MBAA Western New York
Technical Presentation

Optimizing Brewhouse Design
-A plan to expand an existing brewery-

MASTER BREWERS
UNITED WE BREW™

BRIGGS

An Introduction

Reay Dicks, Snr Process Engineer

- BSc (hons), Chemical Engineering – UCT
- MSc, Bio Chemical Engineering – UCT
  - Specializing in Algal Biofuels
- Initial Experience in
  - City Waste Water
  - Coca Cola Packaging Plant
  - Platinum Flotation and Mining
  - Petrochemicals - UK

UCT, 2009

BRIGGS

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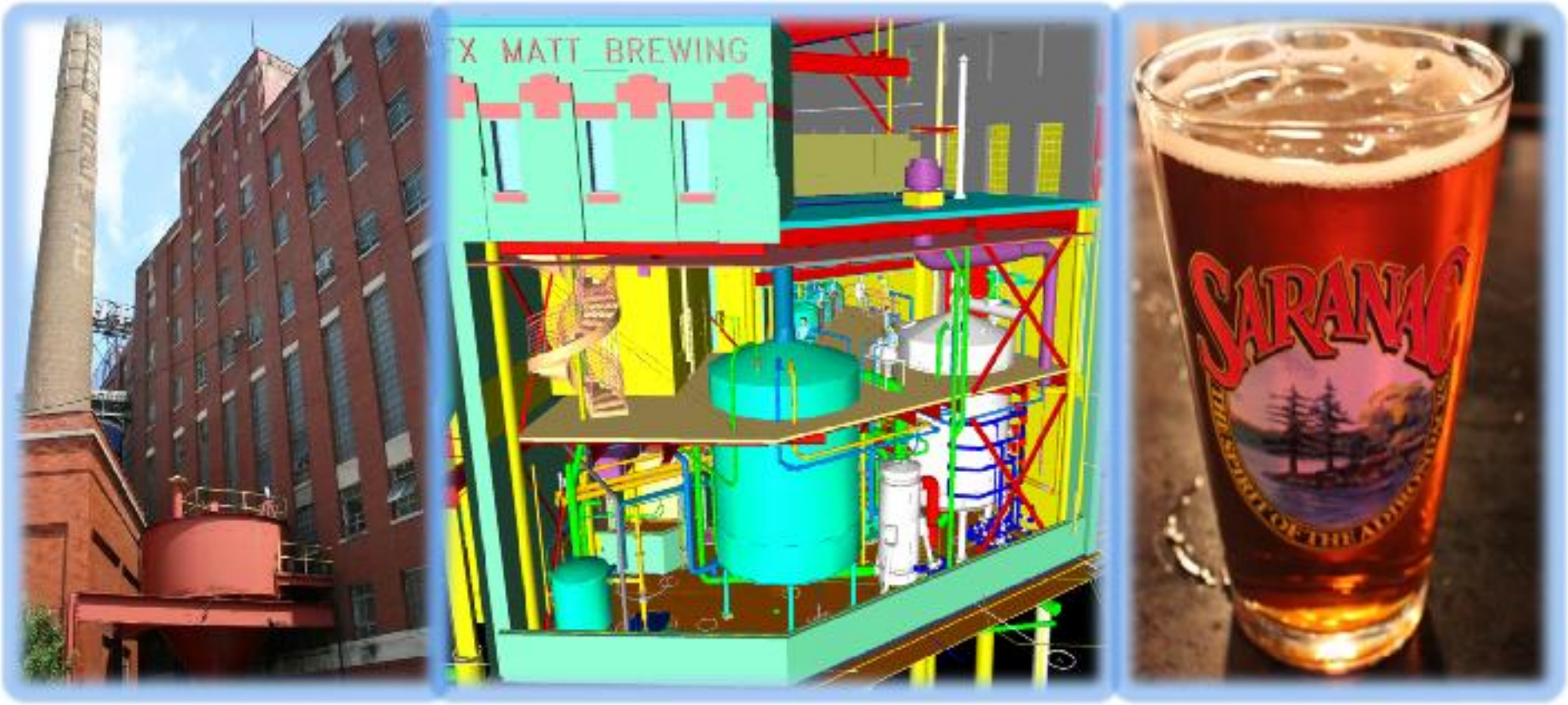
  - Petrochemicals - UK
- Briggs of Burton, PLC
  - 2.5 years
  - C.Eng, MIChemE
- Briggs of Burton, Inc
  - 2 years, Brewing and Distilling
  - P.E. Chemical



Optimizing Brewhouse Design
-A plan to expand an existing brewery-

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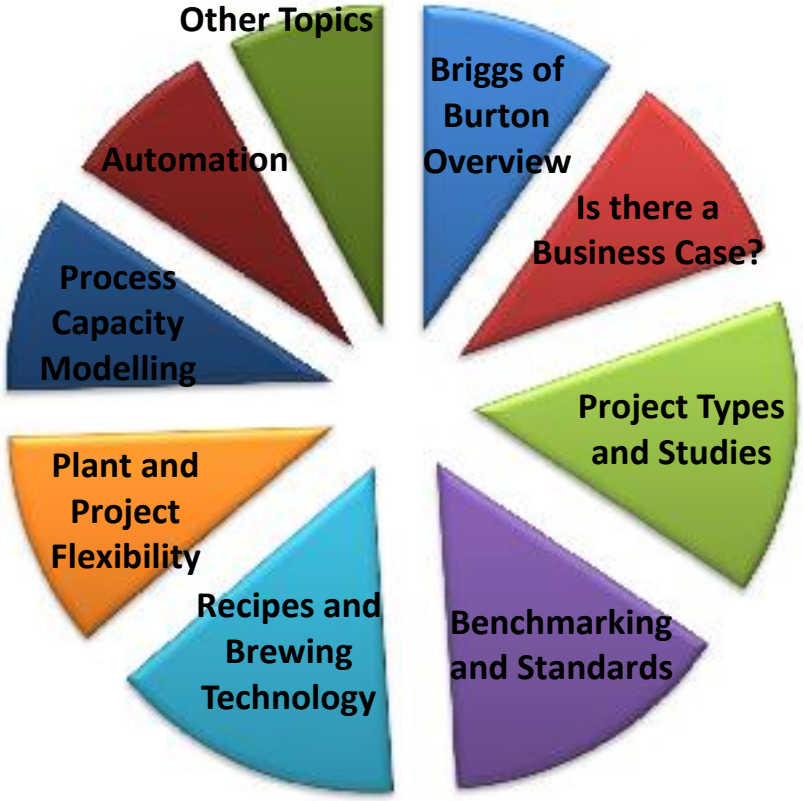
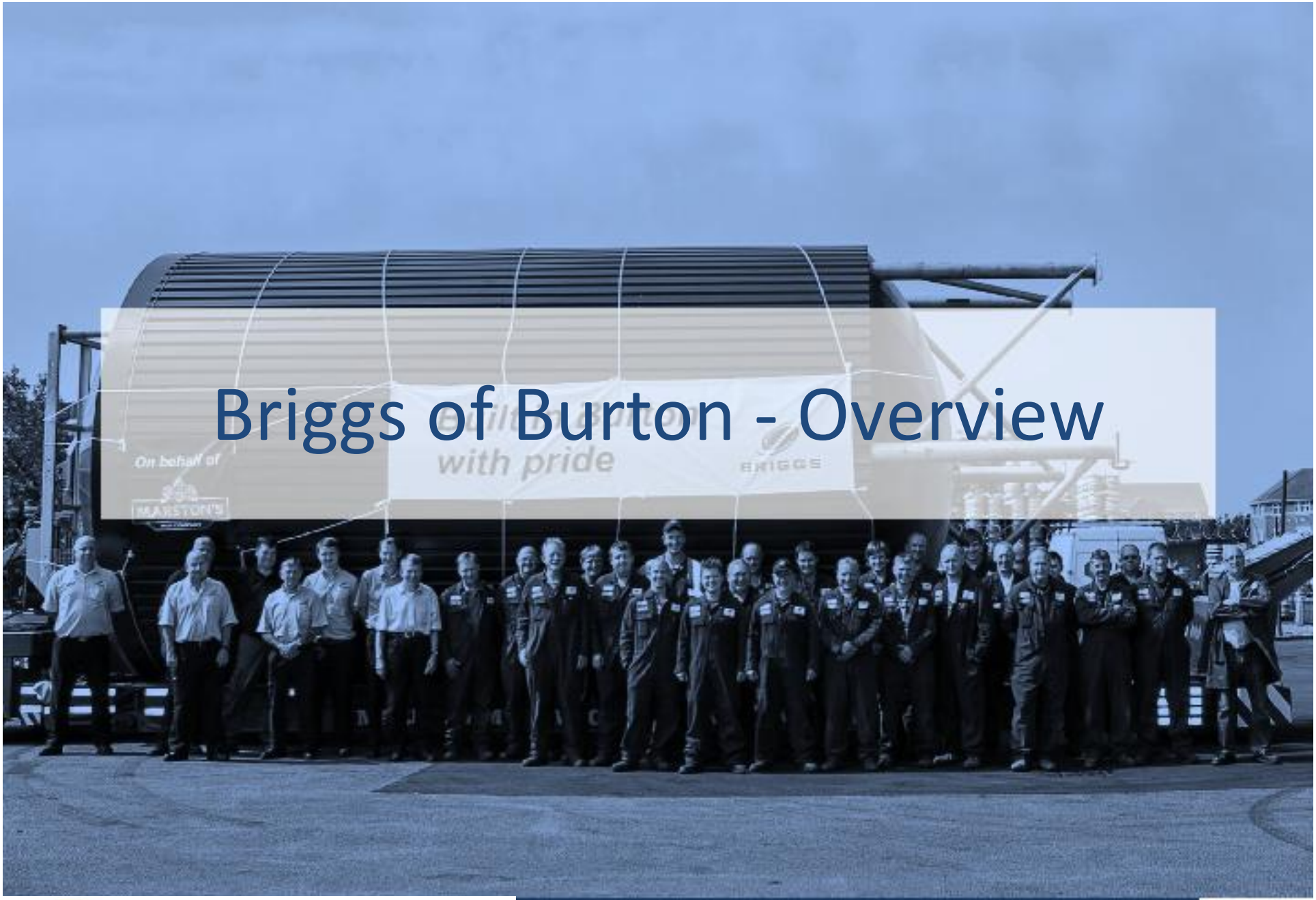
Presentation Overview



Presented By

- Reay Dicks, PE, Briggs of Burton Inc.

