
Data-Driven Maintenance Operations

Training Session for Competency

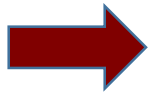
Richard G. Lamb, PE, CPA, ICBB

Tel: 832-710-0755

Email: rchrd.lamb@gmail.com

Website (educational): <https://analytics4strategy.com/>

Agenda:



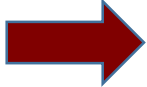
- ❑ **Purpose of the training session.**
- ❑ **Competitive North Star for maintenance**
- ❑ **Structure North-Star maintenance processes**
- ❑ **Description of the North-Star processes**
 - **Mandatory practice and process**
 - **Workload and service interval processes**
 - **Maintenance capacity processes**
 - **Recountive insight processes**

Purpose of the training session:

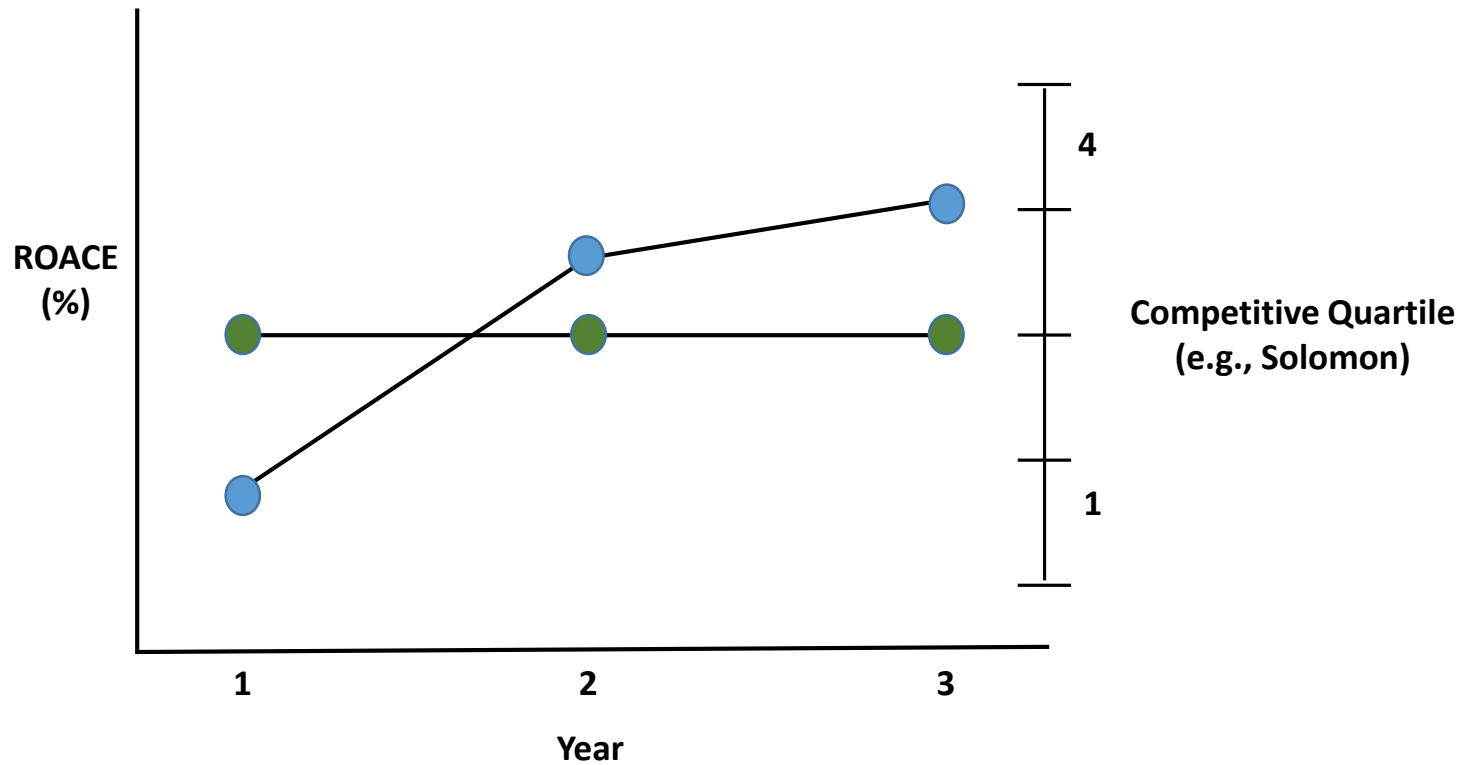
The first step to becoming a data-driven operation is that process role holders must reach a clear, implementable understanding of what it entails. Training to distribute the understanding is the prerequisite to this session—First Step to Becoming a Data-Driven Operation.

The purpose of this session is to describe the particular data-driven maintenance processes to achieve a plant's inherent maximal uptime, stay abreast of its site and facility deterioration, and match a plant's maintenance capacity to those ends. The subject processes are remarkable because they are only possible through data-drivenness.

Agenda:

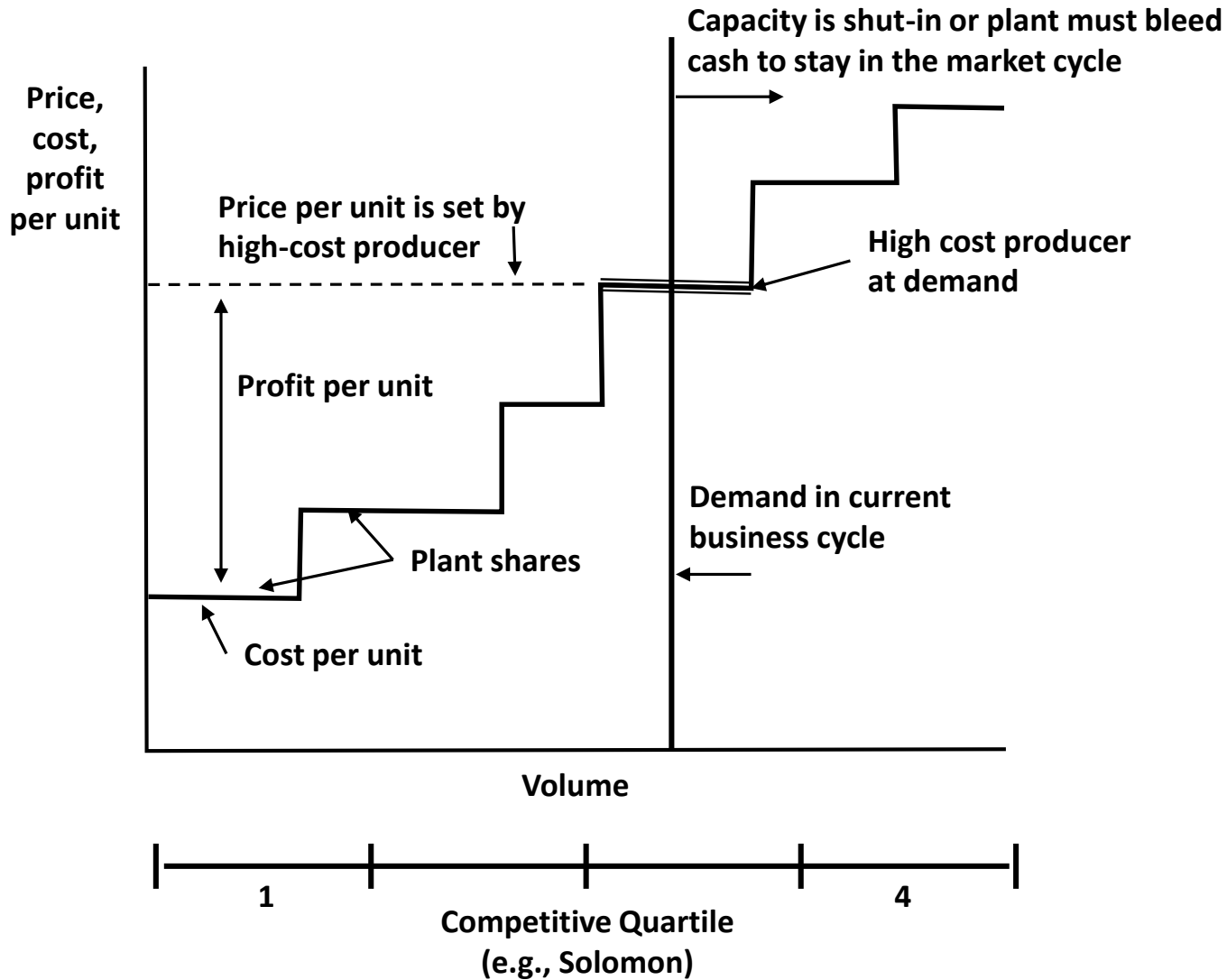
- ❑ Purpose of the training session.
-  ❑ **Competitive North Star for maintenance**
- ❑ Structure North-Star maintenance processes
- ❑ Description of the North-Star processes
 - Mandatory practice and process
 - Workload and service interval processes
 - Maintenance capacity processes
 - Recountive insight processes

All firms chase the same prize regardless of the basis of competition—a rate of return above the average of its industry

