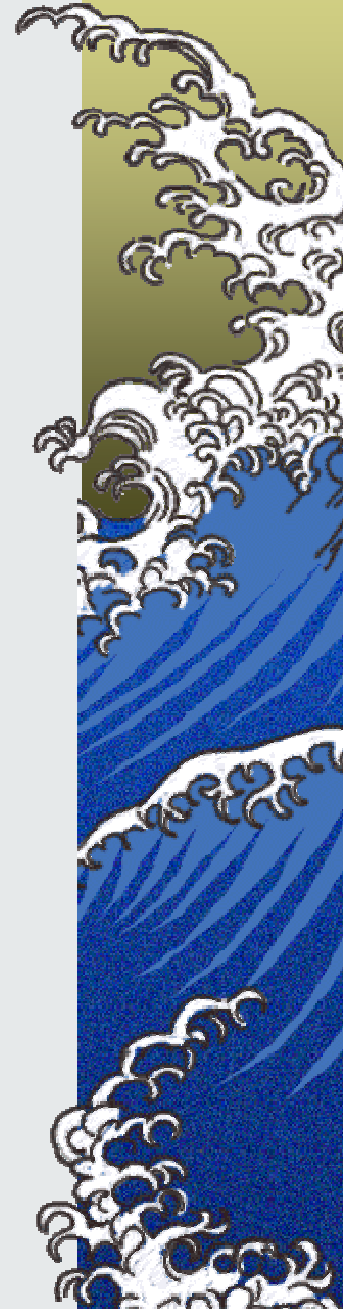


Flow Measurement in an IIoT Digitized World

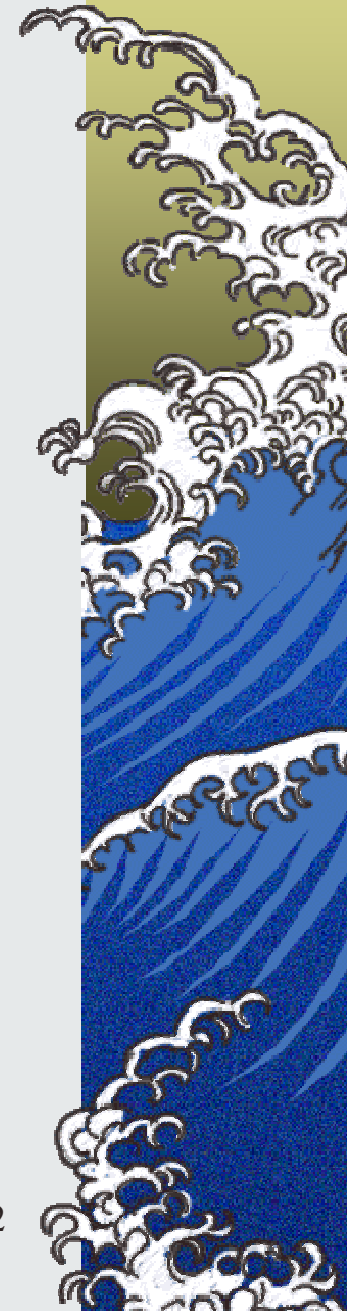
Presented by
David W. Spitzer
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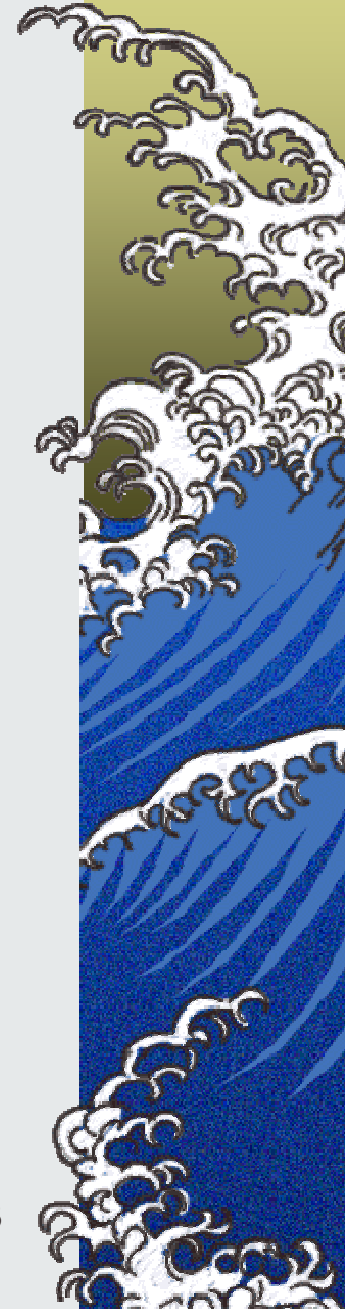
IIoT in Theory

