Incoming raw material receiving optimization

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Abstract *— Every company seeks for new ways to grow their business, but such growth adds new challenges in the operation. Increment in overtime expenses and backlogs are the most common challenges nowadays; lack of communication and poor resources utilization contribute to worsen those challenges. The process from receiving to disposition was analyzed with the objective to reduce the overtime expense and eliminate backlogs. It was proven that aligning business prioritization between departments, implementing a schedule to support the prioritization process and understanding workload is possible to reduce overtime expenses and eliminate backlogs.*

Key Terms — Capacity, Manufacturing, Scheduling, Supply chain

INTRODUCTION

After the business crisis in 2008, all the companies are searching for the best combination on their business model in order to satisfy the customer. This is a big challenge for the new era manager because now they have to use their resources to manage more workload than before even though more resources are needed. Since the last quarter of 2012 the production on the company increased significantly causing an increase in backlogs, and overtime on the Incoming Quality Assurance area. Appraisal analyses are often not sufficient to make decision on a complex business structure. A scheduling process will be designed to help the departments to align their priorities and help the company to manage the workload.

DEFINE

Problem Statement

The incoming material lots incremented by 18% since 2013 due to volume increase and site multiple projects. This volume cause additional workload in Receiving, Incoming Quality Assurance (IQA) and Quality Control Labs (QCL) areas. In addition these areas are working with a variable schedule that doesn't target the capacity keys of the areas. Incoming Quality Assurance release metrics are above target causing receiving backlogs, IQA backlogs, overtime and an internal lead time above 30 days.

Objectives

The following objectives were established in order to narrow the expectations of the project.

- Design a optimized receipts schedule
- Reduce overtime in Incoming area
- Impact Resources in Incoming area
- Design a Pilot process for Inspected while receiving

Deliverables

Below are the three most important deliverables of the project.

- Design IQA Capacity model
- Implement pilot process for Inspected While Receiving
- Implement Optimized receipts schedule

Figure 1 presents the current state map of Incoming Quality Assurance (IQA).

