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Changing Organisational Behaviours in Lean Transformation

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Abstract

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Summary

One of the major challenges organisations facing employing lean manufacturing practices is defining the behavioural landscape necessary to sustain lean-based operations, and devising appropriate change management mechanisms to reach this state. This study examines the efficacy of adopting a two-phase transformational strategy in driving systematic behavioural changes. It was found that the implementation of a pilot lean roll out provided the opportunity to observe and document the behaviours of the stakeholders involved in the change process and assess those that are enablers or barriers to change. This information can be leveraged to enhance the likelihood of success as a business wide roll out of lean techniques is endeavoured. This provides a framework for the implementation of lean manufacturing principles in non unionised, medium size manufacturing facility undergoing first pass lean transformation. Further studies can be conducted in unionised sites to further elucidate what behavioural management techniques are effective in driving the cultural change involved in conducting lean transformations.

Dedications and Acknowledgements

Many have provided help and support with all the work necessary to complete my Knowledge Transfer Partnership (KTP) project from which this paper is derived. I would like to thank all those who have provided guidance and tutoring from The Lean Enterprise Research Centre, Pauline Found my academic supervisor, Simon Elias, John Darlington and John Bicheno. I'll also like to extend gratitude to everyone at my company base DePuy CWM Blackpool for their kind support and always making me feel part of the family, most especially my company base supervisor Steve Ramsay, and the site general manager Debbie Steane. I would also like to thank my KTP advisers John Burrows and Andrew Kenney for always steering me on throughout the project, and last but not least, all my family and friends, most especially my wonderful and loving Fiancé Julie Mitchell.

Introduction

1.1 Lean Manufacturing

Lean manufacturing, lean production or simply “lean” is a term first coined by John Krafcik and popularised by Womack and Jones to describe the production system developed by the Toyota company in the post World War II years (Womack, Jones, & Roos, 1990). The term “lean” comes from the ability to achieve more with less resource, by the continuous elimination of waste (*Muda*). Lean was defined as having five principles (Womack & Jones, 1991):

- Specify Value
- Identify the value stream
- Flow
- Pull
- Perfection

The pursuit of customer value which is synonymous with a market orientation was further cemented by the Lean Enterprise Institute (LEI), founded by Womack in 1997, by defining the core idea of Lean as being:

“to maximise value whilst minimising waste. A Lean organisation understands customer value and focuses their key processes to continually meet those needs.”

It's described by some as a management philosophy derived from the Toyota Production System (TPS), and focuses on the reduction of the *seven wastes* of Transportation, Inventory, Motion, Waiting, Over-production, Over-processing and Defects (TIMWOOD) to improve overall customer value, but there are various proposed techniques on how best this can be achieved. The focus and attention garnered by Toyota and TPS can be attributed to Toyotas' steady growth from a small company to the world's largest automotive manufacturer.

There is some widespread misconception on that the sole aim of Lean is the elimination of waste, another variant of Lean Manufacturing focuses on improving "flow" or smoothness of work, thereby steadily eliminating unevenness (*Mura*) through the production process which at sharp peaks cause overburden (*Muri*) on the manufacturing process The attention to the creation of smooth flow exposes productivity,

quality and lead time issues present in the processes, and thus waste reduction naturally happens as a consequence. The advantage claimed for this approach is that it naturally takes a system-wide perspective, whereas a waste focus sometimes wrongly assumes this perspective.

There are obviously differing perspectives as to the goals of Lean manufacturing. While some focus on increasing profit as signified by the equation ($\text{Price} - \text{Cost} = \text{Profit}$) others take more of a market orientation view on that it's about understanding what the customer values and improving flow through value creating processes by eliminating waste. Common themes which resonate about the goals or benefits of a lean manufacturing system are improved quality, reduced time and effort to complete manufacturing operations, or develop new products from concept to launch at reduced total costs.

1.2 The Organisation - DePuy CMW

DePuy CMW is a **Medical Devices & diagnostics** (MD&D) manufacturing facility based in the northwest of England. It is a non unionised facility with approximately 90 staff on site. The company generates revenue by selling bone cements, bone substitutes, cement mixing systems, re-absorbable implants and associated surgical instruments for use in Hip, Knee, Spinal and Cranial surgery through its worldwide distribution network. It is one of the companies of Johnson & Johnson (J&J). J&J generated \$61.6 billion in annual sales in 2010, of which the MD&D sector contributed around 39.9% with sales of \$24.6, making the MD&D segment the largest of J&J and the world's largest medical technology business at the time.

DePuy CMW is estimated to hold an 18% market share of combined Bone Cements & Accessories market in US, Europe, Brazil, India, China, South Africa and Japan, worth an estimated \$600 million and predicted by leading market researchers to be growing annually by 6%. Its main competitors are Stryker, Biomet and Zimmer. The growing need for joint repair/replacement surgical operations, in addition to the decline in hip resurfacing implant adoption, will fuel demand for bone cement products. This is attributed to the rapidly growing number of individuals over the age of 65 globally, thus presenting a possible upward trend in the number of joint replacement procedure volumes because conditions such as osteoarthritis develop with age and will require treatment with cemented implants. However the continued adoption of cementless implants in favour of cemented implants which wear down more quickly than the former may restrict growth in the bone cement and accessory market.

However the current economic climate, political austerity measures and cost-containment efforts in medical facilities will impose downward pressure on the average selling prices (ASPs) of medical devices; however the rising penetration of premium-priced devices, such as antibiotic bone cement, cement gun cartridges, and vacuum mixing systems, will promote increases in aggregate device ASPs and thereby facilitate revenue increases.

