

# Integrating lean and visual management in facilities management using design science and action research

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## Abstract

**Purpose** – The purpose of this paper is to create a value-based facilities management (FM) workplace by integrating lean principles, lean concepts, and specifically visual management technologies to improve efficiency, transparency, and value in the built environment.

**Design/methodology/approach** – The original research methodology used design science research framework with an action research (AR) approach. The chosen qualitative research methods included questionnaires, unstructured and semi-structured interviews, and participatory observation in action.

**Findings** – The facilities asset management department needs to align itself more strategically with organization leadership by understanding core business values, mission, and vision. It is essential they become a partner in creating a value-based contribution to the organizations bottom line and strategic plan. This can be established by embracing lean principles, concepts, and visual technologies, strategically linking the FM and asset management department to the organization holistically. The research acknowledged that a lean visual workplace management system could be introduced in facilities asset management with success. The findings suggest that change management should form part of the lean journey.

**Research limitations/implications** – The original research was limited in scope to one UK university estates and property services department's lean journey and their third party outsourced FM service provider.

**Originality/value** – By using the visual workplace management system to integrate lean and visual management technologies in FM asset management systems value-based FM services and recognition from the C-suite will be achieved. Additionally, a new design science framework with an AR approach was developed as a research method

**Keywords** Lean, Change management, Action research, Visual management, Design science research, Facilities asset management

**Paper type** Research paper

## Introduction

The global recession of 2008 generated economic constraints that prompted world governments to establish leaner, more efficient, value-added initiatives. This trickled down to governments, universities, and organizations around the world. Even the United Nations requested governments to seek leaner more creative practices in distributing value to their operations (United Nations, 2008). As a result, severe financial reductions in government funding developed causing organizational leadership to seek leaner, more efficient value-added strategies that meet budget constraints, investment decisions that would gain attention of potential clients and real estate (RE) investors. This prompted leadership to except the concept of facilities asset management as a strategic entity in the whole building life cycle.

Facilities Management (FM) companies are becoming more competitive and reaching in to newer markets. This development brings about strategic management plans that aim to reengineer core business objectives to include the mission, vision, and delivery of how FM services and building assets are provided. Organizations are paying more attention to efficiency gains in the workplace. With the high cost of RE, leases and aging buildings in major cities across the globe, the cost of leasing and owning RE is at the forefront of an organization's expense succeeding employee salaries (Wiggins, 2010).



This research envisions that if organizations embrace lean principles, concepts, and visual management technologies at the facilities asset management department level, a lean visual management workplace will be established. Therefore, the FM department will form a more strategic alliance with organization leadership. Reuniting the core goals of facilities asset management that were envisioned when the industry was conceptualized. Engaging the FM department in lean philosophy and visual management technologies establishes a creative integrated approach that enhances culture, productivity, profitability and success of the physical workplace. This in turn links the facilities and asset management to the enterprise strategically through the elimination of inefficiencies, cost, and resources across department workflows.

The literature yields that lean visual workplaces are limited to manufacturing, aerospace, retail maintenance, and transportation sectors. That doesn't mean that facilities asset management is not practicing lean or have not developed visual management workplaces. What it suggests is that there is a lack of published research attesting that a lean visual facilities asset management department exists. The deficient evidence of lean and visual management in facilities asset management makes a strong case to investigate integrating lean principles, concepts, and visual management technologies.

### Lean visual management

The intent of a lean enterprise is to embrace customer value, improve process driven efficiencies and reduce wasted efforts. According to Mann (2010, p. 54) "lean is an improvement system" that establishes quality of workflows, continuous improvement, appreciation for co-workers, and elimination of inefficiencies. John Krafcik, an engineer and researcher at Massachusetts Institute of Technology, introduced the term "lean" (Zokaei *et al.*, 2010; Womack *et al.*, 2007) and "lean production system" in his 1988 article, Triumph of the lean production system (Krafcik, 1988). Krafcik's lean production theory was considered lean "because it uses less of everything, half the human effort, half the space, half the investment in tools, half the hours, half the time. Also, it requires far less than half the inventory on site" (Womack *et al.*, 2007, p. 11). Krafcik's lean production system is based solely on production and manufacturing of automobiles.

