Visual Management in production management: a literature synthesis

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Abstract

Purpose- The purpose of this paper is to holistically discuss, explore and synthesise the key literature on Visual Management, an important, yet highly fragmented subject that is frequently referred in lean production accounts.

Research Methodology - An extensive literature review was conducted to classify the current literature, to explore the different aspects and limitations of the current discussions on the subject, to clarify in what ways Visual Management benefits manifest themselves in a workplace and to identify the future research focus.

Findings- Visual Management is an important close-range communication strategy based on cognitively effective information conveyance. This strategy has been frequently discussed in the production management literature. However, (a) the literature is fragmented as to the roles of Visual Management in a production setting, (b) the body of literature lacks integrated focus and cohesion with an abundance of related terminology from scholarly works and consultant books, (c) a practical VM tools taxonomy and a visual workplace implementation framework were presented (d) there is poor clarity with regards to the functions (benefits) that Visual Management may provide within organisations; nine conceptual Visual Management functions were proposed (e) a wide array of future research directions related to Visual Management was identified.

Originality/Value- This paper synthesises the key literature related to Visual Management, providing a conceptual picture of the current knowledge.

Keywords: Lean production, literature, Visual Management, visual tools, visual controls, functions.

Paper type: Conceptual paper.

1. Introduction

Contemporary society has experienced an explosion of the visual (Baudrillard, 1994; Lester, 2013), which permeate our everyday lives through photos, videos, television, mobile devices, web pages, signs, electronic boards and many others. Acknowledged to be powerful in cognition and memory when compared to the textual and verbal, the visual have also taken prevalence in our modes of communication and management (Bell and Davison, 2013). With the fast developing technologies, the problem of conveying information over long distances has been largely solved. Instead, one of the current challenges confronting organisations is how to improve the ineffective delivery of information to their workforces in close-range communication (Bilalis *et al*. 2002). Complex and heavily textual work instructions, or safety information located in a drawer, out of sight, rarely avail the overall operational performance.

Some organisations address that challenge by adopting economically affordable and cognitively effective sensory information systems or tools, integrated into the workplace, to increase the pervasive information availability at their work settings (Greif, 1991; Goodson,

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2002; Achanga *et al*., 2006). In such systems, information is presented in a highly sensory manner, fitting well to the cognitive requirements of human beings, appealing directly to the human senses and located close to where the information need might actually occur. Those systems are aptly described as simple and compact (Murata and Katayama, 2010). The strategy of increasing pervasive information availability, providing people with sensory work aids and consciously removing blockages in the information flows at a work setting is called Visual Management (VM). The expected result of VM is improved operations at a work setting (Herron and Braiden, 2006; Parry and Turner, 2006; Bhasin, 2008).

It can be argued that VM has originated and evolved through a set of distributed and somehow unconnected efforts, mainly by practitioners. The focus of such efforts was basically on helping solve specific information need problems, through the development of visual aids or tools. Partly due to their intuitive design features, the relative simplicity in how they function, and the misleading notion fuelled by management consultants that "lean production is just the common sense that organizations need", the literature on many lean concepts, such as VM, is mostly directed to practitioners with a general focus on a superficial "how" (more practical), rather than an in-depth "what" (more conceptual) (Sorge and van Witteloostuijn, 2004; Farris *et al.*, 2009; Saurin *et al.*, 2012; Langstrandt and Drotz, 2015). Furthermore, it is argued in this paper that there is a mismatch between the proposed benefits of VM and those achieved in practice, partially due to the poor conceptual clarity and the scattered, narrow-scoped literature, which allows us to see only limited aspects to VM. This is also reflected in the actual fragmentation of the body of knowledge that exists today, the poor care in separating the strategy (VM) from the method(s) of adaptation/implementation, which further fosters the fragmentation, and the excessive emphasis on specific tools and applications, as opposed to a more coherent improvement strategy.

Cogently, this fragmentation extends to the terminology. Some of the terms found in the literature include Visual Management (Imai, 1997; Goodson, 2002; Liff and Posey, 2004; Drew *et al*., 2004; Bonavia and Marin, 2006; Denis and Shook, 2007; Liker and Hoseus, 2008; Waeyenbergh and Pintelon, 2009; Papadopoulos *et al*., 2011), visual workplace (Greif, 1991; Hirano, 1995; Galsworth, 1997; Galsworth, 2005), visual controls (Schonberger, 1986; Ohno, 1988; Shingo, 1989; Monden, 1998; Liker, 2004; Mann, 2005), visual factory (Bilalis *et al*., 2002; Aik, 2005), shop floor management (Suzaki, 1993), visual tools (Parry and Turner, 2006) and visual communication (Mestre *et al*., 1999). The abundance of the terminology, however, does not similarly yield detailed explanations. It can be inferred that a distinction and a clarification of the connection between the related, yet different terms is necessary to unify the fragmented discussions. VM is a managerial strategy that emphasises close-range visual (sensory) communication and is realised through different visual tools, including visual controls. A systematic implementation of those tools within the VM strategy at a work setting creates a visual workplace in which various functions (benefits) of VM can be observed. VM also goes beyond production management in shop floors (factories), as it can be successfully adopted by commercial, educational, healthcare and governmental service, IT and construction organisations (Liff and Posey, 2004; Dos Santos, 2009; Joosten *et al*., 2009; Radnor, 2010; Ahmad *et al*., 2013). Therefore, it is important to attain a generic understanding of the subject, without confining it only into the production domain.

It should be noted that a broad definition of production management has been adopted in this paper while analysing the VM strategy. Production management is a management function of planning, organising, directing, coordinating and controlling resources (space, man-power, machinery/plant, material/equipment and capital) and process elements (methods, configurations, interfaces, technology, information, etc.) to generate value added goods and services as per the policies of an organisation (Chase et al., 1998; Kumar, 2006; Gupta and Starr, 2014). This definition also encompasses operations management for

production activities. The purpose of operations management is to make certain with a process focus that the operations of an organisation are efficient and effective, and result in minimum of wastage through the optimum usage of resources (Slack et al., 2010; Stevenson, 2014). Thus, the role of VM in production management is illustrated over production planning/control, processes, quality, safety, maintenance, workplace, inventory, change (improvement), human resources, internal/external marketing (image management) and knowledge management efforts.

This paper aims to contribute to a more unified theoretical constitution of the VM concept through a synthesis of the related literature. The absence of scholarly papers that investigate VM as one of the core strategies of the lean production system (Mejabi, 2003) is another motive in writing this paper.

In the following section, the literature on VM is classified from a production/operations management perspective demonstrating its fragmented nature. In the subsequent section, the research method of the paper is explained (synthetic literature review) linking the findings to the research method. In the visual tools section, a detailed discussion on the characteristics of different VM tools, as the means to realise the VM functions, with their role and practical implications, and a framework for creating a visual workplace are presented. Following the discussion on the VM tools, the functions of VM are proposed for a more conceptual understanding of the subject. The paper concludes with a general discussion on the findings and a presentation of the future directions for VM research and practice.

2. Emergence of Visual Management in the literature

The existing literature can be divided into five distinct categories, i.e. (a) descriptions of the Japanese originators and interpreters of the Toyota Production System (lean production); (b) books by Western and Japanese consultants; (c) few scholarly papers on VM and (d) scholarly literature in ergonomics and human factors that touches similar phenomena, but with a different vocabulary;(e) diverse approaches discussing VM beyond production management. These are briefly presented as follows.