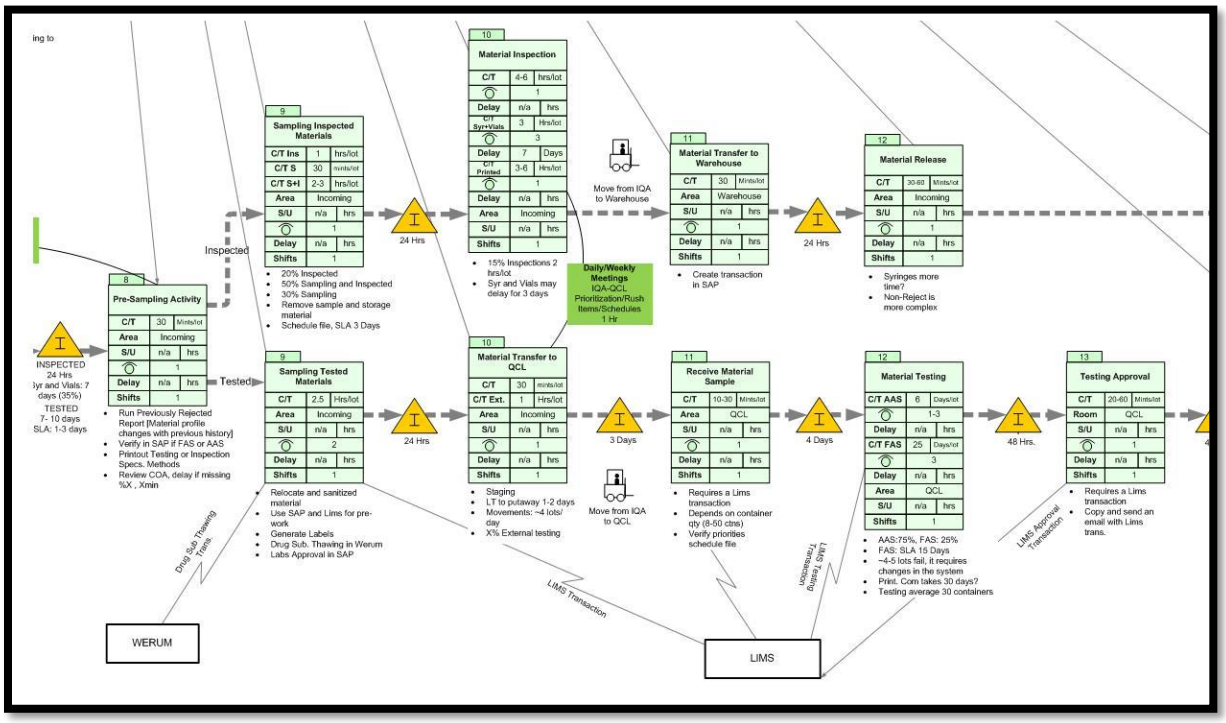

Figure 1
Current State Map

ANALYZE

As part of the development of the project, there are three main areas to focus on: the lot size validation, capacity model and the expeditor schedule. Starting with the lot size, validation for "EXCIPIENTS" was made taking into consideration the time it takes to process one lot in the Incoming Quality Assurance area. Amgen®. classified raw materials as tested, inspected and sample/inspected. For tested materials they need to sample 32 containers or 50 containers depending on the supplier classification. EXCIPIENTS materials are an exception to the rule; they need to sample 100% of the lot. For inspected and sample/inspected materials, the sample size is determined as $\sqrt{N}+1$ .The high level Capacity Model for IQA was developed using historical information about the amount of processed lots in the area with their respective estimated processing time. The Expeditor schedule used in Amgen® Manufacturing Limited (AML) is based in the expected amount of orders to arrive every week. The information provided in the expeditor schedule do not add value to the process, it does not take into account how the IQA and receiving capacity are being affected. The schedule shows the supposed sequence of the incoming materials, but its lacks of a scheduling model. The delivery date has variability because Corporate (Amgen®.) has 3 days before 0 days later metrics to measure the delivery of a supplier. The new proposed metric to reduce the delivery variability is a 0 days before 0 days later for local suppliers.

Table 1

Actual Expeditor Schedule

Purchase Order	Vendor Name	IM Material	Description	Open Quantity	Unit	Delivery Date	Comments
1	A	1234	Acid	123	EA	8/22/2013	
2	B	5678	Liquid	1000	ML	8/22/2013	
3	C	91011	Solid	150	G	8/23/2013	

The actual expeditor schedule presented in Table1 shows some information that is supposed to guide the Incoming Quality Assurance and Receiving areas for the weekly requirements. From Table 1, these areas only use the delivery dates column, which represent the value added information. The rest of the document does not represent any value added information they could use to prepare for the receipts.

Formula Determination

The following formulas and analysis tools are used to calculate available hours per FTE, Man-Hrs. requirements, Headcount requirement, workload, required hrs. per shift and overtime.

- Ava. Hrs.= $\text{Prod. days} * \text{\# shifts} * \text{\% Allow}$ (1)
- Man-Hrs. Req.= $\Sigma(\text{CT per Mat. Subgrp} \times \text{\# of lots})$ (2)
- Headcount req.= $\frac{\text{Man Hrs Req}}{\text{Available Man hrs}}$ (3)
- Workload = $\frac{\text{Resource available per shift}}{\text{Headcount Req}}$ (4)
- Overtime= $\frac{\text{Req.hrs shift}}{(\text{Resr.Avai. per shift}) * (\text{avai Man Hrs per FTE})}$ (5)
- Req. Hrs. shift = $(\text{Headcount Req.} - \text{Resource Available per Shift}) * (\text{Available Man hrs per FTE})$ (6)

At the beginning of the year the company makes their forecast and set the overtime goal, but Table 2 shows how high the overtime is compared with the forecast.

Table 2

Incoming Quality Assurance Overtime

	Average Overtime
Forecast	3%
Receiving (Data)	13%
Incoming (Actual)	17%

Table 3 presents a comparison between the forecasted overtime for IQA and Receiving. The difference between them is of over 9% in both areas. These results support the management request for human resources and an accurate schedule for IQA and receiving that would represent the actual workload

Table 3

Comparison between the forecasted overtime for IQA and Receiving.

Overall	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13
Man-Hrs Requirements	0	1629.5	1947.8	2732.1	1831.7	1971.3	1276.2	1949.4
Resource Available per Shift	11	14	14	14	14	14	14	14
Available Man-Hours (Per FTE)	98.3	98.3	115.6	132.9	109.8	121.4	127.2	109.8
Headcount Requirement (100%)	0	18.2	18.5	22.6	18.3	17.9	11	19.5
Headcount Requirement (~90%)	0	20.3	20.6	25.1	20.4	19.9	12.3	21.7
Current loading	0%	140%	143%	174%	141%	137%	85%	150%

Assumptions

Based on the production days in the month, the hours per month are assumed. Also, the allowances given were for personal needs 5% and 4% for Fatigue. On other hand, the raw material fixed lot size assumption that, for less or equal than 5000 container, the sample size is 32 Containers. Otherwise, for more than 5000, the sample size is 90 Containers. As part of the business needs, the analysis take into account the arrival of new material twice per year.

