Systems Analysis and Restructuring

Part I – Systems Analysis

Introduction

In an effort to understand inefficiencies present at Euro Solutions, a detailed analysis of production data was performed coupled with a qualitative review of operational processes, where such processes are defined and exist. While instances of resource waste and inefficient deployment are present, further investigation demonstrates such issues secondary to overall, systemic process failure. An employee centric, versus process centric, structure combined with a lack of accurate, well defined sampling techniques has created internal impedance which serves to obstruct and obfuscate processes. This paper will attempt to elucidate areas of highest concern, while proposing solutions to immediate issues as well as suggested mid to long term strategic restructuring. Further, the scope of this review shall be defined strictly to the manufacturing process, contained within simultaneous Kanban and MRP scheduling procedures, with other support processes addressed at a future date.

Methodology

The review of Euro Solutions was performed via observational analysis of day to day operations, inspection of formal communication records, employee conversations, both one on one and group settings, and statistical analysis of internal quality metrics. Statistical analysis involved identifying the probability density function of all manufacturing processes, determining mean process times, distribution spreads and construction of prototype control mechanisms.

Analysis

<u>Observational Analysis</u>

At present, processes are employee centric; that is, a process is assigned to an employee, as opposed to an employee being assigned to a process. Most processes are assigned to multiple employees. Figure 1 depicts the current networked-dependency structure amongst manufacturing processes.

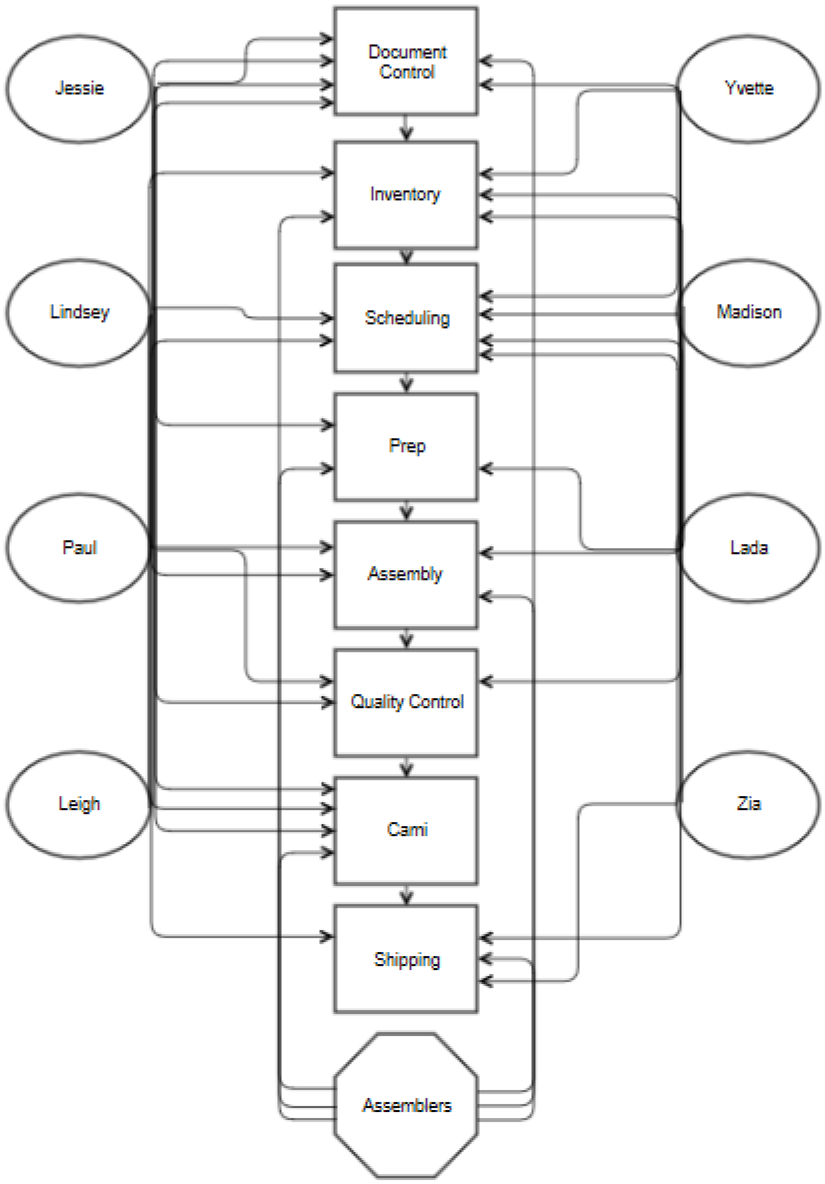

Figure 1 - Current Process Flow

The flow of jobs enters the queue at document control, terminating at shipping with employees being inserted at multiple locations. The difficulty with tracking process inputs and outputs in evident. The current approach is to track employees individually and then create aggregate summary statistics in an attempt to analyze each process. The system also creates confusion amongst employees as job requirements and responsibilities are not clearly defined. Such confusion results in a diffusion of responsibility. No single employee, or employee subset, is willing or able to claim responsibility for task execution and completion. Tasks being passed back and forth through multiple employees result in substantial drag. Analogous to physical friction, project inertia is lost and tasks decelerate, in some cases stalling outright.