Starting from the late 1940s with visual standards and instructions, most of the well-known VM tools (e.g. the kanban and andon) had been developed gradually in the 50s and 60s at Toyota (Ohno, 1988; Fujimoto, 1999). The 5S (Gapp *et al.*, 2008) and mistake-proofing (Shingo, 1986) concepts were also developed in parallel. The use of VM tools are generally explained by means of anecdotal accounts in a production context, without much clarification of their background. The Japanese originators and interpreters of the Toyota Production System emphasise more the production control efforts through VM (Schonberger, 1986; Ohno, 1988; Shingo, 1989; Monden, 1998). The frequently used term in those interpretations is visual controls. Achieving relatively simple and easy-to-see control is an important contribution; however there is more to VM than just the control dimension.

Western and Japanese consultants' books have illustrated many application areas beyond visual controls, even though the greater emphasis in these books tends to be on the role of VM in workplace structuring and organisation (Hirano, 1995; Galsworth, 1997; Liff and Posey, 2004; Mann, 2005). The VM strategy that these authors portray is pervasive and ubiquitous in workplaces. The concern with the books by consultants is the lack of a theoretical approach, an overemphasis on practical applications with rare conceptual discussions and the positive bias that is inherent in their depiction and narrative of VM.

There is little scholarly and empirical research on the subject. VM is often mentioned in lean production research with its supportive role in performance management (e.g. Bhasin, 2008; Hodge *et al.*, 2011; Bititci *et al*., 2015), workplace organisation (e.g. Bhasin and Burcher, 2006) and continuous improvement (e.g. Detty and Yingling, 2000; Hodge *et al*., 2011). However, the VM discussion is limited in those works. One type of research taking

VM into its centre is to describe or suggest the use of a VM method or tool in a production setting e.g. colour coding of walls (Bilalis *et al*., 2002), diverse production control boards (Parry and Turner, 2006) or the extensive VM role in the design of cell production systems (Kulak *et al*., 2005). Another type of research focuses on discussing the principles and barriers for a VM function or outcome, such as process transparency, that is rendered at a work setting through VM (e.g. Formoso *et al*., 2002). A common missing element in the existing research is that VM is not represented as a management strategy, which hinders a broader understanding of the subject with its different dimensions.

Ergonomics and human factors engineering analyse and design systems and its elements, considering environmental constraints (e.g. organisational goals or human psychology, physical abilities, limitations etc.) (Karwowski, 2005; Lehto and Landry, 2012). According to Ho (1993), the objective of VM is to make communication simple and attractive. Attaining simplicity and attractiveness in sensory communication and task design are the questions of ergonomics as well (Hameed *et al*., 2009). The frequent use of ergonomics related concepts such as colour coding, shadowing and the Gestalt law of perception has been recorded in the design of many VM tools and systems for production management (Hirano, 1993; Galsworth, 1995). The use of those visual (sensory) concepts is discussed in ergonomics and human factors engineering to facilitate visual inspection, and to design safer and more efficient operator/workstation interfaces (Yeow and Nath, 2004; Ahlstrom and Arend, 2005; Van Laar and Deshe, 2007). In spite of this strong connection, the underlying ergonomics and human factors engineering science factors are generally detached and absent from the general VM discussions.

There are also diverse approaches in the literature to VM that take the context of the subject beyond the production management discipline. VM can be approached as a part of the lean information management toolkit in designing and managing both conventional and IT based information systems (Ibbitson and Smith, 2011; Bevilacqua *et al*., 2015). It can also be treated as a sensory communication interface for knowledge management and coordination efforts (Eppler and Burkhard, 2007; Tjell and Bosch-Sijtsema, 2015). Attempts for a more theoretical exploration of the use of visual tools in different management disciplines through organisational studies, visual content analysis, visual aesthetics, its semiotics, rhetorical and ethical dimensions can also be seen (Emmison and Smith, 2000; Rose, 2007; Bell and Davison, 2013).

It can be inferred from the literature that there is diversity about the concept of VM, a plethora of related terminology and a lack of clarity regarding its generic functions.

3. Research method

It should be highlighted here that the research method for this paper is a synthetic literature review that endeavours to create new knowledge, rather than a systematic review (Jesson *et al*., 2011; Lightfoot *et al*., 2013) aiming to document the state-of-the-art with a specific research question in mind.

This synthetic review is based on an explorative, critical review (Gibson and Brown, 2009; Danielsson, 2013) aimed at clarifying the multitude of jargons used in the field and understanding the underlying purpose and outcomes of VM implementations to make inferences from a more theoretical standpoint. This requires a critical analysis of the motives in VM discourses. Those discourses are mostly coming from the accounts of consultants working in the field, which generally lack scientific rigour. This approach was found necessary, as the current literature is fragmented and complex with abundance of the unsystematic use of many related yet different terminology in different real-life accounts.

Critical literature reviews, on their own, are valid methods for creating new knowledge as they can give a general overview of a body of research that has been scarcely

investigated, they can reveal what has already been done well, so that one does not waste time "reinventing the wheel", they can give new ideas one can use in their own research, they can help one determine where there are problems or flaws in existing research or body of knowledge, and they can enable one to place the research theme in a larger context, giving an overview of existing efforts and their characteristics, which is particularly relevant to fragmented research themes, such as VM (Knopf, 2006; Vom Brocke et al., 2009). In line with this, there are many production management research papers that are based on critical literature reviews on fragmented topics to create new knowledge (see for instance, De Toni and Tonchia, 1998; Dangayach and Deshmukh, 2001; Bernardes and Hanna, 2009; Bask et al., 2010; Hu et al., 2015).

As stated by Seuring and Gold (2012); "constantly increasing research output which provides large amount of similar, deviant and contradictory findings, make critical reviews crucial tools for excavating the nuggets of knowledge that lie buried underneath". This is also valid for VM, as the current practice focused, fragmented literature on VM does not permit constituting conceptual baselines. Synthetic literature reviews can create new knowledge by (Torraco, 2005);

- Unearthing generic research agendas on the theme to give directions to future research,
- Giving taxonomies or other conceptual classification of constructs,
- Creating alternative models or frameworks,
- Developing meta theories across different theoretical domains.

In line with the knowledge creation classification by Torraco (2005), after a synthetic literature review, this paper identifies the generic research agendas and directions on VM, and gives a taxonomy of the VM tools along with a visual workplace framework. The paper also proposes the fist steps towards a meta-theory for the functions (benefits) of VM beyond manufacturing settings.

The discussion in the paper is mostly based on the production and operations management literature targeting manufacturing organisations. However, VM is a complex and multi-dimensional subject. Also, the works focusing on the VM strategy beyond the VM tools are scarce. To draw a broader picture of VM and to infer its generic functions, the following composition of works were investigated for the synthetic literature review:

- 81 publications from the production and operations management domain. Those works generally explain the adoption of one or more of the VM tools with their implications or give the VM strategy a secondary place within other subjects. They were mostly used to create a comprehensive taxonomy of the VM tools (see Table 1) and the visual workplace framework (see Figure 2) described in the paper. Those works were also useful identifying the characteristics of the VM discussions in production and operations management,
- 31 publications from organisational and management studies. They were mostly used to explore the generic functions of VM (see Table 2),
- 17 publications from visual communication and design studies. Those works were used both to collate the practical aspects of VM (Table 1) and to explore the generic functions of VM (Table 2),
- 13 publications focusing solely on VM or one of its related concepts (i.e. visual workplace or visual factory). Those scarce works were mainly used to

understand the range of VM applications, its functions and to clarify the VM terminology,

- 8 publications from the ergonomics and human factors engineering research domain. They were used to identify the fragmented nature of the VM discussions and the connections between the ergonomics and production/operations management discussions for VM,
- Also, publications from the construction production management (9), healthcare (4), service management (4), marketing management (3), and software development (2) domains were used to support the general VM discussions in the paper.

