2019 ISC X

Instructor Skills Conference

League City, TX • September 24-26

Boost your Operators' Competence and Confidence with Research-based Troubleshooting Exercises

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Abstract & Session Outcomes

- Data from 468 plant operators has been collected by asking operators to rank their confidence in 30 competencies of an operator's job. These figures are shared and the resulting innovative troubleshooting exercises are discussed that attack these self-identified gaps in order to build operator competence and confidence.

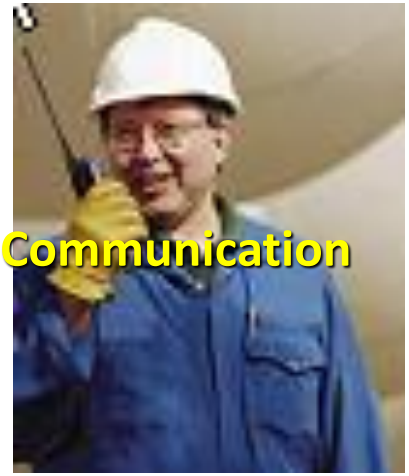
- Plant trainers and PTEC Instructors will learn about the most common competencies in which operators lack confidence. Instructors will be exposed to new simulator/workbook exercises that attack these gaps that they can bring back to their plant or classroom.

30 Item Operations Assessment

- Adapted from a British Energy Study on Conduct of Simulator Assessments

- Simulation Solutions created six major groups for these competencies:
  - Console Manipulation (1), Procedural Adherence (2), Situational Awareness (3), Decision Making (4), Cooperation (5), Communication (6)

Operations Jobs are Complex



Console Manipulation
DCS Skills

- Responds to Alarms; Analyze Trends;
- Familiar, practiced, timely;
- Confident, independent;
- Calm, in control;
- Manual control.

Situational Awareness

Learn from Normal and Abnormal Operations

- Have a “mental model” of the process;
- Monitor and respond to Alarms;
- Explain current problem/cause;
- Refocus & prioritize actions;
- Anticipate & predict response/unit interaction;
- Aware of time & actions of others.

Procedural Adherence & Compliance

- Locate and follow procedures;
- Prioritize parallel SOP procedures;
- Within Operating rules;
- Recognize limiting conditions of Operations.

Decision Making
Practice "Live" Troubleshooting

- Diagnosis (Questioning attitude);
- Systematic Approach, Considers Options;
- Decides (conservative);
- Assigns tasks; Documents
- Reviews.

Communication

- Concise & Accurate;
- 3-Way Communication
- Use of correct terminology;
- Phone/radio/face to face;
- Confirmation/feedback sought;
- Inform Supervisor/feedback sought;
- Logging.

Co-operation

Practice working with Teams
Console & Outside Operations

- Team building & maintaining;
- Consideration of others;
- Support of others;
- Conflict solving.

Survey Participants

- The results from the self-assessments are operators who have gone through Simulation Solutions' 2-Day Troubleshooting Courses.

- The operators were told to complete the survey based on their confidence **on their own unit.** The survey is not a measure of their confidence on a process simulator.

- At times, engineers or training managers would go through SSI's 2-Day Course. They were not asked to fill out the survey.

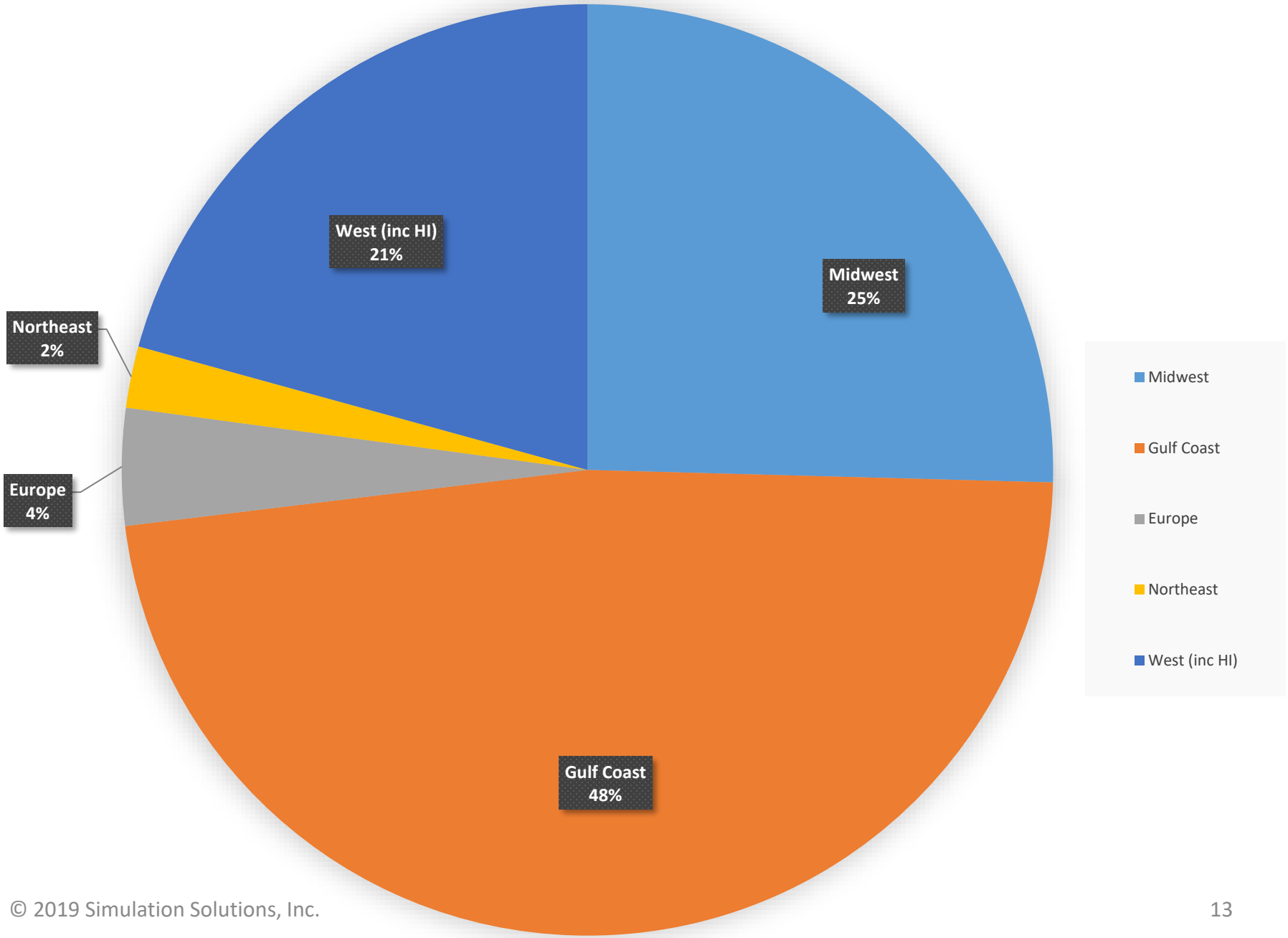
Survey Participants Demographics

- 468 Operators who are either already on the board, or who have begun the process of becoming board qualified. (Roughly, 90% board qualified, 10% outside operators on track to work the console).

