Sustainability in Healthcare: the (un)solved quest for aligning organizational and architectural levers for change

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Abstract

Healthcare urges to reinvent itself since the sustainability of present delivery paradigms cannot be taken for granted also in the very short time. Hospitals are reinventing themselves to improve their capability to deliver high-quality care that is also sustainable from an economic, ecological, social perspective. Despite their efforts, results are limited. Even a cursory literature review would show that many initiatives have become rapidly failures and the abandoned. Moreover, our understanding of the levers to make this change happen is limited. The term "sustainability" in healthcare mainly refers to hospitals that adopt some architectural features for being green, and evidence came mainly from anecdotes or case studies and results from large-sample surveys are largely missing.

This paper aims at furthering the ongoing debate about sustainability in healthcare by developing a literature-grounded framework (and relative hypotheses) that may be tested in future large-sample surveys. In particular, we want to conciliate in a unique framework two bodies of literature and two approaches to this issue: organizational levers and architectural levers. This linkage is still today not fully understood and the failure of many sustainability initiatives can referred to the misalignment between the new facilities and the persistence of the past routines and behaviors.

We searched contributions on Scopus, Ebsco, Proquest, Pubmed databases: 21 contributions were selected as relevant and grounded the development of our framework and hypotheses. The "Methods" section in the full paper will detail our search and assessment criteria.

Five leverages emerged from the architectural literature: ambient condition; space/function; signs, symbols and artifacts, materials and systems. Five leverages emerged from the organizational literature: culture; structures and roles; human resources practices, leadership and work processes.
Only two contributions took explicitly into consideration the linkages between the architectural and the organizational leverages. This paper conciliate these nine levers in an unique framework.

Introduction

Global warming emissions, local pollution, nurses shortage and financial strain are something that the healthcare systems of the most developed Countries are experiencing in one form or another (WHO, 2009). With this regard, in both Europe and North America there is a rising commitment to develop a comprehensive strategy to reduce healthcare-related climate footprint and move toward climate-neutrality. These efforts are contributing to a severe debate about the delicate relationship between hospitals and sustainability. At present, its focus has been mainly the environmental pillar, as demonstrated by the various projects in Europe and US. For example, *Practice Greenhealth* is a networking organization for institutions in the healthcare community that has made a commitment to sustainable, eco-friendly practices. The *Green Guide for Health Care* is a best practices guide for healthy and sustainable building design, construction, and operations for the healthcare industry.
Additionally, the European Commission has also recommended hospitals to design and implement strategies to save energy and preserve the environment, and with this regard decided to fund the construction/renovation of five European hospitals – i.e. Aabenraa/Haderslev Sygehus (DK); Fachkrankenhaus Nordfriesland (D); Meyer Children Hospital (I); Torun City Hospital (PL); and Deventer Hospital, (NL) – to show examples of eco-friendly hospital building design.
However, the innovation of hospital buildings is only one half of the challenge that healthcare regulators and hospital managers have to cope with. The other "half of an apple" is the innovation of organization, practices and behaviors. When the first innovation happens without the second one, hospital professionals tend either to replicate the practices and behaviors they were used to engage in the previous layouts, vanishing the benefits and potentialities of the new buildings, or to be resistant to change (McKeel & Healy, 2000), since the new spatial organization is alien or unsuitable for them. With this regard, past research claimed that sustainability can be achieved only through a profound change that is not limited only to structural and architectural factors, but that includes – and leverages on – every element of business and clinical practice, such as decision making and processes associated with institutional support systems, technology, clinical support, and clinical practice (Porter-O'Gready & Malloch, 2010).

Despite this recommendation, our current understanding of how architectural and organizational factors should be aligned to promote and facilitate sustainability-oriented performance in a hospital setting is still very limited, since literature has developed along two parallel directions – the first that investigated the architectural/structural factors and relative leverages, the second interested to the organizational factors and relative leverages – with no clear interconnections. The shortcomings of a current limited understanding of the interplay between architectural and organizational factors become critical when a number of healthcare systems implement strategies towards sustainability by building or renewing hospital buildings and layouts. Architects define new solutions that appear to facilitate an economic, environmental and social sustainability, but they lack clear indications on how to achieve these advantages, since organizational factors and relative changes can modify their expectations radically. Hospital managers desire state-of-art hospital buildings and new layouts for improving performance, but they are unable to provide architects with clear indications since they have no idea on which architectural leverages might facilitate the organization, the practices and the behaviors they want to be engaged in the new facilities. Also healthcare professionals are unable to converge to shared proposals, while they focus on local improvements.