4. Visual tools

VM is realised through using a multitude of visual tools and it is important to understand their role in VM. Some are very distinctive and, therefore, cited so much that sometimes the tools overshadow the managerial strategy. In addition, it is not difficult for an employee to create a visual tool for his day-to-day information needs (Kattman *et al*., 2012). Visual tools are integrated and openly exposed in the work environment for being easy-to-reach and easy-to-see (Greif, 1991; Suzaki, 1993). There are four common characteristics of those VM tools (Greif, 1991; Berkley, 1992; Suzaki, 1993; Galsworth, 2005, Harris and Harris, 2008); (a) the information in VM tools are presented to create information fields in the workplace, from which people can freely pull information in a self-service fashion, (b) the information need is determined ahead of time to prevent information deficiencies (pre-emptive approach), (c) the information display is integrated into process elements (space, machinery, equipment, components, materials, tools, gadgets etc.), in the direct interface between the operator and the process element (not in a file or server far from the production field), and (d) the communication is simple and relies little or not at all on verbal or textual information.

Galsworth (1997) proposed a general classification of tools, i.e.: (a) information giving (e.g. signboards); (b) signalling (e.g. *andon* [4]boards); (c) response limiting /controlling (e.g. *kanban* [5]cards); and (d) response guaranteeing (*poka-yoke* [6]systems) visual tools.

This multitude of described visual tools can create confusion in the understanding of which tool may be used for what. A classification and summary of the commonly used VM tools with their definition, roles in production/operations management and practical implications is presented in Table 1. An example of *kanban* production control in a building construction project is shown in Figure 1.

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According to Mestre *et al*. (1999), visual tools can be utilised to signal group membership, to acquaint members with organisational vision and culture, to maintain organisational vision, to manage human relations, for business communication etc. They can be used to clarify, simplify, emphasise, summarise, reinforce an idea, and unify and attract people around a cause (Bovee and Thill, 2005).

It may be tempting for managers to recklessly copy such simple looking visual tools from different settings. Without establishing the necessary organisational connections and

[4] An audio-visual system that immediately notifies people of quality and process problems.
[5] A "pull-production" scheduling and control system that is executed by workers through visual signals (often cards).
[6] Mechanical or electrical systems that mitigate and eliminate mistakes.

reaching a certain organisational readiness, most of the tools may not yield the expected contribution. Furthermore, carelessly adopting some of the more sophisticated visual control tools like the *kanban* can even have negative impacts on the production process. Those negative impacts may include excessive or deficient work in progress stocks, an uneven production rate, and disruptions in material/delivery flow, supplier and quality related problems (Spearman and Zazanis, 1992).

Also, visual tools are the means to realise the fundamental principles of a system as a whole (Ortiz and Park, 2010). The current means can be changed, modified or abandoned altogether, when more desirable means emerge or perhaps when the fundamental principles change. As Spear and Bowen (1999:104) explained:

"Toyota does not consider any of the tools or practices – such as kanbans or andon boards, which so many outsiders have observed and copied – as fundamental to the Toyota Production System. Toyota uses them merely as temporary response to specific problems that will serve until a better approach is found or conditions change."

The statement further highlights the importance of adopting an overarching strategy for visual tools. Although the practical implications of various VM tools were collected from the literature and given in Table 1, those underlined implications do not yield a generic, conceptual understanding of VM functions (benefits). Also, VM as a managerial strategy should be analysed independent of production systems (i.e the lean production system). This further necessitates the conceptualisation of its generic functions. The VM tools and systems given in Table 1 were used to synthesise those required conceptual benefits.

The VM strategy essentially employs visual tools to effectively communicate with the human element by creating a communication interface. As discussed in the section on emergence of VM, although not explicitly underlined, the tools are designed in accordance with some ergonomic (physical and cognitive) design principles and techniques.

Thus, it is concluded that there are three important parameters to consider before adopting a visual tool: (a) the readiness of the organisation for the implementation of the visual tool; (b) whether the visual tool contributes to and facilitates the overall system objectives and (c) the compliance of the visual tool to ergonomic design principles.

In line with the literature review and Table 1, a framework for creating a visual workplace is proposed in Figure 2. In the framework, the 5S, visual standards/specifications, and visual performance centres/*obeya* rooms constitute the basis and set the standards for more operational concepts such as visual signals, visual controls and visual guarantees, as suggested by Hirano (1995) and Galsworth (2005). At the upper part of the framework, a visual workplace is improved and supported by the visual continuous improvement tools, knowledge dissemination methods and the VM tools for internal/external marketing. This type of a practical visual workplace implementation framework was found missing in the lean literature. The framework is essentially a design proposition for creating a visual workplace that satisfies the given sets of VM's practical aspects. As the framework was derived from the literature, it requires practical analysis, evaluation and reflection in the field.

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5. The functions of Visual Management

Various visual tools are applied in a work setting under the VM strategy to obtain some conceptual benefits for an organisation. This section is aimed at conceptually discussing why VM and its tools are employed in a work environment. It is important to understand the underlying implementation functions of different (visual) tools, instead of directly copying them (Spear and Bowen, 1999). Different organisational realities may need specific, out-of-

template VM solutions that cannot be found in the literature. This evokes the necessity for a clarification of what the VM strategy can render at a workplace. In other words, it is important to explain the possible functions of VM, as those should enable an organisation to tailor its own VM strategy.

This research identified and conceptualised VM functions, and also identified the mainstream practices that can be improved by its adoption, which are summarised in Table 2 and discussed as follows.

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5.1 Process transparency

Process transparency is the degree of the communication capacity of a production process (or its parts) with people (Formoso *et al*., 2002). Process transparency can be increased by rendering process flows visible through removing visibility barriers, integrating information into process items, and measuring and visually displaying the measured (Koskela, 1992).

Process transparency facilitates management-by-sight, which requires understanding of the workplace at a glance by both the superordinate and subordinate (Forza and Choo, 1996). The increased pervasive information availability and transparency act as a replacement for hierarchical communication, in which subordinates are dependent on their superiors for information acquisition and access (Greif, 1991; Suzaki, 1993). In such a context, information flows and is openly accessible to workers, managers, customers and visitors without hierarchical dependencies or structures (Harris and Harris, 2008).

Therefore, VM through process transparency supports self-control by separating hierarchical order giving structure with information network (Greif, 1991; Suzaki, 1993). VM does not suggest discarding managerial control totally; it rather increases information availability to mitigate the non-value adding activities, such as asking questions, counting, guessing, etc. (Hodge *et al*., 2011). Consequently, VM is an important tool in maintaining an "enabling bureaucratic" structure, where the rules are strictly defined and followed, yet the deviations/problems are easily visible and are open to modifications (Adler, 1999).