The conceptualization of lean production was further developed in 1990 with Womack's *et al.* (1990) book, *The Machine that Changed the World*. In Womack and Jones (1996) book *Lean Thinking* (Dahlgaard and Dahlgaard-Park, 2006; Koskela, 2004) the term "lean enterprise" was conceptualized along with "lean principles" (Furterer and Elshennawy, 2005; Womack and Jones, 1996). Womack and Jones (1996) categorized lean thinking into five lean principles: specify value; identify the value stream; make the value flow; let the customer pull; pursue perfection, or continuous improvement. This research herein used Womack and Jones lean principles as an assessment tool in determining lean implementation in facilities asset management.

The Smithsonian's Office of Facilities Management and Reliability, established that FM may be using lean leadership and not even know it (Wurtzel and Cooper, 2013). There are so many different interpretations of lean, depending upon the organization and industry sector. According to Wurtzel and Cooper (2013) facility managers need to think more strategically and implement lean principles, and visual management to improve workplace metrics. Furthermore, Wurtzel and Cooper (2013) contend that facility managers need to understand two main principles of lean, "continuous improvement and respect for people" (Wurtzel and Cooper, 2013, p. 16).

Visual management is a system that uses a lean approach to implementing visual management in the workplace. Visuality becomes an integral part of the visual workplace as it supports an innovative visual culture where knowledge is shared (Galsworth, 2005). All information on company websites, binders, files and company data systems become

liberated and openly (visually) communicated to employees and customers (interpreted from Galsworth, 2005, p. 17). This is done “by converting that information into a visible, at-a-glance format for all who need it to access and use” (Galsworth, 2005, p. 17). Employees will be able to decipher workplace information “just by looking”. The knowledge shared becomes a powerful tool. “More than ever before, when we work in a fully-functioning visual workplace, we understand that. We become powerful. When we liberate information, we liberate the human will” (Galsworth, 2005, p. 17).

### **Research aim and methodology**

The aim of the research was to conceptualize theoretical and practical understanding of introducing lean principles, particularly visual management technologies, in facilities asset management. This was accomplished through the literature analyses that identified the main constructs: facilities asset management, lean, visual management, and organization change management. Then linking the research aim and objectives throughout the study and developing research frameworks, instantiations, and artefacts. Research in facilities and asset management does not have specific research philosophies or standard methodology frameworks. Therefore, this research explored a triangulation research method. It merged design science with an action research (AR) approach. Focussing on the collaboration of professional practice and research to provide solutions to current organizational problems, designing visual artefacts that improved existing conditions.

