

Lab Commissioning, DDC Systems, Complexity and Persistence

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Overview

- Lab Commissioning
- Complexity
- DDC Systems
 - History
 - Essence of a BAS
 - Ultimate Pieces of a BAS
- Persistence
 - Analogy
 - Observations

What Is Commissioning?



Merriam-Webster OnLine

Merriam-Webster FOR KIDS

Encyclopædia BRITANNICA

Merriam-Webster ONLINE

Merriam-Webster COLLEGIATE®

Merriam-Webster UNABRIDGED

Main Entry: commission

Function: transitive verb

Inflected Form(s): -mis·sioned;
com·mis·sion·ing /-'mi-sh(&-)ni[ng]/

1 : to furnish with a commission: as a
: to confer a formal commission on
<was commissioned lieutenant> b : to
appoint or assign to a task or function
<was commissioned to do the
biography>

2 : to order to be made
<commissioned a portrait>

3 : to put (a ship) in commission



An analogy to a ship's sea trials or "shake-down" cruise

Commissioning;

- Commissioning is a systematic process of ensuring that all building systems perform interactively according to the contract documents, the design intent and the Owner's operational needs
 - Begins in predesign
 - Documents the design intent
 - Continues through construction, acceptance, the warranty period, and through the building's life cycle
 - Includes functional testing
 - Includes training
 - Documents performance