- *Many Sensors (Lick and Stick)*
- *Big Data in the Cloud*
 - *Sensors*
 - *Signal Transmission*
 - *Device Diagnostics / Data Analysis*
- *Digital Enterprise*
- ***RESULT: Better Decisions Quicker***



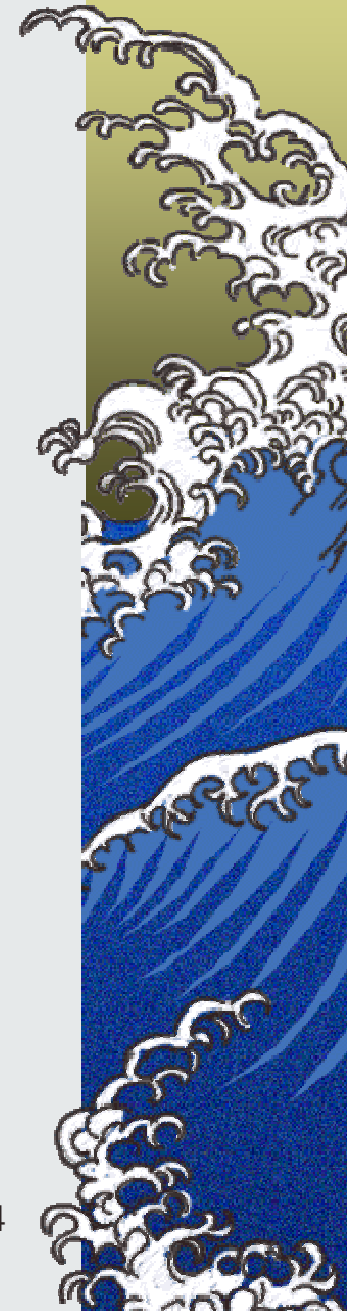
IIoT in Theory

- *Sensors (Lick and Stick)*



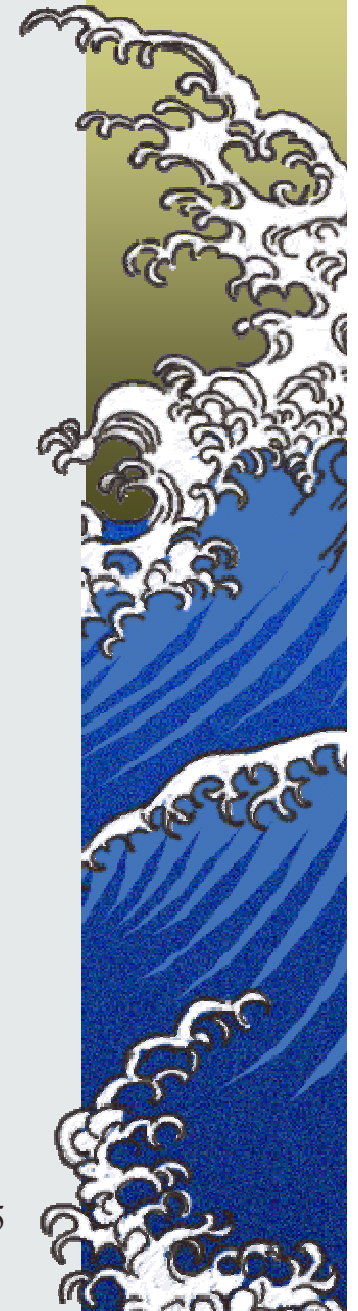
IIoT in Theory

- *Sensors (Lick and Stick)*



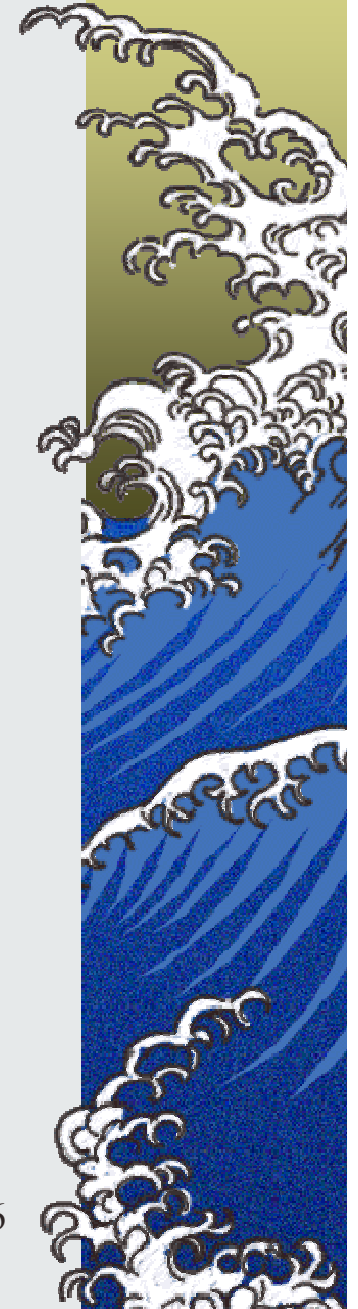
IIoT in Theory

- *Sensors (Lick and Stick)*



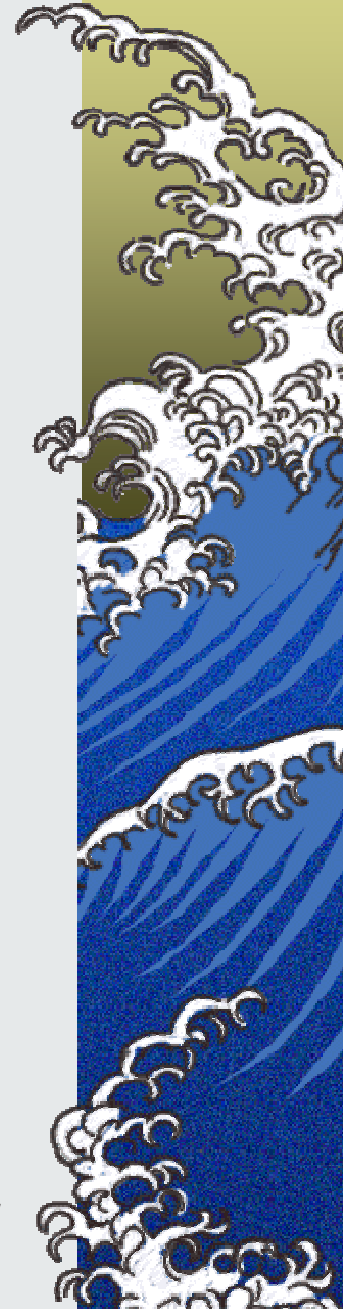
