Understanding the relationship between PMS and MIS in SMEs: An organizational life cycle perspective
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Abstract
This research aims to investigate the relationship between performance measurement system (PMS) and management information system (MIS) adopting a company life-cycle approach. The scope is to show if and how MIS influences PMS and vice versa. The investigation is carried out using the case study methodology in Italian and Scottish small and medium enterprises (SMEs). The empirical results are synthesized in two theoretical propositions.

The first proposition underlines the presence of two circular relationships between PMS, MIS and organizational capability. The first relationship is that; PMS implementation and use promote development in organizational capability, and that improvements in organizational capability supports PMS implementation and use. The second relationship is that; advanced MIS create a favourable context for PMS implementation and use, and that PMS implementation and use encourages investments in MIS.

The second proposition emphasizes that company maturity has a relevant impact on MIS and PMS development where mature organizations are able to recognize their needs and are able to design effective MIS responding to PMS requirements. On the other hand, in less mature organizations an external stimulus is essential for supporting MIS investment and PMS implementation and use.

Keywords: Management information system; Performance measurement system; Organizational capability; Small and medium enterprises

1. Introduction
Organizations grow through expanding their range of products and services in response to more mature and saturated markets. The increasing in product and market heterogeneity requires a more decentralized structure and, therefore, an evolution in managerial system becomes essential. Performance measurement system is often mentioned as an important support to managerial development in SMEs. However, many barriers seem to obstruct its implementation in these companies; particular attention was given to the lack of IT platforms [1–3] and people’s behaviour with information [4–6]. Over the last decade there has been an important increase in the number of software vendors offering different IT platforms to support performance measurement. More recently, the research emphasizes that when managerial practices and human behaviour in information system is advanced, there will be a context that favours performance measurement, regardless of the level of investment in information systems [7]. Researchers claim that information systems must be adapted to the specific characteristics of SMEs and further research on the relationship between management information systems and performance measurement (PM) is required [8,2].

Our research aims to contribute to study the relationship between MIS and PMS implementation in small and medium enterprises from a dynamic perspective; with the life-cycle approach being applied to analyse if PMS and MIS are related to company life cycle stage.

The remainder of this paper is organized in five sections. First, the literature background on management information systems and business performance measurement is reviewed giving particular attention to SMEs. Secondly, the research design is described. Thirdly, the profile of the companies involved in the empirical study and the characteristics of their
PMS implementation are described. Fourthly, the empirical results are discussed. Finally, the answers to the predefined research questions are summarized along with a discussion of the main issues requiring further investigation.

2. Literature background

Since the mid-1980s, increasing attention has been given to the study of performance measurement, i.e. the process of quantifying the effectiveness of action. Most of these studies underline the change from accounting and static approaches to multidimensional and dynamic approaches considering the whole organization. This evolution is reflected in the characteristics of the PMS, i.e. the balanced and dynamic system that is able to support the decision-making process by gathering, elaborating and analysing information [8,2]. However, there is a lack of empirical quantitative research assessing the actual characteristics of PMS. Some empirical evidence suggests that the characteristics of a PMS are simple and rudimentary; at first implementation, by using it, the company enhances its functions and its scope of application [9,10].

For many years there has been constant progress in designing performance measurement systems, while little attention has been placed on the implementation and use of these systems [11–13]. Also, there is a lack of empirical research assessing the evolution of the PMS adopted in both SMEs and big companies.

Plenty of factors are mentioned as obstacles to performance measurement systems implementation and use in SMEs—see, for instance, a lack of human and capital resources, managerial capability, and the misconception of PMS [14]. Many executives and academics believe that the main reason why PMS are short-lived is because of people’s behaviour with the information [6,15]. Providing performance information is not sufficient to improve business performance results. The real success lies in people’s behaviour with this performance information [16,4,5].

Management information system is recognized as one of the critical success factors for PMS implementation. It is defined as a system that deals with the planning, development, management and use of information technology tools to help people perform all tasks related to information processing and management [17]. MIS should deliver many results and benefits. However, in the context of performance measurement, MIS is required [11] to deliver one or more of the following:

- Data collection, analysis and storage [17,18].
- Improving operational control, speed and flexibility and, hence, improve efficiencies of business operations [15,18].
- Improving communications, supporting the efficient and effective running of business processes [17,15].

Some studies suggest that PMS can be made less cumbersome and more dynamic and responsive using information technology support [19,3,20]. An inadequate information system is described as one of the main obstacles to performance measurement [21,5,22–24], especially in SMEs. Many authors write that information systems must be adapted to the specific characteristics of SMEs [25,2,26,16,8].

