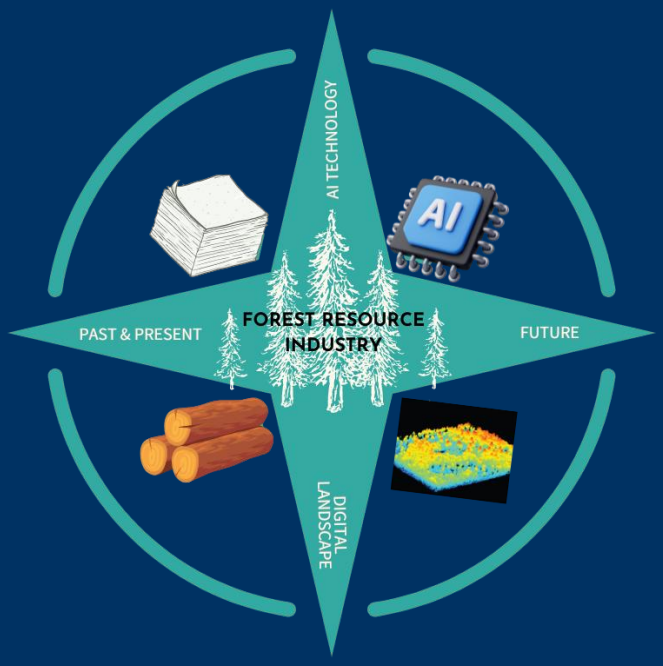

DATA FRONTIERS

The Intersection of Emerging Technologies and Maine's Heritage Industries

AUGUST 8, 2023

University of Maine

Anne Heberger Marino
Associate Director, Portland Gateway

Shane Moeykens
Director, Maine EPSCoR

Pips Veazey
Director, Portland Gateway

Aaron Weiskittel
Director, Center for Research on Sustainable Forests

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Introduction

On June 13, 2023, a diverse group of educators and professionals from across the state of Maine gathered at the University of Maine's Portland Gateway to discuss the field of AI technology and the related areas of data science and informatics. These topics were interwoven with the future of Maine's natural forest resources and the industries that have developed around them. Technology in the digital landscape is ever-changing, and recent developments in artificial intelligence (AI) show potential to benefit industries of all kinds.

With recognition of the historic contributions of these heritage industries also comes awareness of the challenges they face in an uncertain future. Climate change presents a real threat to the world that will cause once-familiar industrial landscapes to shift into new territory. As more people around the globe find themselves in need of different sources of food and forest products, more eyes will turn to the abundant resources in Maine. While this presents significant economic opportunity for the people of Maine, it also represents a potential disruption to the sustainable use of these resources.

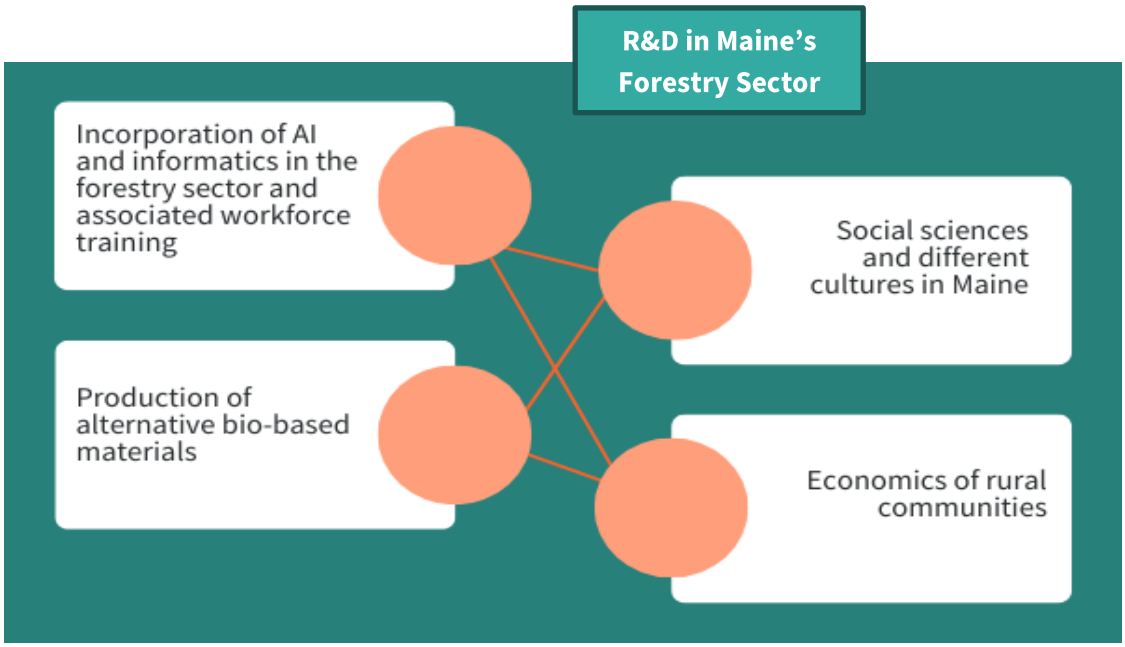
Overcoming these challenges will require a robust, well-trained workforce. As will be detailed later in this report, many of Maine's companies are facing difficulties in finding employees with appropriate skills. Attendees at the Portland Gateway meeting highlighted a multitude of obstacles they are facing in recruiting high tech employees, indicating that barriers exist.