Root causes of system failure become difficult to determine. The presence of multiple path dependencies between processes and employees allow for multiple points of failure; with a single employee potentially influencing multiple failures. Typically, multiple redundancies are desired but the failure of a primary path does not signal to a redundant path. When an employee fails to execute, a lateral employee is not aware of the failure and cannot act as a backup. The corollary of such dependence is the creation of essential employees; processes become dependent on the presence such employees. For example, the loss of lead quality control creates failure in scheduling, assembling, quality control, document control and, though outside of present scope, the quality management system. Central tenants of risk management require that such dependencies be mitigated.

A large number of observations which, in the author's opinion, follow as repercussions of systemic process failure are summarized under their respective authorities.

<u>Production Supervisor</u>

- Inconsistent training procedure. Production throughput favoured over assembler education.
- Lack of command structure. Negotiating with employees instead of assigning tasks.
- Assemblers asked to pull their own work, not being assigned.
- Multiple people assigning daily schedule. No one developing mid to long term schedule.
- Cross training suggested, no plan developed or executed.
- Suggests employees reorder work themselves (Oct 6/15)
- Staff need constant retraining but are all approved via training matrix.

<u>Management</u>

- Excessive meetings which serve to confuse staff with constant refocusing, frequent changing of methods, systems.
- Random people asked to police document control (Oct 6/15)
- Claims rework has doubled. No evidence for this in metrics. Bad data, bad entry? (Sept 18/15)
- Multiple improvement plans, safety issues, no follow through (Sept 18/15)
- Assemblers asked to police inventory. Diffusion of responsibility. Inventory process encroachment.

<u>Quality Control</u>

- Inconsistency in QC allows for failed part to pass, leading assembler to believe lower standard is acceptable in future.
- Tooling responsibilities deferred to random staff.
- Increasing NCR, QC failure
- 60 New world cables bypassed QC or QC failed. (April 21/15)

Inventory

- Parts relocated by floor staff, inventory not informed. Parts lost frequently.
- Work instructions incomplete or lost resulting in kitting delays
- Employees removing controlled inventory items
- Overly obtuse and redundant tracking system, Product Daily log, duplication of labour and data.
- Insufficient lead time for kitting. Inventory rushed at last minute.

Quality Management System

- Raw data entered by multiple employees, potential for inconsistencies and conflicts of interest as employees are self-reporting.
- Multiple authorities spread across QMS. Request for assemblers to push their equipment calibration.
- Quality metrics not calculated correctly. Lack of understanding.
- Document change request procedure unclear.
- Excessive use of red lining controlled documents.
- Deviation from work instruction authorized as long as coworker is informed.
- Discrepancy between document issue sheet and QMS relating to quality objectives. Issue sheet makes claims that were not introduced. Would trigger NCR during audit.
- Supervisor in violation of QPR-013 production schedule, being offloaded
- Repeated audit NCR's. Systems not present to track quality objectives.
- Flowcharts incorrectly constructed. Lack of understanding of ASME standards, logical process design.

Document Control

- Complete breakdown of document control process. Employees suffer extreme frustration.
- Employees changing work instructions directly, pre authorization.
- Document change requests not used to initiate change.
- Change requests purposely omitted from DCR excel file. Work instructions lost in storage folders "stall". Downstream process delays, kitting etc.
- Lack of automated signaling system for supervisor notification. Supervisor must be reminded to check DCR file, set aside time.
- Excessive authorities required to sign off on changes. Claimed purpose is notification and accountability, but staff is not able to remember multiple minor changes day to day, nor is such a request reasonable.
- Diffusion of responsibility from issuing authority, Quality Manager / Supervisor. Instead of having a central authority insuring documents are correct and distributed appropriately, all employees are required to ensure their documents are correct. Such a request is unreasonable, and has not proved successful. Multiple revisions with conflicting information. (See Radius May 19 2017)

- Employees aware of system violations. Documents / process “scrubbed” for compliance pre ISO audit.

Statistical Analysis

Assembly Financials

Financial information was examined from January 2016 through April 2017. Clients were sorted on gross revenue of 2.02 million dollars with summary statistics, accounting for 80% of total revenue, shown in table 1.

