current debates in measurement theory are questioning the validity of those very principles in physical science. With the aim of clarifying these issues and providing an alternative epistemological perspective on PM, an overview of the conceptual history of measurement of physical quantities is now provided.

4.1. Measurement: history and characterizations

The etymology of the Greek word for 'measure' provides an interesting insight into the concept and history

[1] Although the primary focus of this paper is not on the long-standing debate over the nature of social sciences, it should be noted how the paradigm of the 'design sciences', inspired by Simon (1996), has received considerable attention in recent years (Bate, 2007; Denyer et al., 2008; Huff et al., 2006; Romme, 2003).

[2] This assumption is often referred to as ceteris paribus hypothesis. In physics it has traditionally played a critical role to justify the superposition principle, for which, e.g., the problem of computing the state of a system of n interacting bodies, that in general is mathematically intractable for even low values of n, is reduced to the much simpler problem of computing the state of $n(n-1)/2$ systems of 2 bodies. Systems for which such a reduction leads to inadequate results are paradigmatically considered complex.

of measurement science (Mari, 2003). Indeed, two general meanings can be retraced for it: 'subjective evaluation' (as in the well-known quotation attributed to Protagoras: "man is the measure of all things, of the existence of things that are, and of the non-existence of things that are not") and 'objective description', in particular because of the Euclidean systematization of geometry, that interpreted 'measure' as a "comparison with an external standard, to point to a universal sort of inner ratio or proportion, perceived both through the sense and through the mind. (...) [A]s time went on, this notion of measure gradually began to change, to lose its subtlety and to become relatively gross and mechanical" (Bohm, 1980, p. 21). This shift also implied that measures ceased to be seen as forms of insight, and started to be understood more and more as absolute truths about reality as it is. Bohm also argues that this change has had significant consequences on both the ontological and the epistemological bases of science. However, according to Mari (2003), developments in the conception of measurement have questioned this mechanistic view. In order to support this claim, the author singles out three main paradigmatic standpoints, approximately interpretable also as subsequent phases of a conceptual history of measurement:

1. the metaphysical period;
2. the anti-metaphysical period;
3. the relativistic period.

The first position was expressed by the founders of physical sciences, such as Pythagoras and Aristotle on the one hand, and Galileo and Kepler on the other, for whom numbers were part of the empirical world, so that measures were inherent properties of the objects being measured. According to them, phenomena were intrinsically quantitative (Mari, 2005), and measurement operated to determine pre-existing properties, i.e., as a discovery process of 'true values' of quantities (Mari, 1997). The classical distinction between 'primary', i.e., 'intrinsic', and 'secondary', i.e., subject-related, properties also clearly emphasizes the ontological assumptions underlying this position. As late as 1900, reliance on the fundamental possibility and power of measurement led Lord Kelvin to famously state that "there is nothing new to be discovered in physics now. All that remains is more and more precise measurement", i.e., ideally obtaining 'truer and truer' values.

During the 19th century and the first decades of the 20th century the effectiveness of measurement in physical sciences and engineering acted as a trigger to export that paradigmatic knowledge acquisition process to different disciplines, with the aim of increasing the objectivity in the evaluation of properties of psychophysical, behavioral, and social phenomena (Rossi, 2007). In such a broader context, the very concept of true value, usually assumed a real number, was generally deemed to be unmaintainable, and the focus shifted toward the measurability of 'secondary' properties. This led to the endorsement of an a-metaphysical – and sometimes anti-metaphysical, in some neo-positivistic interpretations – perspective, according to which measurement results cease to be true expressions of reality, and they are thought of instead as representation means, i.e., results of operations that preserve the relations observed among entities (Mari, 2003). Through the first representation theorems (Helmholtz, 1887; Hölder, 1901) and the theory of scale types (Stevens, 1946), measurement was then formalized as a (homo)morphism (Krantz et al., 1971/1989/1990), i.e., a function preserving the relations defined on its domain, thus emphasizing the internal consistency of representation, sometimes also characterized as 'empirical meaningfulness' (Roberts, 1979), instead of its truth. It is indeed this consistency constraint that guarantees measurement to be adequate for its goal of expressing information on measured entities. Furthermore, this stresses the importance, if not the unavoidability, of interpretive models in acquiring knowledge about reality.

