

# PPI Position Paper:

## Understanding the True Cost and Impact of Inventory

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### ABSTRACT

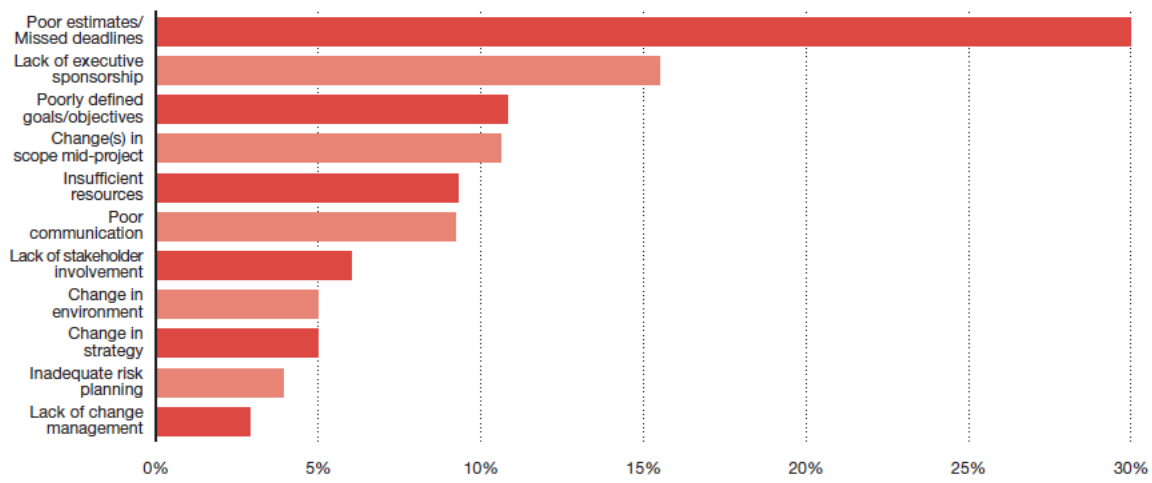
One of the most significant differences between conventional project management and Project Production Management is the view of inventory. In large capital projects, a usual practice is to amass as much inventory as possible, because “schedule will be met if everything needed is already onsite”. Almost no consideration is given to the potential implications of such a decision, with respect to execution or financial risk. The position of the Institute described here is that the timing of ordering and receiving inventory and authorizing work in process is one of the most strategic decisions in project execution and delivery. Project Production Management provides the technical framework to work out the right decisions to make on ordering and receiving inventory.

**Keywords:** *Work in Process; Inventory; Cashflow; Throughput; Variability*

### INTRODUCTION

Any seasoned project manager is familiar with the notion of assessing the risks that potentially can affect project execution, schedule and cost. To manage risks, project teams plan contingencies. For instance, two popular forms of contingency are to plan for a contingency in budget and in schedule. Contingency in budget might be used for instance to plan and procure for early deliver and extra materials in a belief that the presence of materials available for construction and installation improves the probability of keeping schedule.

Almost nobody considers that the premature ordering and amassing of inventory may contribute to poor project execution. Those who practice what we have described as Era 2 thinking [1], most typically codified by Project Management Body of Knowledge [2], almost never identify inventory or WIP as a possible cause of poor project execution. By way of example, Figure 1, shows the results of a 2012 survey of project stakeholders on their perceptions of the factors contributing to poor project performance. The very form of the categories proposed to the survey participants in our view reflects Era 2 thinking – one can almost directly identify each category with a corresponding chapter or section in [2].



Source: *Insights and Trends: Current Portfolio, Program, and Project Management Practices* (The third global survey on the current state of project management), PwC, 2012.

*Figure 1: Era 2 Thinking – Causes of Poor Project Performance*

It would not be an exaggeration to term inventory to be the “crack” of project teams – it’s almost at the point of an addiction from our observation of different capital projects. Almost every project team proposes acquiring more inventory, earlier, as a response to variability and meeting targets.

It sounds reasonable – if I can see it, I’m not waiting for it, and my schedule will be preserved. As we explain next, having too much inventory too early has numerous unintended consequences.

## THE COST AND IMPACT OF INVENTORY AND WIP IN A PRODUCTION SYSTEM

A really curious feature of almost every organization responsible for capital projects is that people pay almost no attention to inventory or WIP – they don’t “see” it. In part, this is because there’s a belief that “when is not important”. Organizations have come to believe that if they have \$5 billion to spend on materials, the timing of when that money is spent does not matter, “as long as it’s in the budget”.