Commissioning is about performance and integration

People Skills Can Matter

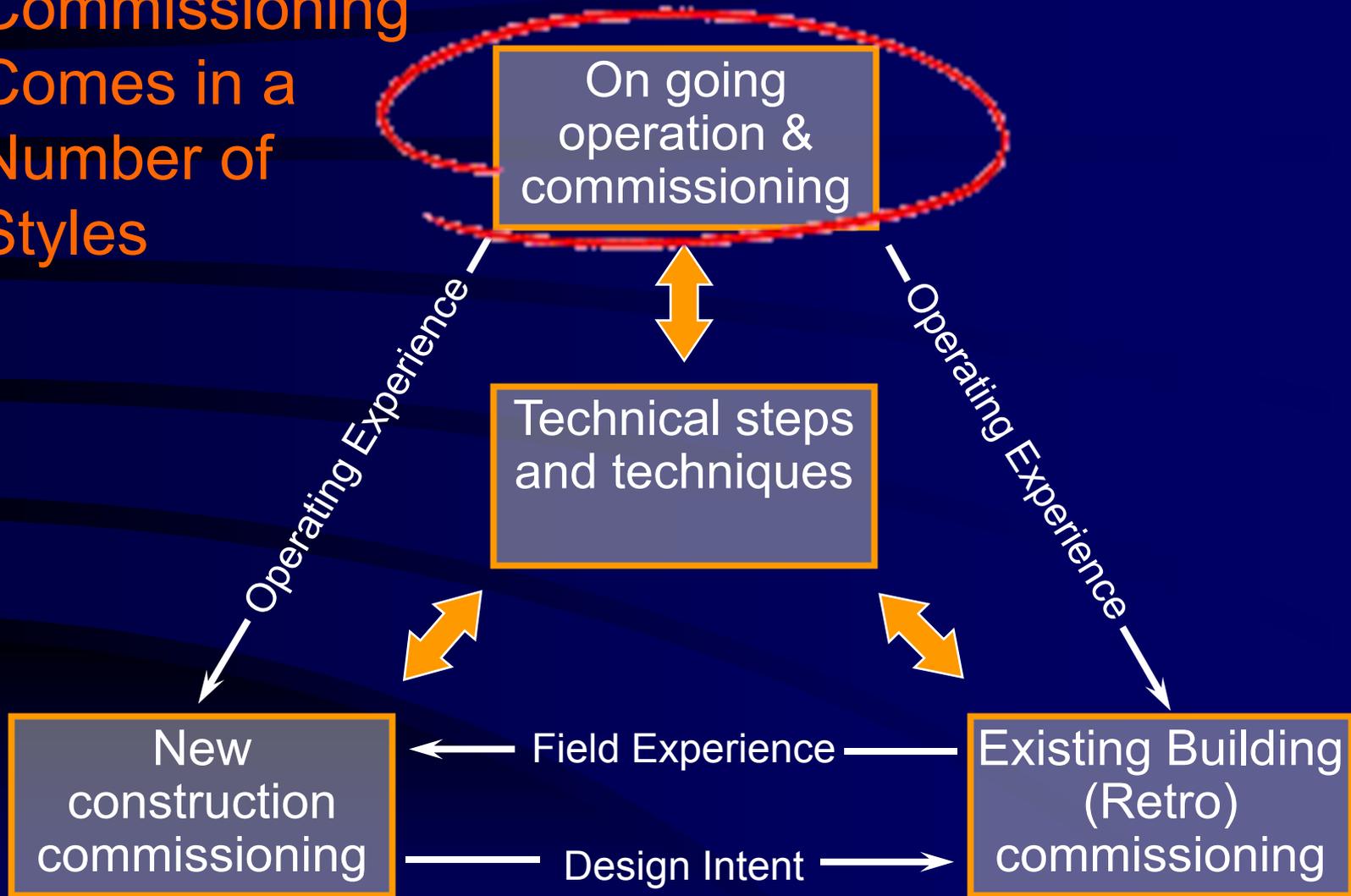
Commissioning

Function: transitive verb

Pronunciation: k&-'mi-sh&ni[ng]

The art of telling people things they don't want to hear at a time when they don't want to hear them and convincing them to do something about the problem despite all of that.

Commissioning Comes in a Number of Styles



LAB HVAC = Complex Systems

- Variable flow supply air
- Variable flow hoods
- Variable flow exhaust air
- Doing the math:

Variable system flow relationships

+ Fixed distribution duct sizes

Variable system pressure relationships

LAB HVAC = Complex Systems

- Variable flow supply air
- Variable flow hoods
- Variable flow exhaust air
- Doing the math:

Variable system pressure relationships

+ Fixed lab pressure differential requirement

Complex control and operation problem

Lab HVAC ≠ Only Complex Lab System

- Variable flow chilled water
- Variable flow hot water
- Central steam systems
- Isolated water supplies
- Waste water treatment systems
- Emergency power
- Uninterruptable power
- IT Systems
- Life safety systems
- Canopy hoods
- Fume hoods
- Bio safety cabinets
- Downdraft tables
- Perchloric acid exhaust
- RODI water
- Ultra pure piping and gasses
- Autoclaves
- Glass washers
- Cage washers
- Rack washers
- Cage cleaning systems
- Animal watering system
- Bag in/bag out filters
- Alarms system
- M&V systems
- Security systems

All complex, all interactive, all the time!

History - DDC Changes over the Years

- 25 years ago, we had Open Protocol, Interoperability, Plug & Play

- Early DDC/EMS - proprietary and expensive

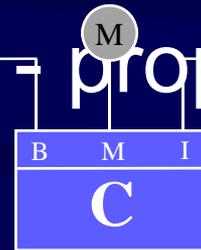
- Move from **Controlled Device** to **distributed Controller**

- Today **HWS** → **Networked Systems, Internet**

– More power at lower levels