	Revenue	COGS	Kit Hr	Cut Hr	Build Hr	QC Hr	Ship Hr	Total Hrs	*Profit	Margin
Oce	1003879.50	453592.74	323.55	541.73	8432.65	715.33	4.81	10018.07	400015.71	39.846985
Ballard	255740.44	76301.81	58.17	149.52	2205.96	122.78	38.90	2575.33	140808.68	55.059216
Crosstown	115765.80	4470.33	66.20	38.38	1206.83	69.20	53.12	1433.73	89789.52	77.561352
Radius	76243.50	8405.52	65.75	71.47	1655.58	110.23	21	1924.03	38977.53	51.12243
Cyclotron	76229.28	0	5.47	40	301.33	6.82	9.58	363.20	70781.28	92.85314
New World	61453.15	4499.39	42.77	33.42	1554.35	63.52	37.83	1731.89	30975.41	50.404918

Table 1 – Build Hours per Client Jan 2016-April 2017

*An average assembler rate of $15.00/hour was assumed.

A total of 21,031 hours of labour were recorded with Oce accounting for 47.63%. Scaled annually, Oce occupied 6324.49 hours build time and 7513.55 total hours, or 3.16 and 3.76 employees, respectively. Another 6021.14 hours, or 3.01 employees, were required for the remaining five clients. In total 6.77 employees were required for 80% of the period’s revenue.

Table 2 summarizes other floor support functions, for all clients, annualized, in their entirety.

	Hours
Kitting	470.12
Cutting	751.97
Quality Control	923.87
Shipping	180.83
Total	2326.79

Table 2 – Total Support Hours Jan 2016-April 2017

The primary concern noted as the cumulative kitting and shipping time of 650.95 hours, representing 0.33 employees. Inventory control / shipping currently require a full time employee, with occasional assistance. Discussion with inventory suggests the vast majority of hours being lost to external interference in the form of internal department maintenance, misplaced parts, documentation restrictions and time keeping.

Quality control represents 0.46 employees on an annual basis. Occupied hours combined with unacceptable levels of process variance, covered later, suggests opportunities for streamlining.

Automation

Throughput of the Molex press was measured at 5.73 seconds per crimp, averaged over 5 minutes, versus a manual crimp time of 15.03 seconds; the press having a greater throughput by a factor of 2.62. It is also reasonable to assume manual crimp time drifting due to operator fatigue. Potential press utilization for major clients, over the last year, is summarized in table 3. Manual time assumes all crimps were by hand. Machine time assumes all pins were automated.

	Total Pins	Manual Crimp (Hours)	Machine Crimp (Hours)	Potential Saved Hours
Oce	93626	390.88855	149.0213833	241.8671667
Crosstown	14132	59.0011	22.49343333	36.50766667
Total	107758	449.88965	171.5148167	278.3748333

Table 3 – Potential Crimping Hours for Current Die Sets Jan 2016-April 2017

A potential savings of 278 hours, or 0.139 employees, would have been gained by automating all possible actions with Oce and Crosstown. Casual observation shows minimal press utilization at present. It is not unreasonable to conclude that total crimping hours are closer to 449 than 171.

Currently, due to client and capability restrictions, the press only has an operational capacity of 8.58%. As the press has the potential for replacing 2.62 employees, with reduced operator expense, potential savings for rerouting of other pins was calculated and presented in table 4.

	Total Pins	Manual Crimp (Hours)	Machine Crimp (Hours)	Potential Saved Hours
39-00-0038	8937	37.311975	14.224725	23.08725
16-02-0082	30890	128.96575	49.166583	79.799167
16-02-0115	24764	103.3897	39.416033	63.973667
Total	64591	269.667425	102.8073417	166.8600833

Table 4 – Potential Crimping Hours for Optional Die Sets Jan 2016-April 2017

A die set for 16-02-0115 does not appear available, but considering an estimated cost of 10,906 CAD, for the 0038 and 0082 die sets, estimated time to break even would be roughly 7 years at projected utilization. Constraints notwithstanding, acquisition of these two die sets would increase press capacity to 13.72%. Location of used equipment should be investigated.

Furthermore, pressure should be applied to clients, incentivized as reduction in hourly labour rate, for potential substitution of parts. For example, a promised 5% labour rate reduction would allow us a 262% increase in crimping throughput. Considering that 2.62 employees at $15.00 per hour costing $78,600 annually could be reduced to a single $10.85 per hour employee at $21,700 reducing overhead by $56,900, if the press were to operate at maximum capacity.

Maximizing automation should be a primary concern with all clients.

Resource Loss - Labour

Rework and the associated labour and materials costs are of great concern to management. Table 5 lists hours lost to rework, distributed per client.

	Hours	% of Client Build Hours
Oce	71.77	0.85%
Ballard	19.17	0.87%
Crosstown	4.38	0.36%
Radius	7.75	0.47%
Cyclotron	0	0%
New World	6.42	0.41%
All others	8.78	0.34%
Total	118.27	0.66%

Table 5 – Rework Hours per Client Jan 2016-April 2017

Annualized, total rework was 88.70 hours accounting for 0.66% of total build hours. Oce and Ballard present a disproportionate amount of rework. Oce rework is likely a combination of loss of diligence due to complacency and the infusion of new employees while Ballard suffers from increased complexity. While any amount of rework must be minimized, and the author does not have full confidence all rework is reported, the current amount of labour is not alarming. Fully automating crimping, where available, would have offset this loss by a factor of 3.15, for example.