Briggs of Burton - Overview



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UNITED WE BREW™

BRIGGS

The History of Briggs

Briggs Industries

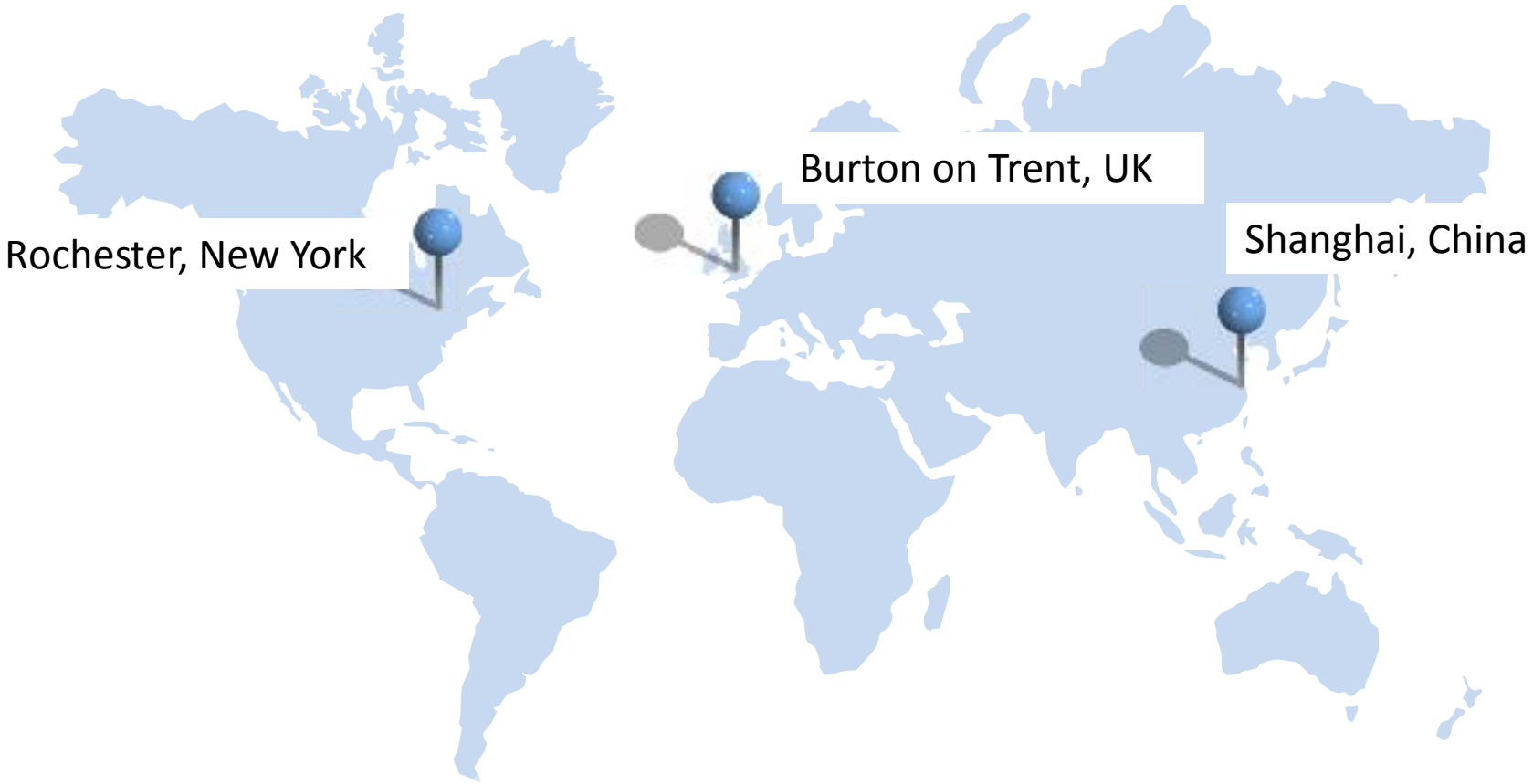
BRIGGS

BRIGGS BREWING | BRIGGS DISTILLING | BRIGGS FOOD | BRIGGS PHARMA | BRIGGS BIOTECH | BRIGGS INDUSTRIAL

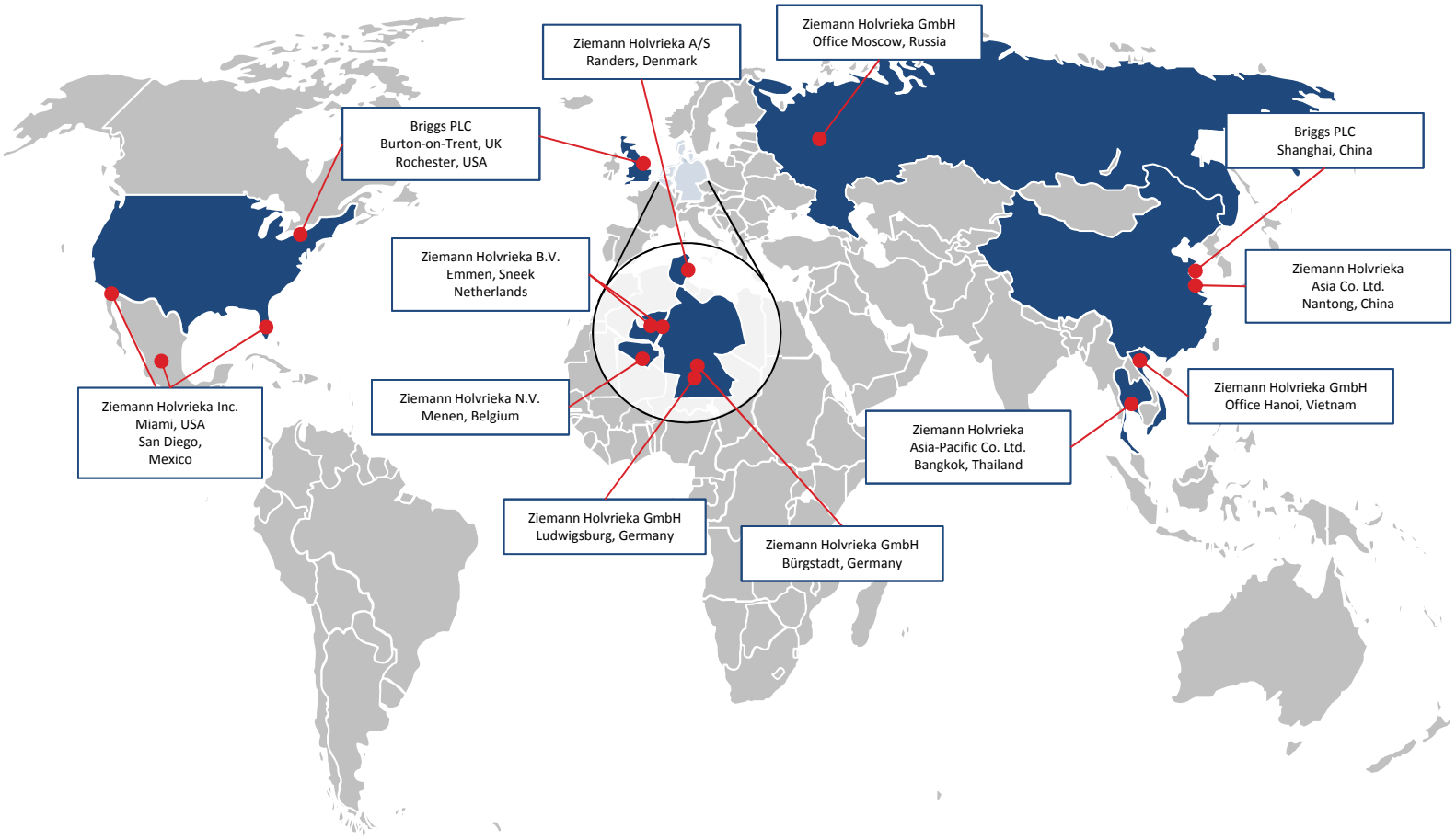





Briggs Main Offices



CIMC ENRIC Offices



BRIGGS BREWING

Briggs Capabilities

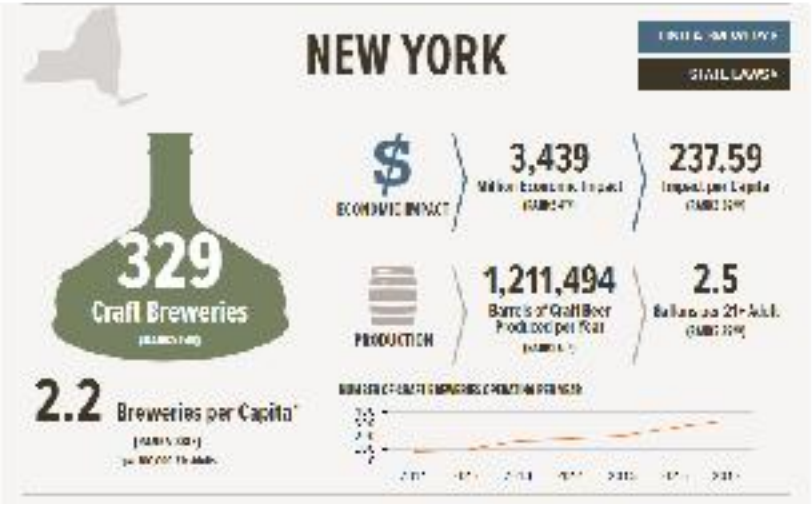
- Full turn-key solution provider
- Project Management
- Process Engineering
- Electrical Engineering
- Automation and Control
- Manufacturing

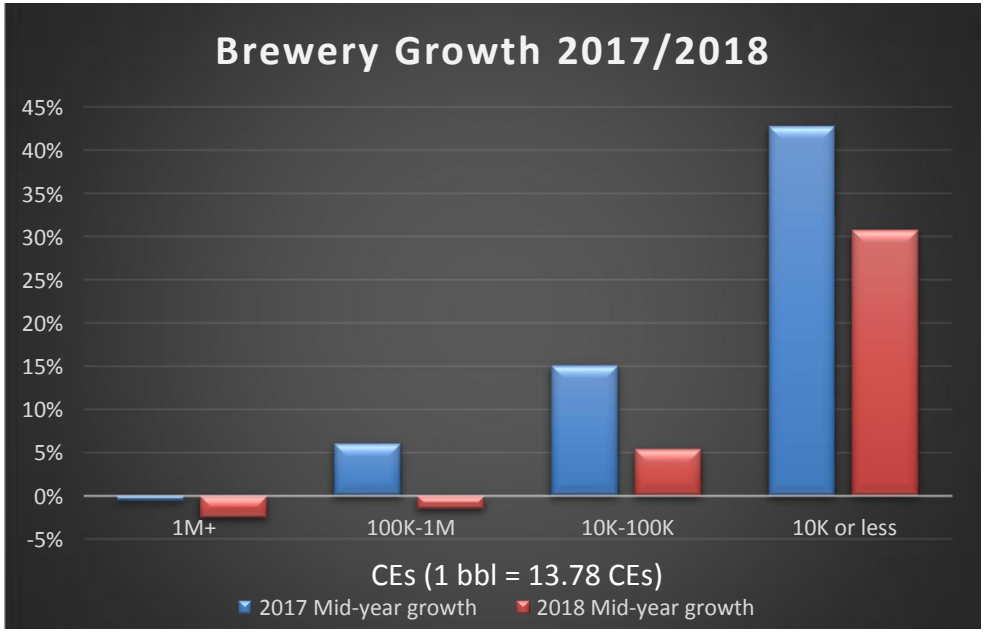
Briggs Specialization

- **Clean In Place (CIP) and Hygienic Process Engineering**
- **Brewing & Distilling**
- Mixing, Blending, Cooking and Cooling
- Yeast & Fermentation
- Process Automation
- Site Management

Expansion
Is There A Business Case?