IIoT in Theory

- *Big Data in the Cloud*
 - *Sensors*
 - *Pneumatic / Analog / Digital Transmitters*
 - *Signal Transmission Protocols*
 - *Analog / Digital*
 - *Wired / Wireless*
 - *Device Diagnostics / Data Analysis*



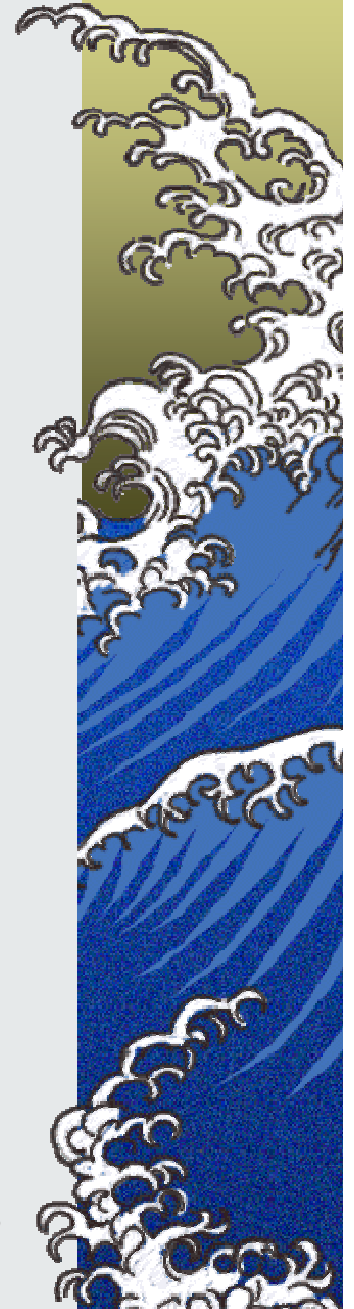
IIoT in Theory

- *Many Sensors (Lick and Stick)*
- *Big Data in the Cloud*
 - *Sensors*
 - *Signal Transmission*
 - *Device Diagnostics / Data Analysis*
- *Digital Enterprise*
- ***RESULT: Better Decisions Quicker***