This move is crucial, as it implies a sharp shift of emphasis, from ontology (measurement as a means to know how reality is) to epistemology (measurement as a means to acquire and consistently express information on reality). As this position maintains, measurement only claims to act as a representational tool, a "bridge between reality, to which the object under measurement belongs, and the linguistic/symbolic realm, to which the measurement result belongs" (Mari, 2007, p. 42): measurement relates to the available knowledge on the state of an object. Along the same lines, Bohm (1980, p. 23) remarks that "measure is an insight created by man. A reality that is beyond man and prior to him cannot depend on such insight". While still requiring the information produced through measurement to be non-ambiguous and inter-subjective (i.e., to be interpretable in the same way by different subjects), and measurement results to convey information solely about the measured property (Cecconi et al., 2006), from a representational point of view the very constraints for measurement to be objective and empirical assume a new connotation. By objectivity is meant here that "the numbers assigned to a property by measurement must, within the limits of error, be independent of the observer" (Finkelstein, 2003, p. 41). Empiricity means that measurement "must be the result of observation and not, for example, of a thought experiment"; this is because "the concept of the property measured must be based on empirically determinable relations and not, say, on convention" (Finkelstein, 2003, p. 41). This emphasis can be understood by remarking that nothing in the representational formalization implies (homo)morphisms to describe empirical processes (a 'thought experiment' can be in fact expressed in (homo)morphic terms), so that the fact of being empirical is an independent constraint and, as such, it must be explicitly introduced.

The further move toward the third, relativistic, position is also significant, as it entails an even more explicit emphasis on a model-based view, as symbolized in the shift from error to uncertainty (Joint Committee of Guides in Metrology, 2008b). The concept of error, as the expression of the discrepancy from a given reference, has been traditionally associated to the empirical inability in the measurement process of determining the true value of the property of an object. Rather, uncertainty is the "lack of complete certainty on the value that should be assigned to describe the object under measurement relatively to the measurand" (Mari, 2007, p. 64) with respect to the available information. In this context, 'measurand' is defined as the property intended to be measured (Joint Committee of Guides in Metrology, 2008a), where this 'intention' further stresses the dependence on models. This relativistic characterization emphasizes that measurement is a knowledge-based assignment process, and not the empirical determination of a pre-existing property value. Accordingly, quantification of phenomena is considered to be possible only within a given, although sometimes implicit, model, so that the notions themselves of 'true value of a measurand' and of its determination become meaningless. In order to explain the substantial implications of this claim, the next section discusses the relativistic paradigm in more detail, also pointing out some ongoing further developments.

4.2. The relativistic paradigm and beyond

From a relativistic perspective the concept of model becomes of primary importance. In particular, a model-based view takes into account pragmatic components, which are not considered in the two previous paradigms, and regards measurement as a process, which aims at attaining 'adequate-to-purpose', rather than 'true', results. Replacing the criterion of truth with a criterion of adequacy has profound consequences, since, according to the latter position, decisions over cost and quality of measurement become essential components of the measurement process itself. As a paradigmatic case, in this context the very concept of 'absolute precision' for measurement results is acknowledged to be meaningless, and the search for their increasing precision is considered relevant only as a trade-off with measurement resources, and therefore, in particular, costs. Similarly, the concept of accuracy could be re-conceptualized as the degree of trust that can be attributed to a value, as obtained by a suitable characterization of the measurement process, rather than its correspondence (its 'closeness of agreement', according to the Joint Committee for Guides in Metrology (2008a)) to the 'true value'. If measurement is regarded as an assignment, rather than a determination (Mari, 1997), any measurement result could only generate information that is meaningful in the context of the model within which measurement is being carried out. Therefore, "measurement results must be assigned (and not determined) according to the goals for which the measurement is performed, with the consequence that they are adequate if they meet such goals" (Mari, 2007, p. 76).

Repeatability is another differentiating factor between the relativistic paradigm and the metaphysical and anti-metaphysical ones. Following the argument of Cecconi et al. (2006), which endorses an anti-metaphysical perspective, in measurement subjects have to be independent, i.e., 'experiments' may be repeated by different observers and, under controlled conditions, each will get the same result. On the other hand, advocates of the relativistic perspective maintain that repeatability is only a desirable, but by no means a necessary, feature of measurement (Mari, 2007).

From a relativistic standpoint, objectivity and inter-subjectivity, features already taken into account by the representational position (Finkelstein, 2003), are still considered to be target points for measurement. However, the traditional acknowledgment that experimental issues (e.g., noise in general sense) make it impossible to fully reach these conditions is complemented with the understanding that the unavoidable presence of models (e.g., for measurand identification/definition) generates a further reason of non-ideality. As a consequence, such experimental and conceptual issues are interpreted as critical elements in the general trade-off with resources devoted to perform measurement. According to this view, measurement itself can be characterized as a process able to acquire and formally express information that is 'objective and inter-subjective enough' for the given purposes.

The main features of the relativistic paradigm can be summarized as follows:

- Measurement is not a determination, but an assignment. Measurement results only generate information that is meaningful in the context of the model within which measurement is undertaken.
- Measurement results are informational, and not empirical, entities.
- The measurability of a property conceptually depends on the current state of knowledge of the property; therefore, it is not an 'intrinsic characteristic' of the property itself.
- The measurability of a property operatively depends on the availability of experimental conditions; therefore it cannot be derived from formal requirements.
- In a measurement process there is a general qualitative trade-off between specificity and trust, i.e., between precision and accuracy; both aspects depend on the available experimental knowledge of the measurand.
- Objectivity, inter-subjectivity and repeatability are desirable, but not necessary, features of measurement.