- The data was collected over 47 training courses since 2014, and 2 training courses in 2011. 49 training courses total.

- 92% of participants work at refineries, 8% work at petrochemical plants.

Survey Participants by Region



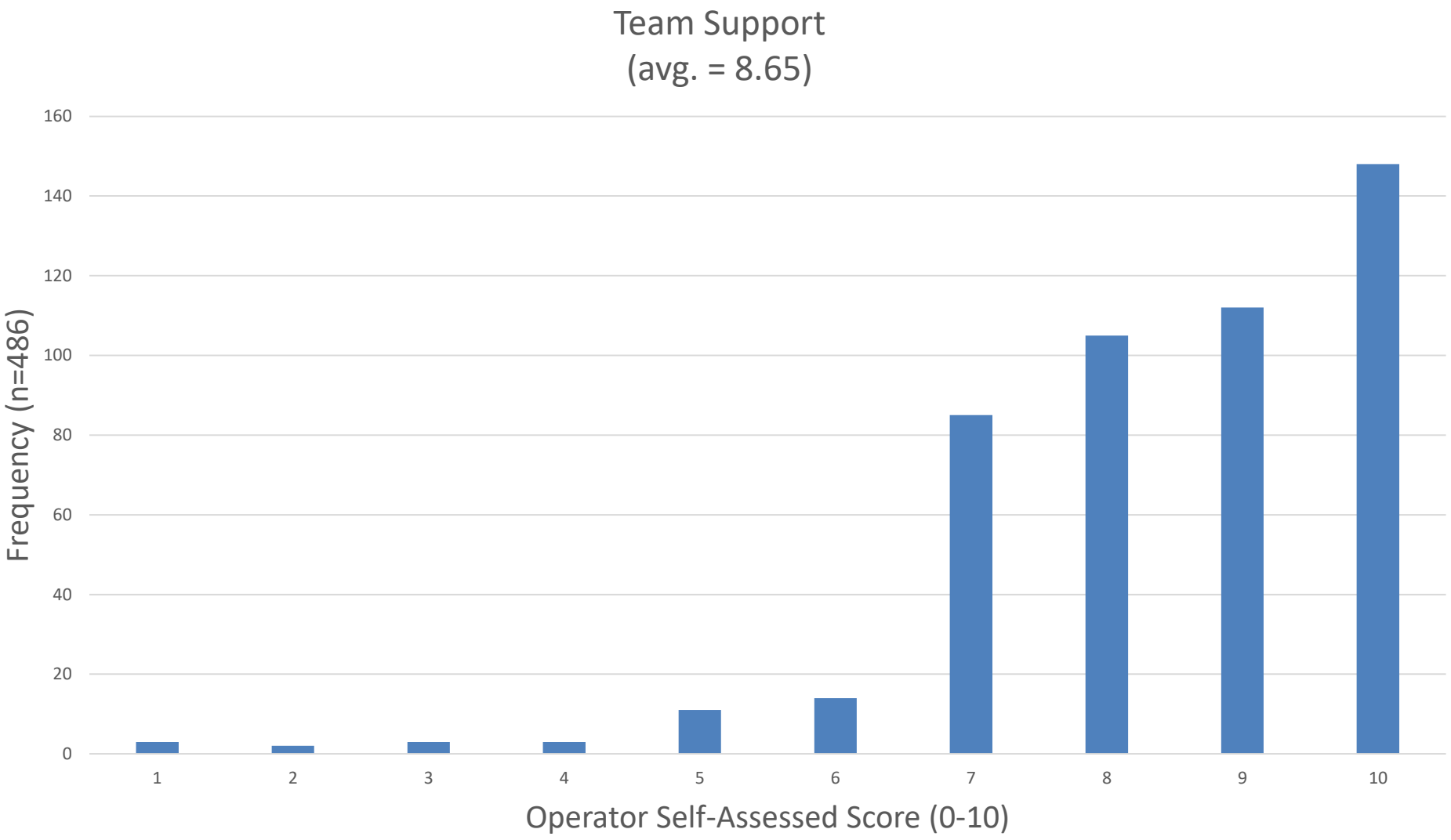
Self-Assessment Complete Results

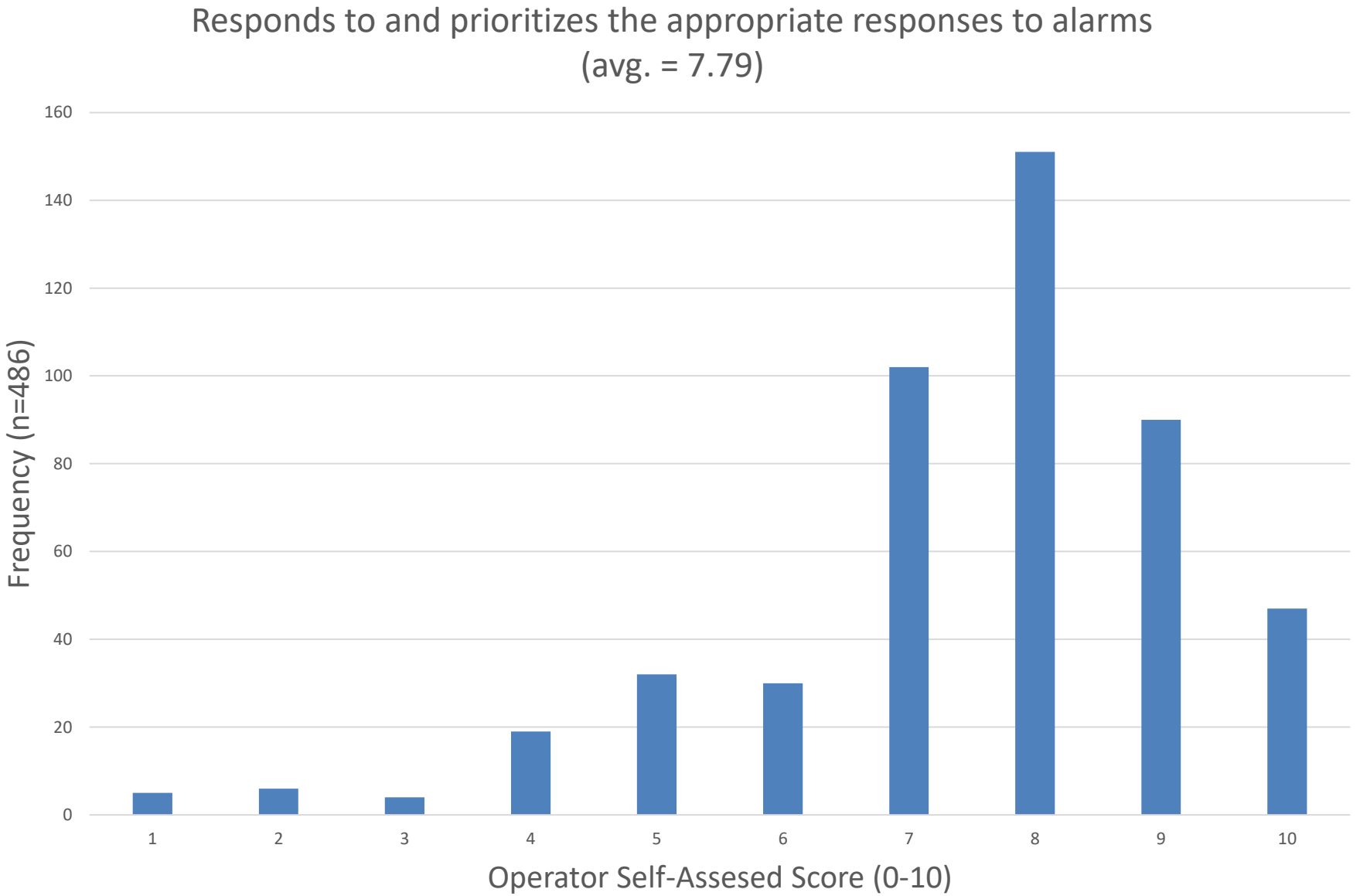
Competency	1	2	3	4	5	6	7	8	9	10
Console Familiarization	2.5%	2.1%	4.8%	8.5%	7.6%	11.2%	18.3%	25.9%	12.2%	6.7%
Control of Plant Conditions	2.8%	3.9%	3.9%	7.1%	12.9%	10.3%	20.7%	27.8%	12.0%	4.6%
Understanding of auto control loops & manual operations	1.8%	1.1%	3.0%	6.4%	6.0%	8.5%	20.0%	30.6%	15.9%	11.0%
Frequency of errors and recovery from errors	2.5%	1.6%	4.4%	6.0%	10.4%	12.7%	31.9%	23.3%	7.6%	3.5%
Response to abnormal events	2.3%	0.9%	3.5%	6.7%	9.5%	10.4%	25.2%	27.5%	13.0%	5.1%
Awareness of operational limits	1.6%	0.7%	2.1%	7.4%	6.5%	9.2%	24.0%	30.9%	15.0%	6.5%
Needs Assistance	2.3%	1.4%	4.2%	6.5%	9.7%	12.1%	37.1%	18.6%	9.0%	3.0%
Ability to cope with auto system failures	2.6%	1.6%	4.6%	6.0%	10.2%	10.9%	26.9%	26.5%	9.7%	5.3%
Ability to locate design conditions and operate unit at withint design limits	1.6%	0.5%	1.9%	4.9%	9.1%	8.1%	24.7%	34.0%	13.0%	6.5%
Ability to prioritize operating procedure action	1.2%	0.7%	3.0%	4.6%	7.4%	10.4%	28.2%	28.6%	14.8%	5.1%
Ability to work with operating procedures and take corrective action	1.2%	0.5%	1.8%	5.3%	4.6%	7.4%	23.6%	35.6%	15.5%	8.5%
Adherence to procedural steps & ability to correct mistakes	0.9%	1.2%	1.2%	3.7%	6.5%	9.9%	31.6%	29.3%	13.4%	6.2%
Ability to identify prioritize and deal with events and their causes	1.1%	1.4%	2.3%	6.6%	8.2%	9.6%	31.6%	27.2%	11.4%	4.3%