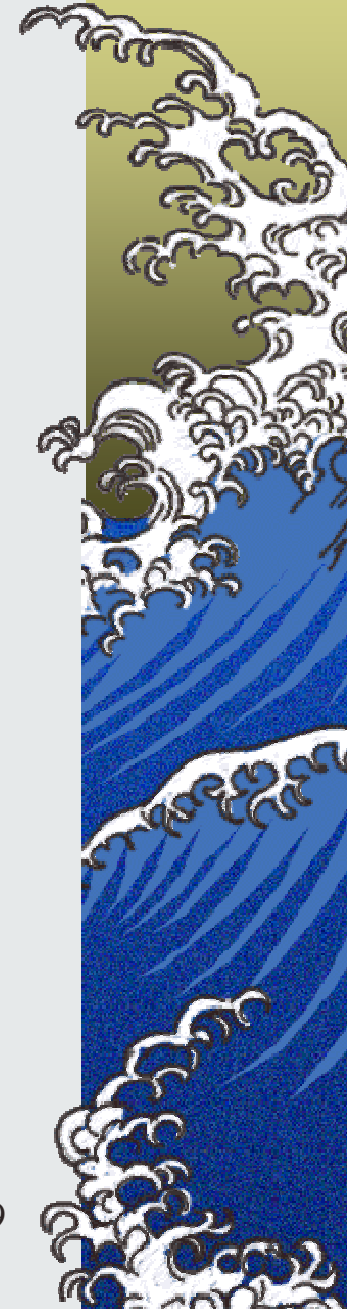
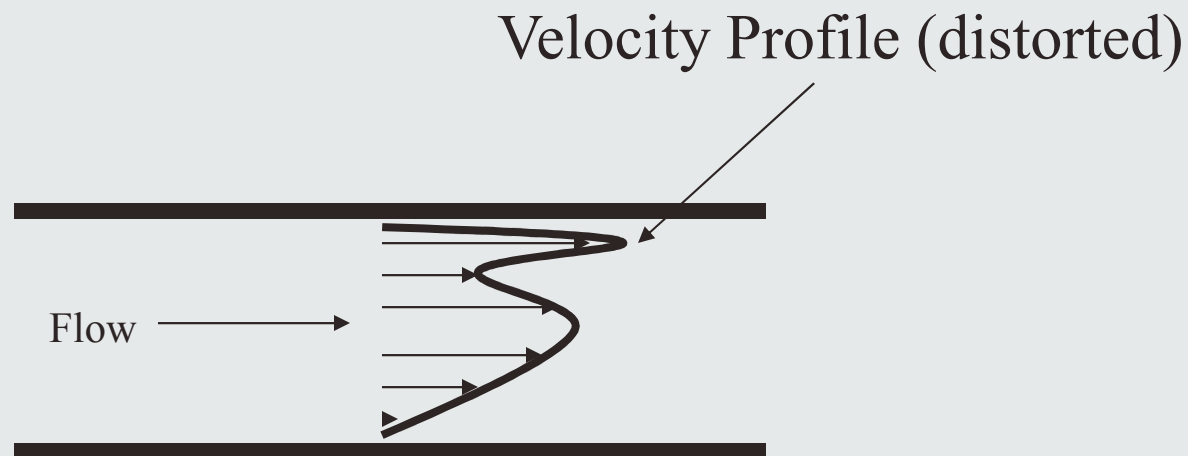
IIoT Headwinds

- *Viability*
 - *Cost must be reduced by 80-90 percent*
 - *Many sensors require wires for power*
- *Important parameters are already measured and/or under control*
- *Sparse documentation of results*
- *Measurements are often not simple*



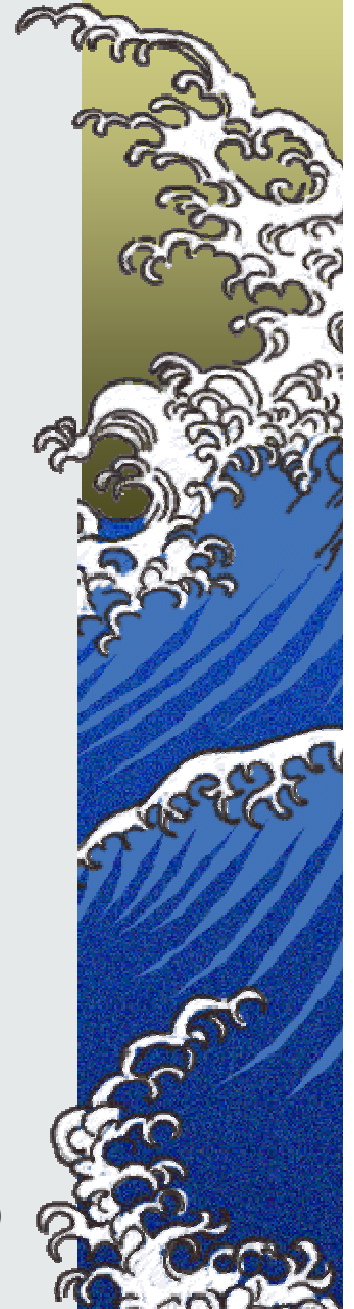
Velocity Profile

- *A distorted velocity profile can introduce significant errors into the measurement of most flowmeters*



