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Performance measurement and management systems as IT artefacts

Characterising, contextualising and valuing their effective use in SMEs

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Abstract

Purpose – Considering performance measurement and management systems (PMMS) to be "mission-critical" information systems for many business organisations, calls have been made for researchers to shift from studying the use of such systems to studying their "effective" use, and in so doing to focus on their characterisation as information technology (IT) artefacts. The paper aims to discuss this issue.

Design/methodology/approach – In seeking to answer these calls, the authors apply Burton-Jones and Grange's theoretical framework to study the dimensions, contextual drivers and benefits of the effective use of PMMS. This is done through a field study of 16 PMMS artefacts as used in small- and medium-sized enterprises (SMEs).

Findings – In characterising, contextualising and valuing the effective use of PMMS, this study provides answers to the following questions: What constitutes the effective use of PMMS? What are the user, artefactual and task-related drivers of such use? And what are the benefits for SMEs of using performance measurement and management (PMM) systems effectively?

Practical implications – With regard to the design of a PMMS artefact, the findings imply that one should concentrate on those artefactual attributes that most enable informed action on the part of owner-managers, as it is these actions have the greater consequences for the realisation of IT business value in SMEs. Moreover, the nomological network resulting from this research provides the theoretical and methodological underpinnings of a diagnostic tool meant to develop the PMM function in SMEs.

Originality/value – This study provides further empirical grounding and understanding. This study provides further empirical grounding and understanding of the concept of effective use, as well as further applicability and actionability to this concept and to the nomological network of its dimensions, contextual drivers and benefits in the case of PMMS and in the context of SMEs.

Keywords SME, IT artifact, Information system, Managerial performance, Competitive performance, Effective use, Performance measurement and management system

Paper type Research paper

1. Introduction

In a globalised knowledge-based economy, business enterprises must now attain a level of organisational performance such that they can compete on a worldwide basis (Busco *et al.*, 2008), including a growing number of small- and medium-sized enterprises (SMEs) in the industrial and manufacturing sectors (Costa *et al.*, 2017). Seeking to improve their competitive performance, many of these SMEs enable their organisational capabilities for innovation, internationalisation and knowledge management by their use of information technology (IT) artefacts (Hagsten and Kotnik, 2017). In this context, such artefacts may be essentially defined as the application of IT to support some managerial, administrative or operational task(s) (Benbasat and Zmud, 2003).

Now, one type of IT artefact is deemed critical to support SME owner-managers in achieving such a "world-class" status for their organisation, namely performance measurement and management systems (PMMS) (Garengo *et al.*, 2005). This artefact is

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defined as an IT-enabled information system (IS) whose design is founded upon a comprehensive view of organisational performance, and whose aim is to support executive decision-making and strategic management by producing information that reflects the organisation's performance logic (Hall, 2014; Marchand and Raymond, 2008). The PMMS artefact may be acquired by a SME in the form of pre-built or "packaged" software, or it may be "custom" developed by the firm internally or with the help of outside consultants (Poba-Nzaou *et al.*, 2014).

The need for a better conceptualisation, contextualisation and explanation of the use of PMMS and a better comprehension of their role in the organisation has also been expressed by researchers in the performance measurement and management (PMM) field (De Toni and Tonchia, 2001; Franco-Santos *et al.*, 2007; Micheli and Mari, 2014). The goal of such research is to produce results that are not only valid theoretically but also useful practically for the design, use and management of PMM systems (Dekker *et al.*, 2013; Evans, 2004; Garengo *et al.*, 2005; Franco-Santos *et al.*, 2012). Moreover, calls have been made in the IS research field to shift from the study of the use of IT artefacts to the study of their "effective" use, observing that the complexity of many organisational situations with regard to IT artefacts and their use was not accounted for in previous IS usage studies (Grover and Lyytinen, 2015) and in PMMS usage studies in particular (Melnyk *et al.*, 2014). Given the rather limited implications of these studies for both PMM and IS theory and practice, the need for a better conceptualisation, contextualisation and explanation of the use of IT artefacts has been expressed by a number of researchers (e.g. Burton-Jones and Grange, 2013; Hsieh and Wang, 2007).

Given the preceding considerations, the aims of this study are both descriptive and explicative, that is, to characterise the extent to which PMM systems are used effectively by SMEs and to identify the principal antecedents and performance outcomes of such use. Thus arise the following research questions:

RQ1. What constitutes the effective use of PMMS?

RQ2. What are the user, artefactual and task-related drivers of such use?

RQ3. What are the benefits for SMEs of using PMM systems effectively?

2. Theoretical background

The ambiguity that surrounds the notion of system usage in the IS research domain is a source of problems with regard to the conceptualisation and operationalisation of this notion (Straub *et al.*, 1995). An inappropriate or inadequate conceptualisation will not provide the contextualisation required to fully understand the usage phenomenon under study, and will produce mixed results that are difficult to interpret and may lead to erroneous conclusions, particularly when dealing with complex ISs such as PMMS (Boudreau and Seligman, 2003; Jain and Kanungo, 2005). Moreover, an inappropriate or inadequate measurement of IS use founded upon superficial indicators (e.g. duration and frequency of use) that neglect task-related aspects, or upon binary variables (0: non-use, 1: use) or proxies (adoption vs use) will not reveal the true nature of the use of a complex IT artefact such as a PMMS (Burton-Jones and Straub, 2006; Silvi *et al.*, 2015).

This measurement problem may indicate a conceptualisation of IS usage that lacks contextualisation or assumes use contexts to be interchangeable. Limiting the explanatory power of contextual elements would then limit our comprehension of the PMMS usage phenomenon. With regard to the IT artefactual context in particular, one could even say that such reductionist approaches assume that all IT artefacts such as PMMS are alike or that their attributes have no importance in understanding their use. A judicious choice of usage variables and measures is thus necessary, if the researcher is

to relate an IS's attributes to the performance of the task supported by this system (Devaraj and Kohli, 2003).