Responds to and prioritizes the appropriate resonses to alarms	1.1%	1.4%	0.9%	4.1%	6.9%	6.0%	21.8%	32.3%	19.3%	10.1%
Ability to analyze reasons for events/upsets	1.4%	0.9%	1.8%	5.7%	6.2%	10.6%	30.3%	26.9%	13.3%	6.9%
Ability to gather information and determine the magnitude of an event/upset	0.9%	1.6%	2.1%	4.6%	6.6%	11.2%	28.6%	30.0%	12.1%	6.4%
Logging/assessment plant information	1.4%	0.7%	1.2%	5.3%	5.6%	7.2%	27.5%	30.8%	15.0%	9.3%
Ability to assess correctness of directives from instructor or others	1.6%	0.2%	0.7%	4.1%	6.0%	9.2%	26.4%	31.7%	16.8%	7.1%
Ability to perform operations correctly	1.2%	0.2%	1.2%	3.2%	4.1%	5.5%	23.3%	33.4%	20.5%	11.1%
Ability to explain the purpose of actions	0.9%	0.7%	1.4%	3.9%	5.3%	10.6%	28.3%	26.4%	16.3%	9.9%
Decision making and diagnostic capabilities	1.1%	0.5%	1.1%	4.6%	5.1%	10.3%	28.3%	30.8%	14.5%	7.6%
Ability to state aims in addition to monitoring and reviewing a situation	1.4%	0.2%	0.9%	4.1%	5.1%	10.3%	31.7%	32.4%	10.3%	7.1%
Informs other	1.2%	0.2%	0.7%	2.5%	3.9%	5.3%	18.5%	33.3%	19.6%	18.5%
Makes recommendations	0.9%	0.5%	1.8%	3.2%	4.2%	7.9%	23.8%	30.0%	18.9%	12.5%
Seeks information	1.2%	0.0%	0.5%	1.2%	3.5%	6.2%	21.9%	28.9%	22.9%	17.8%
Team support	0.9%	0.2%	1.2%	0.9%	2.8%	3.2%	17.8%	22.2%	23.6%	30.9%
Team building and maintaining	0.9%	0.2%	0.7%	1.4%	2.1%	5.2%	23.2%	35.5%	16.1%	18.4%
Flexibility	0.9%	0.0%	0.2%	1.9%	2.8%	5.4%	27.2%	31.4%	19.1%	14.7%
Consideration of others	0.9%	0.2%	0.2%	1.7%	2.1%	3.1%	20.0%	32.8%	18.9%	23.8%
Support of others	1.4%	0.0%	0.5%	0.9%	3.3%	4.5%	23.9%	26.7%	20.1%	22.5%

