

Visual Management and Shopfloor Teams - Utilising Shopfloor Knowledge. In EUROMA, Gothenburg.

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Abstract

This paper explores the use of Visual Management in shopfloor communications boards with the aim of improving the quality of data available for shopfloor based teams and their team leaders. This research takes place in Assa Abloy, and explores the development of their communications boards using an action research methodology. Results include the level of acceptance of various visual principles and conclude that many of these principles are useful at the shopfloor level.

Keywords: Visual Management, Lean, KPI

Introduction

This research into Visual Management was inspired by previous work by the authors into sustainability at a shopfloor level. All of the authors had experienced difficulty with sustaining change particularly following Process Improvement activities. It was considered that making problems more visible would improve sustainability by providing a shared vision (Grief 1991) of the current state of the cell and routes for improvement. So this research focused at the shopfloor level and the development of communications boards used by team leaders. Communications boards are commonly used in lean environments to aid team decision making by displaying relevant, up to date information.

The purpose of this research was to build on previous work (Bateman, Francis and Lethbridge, 2007) whereby Visual Management (VM) principles for use in a lean environment had been developed and apply them in the development of communication boards by team leaders. This research focuses on Assa Abloy, a lock maker at their Portobello site in the West Midlands, and the development of their communications boards using an action research methodology. The VM principles were applied during a series of workshops for a group of shopfloor

based team leaders tasked with developing an existing board so that it better supported the team leaders in their role particularly, for Continuous Improvement.

This paper explores how well the VM principles were accepted and how well they were utilised by the team and embedded in the new design of board. This was then followed up by a six month period of roll-out whereby the boards were implemented in 23 cells across the site. Specifically the purpose of the research was:

1. To improve the utility of communications boards at Assa Abloy.
2. To improve the process of the communication board development at future workshops both at Assa Abloy and other organisations.
3. To test the principles of Visual Management in a real environment and improve current thinking.

Assa Abloy

There has been lock manufacture at the Portabello site for many years, (Green, Ackers and Black 2002) indeed the history of lock manufacture is intimately related to the Willenhall area for the last three centuries. Assa Abloy have other sites in Europe, US and China and took over at Willenhall in 2001. They manufacture and distribute a wide range of door locks from simple mechanical locks, to more complex hotel locks, to electromechanical locks used in high security applications.

The Portobello site employs 300 people and annually manufactures £35M of product. The shopfloor is divided into cells, some producing components but most cells are principally assembly cells with a product range such as small padlocks. In total the site manufactures several thousand different products for the domestic trade and export.

Assa Abloy have been implementing lean since 2006 and using SMMT (Society of Motor Manufacturers and Traders) Industry Forum from 2007 to deliver workshops, provide facilitation and assist with implementation.

From Assa Abloy's viewpoint the purpose of this research was to improve the design of the communications boards used by cell leaders. The boards consisted of two sides – the Production Analysis Board (PAB) which was used for everyday management of the cell and the Key Performance Indicator (KPI) side which was used for more long term analysis and improvement. At the time the research began the PAB side had been recently updated by a small group of team leaders and the plan was to do the same for the KPI side with the aid of a facilitator.

Visual Management

Visual Management is an element of Lean implementation (Bicheno 2004) and is concerned with providing a shared vision of what needs to be improved and the way improvements should be implemented. As such it is intimately connected to the idea of Continuous Improvement that is a core element of Lean. Research into Visual Management is somewhat limited and principally associated with documenting best practice. This approach includes Grief's (1991) *The Visual factory* which lays out many of the benefits of Visual Management and document a number of examples. Hirano (1995) which is essentially a practitioner based text presents ideas for implementation in the visual workplace. However there is a lacuna relating to the effectiveness of Visual Management and which specific methods for developing Visual Management tools are most helpful.

Allied to the idea of Visual Management is the presentation of performance measures. Performance measures and key performance indicators (KPI's) are often an important part of an operational team's understanding of their area. They often feature in communications boards which are large format (usually 1.5m by 2.5m) boards that have operational data displayed on several A3 or A4 sized print outs (Rich, Bateman et al. 2006). These boards are used by cell leaders and their teams to understand the cell's current status and to help identify opportunities for improvement. There has been considerable research in this area often focusing on the development of the measures, such as balanced score card (Kaplan, R, Norton, D. 1993) and performance prism (Neely, Adams et al. 2001) rather than how they are displayed. However some researchers such as Mills, Neely, Platts and Gregory (1998) have started to consider this area particularly in relation to how to display strategy concepts.