Now, the problem is particularly serious for PMM systems as used in SMEs because each SME is a case in point, with its own performance logic (Raymond *et al.*, 2013), and a PMMS must be aligned with this logic to provide the necessary information on the firm's success factors and thus help maintain the firm's competitive advantage (Marchand and Raymond, 2008). In studying the use of a PMMS artefact in a SME, an underdeveloped conceptualisation and measure may produce an erroneous assessment of the artefact's business value (Micheli and Mari, 2014). Situating the PMM system "in context" allows one to assess its capacity to represent the "real world" of the organisation, and thus evaluate these systems in an appropriate manner (Uwizeyemungu and Raymond, 2009).

Given the problems commonly associated with demonstrating the benefits of PMM (St-Pierre and Raymond, 2004) and the lack of consensus with regard to the actual performance impacts of PMMS (Baird, 2017), Micheli and Mari (2014) have drawn attention to the underdevelopment of the "performance measurability" concept, and to the measurement processes that ensue from it. In addition to ontological and epistemological considerations on the act of measuring as such, these authors' questionings imply practical considerations on the tool developed to carry out this measurement, i.e. the PMMS artefact, and on the manner in which this tool is used. Measuring is an epistemic act, that is, one seeks to know something, and this epistemic act should be viewed from a relativist and pragmatic perspective (Mari, 2003). As advocated for the measurement of organisational performance, the pragmatic or situational perspective implies that the PMMS should be founded upon a model that is relevant to the "reality" represented, and that enables the achievement of organisational goals while being readily accessible, easy to use and affordable (Lorino, 2002; Lorino *et al.*, 2017). Moreover, this perspective favours action as it situates the system in context and takes account of its usage contingencies (Micheli and Mari, 2014).

Complex ISs such as PMMS rest upon multiple elements and inter-related IT processes capable of integrating, within a logical ensemble, the firm's operational and managerial processes across its various business functions (Boudreau and Seligman, 2003). These systems are called upon to evolve with the needs of users whose type and level of competency differ (Jain and Kanungo, 2005). For this reason, the study of complex IS use should be founded upon approaches that allow one to encompass the full range of the phenomenon in its specific context (Hsieh and Wang, 2007), and as the habitual constructs and measures of IS usage do not allow one to understand the cases where there is a lack of appropriation of the system by users, where there is unexpected use of the system, where the system is under-used, and where its expected benefits are not realised (Burton-Jones and Straub, 2006).

The need for a richer conceptualisation and measurement of complex IS use is now well-recognised by researchers, in particular when this use is meant to support users in "cognitively engaging tasks" (Burton-Jones and Straub, 2006). By taking into account critical contextual elements such as the nature of use, its extent, its quality and the user's expectations, one should attain a better understanding of a complex IS such as a PMMS, of its impacts and of the value or benefits realised from its use (Frutuoso Braz *et al.*, 2011). This is borne out in a number of empirical studies where, in order to face a diversity of complex systems in a large number of organisations, ISs use, and PMMS use in particular, is not primarily approached from its technological aspects but rather from its teleological aspects such as its support of the firm's management, strategy and decision making (e.g. Lisi, 2015).

Reflecting the different approaches that have been taken to solve these problems of conceptualisation and operationalisation, many definitions of IS use or ancillary

concepts can be retraced in the literature. This includes, for instance, the following concepts: cognitive absorption (a state of deep involvement with software) (Agarwal and Karahanna, 2000, p. 665); user competence (the user's potential to apply technology to its fullest extent so as to maximise performance of specific job tasks) (Marcolin *et al.*, 2000, p. 38); quality of use (one's ability to correctly exploit the appropriate capabilities of software in the most relevant circumstances) (Boudreau and Seligman, 2003, p. 3); IS continuance (behavior patterns reflecting continued use of a particular IS) (Cheung and Limayem, 2005, p. 472).

Notwithstanding the previous research efforts, the use of complex IS remains a phenomenon that is still lacking in characterisation, explanation and contextualisation. Now, in view of the definition of PMMS given above, these systems are considered to be complex. And because of their strategic or "mission-critical" nature, PMMS are highly contextualised (Bourne *et al.*, 2013). While there have not been many empirical studies on the subject of PMMS use, be it in SMEs or in large enterprises, it appears that this use is continuous in nature, focussed on the system's informational content, and influenced by the management style and culture of the organisation (Bourne *et al.*, 2000).

3. Research model

Being part of a network of influences, PMMS usage can be theorised as a context-bound independent or dependent construct integrated in a nomological network (Benbasat and Zmud, 2003). In seeking to provide added validity and relevance to the concept of IS use, we applied Burton-Jones and Grange's (2013) theoretical framework to study the dimensions, contextual drivers and benefits of the effective use of PMMS in SMEs, as synthesised in the research model presented in Figure 1.

One should note at this juncture that the theoretical foundations of Burton-Jones and Grange's (2013) effective use framework rest primarily upon representation theory (Wand and Weber, 1995; Weber, 2003), wherein representations of reality (to the extent that they are "faithful") enable action and thus constitute the essence of any IS. From this theoretical perspective, a complex IS such as a PMMS must be able to represent the real world (and its phenomena) through features that allow its users to build their own representation of this world, and whether this reality is objective or socially constructed (Wand and Weber, 1993). Systems that provide representations allow their users to

