



NOAA
WEATHER
PROGRAM OFFICE

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Developing Guidelines for Defining, Measuring, and Fostering Innovations in Earth Prediction Systems at NOAA's Weather Program Office

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About me

- Senior at University of Delaware
- Meteorology and Climate Science major
- Interests in forecasting, severe weather, and weather communications
- William M. Lapenta Intern 2023
 - Weather Program Office (WPO), NOAA Research (OAR)



Innovation changes the standards of science

- The UFS provides an innovative framework that inspires innovations.
- **What is innovation? How can we measure it? How can we foster it?**
- In a world where people are becoming more vulnerable to extreme weather, innovating forecasts are more important now than ever.
- High risk, high reward ideas welcome!



Objectives for my research

- **Develop guidelines for WPO to:**
 - Understand the meaning of innovation
 - Measure innovation in funding opportunities and within WPO
 - Foster innovation
- **Intended outcomes:**
 - Attract and fund innovative proposals in future NOFOs
 - Innovations Learning Agenda

Methods

- Conducted a structured interview process with 20 interviewees from WPO and throughout the weather enterprise.

Primary Customers (8)

Weather Program Office

- Leadership (2)
- Program Managers (6)

Primary Stakeholders (3)

- NWS/ STI
- CPO
- UFS Steering Committee

External Community (9)

- Academic and Research (6)
- Private (3)



Defining Innovation

- **There are many different definitions of innovation.** People can interpret it in different ways depending on their goals and apply innovation depending on their specific work.
- There are two common types of innovation:
 - **Incremental innovation**
 - **Radical innovation**
- WPO leads initiatives across the entire innovation spectrum
 - EPIC is a WPO program created to use open-development to accelerate the innovations-to-operations process.
 - WPO's FY2023 Innovations for Community Modeling Competition pushed for more **high-risk, high-reward ideas.**
- Where on the scale from incremental to radical does innovation belong?

What Does Innovation Mean?

Main Similarities:

- Innovation is a **new idea** that **provides value** to an existing problem.
- Innovation **opportunities in all steps** and readiness levels of the R2O2R process
- WPO's impact of innovations:
 - To improve earth prediction systems
 - To create better methods to inform the public about weather
 - To better understand the outputs of the forecasts
- **Innovation and risk** go hand and hand

Main Differences:

- In WPO, should innovative proposals be a **brand new, disruptive change or a smaller, incremental change?**
- Program managers each view innovation in their work differently
- **Innovation value changes between different sectors** in the Weather Enterprise

Unique Perspectives in the Weather Enterprise

Government

- Resists innovation
- Why? Their mission requires employees to focus on other priorities and they don't have enough resources to try something new.
- Leads to a risk averse culture

Academia

- Research is always a new idea and on the innovation spectrum
- Professors train the next generation of scientists
- Innovative research can spark more questions for researchers

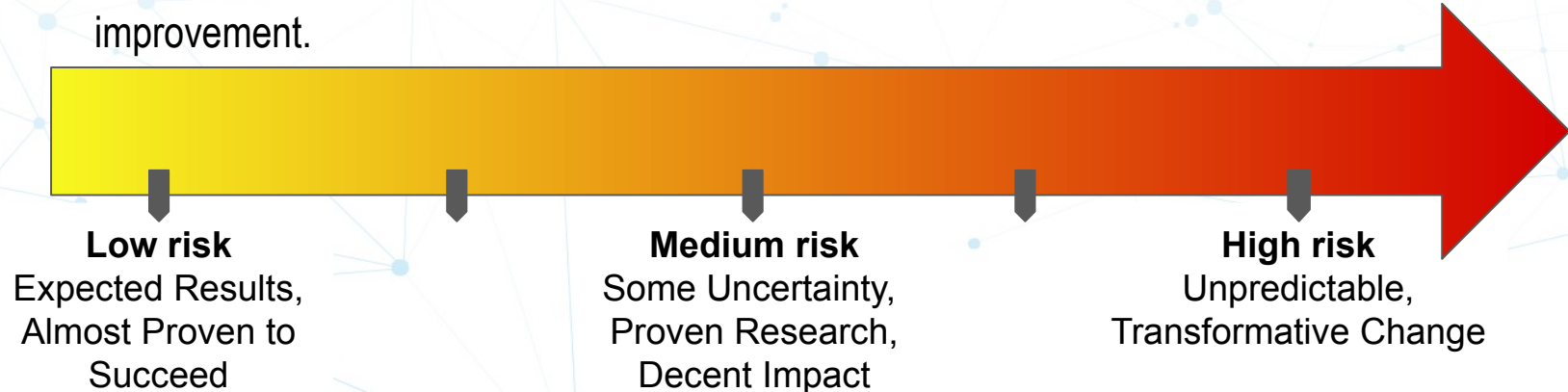
Private Sector

- Innovations are all the lifeblood of industry.
- Teams are usually smaller and more agile
- “When you're trying new things, you're gonna fail. If you're not failing, you're not learning. If you're not afraid, you're not thinking big enough.” (Mark Brooks)

Meaning of Innovation in NOAA's Weather Program Office

An innovative research project is one that is:

- A new concept, method, or strategy that provides value towards improving earth prediction systems.
- Important for both the WPO's priorities and its end users.
- Not limited to one certain readiness level.
- WPO recognizes the need for high-risk, high-reward. WPO is the place for trial and error. It can be incremental and taken in steps, but the end goal should be more than just an improvement.