CAPACITY MODEL DETAILED

Generate and Validate Time Standards

After taking the proper training and obtaining access to the IQA area, the primary task was to familiarize with the process, the area and the operators. A detailed tour of the IQA area with the Director of Quality and the IQA manager was given to see and understand the areas that will be analyzed.

To be able to capture complete processes from the different products in the given amount of time, a meeting with the Sr. Associate QA was arranged to assist in determining key differences and similarities between the Inspection processes of the products in the scope of the project. Figure 2 shows how the materials are distributed. After having observed the process tasks were identified in common between the Inspections. However, there may be minor differences in some materials which can add some additional time during the process. Unless specified, most of the time studies will be based on the materials received in October as long as the schedule permits it. This common task was then corroborated with some of the associate's.

The time studies are currently undergoing according to the Incoming receipts schedule. Currently there is only 1 shift at IQA area. Therefore, the studies are being performed by activities in the process. Most activities in IQA area have been observed. Once a study has been completed, the actual sequence of events is compared with its corresponding Standard Operating Procedure (SOP) to corroborate the information and it is organized in a MS Excel sheet. The values in the tables do not represent the actual data of the time studies to protect Amgen's® confidentiality.

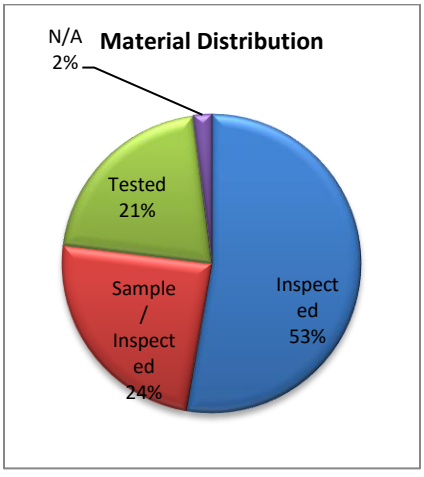

Figure 2

Material Distribution

Figure 3 shows that the blue line is the number of associates that they had working there and the red line shows how many associates they need to satisfy the current demand. This is the root cause for the Backlog and Overtime problem in the IQA area. Right now 3 more associates were added to balance their workload until the Capacity Model detailed will be completed.

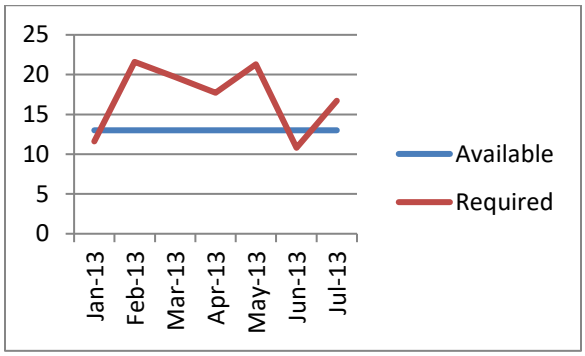

Figure 3

Available resources vs. needed

Table 4

Actual Time distribution matrix

IQA Associates	Drug Substance	Raw Materials	Components	Printed Material	Disposition	Complaints
Rigoberto	75%				25%	
Mariangie	30%	70%				
Ricardo	20%	80%				
Shaira	20%	80%				
Cesar	10%		90%			
Maribel			100%			
Jorge			100%			
Luis			100%			
Iris				50%		50%
Marisol				50%	50%	
Anitza					100%	

After familiarizing with the complete IQA process by studying different stages of the process, some of the associates were interviewed on what other tasks they perform when they are not sampling a material. An actual time distribution matrix was developed and is presented in Table 4. A draft of the work sampling sheet was designed including the primary tasks. For the shift, there are two associates assigned for tested material, and two new associates that help with the sampling but are still under training. To be able to accurately determine the work load for each associate, each random observation will include activities being performed by each associate. The draft was corroborated with one of the formulation supervisors and some modifications were done. Once the time studies related to the formulation process conclude, then a test run of the work sampling will begin to determine the required amount of observations.