Similarly, increased transparency supports management-as-organising (Koskela, 2001) as opposed to management-as-planning (Johnston and Brennan, 1996). Management-as-organising advocates that managers are responsible for structuring the physical, political and cultural settings for autonomous sub-units in a workplace setting.

Finally, the psychological empowerment of the workforce can be strengthened by allowing them access to more information and an increased sense of self-control (Spreitzer, 1995). The sense of empowerment in a workplace also supports an improved work motivation and performance, and a higher work satisfaction among the workforce (Hackman and Oldham, 1976).

Moser and dos Santos (2002) summarise the practical impacts of transparency as follows: (a) simplification in decision making, (b) stimulation of informal contacts, (c) support for decentralisation policies, (d) employees participation and autonomy, (e) distribution of responsibilities, (f) increase in employee morale and motivation, (g) effective production scheduling, (h) simplification of production control systems, (i) making problems apparent and responding to problems, and (j) visibility of errors. Figure 3 displays an example of process transparency in the form of a magnetic hand tool tracking board that informs any interested person about who has what hand tool at any given time.

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5.2 Discipline

Discipline is in simple terms habitually maintaining correct procedures (Hirano, 1995). VM reveals workforce's compliance with processes by converting the abstract concept of discipline into directly discernible, concrete practices (Mann, 2005). Discipline is achieved in varying degrees by influencing, directing, limiting (guiding) or guaranteeing people`s behaviours with the four types (visual indicators, signals, controls and guarantees) of visual tools (Galsworth, 1997).). Edelson and Bennett (1998:6) relate the process-based discipline to consistency: "*Process discipline is a combination of actions and rules which aims to achieve (perfect) consistency of successive iterations of process to assure that each product manufactured is identical*." The consistency stands for reduced variability in process outcomes and processing times by eliminating human mistakes, sloppiness and idiosyncrasy (Edelson and Bennett, 1998; Hopp and Spearman, 2011; Saurin et al., 2012).

Discipline is closely related to process standardisation. VM's role in process standardisation and improvement has been discussed (Greif, 1991; Liker *et al*., 1995; Ho and Cicmil, 1996; Imai, 1997). Process standardisation is achieved by visualising process requirements, work instructions, work specifications and process flows in an attractive, openly-accessible and easy-to-understand manner. Being able to observe processes more clearly (visibility) also expectedly facilitates identifying any deviations, which may lead to continuous improvement (Greif, 1991; Imai, 1997; Detty and Yingling, 2000; Hodge *et al*., 2011). VM particularly stands out in providing a level of discipline in cell production units (Kumar and Harms, 2004).

The 5S (sort, set-in- order, shine, standardise and sustain), a systematic housekeeping and workplace standardisation methodology, is noted as closely connected to VM (Pheng, 2001; Bhasin and Burcher, 2006). In the set-in-order phase of the 5S, many visual tools aim at standardising different workplace elements (e.g. tools, inventory, machines, spatial elements, work areas, aisles, workstations, warehouses etc.) in terms of their identification and localisation, in relation with maintenance, inventory and safety management (Osada, 1991; Hirano, 1995; Galsworth, 1997). Moreover, workplace standardisation increases space utilisation, encompasses routine maintenance for line workers supporting increased capacity utilisation through multi-tasking, and sets the base for continuous improvement (Osada, 1991; Hirano, 1995; Galsworth, 1997; Ablanedo-Rosas *et al*., 2010).

Figure 4 shows the visual site stock identification cards on a construction site as an example for the discipline function. The cards not only increase the process transparency through information display but also reflect the expectation of the management of where the related material should be stocked by marking the stock location. Additionally, the replenishment of the stock is visually controlled and communicated with the green and red coloured cards around the materials. The achieved consistency as to stocking of the materials sustains the process discipline.

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5.3 Continuous improvement

Continuous improvement (or kaizen) is an organisation-wide process of sustained incremental innovation (Bessant and Francis, 1999). VM facilitates continuous improvement (Imai, 1997; Liker and Morgan, 2006; Murata and Katayama, 2010), and stimulates the participation of workforce in the improvement process (Greif, 1991; Schonberger, 1992; Flynn *et al*., 1994). In addition to enabling continuous improvement, a simple VM solution is

often the outcome of a continuous improvement effort within the Plan-Do-Check-Act (PDCA) cycle (Murata and Katayama, 2010; Jaca *et al*. 2014).

Visual tools enable the identification of deviations from the standards through increased process transparency and discipline (Nakamura, 1993), disseminate improvement suggestions (e.g. the idea board) (Mann, 2005), assist in employing problem solving techniques (e.g. the seven basic tools for problem solving) (Imai, 1997), summarise the problem solving process (e.g. A3 sheets) (Shook, 2008), and acknowledge the involvement in continuous improvement (e.g. superstar boards) (Liff and Posey, 2004). The created new standards as the result of a continuous improvement effort constitute the starting point for future improvements.

5.4 Job facilitation

Job facilitation is a conscious attempt to relieve people‘s efforts on routine tasks by providing them with relevant visual aids. VM assists people in performing their duties through easing the cognitive perception (mental workload) and physical execution of their job requirements (Greif, 1991; Suzaki, 1993; Galsworth, 1997). Visual communication and correctly designed visual tools can be more effective in cognition and memory than textual communication for task execution (Norman, 1988; Racine, 2002). In line with the goals of lean production, visual clues integrated into workplaces help reduce the amount of unnecessary human activities (waste) that do not add value to the end product, such as searching, counting, answering, asking, testing etc. (Galsworth, 2005; Ortiz and Park, 2010; Kattman *et al*., 2012).

The design of job facilitating visual tools and systems has been researched and investigated under the subjects of human factors and ergonomics, and work interface design. A frequently used technique for job facilitation in VM is coding in terms of colour, shape, texture, size, location and label (Sanders and McCormick, 1993; Helander, 2006; Lehto and Landry, 2012). A typical shadow board for hand tools at a workshop that utilises shape coding for the tool order is shown on Figure 5.

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5.5 On-the-Job Training

Information in the environment enables On-the-Job Training (OJT), which is an effective way of learning, as it is integrated in actual work settings and helps employees learn by practical experience (Mincer, 1962). Integrating learning with working is a competitive imperative for contemporary organisations (Sumner *et al*., 1999). In connection with continuous improvement efforts, OJT is also directly related to systematically disseminating information and acquiring tacit knowledge in knowledge management (Choo, 1996). It is a cost effective and less work disruptive organisational learning practice that is supported by VM (Rothwell and Kazanas, 2004; Aik, 2005). For instance, in central areas of the workplace, issues like process improvements, changes, safety risks, equipment failures and their root causes, and clarifications on confusing procedural steps can be visually communicated in a simple manner on single-page sheets that are called “One Point Lessons (OPL)” (Bessant and Francis, 1999; Alukal and Manos, 2006). The OPL is considered to be one of the most powerful tools for transferring skills (Badiger et al., 2008).

Historically, the Training Within Industry (TWI) programme deployed in Japan after the Second World War, which is closely linked to OJT and employing visual tools, laid the foundation for important lean concepts such as continuous improvement, workplace training and standardised work (Dinero, 2005).

5.6 Creating a shared ownership and a desired image

Psychological ownership is a feeling of possessiveness and being psychologically tied to an object (material or immaterial) (Pierce *et al*., 2001). Such concept can support the achievement of a sense of shared ownership for both a production system and a company as a whole, assisting in achieving the company's strategic objectives (Greif, 1991; Stuart, 1999; Balzarova *et al*., 2006).

