NFPA Roadmap Committee

January 21, 2021
1:00 PM to 3:00 PM Central Time

Zoom Link
https://us02web.zoom.us/j/86457667441?pwd=VjZSNEpHbGdvTzVOM1NXRGl2WkM4UT09

Agenda

1:00 PM **Welcome, Call to Order, Roll Call** (Eric Lanke)

1:10 PM **Overview – Roadmap Process and Timetable** (Eric Lanke)

1:20 PM **Presentation – Survey on Customer Drivers in Fluid Power Customer Markets** (Eric Lanke)

1:30 PM **Discussion Groups**

1. On-Time Delivery (Pete Alles)
2. Connected Intelligence (Eric Lanke)
3. System and Energy Efficiency (Brad Dittmer)
4. On-Board Diagnostics (Tom Wanke)
5. Environmental Regulations (Mike Betz)

2:00 PM **Discussion Group Reports** (Discussion Leaders) / **Editing List of Customer Drivers** (Eric Lanke)

2:45 PM **Wrap-Up and Next Steps** (Eric Lanke)

3:00 PM **Adjourn**

NFPA Anti-Trust Guidelines

Because of federal anti-trust laws, certain topics are not proper subjects for discussion at any NFPA function. In many cases, our members are competitors and any action or agreement which may eliminate, restrict or govern competition among members or their colleagues could be a violation of anti-trust laws. Those violating the anti-trust laws are subject to severe criminal and civil penalties.

This means that we must not discuss any items falling within the realm of competitive practices, such as current or future prices, terms of service, discounts, production or productivity rates, allocation of markets, profit levels, credit terms, or refusal to deal with a particular supplier or customer.

Please adhere strictly to these guidelines during all NFPA functions to protect yourself, your company and the NFPA from liability.

NFPA Technology Roadmap

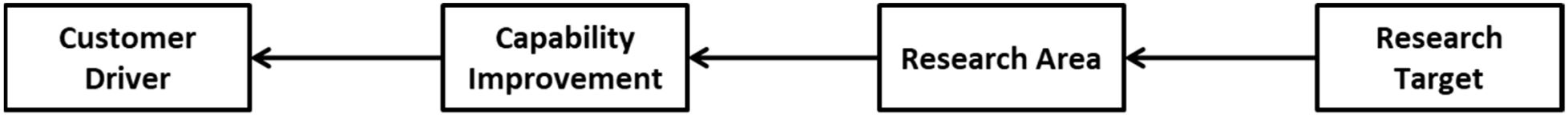
The NFPA Technology Roadmap describes an industry-wide consensus regarding the pre-competitive research and development needs associated with improving the design, manufacture, and function of fluid power components and systems.

The research and development agenda it describes is focused on advancements that will help the fluid power industry meet the future needs of its customers, expand into new markets, and attract the best and brightest students to the field.

It is used by the NFPA and the its academic partners to guide their research efforts, by NFPA members and other industry players to inform decisions about research partnerships and product development, and by academic, government, and other organizations that wish to pursue research and development projects of importance to the fluid power industry.

It is updated every two years under the guidance and leadership of the NFPA Roadmap Committee.