– Open Protocol..... Interoperability

HWR ←



Sensor

*#1,3,5

Essence of a HVAC Control System

- Stuff
 - Sensors
 - Controlled Devices
 - Controllers
 - Interface Devices
 - Networks
- People
 - Programming
 - Installation
 - Quality Control
- Tools
 - Software
 - Documentation
 - Training

Ultimate “Stuff”

- Sensors
 - Super accurate
 - Super cheap
 - Wireless
 - Low maintenance
 - “Green”
 - Self Calibrating
- Controlled Devices (actuators, etc.)
 - Inexpensive, reliable, powerful
 - Feedback
 - Low maintenance

Ultimate “Stuff”

- **Controllers**
 - Powerful, lot of memory
 - Interchangeable (true plug & play)
 - Common programming.....
 - Flexible, expandable
 - Reliable
 - Upgradeable....
- **Controller Interfaces, Networks**
 - Self configurable
 - Use standard Networks
 - “Open”

Ultimate “People”

Ultimate “People”

- Engineers
 - Design
 - Commissioning
- Manufacturers
- Contractor/Installers
- Owners
 - Project Managers
 - Contracting
 - Operations
- Related Parties
 - Other Contractors

Ultimate Tools

- Software
 - Open
 - Intuitive
 - Self Help
 - For DDC Manufacture Specific Issues
 - Diagnostics for Building Issues
 - Help make decisions
- Documentation
 - Accurate
 - Electronic
 - Automatically updating

Ultimate Tools

- Training
 - Better training material
 - Better instructors
 - More
 - Better Students

Current Practice

- HVAC Controls are Performance Specified
- Specifications aren't very specific
- Controls are typically "Design/Built" by 3rd tier subcontractor
- Application Engineer for vendor is key
- Documentation quality varies
- Resources are limited, enforcing good specs are a challenge
- Training is critical
- Difficult to get a system to work as planned
- Commissioning becomes necessary

Problem Solving

The significant problems we have cannot be solved at the same level of thinking with which we created them.