Velocity Profile

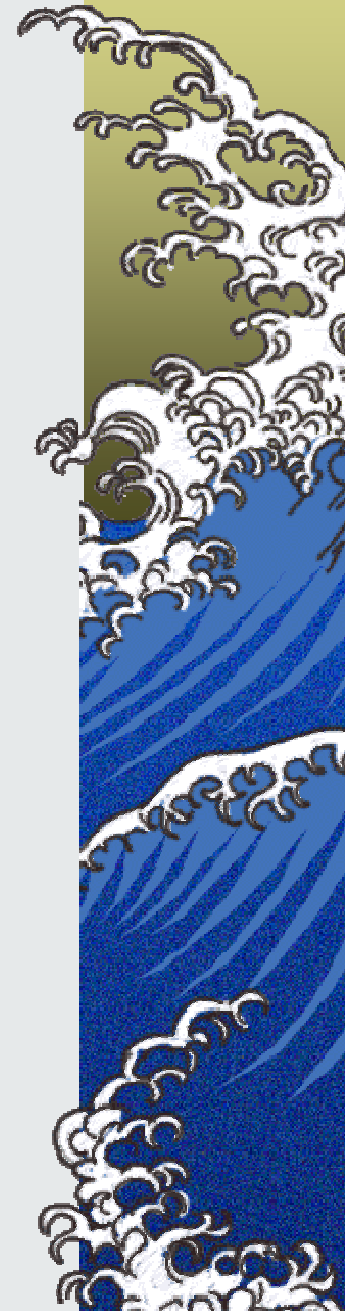
- *Good velocity profiles can be developed*
 - *Straight run upstream and downstream*
 - *No fittings or valves*
 - *Upstream is usually longer and more important*