Roadmap Elements



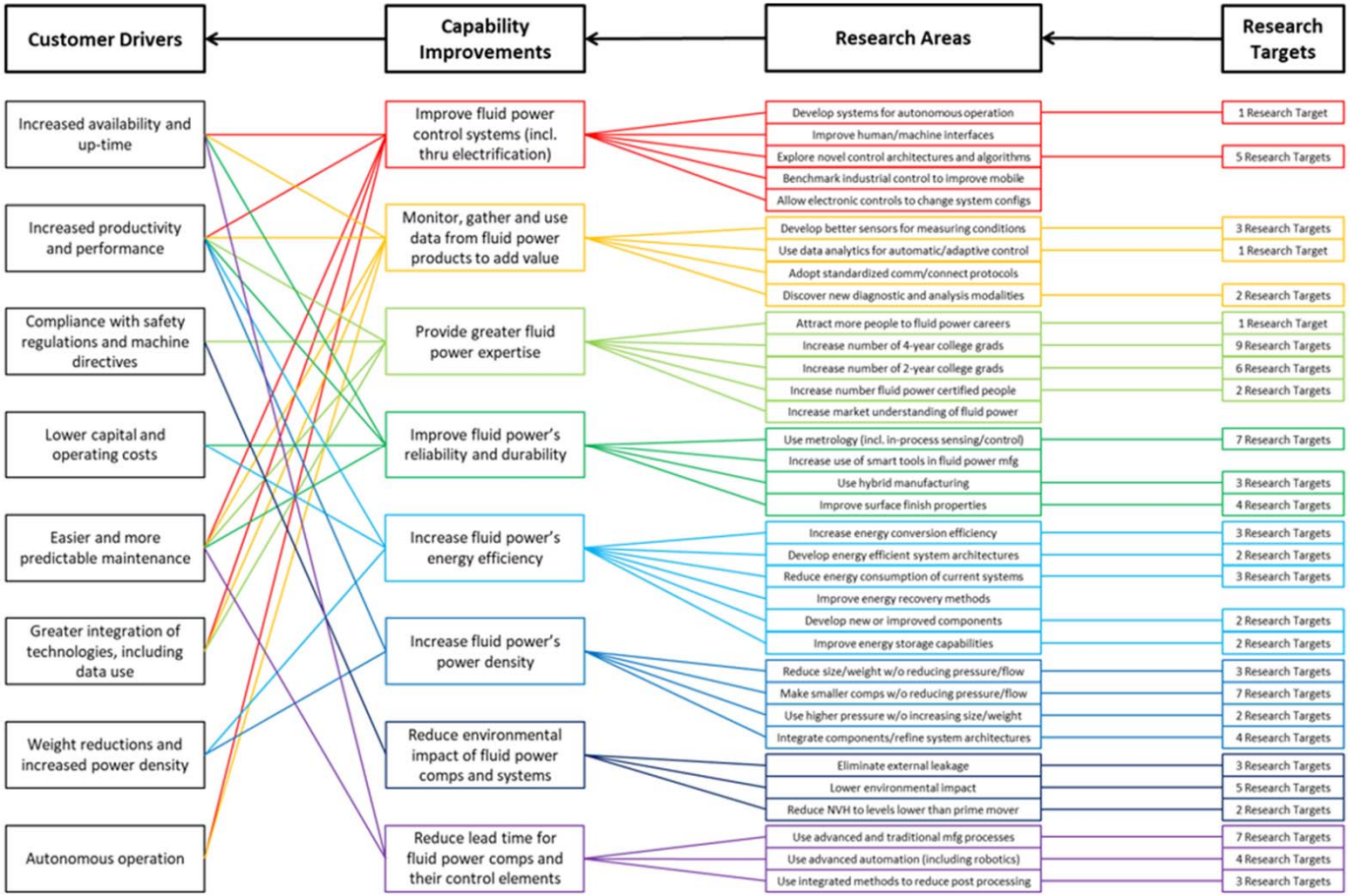
Customer Drivers are the business or technology objectives of fluid power customers. They help them serve the needs of their own customers, and are not necessarily connected to their use of fluid power.

Capability Improvements describe the ways in which fluid power systems must improve if they are to meet or better meet the customer needs described by the Customer Drivers.

Research Areas are the broad areas of pre-competitive investigation that could assist in bringing about the Capability Improvements.

Research Targets are the objectives that quantify or otherwise describe successful strategies for pursuing the Research Areas.