### **Research framework clarified**

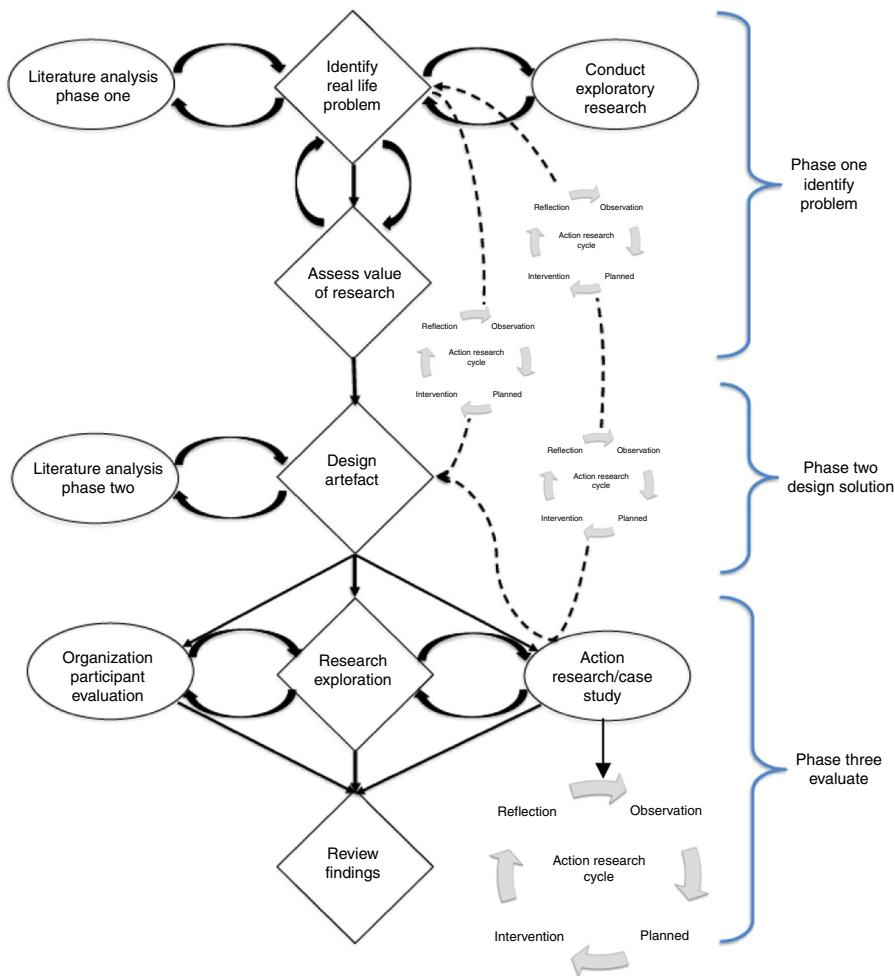
Design science research (DSR) derives from the community of practice which include computer science, engineering, and information systems (IS). In these practices a positivist and interpretive qualitative research view is used in the construction of a technological artefact such as algorithms, computer programs, and software systems (Vaishnavi and Kuechler, 2004). A typical DSR cycle “generate(s) understanding that can only be gained from the specific art of construction” (Vaishnavi, 2008, p. 12). A DSR cycle starts with an awareness of a real problem (Vaishnavi, 2008; Järvinen, 2007; Offerman *et al.*, 2009, Article 7; Holmstrom *et al.*, 2009). The real-life problems can be found in organizations, the workplace, in different industries such as architecture, construction, engineering, facilities asset management, higher education, healthcare, and IS and technology. Numerous design science explanations and frameworks have been published in the IS industry by researchers such as Hevner, 2007; Järvinen, 2007; Holmstrom *et al.*, 2009; March and Smith, 1995; Offermann *et al.*, 2009; Peffers *et al.*, 2007.

### **DSR framework**

Literature suggests that there are various phases and steps in developing a design science framework. Offermann *et al.*'s (2009) research resulted in the development of a framework that combines methodologies such as participative AR through use of case studies and observation. Their investigation is geared toward management and IS; this enquiry continued their research and developed a DSR framework with an AR approach for the facilities industry, illustrated in Figure 1. The researcher used a three-phase approach: Phase 1 identify problem, Phase 2 design solution, and Phase 3 evaluate findings. Within each phase are various steps to conduct research, linking back to a continuous improvement cycle of enquiry.

### **Phase 1 identify problem/AR observation cycle**

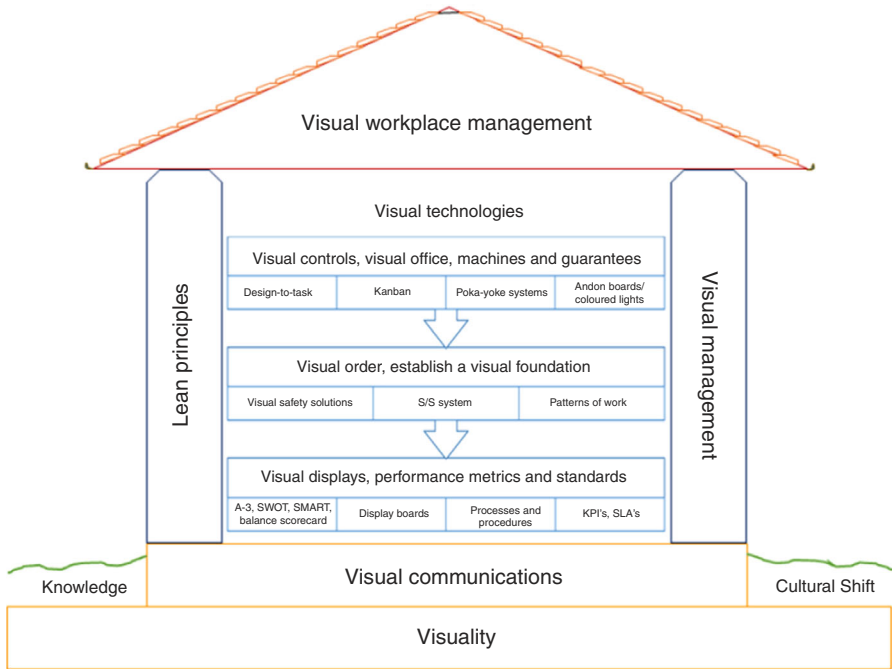
First phase of the literature analysis takes place to gain a better understanding of the research constructs, research methodology, case content, and current issues. A case study