Other disciplines outside operations management are useful in this field of research, principally graphic design and cognitive psychology. From graphic design the work of Edward Tufte (1986) and the informed and lively debate on <http://www.edwardtufte.com/tufte/index> provides many useful ideas and most of the Visual Management principles proposed in this research are drawn from these sources. An example of how graphic design ideas can be applied to the presentation of performance measures has been demonstrated by Few (2006) who also draws on Tufte's work.

In terms of cognitive psychology there are many texts in this area, but suitable texts that can be applied in the area of Visual Management by non-psychologists include Shah and Hoefner (2002) who examine the best ways to display data. Miller (1956) also provides some useful insights in terms of cognitive workspace in that he states that people can hold a limited number of ideas at once and that it is sensible to structure information to reflect this.

Methodology

The methodology employed for this research was action research within a single organisation. The research techniques were participant observation, semi-structured interviews and recording and analysis of board designs through digital photography. Action research is a suitable methodology for this research as the purpose identified was both to improve practice in the subject organisation and to develop theory. The three authors of the paper are represented also by these dual needs: Author 1 is a researcher in the field of Visual Management; Author 2 is an engineer working for SMMT Industry Forum and Author 3 is the Operations Director for the subject organisation. As such Author 1 has an interest in developing the theory and Author 3 in improving practice in the subject organisation. Author 2's interest is in improving practice in terms of developing useful methods for implementing Visual Management in a range of organisations beyond the subject organisation – where he is working as a facilitator. A longer consideration of the action research methodology, definition of the framework of ideas used, as recommended by Checkland and Howell (1998), the research context within the PEARL approach Champion and Stowel (2003) and a discussion of the authors epistemology as influenced by Lean thinking, is further discussed in Bateman, Philp and Warrender, (2009).

This paper will outline the research process and provide brief details of the research techniques used. The primary process for the development of the KPI side of the board is shown in Figure 1. This process served principally the first

research aim - to improve the utility of the communications boards at Assa Abloy. It should also be noted that the process also follows the Plan, Do, Check, Act process as endorsed by Deming (2000) and used in many Lean implementations. The purpose of the first stage, the planning meeting, is to develop a plan for the process, taking in the objectives of the managers, who commissioned the work, and the Visual Management Development team whose role is to redesign the board and assist in its roll-out. The Visual Management Development (VMD) team consists of four Team (cell) Leaders and a quality engineer.

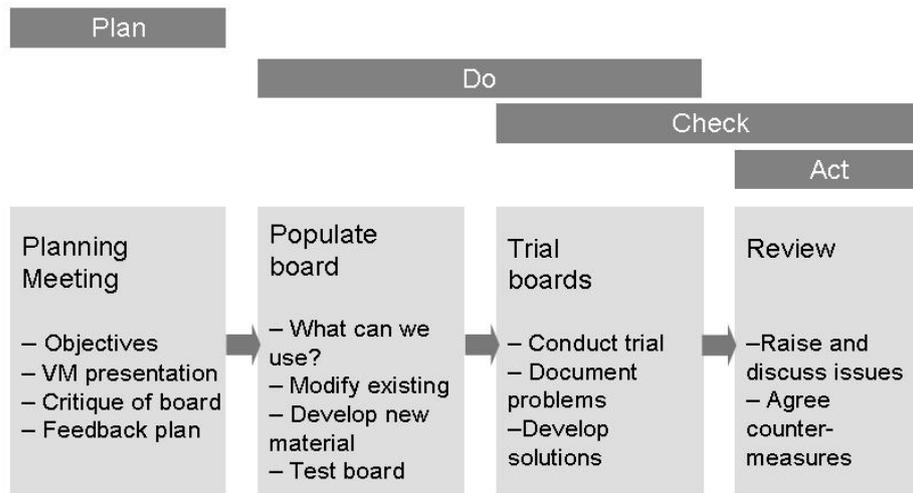


Figure 1: KPI board development process

The planning meeting took place over a day and the feedback element took place at a later date to a wider audience of interested parties such as other team leaders, their managers (known as area managers), Author 3, and support functions such as engineering and planning. The populate board stage is the main discussion forum for the VMD team and took place over three meetings lasting two days in total. The purpose of this stage is to develop a detailed board design that can then be rolled out throughout the factory. One of the final elements of this phase was to test how long it took to update the board with data.