Topics of discussion at the meeting ranged from research and development spending to workforce development to preparing Maine's students to utilize the technologies of the future. Representatives came from industries such as education, venture capital, mechanical engineering, semiconductor manufacturing, and aerospace engineering, aiming to build connections and provide their voice on protecting and enhancing Maine's future.

Maine-FOREST Economy and MIEAP

Prior to working discussions on Maine's future, representatives from the University of Maine, Maine EPSCoR and the Maine Innovation and Economy Action Board (MIEAB) introduced the topics at hand and a plan under consideration for submission as an RII Track-1 proposal to the National Science Foundation (NSF), titled

'Maine-FOREST'. The plan's intent is to expand investments in research and development in Maine's forestry sector, leveraging four key thrusts:



Steven Von Vogt, a member of MIEAB, spoke on the 2023 Maine Innovation Economy Action Plan (MIEAP), addressing both the challenges and opportunities that climate change presents. While the future is uncertain, Maine currently generates the most renewable energy per capita in New England and has an abundance of natural resources. The MIEAP addresses how best to capitalize on those resources and use them to the benefit of the state and the country.

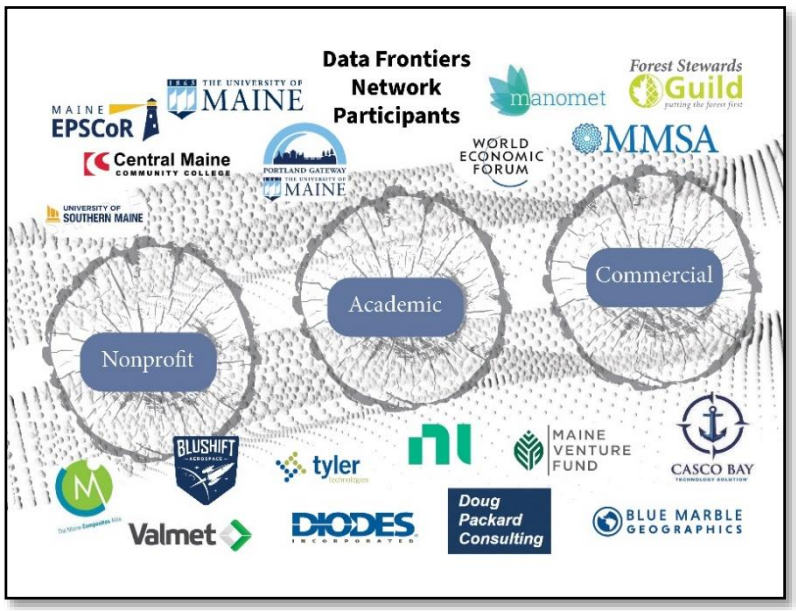
The vision that the Board lays out for MIEAP is to build a resilient, innovation-based economy that creates opportunities for all of Maine's people. The plan is made up of five key goals:

The plan lays out targeted technology sectors, which include heritage industries that have continued opportunity for growth, such as the agriculture, aquaculture and the marine, and forestry sectors, and other upcoming high-growth target sectors, such as aerospace, bio-based materials, human health, and renewable energy. AI is an enabling, overarching technology that offers promise to address many of the challenges in these sectors.

The Maine-FOREST plan is a catalyst for helping the state meet these goals. The plan represents a statewide effort to bring together different organizations to work on the complex issues of developing the state's workforce in AI, data science and related informatics skillsets, and bridging the state's forest industry away from a declining paper manufacturing emphasis to emerging new opportunities. The plan is inclusive of many stakeholders, who will be leveraged to develop an emerging green economy as the state's natural resources continue to shift under the influence of climate change. Maine-FOREST is focused on emerging technologies that may favorably influence the forestry sector, though it also recognizes that the forestry sector is a case study for other natural resource-enabled sectors (e.g., agriculture, aquaculture & marine).