**Figure 1.** Design science research with action research cycles framework

organization was selected and exploratory research was conducted which provides background information, and determines real organization problems. There is a continuous cycle looping the literature analysis Phase 1 back to identifying the problem; then linking to conducting exploratory research. The loop resembles the Deming continuous improvement cycle of plan, do, check, act.

Case study 1 considered a lean facility management third party service provider that won a contract to manage outsourced FM services, managing four floors of a university's newly constructed off campus facility. The outsourced FM services contract was based on service level agreements (SLA's) and key performance indicators (KPI's) that were in line with university's goals, mission, vision, and performance metrics. They were responsible for providing cleaning, janitorial, reception, and security and switchboard services. The case evaluated the leanness of the FM outsourced service provider using Womack and Jones (1996) lean principles and the visual workplace management building system developed during the literature analysis Phase 1, illustrated in Figure 2.



**Figure 2.**  
Visual workplace  
management building  
system

The theory behind constructing a visual workplace management building system is thinking in terms of a residential house, you start from the ground up. The footings are formed and concrete is poured. Visuality is the footing which supports the foundation, visual communications. The exterior walls (lean principles, lean concepts) and interior walls (visual management) structurally support the building and roofing system. The roof becomes the visual workplace management system, encompassing all approaches, technologies, and tools protecting the workplace from external elements.

The interior walls, floor boards are made up of three levels of visual technologies. Level 1 is visual displays, performance metrics, and standard technologies. This includes performance standards such as visual A-3 reports, SWOT analysis, and balance scorecards. Standard workplace practices such as process and procedures, KPI's and SLA's are injected in the system along with visual display boards to communicate workplace performance standards and metrics. The second level is visual order, establishing visual foundation technologies. Comprised of the 5/S organization declutter system, customers specifications and requirements, patterns in the workplace and visual safety solutions. The third level is visual controls, visual office, machines and guarantees technologies. This is made up of kanban systems, pull systems, colour light controls, design to task, and technical devices.

Case Study 2 compared the main university's estates and property services (E&PS) department against the lean FM outsourced service providers operation. Lean principles, and concepts considered were value-based facilities asset services, value stream mapping, continuous improvement, one point of contact and multi-skilled workers. E&PS had lean concepts written in their transformation documents. During the restructuring efforts, the word "transformation" and "lean approach" was introduced in bulletins, directives, and newsletters. Numerous employees immediately thought of employee layoffs. A negative sentiment was expressed throughout the workplace that continued to evolve. A reallocation of staff roles resulted in employees leaving, taking early retirement and severance packages.

The largest reallocations of responsibilities were in combining the helpdesk and expanding the role of the handyperson/porterage services.

E&PS reviewed all facility and asset management services and value stream mapped all services, identifying and removing (some) wasted activities. Adopting a lean approach, identifying and removing wasteful activities, process mapping and transparency are all components of developing a lean enterprise. There was a clear understanding of lean principles at the executive level. Though the notion of training staff in lean principles and techniques had not been considered, this developed into the case studies problem statement. The commitment of time was another unproductive aspect of the case. With new processes, procedures and standards, more use of CAFM systems, new telephone communications system and reporting procedures, training and development of current and new staff was gradual. The problem statement became: estate and property services department have not properly trained employees in lean principles and visual management technologies that are warranted in order for E&PS to sustain their lean transformation efforts.