The trial board stage takes the design and rolls it out in 23 cells. It requires considerably more resources than the previous stage, namely the support of the VMD team acting as advocates of the system, Author 2 providing the technical support and facilitation, participation of the other team leaders their teams and support functions such as engineering and materials. This stage took place over four months. The review stage is to some extent on-going in that part of putting into place communications boards requires a regular review of their content. But an initial review of the KPI development process was to identify problems with the process and put in place actions to solve them. This review was conducted by the authors of the paper but primarily by Authors 2 and 3.

In order to meet the second and third aims of the research, namely to improve the process of the communication board development and to test the principles of Visual Management, an additional process that provided observation of the current use of the boards and the KPI development process. This process, termed observation and reflection process, is shown in Figure 2 and is the principle data

gathering process for the research – it can be seen that this process wraps round the KPI development process from figure 1.

The first stage by Author 1 is to observe the team leaders (TL) conducting their team briefs and take photographs of the boards and the briefing process. The purpose of this stage is to understand how the TLs use their boards and interact with their teams and support functions such as engineering, quality and planning. Eleven briefings were observed.

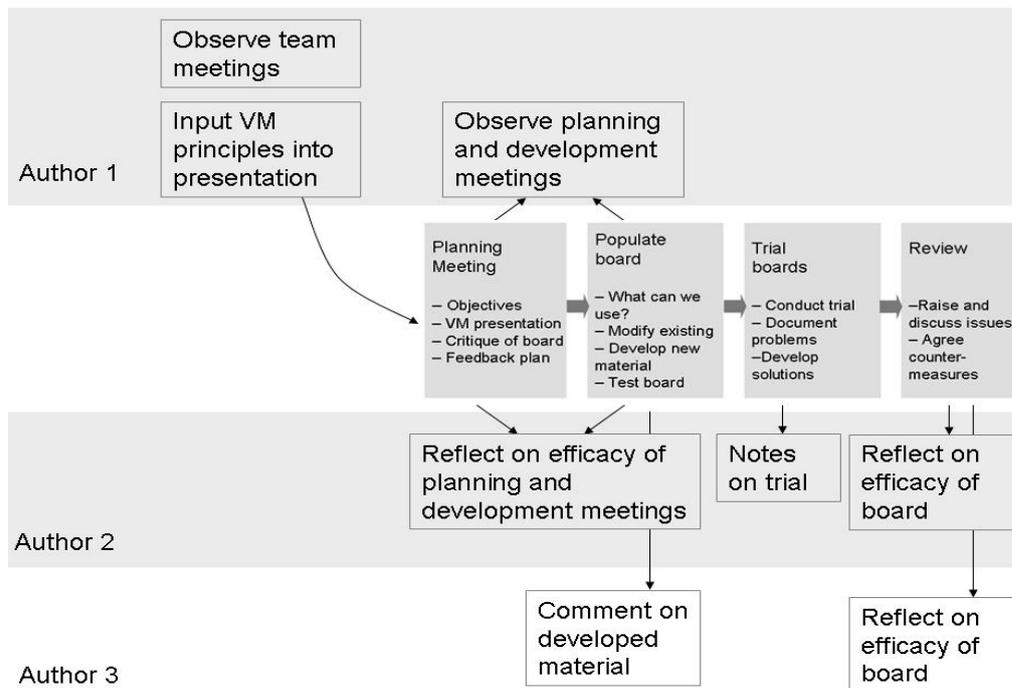


Figure 2: Observation and reflection process

The next stage of the process is to insert the Visual Management principles into the initial presentation that takes place in the planning meeting. These Visual Management Principles are shown below. The principles included were:

1. Using the right graphical tool to convey data – when bar charts are appropriate, when line charts etc. Difference between discrete and continuous data
2. Using colour sparingly – just to highlight key features
3. Avoid using excess borders and boxes – looking at minimum ink to data ratio
4. Use a board layout that reflects the flow and structure of the information you want to present

These principles were derived from a previous project (Bateman et al. 2007) and modified to suit this application. They draw on the texts previously cited, specifically Tufte (1986), Shah and Hoefner (2002) and Miller (1956). These principles were added to an existing presentation by Author 2 about Visual Management. During the planning meeting and populate board phase Author 1 was in the role of observer, writing down comments of the participants, documenting the process and taking photographs of the board designs. Author 2 was in the role of facilitator but was able to reflect on the process afterwards with

Author 1. Author 3 was not directly involved in the process although was present at a meeting that disseminated the outcomes of the planning meeting.