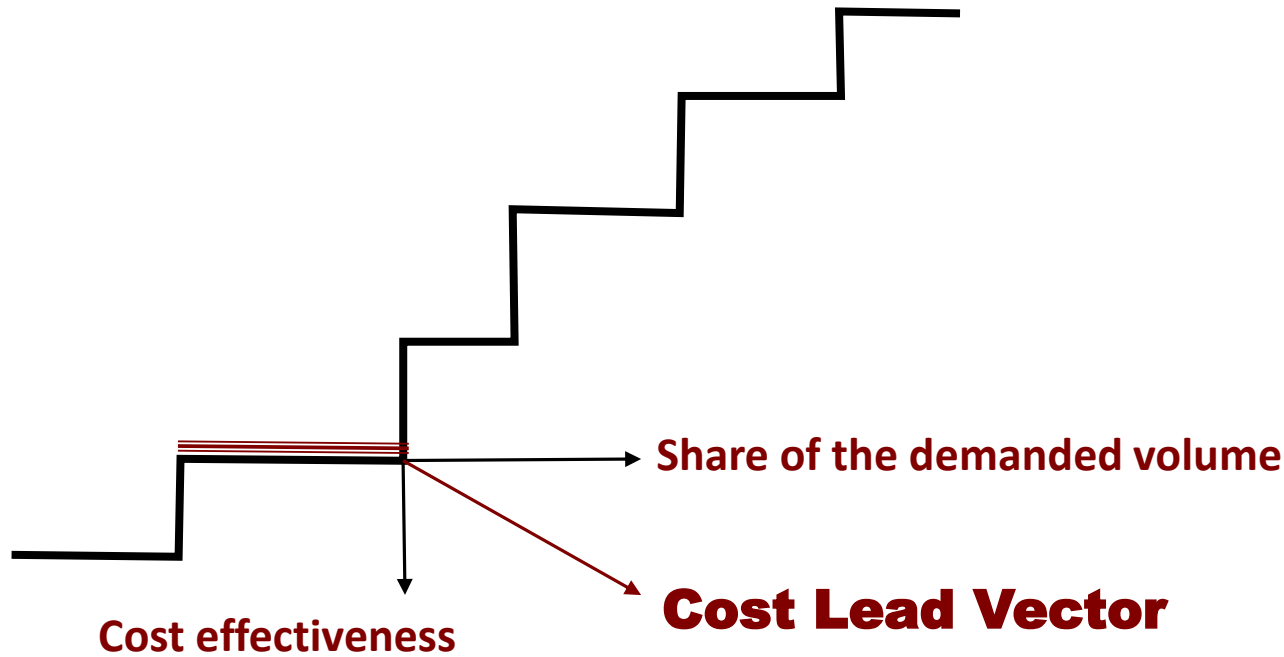


Losers are eventually consumed or pushed out by the winners; something most of our careers have been stung by at some point.

To link plant maintenance and reliability to competitiveness let's look at the core-most basis of competitiveness to commodity industries—cost leadership



The competitive purpose of maintenance and reliability can be depicted as a firm's place in an industry's hierarchy of cost leadership



The overall objective is to drive the Cost Lead Vector to the right and downward.

Maintenance operations have a direct mandate with respect to the **Cost Lead Vector**

- **Recognize and do the work at all levels of the maintenance operation to:**
 - **Sustain the readiness of production assets to deliver the aggregate and weekly production plan.**
 - **Stay abreast of site and facilities deterioration.**

- **Establish and function with the maintenance capacity that matches the workload of readiness and deterioration—craft and staff head count, parts and materials, equipment and facilities.**

A firm's success in the mandate for maintenance operations can be measured as a readily constructible proxy to ROACE (Return on Average Capital Employed)

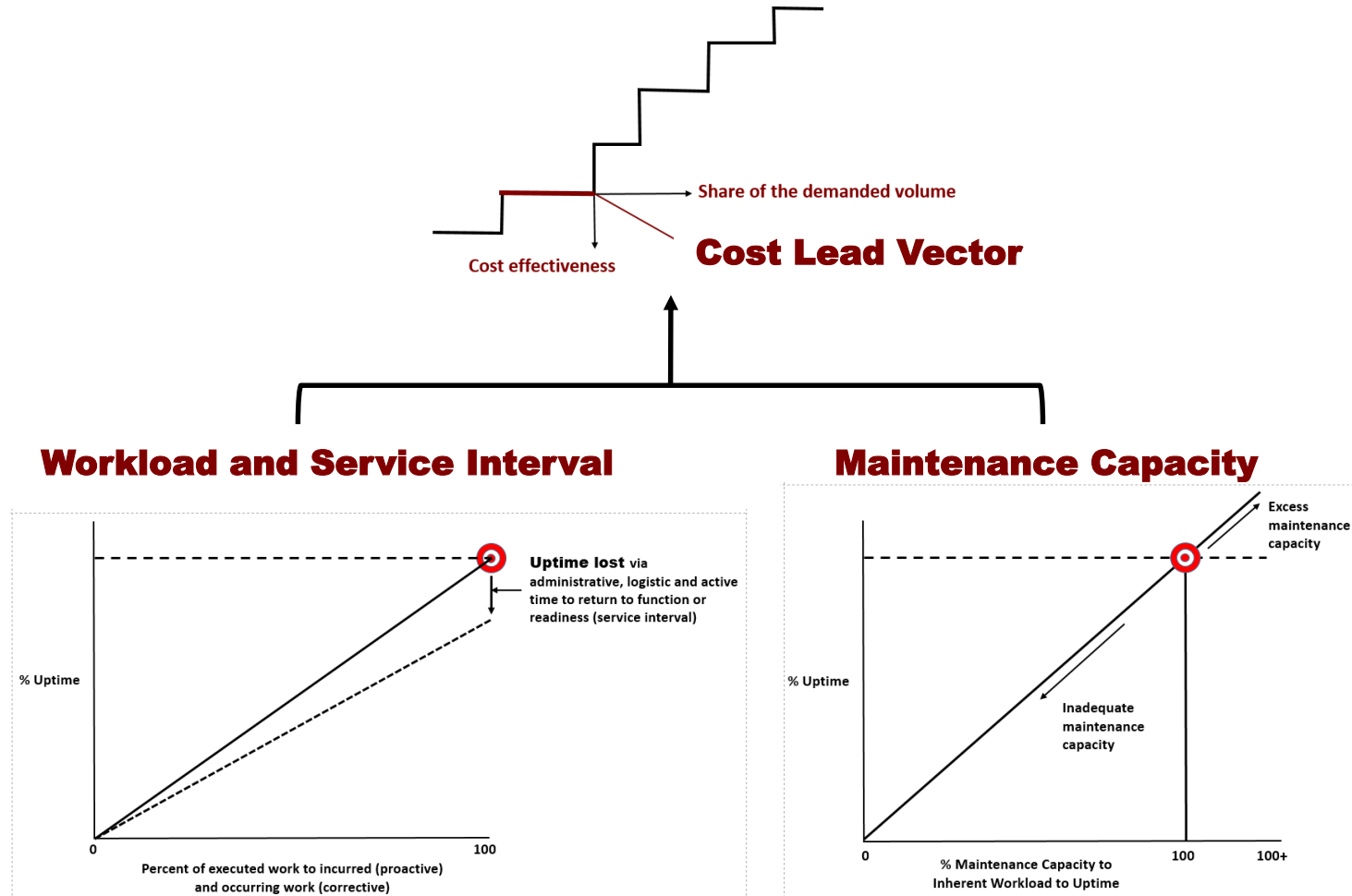
$$\text{ROACE} = \boxed{\text{Unit profit as Percent}} \times \boxed{\text{Ratio Revenue to Assets}}$$

$$\text{Proxy ROACE} = \left[\frac{\text{PricePerUnit} - \text{MaintenanceCostPerUnit}}{\text{PricePerUnit}} \times 100 \right] \times \frac{\text{PeakProductiveCapacity} \times \% \text{Uptime} \times \text{PricePerUnit}}{\text{AssetReplacementValue} + \text{MaintenanceAssets}}$$

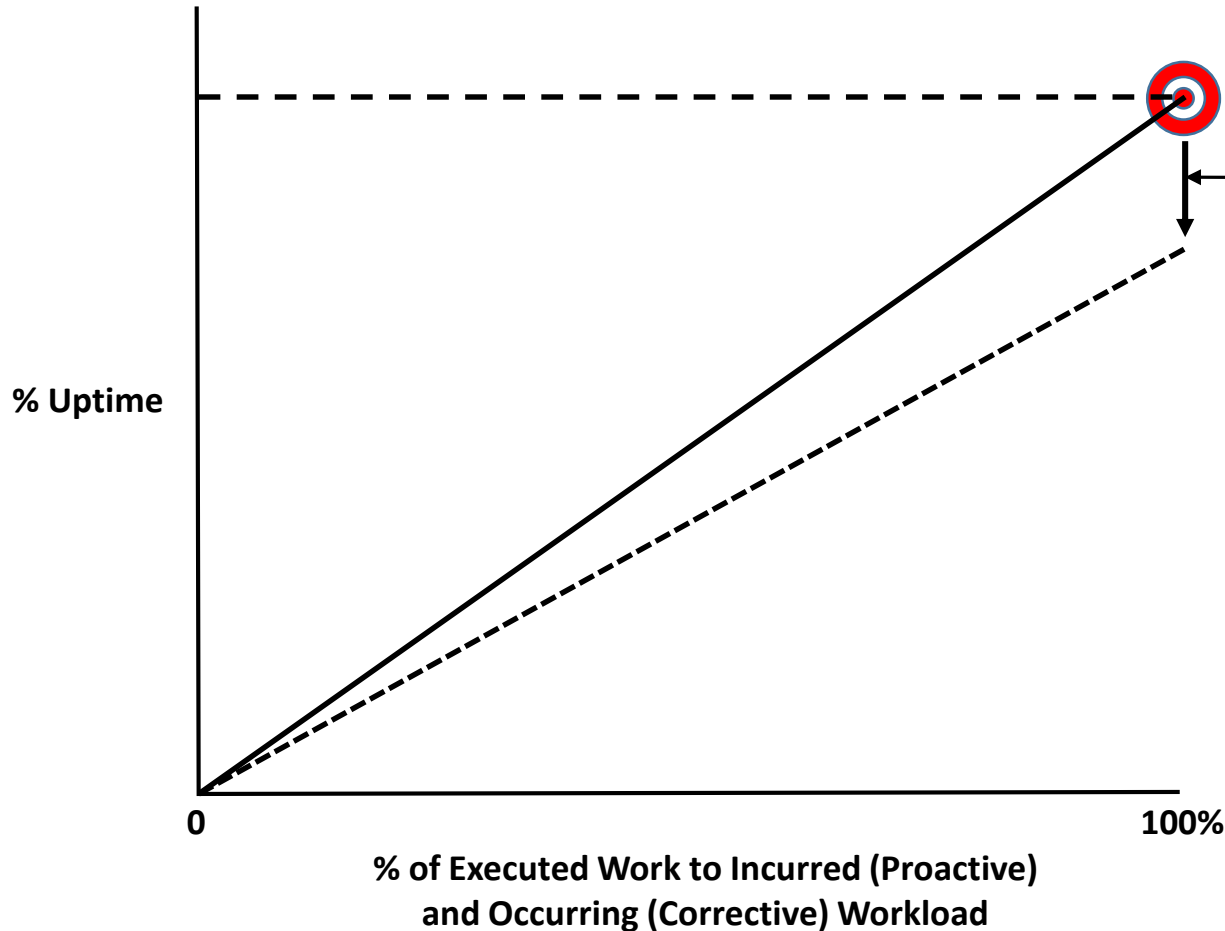
- The proxy will compute a higher than overall ROACE, but allows to isolate influence of the workload of uptime and maintenance capacity on ROACE.
- The training session will focus on the factors to ROACE that operational practices directly influence—maintenance cost per unit and delivered inherent Uptime.
- Assets in the P-ROACE:
 - Replacement value (RAV) is decided by engineering and maintenance assets by policy.
 - Maintenance assets have minor effect on Ratio Revenue to Assets, but play through the effect of service interval on Uptime

See paper, "[ROACE: Financial North Star to Maintenance and Reliability Operations](#)" for explanation of standard ROACE.