Self-Assessment Averages by Competency

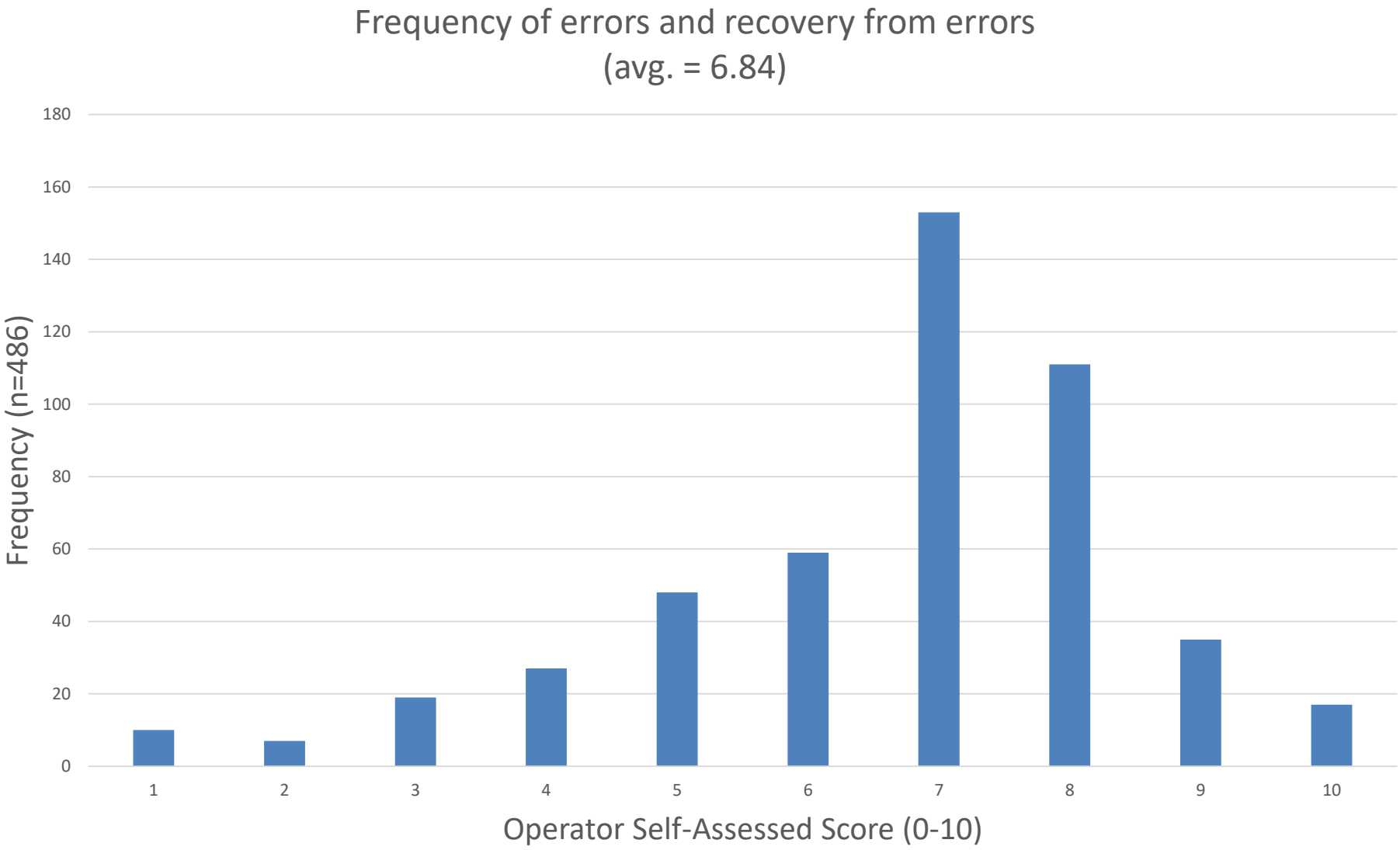
Competency	Industry Average
Console Familiarization	6.72
Control of Plant Conditions	6.98
Understanding of auto control loops & manual operations	7.57
Frequency of errors and recovery from errors	6.84
Response to abnormal events	7.16
Awareness of operational limits	7.42
Needs Assistance	6.85
Ability to cope with auto system failures	7.01
Ability to locate design conditions and operate unit at withint design limits	7.48
Ability to prioritize operating procedure action	7.39
Ability to work with operating procedures and take corrective action	7.70
Adherence to procedural steps & ability to correct mistakes	7.52
Ability to identify prioritize and deal with events and their causes	7.22
Responds to and prioritizes the appropriate resonses to alarms	7.79
Ability to analyze reasons for events/upsets	7.43
Ability to gather information and determine the magnitude of an event/upset	7.42
Logging/assessment plant information	7.66
Ability to assess correctness of directives from instructor or others	7.67
Ability to perform operations correctly	7.97
Ability to explain the purpose of actions	7.67
Decision making and diagnostic capabilities	7.62
Ability to state aims in addition to monitoring and reviewing a situation	7.54
Informs other	8.22
Makes recommendations	7.90
Seeks information	8.30
Team support	8.65
Team building and maintaining	8.26
Flexibility	8.17
Consideration of others	8.48
Support of others	8.36

Histograms for Competencies Operators were Most Confident


Team Support
(avg. = 8.65)
Frequency (n=486)
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
Operator Self-Assessed Score (0-10)
Is often too argumentative or assertive
Displays positive support behavior
Always supports team actions


Responds to and prioritizes the appropriate responses to alarms
(avg. = 7.79)
Frequency (n=486)
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
Operator Self-Assesed Score (0-10)
Does not respond to alarms or makes inappropriate responses
Responds to alarms in a timely manner
Responds to alarms in a timely manner and realizes the importance of the alarm and possible consequences