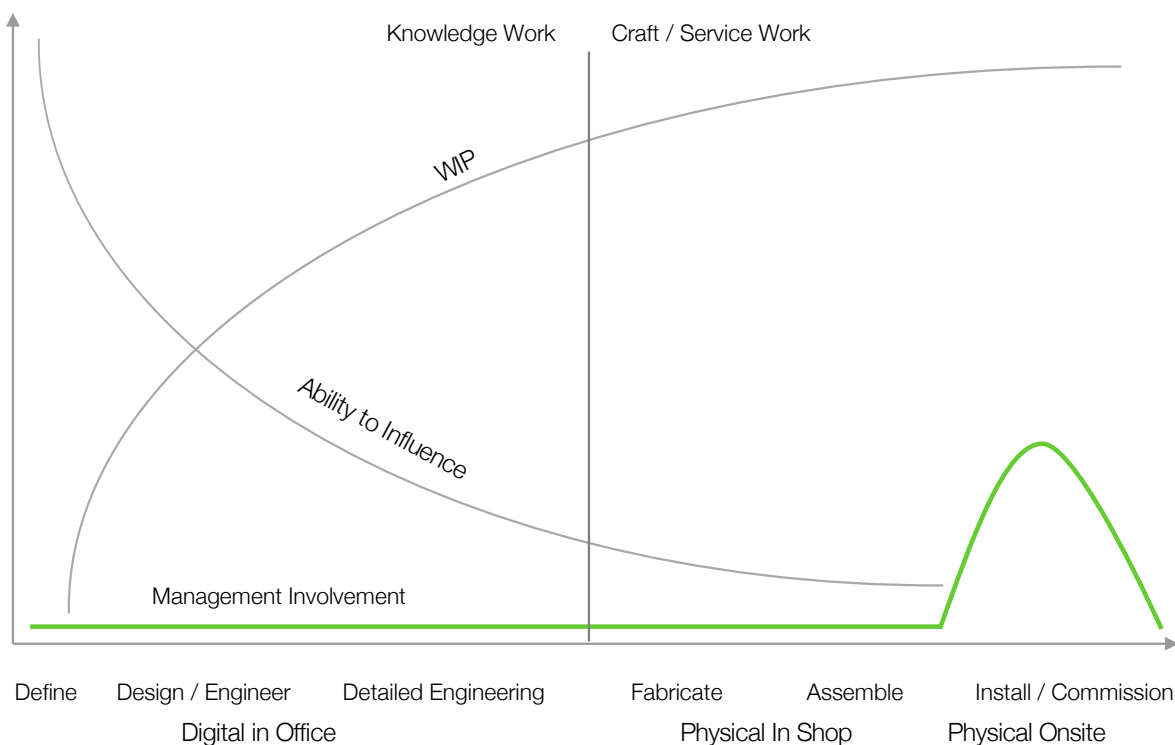
In our conversations with meeting different project teams, we have understood they believe the money in the budget has to be spent, and it doesn’t matter when it’s spent. In fact, we have not come across a project team was incentivized to take into account the impact of capital spending on cash flow for the corporation. Their incentives have generally been concerned with total project cost incurred, regardless of when costs were paid, compared with total project budget. A second consideration is total time taken for project execution, measured against master schedule.

There are numerous unintended bad consequences of the practice of early acquisition of inventory and overstocking as a contingency measure, without careful consideration of the overall production system.

First, the impact on cash flow is clear. All WIP and inventory residing in a production system represents trapped cash in the system, with a detrimental effect on financial returns, especially if the same output can be achieved with lower WIP/inventory levels.

Second, the cost and time to amass, handle, hold, and manage, not to manage the risk of theft, damage and obsolescence of unnecessary WIP and inventory actually makes the financial impact of procuring inventory earlier than necessary far worse than simply the purchase cost of the inventory itself. Simply having inventory early does not assure that it will be on hand at the right time when needed to ensure the project remains on schedule. More often than not, as we cite in an example in the next section, being unable find the right parts to continue project execution in the midst of a pile of inventory is frequently a cause of schedule overruns. The amassing of inventory itself is a cause of delays.

How does this all impact time to market, use of cash? We summarize this in Figure 2 *Figure 1* adapted from a classic Harvard Business Review article, which illustrates how the growth of WIP in a production system reduces the ability to influence change in the production system as the presence of the WIP creates a host of ancillary tasks with holding, managing and preserving it.