While it is highly plausible that this standpoint has been triggered by the dominant epistemological relativism of the last fifty years (see, e.g., Feyerabend, 1975; Hanson, 1958; Kuhn, 1970), that radical relativism ('everything goes', as in Feyerabend's paradigmatic statement) is effectively applicable to measurement is questionable. If the neo-positivistic concept of 'protocol of truth' can hardly be maintained today, measurement has however critical ties to truth that any oversimplification such as 'truth does not exist' does not adequately express. On the one hand, the dependence of measurement results on models and goals, and therefore the operative meaninglessness of the very concept of an 'absolute' true value for measurands, can be taken for granted. An excellent example in this regard is given by the introduction, in the third edition of the International Vocabulary of Metrology (Joint Committee for Guides in Metrology, 2008a), of the concept of target measurement uncertainty, defined as 'measurement uncertainty specified as an upper limit and decided on the basis of the intended use of measurement results'. These explicit references to 'decisions' and 'intentions of use' unambiguously highlight that target uncertainty is, in fact, a pragmatic specification, namely, the epistemic counterpart of tolerance, i.e., a parameter widely used in many industrial contexts to specify the 'acceptable technical quality' of products.

Furthermore, the fact that measurement results include some conventional information can be easily ascertained, given their structure of references to (conventional, indeed) measurement units or scales. On the other hand, such references have an empirical grounding, expressed by the requirement for measurement systems to be calibrated with respect to a standard, i.e., be metrologically traceable to it. Hence, if measurement is defined as the process performed by suitably calibrated measurement systems, and, thus, if such systems and their calibration are in their turn properly characterized, then both the dependence of measurement results on models, i.e., their 'intrinsic uncertainty', and their foundational role of 'truth approximations' can be justified. According to this position of pragmatic (and therefore moderate) relativism, the acknowledged pivotal role of measurement as information acquisition process can be justified once again, although on new bases: set aside any metaphysical assumption, it is precisely on the functional structure of the process that an epistemology of measurement can be developed today. Therefore, we claim that this conceptual framework could evolve into a new, fourth paradigm: a *pragmatic* one. To do so, measurement in both physical and social sciences should be performed taking into account a principle common to all production processes: while quality of products – in this case, measurement results – can be at least comparatively assessed and is the justifying condition to perform the process, the trade-off between acceptable quality and available resources remains the most general criterion for 'good' measurement.

5. Implications for performance measurement

In the wake of modern physics, Galileo argued that the world was written in mathematical terms. As a consequence, the task of scientists was deemed to count what was countable, measure what was measurable, and what was not measurable, make measurable. Over the last twenty years, organizations have invested increasing amounts of resources in the design, implementation and use of performance measurement (PM) systems such as the Balanced Scorecard following a similar, albeit implicit, principle that measurement was a necessary activity for organizations to be successful. Although several studies have demonstrated that PM can have a positive impact on performance, this evidence is not uncontested.

In physics, since the beginning of the 20th century, the metaphysical position expressed by Kepler and Galileo was challenged in a number of ways. This has led to the establishment of two other perspectives – anti-metaphysical and relativistic – which reflect our greater understanding of the powers and limitations of measurement. However, these advancements in physics seem to have had little impact on PM research and practice. Indeed, most practices in PM are driven by clichés such as the above mentioned 'what gets measured gets done' (Kaplan and Norton, 1992) and 'if you cannot measure it, you cannot manage it'[3] (Garvin, 1993), which are arguably aligned to the much outdated metaphysical paradigm. These clichés can be problematic for a number of reasons, including a supposedly deterministic cause-and-effect relationship between measurement and action, and the view that measurement is a necessary antecedent to management. More importantly, it could be argued that it is exactly for these underlying motivations that in recent years organizations in both private and public sectors have been investing increasing amounts of resources to obtain 'true descriptions' of their performance through the use of PM systems (Micheli and Manzoni, 2010).

Rather, from the analysis presented above we argue that PM suffers from the lack of solid theoretical foundations: a more rigorous examination of the epistemological issues of measurement processes could contribute not only to the development of PM from a conceptual standpoint, but also to its practice. First of all, in relation to so-called 'physics envy' (von Hayek, 1989), it is somehow paradoxical that while debates in physics could inform management theory and practice they seem not to have been sufficiently taken into account. From an epistemological perspective, we believe that the main tenets of the pragmatic perspective, which is being developed from the relativistic standpoint, should inform current debates in PM, and that more clarity is required regarding the philosophical underpinnings of measurement in social sciences.

