A Better Brew

Benefits of Applying Systems Engineering in the Beer Industry

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PREMIER STAINLESS SYSTEMS

Key Talking Points

- Brewing equipment design concepts
- Applying SE to HW-centric platforms
- Applying SE in a non-traditional domain where most aren't familiar with it

Speaker Bio

- Education/Certifications:
  - BS Mechanical Engineering Technology
    - Southern Polytechnic State University – 2005
  - MS Systems Engineering
    - Johns Hopkins University – 2013
  - INCOSE CSEP – 2011
- Work Experience
  - Northrop Grumman – Mechanical/Systems Engineer – 2005 to 2014
  - Fairhope Brewing Co – Head Brewer – 2014 to 2016
  - Diamondback Brewing Co – Brewing Consultant – 2016
  - Premier Stainless Systems – Director of Engineering – 2017 to present

About Premier Stainless

- Founded in 2000
- Core product lines:
  - Brewhouses
  - Tanks
  - Keg washers
  - Brewery support equipment
- International customer base

Core Products: Tanks & Support Equipment

Core Products: Brewhouses

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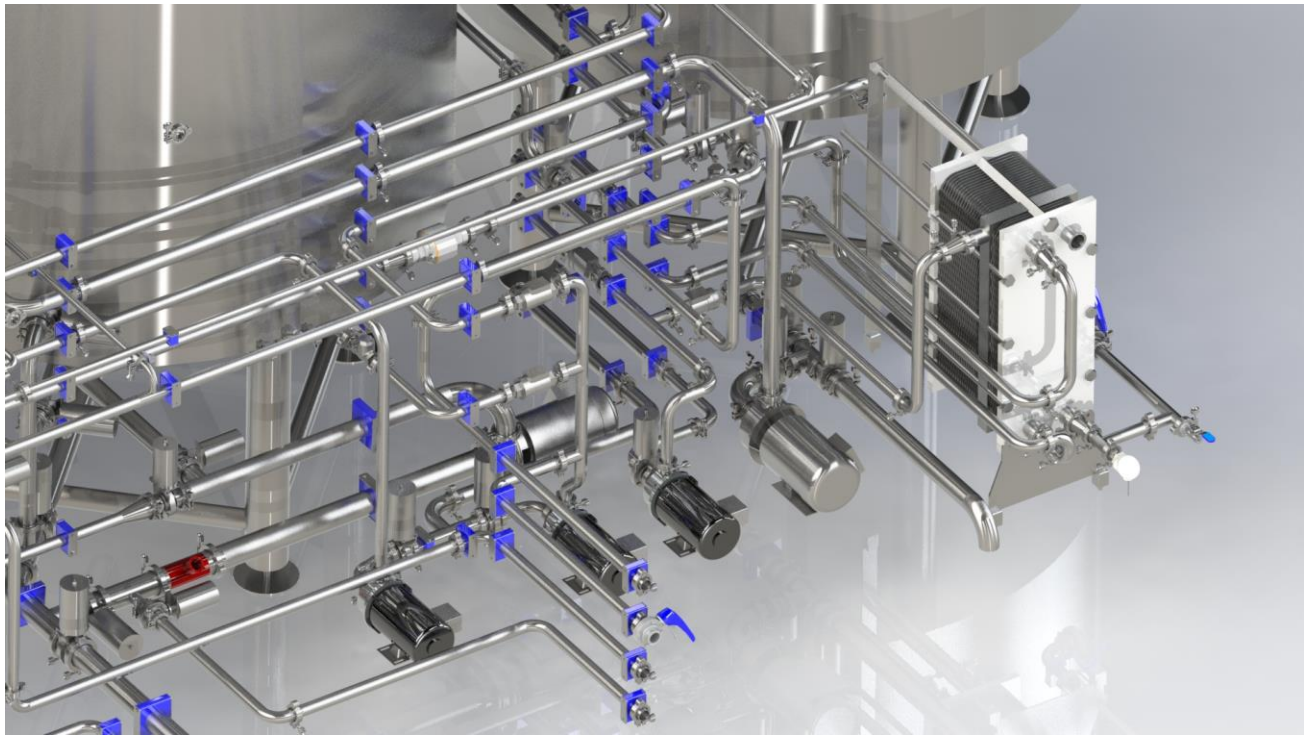
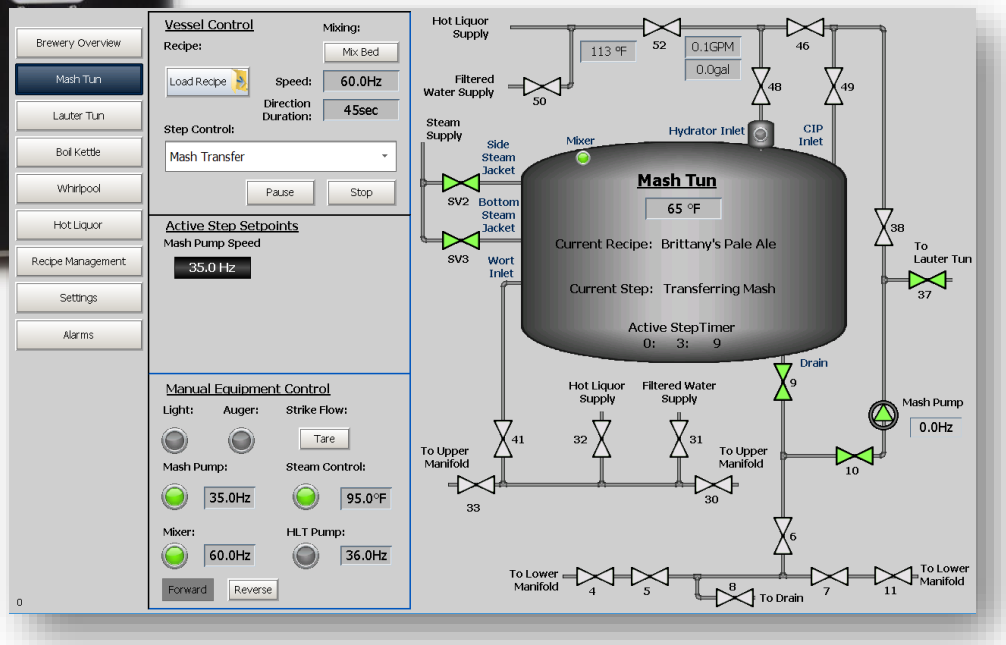
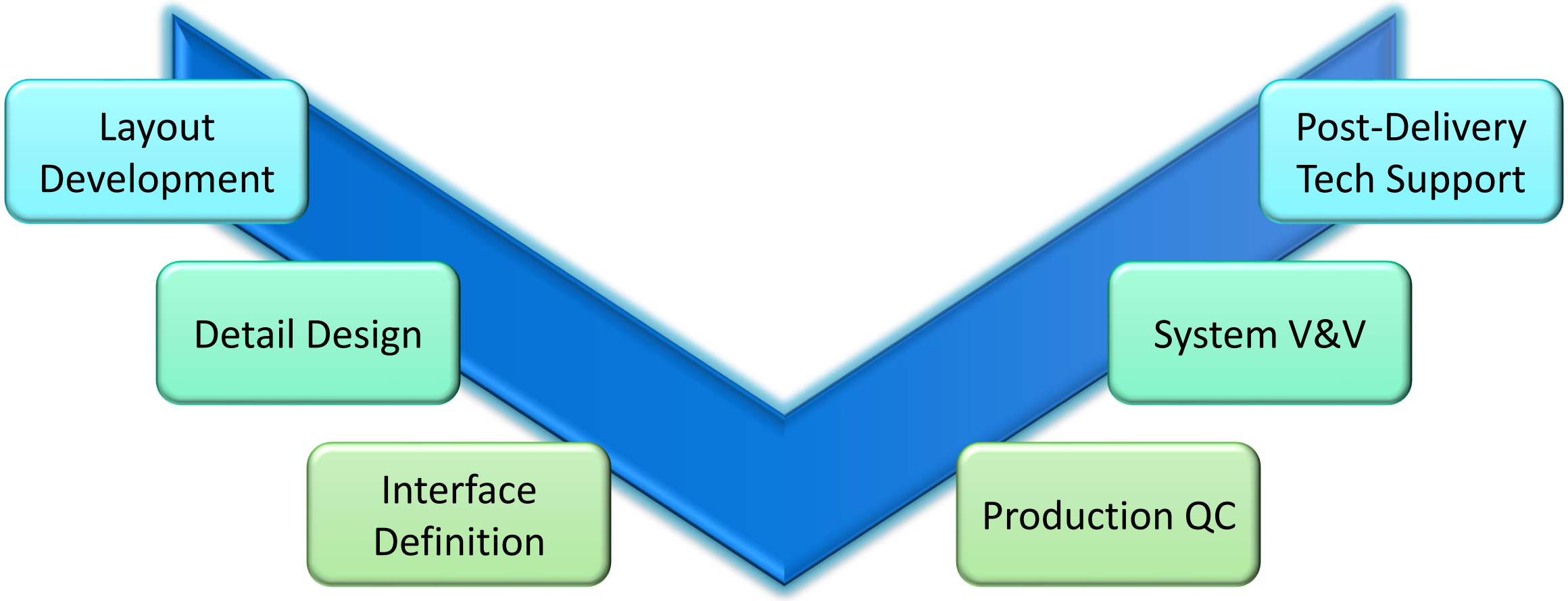