The introduction of powerful technological tools has often led companies to focus their attention on technology – called hard aspects – and to neglect managerial practices and human behaviour—called soft aspects; insufficient attention is given to the organizational impact of information systems [27]. According to many authors, in addition to providing hard aspects of MIS, such as creating databases, installing servers, automating data collection systems, etc., companies are also required to provide soft aspects of MIS, such as Performance Information Practices and Performance Information Behaviour [17,28,15,23,4,5].

3. Research methodology

We carried out exploratory research [29] using a qualitative research approach. Five cases studies were analysed to investigate the relationship between PMS and MIS. This technique was chosen for three main reasons [30–33]. First, the research is explorative, since, as mentioned above, there is a lack of research on the topic studied. Secondly, the case studies were considered to be very useful for uncovering possible contingency effects and for finding empirically grounded explanations for them [34]. Finally, case studies have proven to be one of the most powerful research methods, particularly in development of theory [35]. Moreover, company documents and interviews with managers were used to collect additional information and to better understand the data gathered [31]. The units of analysis were PM, PMS and MIS in SMEs with the following definitions:

- PM: the process of quantifying the efficiency and effectiveness of action [36].
- PMS: a balanced and dynamic system that supports the decision making process by gathering, elaborating and analysing information [2,8].
- MIS: the system for planning, developing and using the Information Technology tools that support company members in managing the information process [17].
- SMEs: manufacturing companies that have between 50 and 250 employees, whose capital is held by one person or a small group of people, and that has participated in quality awards or other improvement projects.

The data was collected by visiting companies and interviewing persons at different organizational levels. During the first phase some frameworks were developed to analyse the relationships between PMS and MIS [35]. The nature of these frameworks is described later in the paper. Then, in the second phase, the influence of company growth and organizational capability was investigated.

4. Empirical study

The empirical study involved three Italian and two Scottish manufacturing SMEs. For each company we collected information about PM, PMS, MIS and the company’s growth. Each company’s PMS was analysed making reference to the framework proposed by Garengo [10]. This framework is based
on two groups of dimensions. The first is called PMS characteristics and it considers how a company is using the measures to manage performance. The second group is called PMS scope and it refers to what the company is measuring, i.e., the existence of many perspectives to measure performance. The evolution of the PMS and company life cycle is shown in Fig. 1; the initial company’s position is marked with an outline and number 1, the final company’s position is re-marked with a continuous line and number 2 (Fig. 1).

Considering recent research on information systems [37,17,28,12], MIS was studied—taking into account both hard and soft dimensions, i.e., technology and managerial practices and human behaviour with information. These aspects were investigated using two main tools: the first one was a questionnaire based on the literature available and the second a predefined tool for studying managerial practices in SMEs [38,14].

During the empirical study, a relationship between PMS and company growth seemed to have emerged. Many models, based on the organizational life cycle, have been proposed over the past decades [39–44]; in this study company growth was investigated using the Scott and Bruce model [45]. The choice of an appropriate life-cycle model to identify different configurations in complex settings was a crucial process. The Scott and Bruce model was chosen for two main reasons. First, the model is able to cover a complete company life cycle from birth to death. Second, the characteristics of each stage are described in detail and the model is suitable to be used empirically.

The evolution of the company life cycle is shown in Fig. 2; number 1 shows initial companies position; number 2 shows final companies position.

For a better understanding of each case study, Figs. 1 and 2 highlight the parallel evolution in PMS and business growth of each company. The relationship between PMS and MIS for the empirical cases are described in the following sections.

4.1. Case A

An entrepreneur founded Company A in 1962 for machining and anodising aluminium components. It specialises in designing and manufacturing handles, trims, panels and knobs for the appliance industry. It employs 57 people and turnover is almost 7.6 million Euros.
Since the Company was established, for 20 years it grew up quite quickly in different market segments. During the 1980s the Company went into crisis, brought about by increasing competitiveness, lack of strategy and managerial culture (A1—see Figs. 1 and 2). In order to bring back the business into the market and compete with competitors, there was a need to change both managerial and operational practices, as well as redefine the strategy. For achieving this it was necessary to adopt suitable tools to manage it. However, the founder was not able to do that; he could not change his managerial approach. In 1989, the entrepreneur was retired and his son took up the management of the firm. The new manager stated the necessary reorganization and a focused/specialized strategy was implemented. The re-organization involved both the core business and the managerial practices. The customer focus was given as one of the Company’s main interests. Soon the Company tried to acquire new markets and a new business model was proposed to answer to the needs of new customers.