Albert Einstein

Insanity

Doing the same thing over and over again and expecting different results

Albert Einstein

Only two things are infinite, the universe and human stupidity, and I'm not sure about the former

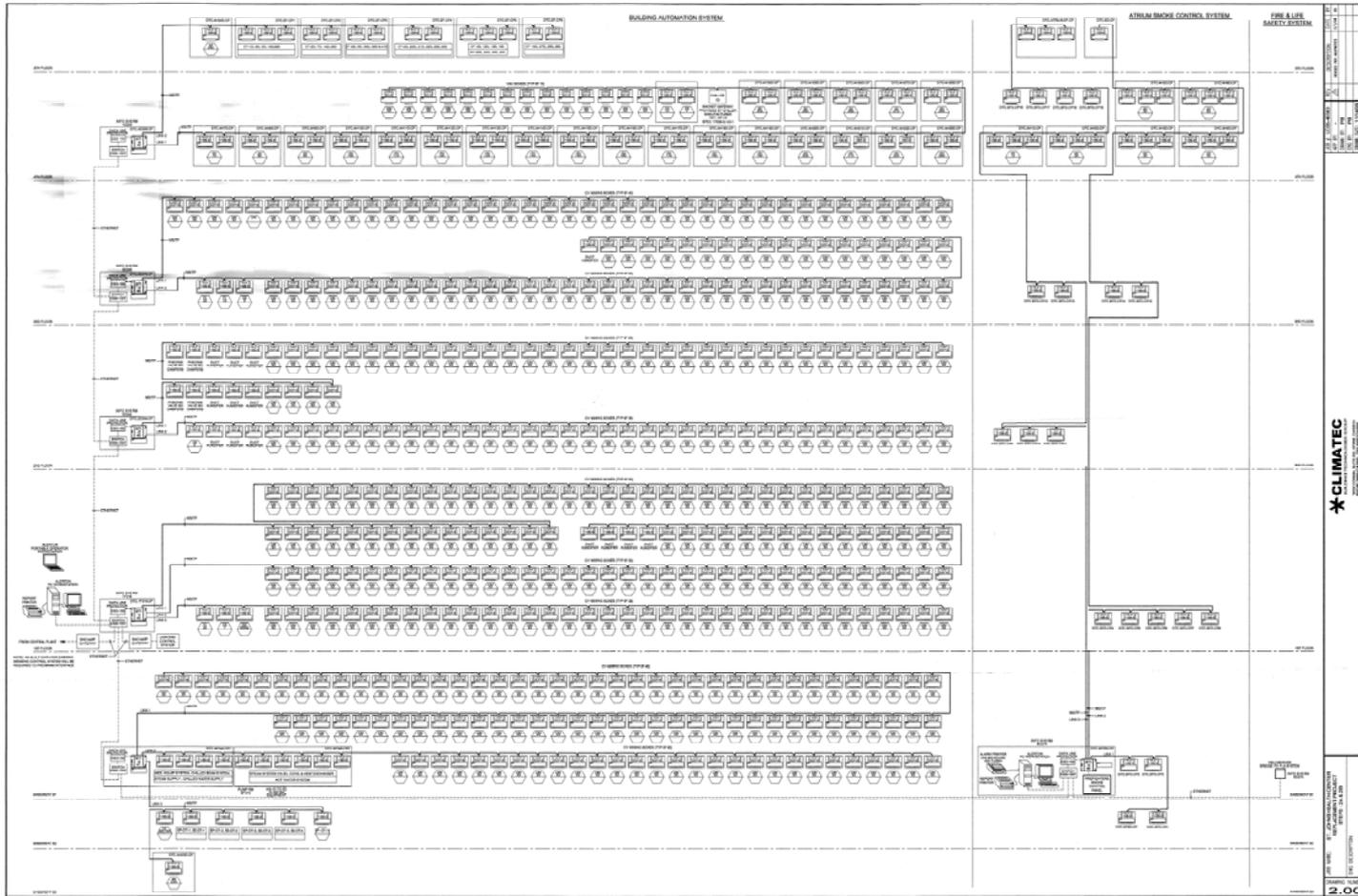
Albert Einstein

An Analogy

- IT Systems
 - Networks
 - Software
 - Organizations
- DDC
 - Networks
 - Software
 - Organizations