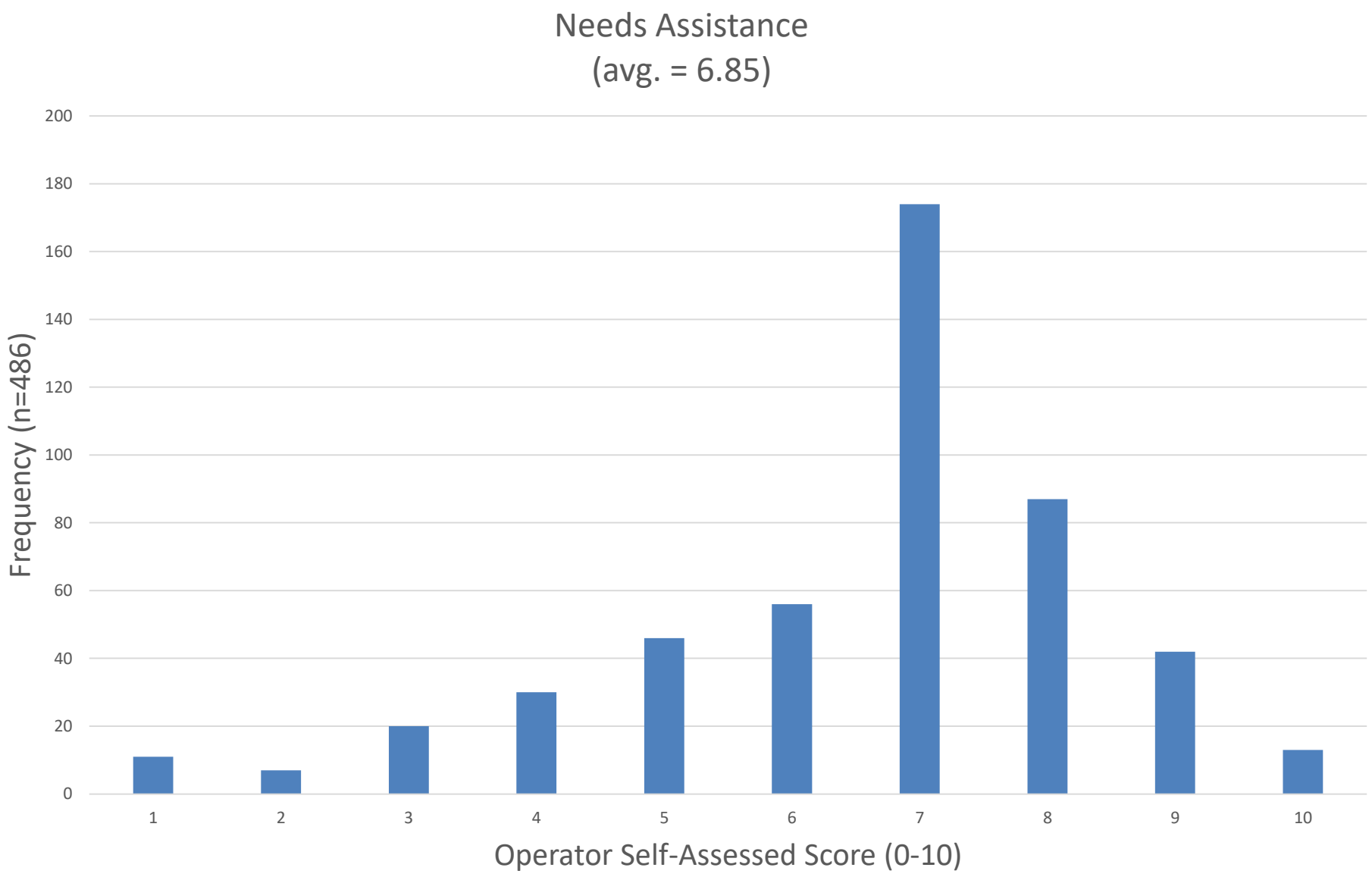
Histograms for Competencies Operators were Least Confident



Frequent errors and Unable to recover

Few errors and is able to recover

Rarely makes errors


Needs Assistance
(avg. = 6.85)
Frequency (n=486)
200
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
Operator Self-Assessed Score (0-10)
Frequently needs Assistance
Rarely needs Assistance
Never needs Assistance

Operations Mechanics vs Operations Mindset

Definitions

- **Operating Mechanics** – The "hands on" skills required to successfully execute and complete an Operations task(s).

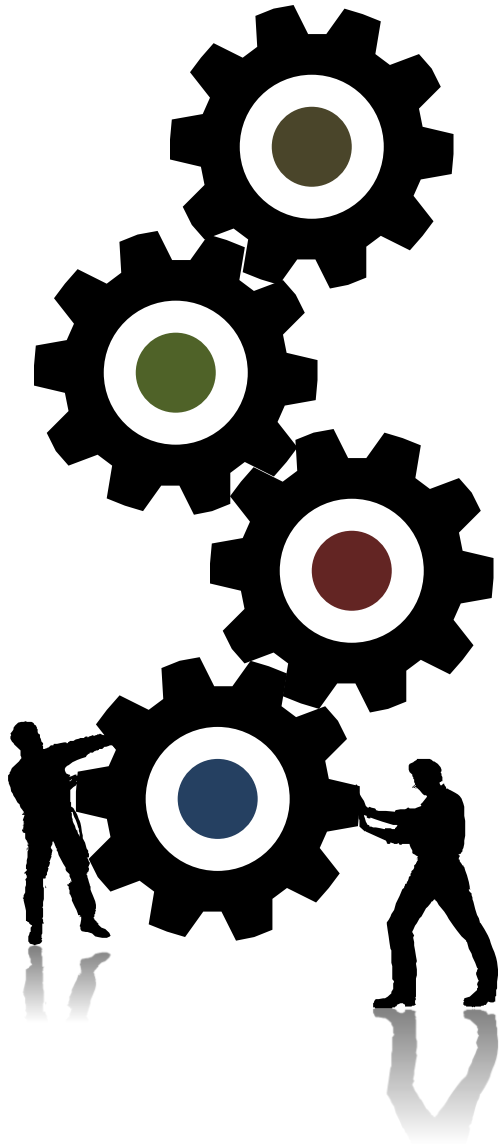
- ***Operations Mindset*** –The "mentality" or "mindset" of an Operator during preparation, execution, and completion of an Operations task(s).

