

Essentials for Planning a Modern Day Wax Room

Traditional Wax Room Methods

“This is the way we have always done it.”

Process is controlled by the operator

Process drifts day to day

No calibration

It's a linear process

Capacity is increased by adding people and equipment



Good equipment but with limited process feedback and operator controls



Safe – But limits profitability – Short term thinking

Today's Wax Room

Question Traditional Methods

Injection die standards, injection runner size, Multi-cavity injection, die clamping method, pattern removal method, wax type, ceramic cores, soluble cores, rods, die slides, die guiding method, **Injection machine**, Industry, Aerospace, Medical, Commercial, paste wax, liquid wax, Vertical injection, horizontal injection, two station injection, automatic injection, injection machine size, clamping force, manual controls, programmable controls, pattern handling method, table size, operator position, shuttle tables, hoist, **Wax assembly** design, pattern commonality, part families, pattern sizes, runner types, runner sizes, runner bar width, pattern gate sizing, pattern to pattern spacing, weld quality, casting pour ratio, metal flow simulation, **Shell** Department, maximum assembly size, mold weight, mold hanging method, cause of pattern drop-off, cause of inclusions, **Casting**, maximum metal pour weight, maximum casting dimensions, major causes of scrap, **Finishing** Department, manual cut-off, automatic cut-off, runner holding features, pattern grinding method, **Engineering**, create specifications/standards, eliminate design variations between Product Engineers and tool makers, ...

Modern Wax Room

Starts with a plan
and a **“Future State Vision”**

- Typically 3 -5 years
- Increase efficiency
- Increase throughput
- Increase capability
- Increased ROI

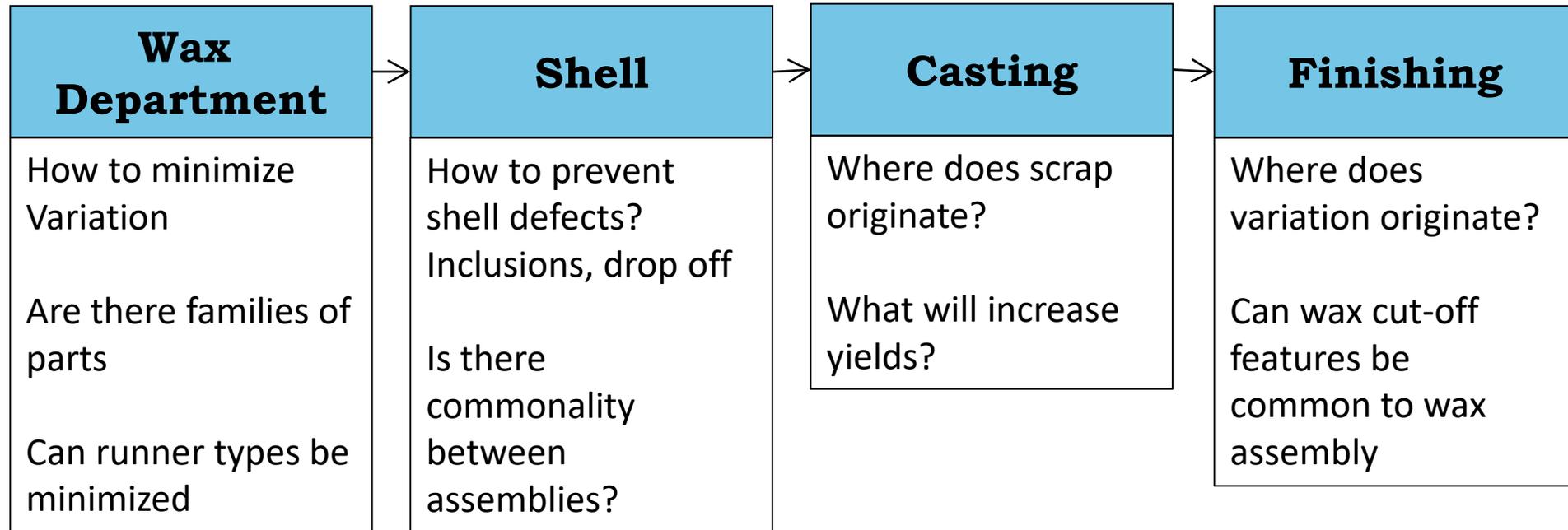


Separate day to day priorities from Future State Objectives

Modern Wax Room

Design patterns and assemblies for the overall casting process

Process variation starts in the wax room and continues throughout the process.