### Phase 2 design solution/AR planning cycle

In DSR Phase 2, the design of an artefact took place, and another literature review was conducted. The AR planned cycle starts the analysis of the problem statement and initiates the researcher to design a solution to fix the problem. The researcher recommends an improvement artefact based on research findings. Theory development is predominant in the design of the artefact, not necessarily how the artefact is created. The more important aspect is what the designed artefact becomes and how the problem is solved. The first designed artefact was a lean transformation visual management workshop blitz. The workshop artefact introduced lean principles and transformation concepts; visual management technologies; and creating a visual workplace. A visual workplace management system is knowledge-based, emphasizes on transparency, productive and sustainable work habits. Employees take pride and ownership in their job and workplace, sharing information and teaching each other.

### Phase 3 evaluate/AR intervention cycle

The final stage evaluation, is reviewing the research exploration findings and writing up the outcomes. This can be in the form of a report or a research thesis. The success of the artefact implementation is determined by how well it was designed to mitigate the problem. Not every attempt at designing an artefact and implementation will be successful. Through the researchers' theory development, the AR cycle selected for this enquiry was: observation, planned, intervention, and reflection, illustrated in Figure 1.

The artefact was implemented in phase 3. The artefacts importance, value, and reliance can only be determined upon implementation. In conventional research knowledge is created, while "action research is an approach to research which aims at both taking action and creating knowledge or theory about the action. The outcomes are both an action and a research outcome" (Coghlan and Brannick, 2010, preface). Another aspect of AR is the collaborative qualities, "in that the members of the system which is being studied (in this case a university estates department) participate actively in the cyclical process" (Coghlan and Brannick, 2010, preface). Where, in traditional research an operative or organization may be the actual object of investigation (Coghlan and Brannick, 2010).

The first AR reflective cycle took place, while introducing the first artefact; E&PS staff shouted, "we don't like the word transformation" and "we don't use the word transformation". Even though the word transformation is plastered all over transformation documents. The fact remains that the university labelled their restructuring efforts as *The University Transformation Programme*. The research validated that E&PS staff did not view the word "transformation" positively. Prior to this event the researcher was not aware of the negative connotation of the

word transformation. This was perplexing given the amount of time spent with E&PS staff, and reading university documents. One of the visual artefacts was labelled, "Lean Transformation, How do We Get Started". The researcher circled back to the literature and found a theory by Vicher (2012) that explains this situation. According to Vicher (2012, p. 128) "employees are likely to express resistance to that which is new and unknown". Such as E&PS employees not liking the word "transformation", it represented change and the unknown.

### **Phase 3 evaluate/AR reflection cycle**

Phase 3 outcomes focussed on the visual workshop by observing participants after they had a better understanding of lean principles and visual management technologies. The workshop gave the attendees an interactive team experience and helped them mitigate real-life issues collaboratively and visually. Throughout the entire process E&PS staff was unwilling to share information or be a part of the research. This was interpreted as a lack of trust. Therefore, the researcher took a less formal tactic in data collection techniques.

### **Data collection techniques**

As an AR scientist observing people in their work environment, one way of building trust, and acquiring knowledge is an unstructured interview. According to Dawson (2009) unstructured interviews are a means to a more holistic enquiry in understanding participants' opinions and circumstances. Due to the culture of the workplace, a more informal social action data gathering method was chosen and a combination of both closed-ended and open-ended interview questions were used. Field observation, shadowing also formed part of the data collection. In writing up the research findings, AR reflective analysis was performed. This is where the researcher stops, steps back and queries insights, while planning the next action steps. Current documents, records, and reports were made available.

### **Phase 3 evaluate/AR observation cycle**

Senior management staff started gemba walks to see first-hand issues affecting operations. This was a positive occurrence for senior management to not always be in their office and physically go see (gemba) the value in the workplace. Lean visual management vocabulary was verbalised, words such as visual management, lean, visibility, and gemba walks. Visual standards of work such as A3 reports started to be used in meetings to rectify issues. Visual display boards and a student CAFM net accommodation instruction sheet was developed that provided students to implement and track all work order issues in their accommodations. This all came about after the lean visual workshop blitz artefact was introduced.