Operating Mechanics + *Operations Mindset* = High Skill Operator

Operating Mechanics

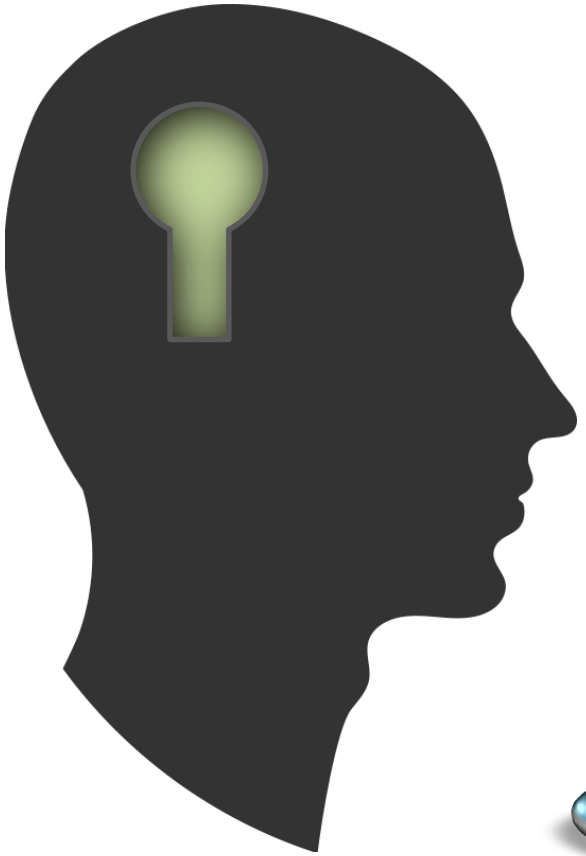
***Operations Mindset*™**

Operating Mechanics



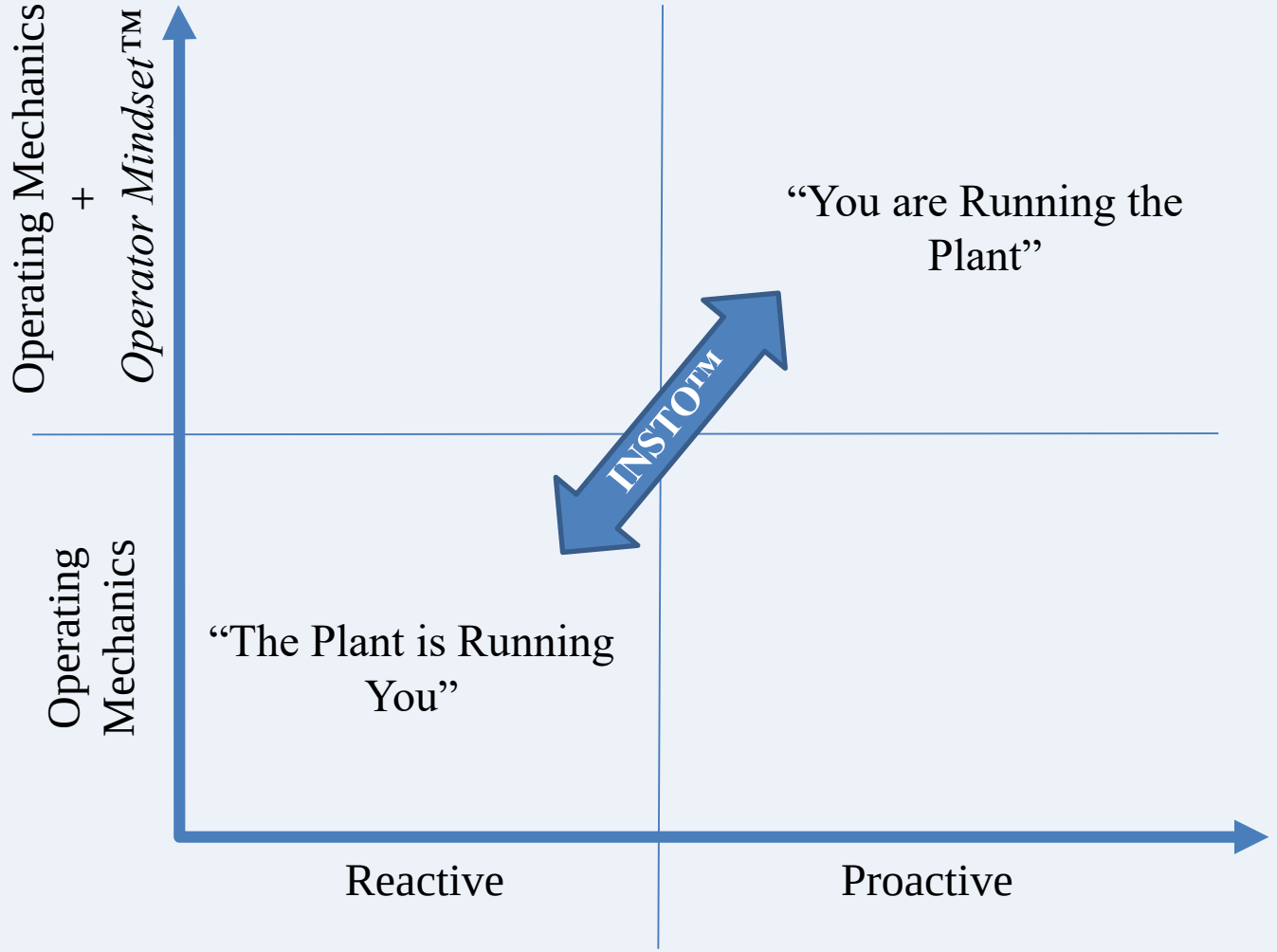
1. Responds to and prioritizes the appropriate responses to alarms
2. Logging/assessment plant information
3. Ability to perform operations correctly

Operations Mindset™

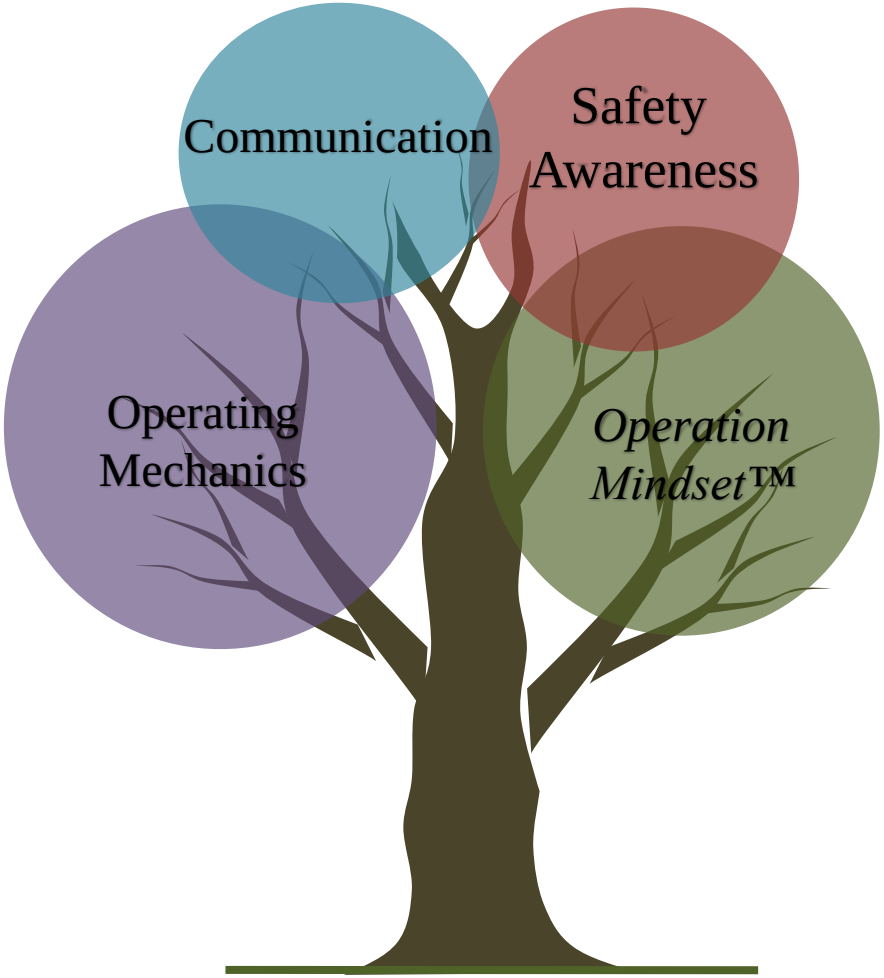


1. Ability to identify prioritize and deal with events and their causes
2. Ability to analyze reasons for events/upsets
3. Ability to gather information and determine the magnitude of an event/upset