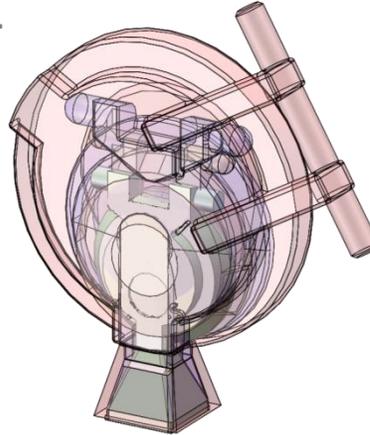
Create Process Standards for total foundry

Modern Wax Room

Design Assemblies for Casting

Simple example of a family of products designed for the entire casting process

#1



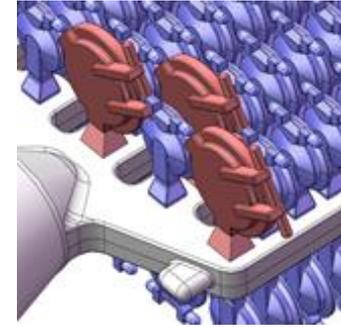
Pattern commonality
(4 sizes)

#2



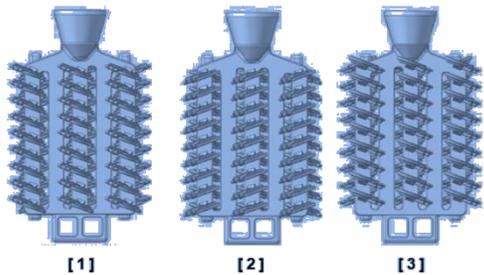
Std. Pattern Gate
Wax asm commonality
Auto cut-off

#3



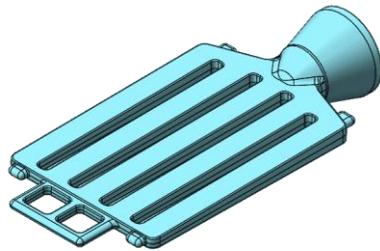
Solid Model Layout
Increased Pattern density

#4



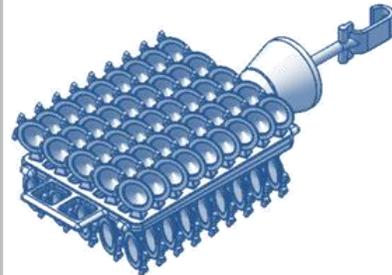
Metal flow simulation
De-wax
Casting Yield

#5



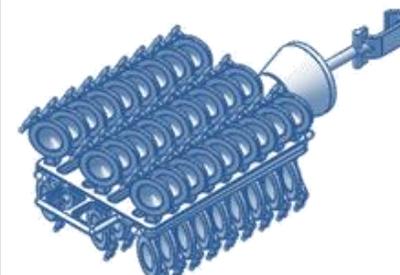
Std. 5 bar runner
Wax Asm Commonality
De-Wax
Casting
Cut-off

#6



Small pattern
assembly
Configuration
80 patterns

#7



Large pattern
assembly
configuration
54 patterns

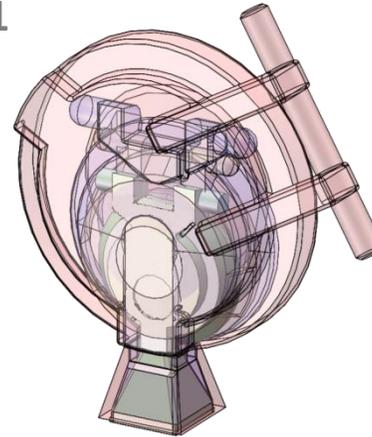
Resulted in
Common Tooling
all assemblies

