

Accuracy, Precision, and Storytelling: Writing Imperatives for Engineers

Dr. Kristina Quynn, Director CSU Writes, Assistant Dean Graduate School

SYSTEMS ENGINEERING FRIDAY TALK



CSU WRITES
COLORADO STATE UNIVERSITY



Colorado State University

Our time together

- Writing Community Guide
- Engineering Stories
- Storytelling Structures
- Accuracy and Precision
- Writing with Readers in Mind (via Star Trek)
- Conversation

CSU Writing Community

Be present, honest, authentic

Listen actively and with respect

Be open to and considerate of other perspectives

(race, ethnicity, nationality, sexuality, gender, age, discipline, appointment, rank)

Share speaking time (avoid dominating)

Encourage others as participants

If uncertain, ask clarifying questions

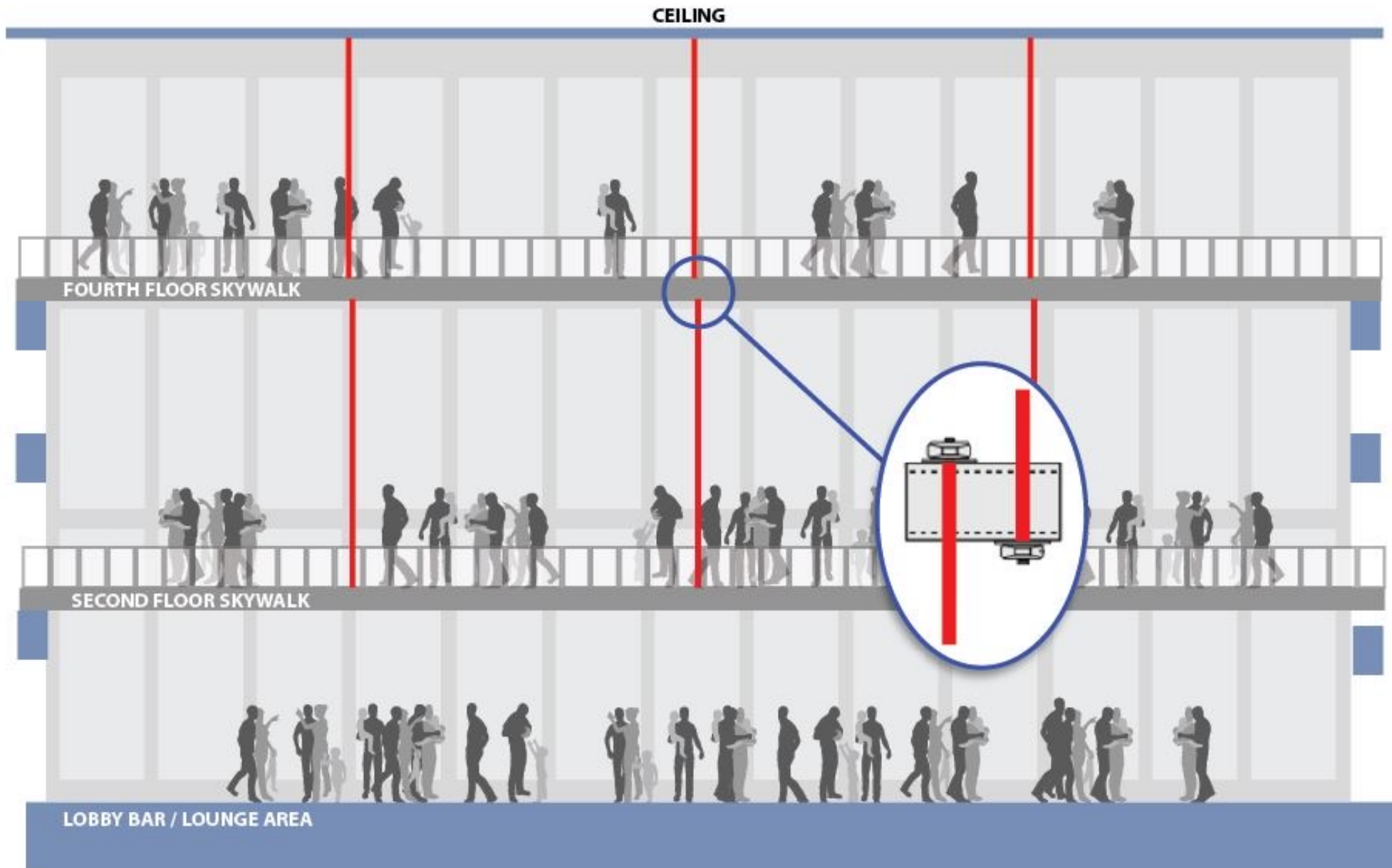
If challenged, respond with grace

After our time together, share only what is yours to share

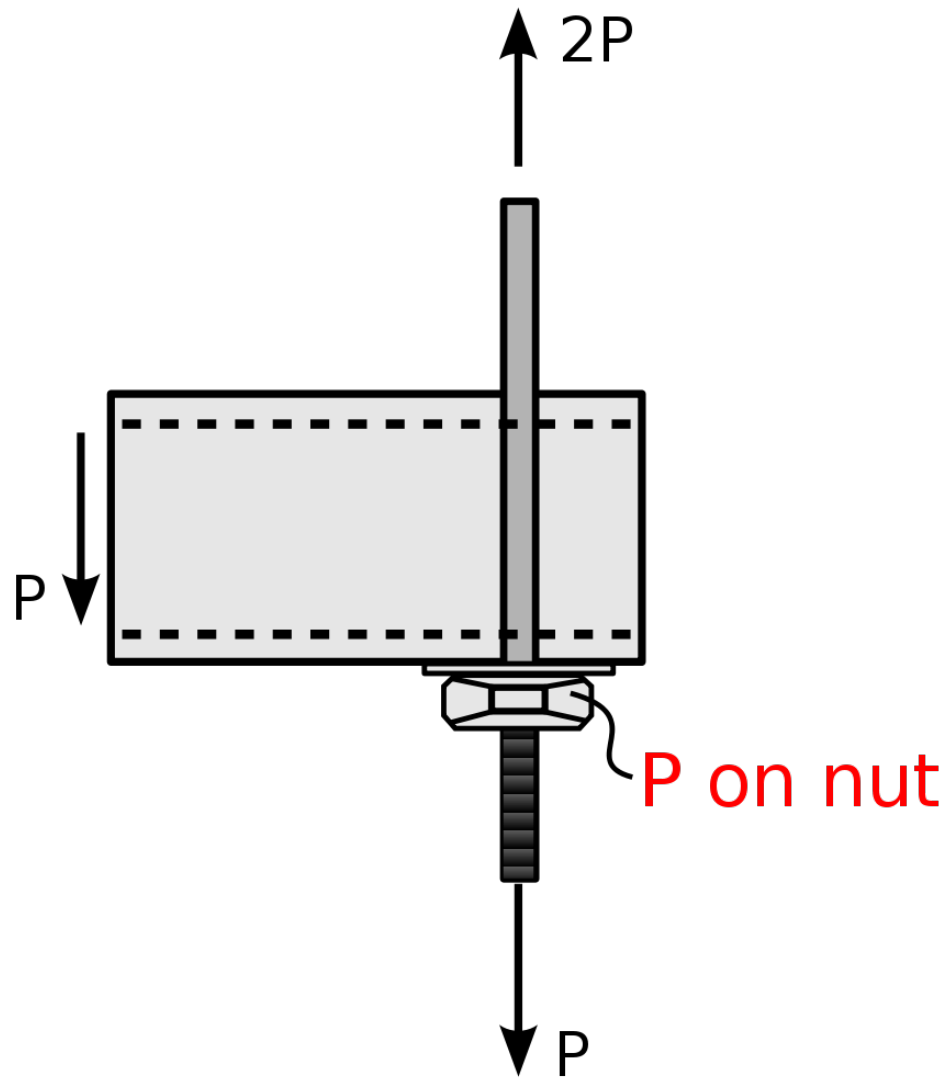




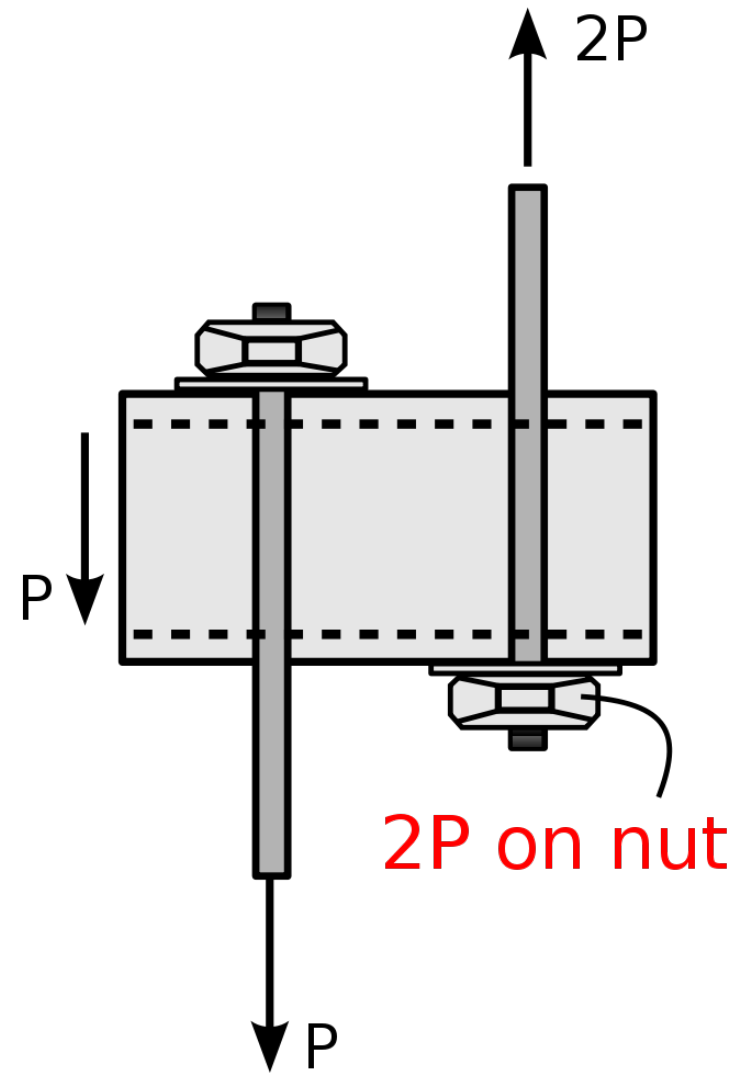
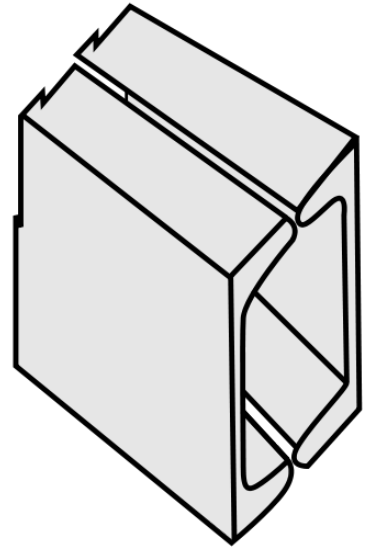
Bettmann Archive/Getty Images