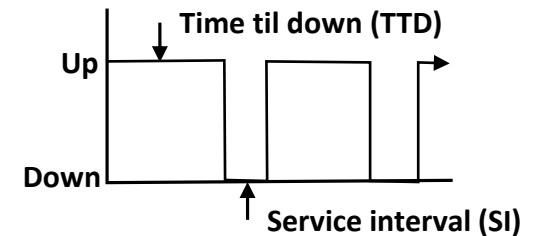
Uptime and cost per unit in the Cost Lead Vector are linked to two specifiable, manageable dimensions of a data-driven maintenance operation



All plants have a workload inherent to targeted uptime and deterioration control, and an inherent service interval to both

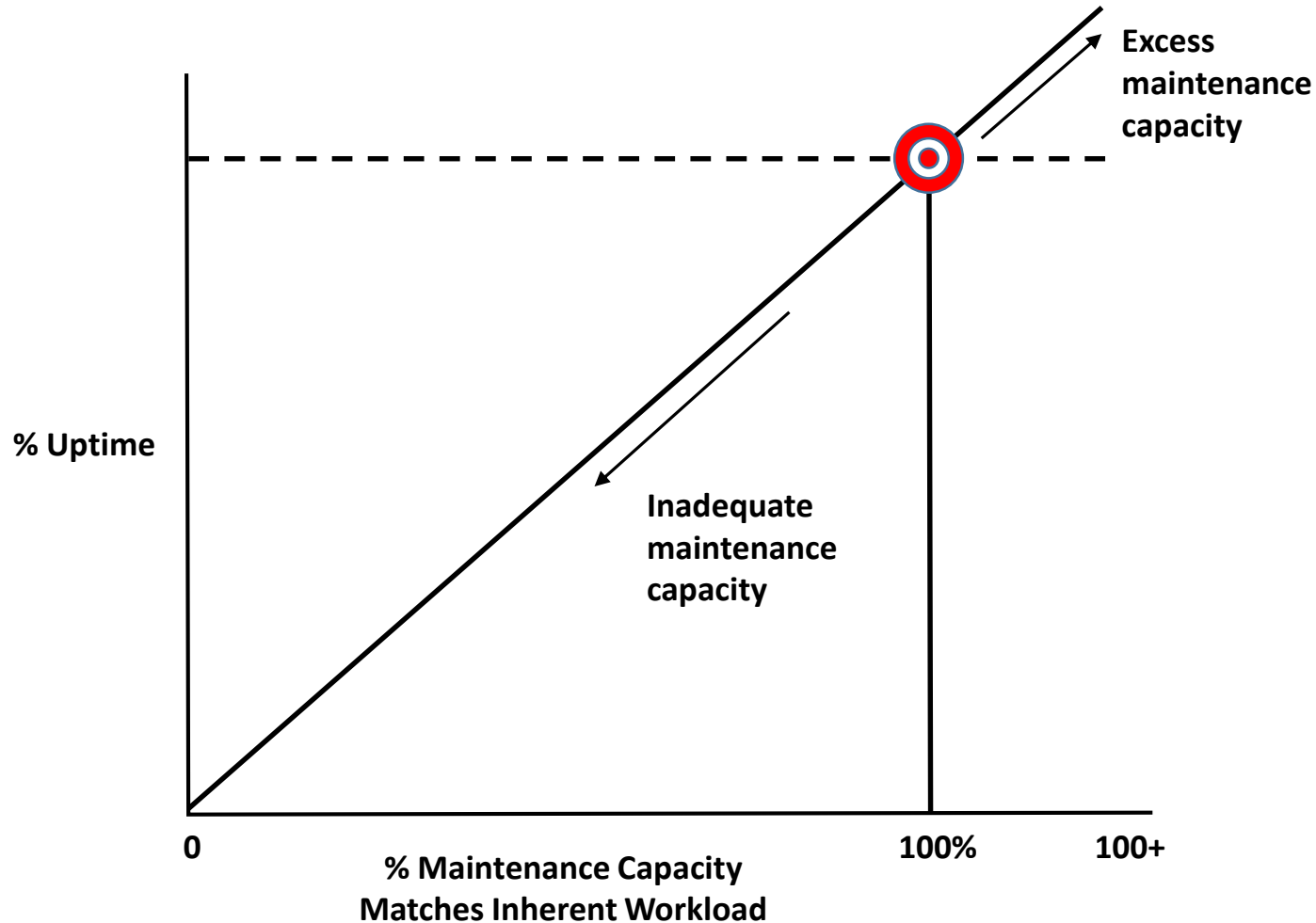


Uptime lost via administrative, logistic and active time to return to function or readiness (service interval)

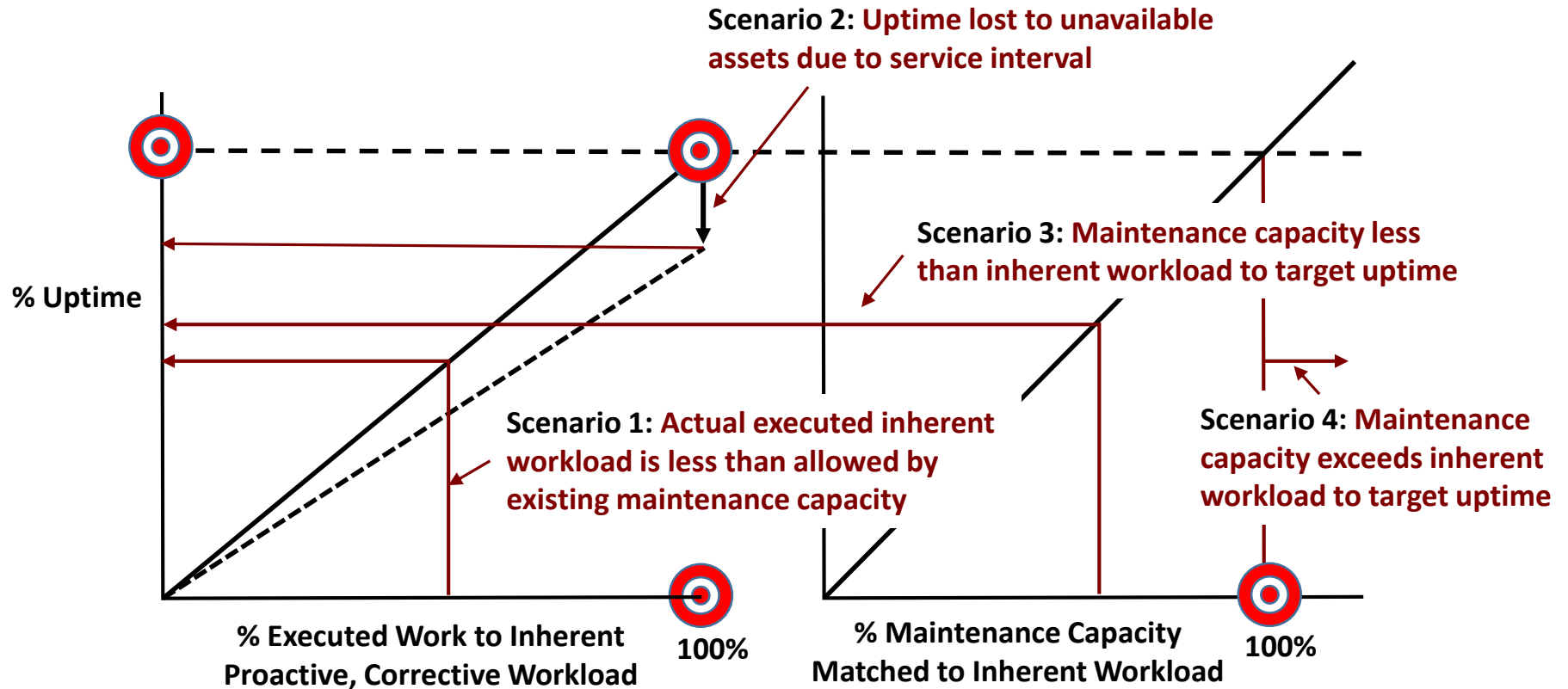


$$\%Uptime = \frac{TTD}{TTD + SI} \times 100$$

Maintenance capacity decides whether or not inherent workload can be executed, but excess capacity reduces P-ROACE



A plant's inherent workload, service-interval effect and maintenance capacity can interplay in four **scenarios** contrary to P-ROACE



The four contrary scenarios of workload, service interval and maintenance capacity variously have a direct **multiplicative** impact on P-ROACE

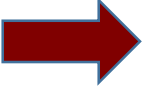
Scenario	Consequence for Proxy-ROACE	
	Unit Profit as Percent	Ratio Income to Assets
1. Executed inherent workload is less than capacity for maintenance.	Reduced by increased maintenance cost per unit.	Reduced as Uptime is less than achievable at existing capacity.
2. Uptime lost to unavailable assets due to service interval	Reduced by increased maintenance cost per unit.	Reduced as Uptime is less than achievable.
3. Maintenance capacity is less than inherent workload	Unchanged.	Reduced as Uptime is less than achievable target.
4. Maintenance capacity exceeds inherent workload to target Uptime	Profit as percent is reduced as cost per unit is increased	Unchanged.