In order to hold a competitive position in its chosen market in the face of downward pricing pressures and social-economic constraints, the company must endeavour in minimising the cost of manufacturing existing product portfolio to generate funds to support new product development (NPD) activities, but also streamline the NPD process to reduce associated costs and time span from concept to final launch.

1.3 The Knowledge Transfer Partnership with the Lean Enterprise Research Centre

The Knowledge Transfer Partnerships (KTP) programme was launched in 2003, replacing the Teaching Company Scheme (TCS), which had been formed in 1975. It is a part government-funded programme to encourage collaboration between businesses and universities in the United Kingdom. The programme is funded by several public sector organisations, and led by the Technology Strategy Board. Each KTP involves:

- a company which may be a private enterprise, public body or voluntary agency
- a knowledge base such a university in this case the Lean Enterprise Research Centre (LERC)
- an associate whom is a recently qualified graduate

Each KTP programme aims to:

1. Facilitate the transfer of knowledge through projects undertaken by high calibre, recently qualified people under joint supervision from a company and an academic institution
2. Provide company-based training for recently qualified people to enhance their business and specialist skills
3. Stimulate and enhance business-relevant training and research undertaken by the academic institutions

4. Increase the interaction between businesses and academic institutions, and awareness of the contribution academia can make to business development and growth

The KTP partnership which bore fruit to this paper was devised to facilitate the development of a truly sustainable lean culture in the company base DePuy CMW. The knowledge base (LERC) is one of Cardiff Business School's major research centres. Originally founded in 1994 by Daniel T Jones as a base from which to explore the ideas centred around the newly coined term 'lean thinking', it is now one of the largest centres of its kind in the world with a mission to research, apply and communicate lean thinking.

The centre currently runs with around 20 staff and associates with a track record of innovative Research, Executive Education and Engagement activities. In congruence with its mission, the KTP project presents a challenge in that it will involve the employment of lean methodologies in a highly regulated manufacturing facility where the application of traditional lean techniques is less advanced. This presents a learning opportunity for the research centre which links back to the third aim of any KTP programme.

1.4 Summary

In summary, DePuy CMW as a MD&D manufacturing facility in the face of downward pricing pressures and social-economic constraints, must endeavour in minimising the cost of manufacturing and streamline its NPD process to position itself advantageously in a competitive bone cements and accessories market. The company sorts to accomplish this strategically by developing of a truly sustainable lean culture with the aim of reaping the associated benefits of improved quality, reduced time and effort to complete manufacturing operations, launch new products from concept to final article at reduced total costs. The knowledge gap in the employment of lean techniques in the highly regulated manufacturing environment of DePuy as seen from the perspective of LERC presented a compelling case for the inception of a KTP programme to resolve these two strategic imperatives.

The primary change management challenge here with regards to implementing lean was answering the question “what are the behavioural characteristics necessary to drive and sustain cultural change in a highly regulated manufacturing environment as that found within the company base DePuy CMW?”

2. DePuy CMW Lean Transformation Plan

The initial project plan outlined was fundamentally based on the gap analysis and mitigation approach where the steps of Product & Process familiarisation, Investigation & Measurement, Data and Skills Gap analysis were aimed to establish the current state of affairs and postulate a future state thus realising the gap currently in existence. Then an improvement plan is to be proposed, outlining the steps to be taken to bridge the gaps identified thus fulfilling a planned future state.

From the onset, it was perceived that adhering to the original project plan as set out in **Error! Reference source not found.**, may result in a dampened pace of change and thus the plan was revised to that shown in **Error! Reference source not found.** This meant that the challenges of introducing, implementing and sustaining lean techniques within the organisation can be brought to light by piloting the transformation in an environment easy for everyone in the organisation to observe, but also constituted a sample of the population with which the behavioural barriers to change within the organisation can be better understood. It also provided the opportunity to deliver quick wins from which a sound business case can be derived for the full site roll out of lean techniques.

3. Pilot Study

The pilot implementation of lean techniques within DePuy CMW was conducted in the final assembly area of the manufacturing facility. The products assembled within the area fall into two distinct categories or product families, namely Standard Cement Packs and the Pre-Filled Cements & Accessories. The distinction can be derived through product family matrix analysis as described by (K. Duggan) in his book *Creating Mixed Model Value Streams*. As approximately 93% of the manufacturing volume and cost was associated with the Standard Cement Packs product family, the assembly process for this product family was selected for piloting the application of lean techniques in process re-engineering in order to improve quality, productivity and manufacturing cost.

Figure 1: Pilot Area Value Stream Map is the value stream map of the pilot area pre-lean process re-engineering. Gamma or ethylene oxide (EO) sterilised powder packs were processed in a preparatory stage that provides moisture protection to the sterilised powder packs. This is a batch process and involves the

transport of inventory (muda) of the sterilised powder packs to and from the final assembly area to in house storage facility, prior to being assembled into the finished product package again in the final assembly area.

The manufacturing operators in the area were led by a single team leader who in turn was supported by a manufacturing group leader, and all reported to the site manufacturing manager. Standard procedures for the existing process were in place and associated training records. The use of daily output recording was already adopted however the data collected wasn't being charted nor analysed as a means of promoting continuous improvement.

