AN EXAMINATION OF VISUAL MANAGEMENT ON FINNISH CONSTRUCTION SITES

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ABSTRACT

Visual Management (VM), which is one of the founding blocks of the Toyota Production System, is the managerial strategy of integrating information and sensory aids into work settings for increased self-management. This paper presents the preliminary findings of a collaborative research conducted between Finland and the UK, as part of an effort to introduce the dissemination of Visual Management in the Finnish construction industry. How the Visual Management concept is realised on Finnish construction sites is the main research question of the paper. The examination of the current Visual Management conditions on typical Finnish construction sites was conducted through multiple case studies carried out on five different construction sites in the country. The findings were presented by case descriptions. The main finding is that the Visual Management strategy is currently at an initial level and based on individual initiatives, not systematic company approaches. The discussion of the Visual Management conditions in Finland, some recommendations for the implementation of Visual Management in the country, and the future Visual Management research efforts were also presented.

KEY WORDS

Visual Management, visual workplace, lean construction implementation, Finland.

VISUAL MANAGEMENT

Visual Management (VM) is the managerial strategy of increasing pervasive information availability at close-range communication, removing information blockages for better information flow and providing people with sensory aids at a work setting (Greif, 1991; Galsworth, 1997). The information and sensory tools are integrated on workplace elements (e.g. walls, floors, material stock, gears, tools etc), close to where the actual information need might occur. Information fields, from which people can pull information, are created (Greif, 1991). The direct effect of VM is an increase in the communication ability of process elements, which is defined as process transparency (Formoso et al., 2002). The other effects include increased workplace discipline, continuous improvement, job facilitation, on-the-job training,

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creating shared ownership, management by facts, simplification and unification at the operational level (Tezel et al., 2009). VM takes roles in other managerial activities (e.g. production management, safety management, image management etc) by increasing the self-management ability of the people in a workplace by making them autonomous in terms of their information needs.

VM is also a fundamental element of the Toyota Production System (Liker, 2004). Overcoming information deficiencies helps reduce the amount of unnecessary human activities (waste), such as counting, asking, guessing, searching for a material/ tool, quality control, and unevenness in a production system (Galsworth, 2005). Being able to sense facilitates the immediate identification of abnormalities and deficiencies for continuous improvement efforts (Imai, 1997). Increased information availability and different sensory aids also contribute to the health, safety and wellbeing of the people at a work setting (Hirano, 1995). VM is realised by using highly visual (sensory) information giving (e.g. posters, sketches), signalling (e.g. *andon* boards), limiting (e.g. *kanban* cards) or guaranteeing (mistake-proofing or *poka-yoke*) tools (Galsworth, 1997). The workplace, which contains different forms/ combinations of the four visual tools (aids) for different managerial purposes, and where VM is realised, is called a visual workplace (Suzaki, 1993). A visual workplace framework, adapted from Galsworth (2005), can be seen in Figure 1:
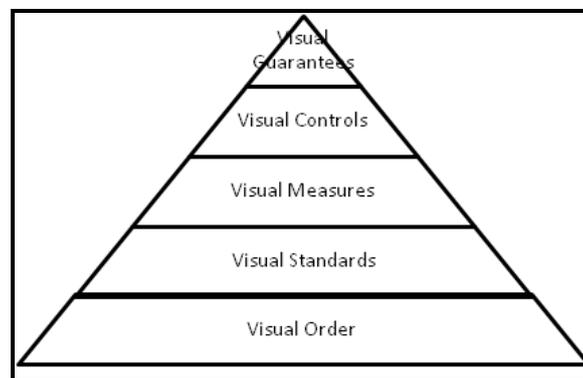

Figure 1: The Visual Workplace Framework

The first step on the framework, the visual order at the bottom, stands for the systematic standardisation of workplace elements in terms of their identification and localisation, which is also known as the 5S. Communicating standards, procedures, how-to-do sketches, process charts, best practices, desired behaviours in a highly visual, attractive and easy-to-remember manner constitutes the visual standards. Tracking the general and workstation specific performance metrics, presenting the metrics visually for everyone at a work setting and providing visual problem solving systems/boards are the essences of the visual measures. Various visual controls, including visual pull production controls (*kanban* systems), are adopted in the visual controls. Implementing mistake-proofing tools (*poka-yokes*) that will either mitigate or prevent human errors and eliminate the need for quality control is the final step of the framework.