Brewing Market Growth



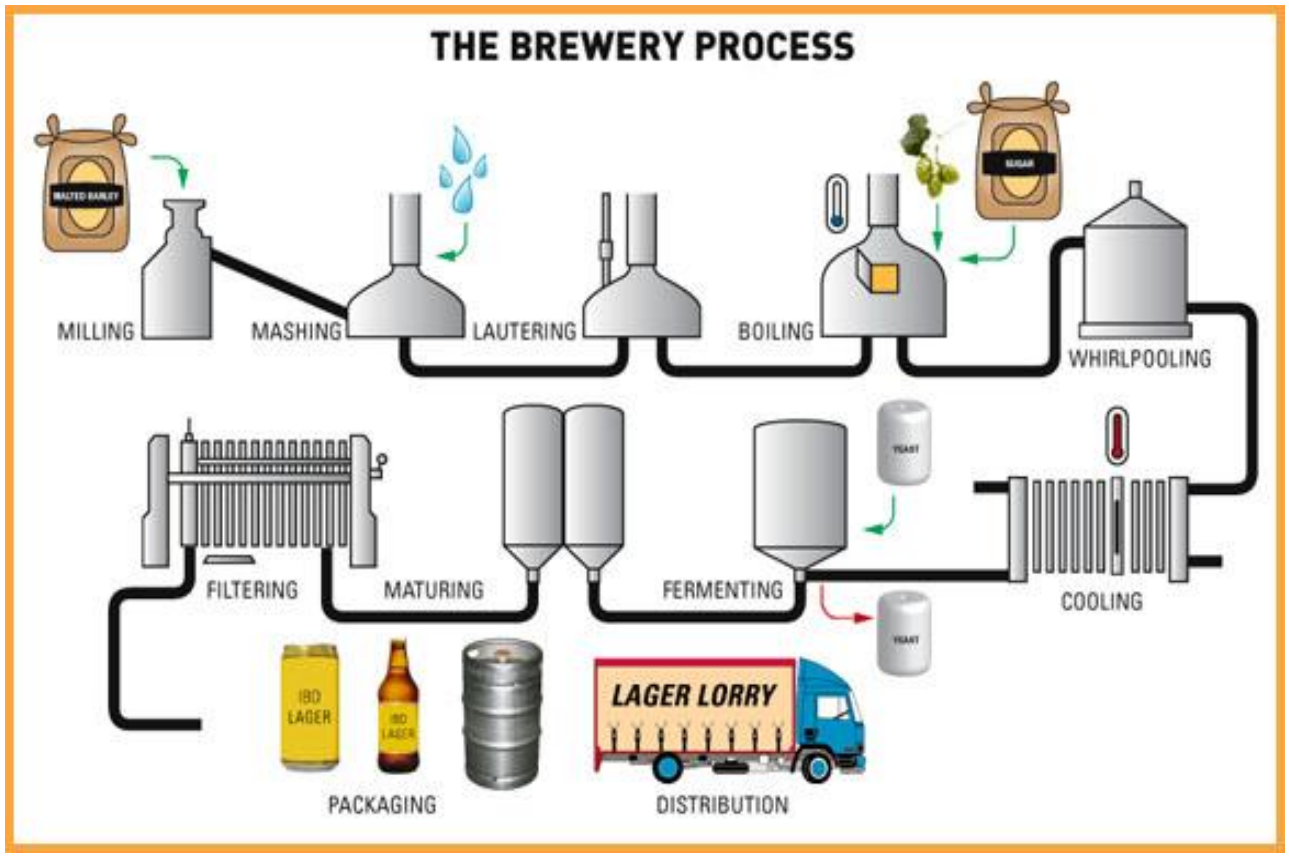


*Bart Watson | Brewers Association Chief Economist, Julia Herz | Craft Beer Program Director.
**IRI Group scan data, YTD through 7/1/18, MULO+C, Total U.S.
***https://www.brewersassociation.org/statistics/by-state/

BRIGGS

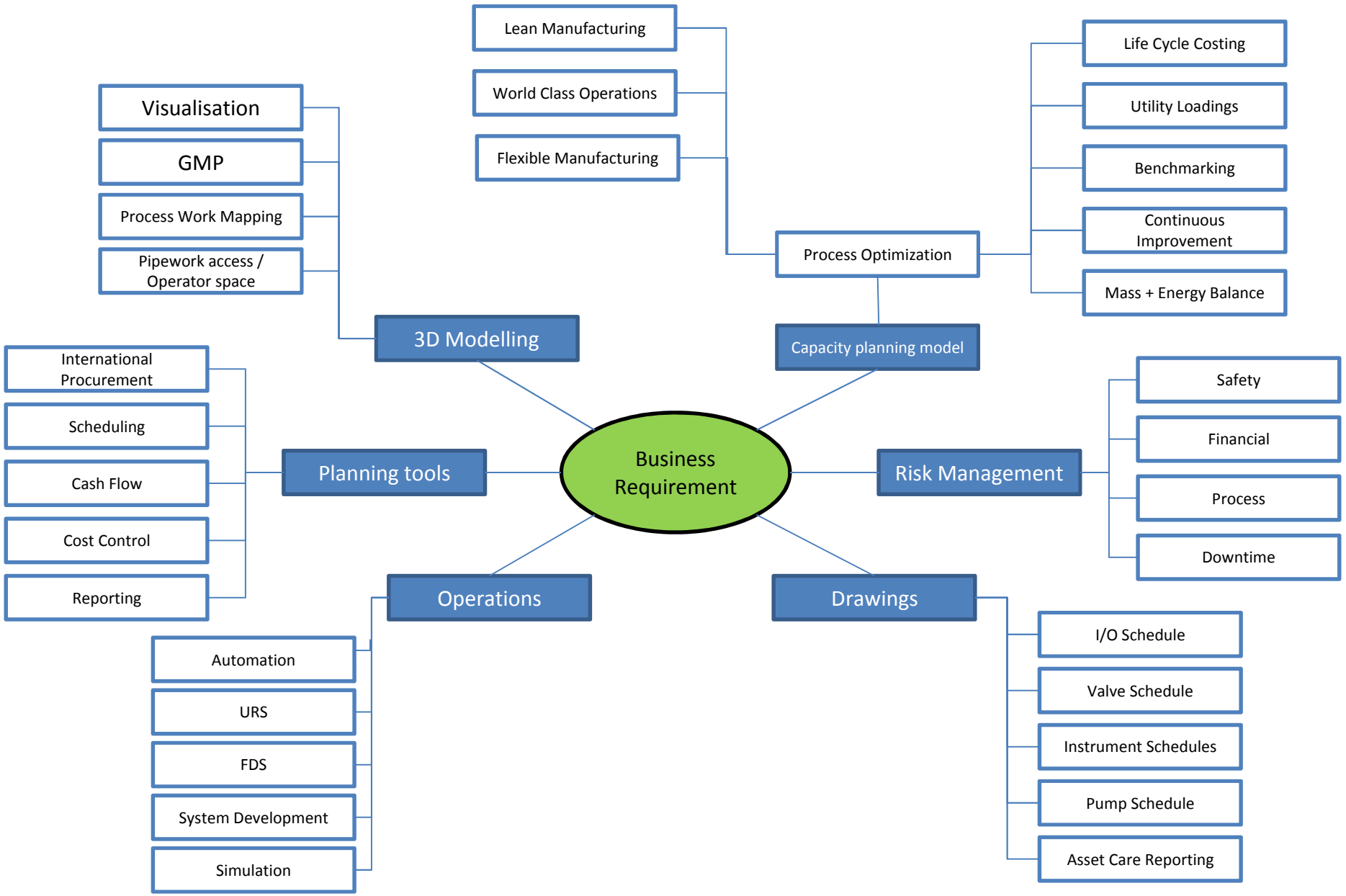

So How to avoid a mess?

Project Scope



But What About?

- CIP
- Co-products
- Utilities
- HVAC
- Structural
- Manning
- Effluent
- Warehousing
- Permitting
- Upstream and Downstream knock-on


Business Requirement
3D Modelling
Visualisation
GMP
Process Work Mapping
Pipework access / Operator space
Process Optimization
Lean Manufacturing
World Class Operations
Flexible Manufacturing
Capacity planning model
Life Cycle Costing
Utility Loadings
Benchmarking
Continuous Improvement
Mass + Energy Balance
Planning tools
International Procurement
Scheduling
Cash Flow
Cost Control
Reporting
Risk Management
Safety
Financial
Process
Downtime
Operations
Automation
URS
FDS
System Development
Simulation
Drawings
I/O Schedule
Valve Schedule
Instrument Schedules
Pump Schedule
Asset Care Reporting

Project Types and Studies

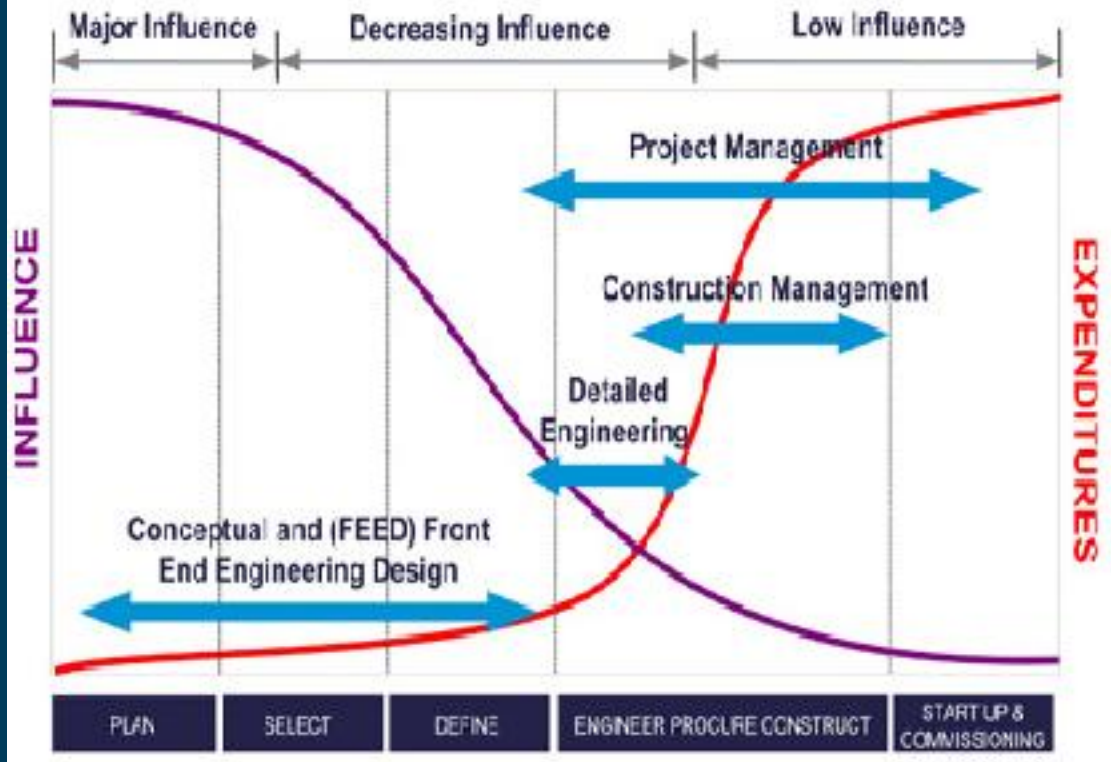
BRIGGS BREWING

Not Sure where to start?

- FEL 1-3
- FEED
- Master Plan
- Preliminary Concept designs
- Stage Gate designs

All trying to deliver:

- **Capital Budget Preparation:**
- Basis of Design
- Mass & Energy Balances
- Process Flow Diagram (PFDs)
- Plant Utilization
- Capacity Calculations
- Plant configuration & sizing summary
- Conceptual Plant Layout / Civil & Structural
- Equipment Loadings / Drainage Plans
- High Level Process Description
- Control System Philosophy & Architecture
- Electrical Distribution
- HAZOP?