 - *Flow conditioner*
 - *Locate control valve downstream of flowmeter*



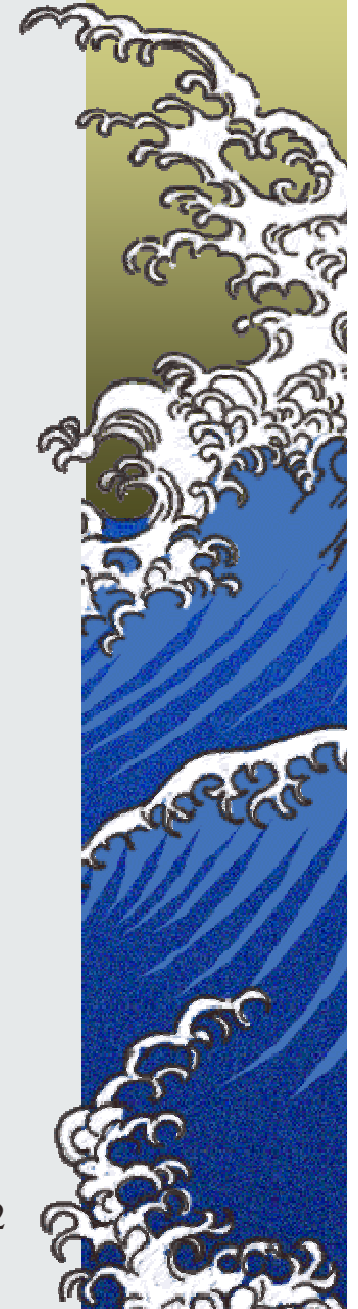
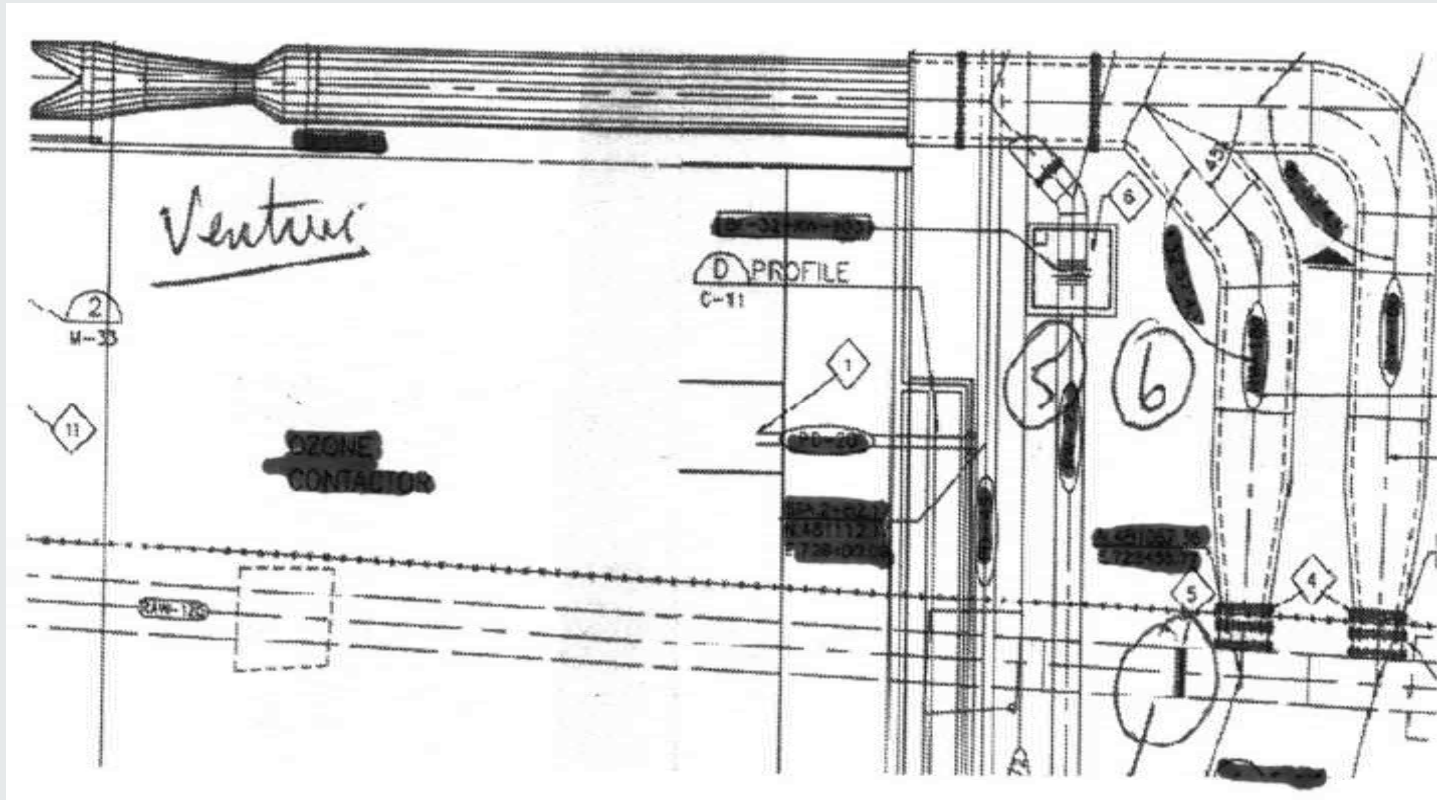
180-inch Venturi



