How Visual Management can help in improving Productivity in Manufacturing Operation

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Abstract:

This paper will review the benefits of using Visual Controls in production operation which will result in productivity in manufacturing operation. Visual Management concept all this year has evolved and has been effectively employed in different manufacturing and service organizations for a last so many years. This process was explained by manufacturing tools, notably 5S and Visual management. This paper will carry out detailed literature review on how to improve productivity by using visual management as tool. The necessity of a holistic approach in order to make more use of the Visual Management process in order to have a good productivity.

Keywords:
Productivity, Visual Management, Visual Control, 5S

1.Introduction:

From the dawn of civilization, people have been sending visual signals to one another; from smoke signals sent into the horizon from a primitive campfire to sophisticated communication signals regulated by advanced control systems, we humans have a long history of using visual means to communicate significant information to one another. In fact, visual communication is in play all around us, performing a critical role in today's fast-paced society. Even though visual communication systems are abundant elsewhere in our lives, however, the benefits of effective visual control systems are not yet commonly realized in manufacturing organizations around the world. In our everyday lives, we negotiate our way through each day, in part by following the signs, symbols, images, and colors intended to communicate key information as we commute, transact, and carry out our daily activities. Many visual signals are created to influence and, at times, to control thought processes, thereby influencing the resulting physical actions. In most cases, the visual signal is presented in a way that is intended to get one's immediate attention and to prompt some type of action. Oftentimes, visual controls are accompanied by a set of audible controls. Together, visual and audible controls can be key players in achieving desired human behavior, not only in our everyday lives but also in business.

2.Visual Controls in Manufacturing:

We will review the benefits of using visual controls in a production operation Controlling the flow of product is very similar to controlling the flow of vehicular traffic. The same combination of elements—demand (movement of product rather than automobiles), people, evolving technologies, and increasingly diverse human demographics—presents similar challenges in both environments. In manufacturing, the accidents or near misses come in the form of nonconforming product, late deliveries, and cost overruns. The need for timely information coupled with desired human behavior is as critical to the competitive survival of a manufacturing operation as it is to the safety of pedestrians at a crosswalk—perhaps even more so. As discussed already, visual controls in a manufacturing facility may be designed to support a company-wide safety initiative or to advertise a strategic business initiative to the workforce. However, an even more important justification for implementing a visual control system is the potential to achieve the proper flow of product, and the balanced consumption and movement of inventory and use of resources, throughout the operation.

The net results are as follows:

- Production employees waste less time waiting.
- More timely, correct decisions can be made on the production floor.
- Improvement of first-pass quality and reduction of rework.
- Lower work-in-process levels.
- Lower purchased inventory levels.

Companies that develop a visual control system to deliver timely, accurate, and appropriate information to the employees working in the process enjoy a heightened level of performance, fewer wasted actions, and improved profitability. This is no secret. When presented with simple (the simpler the better), accurate, and timely information, employees can make better and more timely decisions. The “control” part of visual control suggests that information is communicated in a timely manner to signal, aid, suggest, or influence human behaviour. This, in turn, improves productivity, quality, and delivery performance. A successful visual control system not only can complement other Lean initiatives but also can provide another competitive edge. The use of visual controls is no panacea; it is, nevertheless, a critical tool to leverage in an organization’s quest to operate at the highest level in this increasingly global economy. Visual controls do more than simply communicate nice-to-know information for an employee or a team. Creating a visual control system takes cross-functional planning and implementation to provide those few critical pieces of information and to present them at the right process step, at the right time, and to the right person or team in a visual and easily understood manner.

3.Importance of Visual Factory:

Many owners, senior executives, and midlevel managers claim that their company's products and the highly tuned (and sometimes extremely expensive) manufacturing equipment they operate are quite different from other operations; in fact, they claim that they are unique. The argument often follows that the concepts of *Lean, formal quality systems,* or *visual controls* might work for everyone else, but these ideas and methods simply do not apply in their factory. The uniqueness of their company is most often absolutely valid—which implies that they have a distinct competitive advantage.