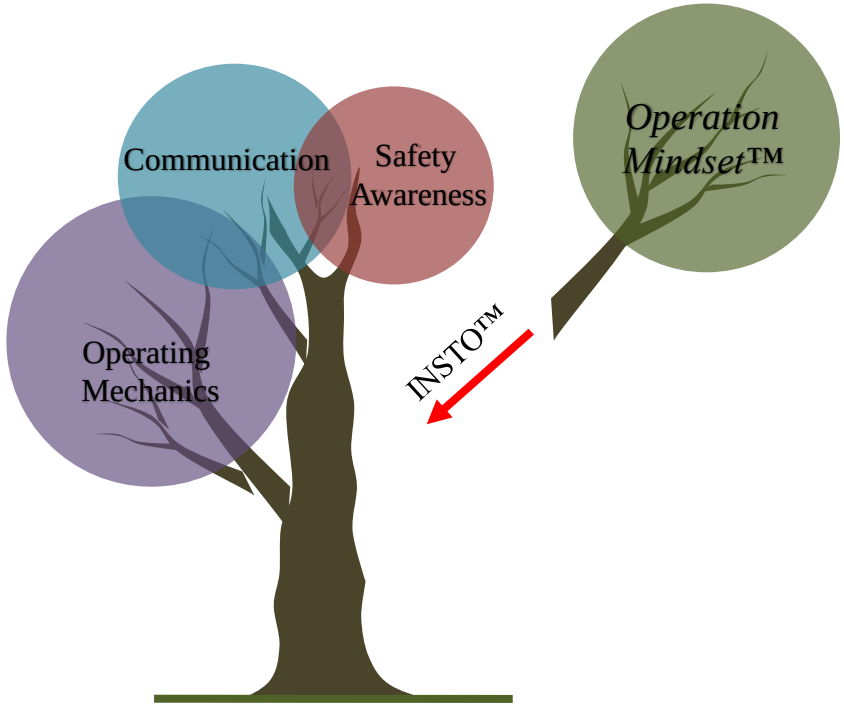
Operating Mechanics vs. *Operations Mindset*™



Grafting an *Operations Mindset*™ to New Operators



"Old School" Operator
Numerous Opportunities for Experiential Learning



"New School" Operator
Vastly Different Circumstances

Green = Mechanics

Yellow = Mindset

Competency	Industry Average
Console Familiarization	6.72
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Makes recommendations	7.90
Seeks information	8.30
Team support	8.65
Team building and maintaining	8.26
Flexibility	8.17
Consideration of others	8.48
Support of others	8.36

Key Takeaways from Operator Self-Assessment Data

- Incumbent Plant Operators feel most confident in “soft skills” that fall into the categories of communication and cooperation
- Plant Operators feel confident in skills such as following written procedures, logging information and responding to alarms [Operating Mechanics]
- Self-assessment scores begin to dip when operators are asked to assess their confidence in explaining the reason for their actions, analyzing the causes of upsets or to determine the magnitude of different upsets/events [Operations Mindset]
- How can we build these Operations Mindset skills??

Workshop Portion:
Troubleshooting Exercises to Build *Operations Mindset* Confidence and Competence

- Trend Match
  - *"Ability to identify prioritize and deal with events and their causes"*
  - *"Ability to analyze reasons for events/upsets"*

- Think Equipped
  - *"Ability to gather information and determine the magnitude of an event/upset"*

- Troubleshooting A
  - *"Frequency of errors and recovery from errors"*

"Think EQ.U.I.P.P.E.D."
Expand your Troubleshooting options

NARROWING DOWN POTENTIAL CAUSES – THINK EQ.U.I.P.P.E.D.

Equipment

Instrumentation

Process

People

Environment

Utilities

Downstream/Upstream

Upset	EQ. Equipment	U. Utilities	I. Instrumentation	P. People	P. Process Material	E. Environment	D. Down/Upstream Product Dist.
Exercise 1							
Exercise 2							
Exercise 3							
Exercise 4							
Exercise 5							

EQuipment: Pumps, Valves, Exchangers…

Utilities: Steam, Cooling Water, Power…

Instrumentation: Controls, Sensors, Regulators…

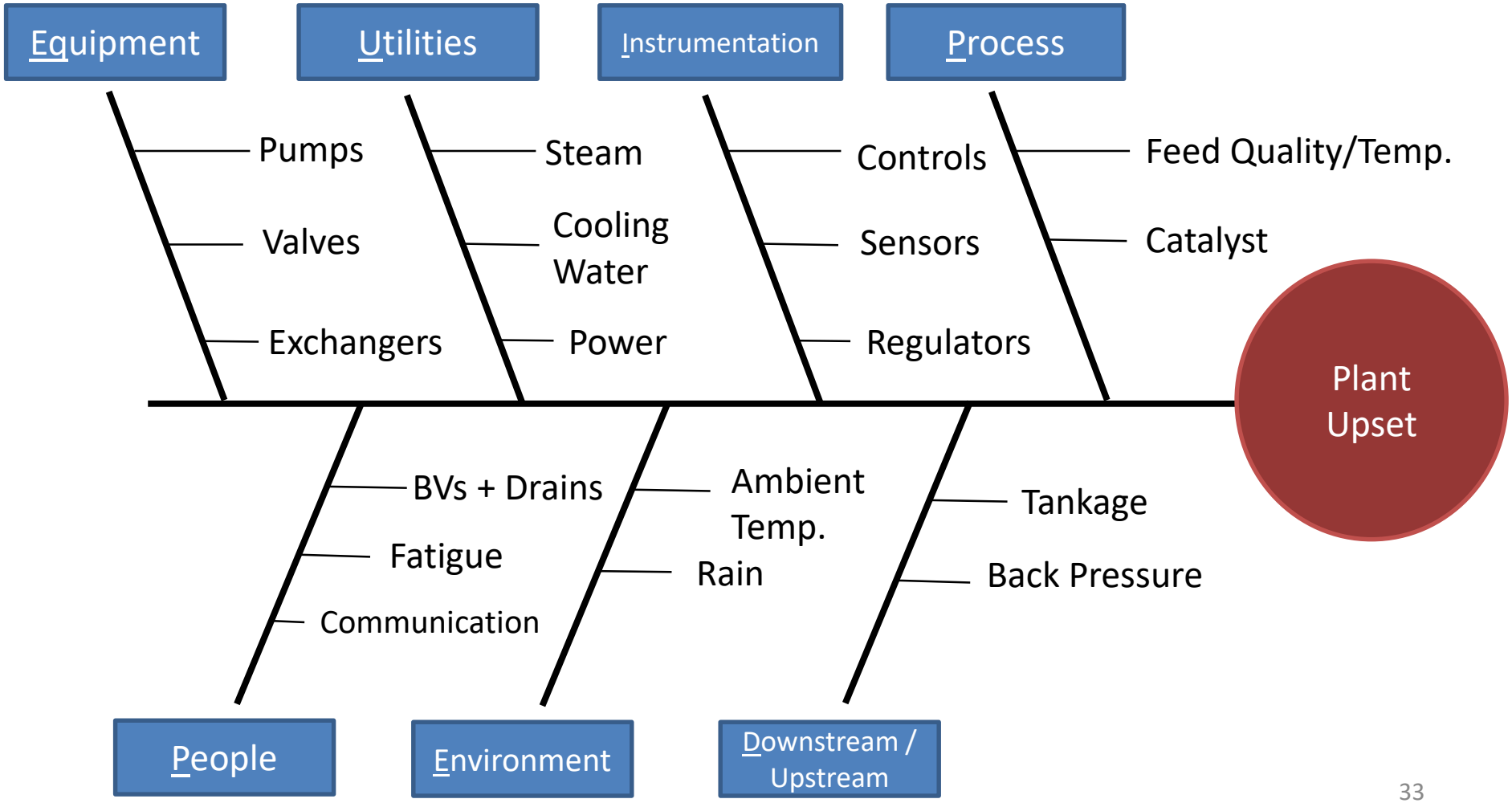
Process: Feed Quality, Feed Temperature, Catalyst…