<https://www.engineeringclicks.com/hyatt-regency-walkway-collapse/>



(a) Original design

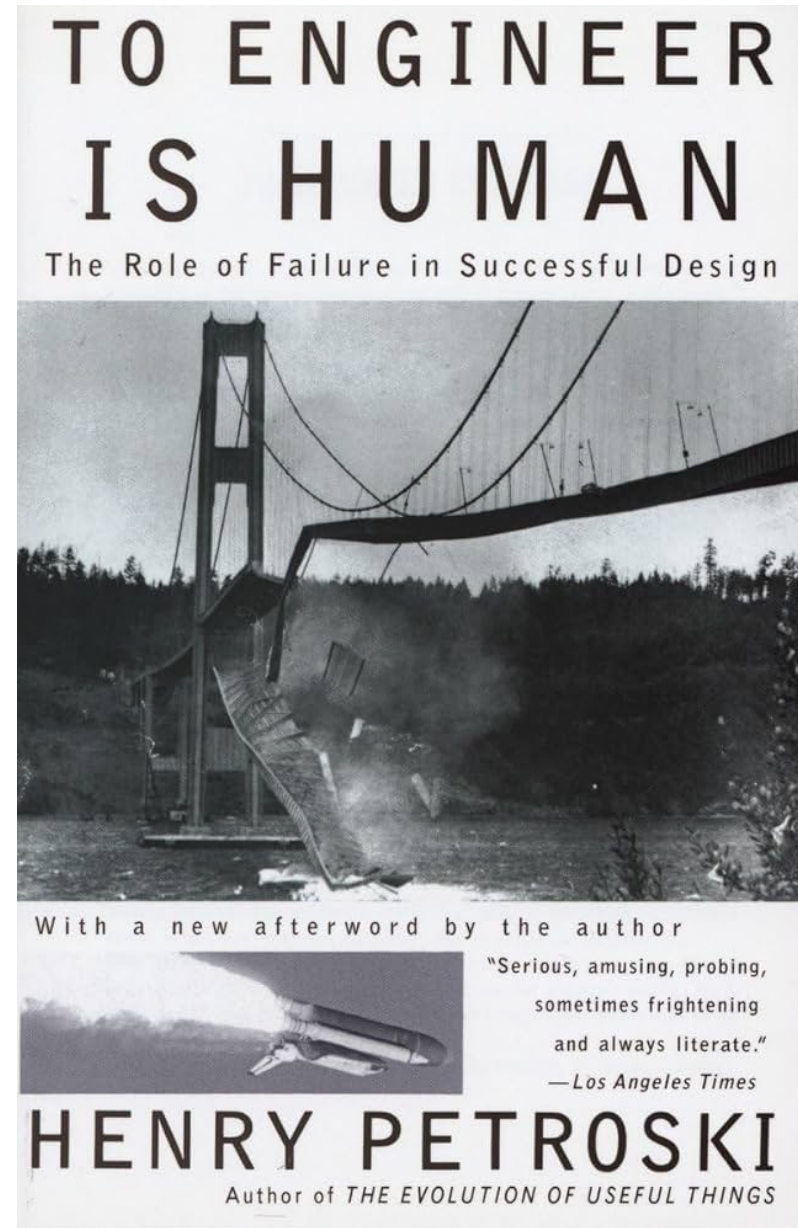


(b) Actual construction

<https://www.aroraengineers.com/the-accountable-engineer/>

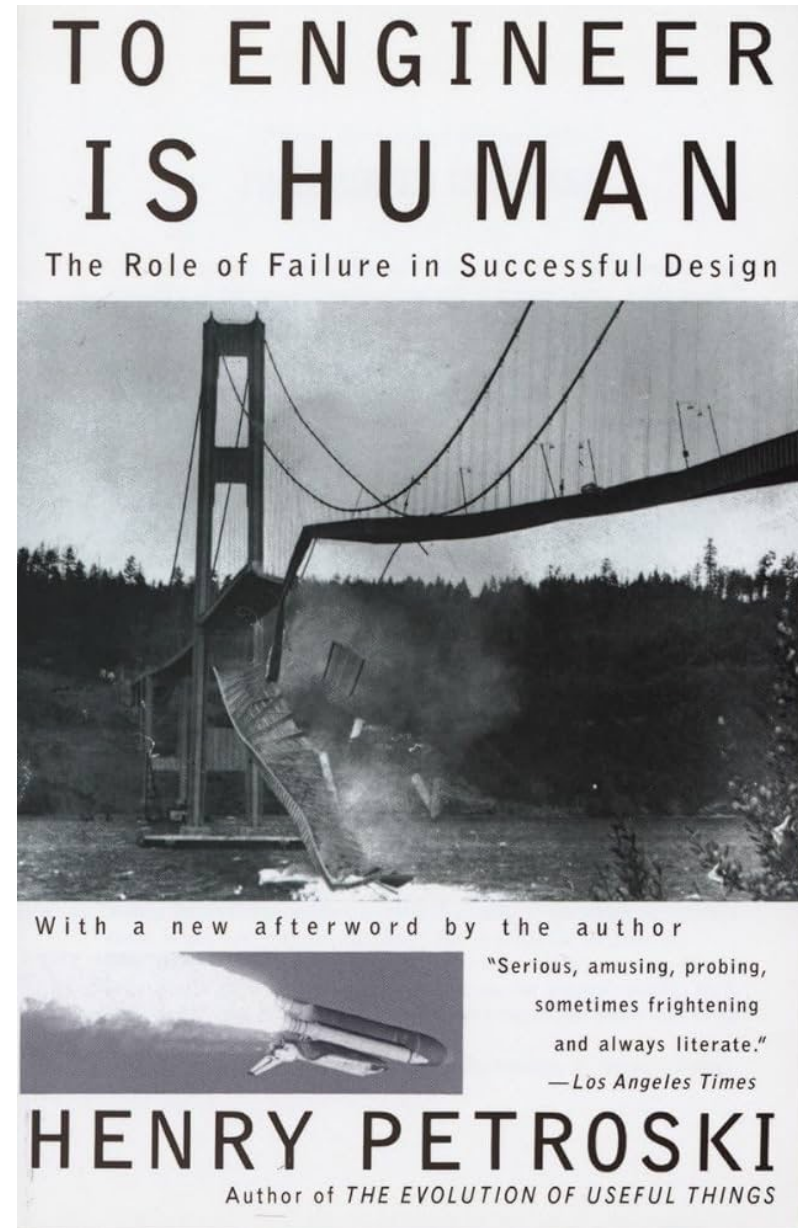
The idea of design—of making something that has not existed before—is central to engineering, and I take design and engineering to be virtually synonymous for the purposes of my development....