The scope of the transformation within the pilot area was to establish flow by adopting a lean DMAIC (Define, Measure, Analyze, Improve, Control) methodology to reduce the in process lead time, increase productivity and reduce process WIP (Work-In-Progress) levels. Secondly it was an opportunity to assess and understand the critical success factors to sustaining the benefits of the lean techniques employed in terms of the required behaviours of all the process stakeholders, from the manufacturing operators, to the team leaders, the support quality and engineering staff and the site senior leadership team. This was conducted in two phases. The first phase sort to balance the two disparate processes of preparation and final packing to customer pace of demand (Takt), and the second phase amalgamated them into a single process.

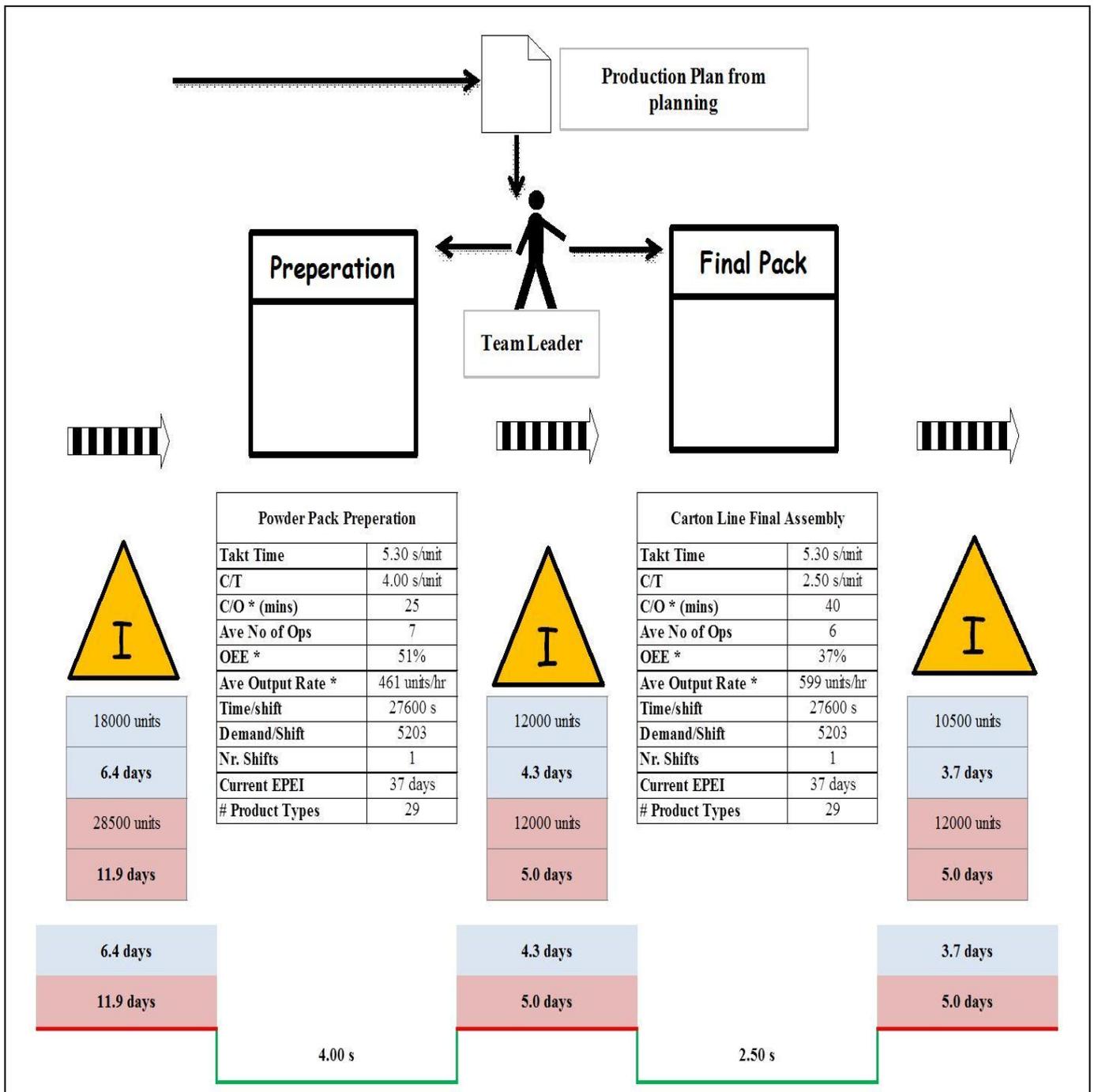


Figure 1: Pilot Area Value Stream Map Pre-Lean Implementation

5. Pilot Study Results & Analysis

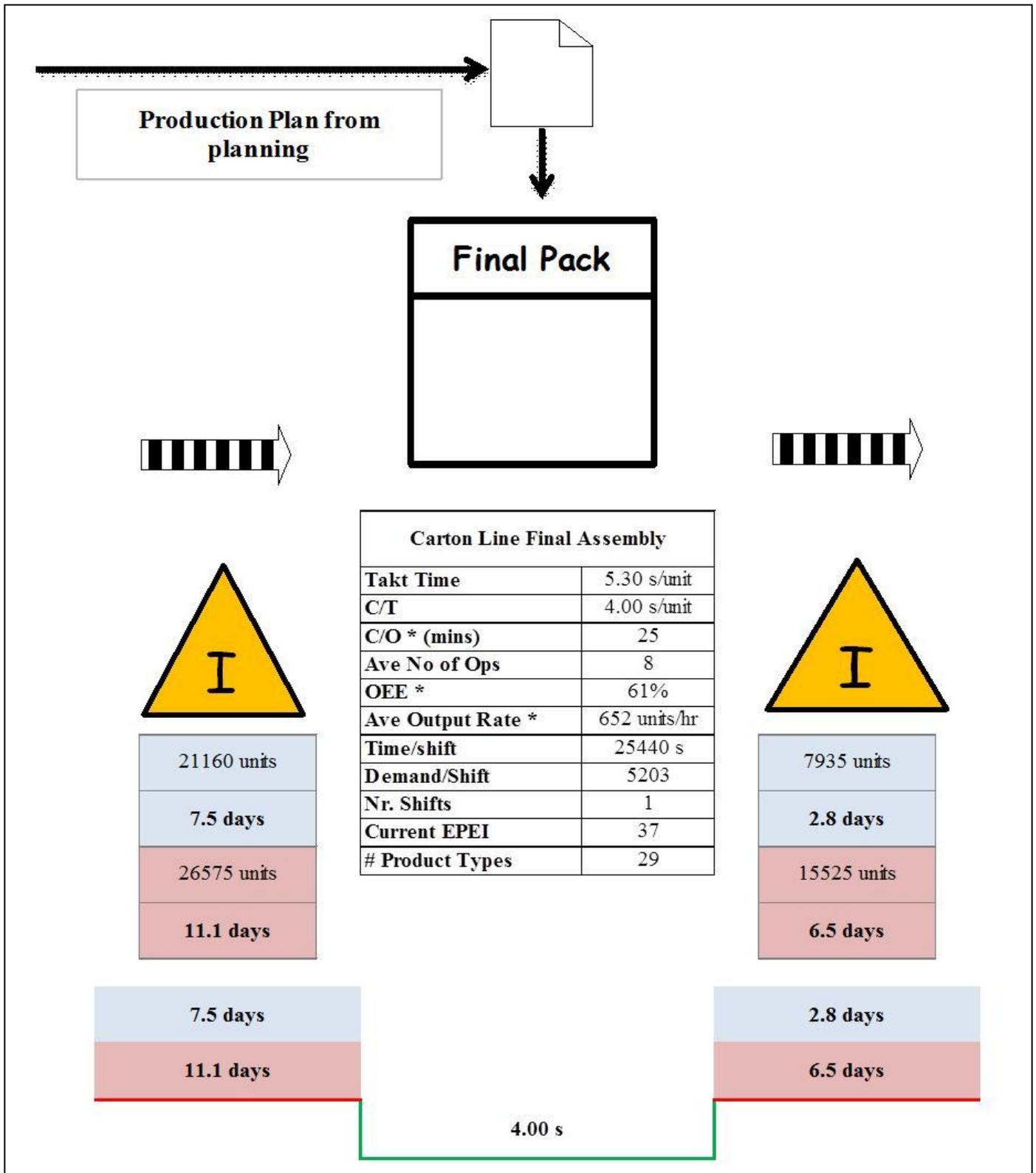


Figure 2: Pilot Area Value Stream Map Post-Lean Implementation

Pilot Area Lean Implementation Metrics			
Metric	Pre-Lean Performance	Post-Lean Performance	% difference
Gamma WIP	14.4 days	10.3 days	-28.5%
EO WIP	21.9 days	17.6 days	-19.6%
Gamma Lead Time	14.4 days	10.3 days	-28.5%
EO Lead Time	21.9 days	17.6 days	-19.6%
C/O Time	40 minutes	25 minutes	-37.5%
Output Rate	599 parts/hr	652 parts/hr	8.8%
Average Number of Operators	13	8	-38.5%
Productivity	46.1 Parts/op/hr	81.5 Parts/op/hr	76.9%

Table 1: Pilot Area Lean Implementation Metrics

Table 1 outlines some of the hard metrics used to assess the benefits of implementing of lean techniques within DePuy CMW final assembly area. The WIP inventory and lead time through the manufacturing area was reduced by an average of 24% between gamma and EO sterilised powder packs. This was due to the amalgamation of the initially two disparate steps of powder preparation and final assembly primarily by employing production cell line balancing and design techniques (equalising the process cycle times (C/T) and bringing them closer to Takt Time), 5S and work standardisation. Visual management tools such as day by the hour recording of output, production cell metrics, and rapid response processes were also implemented to align the rest of the support functions and management in the facility to the needs of the newly re-engineered process.

Using SMED techniques, the Changeover (C/O) time in the final assembly line was reduced by 37.5% thus providing further capacity to the process and improving the Overall Equipment Effectiveness (OEE). The increased capacity and output, requiring fewer numbers of operators meant the productivity in the area was increased by 76.9%. What did this mean from a cost standpoint in the pilot area? Neglecting any savings on labour cost due to less headcount requirement, one noticeable improvement was in terms of the overtime and Absence man hours in the area.