Some innovative construction companies have already adopted the VM strategy and realised the visual workplace framework (Figure 1) to a degree on their sites (Tezel et al., 2010). The research presented in this paper was conducted to explore the VM conditions and the realisation of the visual workplace framework on Finnish

construction sites. It is a part of a collaborative effort between the University of Salford (UK) and the Tampere University of Technology (Finland) to initiate the dissemination of VM in the Finnish construction industry. The research was conducted on five different construction sites of prominent construction companies in Finland, with data collected between January-February, 2010, in the Finnish city of Helsinki. The research question that was explored is how VM is realised on Finnish construction sites. The research methodology for the study is the multiple exploratory case studies, which is suitable when the "how" and "why" questions are asked to a contemporary event over which the investigator has little or no control (Yin, 2003). The unit of study is the construction sites, which will be referred as Case in this paper. The main data collection methods are site observations, unstructured discussions with the site management and local academics working closely with the companies, and investigating the site archieves.

CASE 1

Case 1 belonged to a Finnish construction company, which employs 60 people in total and operates mainly in Finland. The project was worth approximately 15 million Euros and comprised of 2 conventional and 2 energy efficient residential buildings (99 flats in total) with parking garages and a kindergarten. 40 people (including the sub-contractors) were working on the site at the time of the visit. Pre-fabricated structural elements were commonly used in the project. The site was totally snow covered and there was no proper identification information on/around the construction site elements. Thus, it was hard to locate the paths, material storage areas, and to identify where one steps on, which could lead to undesirable health and safety incidents, particularly around the areas where the pile of snow was thick (those areas could be marked with mobile visual signs). Some large construction materials (e.g. gypsum walls, pipes, timber) were grouped on the site to support the site order. The materials in the warehouse had no material labels or identification information whatsoever, which rendered the warehouse lacking in a systematic order. See Figure 2.

Figure 2: The Site Conditions on Case 1

Improvisational and traditional VM practices were common on the site. The worker groups had devised visual communication systems within their own groups, which were mostly unknown to the site management. The electricians, for instance, were writing the number of holes that should have been drilled on the ceiling in a particular room, around the entrance to the room with a chalk. Marking the location and direction of gypsum walls on the floor and ceiling can be given as an example for the traditional visual aids on the site. The floor and room numbers, according to the project, were written on corresponding walls to increase the level of identification for

the people. However, these were all unsystematic efforts, developing within a group of people or occurring intuitively. See Figure 3.

Figure 3: Improvisational and Traditional VM on Case 1

There were some occupational law, waste disposal (recycling) and health and safety related posters and visual information displays in the management's trailer. However, the location of that information was far from the production area, where it was actually needed. Apart from the line of balance chart and some system-wide information displayed in the management's office, the management had devised a colour coded magnetic board, which enabled them to visualise and plan the site layout more easily. The magnetic board was located in the management's meeting room, again far from the production area or the site entrance, where it could be easily seen by the people working on the site or visitors. See Figure 4.

Figure 4: Information located in/around the Management's Trailer on Case 1

CASE 2

Case 2 belonged a Swedish construction company, operating in Northern Europe and Germany. The project was a 5 million Euro residential building project, which comprised of 43 flats. There were 25 people working on the site at the time of the visit. Pre-fabricated structural elements were commonly used in the project. The site conditions were similar to the conditions on Case 1, with respect to the absence of integrated information. The traditional and improvisational communication methods were also observed in application. Some project drawings were posted on the walls, as visual aids, by the workers themselves. In addition, it was identified that material manufacturers had integrated information on some materials (e.g. pre-fabricated, colour coded water pipe channels for cold (blue) and hot (red) water pipes), so that it became easier for the workers on the site to predict the correct installation/ assembly

of different materials. Some materials had arrived on the site already grouped and name tagged by the manufacturers for easier identification and stocking. See Figure 5.