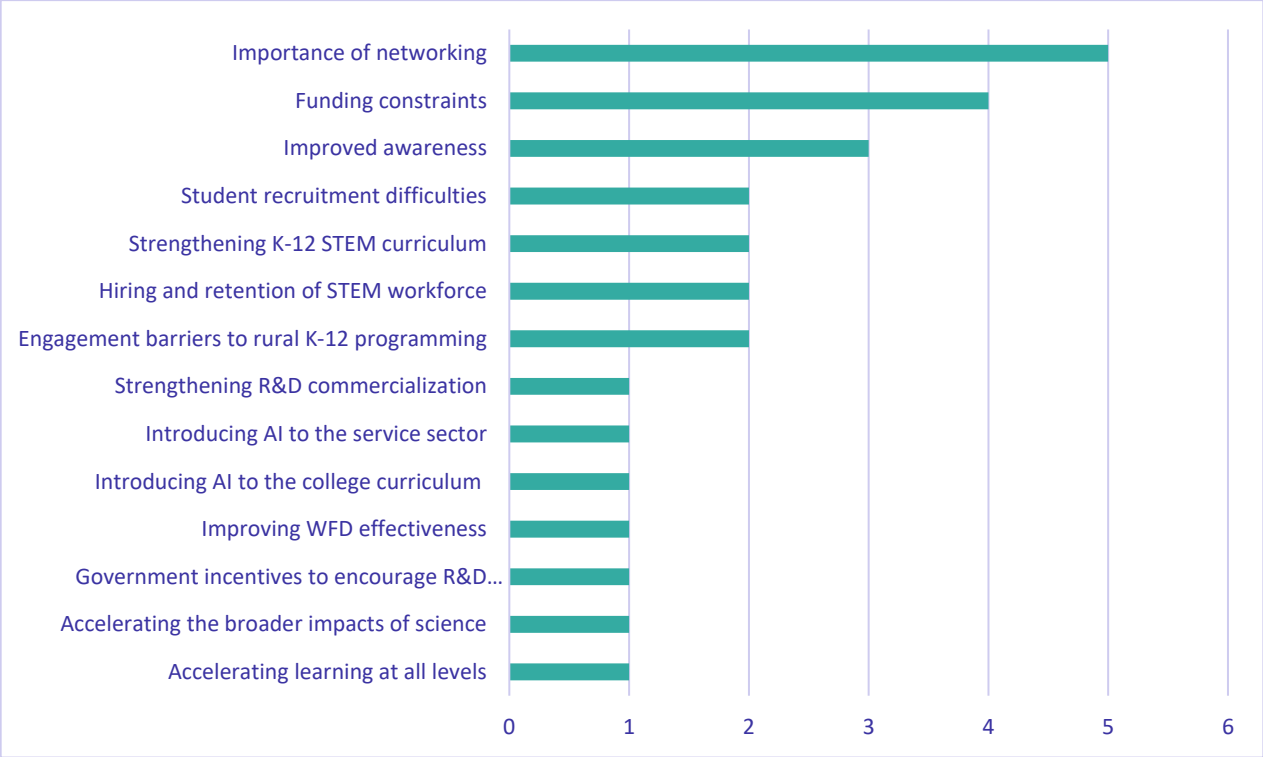
The Maine-FOREST research team views artificial intelligence as a technology that is primed to disrupt industries in all sectors, with forestry being no exception. Environmental AI sits at the interface of industry-specific technology and data science and offers the potential to solve complex environmental issues, allowing for more development in the face of incomplete datasets, complex problems, and a lack of predictable forecasting. With this understanding, stakeholders in Maine will be able to focus on the issues facing diverse communities around the state, including within rural and tribal communities, to build upon a sustainable future that supports collaborations and partnerships in the forestry sector and beyond.

Building Maine Connections



A science of team science session opened the Data Frontiers meeting, recognizing the diversity of attendees (4 nonprofit, 11 commercial, 8 academic; 23 total), summarized in Appendix A. Attendees were introduced to each other through a networking exercise, being asked to identify the opportunities that they personally bring to the group and Maine's economy, and separately, the challenges they and their organizations face. Detailed responses are presented in Appendix B, with challenges summarized in Figure 1.

Figure 1. Challenges described by workshop attendees faced by themselves and/or their organizations presented with the number of attendees associated with each challenge.



The most common challenge identified in the workshop was the importance of networking and difficulties associated with networking in Maine, which likely reflects the nature of the state's relatively small population that is geographically dispersed across a relatively large land mass. Funding constraints were the second most significant challenge identified by attendees, followed by the need for improved awareness of current trends and the needs of the forestry sector as well as the communities who rely on forestry.

The need to strengthen the K-12 STEM curriculum, engagement barriers present in Maine with rural schools, and difficulties associated with student recruitment in targeted, research-oriented programming at both the community college and bachelor levels are all noteworthy responses.

There were only two direct references by respondents to AI technology in this session, one pertaining to promoting the use of AI in the commercial service sector and the other describing the need to bring real world AI problems to Maine students.