During the next, trial stage, Author 2 was facilitating and took notes on this process. The final stage was a review that reflected on the efficacy of the board and also how this process would be improved in future implementations. In addition to the process shown in Figure 2, Author 1 analysed the photographs from the initial team leaders meetings, the planning meeting and populate board meetings. This analysis focused on the progression of the board designs and the levels of data density. Data density calculations are based on the data points required to present a graphic for a unit of area. Originated by Edward Tufte (1986) who posits that high levels of data density are helpful in the analysis and comparison of information, as opposed to the commonly held view that data should be 'simplified'.

Results and observations

Team meeting observation

The purpose of the team meeting is for the team leader to plan the day, deal with any problems from the previous day's operations and manage any on-going issues such as material shortages, labour issues or quality problems. The observations were made in eleven cells by ten different team leaders, one team leader was temporarily managing an additional cell. The meetings took between three and eleven minutes with two distinct styles emerging. The first of these styles included everyone who worked in the cell. Here the leader would typically start with a statement such as 'We did well yesterday' and then start to deal with the matters arising such as "...does anyone have any shortage." Cell members would then join in with problems they had. The discussion would then develop into a more free-flowing one with suggested solutions and, typically, the support functions providing help and being assigned actions. Even within this style there was substantial variation between team leaders, some using the PAB board data and adding to it during the meeting, others TLs using A4 print-out instead. The level of interaction varied between cells with some TLs actively encouraging questions and problem solving whilst in other cells the team were more passive.

The second style of meeting was with the team leader briefing only the support functions of engineering, planning and quality, but without the cell members. These meetings tended to be quicker and more focused on the TL asking the support functions to undertake actions. This inevitably led to less problem solving and discussion.

Planning meeting in the KPI process

The purpose of the planning meeting was to outline a plan for the next stages in the processes of updating the KPI side of the board. This update was required because there was a lack of ownership of the board and the TLs did not use much of the data on the board. The initial stage of the meeting was to state the objectives of the KPI process.

Some of the objectives had previously been agreed by Author 3 – who commissioned the KPI process, however it was important to capture and include the objectives of the VMD team too. The objectives identified are shown below:

1. Develop a consistent approach for all cells
2. Make board measures and information easy to understand

3. Provide a clear link to overall company measures and targets
4. Make boards easy to update – help to ensure boards are always up to date
5. Make boards visually interesting – something that people want to look at
6. Ensure improvement issues are prioritised in a logical way
7. Build a robust link between data and actions
8. Simplify it and make it interesting
9. Make it easy to understand

Objectives 1-7 were set by Author 3 in collaboration with Author 2, whereas 8 and 9 were specified by the VMD team. It can be seen that objective 8 echoes objective 5 and objective 9, objective 2. Nevertheless by stating the VMD teams objectives in this way it highlights their priorities which are essentially: make it useful and easy to use.

The next stage was for Author 2 to present the Visual Management presentation including the VM principles outlined earlier in the paper. The main part of the day was spent critiquing the existing KPI board with a view to meeting the previously outlined objectives. Here the TLs were very clear and forthcoming about their own ideas particularly with reference to what did not work comments include; *“To my team this means nothing.”* and correct ways of recording *“..it’s not a live record.”* and *“Data is not recorded on the day its happens.”* With regard to how KPIs were calculated the team leaders were critical of the productivity measure which they assessed (correctly) as meaningless as it was based on incorrect and out of date standard times. Another interesting observation was the TL’s dislike of the Value Stream Maps (VSM). VSM had been produced for all the cells and were displayed near other process and layout information. The TLs did not understand the maps and did not see how they contributed to the objectives identified above, thus they were removed from the KPI board.