An Analogy

Riser



plant

145
2.00

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18290 IF ("%U%SQFL1" .AND. "%U%1000.CH01.CHWVA" .IF
.OR. "%U%SQFL2" .AND. "%U%1000.CH02.CHWVA" 10000 C
("%U%CHVA.LP.OFF") ELSE OFF ("%U%CHVA.LP.OF--
18300 C          UTRPUP-1 COOLING TOWERS
18310 C          10020 C          OPTIMUM COOLING TOWER AIR FLOW CONTROL FOR TOWERS WITH
18320 C          10030 C          VARIABLE SPEED FANS AND TOWER CW ISOLATION VALVES
-----
29500 C SKIP SHUT DOWN CODE
29510 GOTO 31530
29520 C          10050 C          THE FOLLOWING PROGRAM WILL CALCULATE THE OPTIMAL AIR FLOW
29530 C          10060 C          THROUGH A COOLING TOWER USING SIX (6) VARIABLE SPEED TOWER
29540 C          FANS
30000 C *****
30010 C * SYSTEM COMPLETE SHUTDWN *
30020 C *****
30030 ON (@PDL,"%U%CH.CODE.RESET")
30040 OFF (@PDL,"%U%CH.CODE.RELEAS")
30050 C          10070 C          AND WILL SEQUENCE THE TOWER FANS ON/OFF BASED ON RUN TIME.
30060 C          10080 C          THE OPTIMUM AIR FLOW WILL MINIMIZE THE SUM OF CHILLER PLUS
30070 C          TOWER
30080 C          10090 C          POWER. THE OPTIMUM AIR FLOW CALCULATED WILL BE A PERCENTAGE
30090 C          OF
30100 C          10100 C          THE MAXIMUM TOTAL AIR FLOW THROUGH THE TOWER. ALL FANS WILL
30110 C          BE
30120 C          10110 C          TURNED ON TO MINIMUM SPEED BEFORE THE FANS ARE RAMPED UP IN
30130 C          10120 C          UNISON TO MEET THE REQUIRED AIR FLOW. THE FANS VFDS ARE
30140 C          ASSUMED
30150 C          10130 C          TO BE DRIVEN FROM 0 - 60 HZ SIGNALS. THESE CALCULATIONS ARE
30160 C          10140 C          VERY SIMPLE AND REQUIRE ONLY DESIGN INFORMATION FROM THE
30170 C          10150 C          COOLING TOWER AND CHILLER MANUFACTURERS. THIS PROGRAM
30180 C          ASSUMES
30190 C          THAT THERE IS NO WATER-SIDE FREE COOLING MODE. IF THERE IS A
30200 C          WATER-SIDE FREE COOLING MODE OF OPERATION, THEN THE LINES
30210 C          THAT
30220 C          10180 C          CALCULATE AN OPTIMAL TOWER AIR FLOW FOR PART-LOAD RATIOS <
30230 C          0.25
30240 C          10190 C          SHOULD BE REMOVED. THE PROGRAM BELOW HAS BEEN SET UP TO
30250 C          10200 C          CONTROL THE SIX (6) COOLING TOWER FANS AT THE MD ANDERSON
30260 C          CANCER
30270 C          10210 C          CENTER UTRPUP PLANT.
30280 C          10220 C
-----
30290 C          10230 C          REVISION HISTORY
30300 C          10240 C
30310 C          10250 C          VER    DATE          ENG/SPEC    COMMENTS
30320 C          10260 C          ---    ---          ---          ---
30330 C          10270 C          01    02/28/2008    VCS          PROGRAM MODIFIED &
30340 C          10280 C          REDEPLOYED TO ACCOMODATE NEW PLNT SOO
30350 C          11760 C
-----
30360 C          11770 C          NAME EXCHANGE PROMPTS
30370 C          11780 C
30380 C          11790 C          \THE FOLLOWING ARE PROMPTS WHICH WILL ALLOW YOU TO EXCHANGE
30390 C          POINT\
30400 C          11800 C          \NAMES USED IN THE LIBRARY PROGRAM WITH YOUR OWN POINT NAMES
30410 C          USED\
30420 C          11810 C          \IN YOUR PROGRAM. IF YOU WISH TO DO A GLOBAL REPLACEMENT OF A \
30430 C          11820 C          \DESCRIBED POINT NAME IN COMMISSIONING TOOL, CHOOSE THE TOOLS, \
30440 C          11830 C          \REPLACE EDITABLE VARIABLES" MENU OR PRESS <CTRL>V.
30450 C          \
30460 C          11840 C          \TO EXCHANGE POINT NAMES IN THE INSIGHT PROGRAM EDITOR, CHOOSE \
30470 C          \
30480 C          12120 C          \
30490 C          12130 C          \
30500 C          12140 C          \
30510 C          12150 C          \
30520 C          12160 C          \
30530 C          12170 C          \
30540 C          12180 C          \
30550 C          12190 C          \
30560 C          12200 C          \
30570 C          12210 C          \
30580 C          12220 C          \
30590 C          12230 C          \
30600 C          12240 C          \
30610 C          12250 C          \
30620 C          12260 C          \
30630 C          12270 C          \
30640 C          12280 C          \
30650 C          12290 C          \
30660 C          12300 C          \
30670 C          12310 C          \
30680 C          12320 C          \
30690 C          12330 C          \
30700 C          12340 C          \
30710 C          12350 C          \
30720 C          12360 C          \
30730 C          12370 C          \
30740 C          12380 C          \
30750 C          12390 C          \
30760 C          12400 C          \
30770 C          12410 C          \
30780 C          12420 C          \
30790 C          12430 C          \
30800 C          12440 C          \
30810 C          12450 C          \
30820 C          12460 C          \
30830 C          12470 C          \
30840 C          12480 C          \
30850 C          12490 C          \
30860 C          12500 C          \
30870 C          12510 C          \
30880 C          12520 C          \
30890 C          12530 C          \
30900 C          12540 C          \
30910 C          12550 C          \
30920 C          12560 C          \
30930 C          12570 C          \
30940 C          12580 C          \
30950 C          12590 C          \
30960 C          12600 C          \
30970 C          12610 C          \
30980 C          12620 C          \
30990 C          12630 C          \
31000 C          12640 C          \
31010 C          12650 C          \
31020 C          12660 C          \
31030 C          12670 C          \
31040 C          12680 C          \
31050 C          12690 C          \
31060 C          12700 C          \
31070 C          12710 C          \
31080 C          12720 C          \
31090 C          12730 C          \
31100 C          12740 C          \
31110 C          12750 C          \
31120 C          12760 C          \
31130 C          12770 C          \
31140 C          12780 C          \
31150 C          12790 C          \
31160 C          12800 C          \
31170 C          12810 C          \
31180 C          12820 C          \
31190 C          12830 C          \
31200 C          12840 C          \
31210 C          12850 C          \
31220 C          12860 C          \
31230 C          12870 C          \
31240 C          12880 C          \
31250 C          12890 C          \
31260 C          12900 C          \
31270 C          12910 C          \
31280 C          12920 C          \
31290 C          12930 C          \
31300 C          12940 C          \
31310 C          12950 C          \
31320 C          12960 C          \
31330 C          12970 C          \
31340 C          12980 C          \
31350 GOTO 1000