Figure 5: The Site Conditions on Case 2

The site manager stated that the people on the site heavily relied on verbal communication and they performed their jobs mainly by personal work experience, when asked about the absence of visual work aids on the site. The manager assumed that the workers and managers on the site had already known what they needed to do and all the information they needed. The manager also stated that sometimes it was difficult to locate and identify materials, especially the ones under the snow and they occasionally lost materials on the site. One worker took the initiative of information display, as, according to the manager, he enjoyed posting information around. This worker had pinned system wide information, informative newspaper columns, cartoons etc. on the board in the worker cafeteria. It was the personal effort of an individual, not a systematic approach from the company. The company had located a safety metric display just outside the management's office. See Figure 6.
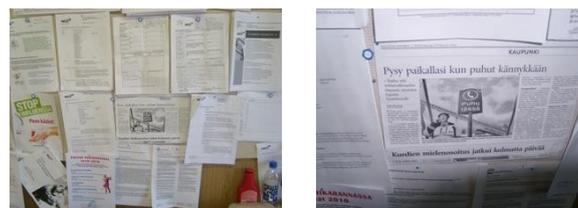

Figure 6: The Personal Initiative of a Worker on Case 2

CASE 3

Case 3 belonged to a Finnish construction company, which operates in the Baltic countries and the Russian Federation. The project comprised of 3 residential buildings (50 flats in total) with 2 parking areas. Pre-fabricated structural elements were used in the project. Case 3 was similar to Case 1 and Case 2, in terms of the limited information integration onto the building site elements, the site area being covered with snow, the existence of some traditional and improvisational visual communication/tools and some information posted mainly in the management's office. The management had also devised a project task tracking table, as an additional visual aid for themselves and put the table in the office room, along with the line of balance chart. See Figure 7.

Figure 7: The Task Tracking Table Devised by the Management for themselves

The management had also provided people with a list of the change orders for every room in each flat and posted those lists on the windows of every room, so the workers could easily track the current changes/ change orders in a specific room. Without knowing the Visual Management concept, the site management had found a good Visual Management solution for an important information need of the workforce. See Figure 8.
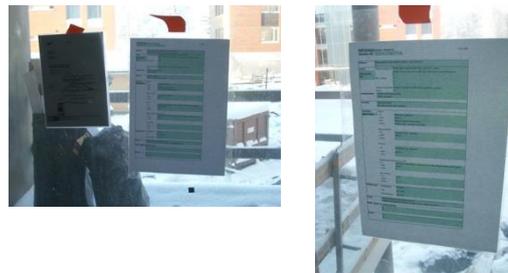

Figure 8: The Change Order List in a Room on Case 3

CASE 4

Case 4 belonged to the same company that managed Case 2. It was an 8000 m^2 renovation project (from a bank to an open office) in the Helsinki city centre. Thus, it involved large amount of mechanical and electrical construction works. The site manager devised a colour coded (red for "hot", blue for "cold" and yellow dots for "quality checked" etc) visual communication system that was systematically and extensively applied on the site, particularly as visual aids and in the quality control/ assurance efforts. See Figure 9.

Figure 9: The Communication System Devised by the Site Manager on Case 4

The site manager stated that he had tried written communication at first but people kept doing mistakes and asking questions, and then he had experimented with the visual communication system integrated on the site elements. There were many Russian and Latvian immigrant workers on the site, who could not understand the Finnish language very well. The manager stated that the visual communication system

helped the immigrant workers understand the requirements of the project to a great extent. The need for a more effective communication system and the manager's personal initiative, attention and experimentation are the important elements on Case 4.

The site manager was convinced about the effectiveness of managing people with visual clues/ aids. He had also systematically put colour coded floor stock plans, floor numbers and location identification, informative posters and projects on the walls, project performance metrics and general project information at the entrance in display on the site for everyone. He also indicated that the construction workers could learn to read the visually decorated plans/ projects (e.g. colour-coded material stock plans for floors) more easily and responded to them as desired. The site had a comparatively higher level of Visual Management adoption and information display, thanks to the efforts by the site manager. See Figure 10.

Figure 10: Case 4 was Comparatively Richer in terms of Integrated Information

CASE 5

Case 5 belonged to the same company that managed Case 3. It was a complex, 36000 m^2 socio-cultural building project, located in the Helsinki city centre. Case 5 was the site of one of the major construction projects in Finland at the moment. 70 sub-contractors and 450 people were working on the site at the time of the study. In fact, the construction company's main responsibility was to manage the sub-contractors. The site area was quite large and some direction signs were observed on the site to guide people. Many on-site material stocks and constrution tools were observed to be under the snow, yet there was no information displayed around those items. See Figure 11.

