Why Use Modular Sampling Systems ?

MSS brings advantages during each Enterprise Phase:

1) **Engineering & Design**

2) **Fabrication & Testing**

3) **Operation and Maintenance**

4) **Upgrade and Refurbishment**

Image © Parker IntraFlow

Why Use Modular Sampling Systems?

According to Jeff Gunnel and Peter van Vuuren IFPAC, Jan 2000:

MSS reduces “Cost of Build” by:

- **Reducing “Life Cycle Cost” of Sample System**
- **Reducing Cost of “Sample Transport System”**
- **Reducing Cost of Climate-controlled Analyzer Enclosure**

Why Use Modular Sampling Systems?

According to Michelle J. Cohn
IFPAC, Nov 2004

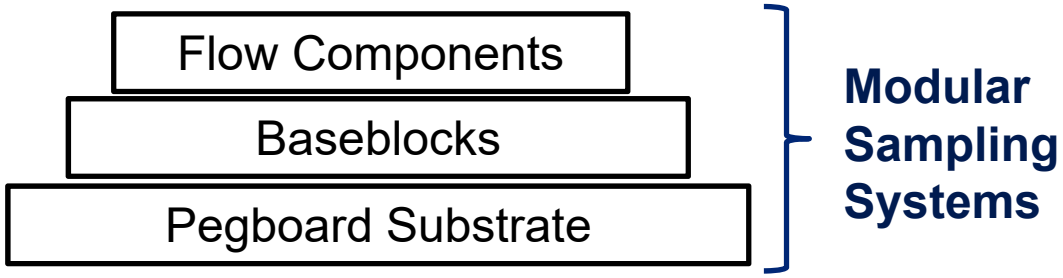
MSS reduces Analyzer System Project Cost:

- **33% Reduction in total Project Timeline.**
- **50% Reduction in Personnel Time**
  - **Design**
  - **Fabrication**
  - **Commissioning**
- **10% Increase in Hardware Cost**

MSS Benefits During Design Phase

Design Tools Reduce Manhours and Schedule

A "Map" is created for each MSS Level



Flow model and 3D imaging Tools

- Calculate Performance
- Assist with Visualization and General Arrangement

MSS Benefits During Fabrication Phase

Reduced Requirement for Manual Skills

- Tube Bending
- Bracket Fabrication
- Simple Hex-head (Allen) Wrench for assembly

Reduced Hardware Inventory Requirements

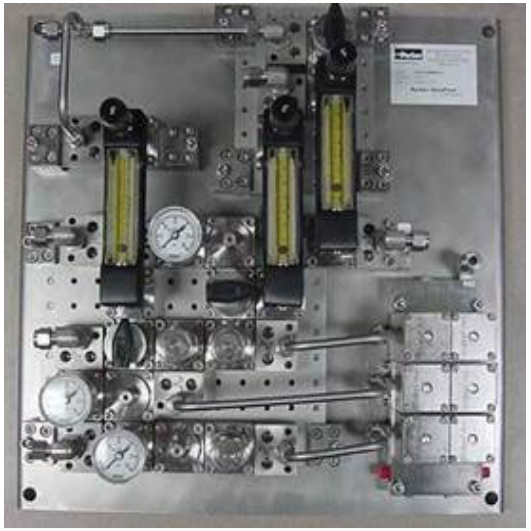
- Standardized Valves, Filters and Regulators
- Standardized Pegboard sizes and formats
- Standardized connectors including process, heating & electrics
- Standard-sized O-rings

MSS Benefits During Operations

In a Major Oil Refinery owned by BP a CEMS (Continuous Emissions Monitoring System) gave trouble-free service for 15 years.

MSS CEMS Automated Calibration was accomplished every shift of every day from 2003 to 2019 with:

- **No Maintenance or Repairs**
- **No Leaks or other Failures**



MSS Benefits During Refurbishment

In a Major Oil Refinery owned by Chevron.

A Conventional Blending System with 8 valves required rebuild every 6 months at a cost of:

- **16 hours to rebuild 8 Valves**
- **Every 6 months**
- **Parts and Labor total = $11,200**

A similar MSS Blending System with 8 valves required rebuild only every 2 years at a cost of:

- **4 hours to rebuild 8 valves**
- **Every 2 years**
- **Parts and Labor total $ = 600**

MSS Benefits During Upgrade and Refurb

According to UOP data published in 2004

	MSS	Conventional
Design Time	**4 months**	**6 months**
Fabrication Time	**2 months**	**4 months**
Hardware Cost	**10 to 15% more**	**Baseline**
Installation Time	**30 % Savings**	**Baseline**

MSS International Project Benefits

UOP's International Laboratories required world-wide inter-laboratory validation.

MSS sampling systems benefited from:

- **Easier shipment of compact Sampling Systems**
- **International standard allowed common designs**
- **Easier cross-checks of standardized systems**
- **No Leakage was encountered with even 1800 psig Hydrogen (H2)**

Successful Modular Sampling System Users

Typical Users of MSS technology

UOP
Imperial Oil
PetroCanada
Dow
Eastman
BP
Lanxess
Sterling
Exxon Baytown
Oxy Vinyls
H2scan
Chevron
Dupont
Hemlock Semiconductor
Restek
Johnson Matthey
Linde
Scanraff
Rose Technologies
Dalkia
Praxair