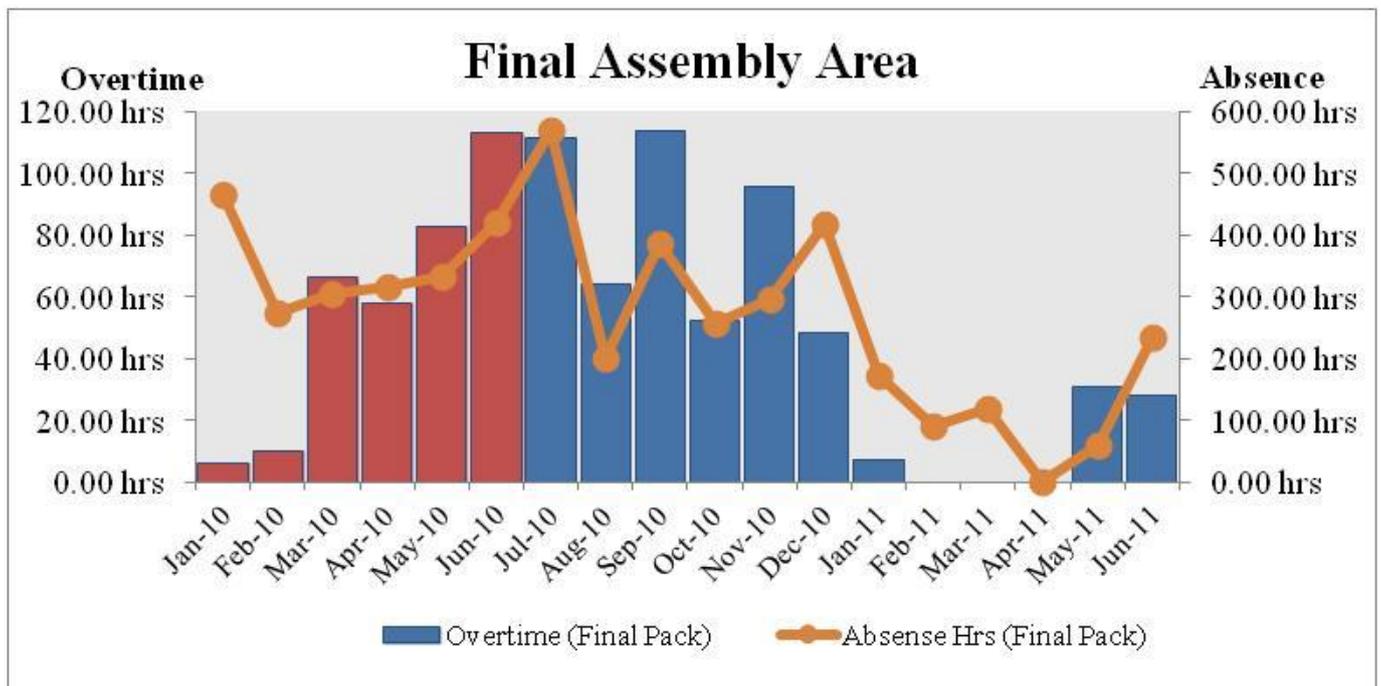


Figure 3: Pilot Area Overtime and Absence Man Hours Monthly Profile

The red bars in Figure 3 indicate the pre-lean implementation periods in the pilot area. The bar chart indicates a steady decline in both overtime and absence in the area post-lean implementation which of course presents some evidence to validate labour cost savings in the area. So with all these benefits, what could have been difficult about the transition from a people perspective and what can be learned about the impact of certain behaviours prior, during and post lean implementation?

A good place to begin is the change management equation

Equation 1 Effectiveness of Change = Quality of Change × Acceptance of Change by Stakeholders

So in simple terms, Equation 1 postulates that if all stakeholders 100% accept the changes made, then the effectiveness of the change will be equal to the quality of the change implemented. The effectiveness can be readily measured provided SMART (Specific, Measurable, Agreed, Realistic, Time bound) objectives are set out as deliverables for the change to be implemented. For example, the objectives for the pilot process DMAIC transformation were to:

- Reduce the process WIP by 30%

- Reduce the process Lead Time by 30%
- Increase productivity by 70%

All the aforementioned were to be achieved by End of June 2011. The **specified** parameters of lead time, WIP levels, and productivity are measurable and the set date of completion time bounds the objectives. The objectives are agreed between the transformation project manager and the project sponsors (such as the site plant manager) during which time the realism of the objectives can be debated. So in this case one way of determining the effectiveness of the change is given below:

Pilot Area Lean Implementation Effectiveness				
Metric	% difference (A)	Target (B)	On Time (OT) % (C)	Effectiveness (A/B) x C
Gamma WIP	-28.50%	-30.00%	100.00%	95.00%
EO WIP	-19.60%	-30.00%	100.00%	65.33%
Gamma Lead Time	-28.50%	-30.00%	100.00%	95.00%
EO Lead Time	-19.60%	-30.00%	100.00%	65.33%
Productivity	76.90%	70.00%	100.00%	109.86%
Average Effectiveness				86.10%

Of course the unanswered question is the efficiency of the change process itself in terms of the amount of resources vested in the project compared to the returns gained. There a varying ways of assessing this question, most certainly from a financial perspective however the subject is beyond the scope of this discussion. The OT % is simply the planned duration of the transformation divided by the actual.

Now remains the subject of change acceptance by stakeholders. Stakeholders are those who are involved or affected by the change implemented and therefore have an influence on the success of the outcome.

Stakeholders influence on the outcome of the change process is a direct result of the behaviours they exhibit. If a stakeholder supports a proposed change, then they are less likely to become barriers to the change being implemented. What tends to be unclear from the outset is what behaviours must these stakeholders exhibit in order to make the change a success and thus sustain the benefits resulting from the change?

What the pilot transformation provided was a means to capture the behaviours of all the stakeholders with respect to the lean transformation implemented and classifying these as an enablers or barriers to the success and longevity of the change implemented. This of course can be leveraged to enhance the likelihood of succeeding with a site wide roll out of lean. This starts by first identifying all the stakeholders and assigning

each a profile such as position or title within the company and level of influence in the organisation and level of interest or involvement in the change being implemented. Of course the thought process of designating involvement and influence level to a given profile is not immune to subjectivity. This can be best illustrated using a stakeholder analysis matrix as that shown in Figure 4 and

Figure 5.