Figure 11: The Site Conditions on Case 5

The company manager stated that it was in the sub-contractors' own interest to identify their tools, materials and people on the site through increased information share. The company management adopted a loose approach in terms of how the sub-contractors arranged their own information flow. Some sub-contractors had already

marked or labelled their materials, tools and warehouse on the site by integrating identification information on them. See Figure 12.

Figure 12: Some Sub-Contractors Chose to Integrate Information on their Materials and Tools on Case 5

There were some BIM based colour coded projects, as visual aids, posted in the managers` offices, far from the production area. The production manager of the company stated that they used those colour coded projects in daily scheduling with the sub-contractors. In some production areas in the building, the workers had taped some projects on the walls. In addition, some improvisational (communication systems developed within worker groups) and traditional visual tools were also observed in use. The company manager stated that in the beginning, they had adopted the use of colour coded helmets to identify different work teams but later they could not have sustained the effort and had just asked the managers to wear white helmets. See Figure 13.

Figure 13: The Information Manifestation on Case 5

CONCLUSION AND RECOMMENDATIONS

Even though some Visual Management related practices were identified on the studied case sites, the efforts were mainly the personal initiatives of a manager or a worker, and not following a systematic approach, such as the visual workplace framework (Figure 1). Therefore, it can be stated that the sites were observed to be at the initial (basic) level of their visual workplace realisations. The main reason for the lack of a systematic and conscious Visual Management adoption supported by the construction companies is perhaps because of the unawareness of the companies of Visual Management. The awareness on Visual Management, its possible functions and methods should be raised. Many Visual Management implementation methods for construction operations do exist (see Tezel et al., 2010). Although explaining the practical methods of Visual Management is imporatant, it is perhaps more important to underline the self-management motive of and the functons of Visual Management. In this way, construction managers and workers can develop their own/ original Visual Management methods and solutions for different information needs.

As an initial effort, a higher level of standardisation of workplace elements (space, machinery, tools, gears, inventory), in terms of classification (naming), location, quantity, type etc. can be achieved by using the visual housekeeping methods, such as visual home addressing, shadowing and labelling (Hirano, 1995). This standardisation is also regarded as the first step in creating a visual workplace (Figure 1). It could be also beneficial to standardise VM practices/ applications throughout the sites, when there are many sub-contractors involved (Case 5). This standardisation may require inflicting some pressure on sub-contractors by the main contractor. The sub-contractors on the sites were identified to work rather independently in managing their own production efforts.

Different worker teams and groups had intuitively developed their own visual communication systems on every site, which were sometimes even unknown to the site management. Those visual communication systems were observed to be particularly used by the immigrant workers, who constitute a considerable portion of the construction workforce in the country and may lack in Finnish language skills (written/ oral communication). The effectiveness of these systems can be evaluated and then documented for further use, development and dissemination in the future. Personal initiatives of some individuals, either a worker (Case 2) or a manager (Case 3 and Case 4), are the mains reasons of the comparatively higher process transparency on some sites. The site managements' initiative will expectedly have a wider impact on a construction site, as on Case 4. However, these individual efforts were not as systematic as company strategies.

One common point among the sites was the existence of some visual aids for the site management in their offices (transparency for the management), which were far from where the construction production actually took place on the sites. Another common point on the case sites was the active existence of strong labour unions. The possible implications from those labour unions should be considered while initiating a Visual Management implementation in the country. The construction technology, construction methods and the high number of relatively autonomous sub-contractors on the sites may also affect the way Visual Management is implemented in Finland.

Some other related lean construction concepts, such as the mobile production cell concept (Dos Santos et al, 2002), can also be introduced to the Finnish construction industry in relation with Visual Management.

Further work, which focuses on the implementation of Visual Management and perhaps the visual workplace framework on a typical (conventional) Finnish construction site seems necessary. Demonstrating the practical benefits of implementing Visual Management to Finnish construction companies will help the dissemination of the concept in the country. The country specific implementation parameters will expectedly become clearer through this kind of an action research effort.

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