Front-End Loading Levels

Industry Standard for large CAPEX projects

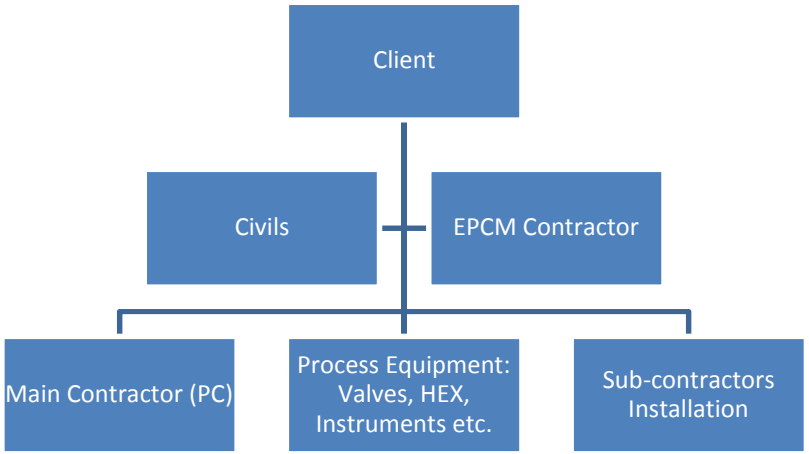
FEL 1	FEL 2	FEL 3	Detailed Design
± 30% Cost Certainty	± 20% Cost Certainty	± 10% Cost Certainty	Cost Certainty with Contingency (<10%)
Block Flow Diagram	Process Flow Diagrams	Preliminary P&IDs (IFB)	P&IDs and equipment drawings (IFC)
Material and Energy Balance	Preliminary Equipment Design	Purchase-ready major equipment specifications	Major and Minor Equipment Tender
Preliminary Layout	Preliminary Layouts	Project Execution Plan	URS/FDS
Multiple options design	Preliminary Schedule	Preliminary 3D model	3D model (IFC)
Major technologies Review	Network Architecture	Electrical equipment List/ Architecture	Line List
Industry standard historical costings	CSA preliminary designs		

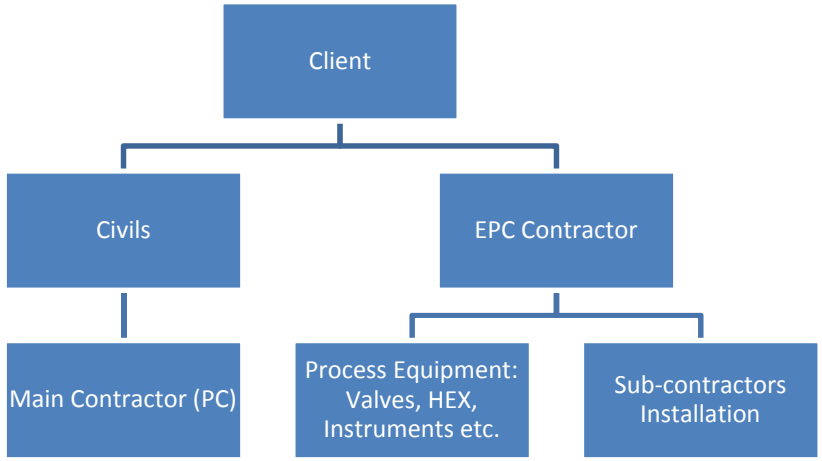
Types of Contracts

- Consulting (E)
- Equipment Supply (OEM)
- Engineering, Procurement & Construction Management (EPCM)
- Engineering, Procurement and Construction (EPC/Turnkey)

- Sometimes a mix
- Look for a long term partner
  - Support
  - SLAs

EPCM vs EPC


Client
Civils
EPCM Contractor
Main Contractor (PC)
Process Equipment: Valves, HEX, Instruments etc.
Sub-contractors Installation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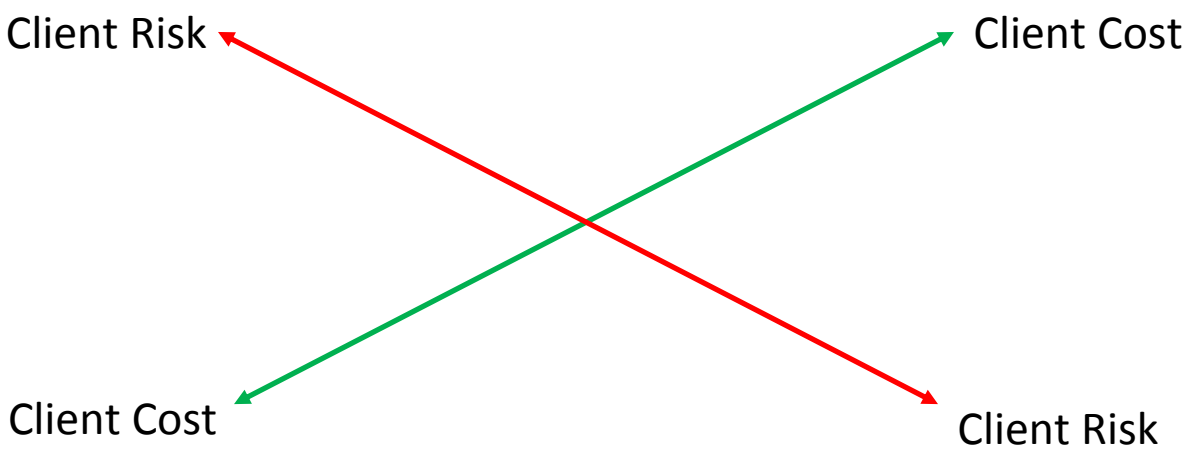
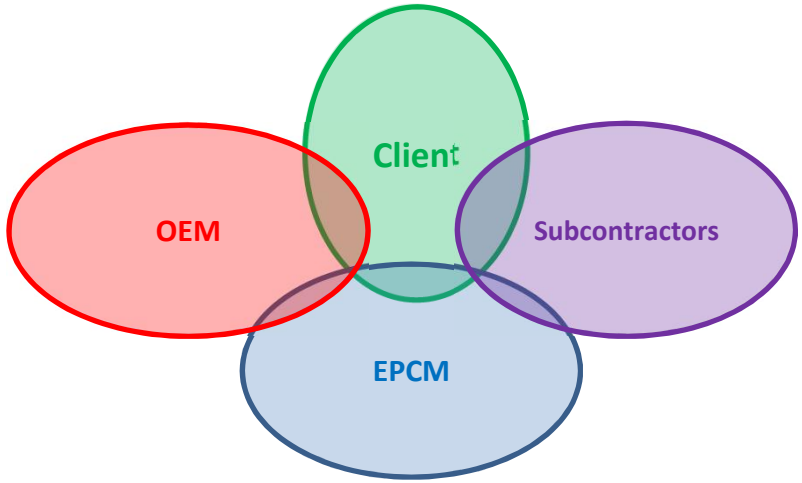

Client Risk
Client Cost
Client Cost
Client Risk

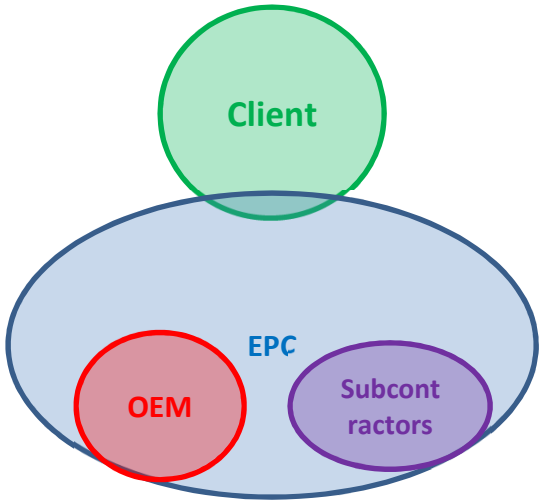
EPCM - Risk Profile

- Construction Risk with Client
- Process Risk shared between Client (material) and Process Contractor (design & performance)
- Risk associated with ALL equipment and installation moves to Client (delays, FOREX, insolvency)
- Engineering fees are estimated in line with programme and subject to changes at Client risk
- Potential of lowest Initial Contract Cost, BUT
  - Contractor has different cost profile (No material O/H recovery)
  - Lowest Cost Certainty
  - Largest Human Resource Requirement
  - Potential delay / extension claims
  - Multiple contracts and points of contact



EPC (Turnkey) - Risk Profile

- Defined risks with Contractors (Briggs)
- Budget responsibility at contractors risk (lump sum bid for scope)
- Process Risk with Process Contractor
- Contractors price their risk in the contract price
- Fixed Price – Cost Certainty
- Minimum Risk
- Lowest Human Resource Requirement
- Minimizes “Extras”
- Programme risk with contractors unless affected by 3rd party.
- Client has no visibility of actual costs
- Single point of contact
- Simplified organogram / R&R matrix
- Potential of reduced programme

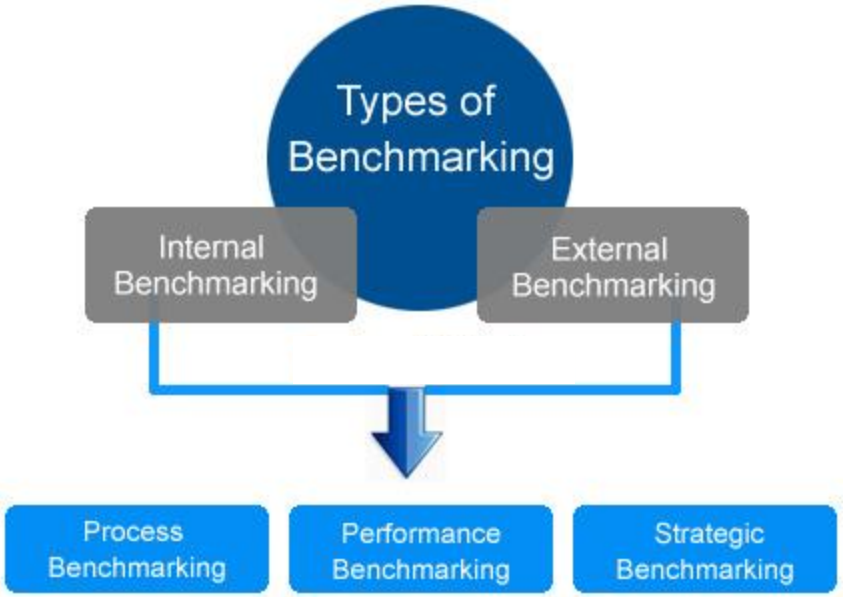


Benchmarking and Standards

Business Case>Scope>Project Type>Benchmark

BRIGGS

Benchmarking and Standards



How many Brew Masters, Brewers, Operations Managers, and Operators?

- ❑ What is your current brewlength and Turn-around Time?
  - What is your extract efficiency and evaporation rate?
    - ❑ What is your plant water:beer and power:beer usage?
      - What is your Lauter Tun/ Mash Filter bed loading?
        - ❑ What is the viscosity of your yeast strain?

Benchmarking and Standards

Benchmarking

- Units and Overall Design and operation.
- OEE %
- Peak Factors
- Utility and effluent capacities
- Raw material specifications
- Used to drive Performance Guarantees on new equipment
- Variances due to recipe, staff, climate, etc
- Possible Energy rebates

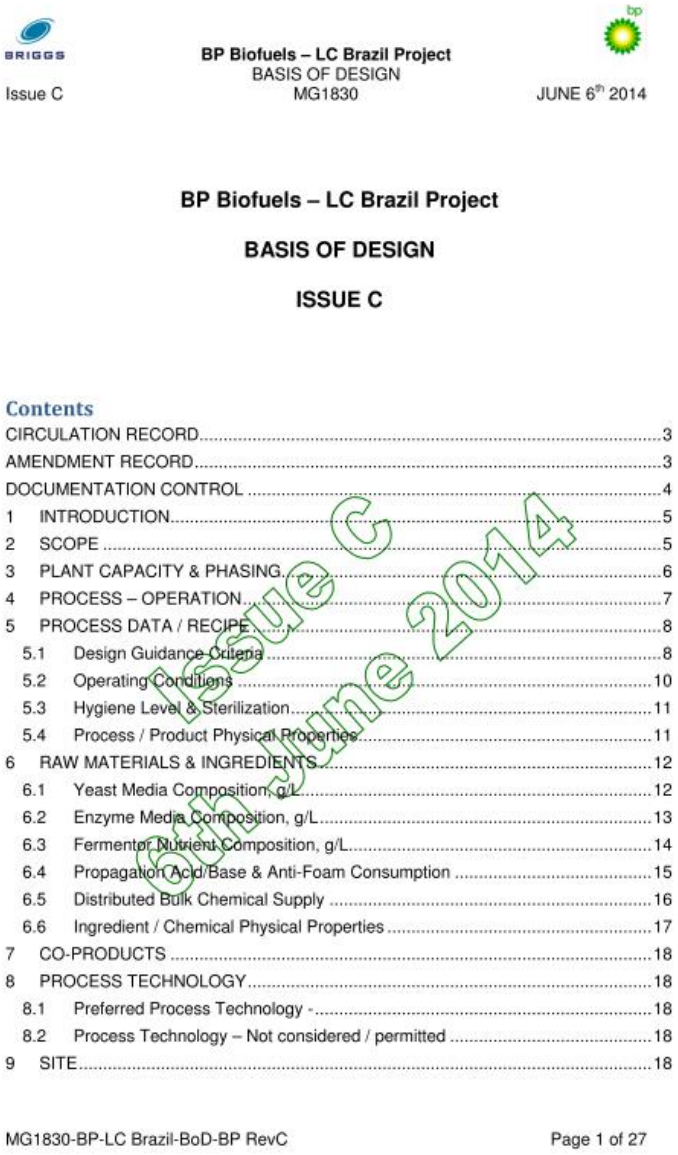
Standards

- Preferred Suppliers
- Electrical and Automation
- Piping and Mechanical
- CIP/SIP
- Tagging and Labelling
- Units
- Maintenance
- Operating and safety procedures

!Never too late to start!