2019 NFPA Technology Roadmap



2021 Roadmap Process and Timeline

Phase 1 – Customer Drivers

Nov 12	Launch of survey on customer drivers
Dec 17	Deadline to respond to survey on customer drivers
Jan 21	Virtual committee meeting to discuss, define and prioritize customer drivers

Phase 2 – Capability Improvements

Jan 28	Meeting report sent with prioritized customer drivers and setting the stage for fluid power alignment and capability improvements
	Launch of survey on fluid power alignment and capability improvements
Feb 18	Deadline to respond to survey on fluid power alignment and capability improvements
Mar 4	Virtual committee meeting at NFPA Regional Conference to discuss, define and prioritize capability improvements

Phase 3 – Research Areas and Targets

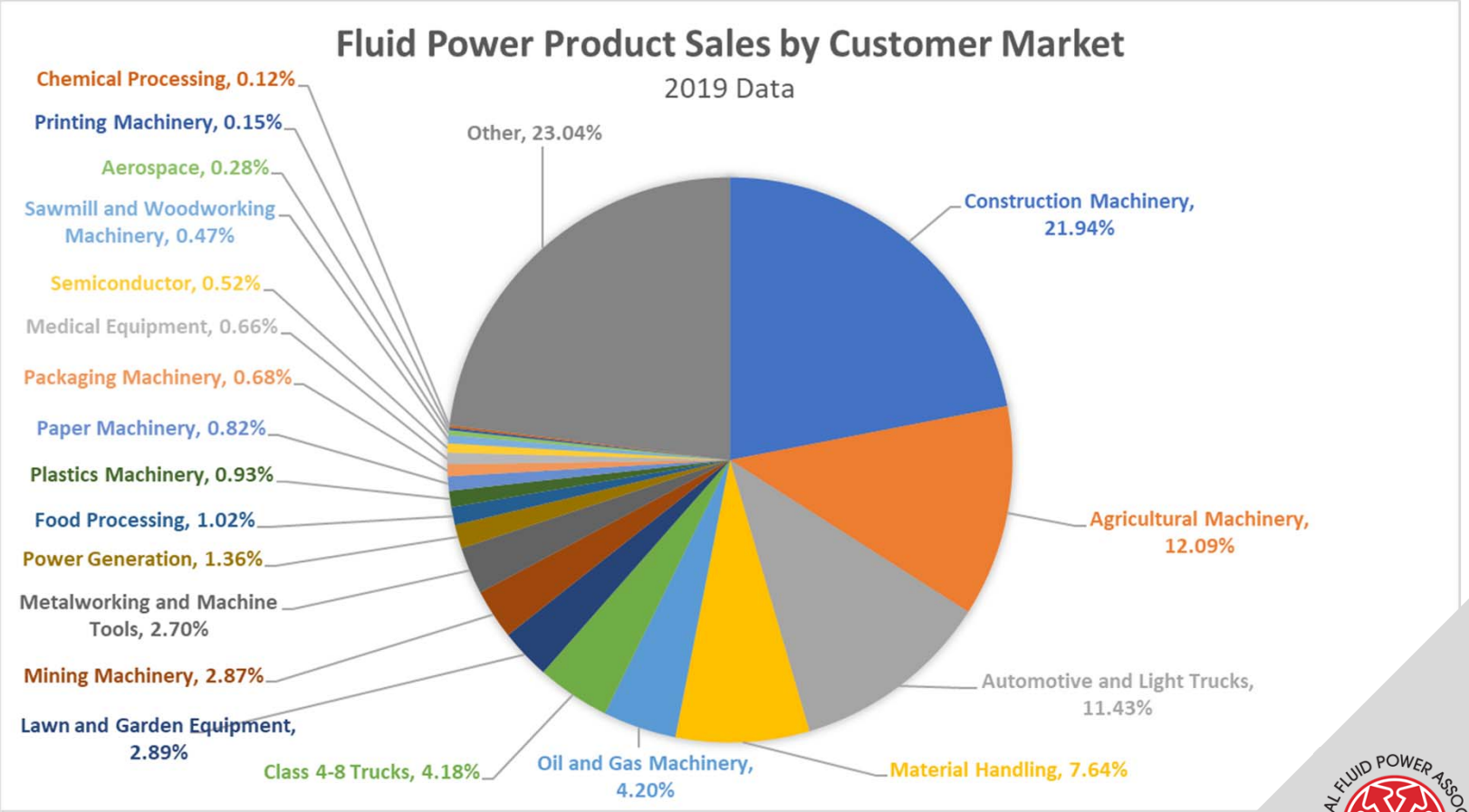
Mar 11	Meeting report sent with prioritized capability improvements and setting the stage for research areas and targets, including process for defining working groups for each capability improvement
	Launch of survey on research areas and targets
Apr 1	Deadline to respond to survey on research areas and targets
Apr/May	Virtual working group meetings to discuss and prioritize research areas and targets for each capability improvement
Jun 3	Virtual committee meeting at NFPA Regional Conference to review and harmonized research areas and targets for each capability improvement