Resource Loss – Material

Cumulative inventory adjustments from January 2016 to April 2017 totaled -4128.10; Total Loss Due To Error is summarized in table 6. Peripheral waste is also occurring off record (Pelican cases), the scope of which is not available for this report.

	Total
Labour Loss at 15.00 per Hour	-1330.5
Adjustments due to rework	-2630.4
Scrap	-92.51
Damaged	-74.69
Total	-4128.10

Table 6 – Annualized Total Loss Due to Error

Assembly

Assembly processes were analyzed and were all found to follow a logarithmic Gaussian probability distribution, with kits received per day following a Poisson distribution. The identification of the probability functions allow for the correct application of summary statistics, mainly the geometric mean (μ), exponentially derived standard deviations (σ), and Poisson parameter (λ), which provide the correct handling of outliers thus increasing forecast accuracy. Total build time of all Oce processes are shown in figure 2 and with a logarithmic scale in figure 3.

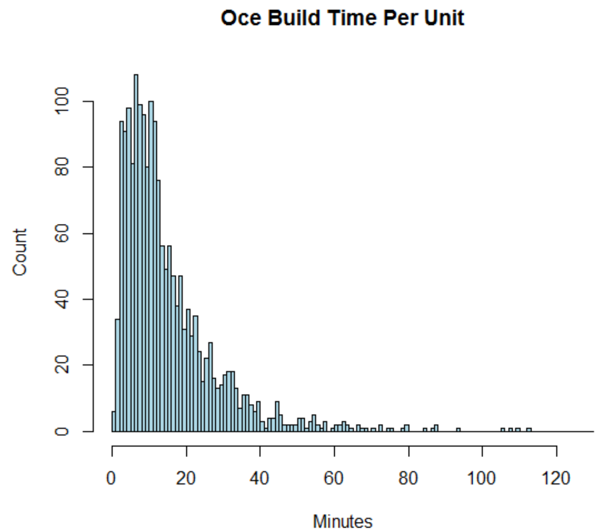

Figure 2 – Oce Total Unit Build Time Jan 2016-April 2017

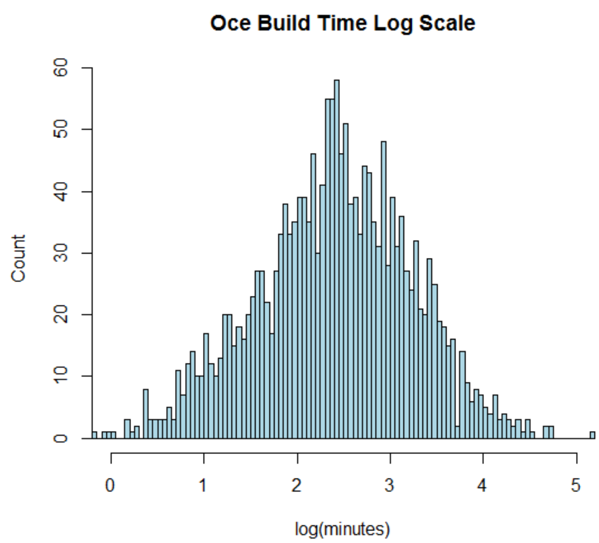

Figure 3 – Oce Total Unit Build Time – Log scale. Jan 2016-April 2017

Computing average build time from the linear distribution produces an incorrect estimate of 15.32 minutes per unit, while the geometric mean, computed from the logarithmic scale gives central tendency closer to 10.97* minutes.

Computed means for Oce units per kit and Oce kits per day are summarized in table 7.

	Total
Time per Unit (Log Gaussian)	10.97
Units per Kit (Log Gaussian)	24.11739
Kits per Day (Poisson)	5.8
Total Estimated Hours per Year	6649.47

Table 7 – Computed Geometric Means of OCE

The estimated total hours per year of 6649.47 differs from recorded hours of 7513.55 by 12.2%. Such a small difference shows the predictive model to be fairly accurate when constrained to assembly time. Further refinement will occur once more accurate data for kitting, shipping and quality control is acquired. True standard times, reasonable control limits and accurate process behavior are then readily extracted.

*To convert from log time to linear time read the value from the log scale x axis and compute via Euler's constant (e^2.395164 min = 10.969997 min)

Process Breakdown

Process analysis for samples representing 80% of Oce's revenue was undertaken. A representative sample, Oce 3010120306, is presented in Figure 4. Mean process time is displayed while control limits are set at 1 standard deviation (34.1% from mean). Breakdown as follows: each count represents a new kit being received, process time is for an individual unit and rework is excluded.