Visual signs and systems are consciously used to convey the message of a caring and supporting workplace culture (Stuart, 1999; Liff and Posey, 2004; Bell and Davison, 2013). Similarly, the importance of customer focus is visually highlighted around the workplace. Employees understand for whom they work and the importance of their jobs for their internal and external customers through the visual systems used in internal marketing (Greif, 1991; Davis, 2001; Ahmad and Rafiq, 2002; Liff and Posey, 2004).

VM is particularly effective in creating a positive impression on potential employees, customers and other stakeholders by giving the message that they are at the focal point (Greif, 1991; Liff and Posey, 2004). This positive image is often reinforced by openly sharing an important performance indicator, for instance, health and safety related information, with the public (see Figure 6)

{Please insert Figure 6 around here}

The role of VM in creating a publicly open communication and information centre at a workplace to visually convey an organisation's performance, strategic directions and improvement efforts has been underlined for workplace management (Tomkins and Smith, 1998; Bhasin, 2008; Murata and Katayama, 2010; Radnor, 2010). Suzaki (1993) and Galsworth (2005) support this thinking, describing VM's ability to convey performance information where it may influence behaviour towards improved performance.

Such information centres can also be created to attractively communicate a planned change initiative at a work setting through visual artefacts (Greif, 1991; Balzarova *et al*., 2006). Those change initiatives are promoted just like marketing campaigns. Thus, it can be said that VM brings benefits and is related to internal marketing, image construction and change management efforts.

5.7 Management-by-facts

Popularised by Deming (1982), management-by-facts underlines the use of objective facts and statistical data (Gunasekaran *et al*., 1998). One aspect of VM is opening the objective organisational reality to relevant people through the flow of information, most frequently displayed on performance boards or in performance areas (Greif, 1991; Liff and Posey, 2004; Galsworth, 2005; Mann, 2005; Radnor, 2010). Creating a sense of openness and objectivity is a condition for obtaining employees' trust in management (Clark and Payne, 1997; Lewicki *et al*., 1998). Through various performance boards, posters and signs management also conveys the organisational expectations and the valued behaviours (see Figure 7).

{Please insert Figure 7 around here}

The shared, objective organisational reality helps managers overcome the negative side of organisational politics; power abuse and secrecy (Butcher and Clarke, 2002). When employees sense a subjective manifestation of the organisational politics, they tend to keep silent, act misleading and selfish, deliberately reduce their performances or largely avoid their external work monde (Witt et al., 2002). Employees who lack other forms of power and

control may resort to misusing information and knowledge as a form of control and a defence mechanism (Brown and Woodland, 1999).

5.8 Simplification

The management of information in dynamic and complex environments may go beyond the capabilities of individuals. While cascading information from upper organisational levels to lower levels, a mechanism for monitoring, processing and presenting the vast amount of information for people to make sense is necessary(see Figure 8).

{Please insert Figure 8 around here}

Mismanaged information with information overloads or information deficiencies usually leads to disagreements, misapprehensions, unawareness, conflicts, stress, waste and poor performance (Eppler and Mengis, 2004). Information simplification is necessary for the decision making process in human beings (Choo, 1996; Bierly III *et al*., 2000). Visualisation of data exploits human cognitive systems better to make sense of data and to extract information from (Tegarden, 1999; Tufte, 2001). VM, as a strategy, requires an organisation to inspect, filtrate, simplify and effectively dispense the system-wide information (Suzaki, 1993; Liff and Posey, 2004; Galsworth, 2005) (see Figure 9). Clearly, attention needs to be given to displaying too much information, beyond the capabilities of recipients; or focusing too much or only on easily quantifiable performance metrics (Dumond, 1994).

{Please insert Figure 9 around here}

5.9 Unification and creating a boundaryless organisation

There are vertical, horizontal, external and geographic boundaries in an organisation, which can be partly diminish through systematic information share with the stakeholders (Ashkenas *et al*., 1995). VM facilitates an increased awareness of the work conditions of different departmental units and the organisational environment (Greif, 1991; Suzaki, 1993). Unification relates to an increased transparency in the organisational boundaries, which should not be mistaken for process transparency that stands closer to the transparency in day-to-day operational practices. While facilitating the control practices in information age, this kind of unification with readily-available information will help organisations make the most out of their human resources and assets with a greater ability of moving ideas, information, actions and talents where they are most needed (Alberts and Heyes, 2003). Forming a unified organisation as such is also a primary goal in knowledge management efforts (Nonaka and Konno, 1998; Rastogi, 2000).

6. Discussion

Various VM tools supporting different managerial efforts have been presented in the literature with many practical implications (see Table 1). Those implications can sometimes directly address motion economy and ergonomics by simple visual indicators or reminders (from way-finding to operator led machine set-up guides). At times they can be used to impose a limit or a strong guidance to employees' actions through visual controls (i.e. *kanban*s, *poka-yokes* or min/max inventory levels in the 5S). Another interesting aspect to their manifestation is their extensive use in training and orientating new and existing employees, such that even a new employee can easily understand the work setting with its layout, process elements, requirements/standards and operations. Their important contributions to internal and external marketing efforts seem to have been overlooked. VM

tools also play a role both in identifying workplace problems (i.e. *Andon*), and communicating the problem solving process itself (i.e. A3s). The improved condition after the problem solving process is also disseminated, taught and standardised by using specific VM tools (i.e. SOSs and OPLs). VM tools are also effective group coordination and discussion agents (i.e. *Obeya* rooms, VMS). Similar to a nervous system, the VM strategy enables the flow of required information through a work setting with its specific tools that are often used in connection with each other.

Beyond manufacturing environments, the applicability of the tools were discussed with positive results for healthcare services, construction production systems, software development, and private and public service organisations. Ever since Levitt's (1972) influential article, it has been common for services to be treated like production lines in both the academic literature and more widely in management practice. However, lean related practices can be perceived as "business-as-usual" or "just common sense" resulting in 'lean' becoming synonymous with 'process efficiency' and missed opportunities for significant performance improvement – as exemplified by Toyota –(Seddon *et al.,* 2011). This further highlights the need for more conceptual discussions for lean related topics.

Some of the VM tools are highly standardised with widely available implementation guidelines (i.e. the 5S, A3 sheets or VMS). However, organisations can also devise their novel VM tools for their specific work conditions. An effective design of the visual tools by using ergonomics and visual communication/design principles is the key parameter to realise their practical implications.

The tools' positive effect on reducing process wastes, production costs, quality problems and safety issues at the operational level eventually translates into economical gains for an organisation. Despite all those important practical implications, one should be careful not to overemphasise VM tools to the point that the discussions on the tools overshadow the discussion on the VM strategy itself.

The functions of VM that were inferred from the synthesis of the literature are the main output of this research. Such functions are aimed at redirecting the attention of VM discussions, which generally focus on visual tools (controls) based discourses, to a more conceptual, integrated level of understanding of the subject.

In practice, the synthesis of the functions underlines the spectrum of VM possibilities that can be exploited by organisations. Additionally, the functions may act as guidance for developing VM solutions. Diverse visual tools can be created with relative ease (Galsworth, 1997). However, the aim of these tools should be justified at a strategic level and there is no guarantee that a tool that is reported to help solve a specific problem at one workplace will not create other problems in others. Therefore, this creation may be directed within and based on the identified function. The functions can also be used as a conceptual basis for evaluating the degree of realisation of the VM strategy at workplaces.