Phase 4 – Final Roadmap Document

Jun	Draft Roadmap document written
Jul 8	Draft Roadmap document sent for review and comment
Jul 22	Deadline to return comments on draft Roadmap
Aug 17	Final Roadmap document presented at NFPA IEOC

Fluid Power Customer Markets

Fluid power technology is used in hundreds of applications in dozens of specific customer markets. Generally speaking, all of fluid power's customer markets can be grouped into two general areas: those that are served by hydraulics and those that are served by pneumatics. According to NFPA's latest data, the 20 largest customer markets represent nearly 77% of all hydraulic and pneumatic product sales.



Customer Drivers

Customer Drivers are the business or technology objectives of fluid power customers. Generally speaking, fluid power customers are the companies that build machines that incorporate fluid power components and systems. We sometimes refer to these customers as “machine builders.” The Customer Drivers help these machine builders serve the needs of their own customers (the companies or people that purchase and use the machines) and are not necessarily connected to their use of fluid power.

In the 2019 NFPA Technology Roadmap, the following eight Customer Drivers were identified as those of highest importance to the majority of fluid power customer markets:

<u>Customer Drivers</u>

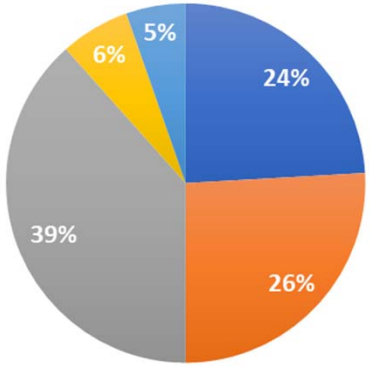
Fluid power’s machine builders want to provide their customers with machines that offer:

1. Increased availability and up-time
2. Increased productivity and performance
3. Compliance with safety regulations and machine directives
4. Lower capital and operating costs
5. Easier and more predictable maintenance
6. Greater integration of technologies, including data acquisition, utilization, and ownership
7. Weight reductions and increased power density
8. Autonomous operation

Survey on Drivers in Fluid Power Customer Markets

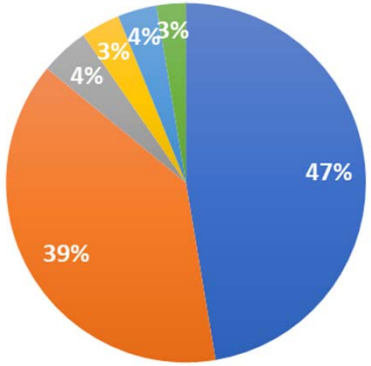
In December 2020, NFPA conducted a survey to determine the importance of these Customer Drivers in the 20 largest fluid power customer markets, and to determine if any new drivers had emerged in these markets since the time of the 2019 NFPA Technology Roadmap. The survey received responses from 113 individuals across the fluid power supply chain, including a large percentage from the NFPA Roadmap Committee.