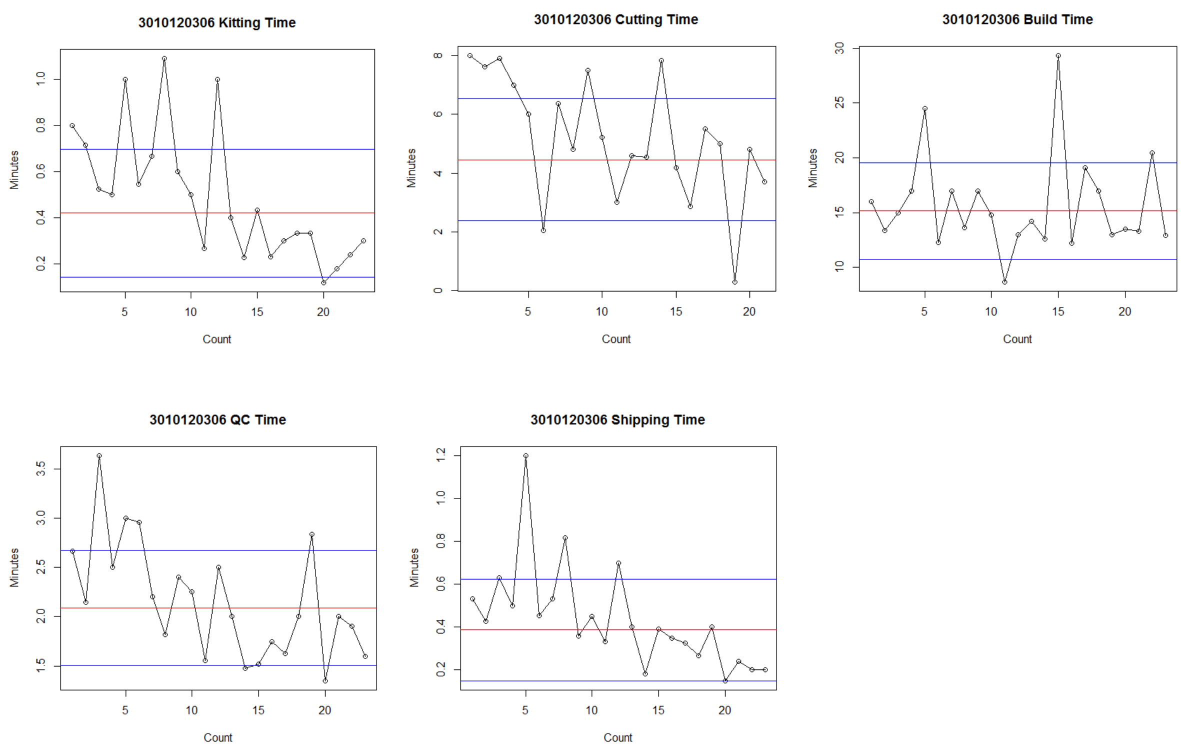

Figure 4 – Oce 3010120306 Process Times Jan 2016-April 2017

All processes display an extreme amount of variance. There is no logical reason for an identical action to vary by over 200% on a unit per unit basis, particularly quality control where the process is mostly visual and performed by the same employees. Such variance is present in all processes for all assemblies. Any discussion of explanations must consider improper time keeping and lack of consistency due to complacency. Minimization of such variances should be the primary concern for improvement.

Required Assemblers versus Actual

For the period of January 2016 through April 2017, Euro Solutions has an employee recorded build time of 17,928.54 hours (see Table 1). Annualized to 13,446.41 hours, and reflecting only building, this figure reflects the need for 6.72 assemblers. At present, the author has counted 11 assemblers with the number growing as other departments are recruited. The discrepancy between a capacity of 22,000 hours and a recorded 13,446 hours needs immediate investigation.

Quality Control Capacity

For the period of January 2016 through April 2017, Euro Solutions has an employee recorded quality control time of 1,231.82 hours, annualized to 923.87 or 0.46 employees (see Table 1). At present Euro Solutions has 3 quality control inspectors plus various employees assisting via cami inspection. Multiple routes through the quality control process have led to extreme variance in both inspection time and construction of what is considered acceptable. Standards are not clearly defined amongst quality assurance and remain the subjective opinion of the individual inspectors. This entire process could be streamlined to a single employee as a part time function.

Current Assembly Routing

At present, assemblers are treated as individual lines with projects scattered across multiple lines depending on the availability of staff. See table 7.