I believe that the concept of failure—mechanical and structural failure in the context of this discussion—is central to understanding engineering, for engineering design has its first and foremost objective the obviation of failure. Thus the colossal disasters that do occur are ultimately failures of design, but the lessons learned from those disasters can do more to advance engineering knowledge than all the successful machine and structures in the world. (vii-viii)



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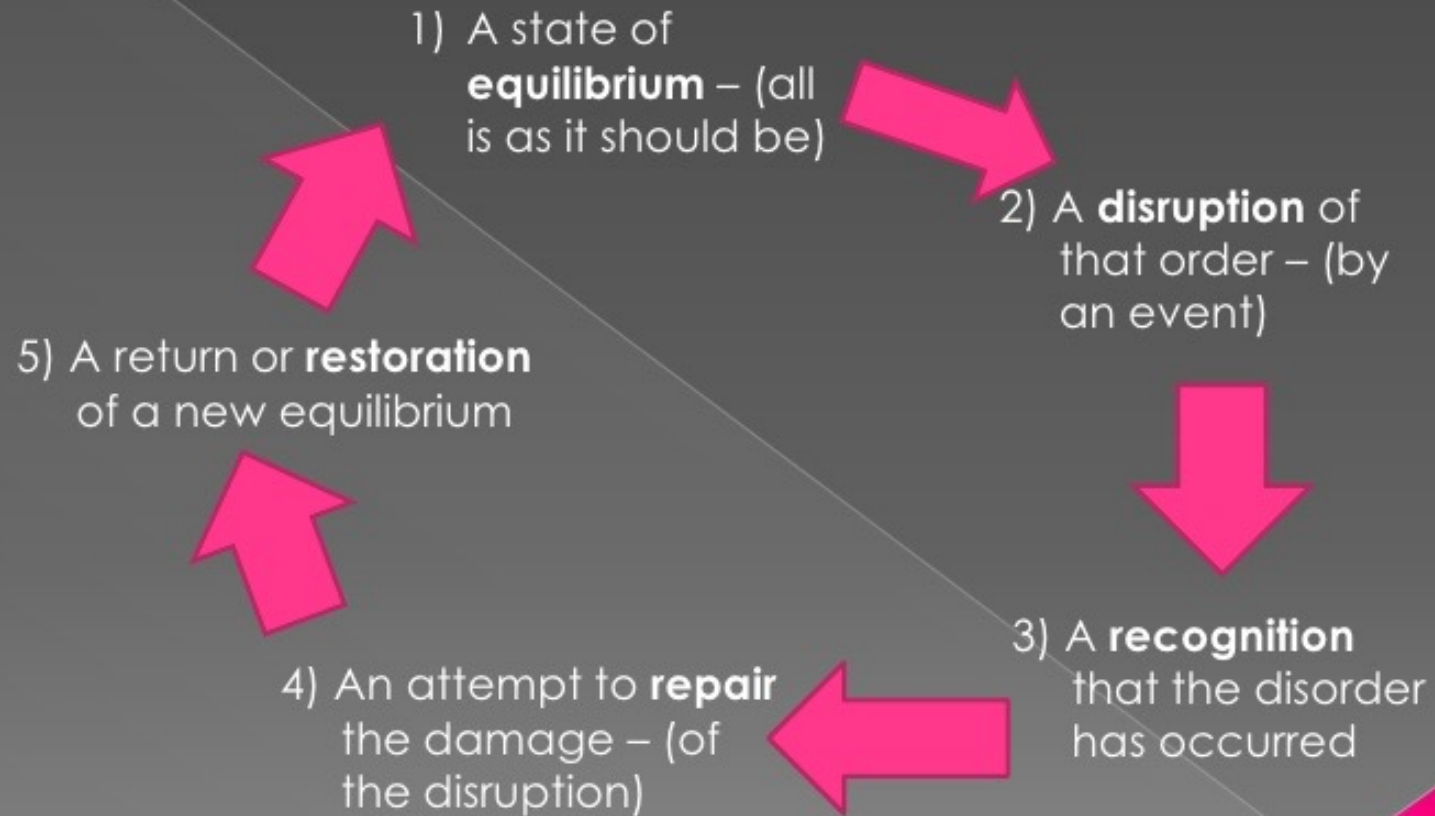
substitution