Supply Chain Representation



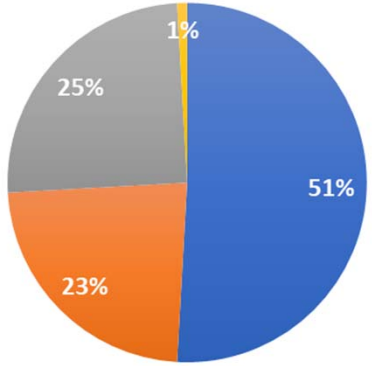
- SUPPLIER to the fluid power industry
- MANUFACTURER of fluid power components
- Fluid power DISTRIBUTOR or system integrator
- MACHINE BUILDER that uses fluid power technology
- USER of machines that use fluid power technology

Associations Representation



- National Fluid Power Association
- Association for High Technology Distribution
- Power Transmission Distributors Association
- Packaging Machinery Manufacturers Institute
- Association of Equipment Manufacturers
- Association for Manufacturing Technology

Job Function of Responders



- Executive Management
- Sales or Marketing
- Engineering
- Human Resources

Importance of Existing Customer Drivers

CUSTOMER MARKETS	N	CUSTOMER DRIVERS: Increased availability and up-time	Increased productivity and performance	Compliance with safety regulations and machine directives	Lower capital and operating costs	Easier and more predictable maintenance	Greater integration of on-board technologies, including optimal data acquisition, utilization, and ownership protocols	Autonomous operation	Weight reductions and increased power density
Aerospace	28	3.929	3.643	4.464	3.214	3.500	3.607	3.143	3.464
Agricultural Machinery	58	4.362	4.276	3.966	3.966	3.672	3.569	3.293	3.293
Automotive and Light Trucks	34	4.294	4.265	4.176	3.824	3.735	3.647	3.029	3.353
Chemical Processing	19	4.579	4.368	4.368	3.632	3.526	3.737	2.842	2.421
Class 4-8 Trucks	10	4.400	4.200	4.500	4.400	4.000	3.700	3.300	4.000
Construction Machinery	47	4.574	4.574	4.319	4.021	3.830	3.553	3.277	3.532
Food Processing	37	4.595	4.514	4.459	4.027	3.892	3.459	2.919	2.703
Lawn and Garden Equipment	15	4.200	4.000	3.933	4.133	3.467	2.867	3.200	3.000
Material Handling	51	4.451	4.471	4.216	3.980	3.784	3.647	3.392	3.235
Medical Equipment	17	4.412	4.235	4.765	3.471	3.647	4.118	3.412	3.000
Metalworking and Machine Tools	41	4.585	4.634	4.220	3.878	3.951	3.805	3.317	2.854
Mining Machinery	29	4.586	4.552	4.414	3.966	3.966	3.828	3.621	3.138
Oil and Gas Machinery	26	4.731	4.500	4.654	3.885	3.885	3.769	3.346	2.962
Packaging Machinery	33	4.697	4.697	4.333	4.121	4.121	4.182	3.697	3.152
Paper Machinery	25	4.760	4.680	4.360	4.240	4.160	3.920	3.200	2.800
Plastics Machinery	25	4.640	4.640	4.240	4.160	4.160	3.800	3.360	3.000
Power Generation	21	4.762	4.429	4.524	3.952	3.905	4.095	3.476	3.000
Printing Machinery	9	4.778	4.778	4.667	4.222	4.333	4.000	3.667	3.333
Sawmill and Woodworking Machinery	21	4.429	4.714	4.429	3.905	3.952	3.048	2.857	2.762
Semiconductor	5	4.600	4.600	4.600	4.200	3.600	4.000	3.600	4.000
All Responses	551	4.506	4.441	4.321	3.938	3.848	3.695	3.281	3.122

Respondents were asked to rank the importance of each Customer Driver in each of the customer markets with which they were familiar. Some variations in importance emerged for particular markets. In the aggregate, all the drivers were ranked as at least somewhat important, with "Increased availability and up-time" ranked highest and "Weight reductions and increased power density" ranked lowest.