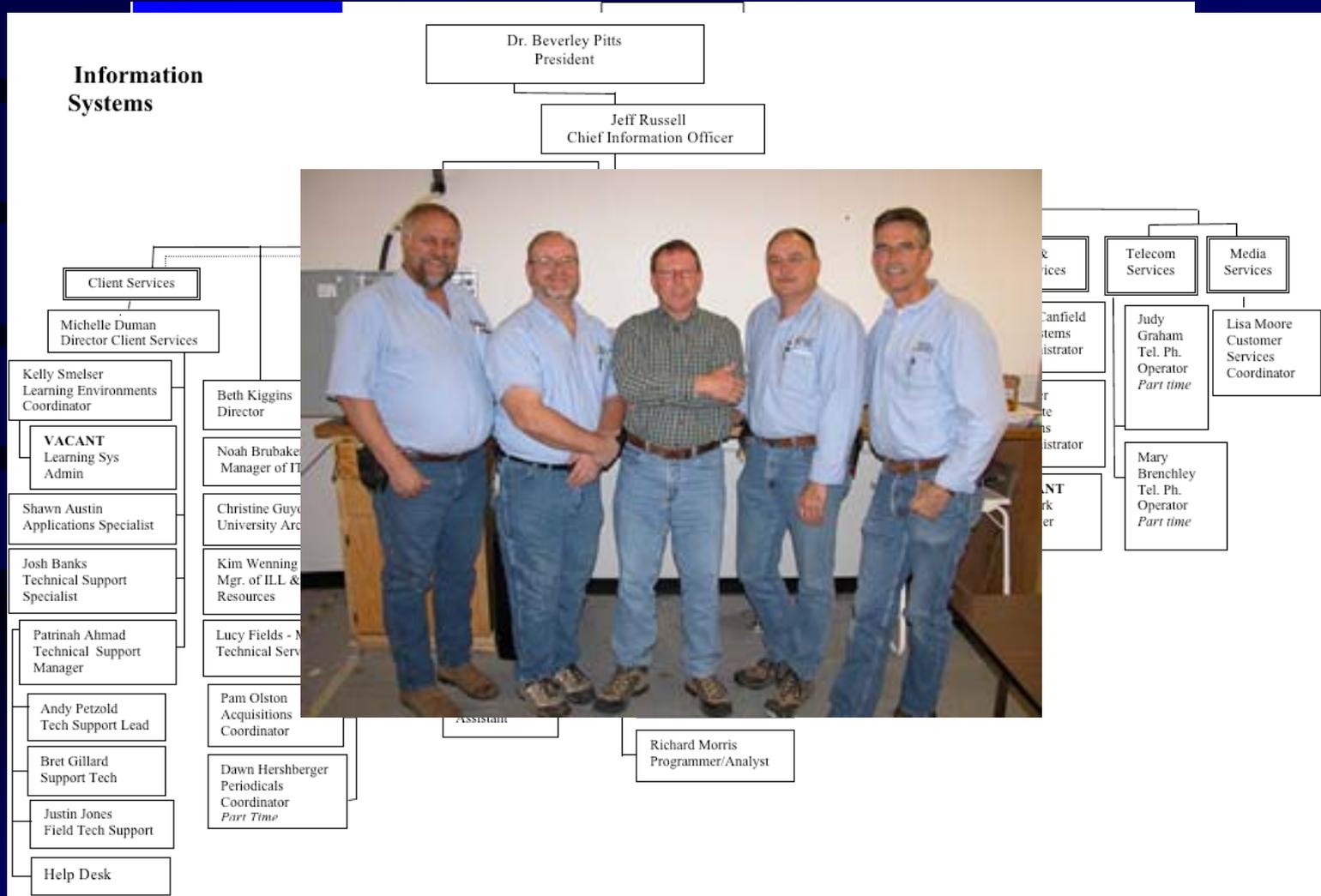
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IPSEESP-j ACCEPT
ICAH-j ACCEPT
ICAH-j ACCEPT
ICITRIXLICPORT-j ACCEPT
ICITRIXLICPORT-j ACCEPT
ACCEPT
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prefix "IPTABLES-
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j ACCEPT

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An Analogy



IT/DDC Impacts

- IT Systems
 - Productivity
 - Computers, Networks, Servers
 - Email, Internet, Security
- DDC Systems
 - Productivity
 - Space Comfort
 - IAQ
 - Energy

Organizational Histories

- IT Organizations are new
 - Ability to structure without any precedents
- DDC Systems are not
 - Subset of Facility Operations & Maintenance
 - Extension of HVAC Controls
 - Pneumatics

Observations

- IT versus DDC career path
 - Technical versus management tracks
 - Allowing people to remain technical
 - And still progress
- Not just training, experiential learning
 - Going to take some time
 - Need to create a career path

Other Observations

- How do we really get plug and play components for BAS?
 - New blood
 - This is more of a procurement/\$ issue than performance one.
- People responsible for HVAC Designs must understand BAS & control details
- Diagnostic tools must mature to stretch and make up for people shortages

Summary

- Get our priorities in line
 - First cost versus life cycle cost
 - \$ for “green” thing, versus \$ for operational people
- Create technical track for HVAC system/control specialists
- Incent long term system performance
 - Energy
 - Performance
 - People
- Persistence is everything