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180-inch Venturi Straight Run



180-inch Venturi Data

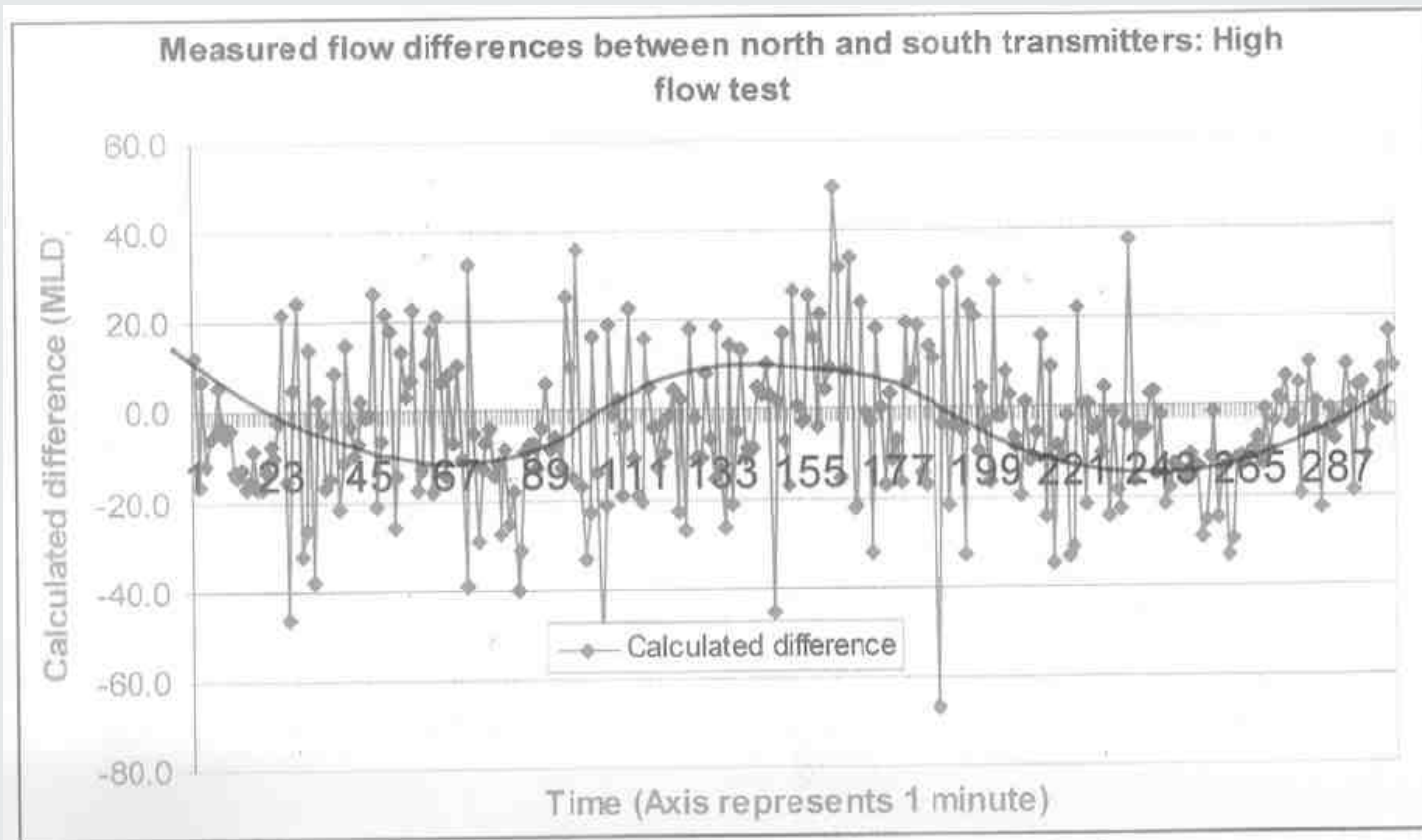
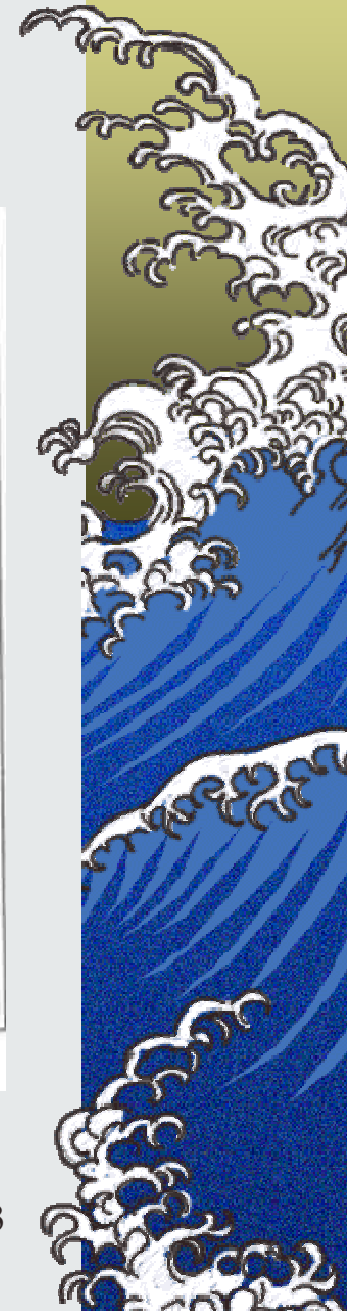
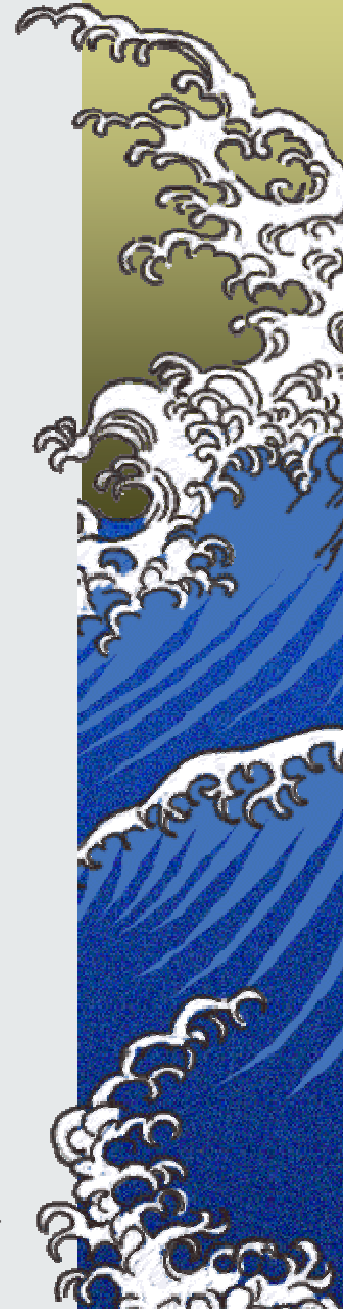