Rank how important each of the customer drivers are in each of the customer markets.
5 = Extremely important
4 = Very important
3 = Somewhat important
2 = Not so important
1 = Not at all important

- 5.000 - 4.500
- 4.499 - 4.000
- 3.999 - 3.500
- 3.499 - 3.000
- 2.999 - 2.500
- 2.499 - 2.000

Customer Drivers – Hydraulic vs. Pneumatic Markets

CUSTOMER MARKETS	N	CUSTOMER DRIVERS: Increased availability and up-time	Increased productivity and performance	Compliance with safety regulations and machine directives	Lower capital and operating costs	Easier and more predictable maintenance	Greater integration of on-board technologies, including optimal data acquisition, utilization, and ownership protocols	Autonomous operation	Weight reductions and increased power density
Agricultural Machinery	58	4.362	4.276	3.966	3.966	3.672	3.569	3.293	3.293
Automotive and Light Trucks	34	4.294	4.265	4.176	3.824	3.735	3.647	3.029	3.353
Construction Machinery	47	4.574	4.574	4.319	4.021	3.830	3.553	3.277	3.532
Material Handling	51	4.451	4.471	4.216	3.980	3.784	3.647	3.392	3.235
Oil and Gas Machinery	26	4.731	4.500	4.654	3.885	3.885	3.769	3.346	2.962
Top 5 Hydraulic Markets	216	4.463	4.412	4.218	3.949	3.769	3.620	3.301	3.278
Automotive and Light Trucks	34	4.294	4.265	4.176	3.824	3.735	3.647	3.029	3.353
Food Processing	37	4.595	4.514	4.459	4.027	3.892	3.459	2.919	2.703
Medical Equipment	17	4.412	4.235	4.765	3.471	3.647	4.118	3.412	3.000
Packaging Machinery	33	4.697	4.697	4.333	4.121	4.121	4.182	3.697	3.152
Semiconductor	5	4.600	4.600	4.600	4.200	3.600	4.000	3.600	4.000
Top 5 Pneumatic Markets	126	4.516	4.460	4.397	3.929	3.865	3.810	3.087	3.246
All Responses	551	4.506	4.441	4.321	3.938	3.848	3.695	3.281	3.122

When comparing responses for the top 5 hydraulic markets to the top 5 pneumatic markets, not much variation emerges – either from each other or from the aggregate of all responses.

This suggests it is appropriate to move forward with a single set of customer drivers for all fluid power customer markets. A Technology Roadmap developed from that foundation will be of greatest use to the greatest number of stakeholders.

Rank how important each of the customer drivers are in each of the customer markets.
5 = Extremely important
4 = Very important
3 = Somewhat important
2 = Not so important
1 = Not at all important

- 5.000 - 4.500
- 4.499 - 4.000
- 3.999 - 3.500
- 3.499 - 3.000
- 2.999 - 2.500
- 2.499 - 2.000

Comparison to 2019 Results

2021 SCALE	2021 SCORE			2019 SCORE	2019 SCALE
5.000					1.000
4.900					1.050
4.800					1.100
4.700					1.150
4.600					1.200
4.500	4.506	A			1.250
4.400	4.441	B			1.300
4.300	4.321	C			1.350
4.200					1.400
4.100			A	1.483	1.450
4.000			B	1.483	1.500
3.900	3.938	D	C	1.512	1.550
3.800	3.848	E	D	1.570	1.600
3.700					1.650
3.600	3.695	F	E	1.744	1.700
3.500					1.750
3.400			F	1.831	1.800
3.300					1.850
3.200	3.281	G			1.900
3.100	3.122	H			1.950
3.000			H	2.029	2.000
2.900			G	2.070	2.050
2.800					2.100
2.700					2.150
2.600					2.200

A Increased availability and up-time
B Increase productivity and performance
C Compliance with safety regulations and machine directives
D Lower capital and operating costs
E Easier and more predictable maintenance
F Greater integration of on-board technologies, including optimal data acquisition, utilization, and ownership protocols
G Autonomous operation
H Weight reductions and increased power density

Comparing these results to those collected in 2019 is challenging because our response scale changed – from a 1-3 scale in 2019 to a 5-1 scale here in 2021. However, by roughly comparing where each Customer Driver fell in the available range of responses each year allows us to make the following observations:

- It appears that each driver has increased its relative importance, appearing "higher" in the available range for 2021 than each did in 2019.
- The overall prioritization of drivers remains the same, with the exception of the two lowest ranked drivers, "Autonomous operation" and "Weight reductions and increased power density," which changed places in the priority order.