Those in the red quadrant are to be managed closely, those in the amber quadrants are to be kept satisfied and informed during the change process whilst anyone in the green quadrant requires minimum stakeholder management. Then this is followed by listing out the observed behaviours of the stakeholder prior, during and following the change implemented and classifying these as an enabler or barrier to the success and longevity of the change implemented. When describing the behaviours, the **NORMS** must be followed:

- **Not** be open to interpretation
- **O**bservable
- **R**eliable (same interpretation, irrespective of who is being observed)
- **M**easurable (done/Not Done)
- **S**pecific

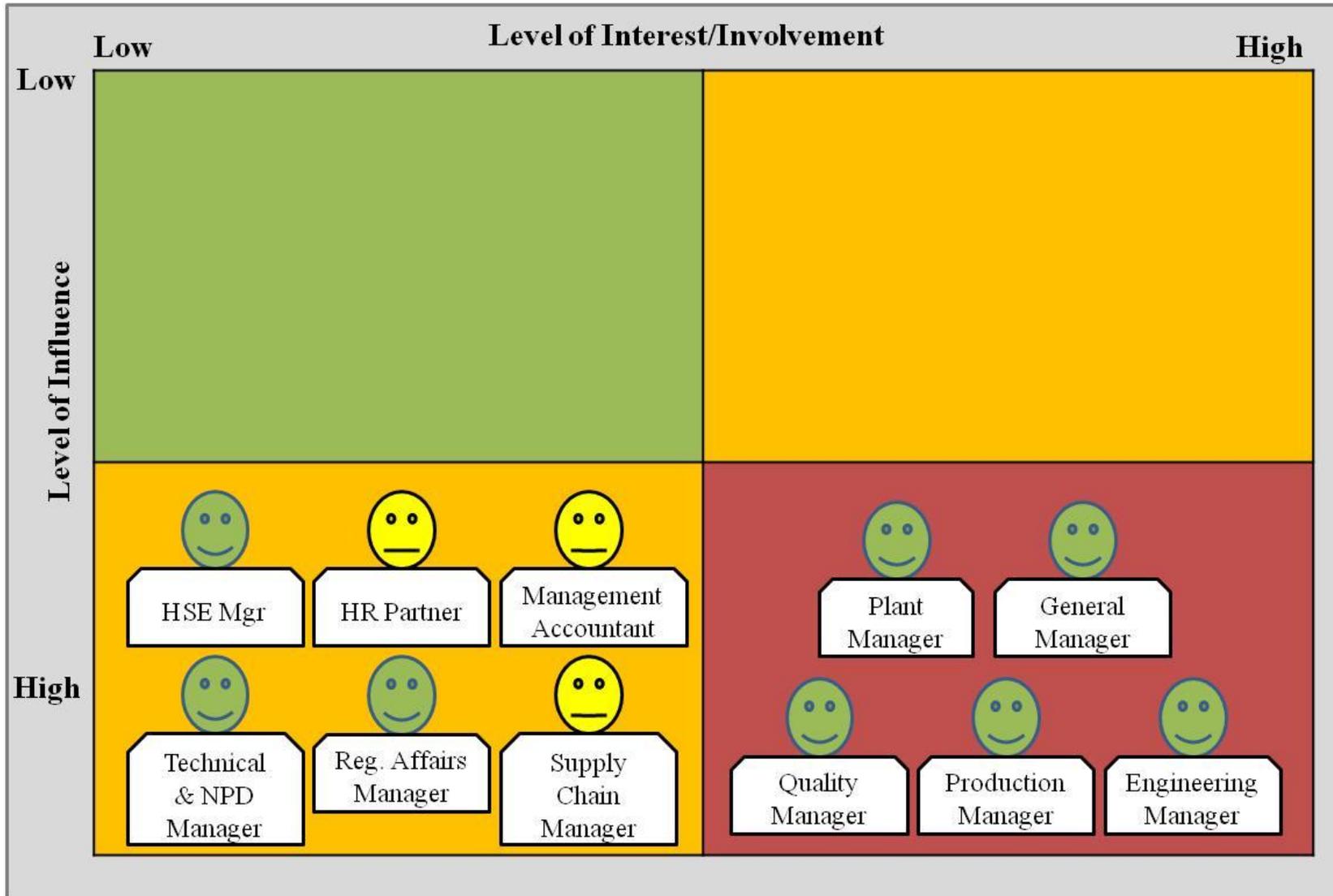


Figure 4: DePuy CMW Senior Leadership Team Stakeholder Analysis Matrix

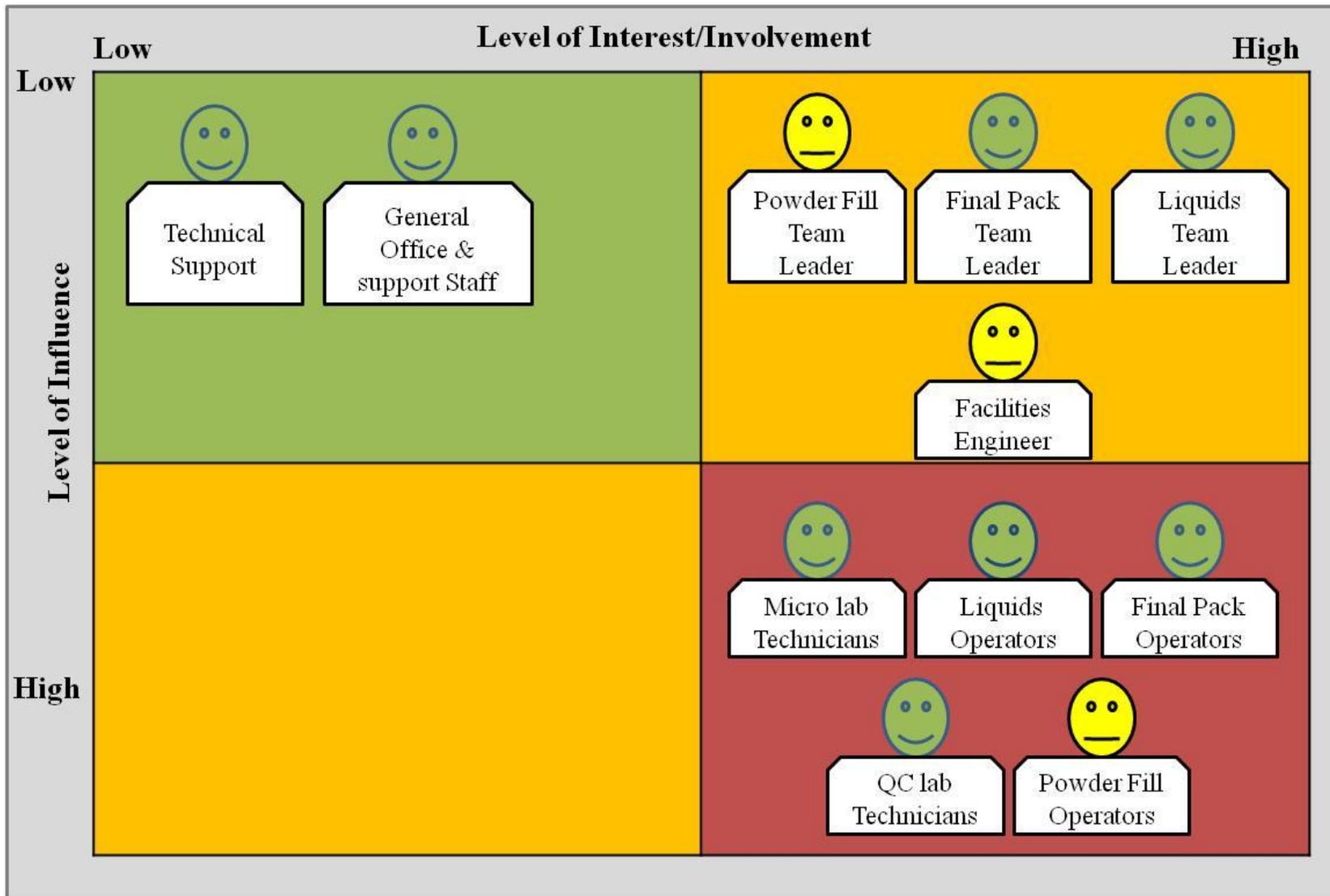


Figure 5: DePuy CMW Manufacturing Operators, Quality Technicians, Facilities Engineers, Office and Tech Support Stakeholder Analysis Matrix

People	D	S	R	Antecedent	Desired Behaviours to be observed	Enabler/Barrier	Expected Consequences	PICNIC
General Manager				Corporate expectations	Cascade the objective to score “Pull” in planned Lean Maturity Assessment (LMA) to the site senior leadership team (SLT)	Enabler	Score “Pull” in LMA Corporate rating of site operational excellence levels	PFC PFC
Plant Manager				Corporate expectations	Creates Site Lean Vision and communicate to rest of site. Regularly visits the pilot area to: Review Metrics, Assess state of transformation, converse with shop floor operators and team leader, holds manufacturing manager accountable for execution of change actions in the manufacturing area	Enabler Enabler	Score “Pull” LMA Corporate rating of site operational excellence levels	PFC PFC