Secondly, it is important to remark that the process of measurement can relate, in principle, to three types of objects: physical, which exist in space and time; ideal, which exist outside space and time; and social, which have a beginning in time and are socially constructed (Ferraris, 2005; Husserl, 1964; Meinong, 1904). Measurement science in physics and engineering has traditionally focused on physical entities, such as phenomena, bodies, and substances (Joint Committee for Guides in Metrology, 2008a). PM is most often concerned with social objects (from stakeholders' satisfaction to brand management, from intellectual capital to patients' experience), which are often complex and difficult to define and measure in their properties. Therefore, it could be argued that in PM, even more than in physical sciences, complete empiricity and objectivity must be considered as goals and not as preliminary, i.e., necessary, conditions. PM should be seen as an assignment, rather than an empirical determination; the relevant influence of implicit and explicit models acknowledged; and the related presence of errors and uncertainties admitted and properly dealt with. Although tools and techniques could become more sophisticated, thus reducing

[3] This latter cliché is easily falsifiable by acknowledging that, instead, 'you can control (and, therefore, manage) even what you do not measure'. As a simple example, let us consider a feedback control system, such as a thermostat or a car cruise control, in which the set point is fixed according to the strategy 'maintain this state' (i.e., the current temperature, the current speed), independently of the availability of any formalized information on the controlled quantity, i.e., independently of any measurement. The most explicit indication that this is 'control without measurement' is that a control system exploited in this way does not require any calibration for its proper usage, nor does it produce any information on the controlled system.

errors and uncertainties in measurement, it will never be possible to reach absolute certainty on the value(s) to assign to what is being measured.

Thirdly, scholars have observed that performance in organizations is often reduced in its meaning and scope to what is technically easier to measure of performance itself (Smith, 1995b), thus following an apparently operational standpoint (Bridgman, 1927). The main implication is that a performance indicator is often equaled to the simplest, and most easily measurable, aspect of the activity or process being performed, e.g., number of complaints expressed by employees = employees' satisfaction; impact factor of publications = academic standing, etc. This issue is particularly relevant and problematic, if we consider the great difficulties encountered in – and, frequently, the impossibility of carrying out – the measurement of properties of very complex activities and processes. Unfortunately, the consequence is that in the social sciences what is treated as important is what happens to be accessible to measurement (von Hayek, 1989). Furthermore, this claim confirms that the ontological and the epistemological dimensions are often conflated, thus reducing reality to what it is easy to access of reality itself.

Fourthly, to measure does not necessarily mean to associate empirical objects with numbers, but, more generally, with information entities (Mari, 2007). This distinction is particularly relevant from a PM point of view, as the measurement of performance – both in practice and in theory – is most frequently equaled to the mere association of numbers to empirical objects. This position is problematic for two reasons. First of all, measurement is an evaluation performed by means of a measurement system, and it is only such a system and its proper setup and usage that guarantee, up to a degree adequate to the given purposes, the objectivity and the inter-subjectivity of measurement results. Therefore, it is not the assignment of numbers, but the adequacy of the measurement system that makes an evaluation a measurement. Secondly, the presumed 'inherent objectivity' of numbers often leads to little consideration given to supposedly 'subjective' qualitative indicators, in favor of substantial reliance on quantitative 'measures' of performance, which, in fact, may be equally problematic and even less informative (Dossi and Patelli, 2010).

6. Toward a pragmatic view of performance measurement

In physical sciences and engineering the metaphysical paradigm has been largely superseded by the representational one, which, in turn, is increasingly complemented by emphasis on the role of models and, therefore, by the relativistic paradigm, moderated by the pragmatic instances analyzed above. The adoption of a pragmatic perspective in PM research and practice requires a critical re-conceptualization. First of all, the adoption of a model-based view, as opposed to a truth-based view, has substantial implications on the measurement process and on the interpretation of its results. From a model-based point of view, measurement is regarded as a knowledge-based process, rather than a purely empirical determination. The object whose property is measured is assumed to exist in the empirical world, but it is acknowledged that the data collected about that object results from an interpretation process, i.e., an explicit or implicit model, which belongs to the symbolic/informational realm. As a consequence, the measurement procedure must be defined, and the system under measurement designed and set up by considering the context and the goals for which the measurement itself is being undertaken. Furthermore, particular care has to be exerted when utilizing any data or information in a context other than that in which it was meant, as this has substantial implications on the drivers, purposes and uses of PM (Behn, 2003; Hatry, 1999). This is particularly significant in benchmarking exercises or compilation of league tables in both private and public sector contexts (Ammons, 1999; Goldstein and Spiegelhalter, 1996). Equally, from a model-based point of view, it would be nonsensical to state that a performance indicator is either 'good' or 'bad' in absolute terms. Rather, on the bases of its goals and other relevant factors (e.g., cost, quality), an indicator could be deemed to be adequate or inadequate-to-purpose. For example, an indicator that considers the average time an organization spends to produce a quote might be appropriate to monitor the organization's responsiveness to customers. This does not equate to saying that the average difference between date of verbal confirmation of receipt of quote by customers and the date of first contact by customers is the 'right measure' for responsiveness to customers. In fact, the calculation of variance in performance could also be informative. However, a simple average might be appropriate for monitoring purposes, whereas richer information would be necessary to support process improvement.