Core Products: Brewhouses



Engineering Process Overview

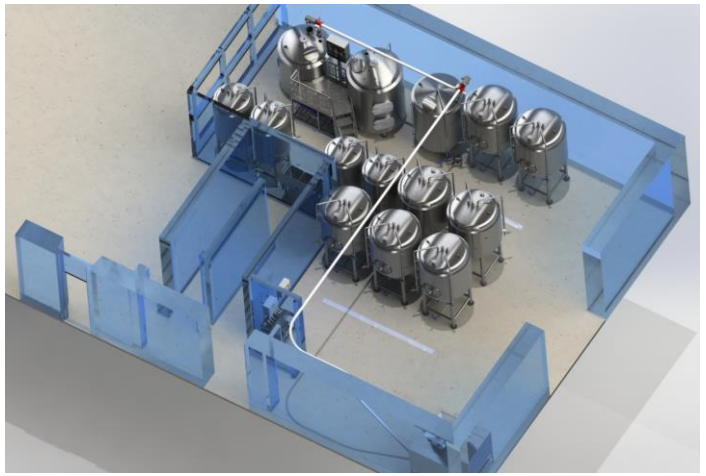


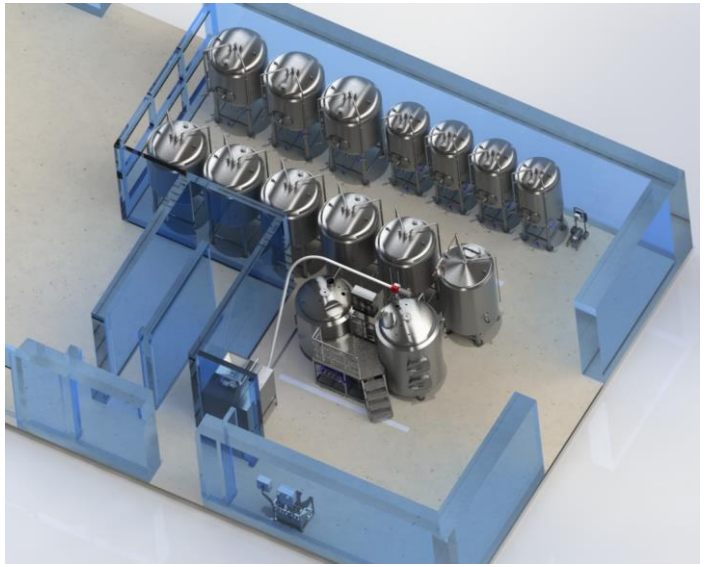
Overarching Design Parameters

- System must efficiently produce wort via the standard brewing process
  - BH efficiency – reducing waste and reducing ingredients
  - Times required to complete each brewing step
  - Repeatability
  - Ease of use
- Tanks – capacities, jacket pressures, insulation, ventilation
- In this context customers somewhat view our brewhouse design as a black box
- Difficult to quantify as the customer's expectation because these parameters are driven by their experience level and preferred brewing process