Envisioning the Future of Maine

Attendees were asked to envision their "big idea" for the future of Maine – if the typical constraints of thought around ideas were thrown out, what would they suggest Maine could accomplish. These ideas were worded as "What if…?" questions that suggested a path for the state. The suggestions can be found in Table 1, grouped into high-level topics.

Table 1. 'Big Ideas' for the Future of Maine.

Topic	Ideas
Artificial Intelligence	✦ What if Maine could be the leader in setting environmental AI standards? ✦ What if Maine implemented the phases of the "Develop Entry Level Skills and Awareness in AI" program?
Education	✦ What if we could clearly identify skills training needed in Maine for K-12 students to fill tech jobs – from technicians to engineers – and implement this training across the state? ✦ What if all Maine high school graduates were STEM capable and 50% of graduates studied STEM related fields in college? ✦ What if we could make code.org or another coding platform part of the Common Core Education for the State of Maine? ✦ What if Maine had an alternative STEM education program for K-12 that partners with programs focused on at-risk youth? ✦ What if Maine developed STEM competitions statewide for K-12 students?
Heritage Industries	✦ What if Maine had a new generation of innovative heritage industry (farming, fishing, forestry production) companies, built on the state's expertise in those areas? ✦ What if we branded Maine forest products successfully as the world's most high-quality forest products?
Policy	✦ What if we could bring over technical resources to address PFAs contamination, remediation, and adaptation? ✦ What if Maine had free internet access in every home and business? ✦ What if Maine could have a unified state plan to grow the Maine economy across rural and urban areas, if we identified the right opportunities and acted strategically? What if we could plan across geography and sectors to the greatest advantage of the state? ✦ What if Maine could provide R&D tax credits up to $500K per year for Maine's resident software developers?
Workforce Development	✦ What if Maine created a high-tech owner/entrepreneur forum to catalyze/accelerate the sharing of ideas, knowledge, connections, and growth opportunities? ✦ What if Maine could create career pathways in the forest-technology-economy that enable young people to earn a living in and stay in Maine, and sustain Maine, for generations? ✦ What if Maine developed a one workforce funnel process?

Once the ideas had been anonymously written, they were passed to other group members on a randomized basis for scoring on a one through five scale, with one being the lowest and five being the highest. Five rounds of scoring took place and the three highest scoring suggestions served as the basis for breakout sessions immediately following the exercise, which were:

- What if every high school student in Maine saw an opportunity and a future in Maine?
- What if we could attract talent by building "Maine" as a cultural export? What if people thought of Maine before Oregon when they heard Portland?
- What if we integrated high-tech innovations with heritage industries to highlight the extensive benefits of well-managed ecosystems?

The breakout sessions were held concurrently, with each session focused on one of the three highest scoring suggestions. Attendees were encouraged to work through each of the ideas using a tool called The Innovator's Compass, with a structure centered around people, observations, principles, ideas, and experiments. After the breakouts were completed, group members from each session presented their design to the entire group. Summaries from each group are presented in Figures 2-4.

June 13, 2023, educators and professionals from across the state of Maine gather to discuss the field of AI technology and the related areas of data science and informatics.

Figure 2. Designing the Future of Maine: High School Student Opportunities.

"What if every high school student in Maine saw an opportunity and a future in Maine?"