Modern Wax Room

Design for Casting

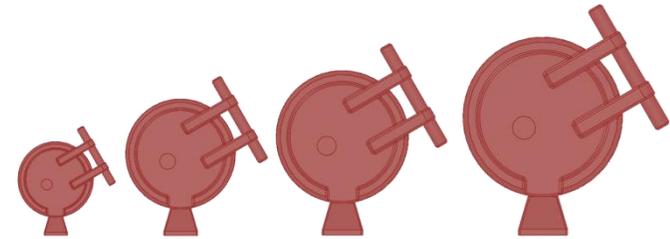
Injection die/tooling design –
After completion of wax
assembly

#1



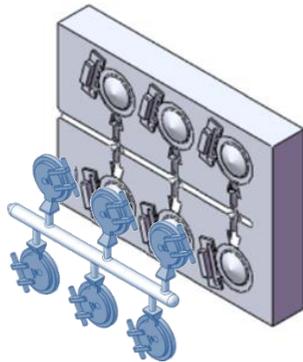
Pattern commonality
(4 sizes)

#2



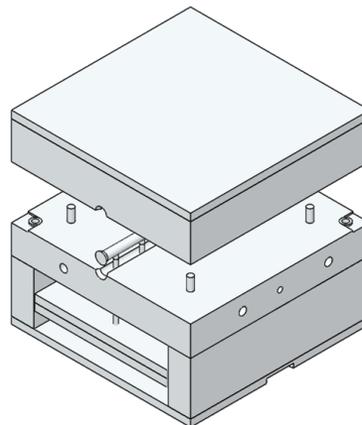
Die design
4 dies or 1 die
(Follow wax assembly standards)

#3



Multi-Cavity Injection
Manual or Automatic die

#4



Injection Dies Standards

Die guiding
Die Clamping
Automatic Pattern Ejection
Automatic die cores
Die Cooling (optional)

Selecting Wax Room Equipment

Key is selecting the right equipment (Capabilities) to meet your process requirements

Equipment selections to be aligned with the future state vision



Modern Equipment - Process lives in the machine not the operator

Selecting Wax Room Equipment

Today's Injection Systems require:

Accurately control...

Wax Pressure

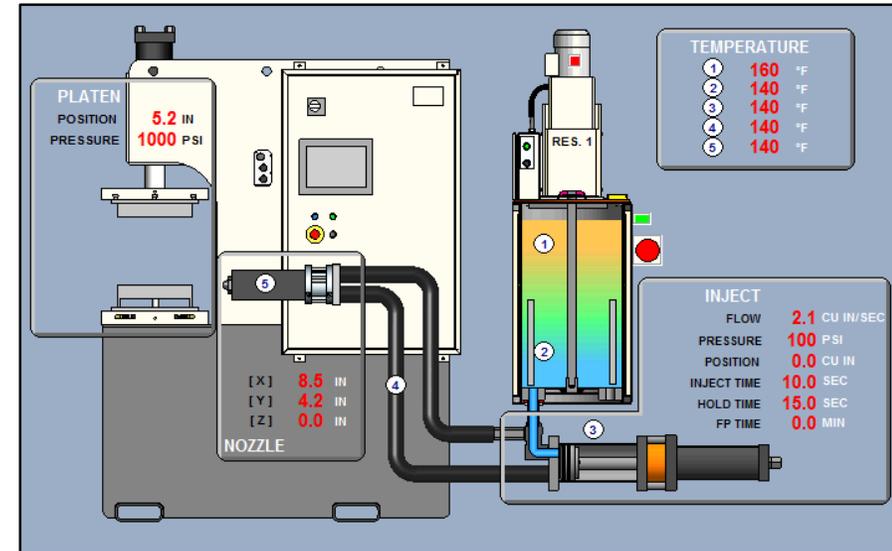
Wax Flow

Wax Temperature

With...