- **publishing** for design
- **writing** for engineering
- **accurate and precise communication among experts** for obviating failure

The idea of **publishing**—of making something that has not existed before—is central to **writing**, and I take **publishing and writing** to be virtually synonymous for the purposes of my development....

I believe that the concept of failure—mechanical and structural failure in the context of this discussion—is central to understanding **writing**, for **writing for publication** has its first and foremost objective **the obviation of failure**. Thus the colossal disasters that do occur are ultimately failures of **publishing**, but the lessons learned from those disasters can do more to advance **writing** knowledge than all the successful machine and structures in the world. (vii-viii)

Todorov's Narrative Theory



Todorov argues that narrative involves a transformation. The characters or the situations are transformed through the progress of the disruption.

4 Core Story Structures


| OCAR | ABCDE | LD | LDR |
|---------------------------|------------------|-----------------------------------|--------------------------------|
| Opening | Action | Lead | Lead |
| Challenge | Background | Development | Development |
| Action | Development | | Resolution |
| Resolution | Climax | | |
| | Ending | | |
| specialty journals | proposals | generalist news, abstracts | generalist publications |

JOSHUA SCHIMEL

WRITING SCIENCE

How to write papers that get cited
and proposals that get funded

A team-centric metric framework for testing and evaluation of human-machine teams

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Abstract

We propose and present a parallelized metric framework for evaluating human-machine teams that draws upon current knowledge of human-systems interfacing and integration but is rooted in team-centric concepts. Humans and machines working together as a team involves interactions that will only increase in complexity as machines become more intelligent, capable teammates. Assessing such teams will require explicit focus on not just the human-machine interfacing but the full spectrum of interactions between and among agents. As opposed to focusing on isolated qualities, capabilities, and performance contributions of individual team members, the proposed framework emphasizes the collective team as the fundamental unit of analysis and the interactions of the team as the key evaluation targets, with individual human and machine metrics still vital but secondary. With teammate interaction as the organizing diagnostic concept, the resulting framework arrives at a parallel assessment of the humans and machines, analyzing their individual capabilities less with respect to purely human or machine qualities and more through the prism of contributions to the team as a whole. This treatment reflects the increased machine capabilities and will allow for continued relevance as machines develop to exercise more authority and responsibility. This framework allows for identification of features specific to human-machine teaming that influence team performance and efficiency, and it provides a basis for operationalizing in specific scenarios. Potential applications of this research include test and evaluation of complex systems that rely on human-system interaction, including—though not limited to—autonomous vehicles, command and control systems, and pilot control systems.

KEYWORDS

agent, artificial intelligence, human-machine team, human-system interaction, metric

1 | INTRODUCTION AND APPROACH

Increasingly capable human-machine teams (HMTs) will be a significant future component of industry, defense, medicine, and many other areas.¹⁻⁷ Increases in autonomous and learning capabilities in modern machines are driving the heightened importance of understanding and

measuring HMT performance to ensure effective and safe collaboration with humans. These increased capabilities arise in the cognitive and physical realms alike, and the technologies employed by HMTs are advancing at a much more rapid pace than corresponding test and evaluation (T&E) concepts. This is particularly true of operational testing and evaluation (OT&E, or just OT) concepts, a situation which poses

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OCAR Story Structure

Wilkins, et al.