Quality Manager				Do it Right	Accountable for execution of “Do it Right” and Human Error Reduction (HER) programme roll out and publicises to the entire site the use of lean techniques as the means to achieving this goal.	Enabler	Score “Pull” LMA Impact Dept performance	PFC PFC
Manufacturing	X		X		Accountable for execution of change actions assigned	Enabler	Score “Pull” LMA	PFC

Manager				<p>to department team members.</p> <p>Cascades Lean goals and objectives into the performance measures of all staff members in the manufacturing department.</p> <p>Regularly visits the pilot area to:</p> <p>Review Metrics, Assess state of transformation, converse with shop floor operators and team leader, holds manufacturing manager accountable for execution of change actions in the manufacturing area</p> <p>Attends every lean meeting on time</p> <p>Holds regular morning meetings line side of process</p>	<p>Enabler</p> <p>Enabler</p> <p>Enabler</p> <p>Enabler</p>	<p>Impact Dept performance</p>	<p>PFC</p>
Engineering Manager	X	X	<p>Expectations for LMA “Pull”</p>	<p>Self assign as Champion for execution of Total Asset Care (TAC) implementation on site and releases resources from department to take part in process</p> <p>TAC workshops and projects</p>	<p>Enabler</p>	<p>LMA Pull</p> <p>Impact Dept performance</p> <p>Impact on Dept Resources</p>	<p>PFC</p> <p>PFC</p> <p>NIC</p>