Team leaders started visually communicating building issues and writing them on whiteboards. Consequently, the main FM office relocated, and team leaders offices were segregated. As a result, the white board went missing. The stores and mail room team leader kept their white board and visually communicated their work, not necessarily employee communications. The efforts of visual communications using visual displays were not sustained. However, two years later, visual communications started again with large workflow charts being displayed in the main administration office.

Additional outcomes were colour coded keys with matching key tags and coloured dots coordinating cabinet door locks and colour coded telephone and data cables. This generated a more efficient workflow for reception/helpdesk support associates. They were able to determine which keys opened up specific cabinet doors and which cables went in to which jacks, saving time, and motion. A door release button to the secured office entrance was installed along with a security panic button. Both were visually labelled using a yellow label with black text. This particular pattern of colour coding is considered the most prominent visual labelling method.

**Phase 3 evaluate/AR planning cycle**

The research underwent another cycle of AR planning. It was noted that a large percentage of lean systems integration was in the operations function. The landscape department, mail room, supply stores and joiners workshop had not been considered lean areas. Therefore, the mail room and supply stores were selected to be the next area of research. A third artefact was designed to provide a visual workplace management project delivery system arranged as a check list, which E&PS could use in continuing their lean journey.

**Phase 3 evaluate/AR intervention cycle**

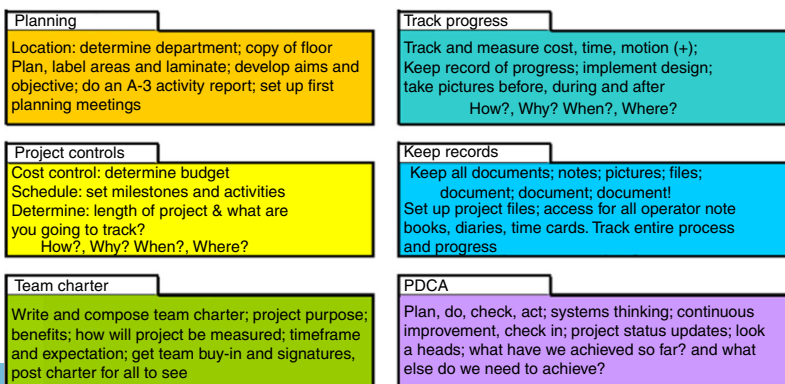
The research project was exploring lean visual management technology artefact development in the mail room and stores. The case study exploration was designed to go phase by phase and test the validity of integrating lean principles and visual management technologies using a structured lean visual workplace management project delivery cycle artefact illustrated in Figure 3. The phases are a colour coded system that can be utilized for labeling documents, project files, and communications. The phased colors can be visually communicated in newsletters, the team charter and posters around the office.

**Phase 3 evaluate/AR planned cycle**

The research continued concentrating on the supply stores. The stores were relocating to a smaller space, and a questionnaire was sent to 31 staff concerning reallocating supplies from existing space to potential storage areas across campus. The researcher received back a few questionnaires. The same scenario occurred in earlier research phases. Employees were not willing to share information and participate even though senior leadership were on board.

**Phase 3 evaluate/AR intervention cycle**

The extended case continued and the researcher worked closely with the stores operative. They were able to provide a floor plan of the new stores site. The stores operative measured shelving units, bin sizes and took stock inventory of exiting conditions, then drew up a new proposed floor plan using CAD. The relocation of the stores took longer than expected due to unforeseen conditions. While demoing a wall asbestos, pipes and control valves were found. The construction was stopped as the asbestos was remediated. The researcher met the stores operative at the construction site when it reopened. The researcher taped borders on



**Figure 3.**  
Lean visual workplace  
management project  
delivery cycle



the floor outlining proposed bin and shelving unit locations according to the schematic floor plan. The intent was for the stores operative to visualize the new proposed design layout. The stores operative was able to visualize what worked and what needed to be reconsidered. The stores operative revised the schematic floor plan to reflect final locations. They labelled the floor plan linking it to the move plan.