Layout Development

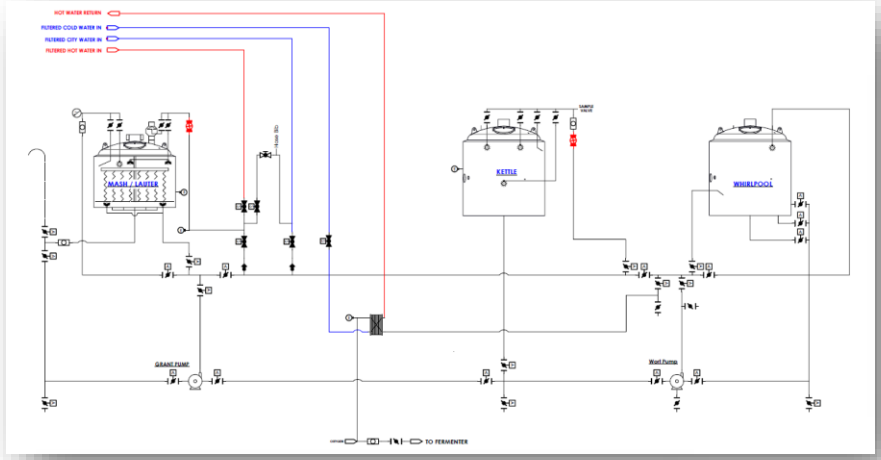
- Begin with equipment set defined by final quote
  - V&V paradigm – are we building the right thing
- Receive building details from customer
- Create 3D models to ensure all equipment will fit
- Organize equipment layout
  - Plan for process flow and look at future expansion
  - Account for infrastructure
  - Account for aesthetics

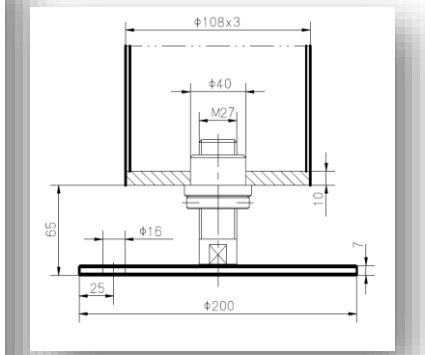


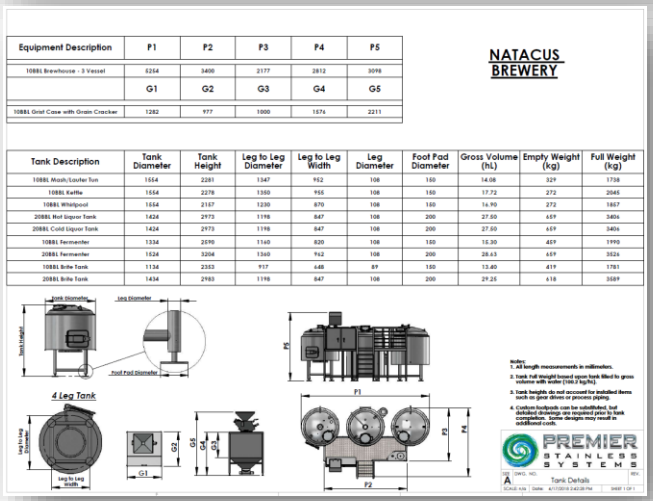


Detail Design

- Start with base design from legacy system
- Customize port layouts to match physical equipment layout
- Add any customer-requested upgrades or customizations
- Create manufacturing drawings and process piping diagrams



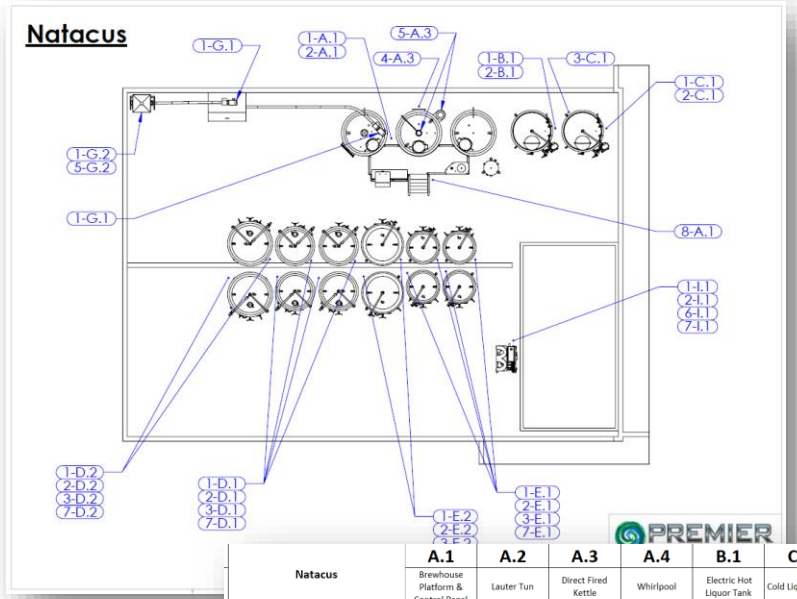




Interface Definition

- Equipment utility requirements
  - Power
  - Plumbing
  - Steam
  - Gas
- Equipment physical specs
- Applicable cut sheets