Detailed capacity model results

The detailed capacity analysis reinforced and proved the initial hypothesis. The increase in overtime and backlogs in the IQA area was caused by the unexpected arrival of material to the area and the communication gap. The detailed results of the analysis are presented in Table 5. The current loading presented in Table 5 validates why IQA area overtime increased.

Table 5

IQA capacity model results

Components	Q3	Q4	2013	2014
Man-Hrs. Requirements	648.3	349.9	2667.8	2228.8
Available Man-Hrs (per FTE)	331	215.4	1276.8	1276.8
Headcount Requirement (100%)	2	1.6	2.1	1.7
Headcount Requirement (~85%)	2.3	1.9	2.5	2.1
Balance (~85%)	1.7	2.1	-2.5	-2.1
Balance (100%)	2	2.4	-2.1	-1.7
Current Loading	196%	162%	209%	175%

Printed Materials	Q3	Q4	2013	2014
Man-Hrs. Requirements	255.2	199.2	1148.7	976.4
Available Man-Hrs (per FTE)	331	215.4	1276.8	1276.8
Headcount Requirement (100%)	0.8	0.9	0.9	0.8
Headcount Requirement (~85%)	0.9	1.1	1.1	0.9
Balance (~85%)	3.1	2.9	-1.1	-0.9
Balance (100%)	3.2	3.1	-0.9	-0.8
Current Loading	77%	92%	90%	76%

COST ANALYSIS

On Table 6, scenario 1 assumed that associate work utilization is 100% and the process is steady. The capacity model for scenario 1 shows that they need 10 associates in order to comply with the demand. Scenario 2 assumed that associate work utilization is 85% and the process has variability. The

capacity model for scenario 2 shows that they need 12 associates in order to comply with the demand and the process variability. On Table 7 the scenario 1 shows an annual savings of $205,920.00 due to the reduction of 3 associates. Scenario 2 shows an annual savings of $68,640.00 due to the reduction of 1 associate

Table 6

IQA capacity model head count requirement

	2013		2014	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
Total Volume FTE's	9.8	11.5	9	10.5

Table 7

IQA capacity model cost analysis impact

Drivers		Scenario 1	Scenario 2
Salary ($/hr)	$ 33.00	$ 33.00	$ 33.00
(weeks/year)	52	52	52
(Shift/ day)	1	1	1
(Days/weeks)	5	5	5
(Hrs/Shift)	8	8	8
Associates/shift	13	10	12
Actual Cost	$892,320.00	$ 686,400.00	$ 823,680.00
Annual Savings	$ -	$ 205,920.00	$ 68,640.00

INSPECTED WHILE RECEIVING PLOT PLAN

An area for improvement was found in the IQA process. A selection of materials was identified as a possible prospects for change their inspection process. As part of this initiative were identified some materials that their inspection could be changed. Figure 4 presents the material distribution of the IWR (Inspect While Receiving).

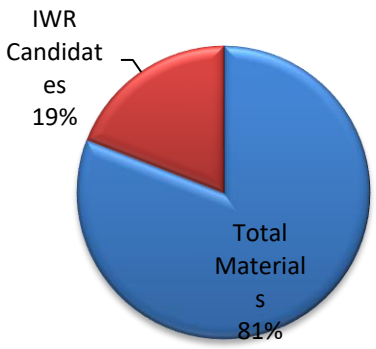

Figure 4

Inspected while receiving material distribution

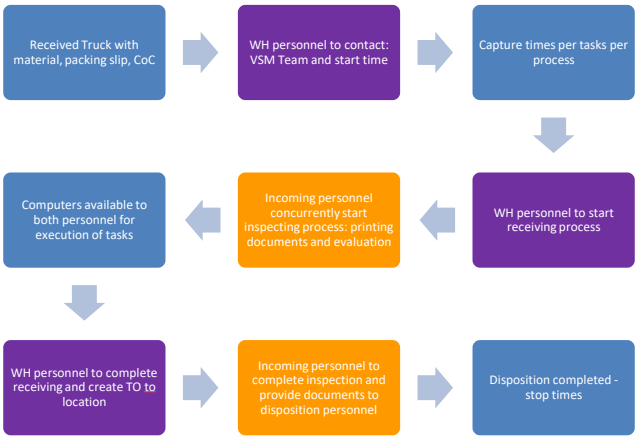

Figure 5

Process map of the Inspect While Receiving

On Figure 5 is presented the flow chart of the IWR process. The materials identified for the IWR (Inspect While Receive) were FLTR, APPRL, TUBNG, and DSTMT. For the IWR Pilot Plan was chosen the DSTMT. Table 8 shows the result of the pilot plan. This pilot plan demonstrated that is feasible to reduce the Lead Time of these materials from 3 days to less than 1 day.