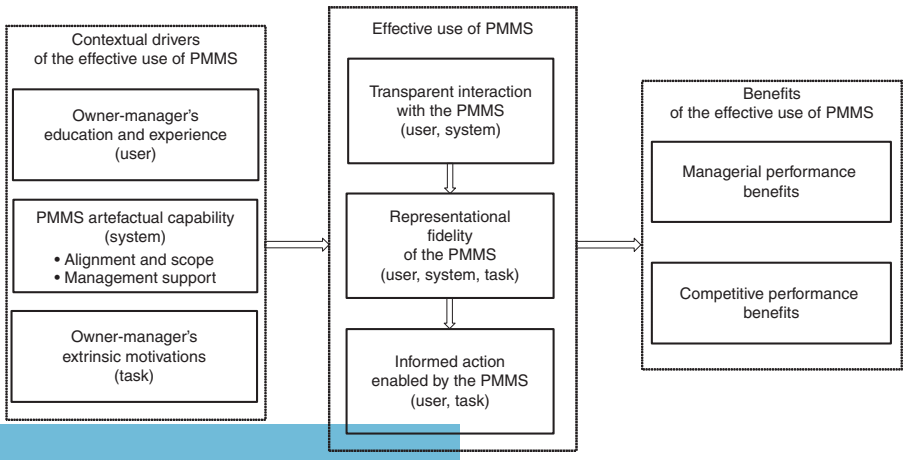

Figure 1.
Research model

faithfully track the state and state changes of other systems such as the organisation or the business environment (Weber, 2003). Moreover, the representation of a real-world phenomenon avoids the cost of having to directly observe the phenomenon in question (Wand and Weber, 1993). Representation systems provide access to phenomena that are difficult to apprehend, impossible to follow directly or that do not yet exist (Weber, 2003). And the more their representations are "faithful" to the system being represented, the more these systems provide an enlightened basis for action (Weber, 1997). With regards to a PMMS, one would expect that if it provides a faithful representation of the firm's activities, it will then help users to understand what is being measured and enable them to take action.

The theoretical framework also relies upon affordance theory (Gibson, 1977), through its interest not only in the physical and sensory attributes of the IT artefact's user-interface (physical and sensory affordance) but also in those attributes that support the user's cognitive ability (cognitive affordance) and capacity to act in the pursuance of a goal (functional affordance) (Hartson, 2003). Essentially, an affordance is the actor's perception of the range of actions made possible by an artefact (Gibson, 1979; Norman, 1988). Affordances are determined both by the characteristics of the artefact and by the sensory, motor and mental capacities of the user (Norman, 1988). Hence, for the same IT artefact, affordances will vary across users and usage situations.

Given the theoretical framework presented above, the three aspects to be prioritised are the user, the IS and the task (defined as "goal-directed activity") (Burton-Jones and Straub, 2006). We thus followed Burton-Jones and Grange's (2013) approach because we deemed it to be most appropriate to our research aim of characterising and explaining the effective use of PMMS in the context of SMEs, given its encompassing multiple dimensions of effective use and its organising of these dimensions into a coherent ensemble. In reaching beyond the purely artefactual dimension of IS use, this framework incorporates other rarely considered dimensions that are more specifically linked to what happens after the user interacts with the system.

Burton-Jones and Grange's (2013) theoretical framework also constitutes a basis for the operationalization and measurement of effective use, providing us with the capacity to contextualise a complex IT artefact such as a PMMS in a particularly rich manner, when compared to previous conceptualizations of IS use. In this regard, Burton-Jones and Grange's theory builds upon, extends and integrates well-known theories and models of IS use, namely Davis' (1989) technology acceptance model, DeSanctis and Poole's (1994) adaptive structuration theory, Goodhue and Thompson's (1995) technology-task fit, DeLone and McLean's (2003) IS success model and Barki *et al.* (2007) use-related activity. And in so doing, Burton-Jones and Grange's (2013) framework is the only one that attempts to simultaneously explain the nature, antecedents and consequences of effective use.

3.1 Effective use of the PMMS artefact

Effective use is defined by Burton-Jones and Grange (2013, p. 633) "as using a system in a way that helps attain the goals for using the system". This notion is conceptualised as three sequentially related components or dimensions: the physical access to the IS by the user (transparent interaction); the representation of an individual, organisational or environmental reality that the system provides to the user (representational fidelity); and the action envisioned by the user from the system's representations (informed action) (Burton-Jones and Grange, 2013, p. 642). Transparent interaction is thus viewed as a necessary condition of representational fidelity, which in turn is viewed as a necessary condition of informed action.

As advocated by Burton-Jones and Straub (2006), our research model explicitly relates each dimension of effective use to the aspects involved in the usage of a complex IS: the user, the system itself, and the task meant to be supported. Our ensuing contextualisation of the

effective use of PMMS was based on the findings of previous IS (Burton-Jones and Grange, 2013; Burton-Jones and Straub, 2006; Hsieh and Wang, 2007) and PMM (Garengo *et al.*, 2005; Sharif, 2002) studies.

Transparent interaction with the PMMS (user/system-related). Defined as the "extent to which a user is accessing the system's representations unimpeded by its surface and physical structures" (Burton-Jones and Grange, 2013, p. 642), this component of the research model reflects the interaction of the SME owner-manager with the PMMS artefact.

Representational fidelity of the PMMS (user/system/task-related). Defined as the "extent to which a user is obtaining representations from the system that faithfully reflect the domain being represented" (Burton-Jones and Grange, 2013, p. 642), this dimension of effective use reflects the perceived quality of the information output by the PMMS in relation to the owner-manager's task.

Informed action enabled by the PMMS (user/task-related). Defined as the "extent to which a user acts upon the faithful representations he or she obtains from the system to improve his or her state" (Burton-Jones and Grange, 2013, p. 642), this dimension reflects the enablement by the PMMS of the actions required of owner-managers as they strive to maintain and improve their firm's performance.

Given Burton-Jones and Grange's (2013) definition and three-dimensional conceptualization of the effective use of an IT artefact, their framework also proposes to explain how such use is meant to improve performance from the user's perspective. Thus, transparent interaction allows users to interact seamlessly with the PMMS artefact and gain time in the accomplishment of their task. Representational fidelity is meant to reduce the task uncertainty of users by increasing their understanding of the performance domain represented by the PMMS artefact. Informed action allows users to leverage the information obtained from the PMMS, that is, to "informate" their task (Zuboff, 1988). Finally, Burton-Jones and Grange's (2013) theorisation of effective use is subject to boundary conditions that delimit its application in different user, system and task contexts. For instance, the fact that certain users are more knowledgeable, experienced and motivated than others and that certain systems (such as a PMMS) and certain tasks are more complex and interdependent than others must be accounted for (Burton-Jones and Gallivan, 2007).