!Keep up to date!

Basis of Design



BRIGGS

BP Biofuels – LC Brazil Project
BASIS OF DESIGN
MG1830

Issue C

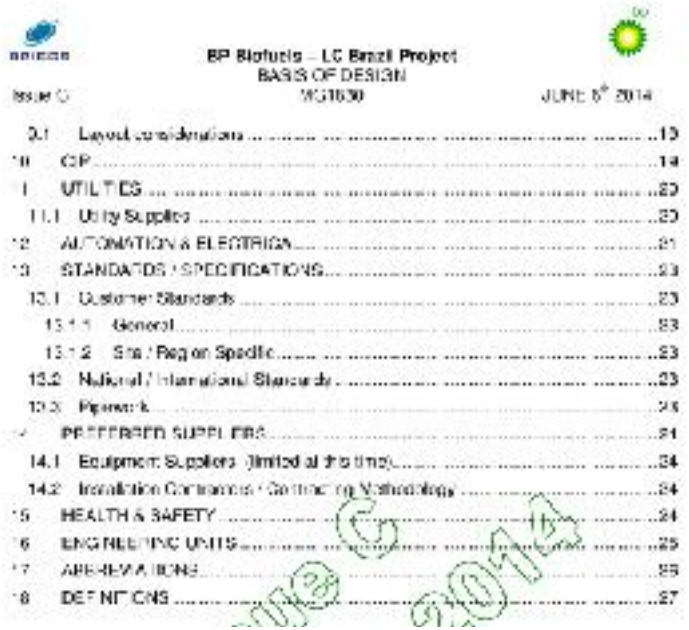
JUNE 6th 2014

BP Biofuels – LC Brazil Project

BASIS OF DESIGN

ISSUE C

Contents



BRIGGS

BP Biofuels – LC Brazil Project
BASIS OF DESIGN
MG1830

Issue C

JUNE 6th 2014

Defines Key Project Objectives in one document -

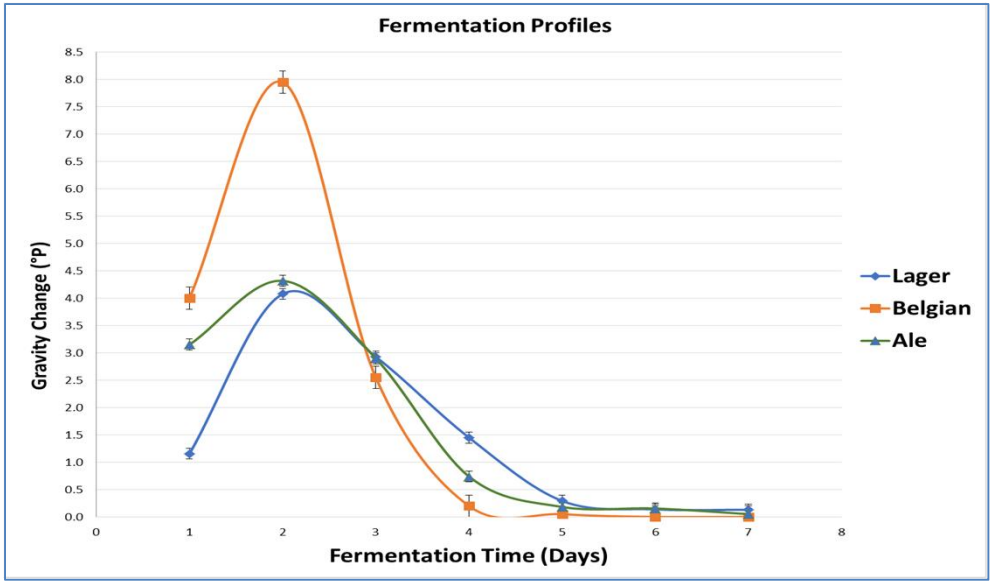
- Scope
- Capacity / Phasing
- Operation
- Recipe
- Materials
- Technology
- CIP
- Utilities
- Automation
- Standards

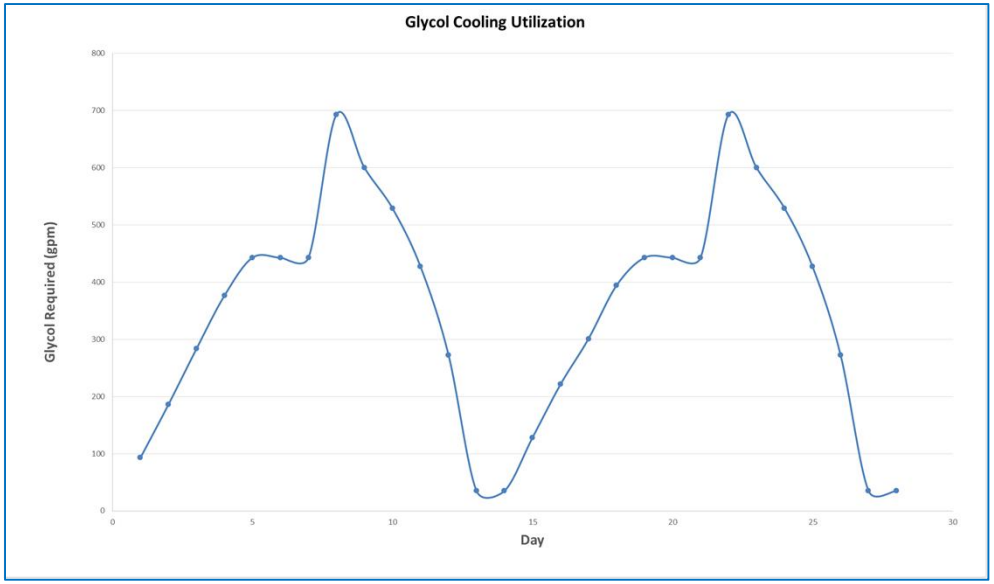
Recipes and Brewing Technology

Recipes

Existing Breweries Hopefully defined?

- Mutual NDAs industry Standard
- Bill of Materials
- Water Balance
- High Gravity brewing
- Equipment design extremities
- Variations and equipment capabilities
- Possible future recipes
- Recipe parameters fixed or open to change?
- Brand Split – Beer Factory vs Innovative
- Brewlengths
- Fermentation profiles





BRIGGS BREWING

Recipes and flexibility

- Mutual NDAs industry Standard
- Bill of Materials
- Water Balance
- High Gravity brewing
- Equipment design extremities
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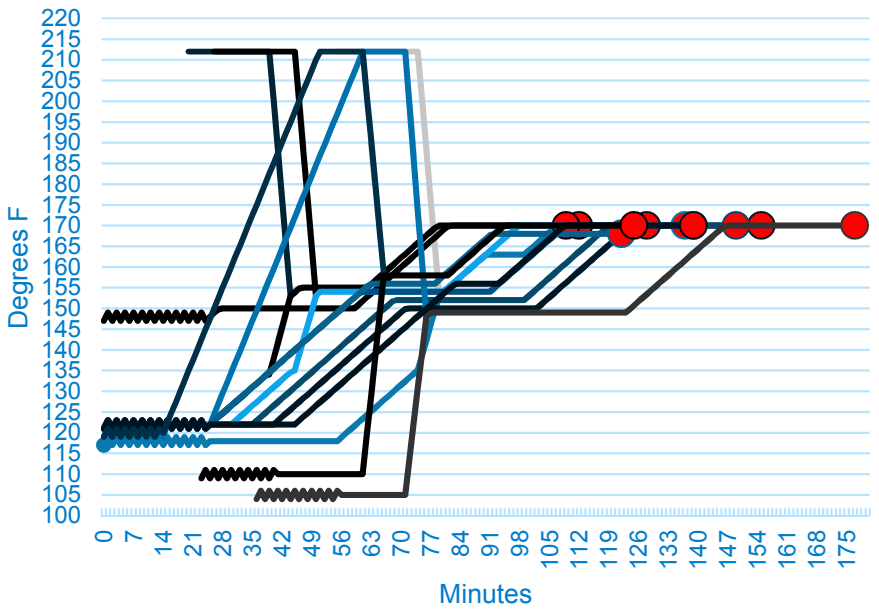
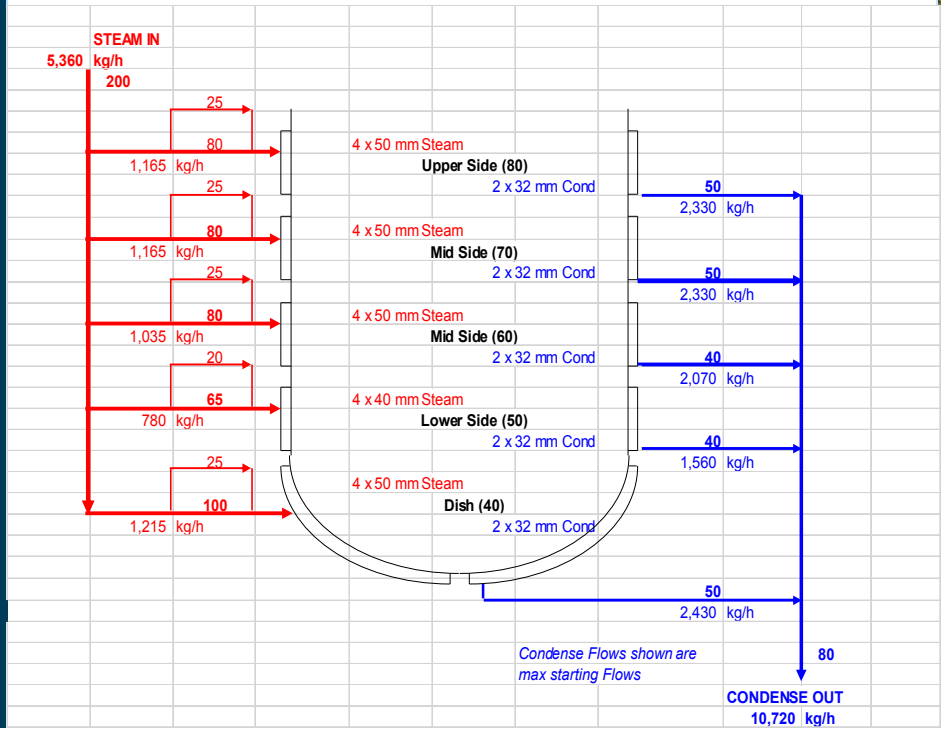




BRIGGS BREWING

Technology

- Decisions typically driven by:
  - Reluctance to change
  - CAPEX Cost
  - Preference
  - Awareness
  - Customization
  - Timescales