P-ROACE = Unit profit as Percent X Ratio Revenue to Assets

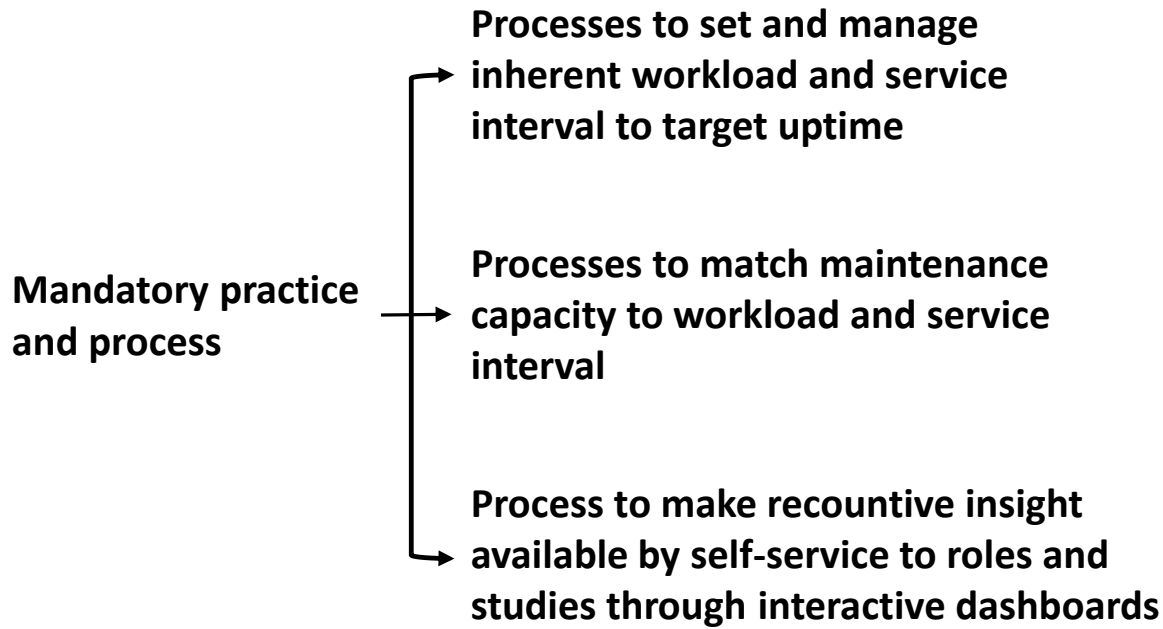


Multiplicative impact

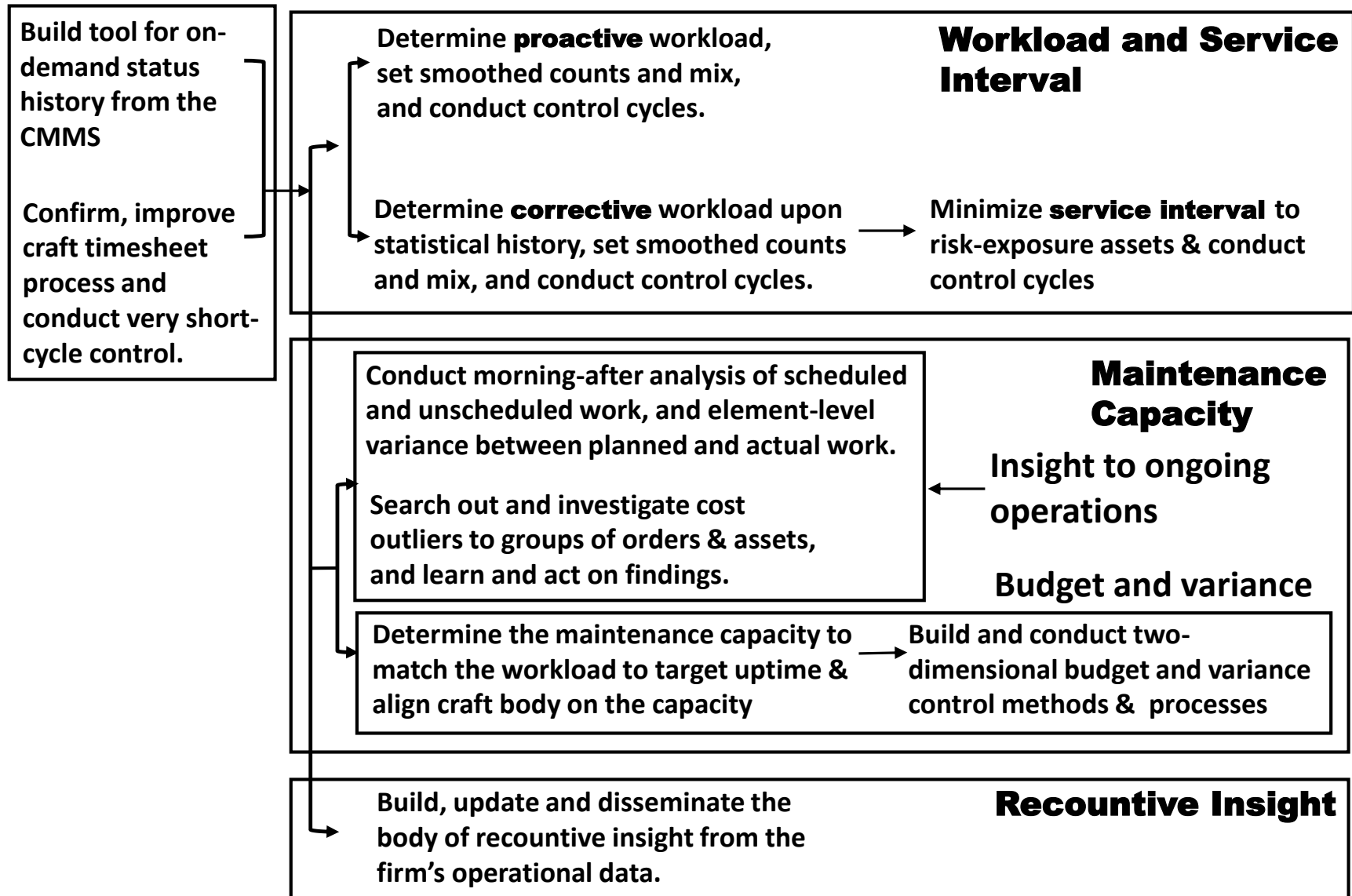
Agenda:

- ❑ Purpose of the training session.
- ❑ Competitive North Star for maintenance
-  ❑ **Structure North-Star maintenance processes**
- ❑ Description of the North-Star processes
 - Mandatory practice and process
 - Workload and service interval processes
 - Maintenance capacity processes
 - Recountive insight processes

Downward from the outcomes of workload, service interval and maintenance capacity to P-ROACE are groups of particular data-driven processes



Working down from the proxy P-ROACE; there are top-level process in which all other best practices of R&M are subordinated



Each process of the structure of processes will be explained in dedicated sections to follow

- The explanations will chart the high-level activities, but are actually frameworks upon which each process will be designed in detail to reflect the firm and plant.
- A generalized implementation plan is by provided and explained in the training session, “First Step to Becoming Data-Driven Operation.”
 - Section titled, “Generalized Implementation Plan.”
 - (download <https://analytics4strategy.com/train-frststpdtdrvnops> with link provided in the session description).
- Threaded throughout each of the processes is the practice of building super tables by joining multiple tables from one or more sources.
 - Introduced in the section to this session title, “Processes for Recountive Insight.”
 - A deep explanation is provided by the section titled, “Gather, Join and Cleanse data, and Form Super tables,” which is also provided by the first step training session.

Throughout all data-driven processes there are control cycles as will be coded in their flowcharts

Code	Definition
VSCC	Very Short Control Cycle: Cycle is less than weekly, next or same day.
WCC	Weekly Control Cycle: Done with respect to a completed business week.
MCC	Monthly Control Cycle: Occurs in conjunction to the reporting cycles at the closing of the books at the month.
YCC	Yearly Control Cycle: Control annually and year-to-date.

Agenda:

- ❑ Purpose of the training session.
- ❑ Competitive North Star for maintenance
- ❑ Structure North-Star maintenance processes
- ❑ Description of the North-Star processes



- **Mandatory practice and process**

- Workload and service interval processes
- Maintenance capacity processes
- Recountive insight processes

Without two types of data—captured in all CMMSs—a plant will be unable to determine and manage workload, service interval and maintenance capacity

➤ Status history to lists of work orders.

- Incredibly CMMS's do not offer the report, but the history data is captured automatically as work orders progress from notification to full close out.
- Status history is actually a simple query that data engineers can develop as a standard on demand report from the CMMS.
- Creating and deploying the data as on-demand report is an easy several day project to one of the firm's data engineers.

➤ Craft hours accurately recorded to the work done.

- It is not unusual to find that hours are recorded to less than 50 percent of the work orders.
- It is also not unusual to find the users of hours data are not aware that they are working with the resulting misinformation.
- Cause is typically poorly designed or unenforced timesheet process.
- Redesign and compliance requires management support one level up from the organizational units that conduct the daily and weekly steps to record craft hours to the plant's payroll process.