3.2 Contextual drivers of effective use of PMMS

In line with Burton-Jones and Grange's (2013) theoretical framework, all three dimensions of the effective use of a PMMS are expected to be influenced by contextual elements related to the user, to the PMMS artefact he or she uses, and to his or her task as owner-manager of a SME.

User's education and experience (user-related). SME owner-managers' socio-demographic attributes such as their age, gender, education and experience have long been known to influence their managerial behaviour (Smith and Miner, 1983). With respect to the use of a PMMS, we expect that owner-managers with the greater general knowledge and greater capacity for analysis, synthesis and abstraction gained from a higher education as well as the greater context-specific knowledge gained from a longer experience in the task and in the work domain will make more effective use of such a complex IS (Raymond *et al.*, 2013).

PMMS artefactual capability (system-related). System usage behaviours are obviously bound by IT artefactual capabilities, i.e. those functional attributes of the IS that determine what can and cannot be done by the user with the system (Wand and Weber, 1995; Hartson, 2003). In the case of a PMMS artefact, we expect its effective use by a SME owner-manager to be primarily driven by two artefactual capabilities (Marchand and Raymond, 2008). The first capability relates to the range of indicators present in the system that allow owner-managers to assess the different aspects of their firm's

performance in a holistic manner (level of alignment and scope of the PMMS artefact). The second capability relates to the system's facilitation of the use of the performance information output for managerial decision making and action purposes (management support functionalities of the PMMS artefact).

User's extrinsic motivations (task-related). In an organisational IS context, the user's extrinsic motivations are based upon his or her perception of the system's usefulness, this perception resting upon the task-related usage goals defined *ex ante* by the user (Lowry *et al.*, 2015). Behavioural theories such as the theory of reasoned action and the theory of planned behaviour have been oft-employed in IS research to successfully predict usage behaviours from such motivations (Cheung and Limayem, 2005). In our case, the SME owner-managers' extrinsic motivations that are meant to predict the effective use of PMMS are based upon the expected usefulness of the system with respect to three primary usage goals, as identified previously in the PMM literature (Bititci *et al.*, 2012; Franco-Santos *et al.*, 2012; Kueng *et al.*, 2001). The first goal assigned by owner-managers to the use of a PMMS is to support their firm's strategic planning process, the second is to support the SME's continuous improvement process, and the third is to support its operations management process. We thus postulate that the greater the importance accorded to these goals by owner-managers, the more effective their use of PMMS.

3.3 Benefits of effective use of PMMS

The primary benefits of the effective use of PMMS are postulated here to be the organisational improvements obtained by a SME in terms of its managerial (internal) performance and competitive (external) performance. The assumed relationship between PMMS use and performance is based on the findings of previous PMM studies (Evans, 2004; Garengo and Bititci, 2007; Chenhall, 2005) and on IS success/benefits/effectiveness measurement models previously developed and validated by IS researchers (Gable *et al.*, 2008; Seddon *et al.*, 2002; Tallon *et al.*, 2000). Our research model diverges in this regard from Burton-Jones and Grange's (2013) proposal in that these authors conceptualise the performance benefits of effective use at the individual level (effectiveness and efficiency of the user). Moreover, our research model initially assumes that all three dimensions of the effective use of PMMS will have a positive impact on the SMEs' attainment of performance benefits.

4. Research method

In characterising the use of the PMMS artefact, we adopted a perspective that respects the ontological value of this artefact. A positivist realist posture was thus taken to achieve this aim (Strong and Volkoff, 2010), while simultaneously accounting for the researchers' presence and involvement *in situ* (Miles and Huberman, 1994).

4.1 Research design and sampling

Contextualising the use of an IT artefact in space and time entails a trade-off between explanatory power and theoretical parsimony. The choice of a research strategy that combines scope and depth must account for the complexity of the environmental and organisational contexts while controlling for relevant variables (Robson, 2002). To this effect, using a multiple case study or "field study" strategy in the sense of Boudreau *et al.* (2001) constitutes an appropriate research strategy as it reduces the study's contextual dependency and simultaneously favours the transferability and generalisability of its results (Lee and Baskerville, 2003).

The case study's theoretical sampling criteria were set to clearly identify the PMMS artefact within the firm's organisational IS (Marchand and Raymond, 2008). As presented in Table I, 16 SMEs located in different regions of the province of Quebec, Canada,

Firm ID	A	B	C	D	E	F	G	H
No. of empl.	16	43	70	39	135	250	55	65
Age of firm	30	17	28	30	32	43	35	13
Sector	Electronics/ telecom	Construction	Industrial equipment	Chemical	Industrial equipment	Chemical	Construction	Construction
PMMS	Different DBs: accounting/cost, orders, production quality	Organisation DB: accounting/ cost, sales, production	Organisation DB: accounting/cost, sales, HRM, production	Organisation DB: accounting/ cost, sales, production	Different DBs: accounting/cost, CRM, HRM, production, engineering	Organisation DB/ ERP: accounting/ cost, sales, HRM, production	Different DBs: accounting/ cost, orders	Different DBs: accounting/ cost, clients, production
Firm ID	K	L	M	N	O	P	Q	R
No. of empl.	75	130	96	524	25	40	23	15
Age of firm	34	30	25	65	31	18	17	47
Sector	Industrial equipment	Industrial equipment	Electronics/ telecom	Construction	Construction	Chemical	Industrial equipment	Construction
PMMS	Organisation DB/ ERP: accounting/ cost, orders, HRM, production	Different DBs: accounting/ cost, sales, HRM, production	Organisation DB/ ERP: accounting/ cost, sales, HRM, production	Organisation DB: accounting/ cost, sales, production	Organisation DB: accounting/cost, sales, production	Organisation DB: accounting/cost, sales, HRM, production	Organisation DB: accounting/ cost, sales, HRM	Different DBs: accounting/ cost, orders

Table I.
Characterisation of the sample

and showing a variety of contexts in terms of the firms' size, age and industrial sector were thus selected. To ensure the selection of firms that met the PMMS criteria as well as to provide richness of experiences, phone calls and e-mails were exchanged with the firms' owner-manager prior to the case interviews.