<table>
<tr><td>Assembler 1</td><td>Oce</td><td colspan="2">Ballard 1/2</td><td>Crosstown 2/3</td></tr>
<tr><td>Assembler 2</td><td colspan="2">Crosstown 1/3</td><td>Radius</td><td>Oce</td></tr>
<tr><td>Assembler 3</td><td>Oce</td><td>Garaventa</td><td>Algo</td><td>Crosstown 3/3</td></tr>
<tr><td>Assembler 4</td><td>Ballard 2/2</td><td>Radius</td><td>Oce</td><td>Algo</td></tr>
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<tr><td>Assembler N</td><td>Job 1</td><td>Job 2</td><td>Job 3</td><td>Job 4</td></tr>
</table>

Table 7 – Typical Job Routing per Assembler

Distribution of projects across all lines has been prioritized, partially due to employee fatigue but primarily from a lack of project planning. Such dispersion makes it difficult to track a project since again we are tracking individual employees versus the project. Substantial startup costs are incurred by the constant reshuffling of employees. This duplication of labour introduces slippage when jobs are divided into small batches with no clear reason other than complaints that an assembler cannot work on the same project for more than a few days. Such complaints are unreasonable. While the assembler may fatigue and “stall” after a few weeks on the same project, it is unlikely such fatigue would occur after a couple days and more likely the assembler would accelerate as they become proficient at the task.

By having frequent job rotation employees fail to become highly proficient at any particular task. This is demonstrated by excessive variance when assemblers are compared against themselves and each other. Employee proficiencies are not harnessed and pooled towards a common task. The result is a collection of employees who perform moderately on all tasks versus highly refined, more specialized groups.

A further complication is the introduction of complex alpha-numeric batching schemes. These schemes fail to maintain process conformity and simplify production but introduce further layers of abstraction that only serve to confuse and burden employees.

Production Performance

Production is currently being driven on a deadline basis. The only performance metric by which overall production performance is measured on is on-time delivery, but this metric is unable to measure efficiency. A two week job would appear “successful” as long as it was completed by the ship date, regardless of actual hours spent. An aggregate of each assembler’s contribution is failing to properly measure production performance, particularly as the supervisor’s organizational performance cannot be directly measured through employee build times.

Employee Performance

Since employees have no objective standards to meet, they are unable to gauge their performance against themselves and others. The only feedback an employee may receive is when an error arises; presenting the erroneous conclusion that performance may be substandard or, worse, the employee feels targeted. Conversely, inordinate praise of some employees presents the impression of favourites. Qualitative feedback needs to be minimized. It cannot be measured and, by definition is subjective and debatable. All employees need to be measured by the same method and performance standards, once defined.

Conclusion

The difficulties Euro Solutions face result from a combination of dysfunctional command structure, broken process flow and lack of clear, delineated employee responsibility, in that order. The application, and reliance, on ineffective process measurement techniques offer an ambiguous picture. The illusion of progress appears on the micro scale, but at disagreement with the bottom line; the colloquial reference being the inability to see the forest for the trees. It is the author’s opinion that restructuring Euro’s production to a modular linear process flow be adopted. All quality related processes including, but not limited to, document control, the quality management system, quality assurance, key performance indicators and facilities management be centralized under a single authority. Centralizing authority ensures the integrity of quality assurance, follow-through of tasks and cessation of cross process encroachment. Finally, a detailed statistical process control system be constructed and implemented to measure process trends and accurately provide near real time feedback on any process or employee.

Part II - Restructuring

Linear Process Flow

Of primary importance is the partitioning of processes from each other. Creating firewalls around each process will serve to protect internal process flow by defining clear gated inputs and output while providing access points for accurate process measurements. Figure 5 presents the proposed modular, linear process flow model. Each process, shaded blue, lists the process authority, with reporting subordinates shaded green.