3.1 **The Common Ground of production Environment**

However, no matter how unique a company's position, there is still common ground shared by all production environments regardless of the specific company or product. This common ground manifests in the form of *people, processes,* and *inventory.* Wherever people are employed, processes are used, and inventory is stored and moved, an opportunity to create positive change through visual communication and visual controls exists, regardless of the product, service, or process in use. In manufacturing operations, the successful combination of visual communication and visual controls is referred to as the visual factory. A properly designed visual control system helps keep waste—once known as "hidden costs"—off the production floor and underscores the importance of identifying and exploiting opportunities to remove waste. Not only do visual indicators help us become leaner; they also keep our focus on items that otherwise fall back into obscurity. For the analytical executive, who requires a quantitative return on investment prior to launching into any Lean initiative, including a visual
control system, please note: the benefits of implementing such a system are not based on fuzzy numbers. Creating a proper foundation for a visual control system relies heavily on the scientific method. Likewise, the results are "scientific": companies commonly report staggering cost, quality, and productivity improvements, with productivity improvements often reported in the double digits or higher.

3.2 Basics of Visual Factory: 5S

To create a foundation for your company's visual factory, it is a good idea to start with a clear and concise understanding of the merits of 5S. A successful 5S implementation becomes the bedrock for a viable visual management system. Although closely related to each other, 5S and a visual management system are, in fact, two separate entities; the existence of the latter depends on a satisfactory implementation of the former. To assume they are the same is to suggest that simple mathematics and algebra are one and the same.5S is focused on where items belong, on identifying a specific location for everything in the work area. A visual management system builds on 5S and is intimately tied to the production operation by directing the flow of work, summoning new parts

from inventory, initiating and stopping production, and aiding the identification, correction, and disposition of products with quality problems.

Table1. Terms and feature of 5S

Japanese Term	Equivalent "S" term (5S)	Equivalent "C" term (5C)	Features
Seiri	Sort	Clear	• Search useful and useless items. • Separate both items & Classify them. • Critical items should be kept for use nearby.
Seiton	Systematize or Set in order	Configure	• Arrange useful items properly. • Discard useless items. • Give color according to their use.
Seiso	Sweep or Shine	Clean and Check	• Clean and polish all working palces. • Remove trash or dirt properly.
Seiketsu	Standardize	Confirmity	• Maintain cleanliness. • Tested/Inspected randomly. • Convert into high standard.
Shitsuke	Self-Discipline	Custom and Practice	• Motivate employee towards work. • Generate self discipline

4.Visual Factory Layout:

This part explains how to make an overall assessment of plant layout and turn it into a more productive visual factory. We also cover factors to consider for your new process layouts, including the importance of identifying work areas or work zones. These zones, explained in more detail, are used to visually show where the definable departments and processes are located. In all cases, each zone is located and laid out to promote the flow of work, including both production and support activities. Let there be no question: the highest priority of any factory layout must be production processes—that is, the processes and people who make and add value to products. Everyone and everything else, no matter how critical in terms of providing key information or materials to manufacturing, is still a secondary priority when laying out a factory. Do you want support staff members placed near the production groups they support? The answer is most likely yes, with a caveat. We do want to encourage positive and productive human-to-human interaction and communication. What is needed most, however, is optimizing the flow of production processes while getting timely, accurate, and complete information into the hands of all those who need it, as they need it. When prioritizing placement within a new facility layout, production support functions, which exist primarily to serve manufacturing processes, are secondary to production processes.

4.1 Visualizing your visual Factory

Picture how your production processes would look if they were designed with no wasted human motion, no wasted product movement, just enough incoming material to support what the process consumes, and a 100% first-pass quality rate. Perhaps the manufacturing area is marked as the “green” area within the facility. You can see signage and colors identifying the area and showing visitors and new employees the status of production activities. You might notice that the amount of incoming material balances with the rate of the production process. Kanban bins and cards, located at the point of use, communicate both what quantities of material should be there and when more parts are needed. Each part in the bin is oriented correctly for consumption to minimize wasted motion. Visual signals indicate to material handling when it is time to retrieve more parts and material—whether purchased or value-added items—and the exact location at which each item can be picked up. Products with different configurations are being assembled and are flowing freely from one value-added operation to the next, with no more travel distance than necessary, and the “all-systems-go” operational status is indicated by a green and on indicator light. All finished goods are moving into the packaging area and are wrapped, labelled, and loaded for shipment without stopping. We can see by the posted workmanship certification sheets that all production workers have been trained. Employees are focused and engaged in their value-adding activities, ensuring product compliance to specifications yet wasting no motion as they complete their work and usher it on to the next process step. Pareto charts show the past day’s and week’s quality reports and what actions were taken to prevent a recurrence of the one nonconformity that occurred. Easy-to-follow, up-to-date work instructions are on each computer screen (and they are actually controlled documents in the company’s formal document control system). In fact, work instructions are