4.2 Data collection

Both flexible and structured data collection methods were employed, thus allowing for different data types as well as their triangulation and corroboration (Yin, 2003). The user being the individual possessing the most knowledge of the PMMS artefact, employing a methodological approach that encourages the expression of his or her usage experience is necessary. The user is thus asked to present the PMMS artefact he or she uses, and in his or her usage context. It is important to recall at this juncture that when the user's perspective is not accounted for, one cannot accurately describe nor truly understand the role that usage plays in the configuration of the IT artefact (Orlikowski and Iacono, 2001).

Combining qualitative and quantitative data analyses, we conducted extensive interviews *in situ* with the SMEs' owner-manager. This individual's influence in formulating his or her firm's strategy and managing its performance is the key to inform these aspects (Spanos and Lioukas, 2001) and consequently to describe the IT artefact dedicated to managing the SME's performance. The interview was initiated with two open questions: What is your definition of organisational performance as it applies to your firm? In what manner do you measure and manage this performance, and what tools do you employ to do so? The interview then continued with the commented administration of a questionnaire on the PMMS artefact, its use and its performance benefits, in addition to contextual variables.

The interview was audio-recorded and notes were taken throughout its course. These notes as well as the interviewer's reflective comments were transcribed in the following 24 h (Robson, 2002). Available print documents relating to the PMMS artefact were also collected and examined. Data collection activities were conducted over a 15 month period and carried out in parallel with the data analysis, to allow for necessary adjustments (Robson, 2002).

4.3 Measurement and data analysis

The three components of the effective use of PMMS were ascertained by adapting Burton-Jones and Grange's (2013) as well as other measures of IS use taken from the extant IS (Hsieh and Wang, 2007; Burton-Jones and Straub, 2006) and PMM (Garengo *et al.*, 2005; Sharif, 2002) literature, through ten linear, numeric scales (transparent interaction with the PMMS, representational fidelity of the PMMS) and five Likert scales (informed action enabled by the PMMS), as presented in Table AI. The two dimensions of the PMMS' artefactual capability (alignment and scope, management support) were measured, respectively, through 12 and 9 Likert scales based on the range of functionalities found in such systems (Marchand and Raymond, 2008), as presented in Table AII.

In line with previous measurement models of IS success/benefits/effectiveness (Kueng *et al.*, 2001; Chenhall, 2005; Gable *et al.*, 2008), the managerial performance and competitive performance benefits of the effective use of PMMS were assessed, respectively, through five and eight Likert scales adapted from the PMM literature (Evans, 2004; Garengo and Bititci, 2007; Chenhall, 2005). Extrinsic motivations were measured by assessing the importance accorded by the owner-manager to three primary goals of PMMS use, taken from the PMM literature (e.g. Bititci *et al.*, 2012; Franco-Santos *et al.*, 2012). The owner-manager's level of schooling (high-school, college or university), years as head of the firm (task experience) and years in the firm's sector of activity (industry experience) were used as measures of the user's education and experience.

The research questions were addressed with "exact" correlational, variance and regression analyses (Weerahandi, 1995), cluster analysis and Runkel's (1990) relative frequencies analysis. This last type of analysis aims to find associations between two variables by using the calculus of probabilities, that is, by testing for the interdependence of events through a comparison of the actual relative frequency of joint events to the frequency to be expected if the events were independent of one another. Note that all four types of analysis use statistical strategies that are particularly appropriate for small sample research (Hoyle, 1999).

5. Results

5.1 Characterising the effective use of PMMS

In applying and testing Burton-Jones and Grange's (2013) framework to characterise the effective use of a PMMS artefact, one must first examine the relationship between the three components of effective use, namely transparent interaction with the artefact (TI), representational fidelity of the artefact (RF) and informed action enabled by the artefact (IA). Now the correlational analysis presented in Table II provides evidence of the sequential nature of this relationship, as postulated by these authors (TI→RF→IA), as TI is shown to be significantly correlated to RF but not to IA, whereas RF is significantly correlated to IA. Moreover, a relative frequencies analysis allows us to determine that the "ease of use" and "completeness" of the information output by the PMMS are the two aspects of its representational fidelity that most benefit from a more transparent interaction with this system. In similar fashion, "fostering the emergence of new ideas" is the key aspect of the informed action enabled by the PMMS artefact that benefits from a greater representational fidelity of this artefact. These initial results thus offer a both novel and confirmatory operationalisation of Burton-Jones and Grange's (2013) theoretical framework of the dimensions of the effective use of an IT artefact.

5.2 Contextualising the effective use of PMMS

In contextualising the effective use of a PMMS artefact, and given our research questions, we must first identify primary determinants of effective use at the user and artefactual levels, as well as the components of this use (TI, RF and/or IA) that are affected. This first implies an examination of the influence of the user's education and experience upon his or her effective use of a PMMS, as proposed in the research model (Figure 1). Now the correlational analysis presented in Table III indicates that it is the user's level of education rather than experience that is associated with a more effective use of PMMS in terms of RF and IA, but not in terms of TI. Here, the capacity to analyse, to synthesise and to transform information into actionable knowledge that is provided to the SME owner-manager by a university education may not be as readily developed solely from experience.

Cluster analysis was used to classify and characterise the 16 PMMS observed in terms of their artefactual capability. A four-cluster solution was most parsimonious, identifying groups of PMMS artefacts that could be clearly distinguished from one another based on the

	Effective use of PMMS		
Effective use of PMMS Dimension	TI *R* (*p*)	RF *R* (*p*)	IA *R* (*p*)
Transparent interaction with the PMMS (TI)	–		
Representational fidelity of the PMMS (RF)	0.46 (0.076)	–	
Informed action enabled by the PMMS (IA)	0.35 (0.188)	0.56 (0.023)	–

Note: Dark/light grey-shaded cells indicate a significant relationship (exact statistics, $n = 16$, $p < 0.05|0.1$)

Table II. Interrelationship of the dimensions of effective use

meaningful pattern of relationships among its artefactual attributes (clustering variables) (Sharma, 1996).