This new strategy and management style required more information. A quality manager with PMS experience was engaged and he encouraged management approach based on quantitative data. He introduced some key performance indicators (KPIs) and in a short time these KPIs increased the entrepreneur’s control. The need to improve the management information system was highlighted, but the entrepreneur did not want to invest the necessary financial resources to implement an integrated PMS. However, using free software and internal knowledge, the MIS was improved to support performance measurement system. In a few months, the advantage of the new system was highlighted and new investments in MIS were planned.

The quality and information director managed the investment in the information system. MIS development supported the initial collection of data for performance measurement. The PMS moved from a dual basic PMS used during the stages 1 and 2 to a balanced advanced system to get over the organizational crisis (Figs. 1 and 2). The PMS was improved using an incremental process, which required years to overcome internal barriers. However, it had an important impact on the organizational capability. As reflected in quality award results, the improvement in MIS and PMS supported the development of organizational capability of the company and further investment in PMS and MIS were planned (Fig. 3).

Recent interviews with the management team lead us to suppose that the company could get into a new organizational crisis (A2—see Fig. 2). Further growth of the company would require delegation and empowerment. Management considers that PMS will be the main tool supporting this further growth from stage 3 to stage 4 and prevent the managerial crisis.

4.2. Case B

Company B produces castings in nodular cast iron and grey iron. It employs 180 people and its turnover is about €31 million. An Italian entrepreneur founded it in 1958 and it was sold 10 years later to a family company. Turnover, employees and the quality of products have grown during these 10 years. Heavy investments have been made, aimed at guaranteeing a flexible and competitive production system, equipped with modern plants, able to meet sophisticated metallurgical requirements. The company developed constantly with improvement in different areas, such as personnel management, high-tech structure, information technology, quality and environment policies, and control policies. The company regularly planned training courses intended to complete the cultural and professional instruction of its personnel. It was one of the first SMEs in Europe to introduce Total Quality, thus achieving the standard required for ISO 9002 certification. The firm has developed an environmental management system organized according to international principles, and in February 2000 it obtained ISO 14001 environmental certification.

Relevant investments in management information systems were supported by the interests of the IT manager and general manager. Information technology applications and tools have been developed internally, such as a company portal and a series of digital control panels delivering efficient and effective communication of information to all company users (Fig. 4).

For many years the company remained in stage 3 (B1—see Fig. 2) and it used a partially balanced basic PMS (B1—see Fig. 1). The company produced an internal PMS suitable to answer the company needs. The performance measurement system was introduced using an incremental approach. In the first few years, it was focused on financial indicators, supplier and production. In the next few years, the management planned a relevant growth of the business to move from B1 to B2 position (Fig. 2). PMS improvement was considered indispensable to do this. Relevant investment and training activities in the information system area were planned and MIS for PMS improved quickly. Much data was collected and it was useful to support the performance measurement and the managerial processes. To control the managerial processes and to support decision making a balanced excellent PMS was introduced.

Fig. 3. PMS implementation in company A.
using an incremental process (B2—see Fig. 1). The PMS is moving towards a diagnostic excellent system.

In this organization, there is significant evidence that PMS promoted and is promoting an improvement in organizational capability. During this time the company obtained national quality recognitions and in 2004 it won the European Quality Award (Special Prize Winner in Leadership and Constancy of Purpose about SMEs category).

In this company, the MIS and PMS were not introduced to solve a crisis. The company was mature enough to prevent this crisis. During the years, the management understood the key role played by PMS and MIS to manage the business and the company growth and, as a consequence, they planned the PMS improvement.

At present MIS and PMS are perceived as the same entity and it is considered indispensable for managerial processes and improvement in organizational capability.

4.3. Case C

Company C produces and sells pumps for use in industry, civil engineering and emergency duty. The company began life in 1932 as an individual enterprise, and pump production commenced in 1948. Its name is known around the world for high quality pump design and construction. Currently it employs 110 people and its turnover is about € 23 million.

In a few years the company increased its dimensions and now it is present in three main markets: industrial, civil engineering and safety. The growth process emphasized the need of organizational capability to promote empowerment, improvement in managerial and cost control, etc. Investments in MIS for PMS were promoted, as well as suitable learning (Fig. 5). In company C, the entrepreneur and a part of the management team demonstrated an in-depth interest in IT investment. This company was one of the first Italian SMEs that implemented an ERP system with computer-based warehouse; large amounts of resources were spent in technological tools and software. This generated an internal context favourable to PMS development.