provided in more than one language to suit the needs of the workers for whom English is a second language. Now that you have visualized this ideal end state, create a sketch of what your new waste-free process might look like. Chances are you will see a very different and far more productive work area, with workers wasting little time and motion and totally engaged in their work, no build-up of work-in-process queues, some opened-up floor space, and a smile on the supervisor's face. In fact, as you include the resident experts (i.e., the production workers) in conceptualizing the new layout, you might find a bucketful of good ideas to make product flow even better.

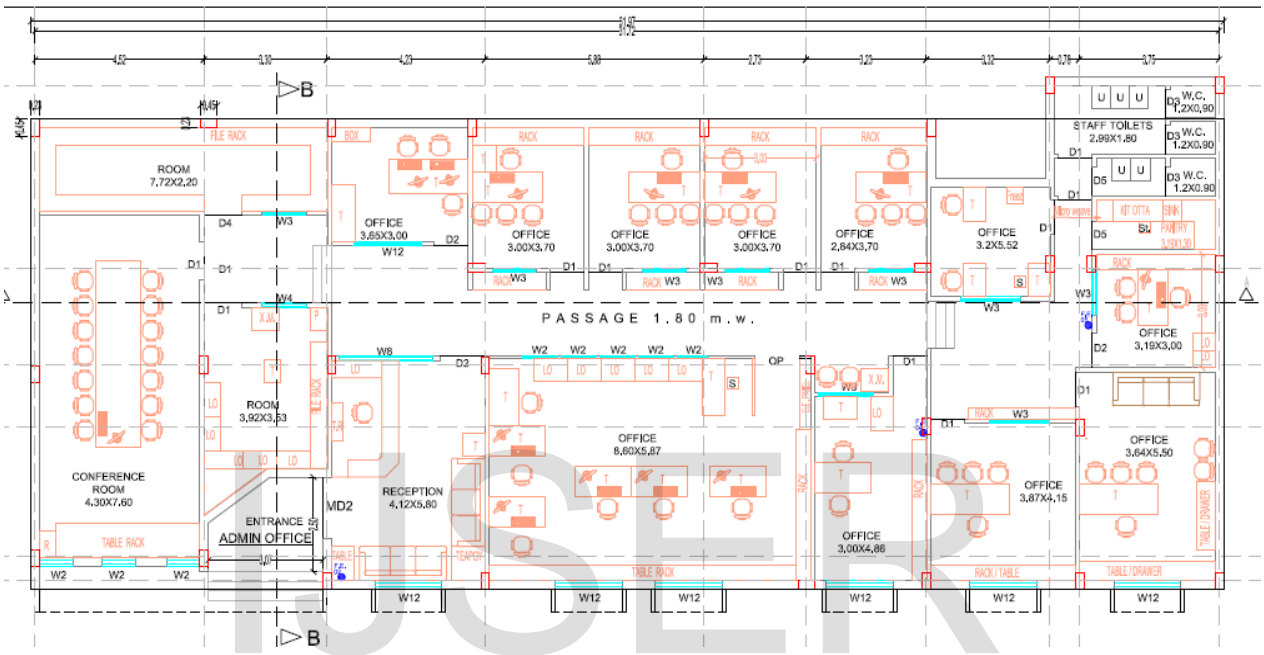

FIG.1 Visual Layout

4.2 Visual Inventory:

Now, let's move on and cover the considerations for handling inventory in a visual factory.

i.Feed Materials and Consumables

On the production floor, a two-bin system for handling the replenishment of feed parts works well in many areas. Using colored kanban cards can enhance the replenishment cycle. Each of the two bins provides a temporary storage location for identical parts near the point of consumption. The number of parts in each bin is calculated based on consumption volume. Parts are pulled from one bin at a time. When the first bin becomes empty, it is a visible trigger to order another bin's worth of parts from inventory.

Nothing can shut down cash flow faster than a problem with material, whether the specific problem is a late delivery, short shipment of parts, defective parts, a recent engineering change, or simply receiving the wrong part. If there is a problem with a supplied product, it is important not to jump immediately to blaming the materials manager but to investigate root causes. It is

absolutely critical to know that all the material entering your facility is, in fact, the correct material for consumption. That means that every bit of it is in complete compliance with the engineering specification it was purchased against. To that end, vendor performance should be communicated visually.