Measuring Innovation

- **Ways to visualize metrics:**
 - **A control panel**
 - **A dashboard**
 - **An innovation balanced scorecard.**

- **Categories of metrics:**
 - **Input metrics**
 - **Process metrics**
 - **Output metrics**
 - **Outcome metrics**

Designing Priority Metrics for WPO

Organizational metrics to encourage innovation:

- Progress report metrics for awardees
- Finance measurements
- Diversity of awardees
- Ideas generated
- Ideas transitioned

Innovation metrics for NOFO's, reviewing and selecting awards:

- Mission value
- Time to transition
- User benefit
- Cost Benefit
- Risk metrics

Fostering Innovation in WPO and in NOAA

What are some things that WPO can implement or change to better foster innovation in NOFOs and within the community?

INCREASE INCLUSIVITY, DIVERSITY, AND COLLABORATION

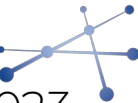
Change review criteria, conquer groupthink, and collaborate more with people from different backgrounds

CONQUER RISK AVERSION

Disregard the stereotype that every selection needs to be a 'success'. Embrace failure. Learn from the outcome, whatever it may be.

ENCOURAGE INNOVATION

Tap into the creativity of employees and researchers alike and fix the mindset block for why people are not as innovative as they hope to be.



FOSTERING INNOVATION IN WPO AND IN NOAA: Inclusivity, Diversity, and Collaboration

Inclusivity in review criteria

- Help applicants with paperwork process
- Write proposals clearly and without constraints
- Is the deadline fair for all?
- Randomized selection that meet criteria to remove bias

Diversity in reviewers

- Broad reviewer group
- Avoid groupthink: private scoring and then collaborate for scores.
- Overcome cognitive distance

Collaboration with decision-makers

- Monthly leadership meetings
- Does being remote diminish innovation?

FOSTERING INNOVATION IN WPO AND IN NOAA:

Conquering Risk Aversion

Cultural change: Expect employees to innovate and embrace failure as a necessary step

- Innate fear of failure because we don't want to disappoint those who fund our work.
- There's value in what you learn
 - Keeps people from trying that method or idea again
 - Teaches people what doesn't work to discover what will.

- Encourage risk and accept failure as opportunities for nurturing innovation
- Develop a de-brief culture
- Take a leap of faith and fund lower RLs. No matter what stage it's at, it will always be a learning process.



FOSTERING INNOVATION IN WPO AND IN NOAA:

Ways to Encourage and Accelerate Innovation

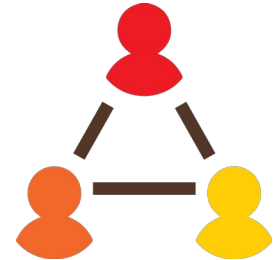
Priorities:

- Continue the efforts to create an open source and science environment.
 - Build a public-private-academic partnership



Things to Consider:

- Common testbed?
- Competitive funding vs. prizes?



FOSTERING INNOVATION IN WPO AND IN NOAA:

Ways to Encourage and Accelerate Innovation

Majority of respondents think they still have a long way to go to being innovative.

How to fix this mindset block:

- Encourage employees to follow the 80/20 rule.
- Interdisciplinary individuals & experts & many generations working together
- Inspiration for an innovative mindset:
 - Think about why the default exists in the first place
 - The more you value achievement, the more you dread failure.
 - “You have to be comfortable with the uncomfortable” -Bill Lapenta



Discussion and Future Research

How to select reviewers and incentivize people from different backgrounds to care about our NOFOs?

How to assist those who have never applied for WPO's NOFOs?

What is the best way to keep track of trends from the innovation metrics?
A survey assessment every year looking at all the variables?

How to make people comfortable with failing and ensure them they will not be reprimanded?

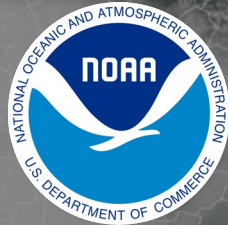
How to get the public sector, private sector, and academia to work with each other and use the benefits that each industry has towards a common goal?

CONCLUSION

Takeaways from my research:

- Innovation is a new idea that provides value towards improving earth prediction systems, and can be anywhere from low-risk to high risk.
- For WPO, it is important to have innovation metrics to fund innovative proposals and to measure how well WPO is doing at 'being innovative'.
- Important Innovation initiatives:
 - More Collaboration among leadership
 - Broader reviewer group to remove bias
 - Develop a de-brief culture
 - Build a public-private-academic partnership

THANK YOU



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Questions & Suggestions