Although no clear ranking is presented in the VM functions, transparency and discipline seem to come to the fore as the more important functions, which facilitate the realisation and effectiveness of other functions. It is important to note that conveying a message is not enough on its own in most cases. Discipline attributes a consistent aim/meaning to VM. The discipline in VM is not imposed from top to bottom; rather, discipline generating visual tools and systems that people are expected to pay attention to are integrated into the work environment.

In a transparent work environment, people will be able to see the intention of the message. In other words, an increase in self-control is achieved. Thus, a general consistency in actions and outcomes will expectedly be observed through VM.

In creating shared ownership and a desired organisational image, VM tools can be used for both internal and external marketing efforts. For simplification, an organisation

should constantly monitor its internal and external environment to extract relative information for its employees to grasp through visual information giving tools. Yet again, the amount, the content and the presentation of that information are important. Unification is related to the degree of interdepartmental connection in an organisation. Therefore, unification requires a degree of standardisation in the application of the VM strategy throughout an organisation. If VM is adopted in just some organisational departments, in that case unification will expectedly be limited.

7. Future research

It is obvious from the current literature that the VM strategy should be analysed from a more theoretical standpoint. A deeper theoretical understanding of the matter will not only contribute to clarifying different yet related terms but it will also facilitate a systematic application of the strategy with its various functions. In doing so, one should not overemphasise the distinct VM systems or tools such as *kanban* cards, *heijunka* boards or *andon* panels but rather strive to understand their functions or purposes; as the means are always open to change and modifications when their expected functions or the overall process goals change. It should be highlighted that there is no empirical and generic VM application framework found in the literature and more research is needed in this sense.

It is also worth underlining that approaching VM implementations from a social-materiality perspective can provide rich insights on how the role and utilisation of workplace 'space', forms of control, and VM reflect and are shaped by organisational values, culture and the 'dictated' goals of flexibility from the workers, an institutionalised continuous improvement culture, increased transparency, empowerment and horizontal and peer based work control (Dale, 2005; Dale and Burrell, 2010). In connection with this social-materiality research vision, the subject can be further investigated from the visual studies perspective within different managerial practices (Bell and Davison, 2013).

Another aspect to the theoretical exploration of VM can be to view the matter and its tools as socio-technical affordances (artefacts) in managerial strategy design to perceiving agents (workers, managers, customers) in different environments for workplace learning (Billett, 2001), workplace navigation (Rooke, 2012), and conventional and IT based workplace controls (Norman, 1999; Streitz *et al*., 2007; Still and Dark, 2013).

Although VM is adopted in some non-manufacturing work settings, the peculiarities of realising VM outside manufacturing environments, such as construction sites, schools or hospitals, are still not well known. The proposed functions of VM are yet to be explored, tested and refined in field. The connection between the practical application of a VM strategy and its contribution to the overall process goals should be well defined for different work settings. In addition, there is a need for further work describing the employees' view on the subject; understanding on this is currently anecdotal and requires more robust research approaches.

Diverse approaches that treat VM as an interface for conventional and IT based information and knowledge management efforts in different work contexts will continue to be seen. In relation to this, the study of how similar visual tools are interpreted differently across different social groups (i.e. customers, workers and managers) as boundary objects will constitute another research direction (Becky, 2003; Barrett and Oborn, 2010). Specific visual tools will be examined and devised from the workplace ergonomics and user interface design perspectives. Additionally, developing technologies such as the Internet of Things (IoT), Big Data, mobile and wearable devices, Virtual, Augmented and Spatial Reality will find a greater place in the content and form of visual tools. A mind map of the identified future research efforts around VM can be seen in Figure 10.

{Please insert Figure 10 around here}

8. Conclusion and recommendations

VM has been generally discussed in the production management literature through its tools or one of its functions (see Table 1). Such a narrow focus has limited its understanding as a managerial strategy. The abundance of related terms and the fragmented nature of the literature in the area are baffling.

In addition, VM is frequently associated with the lean production system. It should be noted that the VM strategy is independent of the production industry and production systems; as it is a close-range visual (sensory) communication strategy. This means that it is not absolutely necessary to have a lean background to exploit the functions of VM (see Liff and Posey, 2004). The lean production system just resorts to VM extensively. Thus, it is important to note that the generic functions described in this paper are not limited to production settings (see Liff and Posey, 2004; Serrano *et al*., 2010; Tezel, 2011), for which VM has generally been explained in the literature. In fact, the illustrations presented in the paper are all from the construction industry but developed within VM efforts in construction production management and very similar to visual tools seen in the manufacturing industry in terms of form and purpose. VM can be employed wherever there is a communication need and interaction between human and process elements. Therefore, understanding the generic functions may help the dissemination of the subject into industries/ work settings other than manufacturing.

Lean production concepts need more conceptual discussions beyond the practice-focused accounts of consultants, practitioners and lean proponents. This paper aims at contributing to those conceptual discussions on the VM phenomenon by (i) identifying the current fragmented structure and main directions of the VM literature, (ii) clarifying the similar yet different VM terminology, (iii) collating various practical VM tools explained in the literature with their common features, (iv) presenting a visual workplace framework for future implementations, (v) proposing the conceptual functions (benefits) of VM and (vi) discussing the future VM directions for both practitioners and researchers. Also, it should be noted that VM has been relatively neglected and has generally found itself a secondary place in the lean literature within other lean production discussions.

There are some implications of the findings both for researchers and practitioners. The given common characteristics of different VM tools, the detailed VM tool taxonomy and the proposed visual workplace framework can constitute a knowledge base for practical VM implementations. Also, the generic VM functions identified in the paper can be used to develop novel VM ideas in different production contexts beyond manufacturing or workshops.

For researchers, the paper calls for more conceptual discussions on practical lean concepts such as VM. A holistic view to VM covering different dimensions of the topic (i.e. ergonomics, visual communication and design) will broaden the scope and quality of academic VM discussions. Researchers can evaluate or modify the proposed visual workplace implementation framework and VM functions in the field. The proposed functions can also be used to conceptually analyse different VM tools in practice for research purposes. The detailed tools taxonomy will help researchers better understand the scope of VM implementations in practice. Also, the VM research directions identified in the paper can act as a guiding base for new VM research efforts in the future.

This paper discusses VM by making its connections with different managerial efforts within production/operations management explicit. The paper also demonstrates the emergence of VM in the literature explaining some related terms (e.g. the VM strategy, visual

tools and visual workplace) and, more importantly, proposing the functions that VM can render at a work setting. A holistic understanding of VM is expected to decrease the amount of direct copying of the VM tools, which will facilitate the creation of original VM solutions. Original VM solutions in different production settings can lead to new dimensions in the VM benefits discussed in the paper. Those benefits can be in the form of extending an in-situ VM strategy or providing a sound theoretical base for a VM implementation from scratch.