Second, the aims of accuracy, repeatability and objectivity in measurement emphasize the necessity to define the properties being measured, and to question and consider the influence of the measurer on the measurement results. Although most organizations utilize measures of 'absenteeism', for example, the ways in which absenteeism is effectively defined and measured can substantially vary (Hausknecht et al., 2008). Moreover, information on absenteeism would be influenced by the person undertaking the measurement, i.e., differences in responses are likely to emerge if measurement is performed either by management or by an independent agency. Reasons for measurement (e.g., understanding reasons for absence, launching a new program to motivate employees, or simply reducing absenteeism) would also influence measurement results. Therefore, operational definitions could be adopted to enhance consistency and trust in the indicators introduced (Deming, 1986; Goldratt and Cox, 2004). However, the relevance and unavoidability of interpretive models in the measurement process also highlight the importance of surfacing mental models in the design and use of PM systems. If mental models are considered as "deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action" (Senge, 2006, p. 8), it is clear how PM could be both influenced by, and used as a way to challenge, mental models. This is particularly relevant, since long-term success often depends on the process through which management teams modify and improve the shared mental models of their organizations, their markets, and their competitors (Argyris, 1977; De Geus, 1999; Senge, 2006).

The consideration of the epistemic role of the measurer also has significant consequences in relation to organizational learning and review of PM systems. As Bohm (1980, p. 23) argued, "the attempt to suppose that measures exist prior to man and independently of him leads [...] to the 'objectification' of man's insight, so that it becomes rigidified and unable to change, eventually bringing about fragmentation and general confusion". If confusion exists between reality and the measurement results obtained from it, in such a way that measurement is seen as capturing the essence of objects, PM systems will inevitably be static. Research has demonstrated how the use of excessively rigid PM systems could lead to organizational paralysis, or 'ossification' (Smith, 1995b). Indeed, after investing substantial resources to design and implement large sets of performance indicators, organizations often decide not to modify them, also because they are perceived as 'perfect representations' of performance. On the contrary, only by analyzing the data gathered through the system and, in particular, reformulating the PM system itself, can organizations improve their performance and generate single and double loop learning. Indeed, "double-loop changes cannot occur without unfreezing the models of organizational structures and processes now in good currency" (Argyris, 1992, p. 11). Therefore, reviews of PM systems must happen through an in-depth comparison between what is measured of the activities performed, and which activities really occur, since measurement is related to the knowledge about the state of an object, rather than the knowledge about the object 'in itself'. Consequently, reviews could be used to challenge not only the current PM system, but also the organization's strategy and its implementation (on the roles of PM systems in strategy formulation and implementation see, for example, Chenhall, 2005; Gimbert et al., 2010; Simons, 1990).

Fourth, replacing the criterion of truth with a criterion of adequacy implies that cost and quality of measurement should be considered relevant components of the measurement process, and, therefore, assessed both before and after measurement takes place. As a consequence, the introduction of PM systems must be considered as an investment from which to expect a certain return, rather than either an inherently fruitful use of resources (Kaplan and Norton, 1992) or a 'necessary evil' (Brignall and Modell, 2000). Both error and uncertainty should be considered in relation to the empirical ability of obtaining appropriate information on the intended property: hence, specificity and trust also become essential features of PM, as performance could be measured with great accuracy, but precision can be misleading, as indicators can be precisely wrong (Mari, 2007).

Fifth, the focus of measurement has to shift from what is measurable, which is a prevalently epistemological act, to the nature of the objects that we want to measure, i.e., the actual organizational processes and activities being performed. Moreover, indicators should not be considered as exact pictures of reality or as unveiling presumed truths. On the contrary, they ought to be used as ways to gather information about organizational performance that is as adequate as possible. Several authors have suggested ways to tackle the inherent incompleteness of PM systems (Chapman, 1997; Lillis, 2002; Wouters and Wilderom, 2008). Although more appropriate designs and implementations could certainly contribute to this aim, it is also important to fully acknowledge the limitations of measurement. In particular, when measuring performance the last word has to go to the object being measured, and not to the subject; as subjects we have to continuously confront ourselves with the object and not vice versa (Ferraris, 2005).

Finally, as the etymology of 'measurement' suggests, PM systems should be proportionate, i.e., they should consist of an adequate number of indicators, which can inform decision-making processes, rather than aim at providing 'true representations' of performance. While great advancements in the theory and practice of performance measurement are certainly possible, they would have to go beyond 'more and more precise measurement'.

References

Ahn, H., 2001. Applying the Balanced Scorecard concept: an experience report. Long Range Planning 34 (4), 441–461.

Ammons, D.N., 1999. A proper mentality for benchmarking. Public Administration Review 59 (2), 105–109.

Argyris, C., 1977. Organizational learning and management information systems. Accounting, Organizations and Society 2 (2), 113–123.

Argyris, C., 1992. On Organizational Learning. Blackwell Publishing, Cambridge, MA.

Atkinson, A.A., Waterhouse, J.H., Wells, R.B., 1997. A stakeholder approach to strategic performance measurement. Sloan Management Review 38 (3), 25–37.