Table 8

Inspect While Receive Pilot Plan Results

	10/20/2012	10/6/2013
Item Number	3000462	300409
Unit (EA)	1,250	1,000
Lot	2	1
pallet	5	4
Process Time (Min)	22	~16

COST ANALYSIS

After analyzing the results of the pilot plan, it was conclude that the IWR are viable. The next steps were performing a cost analysis impact after adding all proposed items to the process. 192 materials were added to the process, with a decrease in the lead time from 3 days to less than 1 day, causing a decrease in safety stocks of these products and leading an annual savings of $393,924.94, as presented on Table 9.

Table 9

Cost analysis for IWR Process

Current inventory	IWR Proposed Inventory	Cost impact	% Reduction
$ 5,268,074.65	$ 4,874,149.71	$393,924.94	7.4%

OPTIMIZED RECEIPTS SCHEDULE

One of the purposes of the capacity model is to link it with the direct inbound schedule in order to determine the workload in IQA. Initially the use of an optimization model to schedule the receipts was considered, but this can't be possible due to business constraints. It was decided to create a tool for buyers so they can balance the numbers of lots received daily in order to comply with the IQA capacity. The first step was to create a schedule that had the necessary information and is called Direct Inbound Schedule (see Table 10).

Table 10

Direct Inbound Schedule

Po Number	Vendor Name	Material Number	Spec Number	Line Description	Tested/ Inspected	Category	Delivery Date	Statistic Delivery Date	Quantity	Base UOM	Est. Amt Cont/ Cases/Rolls
4500025966	TEGRANT ALLOYD BRANDS	5109095	PCS-001208	TRAY 4 V1 3CC	Inspected	TRAY	12/5/2013	12/5/2013	84,000	EA	70
4500026154	RONDO PAK INC	5109140	PCS-001239	FLUTE Insrt 262mm x 113mm	Inspected	FLUTE	12/5/2013	12/5/2013	400,000	EA	206
4500026179	CORTEGRA GRP INC	1003313	PCS-001282	TWEB PFS US 200 mcg 033 r03	Inspected	TWEB	12/5/2013	12/5/2013	1,452,011	IN2	7
4500026302	CORTEGRA GRP INC	1003218	PCS-001284	TWEB PFS US 480 mcg 006 r04	Inspected	TWEB	12/5/2013	12/5/2013	1,980,000	IN2	9

The direct inbound schedule would be the source of the scheduling tool. The programmed sheet (see Figure 7) would extract the items numbers, the dates and the lots. In the output sheet (see Table 10) have the workload each date based on the capacity model and the direct inbound schedule. This tool gives buyers the ability to balance the amount of daily receipts so IQA can process all the lots received.

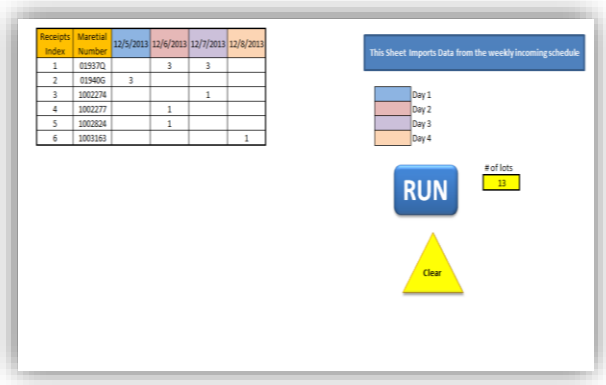

Figure 7

Scheduling tool

Table 10

Output sheet in the scheduling tool

	12/5/2013	12/6/2013	12/7/2013	12/8/2013
Workload	12%	18%	15%	3%

RECOMMENDATIONS

In order to maximize the resources, the company has to Cross Training on IQA Area; also Implement 6s to improve their efficiency. A daily meeting is recommended in IQA area discussing the Direct Inbound Schedule. After analyzing the capacity model, scenario 2 was implemented to absorb the process variability. For now, the IWR Materials arrive at the site on Friday to give the IQA area more time during the week to focus in their other materials.