This paper aims at improving the understanding of the interplays between the architectural and the organizational factors and leverages through an extensive literature review. The main goal is trying to conciliate various bodies of concepts, factors, leverages that are often in conflict each to the other and thus gaining a comprehensive framework. The generation of hypotheses grounded into previous contributions provides researchers with clear avenues for further research. Confirming or not these hypotheses will provide healthcare regulators, hospital managers and professionals, and architects

with clear indications about how to align the architectural and the organizational design of new or renewed hospitals..

Methods

As anticipated, past research focused distinctly to the architectural or the organizational factors that might contribute to make a hospital sustainability-oriented and thus failed to crystallize the various interplays between the two distinct bodies of factors. This study aims at narrowing this limitation and offering new insights to the ongoing debate about sustainability and healthcare.
With this regard, we performed a literature review aimed at collecting the studies that investigated the architectural or the organizational factors and leverages that might be conducive of an increased sustainability in the peculiar context of new or renewed hospitals. Our review was not intended to provide an exhaustive analysis of such factors. Rather, it offers a survey of contributions that may help to improve our understanding of the most relevant interplays between the various factors.
We carried out an electronic literature search from January 1990 onward covering Scopus, Ebsco, Proquest, Pubmed to collect the relevant contributions. The references of the selected contributions were also reviewed. Both factors and leverages were limited to the architectural and organizational domains and to the hospital setting. Potential contributions were identified through the use of the following keywords, i.e.: "sustainability", "sustainable", "green", "environment" combined with "healthcare", "hospital", "design", "service", "workplace", "facility"and "organization".
The identified contributions were reviewed for relevancy by the authors separately, on the basis of the title and abstract. If at least one reviewer identified a contribution as being potentially relevant, the full paper was obtained. The collected papers were then reviewed and selected if all the authors considered them to meet the selection criteria. A brief textual description was written for each factor or leverage, in particular concerning the interplays with other factors or leverages.

Findings from the Literature Review

Findings from our literature review will be illustrated according to the two bodies of past research. With this respect, we will illustrate formerly the main factors and leverages that come from the architectural realm and then the factors and leverages that come from the organizational one.

- *Architectural Factors*

Sustainable buildings, such as those aiming for carbon neutrality or zero waste, as distinguished from their conventional peers, are developed and operated to simultaneously minimize negative impacts on the natural environment, and, benefit patients, staff and local communities (Guenther and Vittori, 2008). Moreover, sustainable buildings are designed for flexibility, long-term use, and high-performance (McCullough, 2009).

Five design factors emerged from our literature review as relevant for enhancing sustainability-related performance, with particular emphasis to issues related to environmental respect, staff well-being and productivity.

The first factor is *ambient conditions*.
Ambient conditions include background characteristics of the environment such as temperature, lighting, noise and scent. As a general rule, ambient conditions affect the five senses (Bitner, 1992).
Natural light and lighting in general have received great amount of attention, because taking advantage of natural light it is possible to minimize the need for electric lighting during the daytime, saves energy and money (McCullough, 2009; Health Estates Investment Group, 2010).

Moreover, the availability of natural light is cited as a major factor influencing the mood of patients and having a beneficial effect on welfare (Alimoglu and Donmez, 2005) and productivity (Ulrich et al., 2008, Practice Green Health, 2008) of staff. The ability to control the immediate environment such as temperature, ventilation and light is cited as one example of an important design feature affecting retention of nurses by the respondents of PricewaterhouseCoopers survey (2004).
Exposure to nature views is appreciated by both patients and staff (Rechel et al., 2009; GGHC, 2007; CABE, 2006; WHO, 2009; Health Estates Investment Group, 2010). In fact, the particular stresses associated with nursing mean that dedicated areas for staff rest and relaxation, especially outside spaces, gardens, and landscaping, are significant factors that attract and retain nursing staff (CABE, 2006).
Noise is also recognized as a distraction and stressor for staff. Topf and Dillon (1988) found that noise-induced stress correlates with reported emotional exhaustion or burnout among critical care nurses.
Finally, smell of the hospital was specifically mentioned in relation to the recruitment of nurses during the workshops carried out by PricewaterhouseCoopers (2004).