Bate, P., 2007. Editorial to the Special Issue 'Bringing the design sciences to organization development and change management'. Journal of Applied Behavioral Science 43 (1), 8–11.

Behn, R.D., 2003. Why measure performance? Different purposes require different measures. Public Administration Review 63 (5), 586–606.

Bhaskar, R., 1978. Realist Theory of Science. Longman Higher Education Division, New York.

Bohm, D., 1980. Wholeness and the Implicate Order. Routledge and Kegan Paul Ltd., London.

Bridgman, P.W., 1927. The Logic of Modern Physics. Macmillan, London.

Brignall, S., Modell, S., 2000. An institutional perspective on performance measurement and management in the 'New Public Sector'. Management Accounting Research 11 (3), 281–306.

Cavalluzzo, K.S., Ittner, C.D., 2004. Implementing performance measurement innovations: evidence from government. Accounting, Organizations and Society 29 (3/4), 243–267.

Cecconi, P., Franceschini, F., Galetto, M., 2006. Measurements, evaluations and preferences: a scheme of classification according to the representational theory. Measurement 39 (1), 1–11.

Chapman, C.S., 1997. Reflections on a contingent view of accounting. Accounting, Organizations and Society 22 (2), 189–205.

Chenhall, R., 2005. Integrative strategic performance measurement systems, strategic alignment of manufacturing, learning and strategic outcomes: an exploratory study. Accounting, Organizations and Society 30 (5), 395–422.

Chenhall, R., Langfieldsmith, K., 1998. The relationship between strategic priorities, management techniques and management accounting: an empirical investigation using a systems approach. Accounting, Organizations and Society 23 (3), 243–264.

Chua, W., Degeling, P., 1993. Interrogating an accounting-based intervention on three axes: instrumental, moral and aesthetic. Accounting, Organizations and Society 18 (4), 291–318.

Corvellec, H., 1997. Stories of Achievements: Narrative Features of Organizational Performance. Transaction Publishers, New Brunswick, NJ.

Covaleski, M.A., Dirsmith, M.W., Samuel, S., 1996. Managerial accounting research: the contributions of organizational and sociological theories. Journal of Management Accounting Research 8 (1), 1–35.

Davis, S., Albright, T., 2004. An investigation of the effect of Balanced Scorecard implementation on financial performance. Management Accounting Research 15 (2), 135–153.