People: BVs+Drains, Fatigue, Communication…

Environment: Ambient Temperature, Rain…

Downstream-Upstream: Back Pressure, Tankage

"Think EQ.U.I.P.P.E.D." Troubleshooting



EQ.U.I.P.P.E.D TROUBLESHOOTING

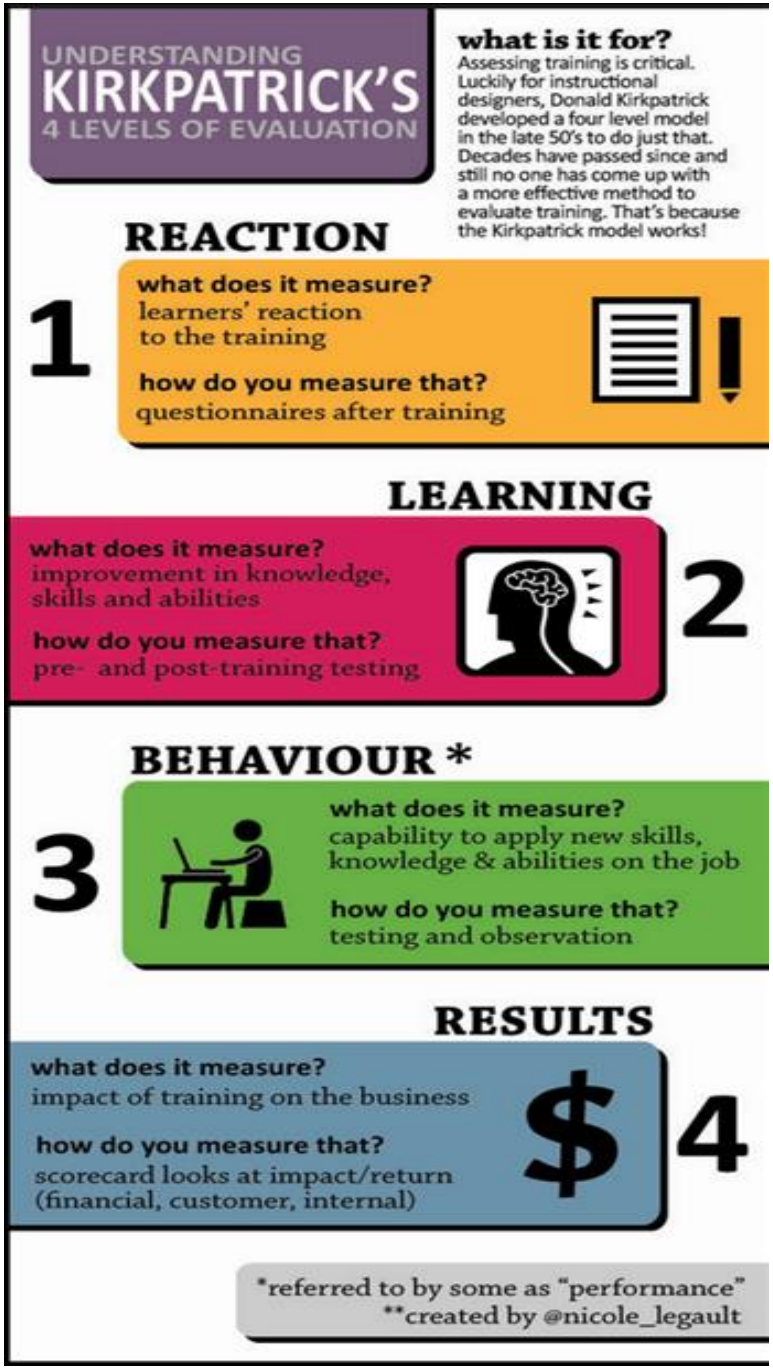
EXERCISE #1:

1. OBSERVATIONS: Make notes of any changes to the system before you begin troubleshooting
1. Write down key changes you see happening to the system.

2. POTENTIAL CAUSES: Try to come up with numerous potential causes from the categories below						
Equipment	Utilities	Instrumentation	People	Process Material	Environment	Down/Upstream
2. Come up with 3-5 potential causes using the "EQUIPPED" categories						

3. Who to contact to "Rule In" or "Rule Out" causes (from corresponding category above)						
Outside Op.: ☐	Outside Op.: ☐	Outside Op.: ☐	Outside Op.: ☐	Outside Op.: ☐	Outside Op.: ☐	Outside Op.: ☐
U/Dstream: ☐	U/Dstream: ☐	U/Dstream: ☐	U/Dstream: ☐	U/Dstream: ☐	U/Dstream: ☐	U/Dstream: ☐
Utilities: ☐	Utilities: ☐	Utilities: ☐	Utilities: ☐	Utilities: ☐	Utilities: ☐	Utilities: ☐
Other:	Other:	Other:	Other:	Other:	Other:	Other:

4. PREDICTION: Which of the potential causes do you believe to be the malfunction/fault
3. Check off who you could contact to quickly "rule out" any of the potential causes 4. Circle any of your potential causes that are still possible after your troubleshooting process.



Trainee Evaluation Kirkpatrick Model

1. We use Course Surveys and present the results to our clients via Bar Charts/Pie Charts etc. from Survey Monkey
2. Each of our Training Exercises comes with a multi-point Trainee Evaluation
3. We use our 30 item Operations Assessment tool – both Self and Instructor along with our Supplemental Strengths/ Weaknesses
4. This is where the client kicks in – only they have access to this info. Plus remember, "Success has many fathers, only Failure is an orphan!"

Industry Courses "Results"

- **What will you do differently because of taking this course?**
  - "Take more time solving problems. Be more methodical"
  - "Think about the consequences of actions before starting"
  - "Have a greater consideration of the plant prior to making process changes"
  - "Different approach to decision making/ troubleshooting"
  - "Practice more troubleshooting at the board in free time"
  - "Use my trends as a tool more"

Industry Courses
"Results" - continued

- "Think about the downstream and upstream cause/effect more."
- "I will be more proactive and think of different simulation while working the board"
- "Think above all operation before making any moves."
- "Think of troubleshooting with a bigger picture."
- "Look at the overall big picture sooner than before the course."
- "Follow more trends for cause and effect of moves made."

Conclusions

- Industry sites do a good job of promoting operator confidence in soft skills and operating mechanics
- An opportunity exists to strengthen confidence in competencies tied to promoting an operations mindset
- Face to face training is valuable training time. To promote this operations mindset, exercises that strengthen critical thinking skills can help increase operator confidence