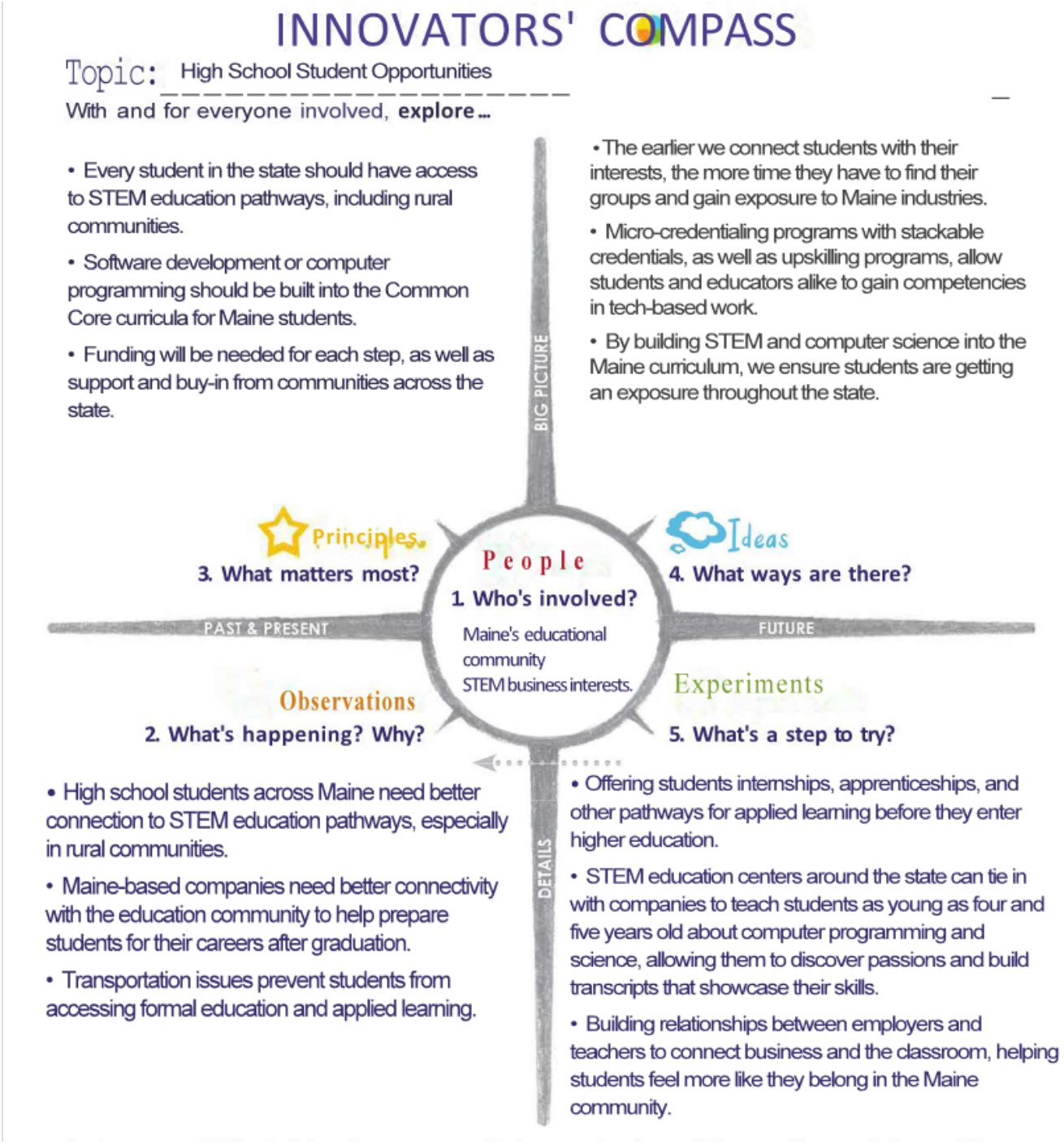


Chart adapted from InnovatorsCompass.org. © InnovatorsCompass.org

Figure 3. Designing the Future of Maine: The Maine Brand.

"What if we could attract talent by building "Maine" as a cultural export? What if people thought of Maine before Oregon when they heard Portland?"