De Geus, A., 1999. The Living Company: Growth Learning and Longevity in Business. Nicholas Brealey Publishing, London.
Deming, W.E., 1986. Out of the Crisis. MIT Press, Cambridge, MA.
Denyer, D., Tranfield, D., van Aken, J.E., 2008. Developing design propositions through research synthesis. Organization Studies 29 (3), 393–413.
Dossi, A., Patelli, L., 2010. The inclusion of non-financial indicators in performance measurement systems used in relationships between headquarters and subsidiaries. Long Range Planning 43 (4), 498–526.
Euske, K.J., Lebas, M., McNair, C.J., 1993. Performance management in an international setting. Management Accounting Research 4 (4), 275–300.
Ferraris, M., 2005. Dove sei? Ontologia del telefonino, 2nd ed. Bompiani, Milan.
Feyerabend, P., 1975. Against Method – Outline of an Anarchistic Theory of Knowledge. Verso, London.
Finkelstein, L., 2003. Widely, strongly and weakly defined measurement. Measurement 34 (1), 39–48.
Franco-Santos, M., Kennerley, M., Micheli, P., Martinez, V., Mason, S., Marr, B., Gray, D., Neely, A., 2007. Towards a definition of a business performance measurement system. International Journal of Operations and Production Management 27 (8), 784–801.
Garvin, D.A., 1993. Building a learning organization. Harvard Business Review 71 (4), 78–91.
Gergen, K., 1973. Social psychology as history. Journal of Personality and Social Psychology 26 (2), 309–320.
Ghoshal, S., 2005. Bad management theories are destroying good management practices. Academy of Management Learning & Education 4 (1), 75–91.
Ghoshal, S., Moran, P., 1996. Bad for practice: a critique of the transaction cost theory. Academy of Management Review 21 (1), 13–47.
Gimbert, X., Bisbe, J., Mendoza, X., 2010. The role of performance measurement systems in strategy formulation processes. Long Range Planning 43 (4), 477–497.
Gittell, J.H., 2000. Paradox of coordination and control. California Management Review 42 (3), 101–117.
Goldratt, E., Cox, J., 2004. The Goal: A Process of Ongoing Improvement, 3rd ed. Gower Publishing Ltd., Aldershot.
Goldstein, H., Spiegelhalter, D., 1996. League tables and their limitations: statistical issues in comparisons of institutional performance. Journal of the Royal Statistical Society 159 (3), 385–443.
Goold, M., Quinn, J.J., 1990. The paradox of strategic controls. Strategic Management Journal 11 (1), 43–57.
Govindarajan, V., Gupta, A.K., 1985. Linking control-systems to business unit strategy – impact on performance. Accounting, Organizations and Society 10 (1), 51–66.
Griffith, R., Neely, A., 2009. Performance pay and managerial experience in multi-task teams: evidence from within a firm. Journal of Labor Economics 27 (1), 49–82.
Hall, M., 2008. The effect of comprehensive performance measurement systems on role clarity, psychological empowerment and managerial performance. Accounting Organizations and Society 33 (2/3), 141–163.
Hanson, N., 1958. Patterns of Discovery. Cambridge University Press, Cambridge.
Hausknecht, J.P., Hiller, N.J., Vance, R.J., 2008. Work-unit absenteeism: effects on satisfaction, commitment, labor market conditions, and time? Academy of Management Journal 51 (6), 1223–1245.
Hatry, H., 1999. Performance Measurement: Getting Results. Urban Institute, Washington, DC.
Helmholtz, H., (Trans.) 1887/1971. An epistemological analysis of counting and measurement. In: Kahl, R. (Ed.), Selected Writings of Hermann von Helmholtz. Wesleyan University Press, Middletown, CT.
Henri, J.-F., 2006. Management control systems and strategy: a resource-based perspective. Accounting, Organization and Society 31 (6), 529–558.
Hölder, O., 1901. Die Axiome der Quantität und die Lehre vom Mass. Berichte uber die Verhandlungen der Koeniglich Sachsischen Gesellschaft der Wissenschaften zu Leipzig. Mathematisch-Physikaliche Klasse 53, 1–46 (Part 1 translated by J. Michell and C. Ernst (1996). The axioms of quantity and the theory of measurement. Journal of Mathematical Psychology, 40(3), 235–252).
Hood, C., James, O., Scott, C., 2000. Regulation of government: has it increased, is it increasing, should it be diminished? Public Administration 78 (2), 283–304.
Huff, A., Tranfield, D., van Aken, J.E., 2006. Management as a design science mindful of art and surprise: a conversation between Anne Huff, David Tranfield, and Joan Ernst van Aken. Journal of Management Inquiry 15 (4), 413–424.
Husserl, E., (W.P. Alston, G. Nakhnikian, Trans.) 1907/1964. Die idee der Phaenomenologie. Nijhoff, The Hague.
Ittner, C.D., Larcker, D.F., Randall, T., 2003. Performance implications of strategic performance measurement in financial service firms. Accounting, Organizations and Society 28 (7/8), 715–741.
Johnson, P., Duberley, J., 2000. Understanding Management Research. Sage, London.
Johnson, H.T., Kaplan, R.S., 1987. Relevance Lost – The Rise and Fall of Management Accounting. Harvard Business School Press, Boston, MA.
Joint Committee of Guides in Metrology, 2008a. International Vocabulary of Metrology — Basic and General Concepts and Associated Terms (VIM, 3rd edition), JCGM 200:2008 (also published in hard copy format as ISO/IEC Guide 99:2007, Geneva (Switzerland):ISO/IEC, 2007). http://www.bipm.org/en/publications/guides/vim.html
Joint Committee of Guides in Metrology, 2008b. Guide to the Expression of Uncertainty in Measurement (GUM 1995 with Minor Corrections), JCGM 100:2008. http://www.bipm.org/en/publications/guides/gum.html
Kaplan, R.S., Norton, D.P., 1992. The Balanced Scorecard – measures that drive performance. Harvard Business Review 70 (1), 71–79.
Kaplan, R.S., Norton, D.P., 2008. Execution Premium. Linking Strategy to Operations for Competitive Advantage. Harvard Business School Press, Boston, MA.
Kennerley, M., Mason, S., 2008. The use of information in decision making – literature review for the Audit Commission, Report available on www.auditcommission.co.uk
Krantz, D., Luce, R., Suppes, P., Tversky, A., 1971/1989/1990. Foundations of Measurement, vols. 1/2/3. Academic Press, New York.
Kuhn, T.S., 1970. The Structure of Scientific Revolutions. University of Chicago Press, Chicago.
Lillis, A.M., 2002. Managing multiple dimensions of manufacturing performance – an exploratory study. Accounting, Organizations and Society 27 (6), 497–529.
Malina, M.A., Selto, F.H., 2001. Communicating and controlling strategy: an empirical study of the effectiveness of the Balanced Scorecard. Journal of Management Accounting Research 13 (1), 47–90.
Malina, M., Norreklit, H., Selto, F.H., 2007. Relations among measures, climate of control, and performance measurement models. Contemporary Accounting Research 24 (3), 935–982.
March, J.G., Sutton, R.I., 1997. Organizational performance as a dependent variable. Organization Science 8 (6), 698–706.
Mari, L., 1997. The role of determination and assignment in measurement. Measurement 21 (3), 79–90.
Mari, L., 2003. Epistemology of measurement. Measurement 34 (1), 17–30.
Mari, L., 2005. The problem of foundations of measurement. Measurement 38 (4), 259–266.
Mari, L., 2007. Measurability. In: Boumans, M. (Ed.), Measurement in Economics. Elsevier, London.
McKevitt, D., Lawton, A., 1996. The manager, the citizen, the politician and performance measures. Public Money & Management 16 (3), 49–54.
Meinong, A., 1904. Über gegenstandstheorie. In: Meinong, A., Ameseder, R., Mally, E. (Eds.), Untersuchungen zur Gegenstandstheorie und Psychologie. Barth, Leipzig, pp. 1–50 (Eng. trans. by I. Levi, D.B. Terrell, and R.M. Chisholm, On the theory of objects, in: R.M. Chisholm (Ed.), Realism and the Background of Phenomenology, The Free Press, New York, pp. 76–117).
Micheli, P., Manzoni, J.-F., 2010. Strategic performance measurement: benefits, limitations and paradoxes. Long Range Planning 43 (4), 465–476.
Morgan, G., 1988. Accounting as reality construction: towards a new epistemology for accounting practice. Accounting, Organizations and Society 13 (5), 477–485.
Nagel, E., 1961. The Structure of Science: Problems in the Logic of Scientific Explanation. Routledge, London.
Neely, A., 1999. The performance measurement revolution: why now and where next. International Journal of Operations and Production Management 19 (2), 205–228.
Neely, A., Adams, C., Kennerley, M., 2002. The Performance Prism: The Scorecard for Measuring and Managing Business Success. Financial Times Prentice Hall, London.
Neely, A., Bourne, M., 2000. Why measurement initiatives fail. Measuring Business Excellence 4 (4), 3–7.
Neely, A., Micheli, P., Martinez, V., 2006. Acting on information: lessons from theory and practice, Report prepared for the National Audit Office. Publication sponsored by the Advanced Institute of Management.
Numagami, T., 1998. The infeasibility of invariant laws in management studies: a reflective dialogue in defence of case studies. Organization Science 9 (1), 2–15.