The second factor is *spatial layout* and *functionality*.
Spatial layout refers to the ways in which machinery, equipment, and furnishings are arranged, the size and shape of those items, and the spatial relationships among them. Instead, functionality refers to the ability of the same items to facilitate performance and the accomplishment of goals (Bitner, 1992).
Convenient layout increase caregiver productivity; reduce horizontal and vertical travel time and patient transfers; reduce energy consumption; and reduce costs of future layout modifications (Pradinuk et al., 2008 in Guenther R., Vittori, G., 2008). Moreover, an appropriate organization of supplies and equipment can save nurses considerable wasted effort, providing more time for patient care, reducing job stress, and increasing job satisfaction (Hendrich, et al., 2004). In fact, 76% of respondents to the Director of Nursing survey (PricewaterhouseCoopers, 2004) indicates that functionality is important to nurses as part of the recruitment process and 90% reports it has a great impact on the performance of nursing staff.
Particularly important is the concept of *design for flexibility* (GGHC, 2007), because the use of space in hospital buildings can be very dynamic, with high demands for adaptability.
As changes in functional requirements emerge increasingly quickly, sustainable constructions will need to adapt their functions over time in order to save resources (Rechel et al., 2009). Adaptability has been demonstrated particularly important for patient rooms. Adopting an acuity-adaptable room configuration, Clarian Health's Methodist campus reduced the number of patient transfers by 90%, and thereby reduced the amount of nursing time expended on this "non-value" activity (Hendrich et al., 2004).

The third design element is related to *signs, symbols and artifacts*.
Signs displayed on the exterior and interior of a structure are examples of explicit communicators.
They can be used to convey rules of behavior and play an important part in communicating firm image. Quality of materials used in construction, artwork, presence of certificates and photographs on walls, floor coverings, and personal objects displayed in the environment can all disclose symbolic meaning and create an overall aesthetic impression (Bitner, 1992).
Moreover, signage is important not only to patients and visitors, but also to staff, both to help them find their own way around the hospital and to avoid wasting time (Rechel et al., 2008; Rechel et al., 2009; GGHC, 2007; CABE, 2006)

The forth element is represented by *materials*.
Building materials and the products used to clean and maintain them can all be significant sources of volatile organic compounds (VOCs) and other indoor pollutants that affect indoor air quality and may cause the emergence of *sick building syndrome (SBS)* and *building-related illness (BRI)*.
Thus, sustainable strategies take advantage of eco-friendly and not toxic materials both for buildings and furnishings (McCullough, 2009; PGH, 2008; GGHC, 2007; CABE, 2006; Deloitte, 2008; Health Estates Investment Group, 2010). Moreover, materials practices are recognized as a major source of environmental pollution and potential harm to health (Lowell Center for Sustainable Production, 2005). Mercury, PVC and latex, which are present in many health care products, are recognized as threats for health of patients, workers, and thus have led many pollution prevention programs.

The last factor highlight in the literature is related to *technical systems*.
In 2010, Health Facilities Management survey respondents put energy conservation at the top of the recent measures undertaken by American hospitals, because of the cost savings it generates.
In fact, lighting and heating/cooling systems are the greatest sources of expenditure also because they are often not subject to proper maintenance.
Moreover, according to the Marginal Abatement Cost (MAC) Curve, developed by NHS Sustainable Development Unit (UK), the largest savings of CO_2 emissions would come from installing combined heat and power (CHP) systems in about half of the existing Acute Trusts that currently do not have CHP, and from introducing biomass boilers to 20% of the Trusts.

Finally, strong evidence emerges about the need of involving healthcare workers in the design of new facilities (PricewaterhouseCoopers, 2004; Parish, 2008; McCullough, 2009) in order to ensure that new buildings improve the delivery of medical care and provide a healthy environment for staff, patients and visitors (Rechel, 2008).

- *Organizational Factors*

Both academic and practitioners argue that organizational models must be reformed to achieve sustainability. Five factors emerged from the literature: culture; structures and roles; human resources practices, leadership and work process.