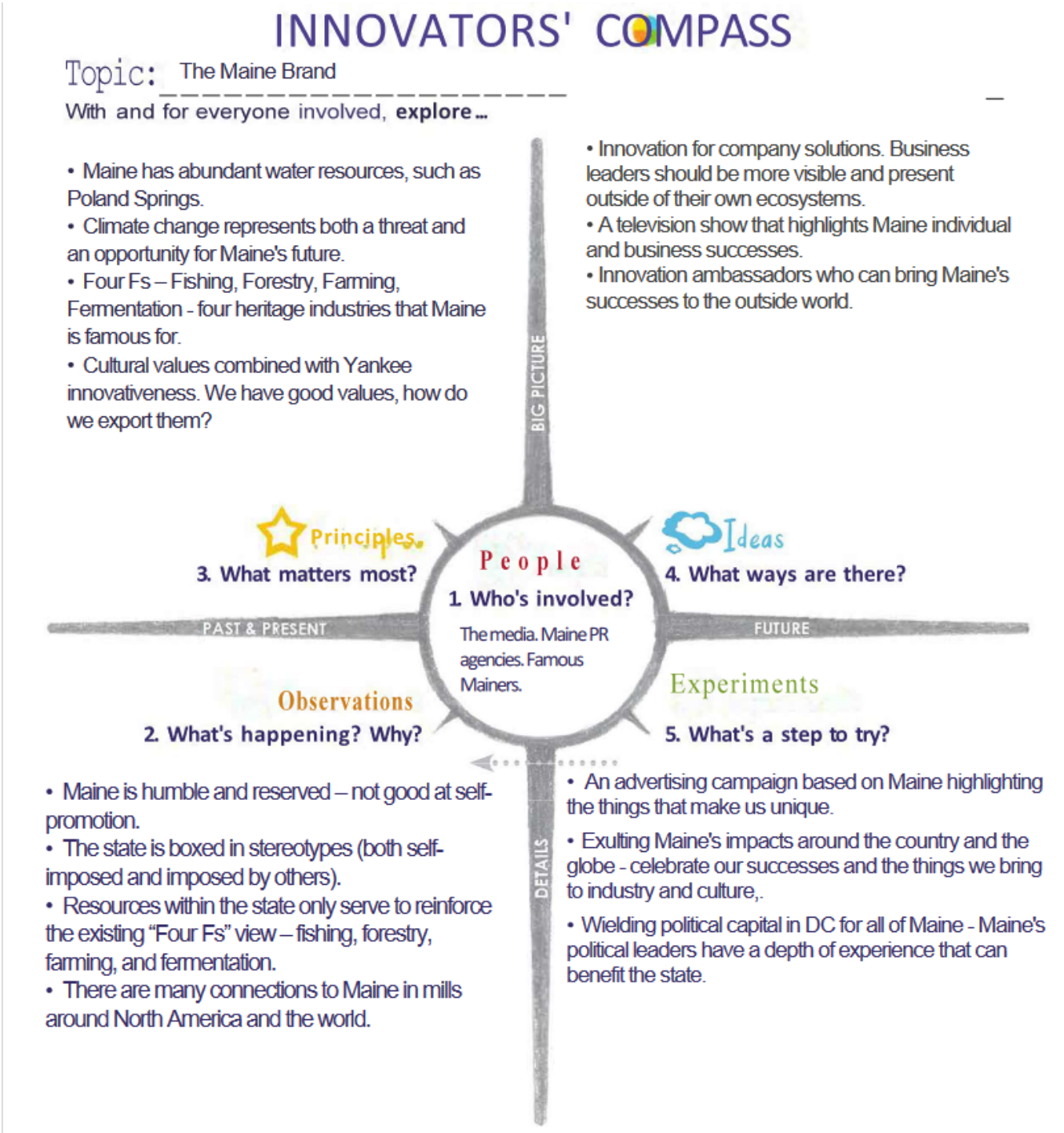


Chart adapted from InnovatorsCompass.org. © InnovatorsCompass.org

Figure 4. Designing the Future of Maine: Forestry Futures.

"What if we integrated high-tech innovations with heritage industries to highlight the extensive benefits of well-managed ecosystems?"