Figure 35 Measured flow differences: High flow test over 1 minute timebase



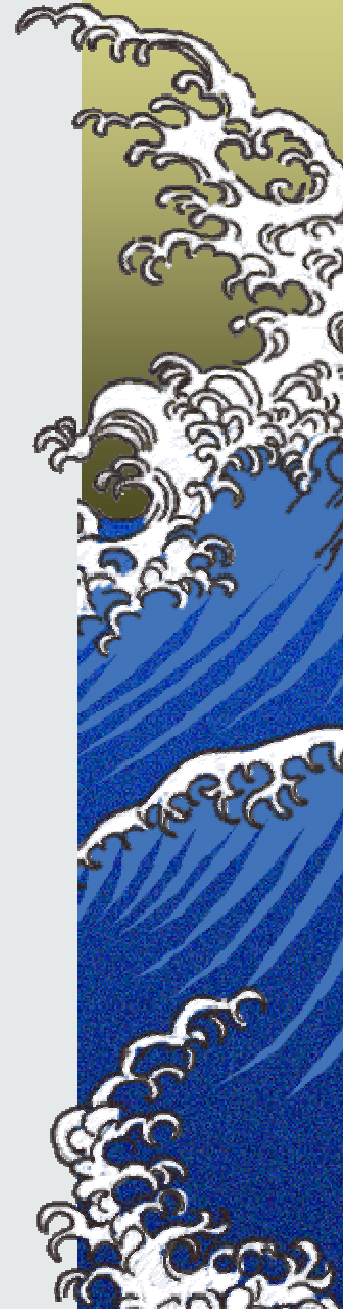
Technical Article

- **What Do We “Know”? Revelations in Flowmeter Straight-Run Effects**
 - Flow Control magazine (2010)
 - <https://www.flowcontrolnetwork.com/what-do-we-know/>



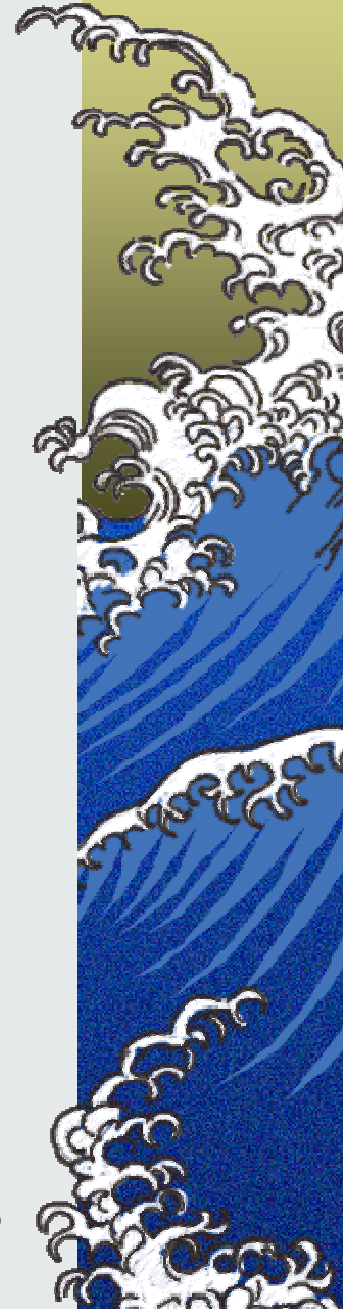
Anecdotal IIoT Examples

- *Vortex shedding flowmeter measurement becomes unstable when pump motor bearing needs to be replaced*
- *Flow drops off as heat exchanger plugs*



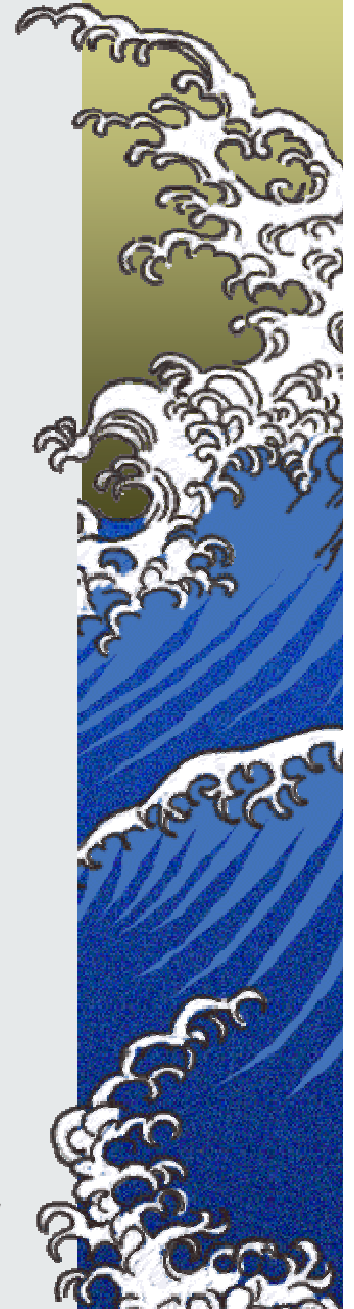
IIoT Practice

- *Limited IIoT adoption*
 - *Flow sensors are relatively expensive*
 - *Not Lick and Stick*
- *Big Data in the Cloud for viable sensors*
- *Digital Enterprise trend continues*



IIoT Practice

- *Benefits typically cannot be accurately quantified prior to installation*
 - *Difficult to justify expenditures*
- *Partial implementation*
- ***RESULT: Better decisions... but not quite as quickly as initially thought***



Flow Measurement in an IIoT Digitized World

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