The first factor is *organizational culture*, that has been defined as shared values, ideologies and beliefs (e.g., Schwartz & Davis, 1981). It is often cited as the primary reason for the failure of implementing organizational change programs (Linnenluecke & Griffiths, 2010).
Enforcing the employee perception that sustainability is entirely consistent with public value may in itself provide substantial motivation to pursue sustainability action (Pflueger, 2009). Moreover, the health care professional value to "do no harm" seemingly is consistent with the research finding that altruistic social norms mediate environmentally friendly behavior (Topf , 2005).

A second element is related to *organizational structures* and *roles*.
Particularly important is the presence of a **s**enior manager with specific responsibility for environmental sustainability, who has to communicate the need to change and prevent "green" actions from being marginalized (Griffiths, 2006).
Facility manager and waste officer/manager are also important figures in promoting and maintaining low energy and resources consumption in the hospital's day-to-day operations, as highlighted in the case studies about NHS Trusts presented by Tudor et al. (2008). However, usually these managers have to report to senior level management and further direction by the CEO or a Board of Directors that oversees expenditures. If facility manager and waste officer are not able to shape the "business case for sustainability", this relation has the potential to create an imperfect

decision making system, especially in the area of plant services where the nature of business is highly technical (Hodges, 2005). Thus, the organizational performance can be improved integrating facility management within the strategic management function and making the organizational structure more effective through a less restricted role for facility managers (Elmualim et al., 2010).
Organizations need also encourage staff to actively participate in sustainability initiatives and feel chartered and empowered to make decisions and take actions that represent green behaviors in their own practices (Ulhoi & Ulhoi, 2009, Porter-O'Gready & Malloch, 2010).

Human resources practices are also crucial to align all the organization members with the sustainability strategy.
Literature recognize a fundamental role to training and education. Training initiatives are useful to both managers and practitioners in order to raise awareness about the consequences of their decisions and actions (Tudor, 2007; Ulhoi & Ulhoi, 2009; Porter-O'Gready & Malloch, 2010). NHS SDU suggests energy awareness campaigns as one of the most cost effective measures to reduce the energy consumption and decrease the level of CO2 emissions of the healthcare sector. Moreover, information barriers on the nature of the environmental crisis in hospitals can be removed with classes on energy conservation, recycling and other specific green products and climate change issues (Topf , 2005; WHO, 2009).
Hospital administrators often forget to train staff prior to a move to a new facility. Training on the appropriate use of building controls and procedures has to be provided also to non-technical building manager and the staff to maintain efficient building operation and minimize operational environmental impacts (Health Estates Investment Group, 2010). Furthermore, if this education does not occur, staff are going to attempt to work in the new environment using old processes, and they frequently become frustrated (McCullough, 2009).
Individuals or groups can also be incentivized to change their actions and break ingrained habits by offering rewards or incentives (GGHC, 2007; Deloitte, 2008). They can be implemented in several forms, such as financial rewards and recognition awards, and function as reinforcement to motivate and increase commitment from staff to be environmentally responsible. Moreover, feedback on energy and resource consumption can increase awareness about the use of resources and maintain enthusiasm and interest often associated with project initiation and the early stages of implementation of an environmental program and (GGHC, 2007; Georg & Fussel, 2000; Deloitte, 2008).
In addition, implementing sustainable and institutional environmental programs requires participation from a wide variety of individuals and departments (HCWH e CHD, 2006). Thus, cross-functional teams may be particularly helpful in achieving environmental improvement. However, to be effective, these teams must be well constructed, particularly diverse (related specifically to the issue at hand), and well facilitated (Porter-O'Gready & Malloch, 2010). In addition, managing the patient pathway trough a multi-disciplinary approach enhances the sharing of professional competences and contributes to a definition of a more appropriate care, that leads to the minimization of wastes and errors on one side, and to the improvement of employees' satisfaction on the other (Longoni et al., 2010).

A forth factor is represented by *leadership* and *management style*.
The right people at strategic level must be committed to sustainability (Griffiths, 2006). Leaders must approach green innovation with a firm commitment to investing in and responding to local innovation teams and their recommendations related to effective environmental transformation (Porter-O'Gready & Malloch, 2010). Thus, partecipatory and transformational leadership style have been found to be essential to motivate workers and increase their commitment to sustainability (George & Fussel, 2000; Pricewaterhouse Cooper, 2004; HCWH and CHD, 2006; Porter-O'Gready & Malloch, 2010).