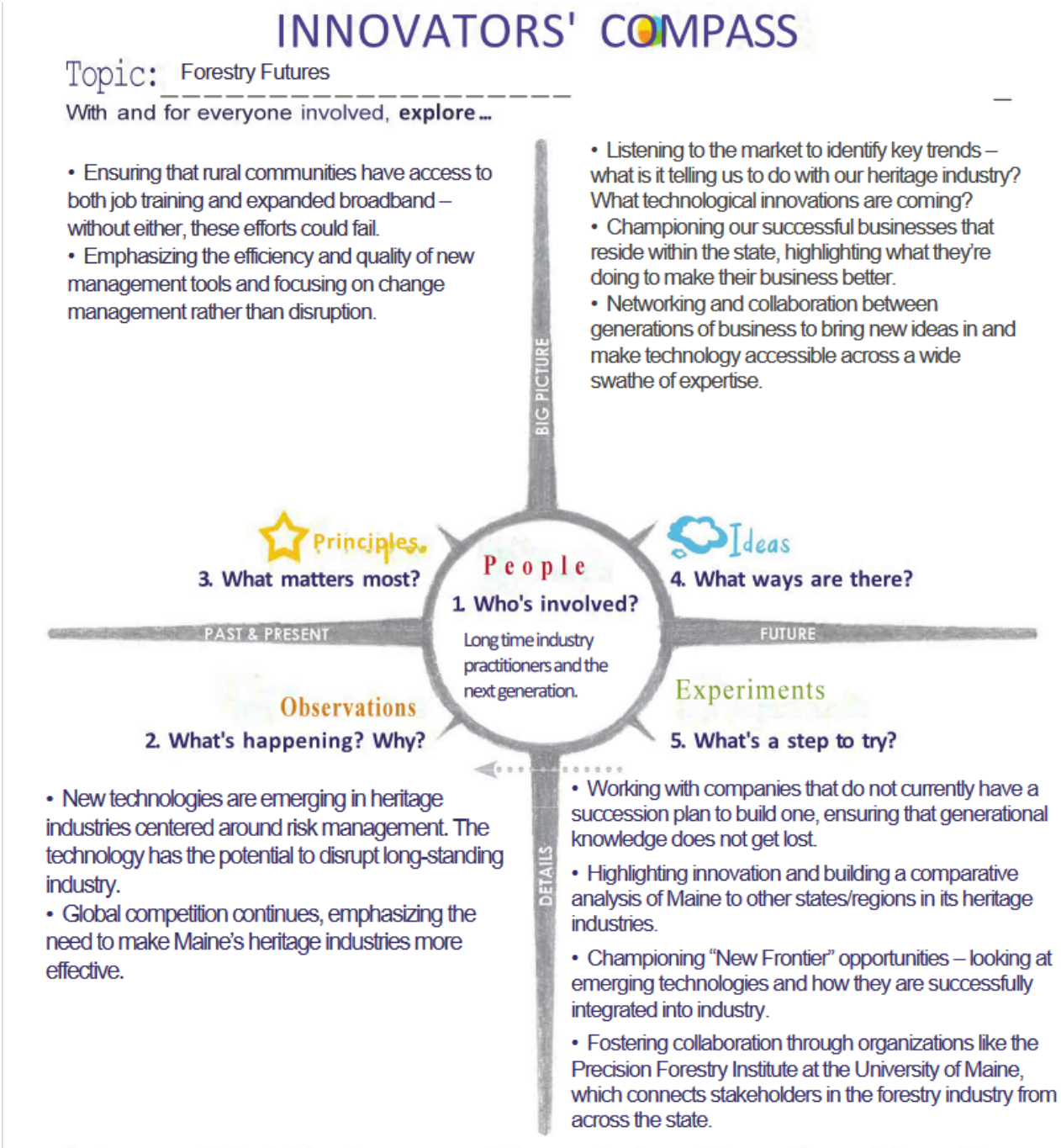


Chart adapted from InnovatorsCompass.org. © InnovatorsCompass.org

Conclusions

At the end of the day's events, attendees were asked to reflect on the various exercises they were part of in the form of writing their key takeaways and follow up points. Each attendee left with a self-appointed task to complete in the weeks following the workshop, while takeaways were read aloud to bring the session to a close. The main themes among attendee takeaways were the value of networking experiences such as the Data Frontiers meeting itself, the potential of Maine's natural resources and technology sectors, and the importance of executing a strategic vision for the state's future.

Takeaway Themes	Attendee Responses
Value of networking	• Lots of connections I haven't made with a lot of knowledge / expertise so I should reach out more to take advantage. • Networking is an essential and valuable exercise. • Never underestimate the value of meeting new people. • There is a lot of opportunity for me to connect with various business representatives for meaningful partnerships. • Maine is innovative with lots of opportunities for connections. • Get more involved in my areas of experience, and resources can be impactful for Maine to be as successful as possible. • There are lots of needs and opportunities in Maine's workforce. Connecting those dots is the big lift. • There are a lot of good people thinking about Maine's tech future. • Maine and various industries in Maine are grateful and blessed to have the Portland Gateway as a resource.
Potential of Maine's natural resources and technology sectors	• Maine has a lot of disconnected resources (e.g., tech, forestry, ag, aquaculture). This [is] probably because the universe of ME tech is much larger than the universe of ME heritage sectors. • Maine has more potential than we think yet with more challenges to be solved too. • The glimpse I got into other perspectives of thinking around technology and the forestry sector.
Importance of executing a strategic vision for the state's future	• We have a new S&T Plan and it helps guide us in terms of identifying key opportunities yet a collaborative approach to developing implementation plans is a key to success. • We need a state of Maine economic strategic plan. Select and place a few big bets. • Maine has many challenges to overcome if it wants its tech sector to grow. • We have a long way to go to develop a unified vision of what Maine can be and how to get there. Then we'll need to double down to execute that vision.

Appendix A: Meeting attendees.

- Ali Abedi (University of Maine, Academic)
- Beth Campbell (Maine EPSCoR, Academic)
- Ian Collins (Maine Mathematics and Science Alliance, Nonprofit)
- Patrick Cunningham (Blue Marble Geographics, Commercial)
- Sascha Deri (BluShift Aerospace, Commercial)
- Dave Dube (Valmet, Commercial)
- Anne Herberger Marino (University of Maine Portland Gateway, Academic)
- Matt Jones (Tyler Technologies, Commercial)
- Thomas Law (National Instruments, Commercial)
- Steve Leibiger (Diode, Commercial)
- Barry Magda (Central Maine Community College, Academic)
- Amanda Mahaffey (Forest Stewards Guild, Nonprofit)
- Shane Moeykens (Maine EPSCoR, Academic)
- Doug Packard (GSB Advisory Board/Doug Packard Consulting, Commercial)
- Joe Powers (Maine Venture Fund, Commercial)
- Kristina Prescott (Casco Bay Technology Solutions, Commercial)
- Nathan Rooney (Maine EPSCoR, Academic)
- Nina Scheepers (Maine Venture Fund, Commercial)
- Topaz Smith (World Economic Forum, Nonprofit)
- Vinton Valentine (University of Southern Maine, Academic)
- Pips Veazy (University of Maine Portland Gateway, Academic)
- Steve Von Vogt (Maine Composites Alliance / MIEAB, Commercial)
- Aaron Weiskittel (University of Maine, Academic)
- Andy Whitman (Manomet, Nonprofit)

Appendix B: Detailed responses for the opening Science of Team Science (SciTS) exercise.