“A Team-Centric Framework...”

OPENING: Who are the characters? Whom is the story about? Where does it take place? What do your readers need to understand about the situation to follow the story? What is the larger problem your story will address?

O: Human and machine team interactions; interactions that will only increase in complexity as machines become more intelligent, capable teammates; Framework for assessing.

CHALLENGE: What do your characters need to accomplish? What specific question do you propose to answer?

C: Collective team as the fundamental unit of analysis (individual metrics secondary)

ACTION: What happens to address the challenge? In a paper, this describes the work you did; in a proposal, it describes the work you hope to do.

A: Must develop a framework with teammate interaction as the organizing diagnostic concept

RESOLUTION: How have the characters and their world changed as a result of the action? This is your conclusion—what did you learn from your work?

R: This framework allows for identification of features specific to human machine teaming that influence team performance and efficiency, and it provides a basis for operationalizing in specific scenarios.

“The Science of Science Writing”

George Gopen and Judith Swan remind us that o tell a good story:

Write with the reader in mind.

Remember that readers do not simply read; they interpret.

Information is interpreted more easily and more uniformly if it is placed where most readers expect to find it.

(Gopen & Swan’s advice works when crafting sentences, figure/tables, or complete works in any given genre.)

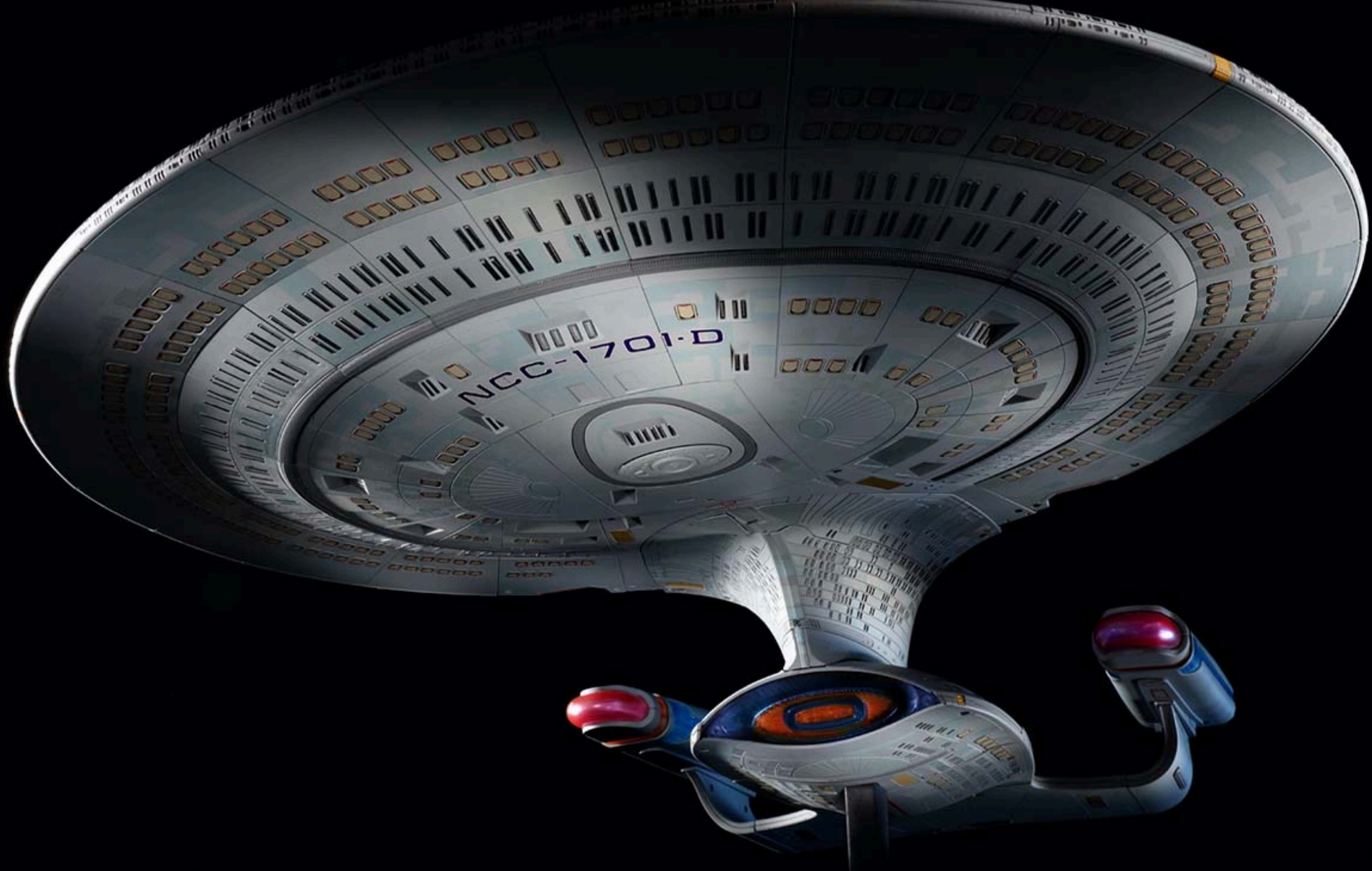
t (time)=15', T (temperature)=32°; $t=0'$, $T=25°$; $t=6'$, $T=29°$; $t=3'$, $T=27°$; $t=12'$, $T=32°$; $t=9'$, $T=31°$

| time (min) | temperature (°C) |
|------------|------------------|
| 0 | 25 |
| 3 | 27 |
| 6 | 29 |
| 9 | 31 |
| 12 | 32 |
| 15 | 32 |