As presented in Table IV, a first cluster regrouping four PMMS artefacts (firms B, D, G and R) was labelled operational PMMS. These artefacts are characterised by a weak capability both in terms of alignment and scope and in terms of management support. A second cluster comprised of two PMMS artefacts (A and H) was named managerial PMMS, as these two artefacts are characterised by a high degree of management support. Their information processing capacity assures an average or standard coverage of the firm's performance domain, and essentially aims to provide information that is easy to use by operational-level managers. The third cluster, regrouping six PMMS artefacts (E, K, L, N, O and Q), was labelled functional PMMS. As these artefacts show a strong degree of alignment and have a wide scope, they allow for a more holistic measurement of performance, i.e. both horizontally (business processes and projects) and vertically (business functions), and both at the operational and strategic management levels. The last cluster comprised of four PMMS artefacts (C, F, M and P), was named organisational PMMS. These artefacts are the ones that show strong capabilities both in terms of alignment and scope and in terms of management support.

The relationship between the four PMMS artefactual capability profiles and the effective use of PMMS is assessed by the analysis of variance results presented in Table V. Here, one first observes that the managerial and organisational PMMS artefact profiles are

Table III.
Relationship of the user's education and experience with effective use

	Effective use of PMMS		
User's education and experience	TI R (p)	RF R (p)	IA R (p)
University education	0.14 (0.609)	0.43 (0.094)	0.49 (0.056)
Task experience	0.04 (0.888)	0.37 (0.158)	0.34 (0.201)
Industry experience	0.02 (0.946)	0.41 (0.117)	0.23 (0.383)

Note: Light grey-shaded cells indicate a significant relationship (exact statistics, $n = 16$, $p < 0.1$)

Table IV.
Classification of the PMMS on the basis of their artefactual capability

Artefactual profile PMMS artefactual capability (SMEs)	Organisational PMMS. (CFMP)	Functional PMMS (EKLNOQ)	Managerial PMMS (AH)	Operational PMMS (BDGR)
Alignment and scope	Strong	Strong	Medium	Weak
Management support	Strong	Medium	Strong	Weak

Table V.
Relationship of the PMMS artefactual capability with effective use

	Effective use of PMMS		
PMMS artefactual profile	TI F (p)	RF F (p)	IA F (p)
Organisational PMMS	0.34 (0.572)	0.17 (0.683)	3.94 (0.067)
Functional PMMS	0.00 (0.990)	0.18 (0.678)	0.14 (0.716)
Managerial PMMS	1.81 (0.200)	2.50 (0.137)	11.1 (0.005)
Operational PMMS	0.15 (0.707)	5.58 (0.033)	0.32 (0.578)

Note: Dark|light grey-shaded cells indicate a significant relationship (exact statistics, $n = 16$, $p < 0.05|0.1$)

significantly associated to the effective use of the PMMS because they both have a strong management support capability that better enables users to take informed action. A somewhat more surprising result is that the operational PMMS profile is also significantly associated to effective use, here in terms of representational fidelity. A possible explanation would be that the operational orientation of these PMMS artefacts makes for simpler software design (limited number of performance indicators and managerial functionalities) and thus makes it easier to output performance information that is up to date, relevant, complete, easy to use and easy to interpret by their targeted users.

The results of the variance analysis linking users' extrinsic motivations to their effective use of PMMS are presented in Table VI. Here one finds that when the SME owner-managers' goal in using a PMMS artefact is to support either or both of their firm's strategic planning and continuous improvement processes, effective use ensues in terms of the PMMS artefact's greater representational fidelity. Whereas when the goal is to support operations management, effective use ensues in terms of the better-informed action enabled by this artefact. This last result again comforts the shift of our research attention from the use of an IT artefact to its effective use (Burton-Jones and Grange, 2013), in that it provides a further explanation as to the conditions under which and the manner by which IT-business value is achieved by an organisation that has invested in IT.

5.3 Valuing the effective use of PMMS

As presented in Table VII, the results of two regression analyses relate the three dimensions of the effective use of PMMS (TI, RF and IA) to both the managerial performance and competitive performance benefits of this use, as perceived by the 16 SME owner-managers. The salient finding here is that the realisation of benefits from the use of a PMMS artefact is solely dependent upon the informed action that is enabled by this artefact. While neither transparent interaction with the PMMS artefact nor its representational fidelity were found to have a direct effect upon performance, these two dimensions of effective use would nevertheless have an indirect effect, as one may recall that they are sequentially prerequisite

	Effective use of PMMS		
	TI	RF	IA
User's extrinsic motivations (goals of PMMS use)	F (p)	F (p)	F (p)
Support strategic planning process	0.80 (0.385)	10.90 (0.005)	0.26 (0.620)
Support continuous improvement process	2.31 (0.151)	3.39 (0.087)	0.35 (0.563)
Support operations management process	0.22 (0.649)	0.27 (0.613)	6.79 (0.021)

Note: Darklight grey-shaded cells indicate a significant relationship (exact statistics, $n = 16$, $p < 0.05|0.1$)

Table VI. Relationship of the user's extrinsic motivations with effective use

	Benefits of the effective use of PMMS (dependent variable)	
	Managerial performance	Competitive performance
Effective use of PMMS (independent variables)	T (p)	T (p)
Transparent interaction with the PMMS (TI)	0.00 (0.381)	1.58 (0.139)
Representational fidelity of the PMMS (RF)	1.81 (0.774)	1.13 (0.282)
Informed action enabled by the PMMS (IA)	0.15 (0.037)	2.69 (0.020)
F (p)	4.23 (0.030)	9.31 (0.002)
Adjusted R^2	0.39	0.62

Note: Dark grey-shaded cells indicate a significant relationship (exact statistics, $n = 16$, $p < 0.05$)

Table VII. Performance benefits of the effective use of PMMS

to informed action. Furthermore, these last results confirm Leonardi's (2007) view in that it is through informed action that the informational capabilities of an IT artefact are leveraged and thus generate value for the SMEs that have invested in this artefact.