Table 2: DePuy CMW Senior Leadership Team Behavioural Management Matrix

People	D	S	R	Antecedent	Desired Behaviours to be observed	Enabler/Barrier	Expected Consequences	PICNIC
Shop Floor Operators	X	X		Schedule Attainment	Executes assigned change actions on time	Enabler	Impact on personal measures	PFC
				LMA "Pull"	Follow & Audit standard work in work area		Risk of headcount reduction	NFC
				Improve OEE	Keep metrics up to date hourly		Loss of overtime hours	NFC
					Adhere to work area 5S standards		Recognition for lean work	PFC
				Use escalation process at all times when process stops				
Lab Technicians	X	X		Do it Right Objectives	Executes assigned change actions on time	Enabler	Stretch n time & workload	NIU
				Batch Release CT	Follow & Audit standard work		Impact on personal measures	PFC
				Reduction Objectives	Keep metrics up to date real time		Risk on headcount reduction	PFC
					Adhere to work area 5S standards			
				Use escalation process at all times when process stops				

Table 3: DePuy CMW Manufacturing Operators & Quality Technicians Behavioural Management Matrix

Once the behaviours have been outlined, the next step is to consider possible precursors or barriers that may promote or hinder the stakeholder from exhibiting the stated behaviours. Using the Direction, Resources, Skills and Motivation (DSRM) model, a behavioural management matrix can be developed as in

Table 2 and Table 3.

With regards to direction about behavioural expectation, if this is not explicitly provided to the stakeholder then even if they possess the skills, resources or motivation to do so, confusion can ensue resulting in an absence of the expected behaviour. Similarly if they have clear direction, skills and motivation but lack the resources required, frustration may build up. The lack of skills may result into fear, anxiousness while the lack of motivation may result into apathy or resistance.

The subject of motivation in this has been assessed using an Antecedence, Behaviour and Consequence (ABC) model. Antecedences are precursors that may prompt an individual to behave in a certain way, much like amber, red, green traffic light signals may prompt a vehicle driver to halt, move or slow down.

Consequences need to be perceived from the stakeholders' point of view. For example a lean goal to reduce cost by increasing efficiency and reducing overtime may be negatively perceived from an operators' perspective as this will impact their take home remuneration – something they may have grown to rely on.

Consequences can be classified into Negative (N), Positive (P), Immediate (I), Future (F), Certain (C), or Uncertain (U). For example the perceived loss of income as a result of adopting lean changes by an operator can be classed as a negative, future and certain (NFC) consequence of adopting lean changes, making them more likely to resist the change.

The aim should be to ensure that strong antecedents are in place to promote the required behaviours, but also that there are more perceived or explicitly stated PFCs or PICs propositioned to the stakeholders than NFCs or NICs to increase the likelihood of them demonstrating the required behaviours. This can be used as a means of stakeholder management which is quintessential in any change management programme.

6. Wider Organisation Lean Roll Out

With the insight gained a much more thorough strategy can be devised to define the scope of the site wide transformation in terms of deliverables to the organisation, the SLT, the subject matter experts (SMEs) such as quality engineers, manufacturing engineers and shop floor operators thus defining the value proposition

of the change to come. It also helps prepare the change agent and manager for the likely responses to the changes proposed and the opportunity to plan ahead mitigating actions to prevent undesired behaviours towards the change. This includes devising the right goals and objectives to assign to the lean transformation but also to the stakeholders of the transformation which in this case acts as strong antecedent if specified appropriately. The DePuy CMW Site Lean Roll out Charter (**Error! Reference source not found.**) details the objectives, methodology, timescales and team involved in the first site lean roll out.

7. Wider Organisation Lean Roll Out Results & Analysis

As shown in the charter in **Error! Reference source not found.**, with regards to the agreed objectives

Pilot Area Lean Implementation Effectiveness				
Metric	Target (B)	Actual (A)	On Time (OT) % (C)	Effectiveness (A/B) x C
Lead Time	30 days	41 days	100.00%	73.17%
HER	Best in Class	Best in Class	95.00%	95.00%
LMA	Pull	Pull	100.00%	100.00%
CIP	\$ 165 K	\$ 165 K	100.00%	100.00%
Average Effectiveness				92.04%

The utilisation of the pilot study to enhance the knowledge on critical success factors has been instrumental in devising the right strategy, objectives and stakeholder management techniques to successfully drive the first pass of the DePuy CMW site wide lean roll out. With higher change effectiveness, it demonstrates the efficacy of taking the pilot phase to site roll out approach in developing a lean culture in a site as that of DePuy CMW.

8. Conclusion

It was found that the implementation of a pilot lean roll out provided the opportunity to observe and document the behaviours of the stakeholders involved in the change process and assess those that are enablers or barriers to change. This information proved valuable in devising a strong strategy to successfully conduct a site wide transformation. This also provides a framework for developing behavioural standards that can be rolled out to sustain the benefits of the changes applied.

9. Reflection and further Study

This study examined the efficacy of adopting a two-phase transformational strategy in driving systematic behavioural changes. It was found that the implementation of a pilot lean roll out provided the opportunity to observe and document the behaviours of the stakeholders involved in the change process and assess those that are enablers or barriers to change. The utilisation of the pilot study to enhance the knowledge on critical success factors has been instrumental in devising the right strategy, objectives and stakeholder management techniques to successfully drive the first pass of the DePuy CMW site wide lean roll out. With a higher change effectiveness compared to the initial pilot study, it demonstrates the efficacy of taking the pilot phase to site roll out approach in developing a lean culture in a site as that of DePuy CMW.

It also provides a framework for the implementation of lean manufacturing principles in non unionised, medium size manufacturing facility undergoing first pass lean transformation. Of course there are limitations to these findings such as the size of the facility in question, process complexity, and the fact that it is non unionised which would have added a different dimension to the study. Further studies can be conducted in unionised sites to further elucidate what behavioural management techniques are effective in driving the cultural change involved in conducting lean transformations in such an environment.

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