Finally, *work processes*, namely the manner in which services are delivered, have been highlighted as one of the major organizational element that need to be modified. Sustainable hospitals have to explore opportunities for sustainable models of care and avoid the ineffective ones. It is also necessary to increase investment to prevent illness, discourage unhealthy lifestyles and benefit from the natural environment (NHS SDU, 2010).

Framework and Hypotheses

The literature review has identified two main sets of factors. Contributions from the architectural and design fields claimed that sustainable hospitals should be characterized by particular features in ambient conditions; spatial layout; signs, symbols and artifacts; materials; systems. On the other side, contributions from the organizational field clarified that hospitals for being successful in improving sustainability-related performance should leverage on their culture, structure, human resource practices, management style and work processes.

Drawing on these results, we propose a set of hypotheses about the still unclear interplay between physical and organizational factors/leverages. It is important to note that three factors – ambient condition, materials and management style – will not included in the framework because the literature did not offer enough evidence to state a clear hypothesis about the interplay between these factors and the other physical or organizational factors. With this regard, we suggest this as an avenue for further research. We hope that in the next future, other contributions will be able to state and test the relationships between these two factors and the others.
In the followings, a set of hypotheses to be tested in further research will be argued.

Organizational culture have often been recognized as embedded within the built environment of health facilities (PricewaterhouseCoopers, 2004). As stated by a nurse during the PwC/CABE focus groups "*You get an impression when you walk in – for example, if it looks scruffy this may reflect the hospital culture*". In fact, artifacts have been defined as the tangible aspects of culture shared by members of an organization (Denison, 1990). Moreover, Starik & Rands (1995) suggest that Ecologically Sustainable Organizations are characterized by numerous cultural artifacts such as slogans, symbols, rituals and stories which serve to articulate and reinforce for their members the importance of ecologically sustainable performance. Thus, hospital sustainability values can be showed through signs, symbols and artifacts to the staff. Furthermore, artifacts can serve as an easy method to give a feedback about the organizational sustainability performance. For example, at Meyer Hospital in Italy in the hospital waiting room is placed a screen that show the amount of energy produced by photovoltaic panels and the amount of CO_2 saved.

Hp1: The alignment of signs, symbols and artifacts with organizational culture is positively related to sustainability performance.

Sustainable design needs to promote desired work processes (Parish et al., 2008). Among the architectural variables, spatial layout and functionality have the strongest relation with processes.
In fact, physical relationships between the hospital functions (bed-related inpatients functions, outpatient-related functions, diagnostic and treatment etc.) and flows of people, materials, and waste are extremely important to determine the most appropriate building configuration (Stalker, 2008). For example, minimizing distance of necessary travel between frequently used spaces can promote staff efficiency.
Furthermore, given the long lifetime of a hospital physical structure, the design of a sustainable hospital need to incorporate sufficient flexibility to accommodate the many changes in clinical care that are likely to occur over its lifetime.

Hp2: The alignment of spatial layout and desired work processes is positively related to sustainability performance.

In order to enhance the effect of a good fit between layout and work processes, human resource practices are needed to communicate staff the appropriate use of building and way of work in the new environment. In fact, often employees attempt to work in the new facilities using old processes (McCullough, 2009), generating unintended consequences that can negate the improvements introduced (Health Estates Investment Group, 2010). To change existing routinized behaviors attitudinal, educational and training initiatives are required (Ulhoi & Ulhoi, 2009).

Hp3: Human resource practices moderate the relationship between aligned spatial layout and desired work processes with sustainability performance.

Finally, advanced technical systems are particularly important to enhance sustainability performance, in terms of energy and water conservation and thus cost savings. However, their day-by-day operations and maintenance requires high technical knowledge and capabilities that are usually held by managers, such as facility or waste managers, who tend not to occupy highly regarded or high status positions within organizations. They are frequently under great pressure from senior levels and constrained in the extent to which they can meet the day-to-day demands (Becker, 1990). In fact, according to Pitt & Hinks (2001), the role of the facility management is often undervalued and seen largely as one of cost management, rather than a role that should facilitate strategic enhancement of the complexities of organizational management. Thus, they advocate the integration of facility management within the strategic management function and a wider and less restricting role in more effective organizational structures (Elmualim et al., 2010).
Thus, in order to take effectively advantage of the technical systems that are part of sustainable buildings, decision making has to be delegated and technical managers have to be empowered, that is giving them the ability and the responsibility to take active steps to identify and solve problems (Leitch et al.,1995) related to technical systems and their daily operations. If the facility management group is viewed as a true partner in running the company, the work required to help an organization develop sustainable practices is much easier and more readily achieved (Hodges, 2004).