6. Discussion

To summarise our findings, and given our research questions and model, the nomological network that emerged from this initial validation is presented in Figure 2. A first point to be made is that the three dimensions of effective use are indeed hierarchically related, as postulated in Burton-Jones and Grange's (2013) framework, that is, TI enables RF which in turn enables IA. In accordance with these authors, it thus becomes important to assess each dimension as a function of use rather than as a function of the IT artefact or the user, and to assess the context of use if one aims to theorise and operationalise effective use.

The second point is that informed action was the lone dimension of effective use to have an effect on performance. This finding diverges from Burton-Jones and Grange's (2013) proposal in that all three dimensions of effective use should have impacted the attainment of performance benefits by SMEs that have invested in a PMMS. Now, this divergence may be due to these authors conceptualisation of performance at the individual level (effectiveness and efficiency of the user), whereas performance was conceptualised in this study at the organisational level (managerial and competitive performance of the SME), albeit as assessed by the owner-manager who is the primary user of the PMMS and is well-placed to make such an assessment (Raymond *et al.*, 2013). It stands to reason however that apart from managerial and competitive performance, the development of the firm's dynamic capabilities and chief among them its sensing, learning, integrating and coordinating capabilities are most susceptible to benefit from the effective use of a PMMS artefact (Sharif, 2002; Pavlou and El Sawy, 2011). We have thus included in the nomological network the development of these two dynamic capabilities as an added value of the effective use of a PMMS.

A third point to be made is that transparent interaction was the lone dimension of effective use not to be influenced by any of the hypothesised user-related, system-related or task-related antecedents. Now, it stands to reason that the firm's IT resources and capabilities, chief among them its IT infrastructure, are the contextual elements most susceptible to influence its effective use of IT artefacts such as PMMS (Fink and Neumann, 2007). We have thus included in the nomological network, for future research purposes, the SME's IT infrastructural capability as a potentially enabling factor of the owner-manager's – and other managers' – transparent

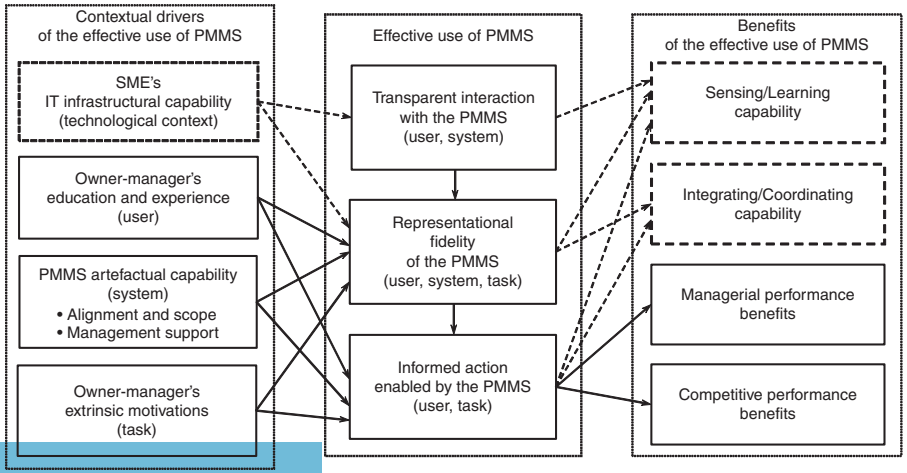

Figure 2.
Nomological network emerging from our initial validation of the research model

interaction with the PMMS artefact, or with any other of the firm's "mission-critical" IT artefacts for that matter (e.g. ERP).

This study has provided an initial validation of Burton-Jones and Grange's (2013) "effective use" framework, a framework that offers a conceptualization of IS use by which it is possible to explain IS effectiveness. It has shown the applicability of this conceptualization and indicates that it is indeed possible to empirically capture the three components of effective use proposed by these researchers. This approach is particularly useful for the study of complex organisational IS whose use cannot be reduced to a few generic or proxy variables, limited in their consideration of the specific context of use. Through the broader and deeper characterisation, contextualisation and valuation that it allows, this study contributes to a better explanation of the PMMS usage phenomenon.

In applying Burton-Jones and Grange's (2013) conceptualization of effective use to PMM systems, we were able to characterize PMMS use through three sequentially ordered dimensions. By thus opening the "black box" of IS use, this approach allowed us to identify the variables that characterize the phenomenon under study in a more valid manner theoretically and in a more useful manner practically. Given the study's aim, these variables were chosen in view of the nature of PMMS as complex organisational IS. By clarifying and proposing a unified basis for the concepts involved, these variables can contribute to the accumulation and integration of IS and PMM research results into a more coherent body of knowledge.

Our study further demonstrates that Burton-Jones and Grange's (2013) framework can provide the contextualisation necessary for an in-depth understanding of IS use and consistent results in terms of the impacts of such use, particularly when it comes to complex organisational IS such as PMMS. Thus, considering the diversity of IT artefacts and of the contexts of use of these artefacts, and given our operationalization of this framework through variables that are rooted in the reality of the organisation (performance management task, user, PMMS artefact) rather than being limited to generic or proxy measures, we were able to understand the true nature of PMMS usage and to explain its contextual determinants and performance outcomes. For example, artefactual characteristics (e.g. strong management support) were linked to particular aspects of usage (e.g. informed action), links that more superficial IS use variables would not have revealed. One can foresee that this approach would facilitate the understanding of usage problems, e.g. divergent use or under-use, by investigating for example the prevailing situation with regard to the representational fidelity of the PMMS artefact.