Practice: Build tool for on-demand status history from the CMMS

SAP transaction: ZPM_WO_HISTORY

Export to Excel Table

Program Edit Goto System Help

Status History for the Orders and Notifications

Plant 7970 to

Status(in CAPS only)

User Status

System Status

Select Orders or Notifications

Orders

Notifications

Orders

Order 6001108853 to

Reference Date to

Notifications

Notification to

Date Of Notification to

List Edit Goto Views Settings System Help

Status History for the Orders and Notifications

Order/Noti	Status Type	Status	Status Description	Active/In	Date	Time	Name
6001007200	User Status	CANC	Cancelled	Inactive	02/07/2013	11:07:55	USTSU0
6001007200	User Status	CANC	Cancelled	Active	02/07/2013	11:07:55	USTSU0
6001007200	User Status	TCMP	Technically Complete	Active	02/07/2013	11:07:55	USTSU0
6001007200	User Status	WAPP	Work Order Approved	Inactive	02/07/2013	11:07:55	USTSU0
6001007200	User Status	WAPP	Work Order Approved	Active	04/10/2012	12:33:52	USMFA5
6001007200	User Status	WOIP	Work Order in Progress	Inactive	04/10/2012	12:33:52	USMFA5
6001007200	User Status	WOIP	Work Order in Progress	Active	04/10/2012	12:33:52	USMFA5
6001007200	User Status	WOPR	Waiting on Operations	Inactive	02/07/2013	11:07:55	USTSU0

Order/Noti	Status Type	Status	Status Description	Active/In	Date	Time	Name
6001007200	System Status	MANC	Mat.availability not checked	Active	04/10/2012	12:33:52	USMFA5
6001007200	System Status	NMAT	No material components	Active	04/10/2012	12:33:52	USMFA5
6001007200	System Status	NTUP	Dates are not updated	Inactive	04/10/2012	12:33:52	USMFA5
6001007200	System Status	NTUP	Dates are not updated	Active	04/10/2012	12:33:52	USMFA5
6001007200	System Status	PRC	Pre-costed	Active	04/10/2012	12:33:52	USMFA5
6001007200	System Status	REL	Released	Inactive	02/07/2013	11:07:55	USTSU0
6001007200	System Status	REL	Released	Active	04/10/2012	12:33:52	USMFA5
6001007200	System Status	SETC	Settlement rule created	Active	04/10/2012	12:33:52	USMFA5
6001007200	System Status	SSAP	Object created	Active	04/10/2012	12:33:52	USMFA5
6001007200	System Status	TECO	Technically completed	Active	02/07/2013	11:07:55	USTSU0
6001007951	User Status	CANC	Cancelled	Inactive	02/13/2013	15:53:39	USMFA5
6001007951	User Status	CANC	Cancelled	Active	01/30/2013	05:54:11	USTSU0
6001007951	User Status	TCMP	Technically Complete	Active	02/13/2013	15:53:39	USMFA5
6001007951	User Status	WAPP	Work Order Approved	Inactive	01/30/2013	05:54:11	USTSU0
6001007951	User Status	WAPP	Work Order Approved	Active	04/14/2012	15:38:58	PADLJF
6001007951	User Status	WOIP	Work Order in Progress	Inactive	04/14/2012	15:38:58	PADLJF
6001007951	User Status	WOIP	Work Order in Progress	Active	04/14/2012	15:38:58	PADLJF
6001007951	User Status	WOPR	Waiting on Operations	Inactive	01/30/2013	05:54:11	USTSU0
6001007951	User Status	WOPR	Waiting on Operations	Active	04/14/2012	15:38:58	PADLJF
6001007951	System Status	CRTD	Created	Inactive	04/14/2012	15:38:58	PADLJF
6001007951	System Status	CRTD	Created	Active	04/14/2012	15:38:58	PADLJF
6001007951	System Status	MANC	Mat.availability not checked	Inactive	04/14/2012	15:38:58	PADLJF
6001007951	System Status	MANC	Mat.availability not checked	Active	04/14/2012	15:38:58	PADLJF

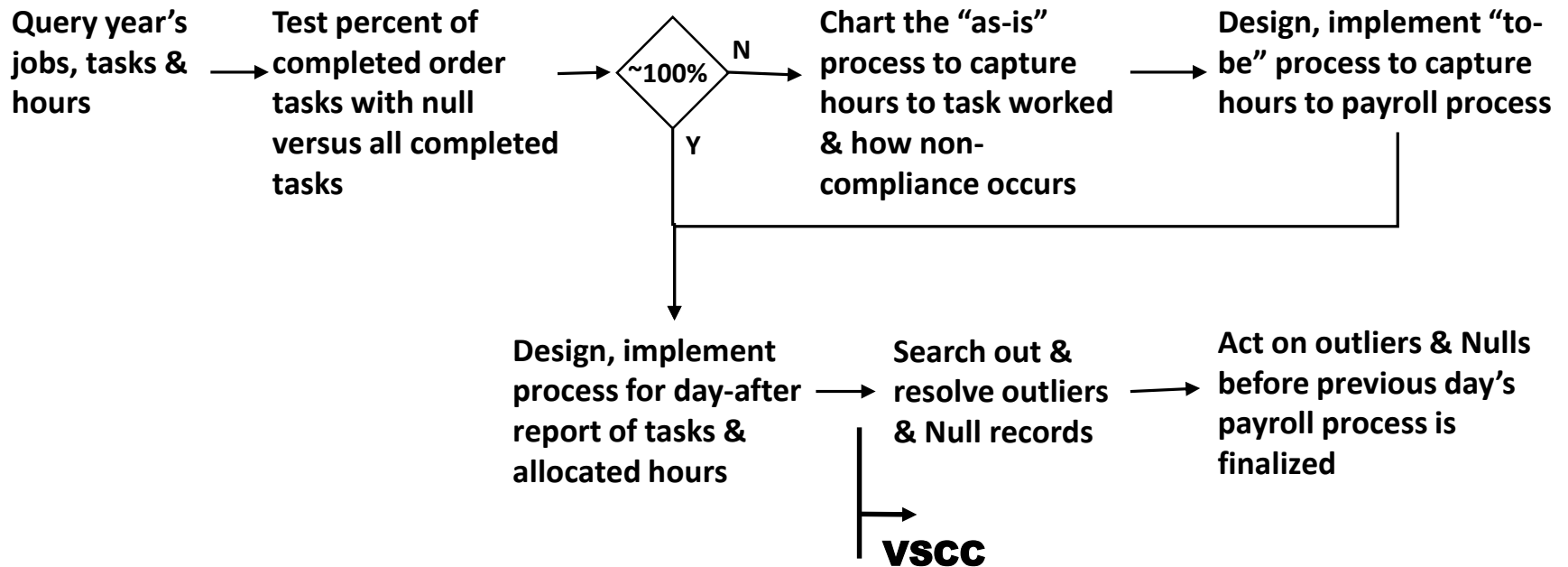
Take same route with respect to notifications

Join the status history to the detail of the notifications through SAP IW29: List of notifications (Done with MS Access query functionality)

- 1 Notification
- 2 Order
- 3 Description
- 4 User status
- 5 System status
- 6 Cost center
- 7 Planner group
- 8 FunctLocation
- 9 Created on
- 10 Changed on
- 11 Description2
- 12 Main WorkCtr
- 13 Notif.date
- 14 Notifictn type
- 15 Priority

Note that the example (SAP CMMS) delivers the what-when detail that is foundational to the analyses and control of any operation through its processes

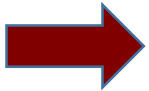
Process: Confirm, improve craft timesheet process and conduct very short-cycle control



- Day-after VSCC is warranted because accurate allocation is life-is-blood data to maximizing P-ROACE.
- Without accuracy, data is only valid at the boundary that a particular body of crafts operate, below that data is misinformation.

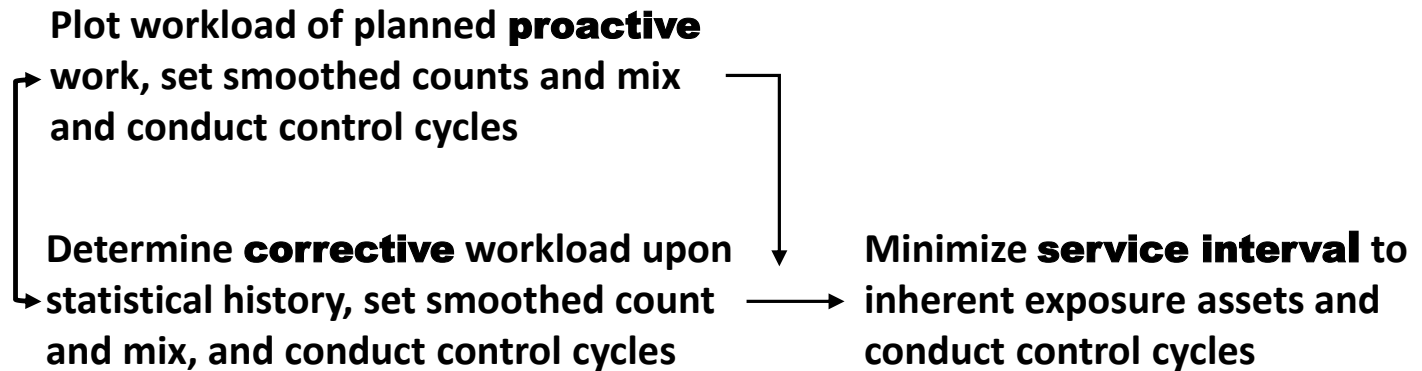
Agenda:

- ❑ Purpose of the training session.
- ❑ Competitive North Star for maintenance
- ❑ Structure North-Star maintenance processes
- ❑ Description of the North-Star processes
 - Mandatory practice and process
 - **Workload and service interval processes**
 - Maintenance capacity processes
 - Recountive insight processes



The platform determinate of realizing targeted uptime and protecting asset value is to quantify and timely execute the workload to sustain both

Process designed to manage to 100 percent compliance to orders “created” by the proactive system, but smoothed to day and week