Real-time Process feedback

Real-time Process alarms



Equipment needs to be process capable – Provide Notification if process drifts

Selecting Wax Room Equipment

Machine Options and Features

Industry: Commercial, Medical, Aerospace

Pattern size / quantity

Injector Type: Semi-Auto, Auto,

2 station, IGT, Purpose built

Die Set size & daylight

Injection Die features

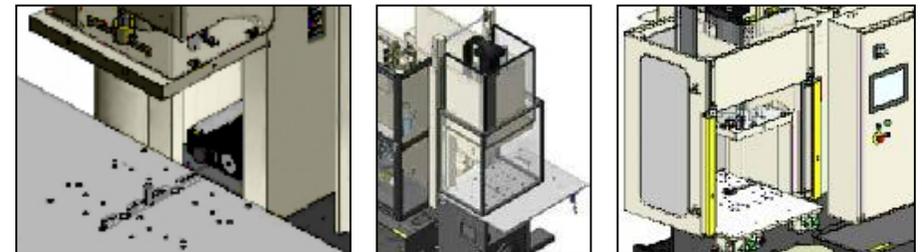
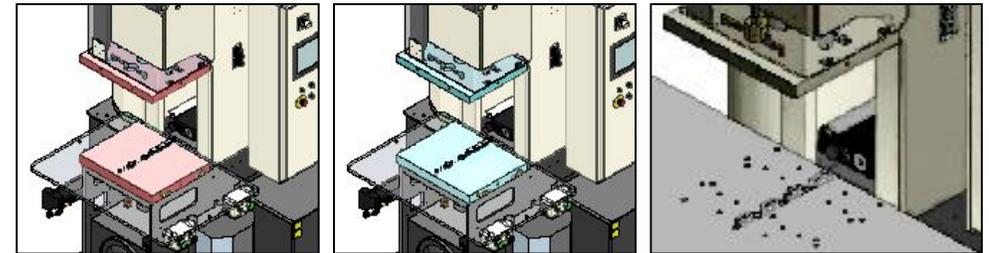
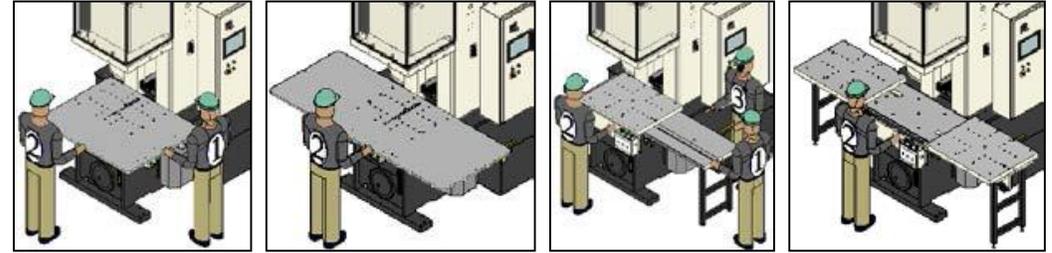
Injection system capability

Injection capacity

Manual or Programmable

Operator Ergonomics and Safety

Selecting the correct machine features is Critical to getting the most out of the equipment and meeting your process requirements.



Selecting Wax Room Equipment

Machine Controls require:

- Intuitive Operator Interface
- User Access Levels
- Recipe Control (Automatic setup)
- Alarms
- Maintenance feedback
- Real time data
- Job Queue

The image displays a collage of screenshots from the SMART SYSTEMS machine control interface, illustrating various functional areas:

- User Access:** A window showing the current user as 'Supervisor' with a 'LEVEL 9' access level. It includes a 'LOG OFF' button and a 'PASSWORD PROTECTION' section.
- Alarms:** An 'ALARM HISTORY' window displaying a table of events. The table includes columns for 'EVENT MESSAGE', 'Value', 'Event Time', 'Norm. Time', and 'User'. Events include 'WEEKLY MAINTENANCE IS DUE' and 'ETHERNET CELL PLC COMM ERROR'.
- Recipe Control:** A 'RECIPE' window showing the 'CURRENT RECIPE NAME' and options for 'LOAD RECIPE', 'PRINT RECIPE', 'SAVE RECIPE', and 'BACKUP RECIPE'.
- Maintenance:** A 'MAINTENANCE' window with checkboxes for 'LUBRICATE PLATEN GUIDE SHAFTS', 'LUBRICATE NOZZLE POSITIONER DRIVE SHAFTS', and 'INSPECT AIR FILTER'.
- Injection Parameters:** A window showing a graph of 'CUBIC INCHES / SEC VS SEC' and numerical values for 'FLOW', 'PRESSURE', 'POSITION', and 'LAST SHOT VOLUME'.
- Graph Data:** A window displaying 'CYCLE TIME' data (e.g., 10.0, 15.0, 15.0) and 'PRESSURE PRESET' (48.1).
- Job Queue:** A window showing a list of jobs in a queue, including 'ACTIVE RECIPE', 'JOB QUEUE 1', 'JOB QUEUE 2', and 'JOB QUEUE 3', with columns for 'RECIPE #', 'JOB #', and 'JOB QTY'.

Selecting Wax Room Equipment

Machine Data Required:

Operator (data at the machine)

Process alarms
Cycle alarms
Job data

Supervisor

Production monitoring
Job quantities
Downtime
Job / Process KPV's

Maintenance

I/O data
Alarms & Messages
PM Schedule

Engineers

Process Monitoring
Real-time data
SPC
OEE

IT / Management

Integration to MES
(Paperless system)
Key KPV,s

OEE Downtime Table

Example of Downtime CSV file when opened in Windows Excel:

Machine number	2313									
Date of Day 1	04/11/2012									
Total Time Machine Available	6660									
Minutes	111									
Hours										
Day 1 (Start)	Day 2 (Start)	Day 3 (Start)	Day 4 (Start)	Day 5 (Start)	Day 6 (Start)	Day 7 (Start)	Weeks total	Weeks total	Week	Weeks
production	production	production	production	production	production	production	production	production	production	production
Attribute 1 (Back of core)	0	0	0	0	1	0	1	0.02	0.02	99.98
Attribute 2 (No search)	0	0	0	0	1	0	1	0.02	0.02	99.98
Attribute 3 (No function signal)	0	0	0	0	1	0	1	0.02	0.02	99.98
Attribute 4 (Planned Downtime)	22	0	0	0	0	0	22	0.37	0.37	99.67
Attribute 5 (Injector Down)	0	0	0	0	3	0	3	0.05	0.05	99.95
Attribute 6 (Signal)	0	0	0	0	2	0	2	0.03	0.03	99.97
Attribute 7 (7)	0	0	0	0	2	0	2	0.03	0.03	99.97
Attribute 8 (8)	0	0	0	0	2	0	2	0.03	0.03	99.97
Attribute 9 (9)	0	0	0	0	6	0	6	0.1	0.09	99.91
Attribute 10 (10)	0	0	0	0	4	0	4	0.13	0.12	99.88
Completed	220	213	0	0	59	37	0	529	8.82	7.94
Downtime	242	213	0	0	63	59	0	577	9.62	8.66
Total										
Machine Availability %	91.34									

Data Types

CSV File
OPC data
SQL data
Etc.

Inject Graph CSV

Date (MM/DD/YYYY)	02/14/2013		
Time (HH:MM:SS)	09:02:11		
Injector	2429		
Die Temperature	0		
Ambient Temperature	29.7		
Time	Flow	Pressure	Temperature
0	0	0.1	66.9
0.1	75.6	1.5	67
0.2	98.9	2.9	67.2
0.3	98.9	4	67.7
0.4	98.9	4.3	68.4
0.5	99.3	4.7	69.3
0.6	99.3	4.6	70.2
0.7	99.3	4.7	70.9
0.8	100	4.5	71.5
0.9	100	4.7	71.9
1	100	4.8	72.1
1.1	100	4.9	72.3
1.2	99.3	7.1	72.4
1.3	83.5	9	72.5
1.4	60	9.7	72.5
1.5	30.6	9.8	72.5
1.6	11.4	9.8	72.5

Benefits of a Modern Wax Room

Manual Process

Creating Standards for wax injection and assembly based on overall casting process.