The company implemented a partially balanced advanced PMS during the first stages (Figs. 1 and 2). However, the PM benefits were not highlighted. Management style boycotted the gathered information. Many detailed reports were periodically prepared but they were not available to management. Nobody knows the real use of it. Only one person, the account manager, could read the information that was used to legitimize her power position. The improvement in organizational capability has not emerged. The company stopped taking part in quality awards because it was clear that organizational development was not taking place. A managerial crisis overpowered the company and in a few months it was sold. The need for managerial development surfaced very quickly with the new ownership. The new management is promoting the improvement of the managerial system to put the company into stage 3.

4.4. Case D

Company D, based in Perthshire, was formed in 1979 and was established as the UK’s biggest British brand of natural mineral water, exporting to over 50 countries worldwide. Since the late 1970s, it has invested over £40 million, establishing Blackford as one of Europe’s most modern natural mineral
water plants. Today, company D is the largest employer in Blackford with 200 employees.

The company, as a whole, did not have performance measures derived from strategy; however they had a few financial indicators. In addition, the company did not have enhanced MIS to support the existing performance measures. The data was collected on paper on the shop floor. In summary, the company had a traditional basic PMS as shown in Fig. 1 in the initial stages. Hence, the company was suffering from information being hidden in paper sources. There were also difficulties associated with data collection on the shop floor. This seriously limited access potential to very useful data. Information was not communicated to the right people. This resulted in a lack of visibility over changes and trends. Although the company had an intranet, it communicated the financial data and static web pages. In general people did not do performance analysis of the data collected on the shop floor.

The management team felt that the company was in an information crisis and could not focus on improvement opportunities (Fig. 6). Hence, the management team has redefined their strategy and deployed it to lower levels using both lagging and leading indicators. For implementing these measures the management involved the IT team to investigate MIS to support the PMS. The data collection, analysis and communication were automated using SCADA system and the Cognos reporting tool, which provided information in real-time (near). These changes moved the company from stage 2 to stage 4, as demonstrated in Fig. 2, with balanced excellent PMS as shown in Fig. 1. After implementation it was found that there was a significant improvement in the following aspects:

- The management team gained confidence in performance information generated by the system because the data was accurate and timely.
- The performance results were communicated to everyone in the organisation, especially to all team leaders and people on the shop floor.
- The management team is more pro-active in decision-making.

The interviews with their senior managers revealed that there was a significant organisational growth as a result of implementing the balanced excellent PMS.

4.5. Case E

Company E, based in Edinburgh, was founded in 1858 and has long been recognised as a provider of self-adhesive labels and flexible packaging solutions to a wide range of market sectors throughout UK and Europe. It has a vast experience in producing different types of labels using digital and combinations press technology. Design, artwork, origination, print and conversion are all provided in-house and are subject to a rigorous quality control system in line with the latest ISO accreditation. There are 64 employees working in the company.
The company implemented a traditional basic PMS (Fig. 1) during the first stages (E1—Fig. 2). However, the PM benefits were not highlighted (Fig. 7). The company has a scheduling and data collection system, Shuttleworth, which collects the data from the shop floor and stores it in a 17-year-old Speed Base Development System (SBDS). SBDS is a non-relational database system, which was not user-friendly and the IT Manager was the only person who could use it effectively. This seriously limited access, potentially, to a very useful data. Information had to be requested from the IT Manager in the specified format, but as SBDS was not a relational database it was not always that easy to format data in a specified fashion. Their existing MIS cannot be changed to adopt new measures.

As a result, the company was in crisis. The management decided to implement a partially balanced basic PMS, as it decided not to invest any further on their MIS as shown in Fig. 1. As a result, there were limitations in the data collected (because the automated data capturing system was originally designed based on financial measures, and it cannot be changed to capture data required to measure operational equipment effectiveness by shift, by product basis, etc.). The senior management did not develop confidence in the system due to the limitations in data capturing and, hence, did not drive the management to develop a new system. The senior managers underlined and the case studies demonstrate, performance measurement activities require MIS to support collection, processing and delivery of the data about performance. Case E clearly emphasizes that deficiencies in MIS obstruct PMS use because the required data cannot be captured. Moreover, the benefits highlighted by PMS implementation and its use were able to promote further management information system investment. For instance in company A, during the first implementation phase entrepreneurs obstructed MIS investment, and only free software and internal knowledge could be used. However, in a few months PMS advantages were highlighted and, consequently, MIS investment was planned and supported by entrepreneurs.