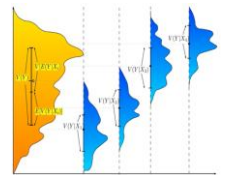
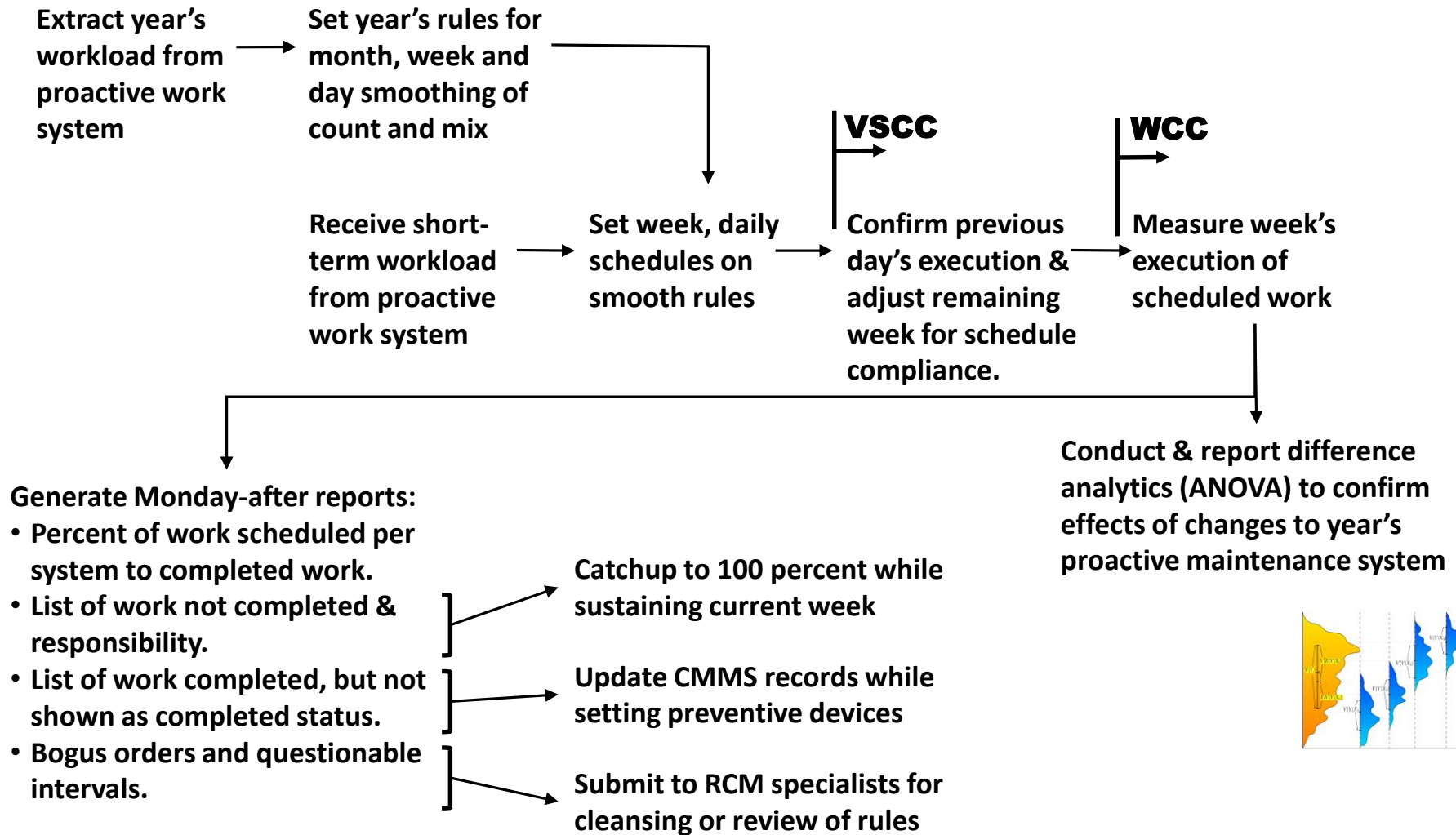
Is workload changing after removing any cycles to occurrence? Are business cycles to production a lead indicator to future workload?

Theory of spared assets to prevent lost uptime does not apply to individual observations in a statistical set —exposure exists because expected failure of spare is only knowable within a confidence interval

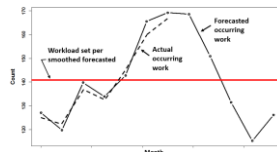
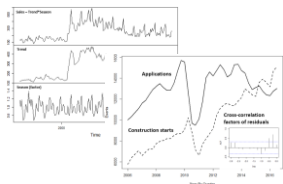
There is a set of principles that are inherent to establishing the year's workload

- All plants have an inherent workload to any given level of aggregate production for the year.
- The workload is quantifiable by plan (proactive maintenance) and by statistical analytics (corrective maintenance).
 - See paper: "[Setting the Budget for Maintenance Workload.](#)"
- The link from workload to maximally cost effective matching maintenance capacity is the outcome of smoothing the count and mix of work orders.
 - See paper: "[Set Maintenance Craft Capacity on Forecasts, Not Backlog.](#)"
- Time series analytics looms large to determining inherent workload and smoothing.
 - See paper: "[Explore what Did and May Happen with Time Series Analytics.](#)"
- Duration analytics looms large to determining maintainability for risk exposure assets.
 - See paper: "[Find the Time that is Money By Asking Durations Questions.](#)"
- The determined workloads are the target metrics to plant function rather than rule-of-thumb to maintenance metrics.

Process: Plot workload of planned **proactive** work, set smoothed counts and mix, and conduct control cycles



Process: Determine **corrective** workload upon statistical history, set smoothed count and mix, and conduct control cycles



Establish corrective maintenance work; grouped by distinctions

Conduct time series analytics to each group for cycle, trend & lead indicators to shift

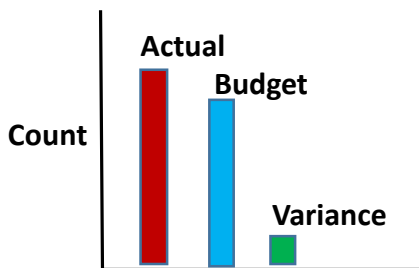
Set smoothed count & mix rules for groups in day's, week's & month's workload

Forecast effects on workload of R&M initiatives (i.e., proactive work)

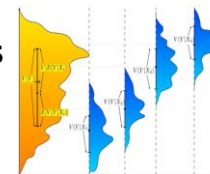
Set group-level workload budget for the year by month

W-M-YCC

Conduct and report actual-budget variance of workload completed—week, month & YTD.



Conduct difference analytics (ANOVA) to confirm effects of initiatives on workload.



Plan, organize & act to regain balance in remaining or subsequent month

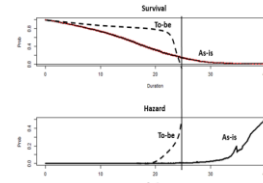
Optional:
Rebudget (current & longer term) the remaining year for changing business conditions

Process: Reduce to feasible minimum the **service interval** to inherent-exposure assets and conduct control cycles

Establish the asset groups of inherent exposure to uptime while not at readiness

Query 1-2 years of work order history for the select asset groups

Establish statuses that decide service interval until readiness



See paper: "Find the Time that is Money by Asking Duration Questions"

Conduct analysis of actual durations—length, exit & shape for each status

Establish (with work planners) nominal durations of total- & sub interval_& sub-stages.

Establish table of actual to nominal durations to each

Set rules for retention and exit of each status with regard for priority

Generate audit metrics and reports.

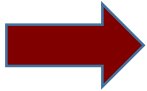
- Orders past retention rules.
- Rate of exit when past retention.
- FIFO to exit for groups and priority rules.

Investigate & remediate non-compliances

W-M-YCC

Agenda:

- ❑ Purpose of the training session.
- ❑ Competitive North Star for maintenance
- ❑ Structure North-Star maintenance processes
- ❑ Description of the North-Star processes
 - Mandatory practice and process
 - Workload and service interval processes
 - **Maintenance capacity processes**
 - Recountive insight processes



Maintenance Capacity is. . .

The workload that can be conducted by a plant's system of crafts and support headcount and skills, parts and material inventory, equipment, facilities, training and instructions, processes in the plant's working environment.

Maintenance capacity decides the cost of maintenance per unit of production, but we should note the characteristics of the cost

- **Maintenance may be the largest cost per unit; after production materials and plant energy.**
- **Most cost elements are inherent to the work done rather than controllable—e.g., maintenance parts and materials.**
- **The assets of maintenance capacity—parts and materials, equipment and facilities:**
 - **If not expensed, pass through denominator of the turn-over side of the P-ROACE calculation.**
 - **Because of relative size to RAV, P-ROACE is largely insensitive to them.**
 - **Can loom large in their influence on the service interval for inherent-exposure assets.**
- **Craft labor is felt directly and significantly in maintenance cost per unit of P-ROACE.**
 - **Is also the most influenceable cost of maintenance capacity.**
 - **Actual hours per work order are decided by crafts in a plant's current maintenance capacity rather than the work job plans.**
 - **Maintenance SMEs believe that maintenance cost is excessive by 15 to 35 percent—something that can only be largely driven by craft body.**

The processes of maintenance capacity focus on match of the plant's quantified workload to the resources to execute them

Insight to ongoing operations

Conduct morning-after analysis of scheduled and unscheduled work, and element-level variance between planned and actual work

Search out and investigate cost outliers to groups of orders and assets, and learn and act on findings

Tests the validity of work plans, match of workload to craft body, schedule compliance, break-ins, etc.

Because villains and interesting work orders are hidden from view by averages—e.g., hours/job.