Response	Organization Category	Opportunities	Challenges
1	***Academic***	• Entry level AI training/awareness courses in development, free for participants.	• Finding time / other resources. • Finding student participants and research partners.
2	***Academic***	• Connections with University of Southern Maine, Maine Geospatial Institute, Maine Library of Geographic Information, Maine Law Center for Ocean and Coastal Law.	• Internships and growing enrollment in Geospatial Technology at USM & UMaine system.
3	***Academic***	• UMaine AI can offer R&D services with >40 researchers.	• Bringing real world AI problems to UMaine students.
4	***Academic***	• K-12 Educational Research. • Understanding the needs and opportunities in Maine's school communities. • Engaging teachers in professional learning that informs and improves their practice.	• Understanding workforce needs / skills / practices that teachers can prioritize in their classrooms. • Keeping teachers up-to-date on innovation/tools.
5	***Academic***	• Regional and national connections to forest sector.	• Changing perceptions of the forest sector.
6	***Academic***	• Research facilitation and UMaine Gateway support.	• Creating strong connections in an age of distraction and competing demands.
7	***Academic***	• Connections to the University of Maine.	• Keeping up with new business development in Maine.
8	***Academic***	• Connections to Maine STEM educators (formal & informal) across the state. • Continuing to build network (including rural communities).	• Selection and development of new STEM education initiatives within Maine that meaningfully support workforce development needs.
9	***Commercial***	• Cutting edge GIS software. • Data translation, positioning, 3D, SIM, drone imaging / processing – anything mapping.	• Tax incentives from Maine. • Getting the University of Maine system to use Blue Marble software in R&D and teaching.

Response	Organization Category	Opportunities	Challenges
		• Team of software developers working on cloud, 3D, ML + PL technology.	• Hiring both tech & non-tech graduates in Maine.
10	***Commercial***	• Experiences & lessons learned of running an R&D heavy start-up in Maine. • Creating & growing an e-commerce / distribution business to multiple warehouses.	• Connecting with other CEOs of R&D heavy companies to understand how to raise capital & investments and successfully commercialize their product or service while being based in Maine.
11	***Commercial***	• Connections to Maine industry and economic development efforts.	• Time in the day. • Focus on true, effective, long-term improvement. • Moving the dial for Maine App.
12	***Commercial***	• Perspective and feedback. • Applied sciences & practical knowledge. • Intersectional engineering. • Commercialization of bleeding-edge tech. • Systems of systems.	• Learning as fast as possible. • Funding and using available resources. • Building relationships with partners.
13	***Commercial***	• Connect people with technical resources / solutions. • Streamline business issues with technology. • Supply chain & renewable energy.	• Looking for engineers in cybersecurity. • Connecting with technology leaders.
14	***Commercial***	• Problem solving for industrial applications / challenges (electronic / mechanical / process).	• Hiring / raising awareness of circularity of pulp & paper.
15	***Commercial***	• Access to high quality leaders in a confidential environment.	• Inexpensive research resources for mid-sized Maine companies. • Workforce development.
16	***Commercial***	• A platform to engage the bright young minds of Maine's youth in STEM through software development.	• Reaching rural communities: introducing STEM to rural middle & high school students. • Raising awareness.

Response	Organization Category	Opportunities	Challenges
17	***Commercial***	• Equity funding for high growth, Maine-based companies.	• Understand the best models for successful R&D commercialization.
18	***Commercial***	• Connection to semiconductor industry in Maine and beyond.	• Hiring engineers and keeping them in Maine.
19	***Nonprofit***	• Connection to large commercial landowners in region & continent. • Connection to 600 dairy farmers at different levels of innovation across New England. • Organization that can distill science into practical actions. • Deep knowledge of forest ecosystems.	• Rapidly moving science into achievable practices. • Keeping abreast of changes in the forest ecosystems and sector.
20	***Nonprofit***	• Boots on the ground understanding of Maine forests & communities. • Facilitation, collaboration. • Forestry community connections. • National network. • Project leadership putting science into practice.	• Funding for projects. • Support for ecological forestry – socially and economically responsible.
21	***Nonprofit***	• Direct federal funding into Maine. • CHIPS Act – 20% of National Science Foundation budget to EPSCoR programs by 2027.	• $20 million grant has limits. • Rural school STEM barriers. • Need to be razor focused.
22	***Nonprofit***	• Entrepreneurship. • Travel & tourism. • Business strategy. • Connections within hospitality sectors. • Economic development.	• Making connections to relevant parties. • Connecting AI and tourism. • Innovations in tech and travel.