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Table 1. Visual tools taxonomy

Visual tools	Definition/ methods of use	Supportive roles in production management efforts	Practical Implications	References
Signs, labels, name tags and direction lines; Borders, shadows and coding (i.e. colour and shape)	Systematic workplace structuring and housekeeping efforts (i.e. the 5S).	Workplace management, inventory management, safety management, maintenance management (preventive maintenance), process management, production management (max/min points and replenishment marks)	Better workplace orientation for employees. Reduction in learning curve/training time for new employees. Reduction in process wastes (waiting, unnecessary inventory, unnecessary motion – searching, wondering, etc). Reduction in delivery delays. Improved workplace safety. Reduction in process set-up times. Higher equipment availability (preventive maintenance). Easier identification of problems and deviations.	Osada, 1991; Hirano, 1995; Monden, 1998; Chapman, 2005; Helander, 2006; Ablanedo-Rosas et al., 2010
Graphs, photos, films, posters, mascots, sketches, drawings, models	Communicating performance, lessons learnt, mission statement, goals, change programmes, best practices and internal/ external marketing efforts.	Internal/ external marketing efforts, change management, performance management, quality management, image management, knowledge management, human resources management	Influence, reinforce or change employee behaviour for the better. Create a positive image of the organisation for both internal and external stakeholders. Raise commitment among employees. Inform employees of and obtain their buy-ins for new programmes and initiatives. Provide training for employees on critical issues.	George, 1990; Greif, 1991; Suzaki, 1993; Liff and Posey, 2004; Maskell and Bagaley, 2006
Pareto Charts, sticky boards, decision trees, A3s	Visual tools and systems supporting continuous improvement.	Process management, change management (continuous improvement)	Facilitate problem solving. Summarise and communicate a process (i.e. continuous improvement)	Greif, 1991; Suzaki, 1993; Galswoth, 2005; Sobek and Smalley, 2008; Saad et al., 2013
Performance centres and *obeya* rooms	Visual performance figures, process information and KPIs grouped in designated locations in a workplace. They can be used for product design to shorten-lead times, specific problem solving efforts or regular meetings	Performance management, process management, change management	Greater focus and efficiency in meetings. Reduction in meeting durations (waste). Facilitate group discussions, coordination and problem solving. Facilitate identifying improvement opportunities.	Maskell and Bagaley, 2006; Lindlof and Soderberg, 2011; Javadi et al., 2012
Control tables	Visual tracking boards	Production management (production control), inventory management, human resources management (e.g. skills matrix, personnel morale etc).	Facilitates visual production control through increased transparency. Visual communication of production plans for an increased awareness in employees. Better material	Mann, 2005; Brady, 2014

			flow. Improved group communication and coordination. Better utilization and development of human resources.	
Samples and prototypes	Demonstrating a real sample or a prototype of the end product	Quality management, knowledge management	Facilitate the visualization of end product for a better understanding of what is "good" and what is "bad" in terms of quality. They are also used for training purposes.	Greif, 1991; Suzaki, 1993
Standard operating sheets (SOSs)	Visual instructions of operational steps, approximate durations, critical points, WIP amounts etc	Process management, quality management, maintenance management (preventive maintenance), safety management	Standardises procedures defining optimal process parameters, so it becomes easier to control what is actually in place to handle repetitive situations/tasks (consistency). Reduction in motion wastes and guess-works. Reduction in mistakes and variations. Reduction in learning curve/training time for new employees. Reduction in safety incidents. Ensures business continuity against personnel turnover. Facilitates job delegation.	Chen et al., 2010; Furlan et al., 2011; Lyons et al., 2013.
One-point-lessons (OPLs)	Visual one-page-sheets (short) to disseminate new ideas, new knowledge and critical points on a specific topic. They can be basic information sheets, problem case study sheets and continuous improvement sheets.	Knowledge management, safety management, maintenance management, quality management, workplace management, process management	It is used to pass on new or better knowledge on quality, safety, maintenance, equipment operations, inspection and improvement tools at the point of use. Strengthens the understanding for process functions (i.e. machines and lines). Provides on-the-job training opportunities for employees.	Bessant and Francis, 1999; Chan et al., 2005; Alukal and Manos, 2006
Value Stream Maps (VSMs)	Visual documentation of the flow of information and materials required to produce a product or service. Flow improvements generally start with VMS	Process management (documenting, analysing and redesigning processes), change management (communicating improvements)	Visually summarises processes from end-to-end. Facilitates the identification of bottlenecks for improvements. Usually a group exercise that triggers group communication among employees. The planned state of a process can also be communicated (future state VSM).	Hines and Rich, 1997; Rother and Shook, 2003; Serrano et al., 2008.
Andon – electronic displays	Audio-visual signalling boards to communicate the status of a process (i.e. stopped, on-going etc)	Quality management, (in-station quality), change management (continuous improvement), production management (showing real and planned production levels- production	Displays the status of production. Allow a supervisor or team lead to quickly spot a problem before it escalates. Empower and increases accountability of operators. Reduction in quality and	Monden, 1998; Galsworth, 2005; Inman et al., 2003; Harris and Harris, 2008; Li, 2013

		control).	safety issues. Facilitates the identification of deviations and continuous improvement opportunities. Support information flow between management and personnel.	
Heijunka boards	Visual levelling boards (volume and mix) often linked with *kanban*s	Production management (production planning and levelling), maintenance management	Levelling or stability in the workload. Reduction in unnecessary overtime. Reduction in inventories (with *kanban*s).	Harris and Harris, 2008; Deif, 2012; Thürer et al., 2014
Kanban systems (cards, lights etc)	Visual signals used to "pull" a product or service from preceding work units or other functional departments	Production management (pull production control – production/replenishment *kanbans*), maintenance management (maintenance *kanbans*), safety management (safety *kanbans*)	Harmonising planned production rates (*takt* rate) with actual field operations. Reduction in work-in-progresses and inventories. Reduction in overproduction. Reduction in the risks of inventory obsolescence. Facilitates small-batch production. Supports product variation. Facilitates smoother production or service flow. Quality control issues and disruptions in production can be easily pinpointed at the source.	Sugimori et al., 1977; Ohno, 1988; Berkley, 1992; Coleman and Vaghefi, 1994; Hirano, 1995; Bonvik and Gershwin, 1996; Monden, 1998; Jang and Kim, 2007; Persona et al., 2008; Hüttmeir et al., 2009; Ahmad et al., 2013
Mistake Proofing (*Poya-Yoke*)	Electro-mechanical systems used to warn operators of or totally control mistakes before they turn into defects	Safety management, quality management and process managemen	Reduction in the need for quality control (waste). Reduction in the amount of defective end products and services. Improved safety in machine/equipment – operator interfaces. Reduction in production set-up (waste).	NKS, 1987; Shingo, 1989; Robinson and Schroeder, 1990; Furlan et al., 2011; Saurin et al., 2012

Table 2. The functions of Visual Management

Function of VM	Definition of the function	Practices to be replaced by the function of VM
Transparency	The ability of a production process (or its parts) to communicate with people.	Information held in people's minds and on the shelves.
Discipline	Making a habit of properly maintaining correct procedures.	Warning, scolding, inflicting punishments, dismissing etc.
Continuous Improvement	An organisation-wide process of focused and sustained incremental innovation.	Static organisations or big improvement leaps through considerable investment.
Job Facilitation	Conscious attempt to physically and/or mentally ease people's efforts on routine, already known tasks by offering various visual aids.	Expecting people to perform well at their jobs without providing them any aids.
On-the-Job Training	Learning from experience or integrating working with learning.	Conventional training practices or offering no training.
Creating Shared Ownership and a Desired Image	A feeling of possessiveness and being psychologically tied to an object (material or immaterial).	Management dictation for change efforts, vision and culture creation.
Management by Facts	Use of facts and data based on statistics.	Management by subjective judgement or vague terms.
Simplification	Constant efforts on monitoring, processing, visualising and distributing system wide information for individuals and teams.	Expecting people to monitor processes and understand the complex system wide information on their own.
Unification	Partly removing the four main boundaries (vertical, horizontal, external and geographic) and creating empathy within an organisation through effective information sharing.	Fragmentation or "this is not my job" behaviour