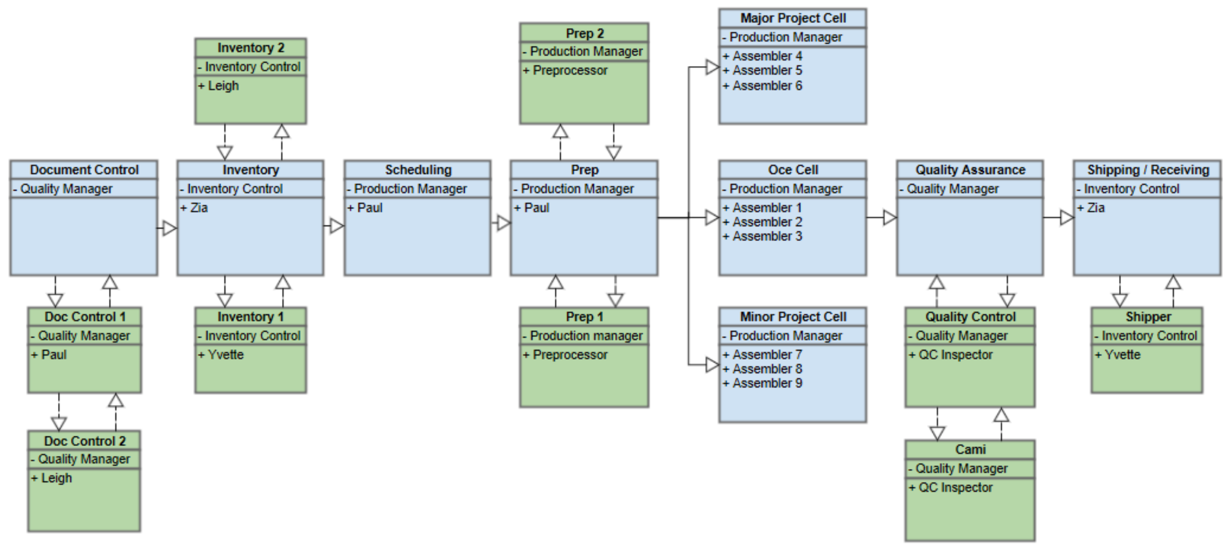

Figure 5 – Modular Process Flow

Processes flow the same as figure 1, but gated authorities restrict who and what can traverse production flow. Each process becomes a self-sufficient module that triggers on automatic signals; that is, they don't require concerted employee interaction.

Employee Integrity

Employees have an immediate authority through which information will flow. Clearly defined responsibility and reporting authorities reduce confusion and eliminate the necessity for consensus on how to distribute labour. A reduction in lateral communication, i.e. excessive meetings, is achieved. As employees focus on their primary function, process monitoring becomes more accurate allowing for insight into employee suitability and, with time, increased employee efficiency. Production inertia is not lost due to cross departmental friction, reordering tasks, juggling etc.

System Integrity

System failures are quickly isolated to a single point of failure. Confusion about who had primary responsibility ceases, as does “finger pointing”. Essential employees are eliminated. Loss of a key employee does not cripple the system in multiple locations. Distinction must be made between cross trained employees, who serve as backups, and simultaneous function duplication. Simultaneous function duplication, i.e. having 3 schedulers, serves to reintroduce cross process interference and diffusion of responsibility. Backups should be pulled from the assembler pool, not from ancillary support functions, as to not introduce other system gaps. Increased production time should always be favoured over process breakdown.

Maintaining process isolation is paramount. If vigilance is not undertaken to maintain process integrity the modular design will devolve into a chaotic structure. Undergoing a transition period, a central authority, namely the Quality Manager, would serve to direct flow.

Modular Assembly Cells

In a modular cell design, individual lines, typically 3 or 4, are combined to provide focused effort on a project. Cells should operate autonomously with minimal supervision once initiated and should not interfere with each other. Cascade failure across cells must be avoided, as one cell’s problem must not affect another cell. Each cell may function in a typical lean fashion, with standalone work stations, or a miniaturized segregated line, depending on the projects nature and the production manager’s discretion. Table 8 displays one possible configuration.

Oce Cell	Oce			
Major Project Cell	Crosstown		Ballard	
Minor Project Cell	Algo	RCMP	Leading Edge	BC Hydro

Table 8 – Tri-Cellular Model

Prior to project initiation, cellular layout would be determined given constraints of labour required, labour available and desired time frame. Employees should be assigned to a cell on a permanent or semi-permanent basis, primarily to enforce role responsibility, but to foster a group effort and appreciate “the big picture”; targets versus actual work flow. Ideally the floor should be grouped by cells to reinforce the partitioned mentality. Once a stable labour pool is determined, production can be scheduled in advance, where it is most convenient, versus an uncoordinated last minute effort with disproportionate, mismatched or expensive labour.

Major Project Cellular Construction

Major project cells should be configured for sustained, continuous effort without any specialized expertise, i.e. surface mount soldering. A major project cell should combine 3 or more moderately skilled employees, with each employee having a similar skill set, on a semi-permanent basis. Increased resistance to a missing employee, particularly a “rock star assembler” whose skill is frequently used to cover shortfalls in scheduling, is gained. Capacity should typically run at 75% with the expectation than individuals are able to increase capacity for a short period in the case staffing issues. That is, a project expecting to take 100 hours and requiring completion in 3 days would require 6 employees at 75% capacity or 4.44 employees at 100% capacity.

Minor Project Cellular Construction

A minor project cell consists of essentially an ad hoc collection of small project lines. A minor project cell should be reconfigured frequently on a project by project basis, and consist of more specialized employees; both in the sense of highly refined, project necessary skill, and low skilled, general labour. While the cell may appear as simply a collection of floating employees, it would more accurate to treat the cell as a module with rapid project turnover. Cell members would focus all attention to a single project, when possible, to avoid duplicated startup efforts and line cross contamination. Production deadlines and resource constraints would dictate daily cell planning. Essentially, all employees not deployed to a major project cell would be assigned to a minor cell. Minor cell use should be minimized as it retains the difficulty of tracking project throughput

Efficiencies Gained

A cell’s throughput becomes simple to manage as quoted labour time for the project can be directly compared to the cell’s output. In near real time daily, or weekly, production targets are readily followed. Adjustments to planning can be proactive versus reactive, perhaps months later, after capital is lost. Projects being produced at a consistent, predicted rate become resistant to focus loss, employee burnout and missed deadlines while reducing the need for management oversight. Since cells can be expanded and duplicated as necessary, a modular design scales as necessary to changing business cycles. The adoption of modular cells drastically simplifies scheduling and micro management of individual lines which, at present, is unstable and inefficient. Employees will also gain proficiency at their assigned tasks, complaints notwithstanding.