Visually reporting the performance of a vendor or supplier will accomplish three things:

1. It will show the supplier's salesperson that you are communicating to the world the salesperson's company's ability to hit pricing, delivery, and quality expectations.
2. It will show the supplier's competitors when they may have an opportunity to do more business with your company.
3. It will communicate to the supplier how you classify it and which strategy (and how much effort) it must employ to work successfully with your company.

ii. Purchased Inventory

In the stockroom, no part, subassembly, or raw material should ever be entered into inventory until it is known to be a compliant part to specification and is identified as such. Visually indicate stock levels and reorder points in the purchased part inventory locations.

FIG.2 Visual Inventory Stores

iii. Finished Goods

The finished goods location, if your company has one, can be in proximity to the manufacturing area but should be segregated from the production processes. The finished goods area should be designed to accommodate the company's strategic inventory levels for various product configurations and identified as such. Visual controls can indicate where and how many finished goods are to be stored.

Another factor to consider for all inventory layouts is to provide for a first-in, first-out (FIFO) flow of material. Maintaining only required levels of inventory at each inventory stage and identifying and shedding unnecessary inventory will make it easier to achieve a working FIFO inventory system.

FIG-3: FIFO Inventory method

5.Visual Communication:

This Paper is all about visual communication. Implementation of 5S is ultimately about creating a workplace that communicates the status of all activities visually and have a good productivity. Color-coded work areas quickly communicate when the wrong item is out of place. Designated addresses on tools visually communicate the location to which tools should be returned. Kanban cards visually communicate ordering procedures and home locations of bins, parts, supplies, and material. Visual control in all its glory is about communication. This is dedicated to describing the importance of visual communication of the performance, goals, and objectives necessary to support a visual factory. It covers the following items:

- Facility performance
- Metrics communication boards at the production level
- Production control boards
- Communication lights

5.1 Facility performance

Factory needs to decide what information it makes sense to communicate. Some executives keep performance information out of sight of employees, because they are reluctant to communicate bad information like reduced orders, poor deliveries, or poor sales. To be honest, this is exactly what should be communicated. Obviously, we prefer information to be positive, but showing performance trends is healthy. Here are the company metrics that should be communicated visually on a company communication board in places like break rooms:

- Sales
- On-time delivery (OTD)
- Productivity
- Quality
- Safety
- Environment

Productivity

The metric to communicate is plant-wide productivity. This metric reflects the productivity of every individual work area, workcell, or assembly line in a cumulative score of overall plant efficiency. Like any metric, the selection of the measurable is important. Productivity can be measured in a variety of ways, such as labor dollars per unit, the distance product travels per person, pound per machine, or bags per person. Productivity is improving when products are manufactured with less effort, fewer workers or hours, less equipment, and less use of utilities (overhead). If you are using labor amount per unit, you are essentially measuring your ability to overproduce. Are those units you are making and measuring at labor amount per unit headed straight to the finished goods shelf where they will sit until an order comes in? A better productivity measurement is sales per head count or labor per unit sold. Regardless, like all the

items on your facility performance board, you should show the current rate of productivity and recent trends.

5.2 Metrics communication boards at the production level:

It is important to take the concept of the facility performance communication board down to the production and departmental level. Communication boards that visually depict the performance of individual work areas should be constructed and placed in each work area. Although it is important to know and improve on plant-wide OTD (On Time Delivery) , for example, the plant-wide OTD metric does not necessarily help an individual work area improve its own OTD. Metrics at the work area or cell level must be relevant to that area. What is the area's productivity and quality? What is the goal for output and delivery to the next process? For example, if a product is partially manufactured in cell 1 and then has to travel and be processed in three more areas, the plant-wide OTD metric does not help cell 1 assess its own OTD percentage. Instead, use the work-in-process date (WIP) date for a given work area. When is it due to the next consuming process? That is the immediate internal customer. When developing area or departmental metrics boards, try to keep them as standard as possible so that each one conveys the same set of metrics. We recommend the following information:

FIG-7: Work cell Communication Board

The above metrics communication boards are used to constantly monitor performance about the productivity and to provide information that drives future improvements. While it may be hard for individual employees to take ownership of plantwide rework hours, they can more easily take ownership of the rework hours in their own work areas.