Hp4: The interaction of technical systems and organizational structure is positively related to sustainability performance

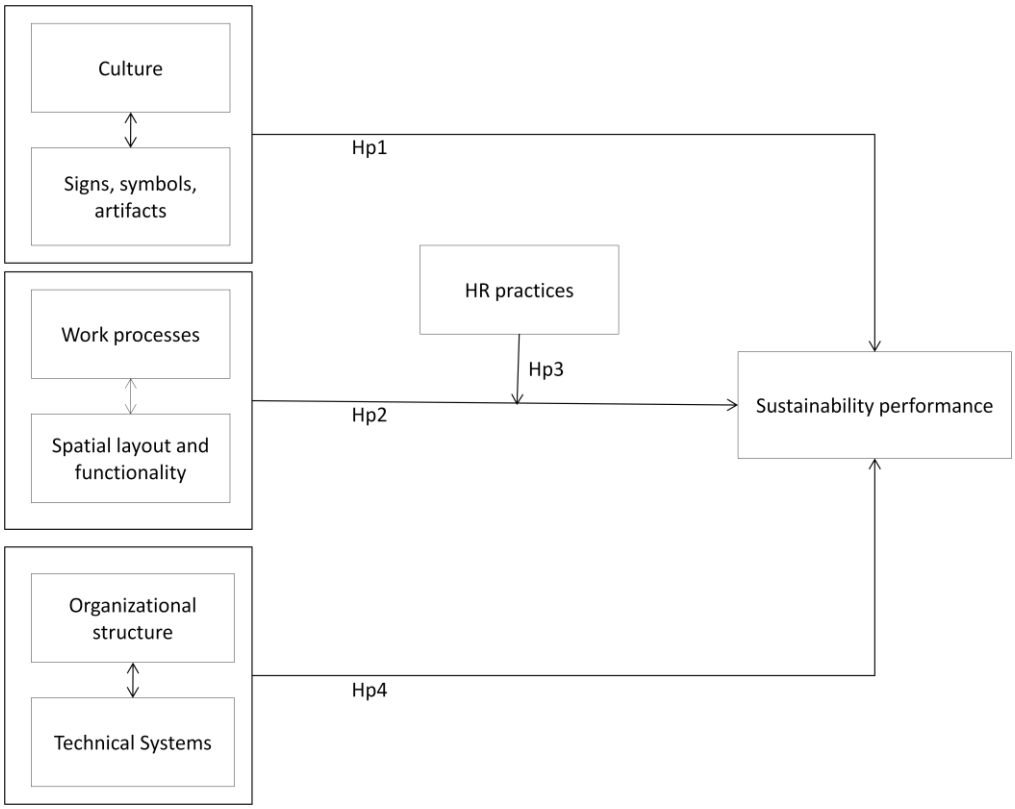

Figure 1. Conceptual framework and hypotheses

Conclusions

Different groups of stakeholders require that hospitals meet sustainability-oriented targets and adopt sustainability-oriented practices and behaviors, since they have a significant impact on the local community they serve in terms of pollution, energy and water consumption, and as work employer. Any failure in engaging this challenge might have relevant consequences for how healthcare will be delivered in the next 30–50 years (Black & Gruen, 2005 in Rechel et al., 2009).

With this regard, synergic changes in both the physical structures and the organizational approaches are needed to meet the sustainability goals in the mid-long term (Porter-O'Gready & Malloch, 2010). Unfortunately, the relationship between architectural and organizational elements in hospitals has been largely overlooked by past research on the sustainability issue in healthcare. Two bodies of contributions have developed separately during the last years. The architectural literature identified five factors that should be adopted or leveraged by a sustainable hospital, i.e. ambient condition; space/function; signs, symbols and artifacts, materials and (technical) systems. The organizational literature, on the other side, argued other five factors, i.e.. culture; structures and roles; human resources practices, leadership and work processes.

This paper shed first light on the connections between seven of these ten factors – ambient condition, materials and management style were not included since there was an insufficient evidence to gain a full understanding of their role in conducing or moderating other factors – and a set of hypotheses have been generated. The comprehensive framework and each hypothesis offer promising new avenues for further research.

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