BRIGGS BREWING

Technology

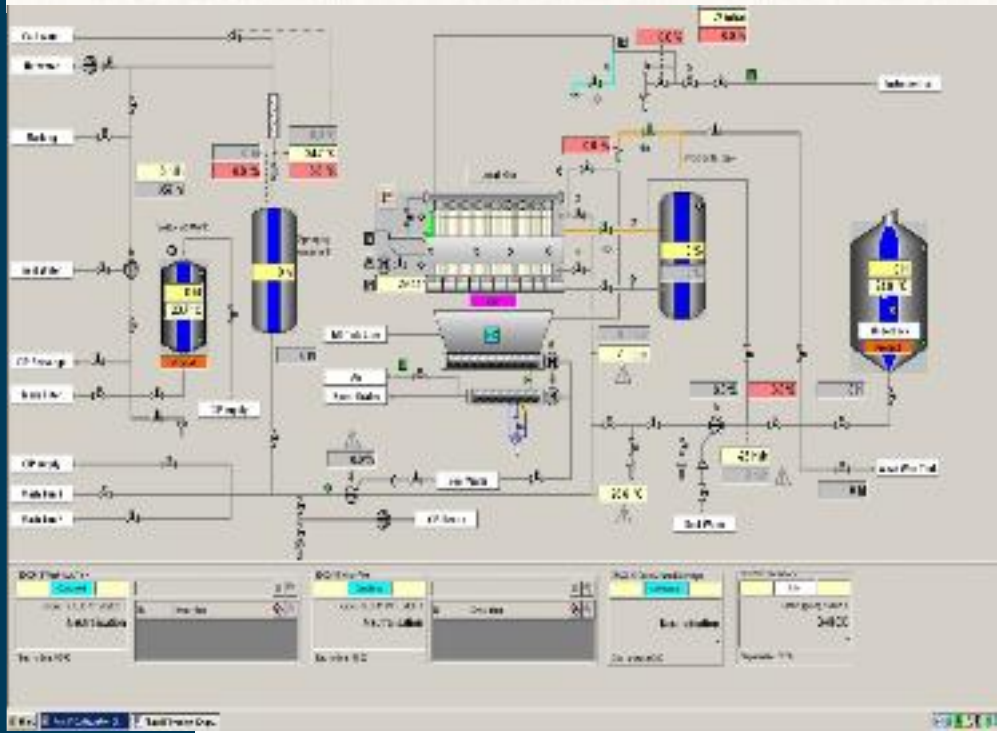
- Decisions should be driven by:
  - ~~Reluctance to change~~
  - Spares and Support
  - CAPEX Cost
  - **Cost of Ownership**
  - Preference
  - **Fit for Purpose/Design**
  - Awareness
  - Track Record
  - Customization
  - Timescales
  - Reliability
  - Performance Guarantees

BRIGGS BREWING

Technology

- What process has changed in brewing over time?
- What has changed in last 10 - 20 years?

- Energy Efficiency
- Water Efficiency
- Cost of Automation
- Hygienic Design
- Qualitative Instrumentation
- Equipment Utilizations



A few Unit Technology Options

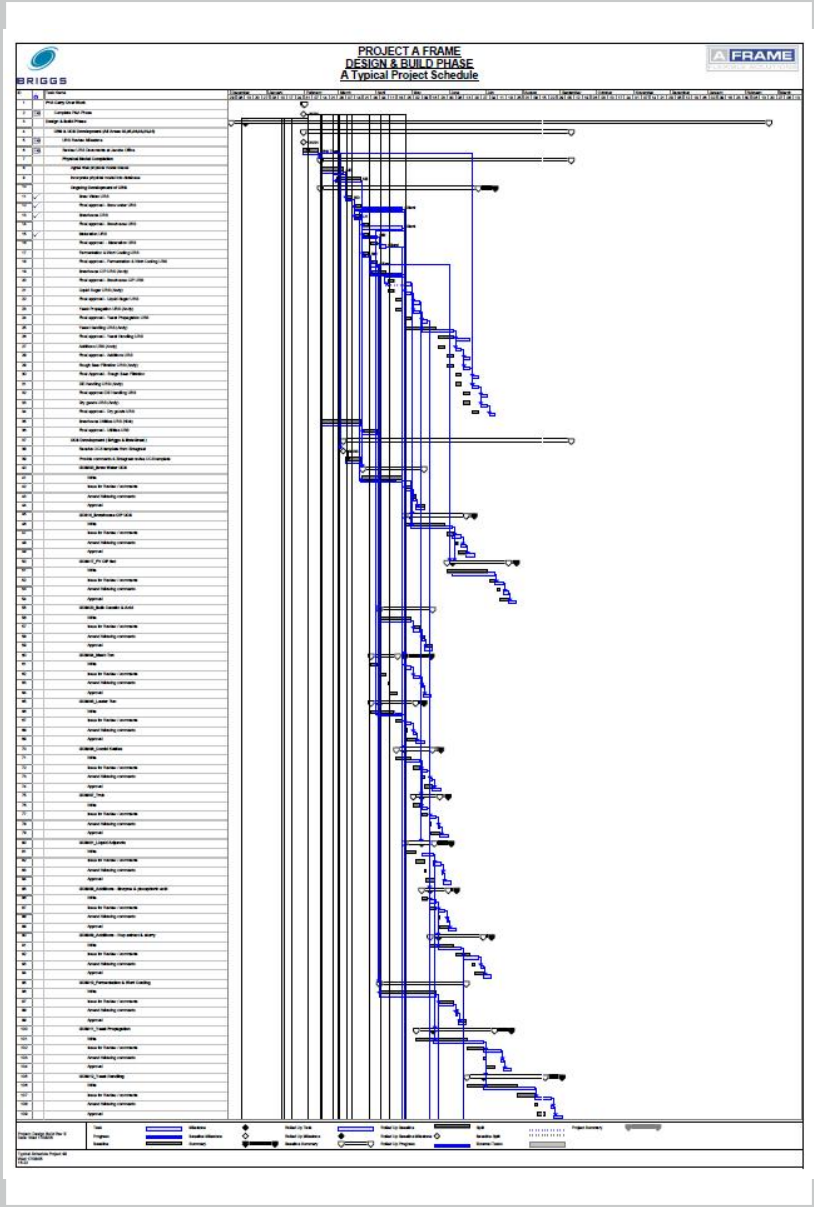
Milling	Mashing	Cooking	Wort Separation	Boiling	Whirlpool
Dry	Direct	Infusion	Lauter Tun	Vacuum/Pressure	Additions
Wet/Steep	Pre-masher	Decoction	Mash Filter	Internal/External calandria	Decanter
Cracking	Steeles Masher	Multiple heat zones	Weak Worts	Simmer/Strip	Combi-kettle
Roller Mill	Conveying types		Pre-run Vessel	Vapor Condenser	Trub re-use
Hammer Mill	pH adjustment		Preheating	Additions	
			Spent Grain Pneumaveyor		

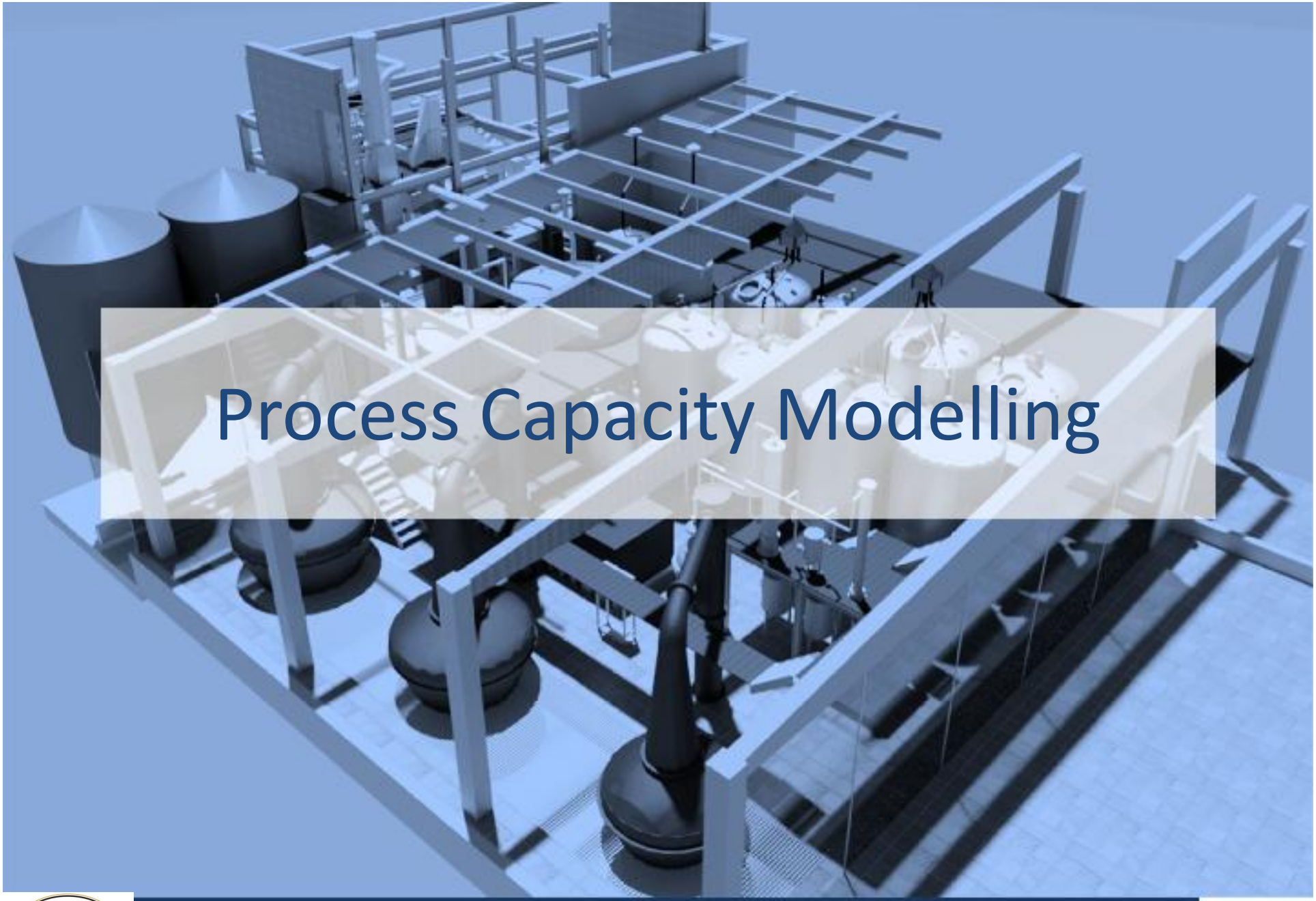
Wort Cooling	Yeast	Fermentation	Clarification	Finishing	Utilities
1 or 2 stage	Cell Count pitching	Unitanks	Membrane filtration	Blender carbonators	Different temp ringmains
Low pressure oxygenation	Fully closed multiple strain systems	Density Fermentation	Hermetically sealed Centrifuges	Recovered beer	Energy Store tank
Hop Strainers	Additions	CO_2 Recovery	Inline dosing	Beer Blending	Recovery CIP sets
	Rapid Batch yeast Propagation	Homogenizers	Volume purging	Zero DO pickup	Multiple fuel boilers
	De-aeration	Sparging	Recovery Stabilization systems		Full condensate recovery
		Autosampling	Yeast collection		
		Dry Hopping			
		Yeast Cropping			

Project Flexibility

Schedule

- Upgrade or Continuous improvement.
- T&M or Fixed Priced
- Overall timescales/Phasing identified
- Long lead procurement needs
- Critical path analysis
- Resource / staffing plan identified
- Threat to timescale study
- Tax Exemptions
- Program Control - EWNs