Lastly, our study confirms that Burton-Jones and Grange's (2013) three-dimensional conceptualization of effective use (TI→RF→IA) provides the opportunity for researchers to observe, in context, a logical transition from the use of a performance management tool to the effects of this use, here from the use of a PMMS artefact to its organisational impacts in SMEs (Kueng, 2000). This provides the researcher with the theoretical means for a deeper understanding of the benefits that complex IS can provide to an organisation, and in particular when the expected benefits of such systems (e.g. improved competitive performance) do not materialize.

6.1 Contribution to theory

Given the results of this study and the theoretical approach taken to analyse PMMS use, its contributions concern both the PMM and the IS research fields. First and foremost, this study has shed new light on – and provided greater understanding of – the nature, extent, drivers and benefits of PMMS use by SME owner-managers. As questions remain unanswered with regard to managers' use of IT-enabled ISs to measure and manage their organisation's performance, be it in large organisations, private or public, or in SMEs, our study has provided both an empirically validated conceptual framework, in the form of a

nomological network, and a measurement apparatus that may be employed by researchers to tackle many of these questions.

Our application and operationalisation of Burton-Jones and Grange's (2013) theoretical framework was found to be initially valid and fruitful in characterising, contextualising and valuing the effective use of PMM systems in SMEs. As many researchers are still preoccupied with the study of complex organisational IS in decision-support roles, such as PMMS, and with the realisation of IT business value from such use, our study contributes to the integration of these research efforts through a conceptualisation and operationalisation of IS use that is adapted to this type of IT artefact (Benbasat and Zmud, 2003). Our conceptualisation and operationalisation of the IT artefactual capabilities included in the research model answer the call for researchers to account for the central position of the IT artefact (or IT materiality) in further attempts to understand why, how and to what effect managers use IT-enabled IS to measure and manage their organisation's performance (Weber, 2003; Orlikowski and Iacono, 2001).

6.2 Contribution to practice

As the use of PMMS and the performance benefits of such use are not yet well understood (Franco-Santos *et al.*, 2012), and especially in the context of SMEs (Bititci *et al.*, 2012), the results of this study provide conceptual and empirical foundations to improve PMMS practice in this context, for organisations currently using a PMMS or for those planning to use such a system. For instance, with regard to the design of a PMMS artefact, one would concentrate on those artefactual attributes that most enable informed action on the part of owner-managers, as these actions have been shown to have greater consequences for the realisation of IT business value in SMEs.

The study's findings further indicate that PMM systems possessing strong management support capability, i.e. organisational PMMS and managerial PMMS, better enable informed action and a PMMS artefact that incorporates attributes providing such support (e.g. that "allows for external benchmarking", that "shows cause-effect links") will promote a more informed management of performance on the part of SME owner-managers. Furthermore, a simpler PMSS software design, i.e. an operational PMSS with a limited number of indicators and managerial functionalities, would positively influence the managers' ability to view the performance of their organisation in a holistic manner and thus reduce the risk of unintended consequences resulting from under-informed action. These findings may also be useful for organisations that already use a PMMS and would like to evaluate its business value. Indeed, the three-dimensional conceptualization of effective use provides an expanded frame of reference for such an evaluation, that is, an evaluation whose scope is wider scope and whose depth is greater.

Finally, the nomological network resulting from this research could provide the theoretical and methodological underpinnings of a diagnostic tool meant to develop the PMM function in SMEs, and in particular to evaluate the alignment of the firm's PMMS with its business strategy and IS strategy.

7. Conclusion

While this field study has some limitations related to the nature of the sample, its results nonetheless provide further empirical grounding and understanding of the concept of effective use, as well as further applicability and actionability to this concept and to the nomological network of its dimensions, contextual drivers and benefits in the case of PMMS and in the context of SMEs. Future research should however add technological, environmental and organisational context-related antecedents to this network, including first and foremost the IT infrastructural capabilities of the organisation. Other consequences of the effective use of PMMS should also be studied, the priority being given to the influence of such use upon the development of the dynamic capabilities that enable SMEs to remain competitive in a global, knowledge-based economy.

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Appendix 1

Transparent interaction with the PMMS	Representational fidelity of the PMMS	Informed action enabled by the PMMS
The PMMS is:	The PMMS produces information that is:	Using the PMMS:
simple to use	up to date	allows me to verify hypotheses
insures a secure and confidential access	relevant	allows me to better understand my firm's performance
filters the content by user profile (personalised access)	complete	fosters the emergence of new ideas on my part
is interactive (internet/web technology)	easy to use	fosters my interest in measuring and evaluating my firm's performance
is accessible from outside the organisation	easy to interpret	fosters my interest in applying appropriate management practices

Table AI.
Measurement items of the effective use of a PMMS

Appendix 2

Alignment and scope	Management support
The PMMS:	The PMMS:
includes strategic-level performance indicators	provides relative measures (trends, ratios, gaps)
includes operational-level performance indicators	presents information in graphical format
includes prospective performance indicators	includes qualitative performance indicators
includes business function performance indicators	shows links between operations and strategy
includes business process performance indicators	shows cause-effect links
measures production quality	allows for external benchmarking
measures production delays	interprets content
measures production flexibility	allows for the development of scenarios
measures R&D	formulates recommendations
measures customer satisfaction	
measures the organisational climate	
measures training and learning	

Table AII.
Measurement items of PMMS artefactual capability

Appendix 3

Managerial performance benefits	Competitive performance benefits
Using the PMMS has a favourable impact upon:	Using the PMMS improves:
the development of the firm's strategy	the capacity to respond adequately to market changes
the development of managerial processes overall	the firm's flexibility
the development of decision-making processes	the capacity to identify market opportunities for products and services
the capacity to quickly react to market changes	the firm's capacity to innovate
the firm's productivity	the capacity to focus attention on the firm's critical success factors
	the alignment of the firm's resources with its strategy
	the cohesion of objectives at all levels of the firm
	the coordination of the firm's functions, processes and projects

Table AIII.
Measurement items of the performance benefits of PMMS use

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