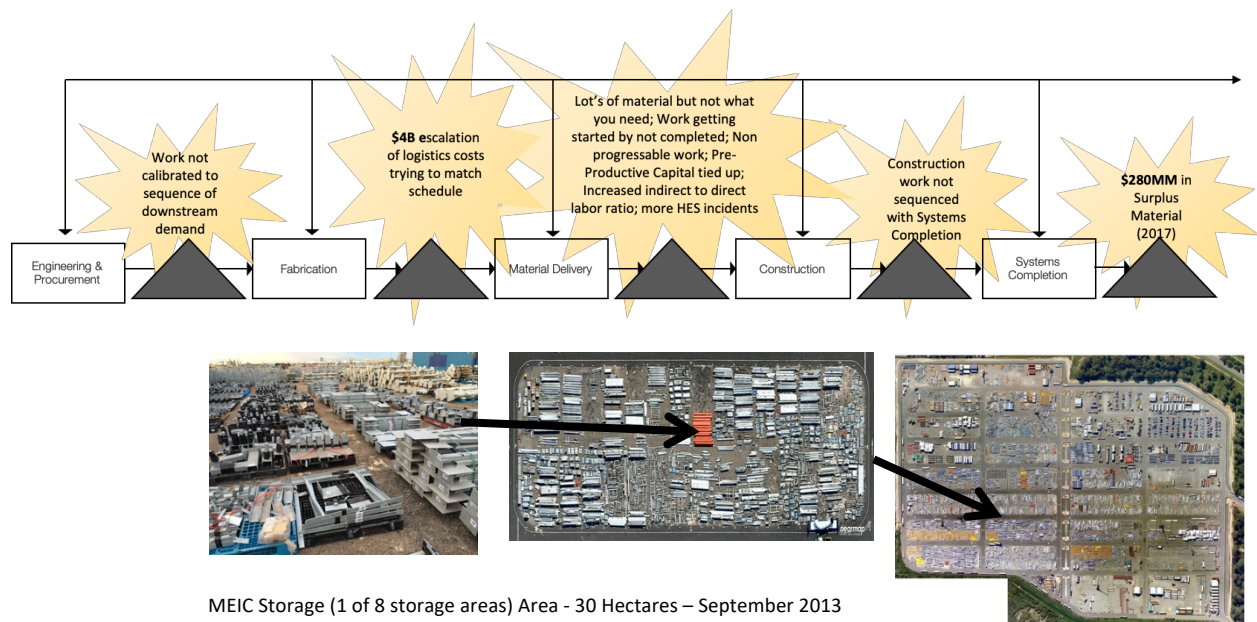


Ability to Influence Curve adapted from Gluck & Foster HBR September 1975

*Figure 2: Amassing WIP causes inertia reducing the ability to influence change*

## AN EXAMPLE

The following example is cited from the 2016 Project Production Symposium presentation [3]. Figure 3 shows pictures of WIP and inventory built up over the course of a major oil & gas capital project, over the course of major stages in the project—engineering & procurement; fabrication; materials delivery; construction; and systems completion. As the captions in Figure 3 show, all the negative consequences of WIP buildup are exhibited in this example. The work execution was not synchronized to the materials procured. This led to an escalation of logistics costs in managing and handling the inventory that was mismatched to the demands of construction, as large as \$4 billion. Despite this, as the photographs suggest, there were huge amounts of materials that were present but not matched to the needs of the work that needed to be completed. This led to work starting but not completing. So inventory led to the growth of additional WIP, with the associated implications on cash tied up and schedule overruns. All of these consequences culminated in schedule delays and additional costs in surplus inventory and obsolescence of over \$250 million.



MEIC Storage (1 of 8 storage areas) Area - 30 Hectares – September 2013

*Figure 3: Illustration of WIP build up in a major capital project*

Now let's put some numbers on Figure 3. Suppose each of the five stages takes 20 days and there are 4 resources for each stage. One new project is started every 6 days. Now suppose we begin with \$1,000,000 in materials and that it costs \$25,000 per day for each of the resources at each stage (i.e., \$100,000 per day because there are 4 resources and \$500,000 per unit because each unit takes 20 days). If we try to keep enough inventory in front of each station to guarantee we never run out (i.e., a fill rate of ~99%), we will tie more than \$374 million in WIP and inventory and the project will take 841 days. However, if we avoid maintaining inventory at every step and only focus on finishing on time (with the same 99% probability of success) we tie up much less cash, “only” \$192 million with the project taking 322 days.

Thus, by keeping everyone busy by having plenty of inventory would require 95% more cash tied up and would take 162% longer to complete than focusing only on making sure that the entire project finishes on time.

It is also of interest to understand at a very late stage, when a lot of the inventory had already been procured, how the project owner used Project Production Management to mitigate losses and bring the situation under control. That is the topic of a future article.

## CONCLUSION

It is a usual practice among many major capital project teams to procure and assemble as much inventory as possible in the belief that it facilitates project execution and assures project schedules. As we have explained, such beliefs are misguided. The premature acquisition of inventory not only is a poor use of cash but increases costs and jeopardizes project execution. Project Production Management provides a technical framework to understand the *right* levels of inventory to procure to optimize project execution.

## REFERENCES

- [1] R. G. Shenoy and T. R. Zabelle, "New Era of Project Delivery: Project as Production System," *Journal of Project Production Management*, pp. 13-24, 2016.
- [2] Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Sixth Edition*, Project Management Institute, 2017.
- [3] W. Crabtree, "2016 Project Production Symposium Presentation," November 2016. [Online]. Available: <https://projectproduction.org/presentations/2016/5-Gorgon-PPI-Symposium-Nov-30-2016.pdf>. [Accessed 6 11 2018].