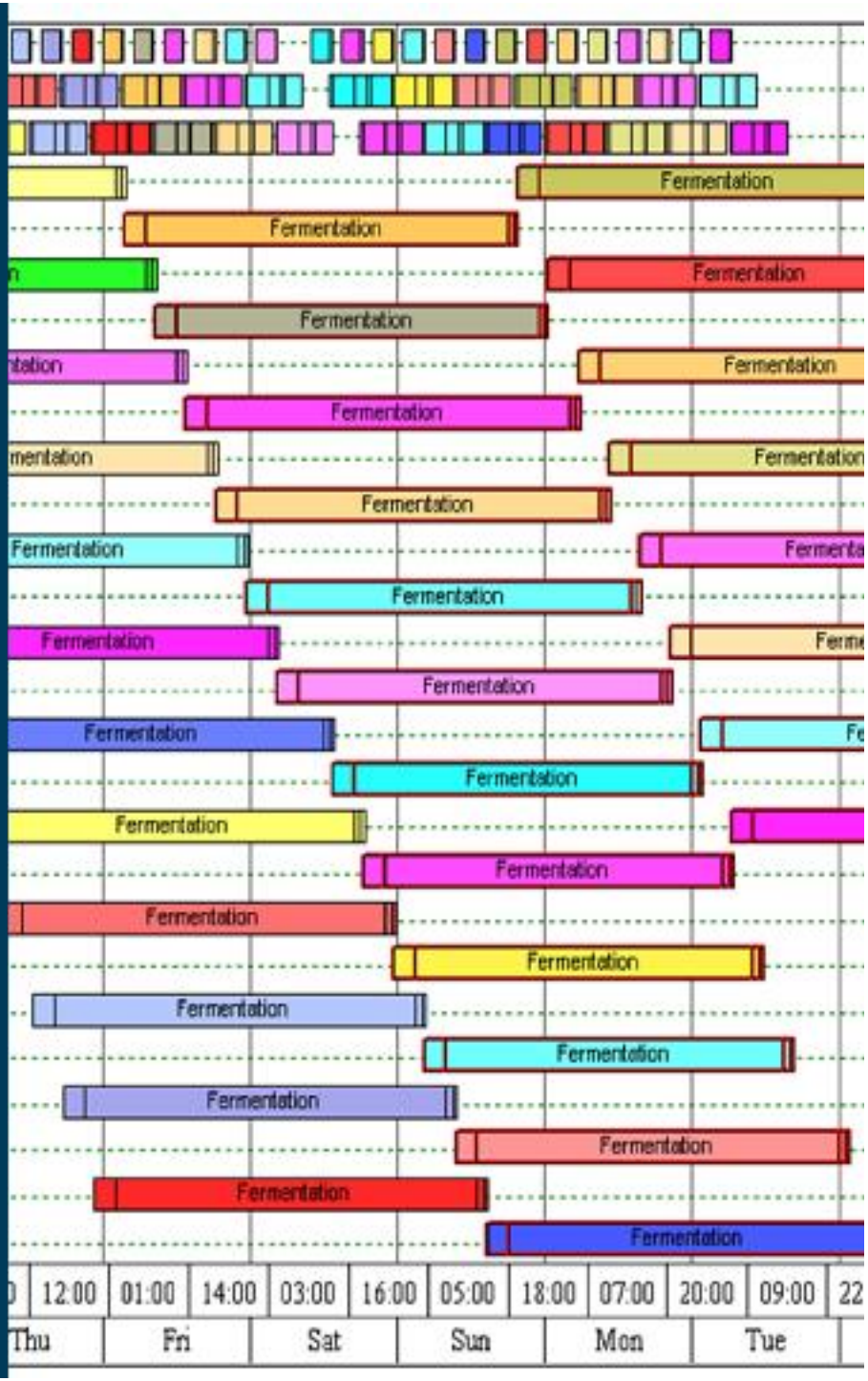
Process Capacity Modelling

BRIGGS BREWING

What is Capacity Plan Modelling?

- Allows visualization of equipment requirements to suit plant capacity
- Graphical representation of the plant operation, alongside capacity calculations
- Identifies equipment and manning requirements, route design including process and CIP, utility loadings
- Identifies pinch points and bottlenecks
- Can be used to quickly evaluate multiple scenarios and generate OPEX and CAPEX optimal solution.

Where should I spend my Money??



Capacity Modelling

8 BPD																											PINCH POINT
	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	500 hL	500 hL	500 hL	500 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL	1000 hL
Days	CCT 1	CCT 2	CCT 3	CCT 4	CCT 5	CCT 6	CCT 7	CCT 8	CCT 9	CCT 10	CCT 11	CCT 12	CCT 13	CCT 14	CCT 15	CCT 16	CCT17	CCT18	CCT19	CCT20	CCT21	CCT22	CCT23	CCT24	CCT25	CCT26	CCT27
1	Fermenting	Fermenting	Fermenting	Fermenting																							
2	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting																			
3	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting															
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6	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting					
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8	CRASH	CRASH	CRASH	CRASH	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting	
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13	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	MATURING	Fermenting	Fermenting	Fermenting	Fermenting	Fermenting
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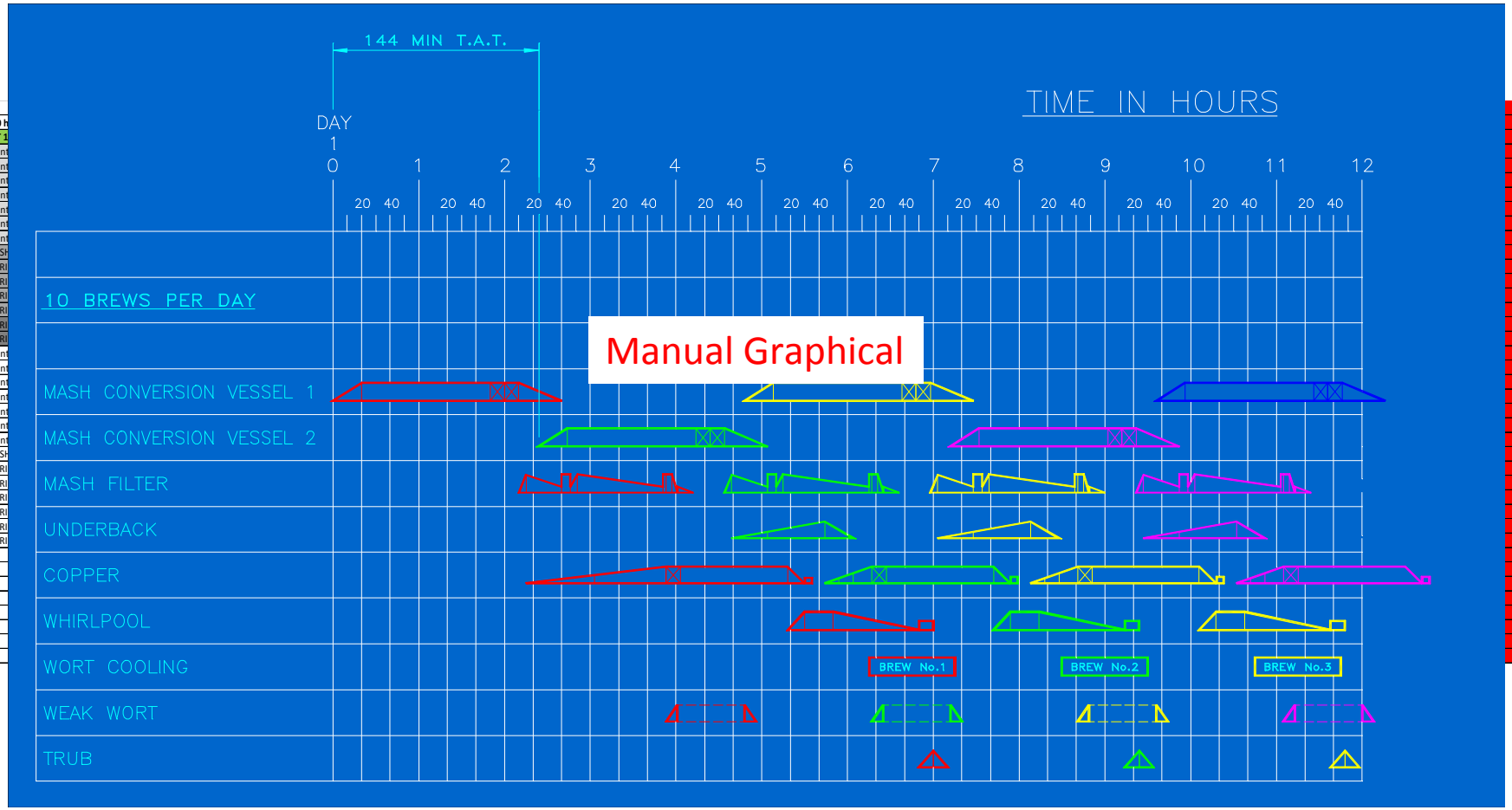
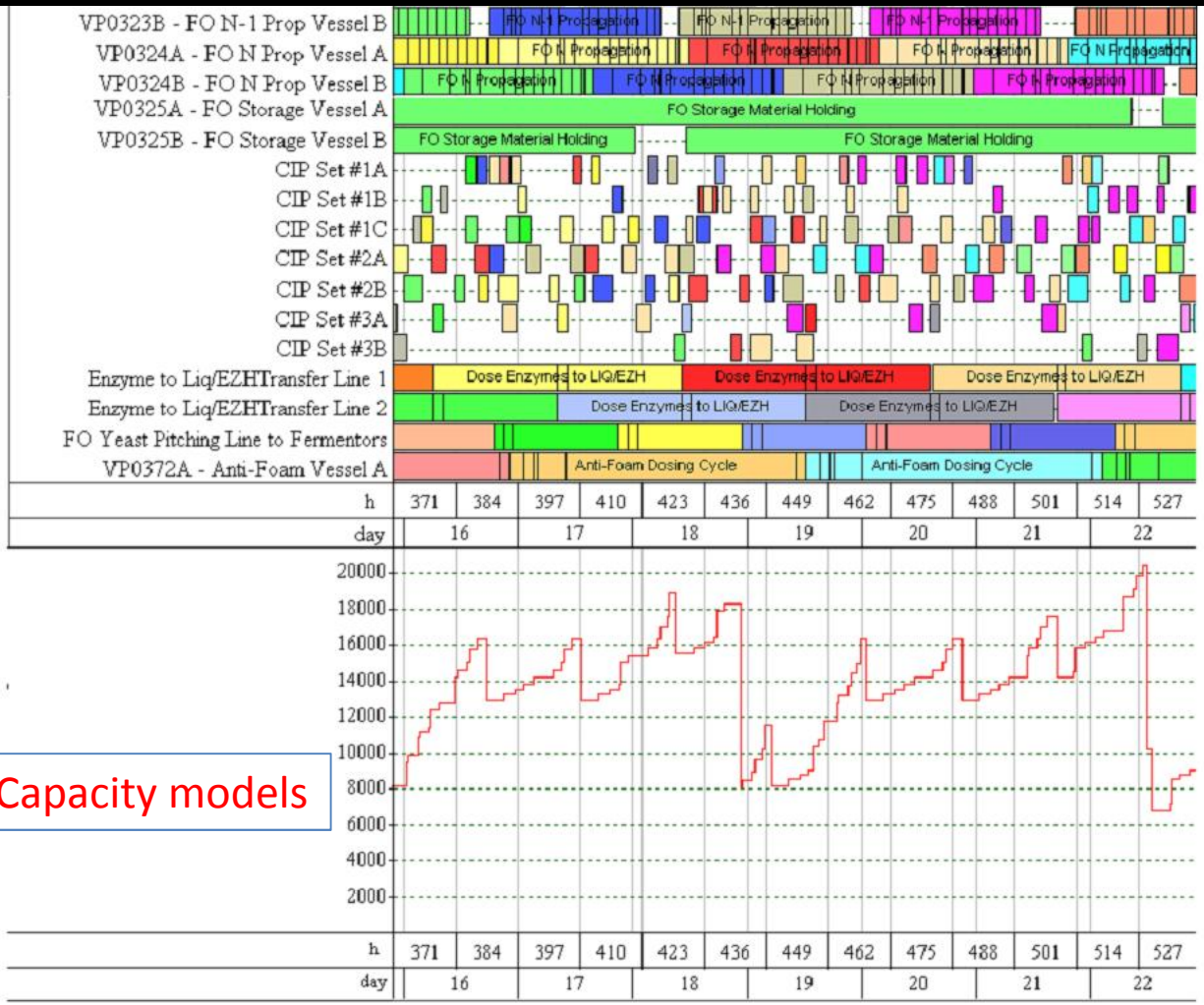
Manual EXCEL