Budget, variance and remaining year

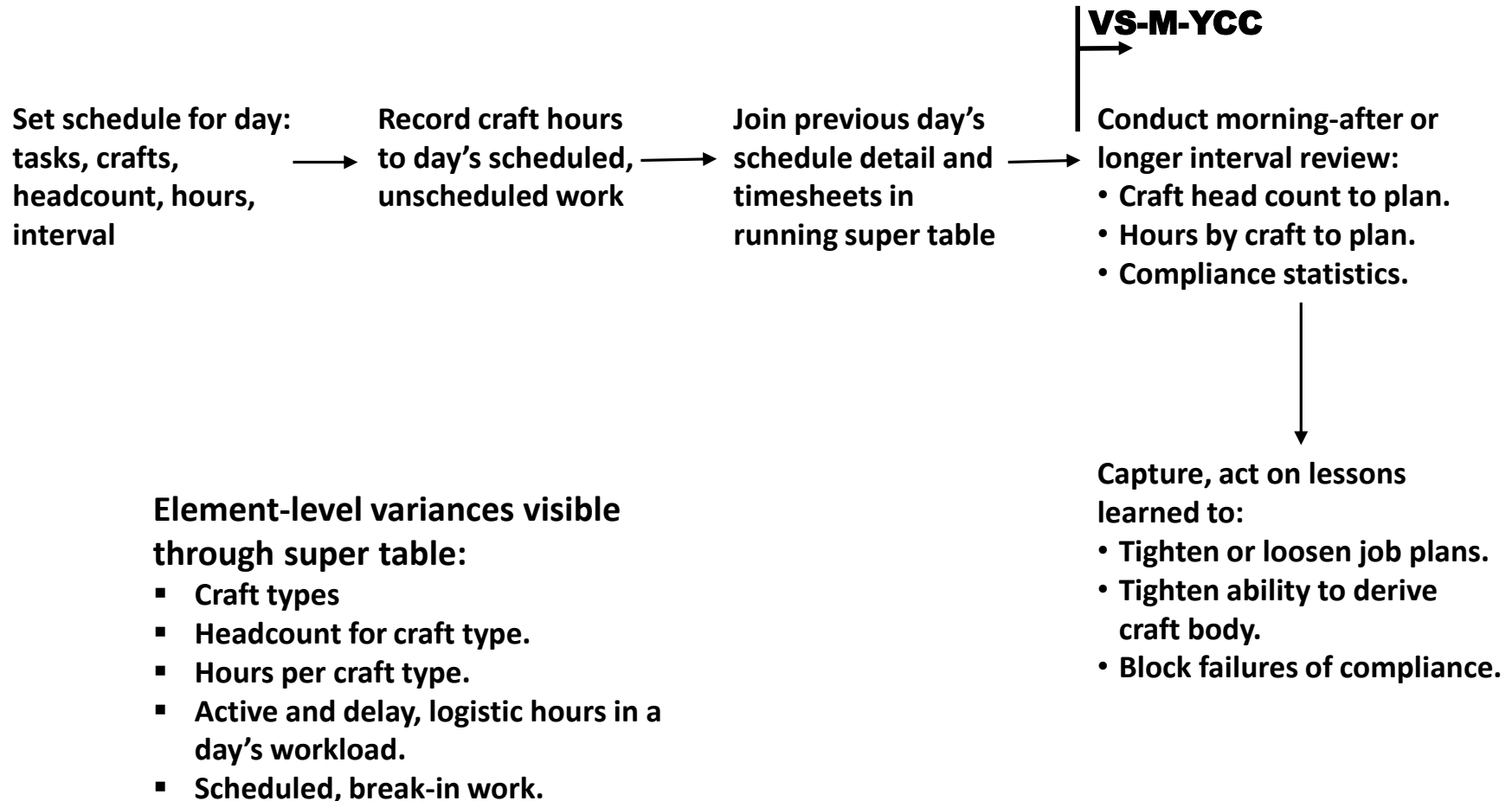
Determine the maintenance capacity to match the workload to target uptime and align the craft body on the determined capacity

Build and conduct two-dimensional budget and variance control methods and processes

Because labor per order is not decided by the job plan, but by the craft body

Because variance reporting is misinformation if not reported as due to workload and due to resources to the workload.

Process: Conduct morning-after analysis of scheduled and unscheduled work, and element-level variance between job plans and actual work



Process: Search out and investigate cost outliers to groups of orders and assets, and learn and act on findings

$$\text{Z-score Standardize} = \frac{\text{Case} - \text{Average}}{\text{StdDev}}$$

$$\text{Min-Max Normalize} = \frac{\text{Case} - \text{Min}}{\text{Max} - \text{Min}}$$

Build table of standardize and normalize limits for work types & elements of interest

Filter orders of completed status during period of interest

Contrast orders & tasks against the outlier variables & filter outliers

M-YCC

Conduct times series & ANOVA analytics for insight to changing performance:

- % outliers overall & by groups.
- Spread to limits

VS-W-MCC

Generate list of outliers to investigate:

- Group % outliers to all groups
- % outliers by group.
- List of outlier orders, tasks.

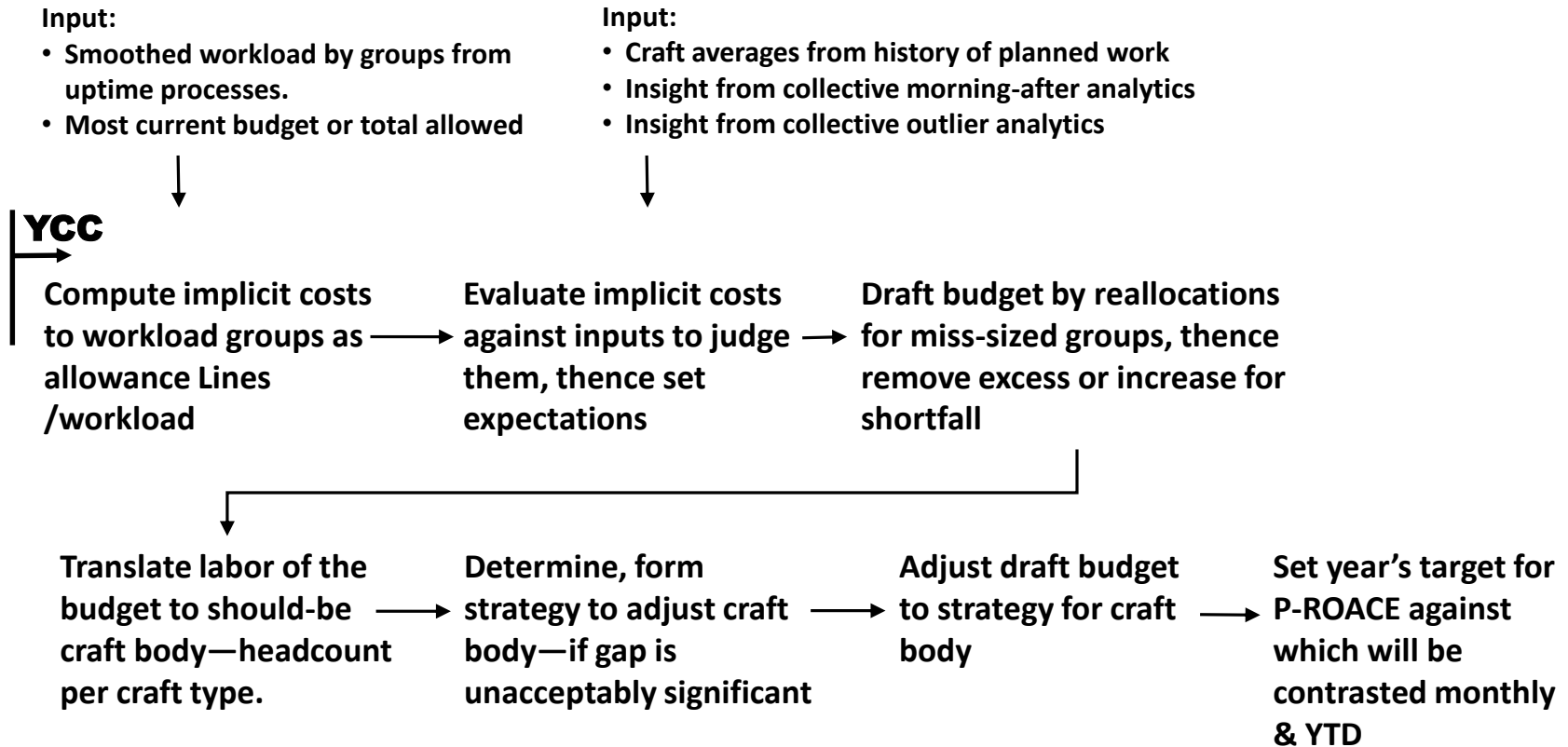
Investigate outliers, trends in outliers learn & take actions

We seek outliers because, without process to find them, they will go unnoticed in typical averages-type presentations—e.g., hours per job

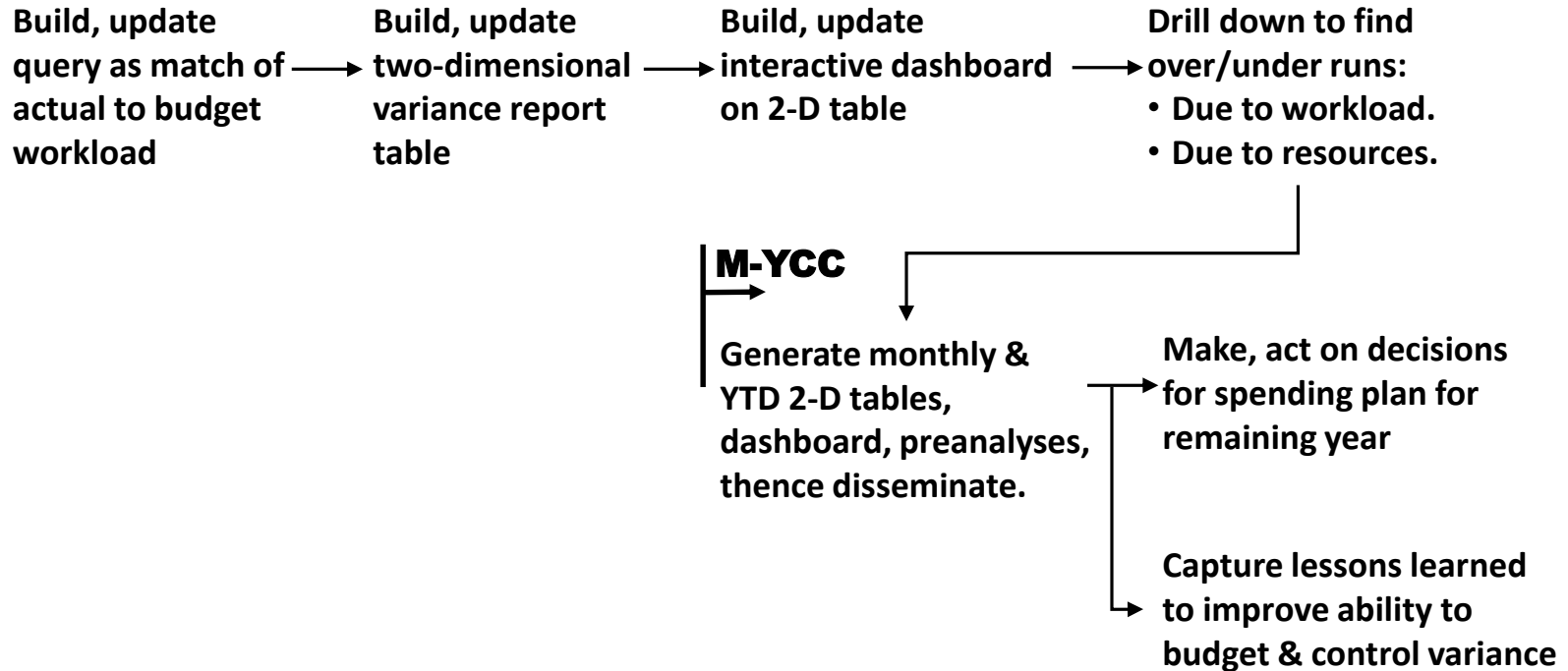
The search is a dragnet to all sorts of anomalies.