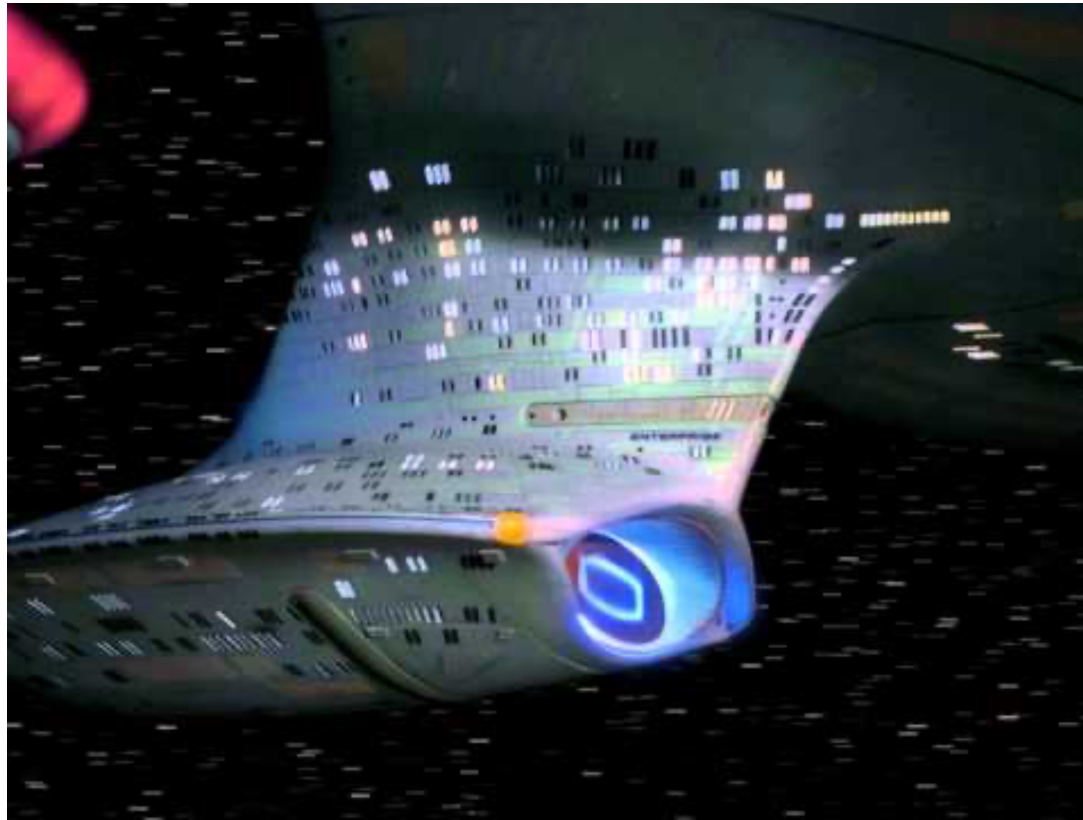
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|------------------|------------|
| 25 | 0 |
| 27 | 3 |
| 29 | 6 |
| 31 | 9 |
| 32 | 12 |
| 32 | 15 |

Since we read left to right, we prefer the context on the left, where it can more effectively familiarize the reader.

We prefer new, important information on the right, since it's the job to intrigue the reader.



To seek out new life and new civilizations. These are the voyages of the starship Enterprise. Its continuing mission: to explore strange new worlds. To boldly go where no one has gone before! Space: the final frontier



Space: the final frontier. These are the voyages of the starship Enterprise. Its continuing mission: to explore strange new worlds, to seek out new life and new civilizations, to boldly go where no one has gone before!

OCAR Story Structure

Star Trek Introduction (1987 version)

OPENING CONTEXT

Space: the final frontier.

CHALLENGE

These are the voyages of the starship Enterprise.