The empirical evidence provided so far could be synthesized with the following theoretical proposition and is shown in Fig. 8.

**Proposition 1.** PMS implementation and use promote improvement of organizational capability. The development of organizational capability favours an effective use and growth of PMS. Moreover, the mutual relationships between PMS and organizational capability start up a dyadic relationship between PMS and MIS. Advanced MIS is essential to create a favourable context for implementing and using PMS; the

![Fig. 8. The relationship between organizational capability, PMS and MIS.](image-url)
benefit highlighted by PMS implementation and use promotes further investment in MIS.

The analysis of the case studies highlighted that some organizations found more barriers to PMS and MIS investments than others. They had difficulties producing a persuasive business justification for MIS and PMS investments because of the frequent misconception of performance measurement and a high uncertainty about the scale of impact and the scale of costs likely to be incurred. The analysis of a company’s life-cycle demonstrated a better understanding of this. Mature organizations – i.e. companies at stage 4, stage 5 and partially at stage 3 – (Fig. 2) were able to recognize their needs and to design effective MIS responding to PMS requirements (company A2, B2 and D2). These companies seemed more dependent on sharing and using performance information dynamically and hence became more knowledgeable and proactive. Consequently, these organizations could design and implement effective MIS and adopt advanced or excellent PMS practices. Less mature companies – i.e. companies at stage 1, stage 2 and partially stage 3 – (Fig. 2) had more barriers to design and implement effective MIS (company A1, C1, D1 and E1). In companies A1 and D1 the organizational crisis underlined the need of improving managerial capability. After the initial evidence of the benefits, these businesses followed the use of some performance measurement indicators, and a PMS was implemented. In these companies, initial elementary MIS investment encourages PMS development. The free external support or the presence of at least one person with MIS knowledge and interest were the main starting points for emphasizing MIS in supporting performance measurement for decision making. These personal drivers or/and external support allowed the development of some indicators or “rudimentary” information systems that could highlight, with actual facts, the importance of PM. Subsequent investments in MIS for PMS were encouraged and a dyadic loop between PMS and MIS was stimulated with a positive impact on organizational capability.

Lacking in external stimulus impedes to recognize MIS and PMS benefit and company is kept into the organizational crisis. This empirical evidence could be synthesized into the following theoretical proposition.

**Proposition 2.** Mature organizations are able to recognize their organizational needs and design effective MIS responding to PMS requirements by themselves; in less mature organizations, an external stimulus is essential for supporting MIS investment and PMS implementation (or improvement) to get over organizational crisis.

6. Conclusions

Five Scottish and Italian case studies were investigated to study if, and how, MIS influence PMS and vice versa. Using categorical aggregation and interpretation technique [46,47], two theoretical propositions were formalized to summarize the conclusions.

The first theoretical proposition identifies two dyadic relationships between PMS, MIS and organizational capability. During the first part of our research, we found that PMS implementation and use have a positive impact on the improvement in organizational capability, i.e. company’s ability to establish internal structures and processes that create firm-specific competencies and enable it to adapt to changing external pressures. Moreover, the benefits highlighted by PMS implementation and use push further investments in PMS itself and a circle relationship between PMS and organizational capability is set out.

Subsequently, we found out that the mutual relationships between PMS and organizational capability starts up a dyadic relationship between PMS and MIS. Advanced MIS is essential to create a favourable context for implementing and using PMS; the benefit highlighted by PMS implementation and use promotes further investment in MIS.

The second theoretical proposition points out that these relationships are affected by company life cycle. Mature organizations are able to recognize their organizational needs and, consequently, they can design effective MIS responding to PMS requirements by them; in less mature organizations, the need for improvement in organizational capability is emphasized by organizational crisis and an external stimulus is essential for supporting MIS investment and PMS implementation or improvement to get over organizational crisis.

The achieved results support a better understanding of the relationships between PMS, MIS and organizational capability in SMEs. However, further empirical testing and reiteration of the research cycle should be required to increase external validity [48]. It would be interesting to extend the investigation to a wider group of companies, selected by the European SMEs that have had experience in managing of organizational crisis.

In this study attention was focused solely on PMS and MIS in SMEs. As mentioned before, PMS implementation and use are affected by many specific factors that characterize the small dimension, seen for instance lacking in MIS and a shortage in managerial capacity. As a consequence, the achieved results could not be generalized to large companies. Further investigations should be useful to study the relationship between PMS and MIS in large companies to emphasize differences and similarities between large and small organizations.

References


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