Suggestions for New Customer Drivers

In addition to ranking the importance of the existing Customer Drivers, respondents were asked to suggest any additional Drivers that they would have ranked as “Extremely Important” or “Very Important” for the customer markets with which they were familiar. Here’s a summary of the responses collected, sorted by market, with the percent of the fluid power market that each represents.

Aerospace (0.28%)
Long life

Agricultural Machinery (12.09%)
On-time delivery within the prescribed time window
Compliance with environmental regulations
Financing

Construction Machinery (21.94%)
On-time delivery within the prescribed time window
System and energy efficiency
Connected intelligence
Automation of implement function is more important than autonomy
On-board diagnostics access

Lawn and Garden Equipment (2.89%)
On-time delivery within the prescribed time window

Material Handling (7.64%)
Connected intelligence

Metalworking and Machine Tools (2.70%)
IoT, Connected intelligence

Oil and Gas Machinery (4.20%)
Reduced emissions/electrification
Business cycles

Power Generation (1.36%)
IoT, Connected intelligence

Sawmill and Woodworking Machinery (0.47%)
Environmental compliance

Discussion of Suggested Customer Drivers

The following table groups and lists the suggested Customer Drivers in descending order for the aggregate size of the markets for which they are relevant. The Roadmap Committee will discuss what action to take for each, understanding that its goal is to define and prioritize a finite list of the most important customer drivers, from which the remainder of the 2021 NFPA Technology Roadmap can be built.

Suggested Driver	Market Weight	Proposed Action	Discussion Group
On-time delivery within the prescribed time window	36.92%	**Discuss.** Is "on-time delivery" a customer driver distinct from and of importance commensurate with the eight existing drivers? If so, how can it best be worded and where, approximately, should it be placed in priority?	1
Connected intelligence	33.64%	**Discuss.** How should "connected intelligence" be viewed relative to the existing driver re: the greater integration of technologies? Which concept takes precedence, and how can it best be stated as a capability that a machine builder wants to offer their customers?	2
System and energy efficiency	21.94%	**Discuss.** How should "system and energy efficiency" be viewed relative to the existing driver re: increased productivity and performance? Which concept takes precedence, and how can it best be stated as a capability that a machine builder wants to offer their customers?	3
Automation of implement function is more important than autonomy	21.94%	**Revise** existing driver to read: "Autonomous functions and operation."	None
On-board diagnostics access	21.94%	**Discuss.** Is "on-board diagnostic access" a customer driver distinct from and of importance commensurate with the eight existing drivers? If so, how can it best be worded and where, approximately, should it be placed in priority?	4
Compliance with environmental regulations	12.56%	**Discuss.** Is either "compliance with environmental regulations" or "reduced emissions/electrification" a customer driver distinct from and of importance commensurate with the eight existing drivers? If so, how can it best be worded and where, approximately, should it be placed in priority?	5
Financing	12.09%	**None.** Suggestion unclear and relevant to only a small portion of markets.	None
Reduced emissions/electrification	4.20%	**None.** Included in Discussion Group 5.	None
Business cycles	4.20%	**None.** Suggestion unclear and relevant to only a small portion of markets.	None
Long life	0.28%	**None.** Suggestion relevant to only a small portion of markets.	None

Draft List of Prioritized Customer Drivers

As each discussion group reports its findings, this list will be revised and finalized by the full Roadmap Committee.

2021 NFPA Technology Roadmap

Customer Drivers

Fluid power's machine builders want to provide their customers with machines that offer:

1. Increased availability and up-time
2. Increased productivity and performance
3. Compliance with safety regulations and machine directives
4. Lower capital and operating costs
5. Easier and more predictable maintenance
6. Greater integration of technologies, including data acquisition, utilization, and ownership
7. Autonomous functions and operation
8. Weight reductions and increased power density
9. On-time delivery?
10. Connected intelligence?
11. System and energy efficiency?
12. On-board diagnostic access?
13. Compliance with environmental regulations/reduced emissions/electrification?

Wrap-Up and Next Steps

Phase 1 – Customer Drivers

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