There ended the lean visual workplace extended case study. A few months later, the stores finally relocated. The store's manager stated that the move went smoothly. They were impressed with the stores operatives knowledge of the new site, and how well organized and methodical the move went. The stores operative was able to direct the movers where to place everything. This was as a result of the initial site visit, tape planning method, revised space plans, and move management labelling system.

### **Phase 3 evaluate/AR reflection cycle**

A third artefact designed was a lean visual workplace management project delivery cycle. The project delivery system was designed as a project management tool for lean implementation. E&PS was informed that they could develop a more holistic approach by incorporating the mail room and stores in their restructuring programme. Unfortunately, a mail room operative was not keen on helping with the research. They voiced their opinion to the researcher and management halting the research effort. They intimidated mail room operatives to not associate with the researcher and not assist with the study. On the other hand, minor accomplishments occurred in the stores. The researcher was able to work with the stores operative in designing a new space layout. They made arrangements for the stores operative to visit the construction site. The intention was for the operative to get a visual sense of the new location, size and existing conditions. During the construction site visit, the researcher border taped the proposed layout on the floor for the stores operative to assess. This ended the stores research study.

### **Comparative case study analysis**

In comparing visual technologies between E&PS and there outsourced service provider; the outsourced service provider used visual communications, and organized and labeled working files from the beginning of their contract. There receptionist colour coded work related clipboards with university logo's and student instructions. E&PS started visual order integration only after the first artefact was introduced and they did not sustain visual white board communications. Lean principles and visual management technologies that both facilities asset management departments integrated are organized in the list below. This list is a guideline of lean principles, concepts, and visual management technologies that have been successfully integrated in facilities asset management systems.

Recipe for value-based FM department lean. Concepts and visual management technologies for successful integration in FM systems:

- (1) Lean principles:
  - value-based FM;
  - multi-skilled workers;
  - one point of contact;
  - value stream mapping;
  - continuous improvement cycle;
  - appoint a lean/visual manager or champion; and
  - reading books on visual workplace, visual thinking.

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- (2) Visual communications:
    - visual creativity;
    - establish a lean visual knowledge-based work force; and
    - speaking the Language of Lean and Visual Management.
  - (3) Visual controls, visual office, machine and guarantees:
    - design to task;
    - colour coded data/phone cables;
    - reception/helpdesk staff 24/7/52;
    - CAFM systems or CMMS systems;
    - intelligent call monitoring phone system;
    - IPD and smart phone or tablet use in O&M;
    - furniture re-use and recycling e-brochure for re-use; and
    - colour coded clipboards, easy access in lieu of files.
  - (4) Visual order, establish a visual foundation:
    - 5S system;
    - pattern of work;
    - security panic button;
    - gemba walks, go see;
    - colour coded cabinet doors with coordinated key chains, and colour coded dots;
    - visual safety solutions, door release button and security; and
    - identifying through labels, black letters/numbers with yellow background, best visual colour combination.
  - (5) Visual displays, performance metrics and standards:
    - A3 report;
    - benchmark systems;
    - visual display boards;
    - visual problem solving;
    - SLA's;
    - KPI;
    - restructure security systems;
    - monthly performance reports;
    - comply with customer funded works policy;
    - reduce planned preventive maintenance;
    - new standards of work and processes and procedures; and
    - student CAFM net accommodation instructional sheet.

A second visual artefact was co-created with university FM staff; a Student CAFM Net Accommodation Instructional Sheet. It was laminated and posted in all student accommodation units. A third artefact designed was a lean visual workplace management project delivery cycle. The implementation process was stopped by a disgruntled employee. A mail room operative was not willing to participate in the research and pressured all mail room operatives to not participate. An additional theory that had not been considered developed. Some employees get used to their surroundings and are not willing to change with the organization. They meet with resistance and embody a force field around themselves and their workplace, not letting anyone in unless they pass their trust marker. In order for this situation to amend, it will take a strong facilities asset manager who is knowledgeable about change management and can embrace the situation with a light touch and positive visual communications.