- For overall brewery construction effort we're just one equipment provider
  - 3rd party is responsible for official set of MEP drawings
  - We're just a part of a SoS



Natacus	A.1	A.2	A.3	A.4	B.1	C.1	D.1	D.2	E.1	E.2	F.1	G.1
	Brewhouse Platform & Control Panel	Lauter Tun	Direct Fired Kettle	Whirlpool	Electric Hot Liquor Tank	Cold Liquor Tank	10 BBL Fermenter	20 BBL Fermenter	10 BBL Brite Tank	20 BBL Brite Tank	Cellar Control Panel - 16 Controller	Model 75 Auger
Quantity	1	1	1	1	1	1	4	2	4	2	1	2
1 - Power Requirements												
Power (volts, phase, hertz, amps)	400V, 3PH, 50Hz, 48-53A FLA Pending 4 Pole/5 Wire	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	240V, 1PH, 50Hz, 7.5A	see Chronline Auger Manual for wiring 3/4 HP motor for Grain Cradler. Auger to Brewhouse will be powered by brewhouse. Power to be ran to auger motors
Connection Type	Power to be landed at terminal blocks within brewhouse junction box	n/a	n/a	n/a	see HLT cut sheet for field wiring connections	see CLT cut sheet for field wiring connections	see Fermenter Control Wiring cut sheet for field wiring connections	see Fermenter Control Wiring cut sheet for field wiring connections	see Fermenter Control Wiring cut sheet for field wiring connections	see Fermenter Control Wiring cut sheet for field wiring connections	Power to be landed inside panel. Watertight panel feedthrough required.	Auger to Brewhouse will have power cord provided with brewhouse
Electrical disconnect	Electrician to provide Ska emergency disconnect	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Notes	n/a	n/a	n/a	n/a	n/a	n/a	Fermenters typically have multiple RTD ports. PSS recommends using port just above cone.	Fermenters typically have multiple RTD ports. PSS recommends using port just above cone.	Brite Tanks typically have multiple RTD ports. PSS recommends using lowest port.	Brite Tanks typically have multiple RTD ports. PSS recommends using lowest port.	Location of Cellar Control Panel to be determined by customer	n/a
2 - Filtered Water Requirements												
Filtered water demand	15-30 GPM	n/a	n/a	n/a	15-30 GPM	15-30 GPM	n/a	n/a	n/a	n/a	n/a	n/a
Filtered water connection quantity and size	1x 1.0" FNPT	n/a	n/a	n/a	1x 1.0" FNPT	1x 1.0" FNPT	n/a	n/a	n/a	n/a	n/a	n/a
Required water pressure	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Notes	All water connections to be provided by customer. All piping to equipment to be provided by customer.	n/a	n/a	n/a	see HLT cut sheet for additional field plumbing connections	see CLT cut sheet for additional field plumbing connections	n/a	n/a	n/a	n/a	n/a	n/a
3 - Glycol Requirements												
Glycol demand	n/a	n/a	n/a	n/a	n/a	19-38 L/min	19-38 L/min	19-38 L/min	19-38 L/min	19-38 L/min	n/a	n/a
Glycol jacket volume per tank	n/a	n/a	n/a	n/a	n/a	32.5 L	18.2 L	28.6 L	17.6 L	26.0 L	n/a	n/a

System V&V

- Production QC
  - BOM validation
  - QC as-built equipment
  - Automated BH system-level control testing
- Deployment & On-site testing/training
  - Reassembly and integration with building infrastructure
  - Full system testing – verification
  - Training & first brews – validation

Takeaways

- Interface definition and control are critical
- With hardware design – changes become exponentially more expensive the later in the process they occur
- SE in this type of environment requires additional effort and diligence as the engineer has to perform the role of the customer as well
- Process tailoring and agility is key to maintaining short development cycles
  - Re-use and standardized designs ease schedule pressures

Q&A