Part III – Immediate Action

Command Structure

Modular process flow, depicted in figure 5, can be realized immediately. Once core members are familiar with their position, responsibility and reporting authority enforcement by the quality manager can be relaxed.

Quality Management Centralization

Centralization of quality functions under a permanent quality manager should occur immediately, particularly document control. An increased oversight will help to reduce bottle necks, while offloaded responsibility will help free up labour elsewhere.

Segregation and Assimilation

Since it is not feasible to shut down production for restructuring and retraining, a divide and conquer approach is warranted. As Oce represents the greatest share of revenue, the lowest profit margin and high rework, they offer the greatest potential multiplier for immediate efficiency improvements. Processes and control mechanism can be implemented around the stability Oce provides. Once fully matured, control mechanisms can be applied to other cells.

Oce Cell Construction

Three employees, based on previous annual workload, should be chosen to form the Oce cell and located at the same workstation. The employees should be experienced and equally skilled. Oce represents Euro's core-competency; it must be partitioned and protected. New employees should not be used as the goal is maximizing the multiplier effect of gained efficiencies. Employees may cycle through the cell in a FIFO queue on a quarterly or semi-annual basis. That is, every 3-6 months the senior cell member is removed and replaced.

Oce Queue / Scheduling

Kanban, by its nature, is self-scheduling, creating a queue as bins are received. Reordering this queue based on employee preference wastes resources. Scheduling of Oce Kanban should be eliminated in all cases, with the exception of client requested preemption. The Oce cell will work according to the received bin order. This queue provides sufficient randomness, both in received bins and in recorded clipboard order, to avoid complaints of repetitive work and unfair assignment.

Molex Press Schedule

As noted in table 3, the Molex press only has a potential utilization of 7.45%, when restricted to Oce. Regardless, a potential savings of hundreds of hours per year must be realized. Due to the low utilization, preemptive scheduling of press jobs isn't required. An immediate solution would be for the Oce cell to utilize the press when possible by flagging press bins with a distinct colour and jumping ahead in the queue if the press is presently occupied; reverting to the previous queue item when the press becomes available. Full implementation of the press will increase Oce's throughput by 3.22%, immediately. As press utilization is increased, a distinct press schedule can be constructed.

<u>Quality Control</u>

To maintain modular design a single person should be assigned to quality control, both for visual and cami. This function could be performed at a fixed time, 7am-11am, or on an as-required basis. A rotational schedule could also be developed if employees desired. A fixed inspection time reduces necessary signaling from employee to employee; the employee wouldn't need to check, while eliminating friction from task shuffling.

This module's capacity could be expanded, 7am-330pm, and duplicated as necessary. Centralizing quality control will eliminate subjective discrepancy. Using skilled labour to perform cami functions may appear as a misapplication of labour, but value gained by increased inspector efficiency and increased diligence would offset any labour cost. Current cami staff, preprocessors or new assemblers, illustrate further examples of process encroachment. Restricting new assemblers would create more opportunity for improving their assembly skills as opposed to shouldering busy work.

Furthermore, measurement of the quality control process would become vastly more accurate reducing variance. External NCR's could be being traced to a single source versus a potential of 5 or more employees.

<u>Collective / Individual Process Measurement</u>

Self-reporting is not accurately capturing true production time. Accounted time is lost as employees move from task to task and make poor estimates. Throughput of a cell should be monitored, in real time, by its daily production. Since standard times of Oce kits have been calculated, it is a trivial matter to assign production targets to a cell. A daily, or weekly, production display will provide the assemblers with quantitative, non-biased feedback on their group performance. Once Oce standards are well established employees can be transitioned away from individual time keeping which will reduce book keeping.

Other Oce functions which are not well established, kitting, cutting, quality control and shipping will be monitored via various control charts (X/R, Q). Control charts will help to refine process expectations which will allow for a simple throughput metric to be established. Eventually time tracking will be phased out from these processes. Computing employee efficiency becomes a simple matter of monitoring daily output against established standards.

Part IV – Mid Term Action

(This section to be expanded as required)

Individual employee performance metrics

Fully realized training procedure and evaluation process

Reconstruction of ISO Metrics to better reflect quality objectives

MRP Expansion, LSR and PLT automation

Floor adjustments / Inventory centralization.