An unstructured interview follow up was conducted one year later, it was discovered that there had not been any additional visual artefacts designed or lean concepts initiated. The continuation of E&PS's lean journey momentum stopped. Everything stayed as it was for several years. According to Kurt Lewins (Cameron and Green, 2015) three step frozen theory of organization change; once you unthaw the existing "as is" state, you create the new proposed state and only when the new "to be" state is developed, you refreeze the new organization. The research concludes that the university's facilities asset management department may never achieve the ability to refreeze, since they have not come to terms with new "mind sets and habits" (Cameron and Green, 2015, p. 36).

### Findings

The DSR with AR cycles framework was designed specifically for this study. The framework used a three-phase DSR concept: Phase 1 identify problem, Phase 2 design solution, and Phase 3 evaluate. Phase 1 literature review tracked a UK university E&PS departments lean journey. UK higher education has been hit hard by economic factors, funding issues, insufficient resources, and increases in student tuition. These challenging circumstances influenced a university wide transformation programme. As a result E&PS was tasked with cutting £1 million from their facilities operating budget. Their own restructuring programme objective took on a lean approach. Though staff at all levels had never heard of lean, let alone process mapping and value-added initiatives. Phase 1 problem assessed if E&PS was in fact practicing lean facilities asset management. It was determined that E&PS had launched a lean restructuring programme. It established that they are far from perfection and need to focus more on the people in order to succeed. Management needs to reinforce continuous improvement and educating staff in lean principles, concepts, and visual management technologies.

In Phase 2, the artefact designed to mitigate a real-life organization problem took the form of a lean visual management workshop blitz. The artefacts main objective was to educate E&PS staff in lean transformation concepts and visual management technologies. The methodology took on a unique triangulation of research methods, starting with design science philosophy, creating a solution to a real workplace problem, and using AR cycles of integration. AR is based on cycles of research similar to design science, both seek to find a resolution to real-life problems. In AR the researcher closely engages with people in a collaborative format. Its goal is to self-reflect and enquire at various stages of research to formulate personal discoveries that emerge, and how it affects the researcher or situation (Ivankova, 2015). For this exploration, the AR cycles chosen where: observation, planned, intervention, reflection. The study went through three AR cycles and four AR reflection learning cycles.

Design Science Phase 3 evaluated the outcomes of Phase 2. It reflected back on what transpired once lean concepts and visual management were introduced to E&PS staff. The research strictly followed the research framework illustrated in Figure 1. Every step of the study reflected back to the framework and intervention through AR cycles. It presented a methodical structure and kept the researcher focussed. There is a lack of visual identifiers

in DSR, especially with an AR approach. It is the researchers expectation that the framework designed is carried forward.

What was discovered is lean principles, concepts and visual management technologies were implemented in order to produce proficient process driven, value-based facilities asset management services. Although, employees were still full of anxiety and stressed from the original transformation. The challenge was to manage and build the workplace through process management systems and designate lean change agents at every level of the socio-technical system. In other words, nominate a lower level operative in the mail room as a lean visual change mediator. Designate a middle manager as a visual project delivery manager. At the executive level, appoint a transformation programme manager to oversee the process. Have them meet weekly to bring questions, ideas, and project challenges to focus. This is fundamental to the overall success and lean visual management implementation efforts. Careful consideration of department culture, policies, and willingness to change should be taken in to consideration for lean visual management implementation to be effective.

### Conclusion

The original constructs did not consider change management, during AR learning cycles it surfaced. Three of the four reflective cycles dealt with pragmatic people issues. The challenges of change are not just in building assets, they can be in the form of new technologies, computer system upgrades, developing new work standards, performance metrics, and transformation programmes. Changing the facilities asset management department functions and culture by restructuring the workplace and not paying attention to people is likely to develop bad attitudes, resistance to change; mistrust of management; and instill fear of the unknown. Employees have a tendency to resist anything new and sometimes sabotage the process. It is advocated that a lean project management delivery system and change management plan be part of all organizational transformation and lean visual management integration systems. The facility asset manager needs to be proactive in communicating and reinforcing change, and most of all engage employees in the process and then the organizational culture will become a positive outcome.

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