ACTION

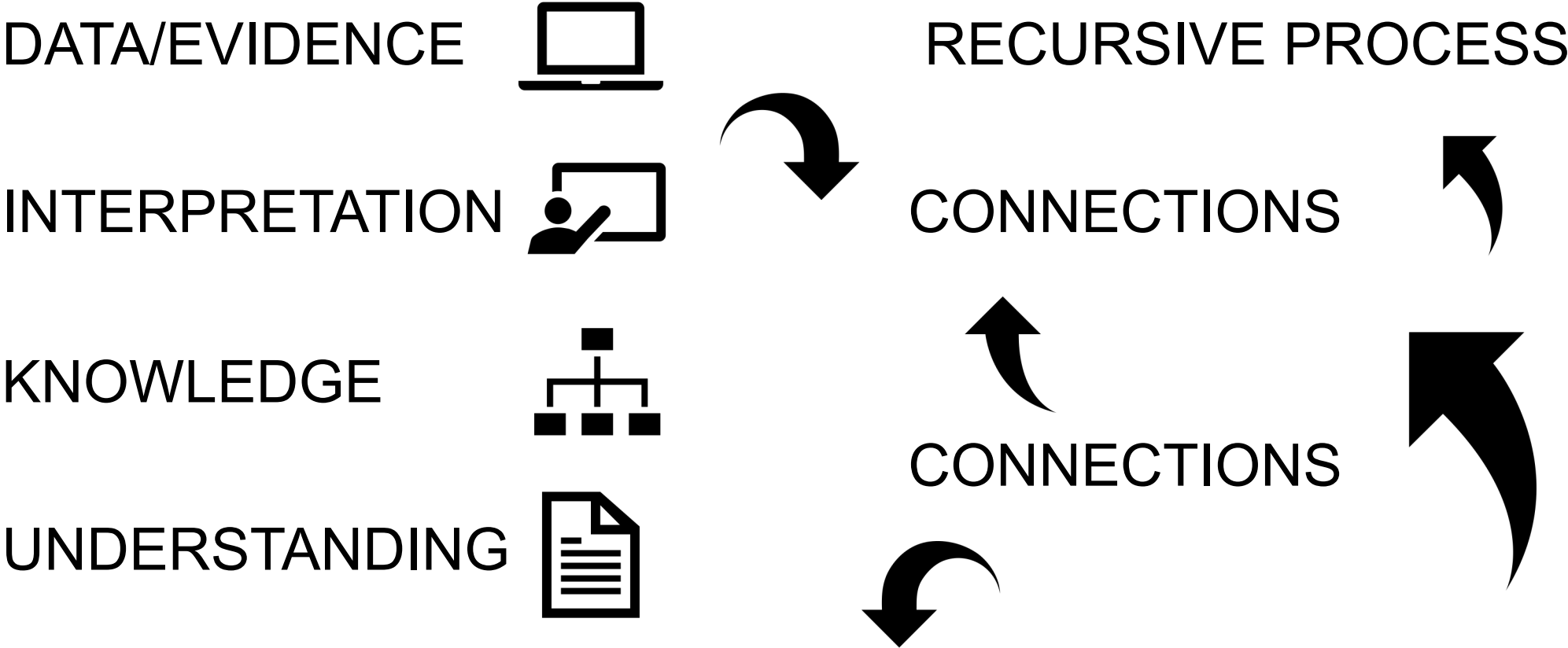
**Its continuing mission: to explore strange new worlds.
To seek out new life and new civilizations. To boldly
go where no one has gone before**

RESOLUTION

!

The continuation of expansionist policies off-earth occur in **space**, which has been coined in the literature as "**the final frontier**." What this project will show is that **these are the voyages** through which the off-earth territories will be explored and that these voyages will be situated almost entirely within the confines **of the starship** the Federation team has decided to call the **Enterprise**. The mission of the starship is **its continuing mission** and it demonstrates the complex underlying methodological approaches that inform the Enterprise's travels **to explore strange new worlds**. Additionally, the methodology includes another mission component, which is **to seek out new life and new civilizations**. This component is finalized with the specific mission aim **to boldly go where no one has gone before**, which will lead to novel findings and contribute much to the field.

Writing Process is not Story Structure



Precision through revision

While these studies suggest that plants should take up amino acids and possibly other forms of organic nitrogen in the field, they do not provide conclusive evidence of this.

While these studies suggest that plants ~~should take up~~ amino acids and possibly other forms of *use* organic nitrogen in the field, they *are not* ~~do not provide~~ conclusive ~~evidence of this~~.



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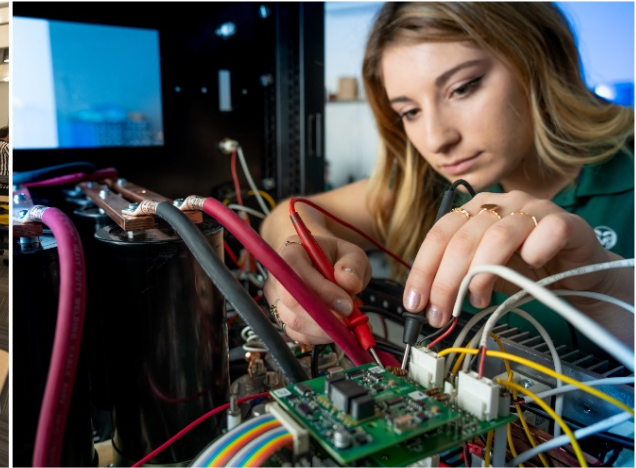
Series Short Courses Special Events

- GRANT WRITES
- How to Take Smart Notes (April)
- International Writes
- DATA: Dissertation & Thesis Accountability

Coming
Soon

Department of Systems Engineering

Our students and faculty implement systems-thinking to solve the world's most complex problems, ranging from aerospace systems to cybersecurity implementation.



Conversation



CSU WRITES
COLORADO STATE UNIVERSITY

Thank you



Colorado State University

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