Osborne, D., Gaebler, T., 1992. Reinventing Government: How the Entrepreneurial Spirit Is Transforming the Public Sector. Addison-Wesley, Reading, MA.
Perera, S., Harrison, G., Poole, M., 1997. Customer-focused manufacturing strategy and the use of operations-based non-financial performance measures: a research note. Accounting, Organizations and Society 22 (6), 557–572.
Peters, T.J., Waterman Jr., R.H., 1982. Search of Excellence: Lessons from America's Best-Run Companies. Harper & Row, New York.
Poister, T.H., 2003. Measuring Performance in Public and Nonprofit Organizations. Jossey-Bass, San Francisco.
Pollitt, C., 2006. Performance information for democracy: the missing link? Evaluation 12 (1), 38–55.
Power, M., 1997. The Audit Society – Rituals of Verification. Oxford University Press, Oxford.
Power, M., 2004. Counting, control and calculation: reflections on measuring and management. Human Relations 57 (6), 765–783.
Roberts, F., 1979. Measurement Theory – With Applications to Decision Making, Utility, and the Social sciences. Addison-Wesley, Reading, MA.
Romme, A.G.L., 2003. Making a difference: organization as design. Organization Science 14 (5), 558–573.
Roos, G., Roos, J., 1997. Measuring your company's intellectual performance. Long Range Planning 30 (3), 413–426.
Rossi, G.B., 2007. Measurability. Measurement 40 (6), 545–562.
Royal Statistical Society, 2005. Performance Indicators: Good, Bad and Ugly, This document can be accessed from the Royal Statistical Society site at: http://www.rss.org.uk
Senge, P., 2006. The Fifth Discipline: The Art & Practice of the Learning Organization. Doubleday, New York, NY.
Simon, H., 1996. The Sciences of the Artificial, 3rd ed. MIT Press, Cambridge, MA.
Simons, R., 1990. The role of management control systems in creating competitive advantage – new perspectives. Accounting, Organizations and Society 15 (1/2), 127–143.
Smith, P., 1995a. Performance indicators and outcome in the public sector. Public Money & Management 15 (4), 13–16.
Smith, P., 1995b. On the unintended consequences of publishing performance data in the public sector. International Journal of Public Administration 18 (2/3), 277–310.
Stevens, S.S., 1946. On the theory of scales of measurement. Science 103 (2684), 677–680.
Townley, B., Cooper, D.J., Oakes, L., 2003. Performance measures and the rationalization of organizations. Organization Studies 24 (7), 1045–1071.
Tsoukas, H., 1989. The validity of idiographic research explanations. Academy of Management Review 14 (4), 551–561.
Veliyath, R., 1992. Strategic planning: balancing short-run performance and longer term prospects. Long Range Planning 25 (3), 86–97.
von Hayek, F., 1989. The pretence of knowledge. The American Economic Review 79 (6), 3–7.
Wouters, M., Wilderom, C., 2008. Developing performance-measurement systems as enabling formalization: a longitudinal field study of a logistics department. Accounting, Organizations and Society 33 (4/5), 488–516.