Having decided what was usable and not usable on the old board the VMD team went on to create the macro-design of the KPI board. By macro-design we mean identifying the type of measures and general layout of the board. This does not mean specifying the detail of each measure such as how it will be calculated and where the data will come from. To do this the team drew on the objectives identified above and referred heavily to the Visual Management principle *“Use a board layout that reflects the flow and structure of the information you want to present”*. This whole process was done using full size paper mock-ups blu-tacked to the wall. This macro-design process involved several iterations but ended up with a design the team were happy with and met the objectives for the process.

The final stage of the planning meeting was to present the plan to other interested parties, such as other TLs, staff from support functions, area managers and Author 3.

Populate Board

This phase took the macro-design from the planning meeting and populated it with detailed designs and finally tested the design with real data. This took place over three meetings, the first taking half a day, the second a whole day and the third another half a day. The VMD team were the main attendees with Author 2 facilitating and Author 1 observing.

The team took each A4 sheet (essentially one KPI) that had been specified at the planning meeting and considered how best to develop and display the data. Where a similar existing measure was available this was a starting point, but essentially for each measure the team asked: does it measure the right thing;

what is the best way to show this; and how do we format it? This inevitably meant the team were starting to consider areas covered by the VM principles. However the primary concern for the VMD team was the measures functionality and utility - “*What do we use this for?*” was a common question. The team seemed to have an instinctive feel for the appropriate graphical tool such as bar charts etc., thus the first VM principle was already inculcated in the team.

In the detailed design Author 2 in the role of facilitator drew the team’s attention to the other VM principles which were less readily adopted, in some cases examples demonstrating the benefits were required, but nevertheless were used by the VMD team. Other issues raised included the limitation of existing data collection processes – for example scrap data was collected at too high a level of aggregation so that it did not allow the TLs the level of detail to allow decision making at cell level, thus failing on the utility criteria.

An element of the detailed design that had not been specified by the VMD team was the need for a strategy representation on the KPI board. This had been a particular request of Author 3 who had commissioned the redesign. It’s purpose was to allow the TLs to see the strategy for the Portobello site and their cells’ role within achieving that strategy. A three by three matrix was proposed that focused on the three KPIs at three levels, site, product group and cell. The detail of how this should be presented was much debated but a final design was eventually agreed.

A primary concern for the TLs was the amount of time needed to fill in the board. The TLs were understandably anxious as they were representing the needs of all the team leaders in this process and they knew they would have to support and justify the final design to their colleagues. To address this anxiety and ensure the work load was not too heavy on the TLs the final stage of the populate board phase was to run a test and time how long it would take the TLs to fill in the proposed designs. The time trial was conducted with two TL s completing the board. One TL took twelve minutes and the other seventeen. This trial was pivotal in reassuring the TLs that filling in the board would not be too onerous.

Trial board phase

The trial board phase rolled-out the detailed and tested design from the populate board phase to 23 cells. Author 2 facilitated this process by providing support and reviews. These reviews took place over four months and took seven half-days. The additional support by Author 2 was quite extensive and took 11.5 days. The following observations were made by Authors 2 and 3.

The principal reason for updating the design of the KPI boards was achieved during the trial phase. TL ownership of the boards increased with the boards becoming a central focus point during the morning cell meetings. A key element of this was the design of the board to match the order in which the elements of the meetings take place. This was supported during the trial board phase by a support tool for the TL that standardised the meeting agenda using a numbered sequence that matched the graphs on the board. During the trial phase it was identified that the role initially taken by Author 2 of attending and supporting the morning meetings should be handed over, in the long term to the team leaders managers, namely the Area Manager. Both Authors 2 and 3 considered the handing over of this role from an external facilitator to a manager with the company an essential part of sustaining this way of working.

The method of roll-out applying one tool across a site is an unusual approach for Industry Forum. It is described in Hines et al. (2004) as a Platform approach as opposed to Industry Forum's more usual Pillar approach. This platform approach in this case has the benefit of quickly standardising the approach across the site and everyone using a consistent approach. The problem with this approach was the heavy drain on similar resources as the same time – because all the cells were implementing KPI boards which then identified actions that needed implementing, 23 cells were expecting action, all calling on people and support function to perform these actions.