Figure 1. Kanban cards used in construction – the materials shown are pulled by workers from preceding workstations

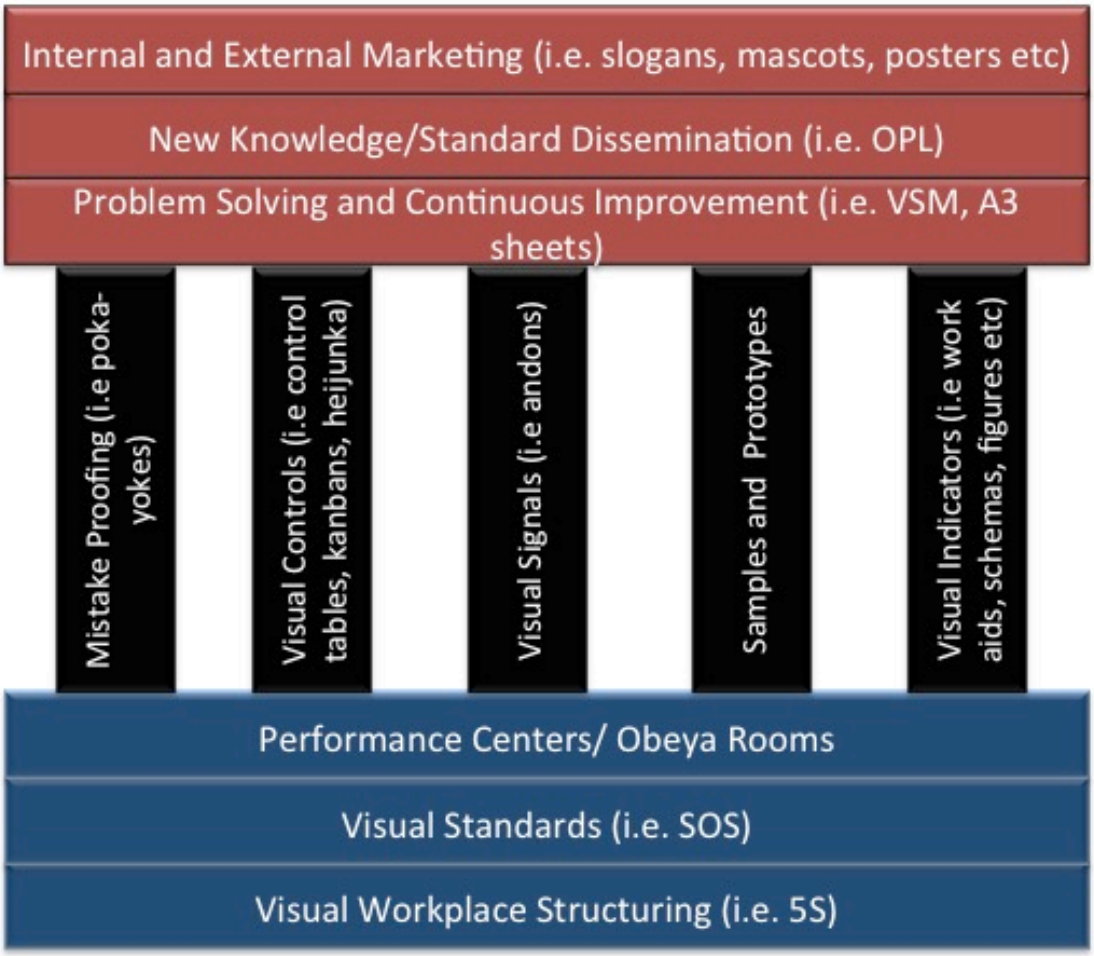

Figure 2. Visual workplace implementation framework; the bottom tier for the founding blocks of visual workplace organisation, visual standards and visual metrics, the middle tear for the more operational VM tools and the upper tier for continuous improvement, knowledge dissemination and marketing

Figure 3. A tool-responsible matrix showing who is responsible for what tool for process transparency through Visual Management

Figure 4. 5S Signs and kanban cards for material stock location standardisation and replenishment: Visual Management for process transparency and discipline

Figure 5. A shadow board for shape coding the hand tool locations

Figure 6. Health and safety related information with the quality politics of the company is shared to reinforce a positive image

Figure 7. Quantitative (objective) performance figures are on display for management-by-facts

Figure 8. Filtering and presenting the vast amount of information coming from the organisational environment for the workforce for simplification

Figure 9. A monthly calendar that marks upcoming important events and dates for the organisation for simplification

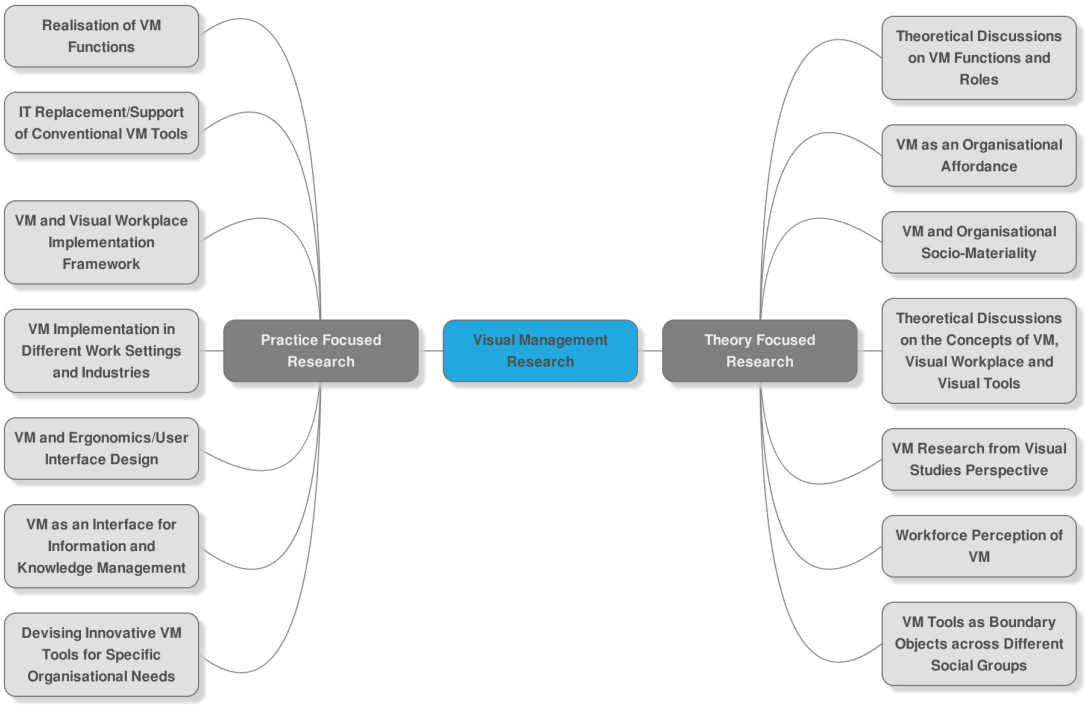

Figure 10. Future Visual Management research directions