- **Find hidden excess maintenance capacity.**
- **Unusual events during the period of interest.**
- **Bad actors revealed as outliers in hours, parts and materials, status and related work orders.**

Process: Determine the maintenance capacity to match the workload to uptime and align the craft body on the determined capacity

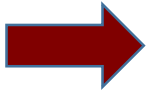


Process: Build and conduct two-dimensional budget and variance control methods and processes



Agenda:

- ❑ Purpose of the training session.
- ❑ Competitive North Star for maintenance
- ❑ Structure North-Star maintenance processes
- ❑ Description of the North-Star processes
 - Mandatory practice and process
 - Workload and service interval processes
 - Maintenance capacity processes
 - **Recountive insight processes**



None, one or more of four types of insight deliverables may be relevant to the outcome at sectors, paths and steps along any operational process

Category	Description
System reports	Taken from operating systems as standard reports.
Know-thy-data	Data is presented in descriptive, graphic and statistical perspectives as a window into how the process is working compliance-wise in contrast to how it should be working.
Recountive	Insight direct from data—without processing through analytics—to ask and answer questions of who, what, when, where and how much, and metrics formed across them.
Indicative	Insight gained upon data flowing through ML/AI models that ask and answer questions of relationship, difference, time series, duration and apparency.

The insight deliverables are explained more deeply in the training session, “First Step to Becoming Data-Driven Operation.”

- See section titled, “The Primary Types of Insight Deliverables” and papers associated to each type.
- Download session slides via <https://analytics4strategy.com/train-frststpdtdrvnops> with link provided in the session description.

Recountive insight is the plant's body of data transformed to all possible insights that are inherent to the data, without purpose other than insight

Order	Order type	Sheet text
600091375	MX01	7370-12H5099S-PM LUBE
6000946709		
6000977049		
6000972226		
6000990224		
6000972901	2	8/15/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
6000912328	3	8/15/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
6000932340	4	8/15/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
6000958845	5	8/15/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
	6	8/15/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
	7	8/16/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
	8	8/16/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
	9	8/16/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
	10	8/16/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL
	11	8/16/2012 CUI RegularShift CaiContractor NonRoutine(MX07) CRL

Cost center	OrderNo/Text	ShopNo/Text	MntType	CshT
70160	6000707049- MA-DCU-PUB818 Install max impeller & 15h	180; DCU PUB818-SA & INSTALL PUMP	Proactive	MachIn
70160	6000707049- MA-DCU-PUB818 Install max impeller & 15h	30; DCU PUB818-SA & LO/TO MOTOR	Proactive	Electric
70160	6000707049- MA-DCU-PUB818 Install max impeller & 15h	60; DCU PUB818-OPERATION TO ENERGIZE MOTOR	Proactive	MachIn
70160	6000707049- MA-DCU-PUB818 Install max impeller & 15h	80; DCU PUB818-LO/TO MOTOR	Proactive	Electric
70160	6000707049- MA-DCU-PUB818 Install max impeller & 15h	80; DCU PUB818-LO/TO MOTOR	Proactive	Electric
70160	6000812732- MC-DCU-Pull/Repair Dump Reg. on Jet Pump	40; DCU Repair Dump Reg INSTALL	Reactive	MachCr
70160	6000812732- MC-DCU-Pull/Repair Dump Reg. on Jet Pump	50; DCU Repair Dump Reg RECONNECT	Reactive	Instrum
70160	6000860441- MC-uff TIG350 to add nozzles	27; DCU-TIG350-CENTER PUNCH AND BUFF AREAS O	Reactive	MachCr
70160	6000860441- MC-uff TIG350 to add nozzles	70; Crane to assist Electricians	Reactive	Electric
70160	6000915285- MC-DCU-Bridge Crane AC unit installation	70; Crane to assist Electricians	Reactive	Electric
70160	6000915285- MC-DCU-Bridge Crane AC unit installation	90; Motiva Inspector	Reactive	Electric
70160	6000920113- EL-DCU-MOV open/close switch replacement	70; EL-DCU-MOV open/close switch replacement	Reactive	Electric
70160	6000920113- EL-DCU-MOV open/close switch replacement	70; EL-DCU-MOV open/close switch replacement	Reactive	Electric
70160	6000920138- MA-DCU-35304 tensionometer no indication	20; M-DCU-35304 tensionometer no indication	Reactive	Instrum
70160	6000920138- MA-DCU-35304 tensionometer no indication	20; M-DCU-35304 tensionometer no indication	Reactive	Instrum
70160	6000914342- MA-DCU-PUB871 seal leaking	130; DCU PUB871- INSTALL PUMP	Reactive	MachIn
70160	6000914342- MA-DCU-PUB871 seal leaking	130; DCU PUB871- INSTALL PUMP	Reactive	MachIn

A “**super table**” does not, cannot and never will exist in any one operating system.



Single tables have some of all needed variables to all envisioned insight deliverables.

Interactive **Dashboards** transform the massive data of super tables into a consumable table and visual form.

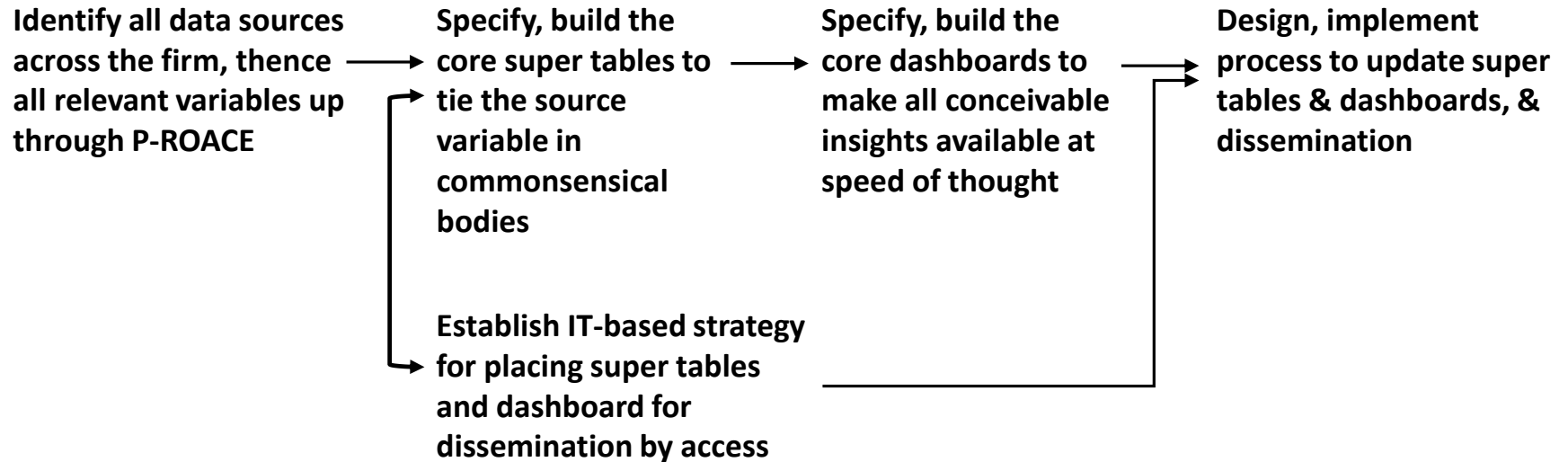
The structure of recountive insight has three layers:

1. Identified individual tables available in operating systems or Excel spreadsheets records.
2. Individual tables joined together in a super table by the unique identifiers they have in common.
3. Dashboards that rollup or drill down into the data of one or more super tables.

It is important to recognize that the ease by which we can play in the three layers has changed the “rule” that all insight must be connected to a user need

- **Cost of data is not an issue to all types of insight because operating systems are natural sources through their role in a firm’s operations.**
- **Building and updating super tables upon the firm’s natural data has become largely effortless done with click-and-drag.**
- **Recountive insight can be open-ended because. . .**
 - **Every imaginable variable of interest to constructing insight resides in tables behind the curtain of one or more operating systems or other sources.**
 - **Every imaginable recountive insight can be constructed upon one or more of the imaginable variables.**
 - **Every recountive insight does not need to be predefined, is generated as speed of thought with interactive dashboards.**
- **Recountive insight is prepared automatically or by one for many—real-time, daily, weekly, monthly and annually.**

Process: Build, update and disseminate the body of recountive insight from the firm's operational data



The methods to build super tables is explained in-depth by the training session, “First Step to Becoming Data-Driven Operation.”

- Section titled, “Gather, Join and Cleanse data, and Form Super tables”
- Slides are downloaded <https://analytics4strategy.com/train-frststpdtrvnops> with link provided in the session description.