The use of minimal ink – using lighter lines or none where possible – derived from the VM principles (number 3) was noted, on the KPI side and it was decided that approach aided understanding. On this basis revisions were made to the PAB side to reflect this graphic design approach.

The strategy representation on the KPI board was the most challenging element of the populate board phase. Nevertheless it was deemed unsatisfactory and was redesigned twice during the trial phase. The final design required 1018 data points plus commentary by the Area managers compared to the 189 data point and no commentary of the original design. It is hoped that this design will provide context and a rich picture for decision making for team leaders although there is an acknowledgement that the current design is likely to evolve further.

Generally the reaction to the KPI boards has been positive with increased assurance shown by TLs in their use. Customer visits have demonstrated this with TLs explaining the data confidently. One of Assa Abloy's European sister companies was sufficiently impressed with the design to ask for details with a view to implementation in their own plant.

Data density calculations

Photographs taken by Author 1 allowed the number of data points required to produce a graphic to be calculated. The purpose of doing this was two fold, primarily to assess if there is a suitable level of data density that TLs find acceptable and to see if the Tufte (1986) idea that higher levels of data density are more acceptable than lower levels. The layout of the KPI board before redesign required 11584 data points, whereas the board after redesign required 18786 data points - an increase of 62%. The boards are the same size so there is an pro rata increase in data density.

Readers might expect that this increase in data density was spread evenly throughout the charts in the KPI board. However this was not the case, all of the increase took place in two (of fifteen) charts on the board. These two charts were the strategy representation and the team time planner. The development of the strategy representation has been briefly mentioned, but the considerable increase in data density of the time planner was due to an increase in 'not working' options from three to five and this reflected a change in working legislation such as parental leave. In fact the time planner was the most data dense graphic on the board with 251,819 data points per m².

Discussion

This research took place in an organisation that is experienced in lean implementation with team leaders who have had communications boards for some time. Nevertheless Author 3 – the Operations Director felt that the process could be improved and hence commissioned the KPI board redesign. Initial

observations showed that TLs conducted their daily meetings in different ways, and some methods encouraged more open discussion that is likely to lead to problem solving and Continuous Improvement.

The actual redesign process highlighted that TLs had an appetite for improving the current KPI board and had a clear idea about what did not work. Generating what did work required discussion over two days and additional considerable support and facilitation skills from Author 2. In terms of the Visual Management principles explored in this research the TLs readily grasped and enthusiastically applied concepts of flow and structure on the board. The other principles relating to use of colour and borders were happily applied by the TLs but required more explanation in their use. However, the veracity of their utility was borne out, because their use was further applied to the PAB side of the board. The most challenging element of the board design was the strategy representation which took considerable effort in the populate board phase but was then redesigned during the trial board phase.

Implementation during the trial board phase placed a high demand on the resources both of Author 2 and also supports services internal to Assa Abloy. It is unlikely the implementation would be successful without this level of support. This is linked to the platform approach to implementation, however it does have the benefit of all team leaders going through the same processes at the same time – thus providing consistency and a peer network among team leaders.

The data density of the most dense graphic was high compared to other elements on the boards and high compared to other measured publications. The time planner was equivalent in data density terms to the most dense graphics published in sophisticated journals such as the Journal of the American Statistical Association (Tufte 1986).

The whole process of review and redesign of the KPI board has allowed the team leaders to take ownership of the board. It had also addressed minor issues associated with the design of the board to be corrected. Many of these the TLs would have identified with out the Visual Management guidelines.

Conclusions

In terms of the aims of the research, the consensus is that redesign of the KPI board did improve the utility of communications boards at Assa Abloy. The extent to which the Visual Management principles contributed to this is not possible to assess exactly, but the ready acceptance of ideas of flow and structure and the extension of the design principles to the PAB side would indicate that they had made some contribution.

The second aim *to improve the process of the communication board development at future workshops both at Assa Abloy and other organisations* is likely to be fulfilled in that Industry Forum will be taking these principles and incorporating them in their approach at other organisations. The final aim *to test the principles of Visual Management in a real environment and improve current thinking* has been achieved by this research. The Visual Management principles have been largely accepted and proved useful. However, in order to establish more specific and generalisable guidelines a series of trials should be run to test the principles that allows statistical significance of their utility to be established.

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