Selection of Equipment aligned with future state vision

Selection of Equipment that is process capable

All leading to:

- Labor savings
- Reduced setup times
- Reduction in tooling cost
- More efficient short runs

Produces immediate benefits to the current manual process and facilitates a path to future automation



Automation in the Wax Room

AUTOMATED INJECTION

Builds on capability of the manual injection process and standards created

Removes variation caused by Operator handling

Performs **Secondary Operations**

Core Insert

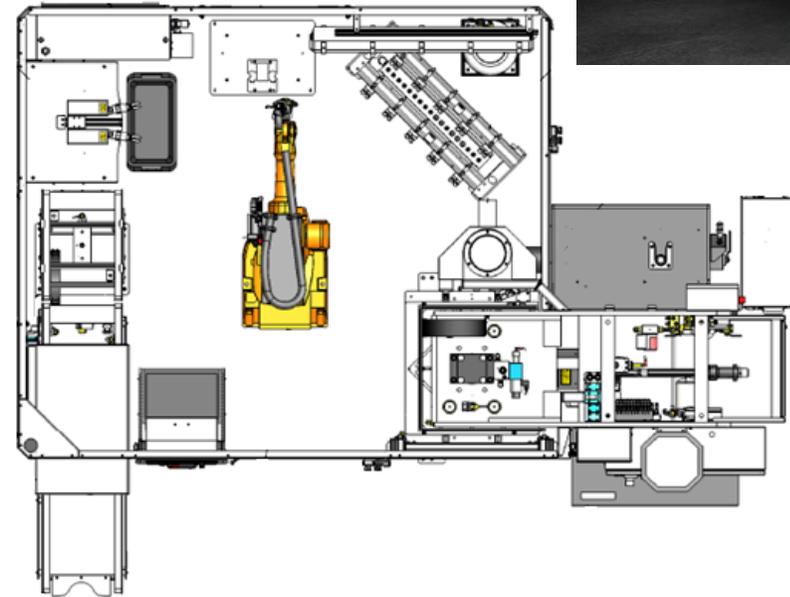
Pattern trimming

Pattern vision inspection

Pattern engraving

Pattern dip sealing

Etc.



Lights Out Operation - Designed for Ease of Use – Auto Recovery

Automation in the Wax Room

AUTOMATED ASSEMBLY

Transforms the manual wax assembly process

Removes variation

Caused by Operator

Provides assembly-assembly Repeatability

Welds many Assembly types

Multi-pattern welding

Complex multi-plane welding

Welds many runner types

Reduces Scrap

Eliminates pattern drop off in shell

Minimizes inclusions

Eliminates rework

Etc.

Facilitates automatic cut-off



Purpose built Assembly Cell



Standard Assembly Cell

Fusion Welding – Sticky Wax Process - Pattern Gluing

Benefits of a Modern Wax Room

Automated Process

Transforms the process, bringing with it 24/7 operation without needing breaks.

On average robotic cells out produce manual 3 - 10 times

Additional gains by performing secondary operations

Payback in a 2-3 year period, profits continue exponentially after that

- Better, Faster, More Efficient
- Repeatable & Reliability (Same part, same way every time)
- Consistent Results
- Reduced Scrap



Maximizes overall profitability, long term thinking

People

“At the End of the day it’s about the People”

Requires a **Team** of individuals representing the entire process with a single vision

- Breaking current habits
- Implementing new ideas
- Taking individuals outside their comfort zone
- Changing “Can’t do it” into “How can it be done”

Turns individuals and departments into a unified winning team



**People are essential to achieving the companies
“Future State Objectives”**

Achievement

Having a Plan and a Future State Vision Leads to ...

- Reduction in Variation
- Reduction in Scrap
- Improved Throughput
- Higher Casting Yields
- Lower Labor Costs
- Increased Profits

Allowing you to be Competitive in a Global Market

Questions

Thank You !

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