5.3 Production control boards

Production control boards can be one of the most valuable management tools for increasing output. Of course, to be effective, the information on the board must be accurate—but, when it is, the results are absolutely awesome. A production control board monitors production progress with real-time information, allowing everyone to see whether the process is producing the required amount of work. To illustrate, let's think about an assembly operation, where the line is required to produce 10 widgets per hour and the associated takt time has been set to accommodate that. Figure 8 below illustrates this idea.

Time	Required	Actual	Difference	Current	Comments
9:00	10	10	0	10	N/A
10:00	10	8	–2	18	Tool Broke
11:00	10	11	+1	29	N/A
12:00	10	10	0	39	

FIG-8 : Production Control Board

As you can see, assembly progress is monitored hourly, and current information is displayed. If the required output is not being met, you can see this on an hourly basis not just at the end of the day, when it is too late to do anything about it. Assembly plants have also used takt time to monitor progress by counting how often a widget would have to come off the line—whatever makes sense for each company and process. Each production control board must be designed for the needs of each process a single template applicable to any and all processes does not exist. A simple dry-erase board will do nicely for most purposes.

A production control board is a marvelous visual control tool that technicians can use to flex workers in and out of work areas, maintaining flow and takt time, as discussed in the previous section. As technicians complete their work in an area, they simply update the board and begin working on the production.

5.4 Communication Lights:

Communication lights are a critical aspect of visual control. They are quite common even in a facility not practicing all the elements of visual control. These lights are the visual communication system between operators and the rest of the plant. A variety of different styles is available, as shown in Figure 9. Choose the type that makes sense for your plant. The most

common type of light used in visual control applications consists of three different colored lights—red, yellow, and green—each conveying a specific meaning.

FIG-9 Communication Lights

Defining what each color means is up to you, but the most common uses are described as follows. Red signals to everyone that a major problem has occurred. Possible reasons to turn on the red light:

- Machine down
- Out of parts
- Tool broke
- High quantity of defective parts

Ideally, the red light should never come on if all the visual control pieces described in this book are in place to give you early warnings that a deviation from the standard is coming. However, it does happen. When the red light goes on, it should be considered a major issue and reacted to immediately.

Yellow communicates that a potential problem is coming but that the process appears to be in control at the moment. Perhaps a machine is acting oddly or making funny sounds that mean a breakdown is coming. Perhaps, even though the kanban card or empty bin from the two-bin system was submitted, material and parts are getting down to uncomfortably low levels. The yellow light can also be turned on if the production control board shows that the process is slowly getting behind schedule. The yellow light is a proactive light to be used ahead of time and hopefully to avoid a major issue that would require red-light initiation.

Green means all is well. No problems need to be reported. Output, quality, material, machines, people, and tools are all working properly, and everything is on track for optimal performance. The visibility achieved from a properly operated communication light system is profound. Managers, operators, and support staff can look across the factory at any moment and see whether the plant is in control. The amount of time and effort wasted in a factory just getting a

hold on the status of operations boggles the mind. Production control boards and communication lights convey that information instantly, as do all visual control tools.

6. Conclusion:

In this paper, we have seen plethora of visual control concepts and examples and ways to make them work. we have recognized the vast use of visual communication in normal daily activities, and we suspect you will now begin to view road signs, crosswalks, stoplights, emergency signs, and other visual indicators (signs, symbols, floor markings, and placards) a bit differently. We will begin to look at the use of visual controls within manufacturing facilities differently, too in a simpler and more systematic way.

The expected bottom-line impact of Visual Management on productivity is easy to understand:

- Lower costs to produce the product.
- Higher first-pass quality rates
- Less need to carry inventory
- The ability to reduce the time it takes to fill a customer's order

A well-conceived visual management system can prove invaluable in helping achieve these objectives. Yet a visual management system is still only a tool; it will work well only when it is properly designed to fit your particular manufacturing operation. And, to be of any value, the system must be used and maintained as intended. We understand that many companies simply lack a culture that has matured enough to sustain such an endeavor. These are the companies whose metaphorical crosswalks still lack any visible means of control. System success is only as great as the level at which management team embraces the concepts and company culture sustains it. If company leaders create a culture that encourages employee involvement and also fosters a mind-set of continuous improvement, will have a good chance of success.

When applied correctly, visual management do help in good productivity, reduce waste, improve communication, and simplify work throughout the factory.

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