Capacity Modelling



Capacity Modelling



Capacity models

Capacity Modelling

Brewlength vs BPD

Brews/Day	TAT (mins)	Brewlength (Bbl)	Daily Production (bbl/day)
14	100	200	2800
12	120	233	2800
10	140	280	2800
8	180	350	2800
6	240	466	2800

- More brews/day x Smaller Brewlength
- Lower peak / smoother utility loads
- Smaller physical size – shorter runs
- Reduced energy loss


Rockwell Automation
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Integrator Programme
ProLeiT brewmaxx
DELTAV
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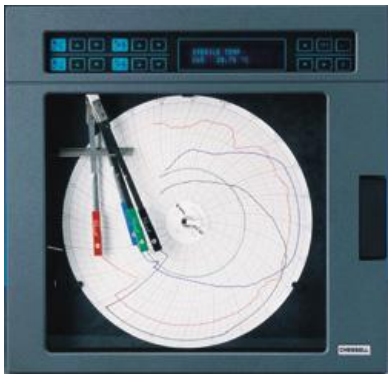
SIEMENS
Automation and Control
CERTIFIED SYSTEM INTEGRATOR
iFIX™
FANUC
Solution Provider
Modicon PLC
CERTIFIED DEVELOPER
Intellution
Ignition
OMRON
OMRON
engineering partner

Automation and Control



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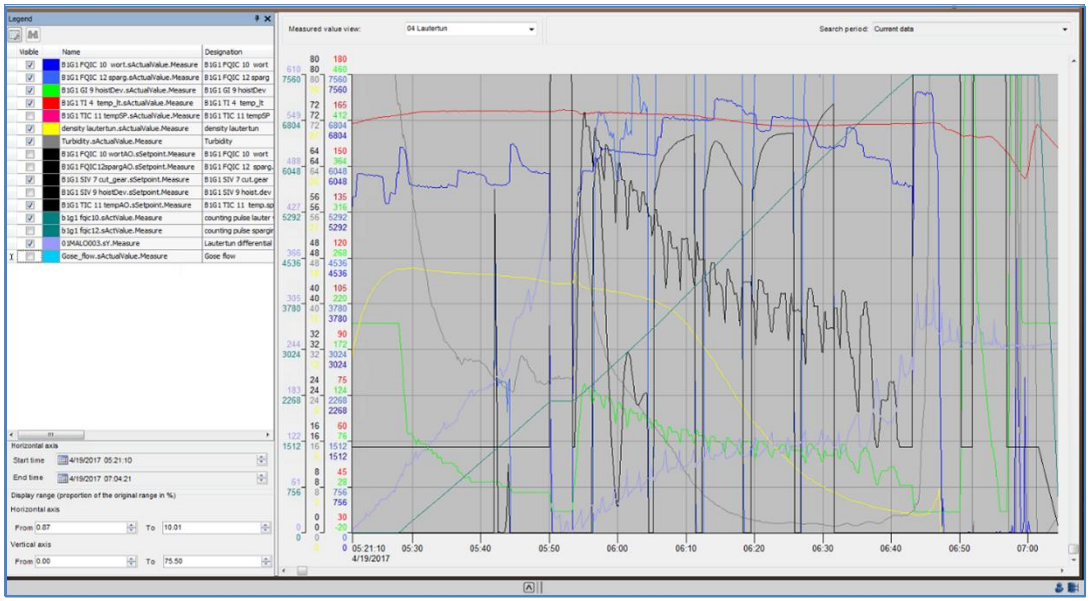
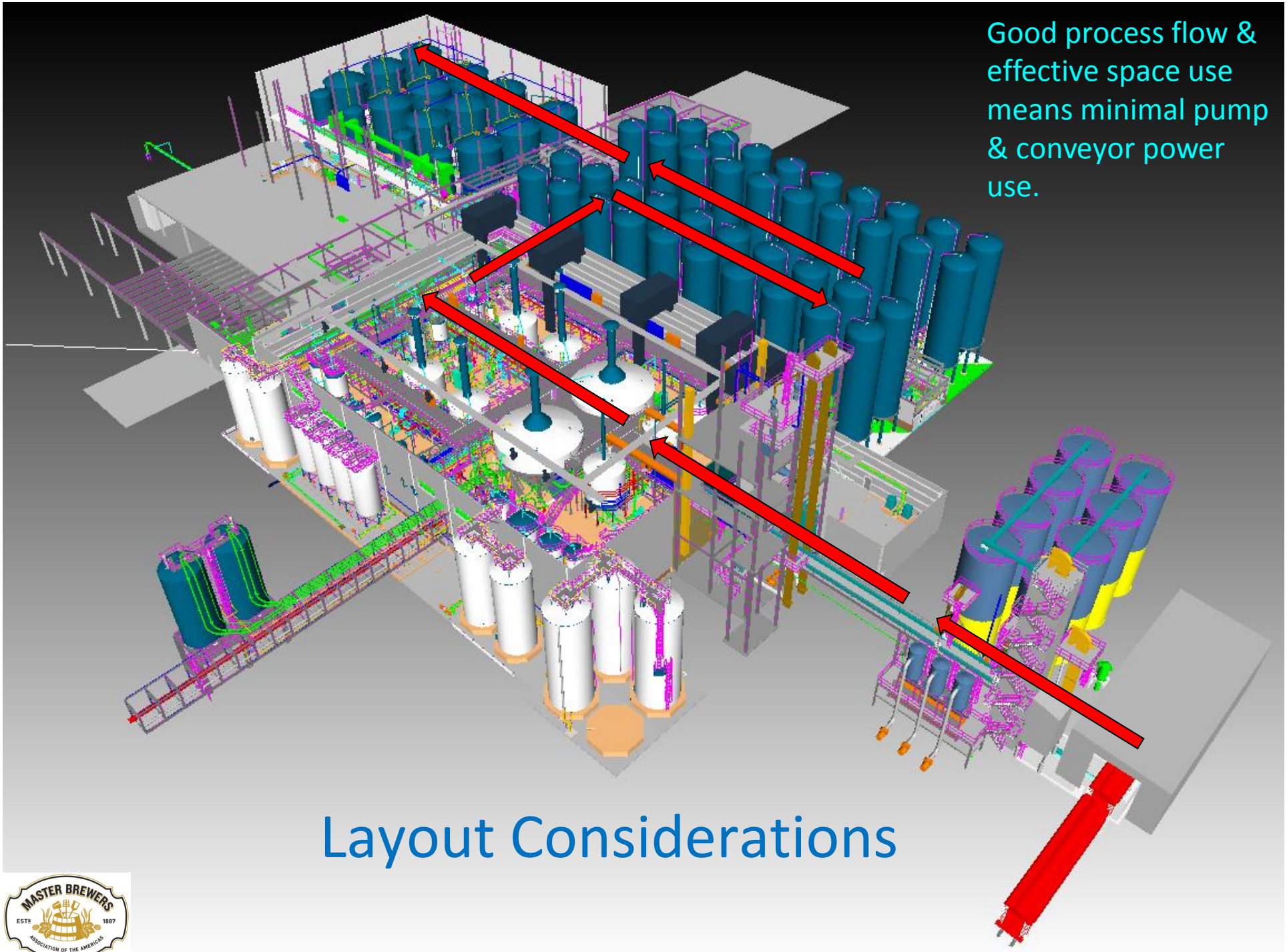


My Industry Observations

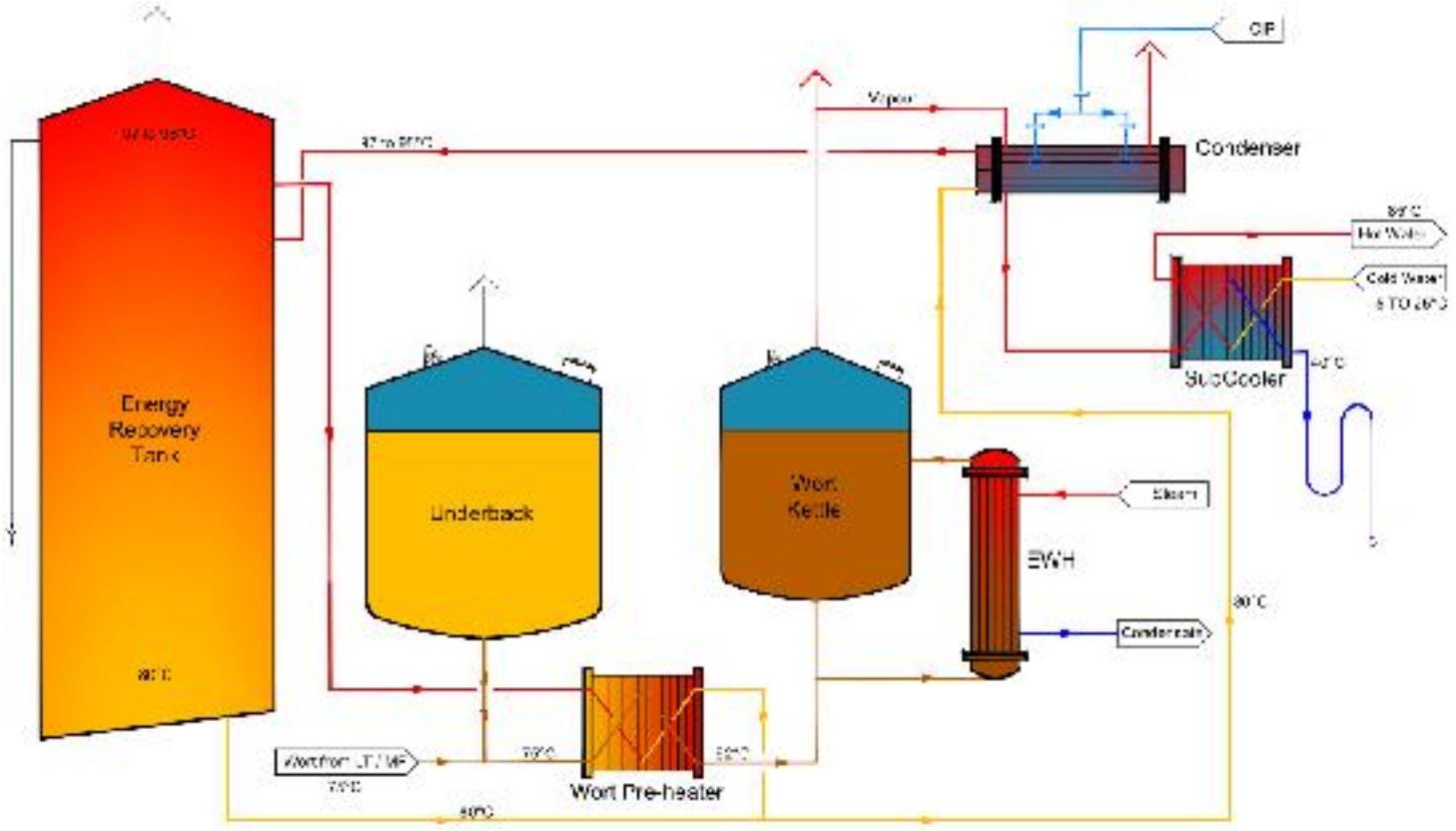
- Allen Bradley vs Siemens.
- Rockwell Factory Talk Brew, Brewmaxx and Ignition
- Conventional and 24v vs Profibus and Asi
- Conduit vs Cable Tray
- Hardwired vs Ethernet
- Reporting
- Variable control vs sequence control

Other Topics



Layout Considerations

Energy Saving Systems



Energy Recovery System - Wort Pre-heating

Special Thanks

Briggs of Burton

Sponsors of the Event

FX Matt Brewing Co

Andy and the MBAA team

Thankyou for your attention

BRIGGS

Questions?