

Exploring the Unintended Consequences of Automation in Software



Courtney Nash
The VOID

SRECon EMEA
Oct 29, 2024





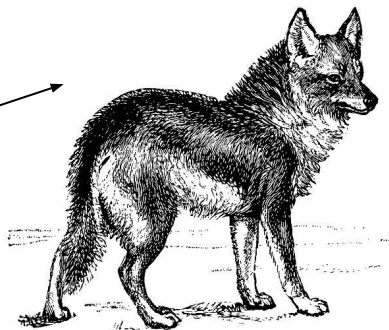
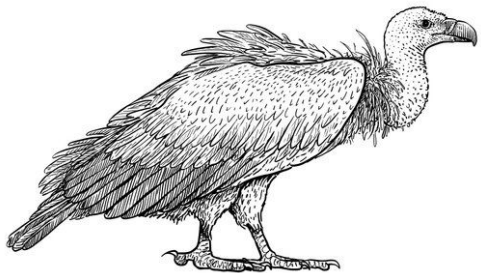




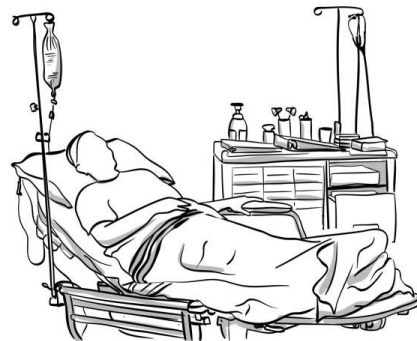
An estimated 500,000 people in India died over the course of 5 years due to the sudden loss of their vulture population.

Other predator populations increase

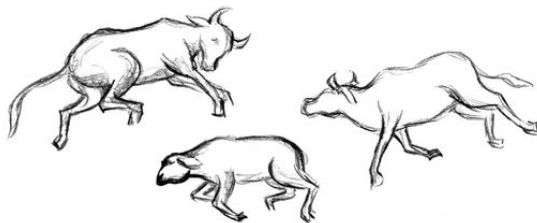
Vultures disappear



*Disease rates
(e.g. rabies) increase*

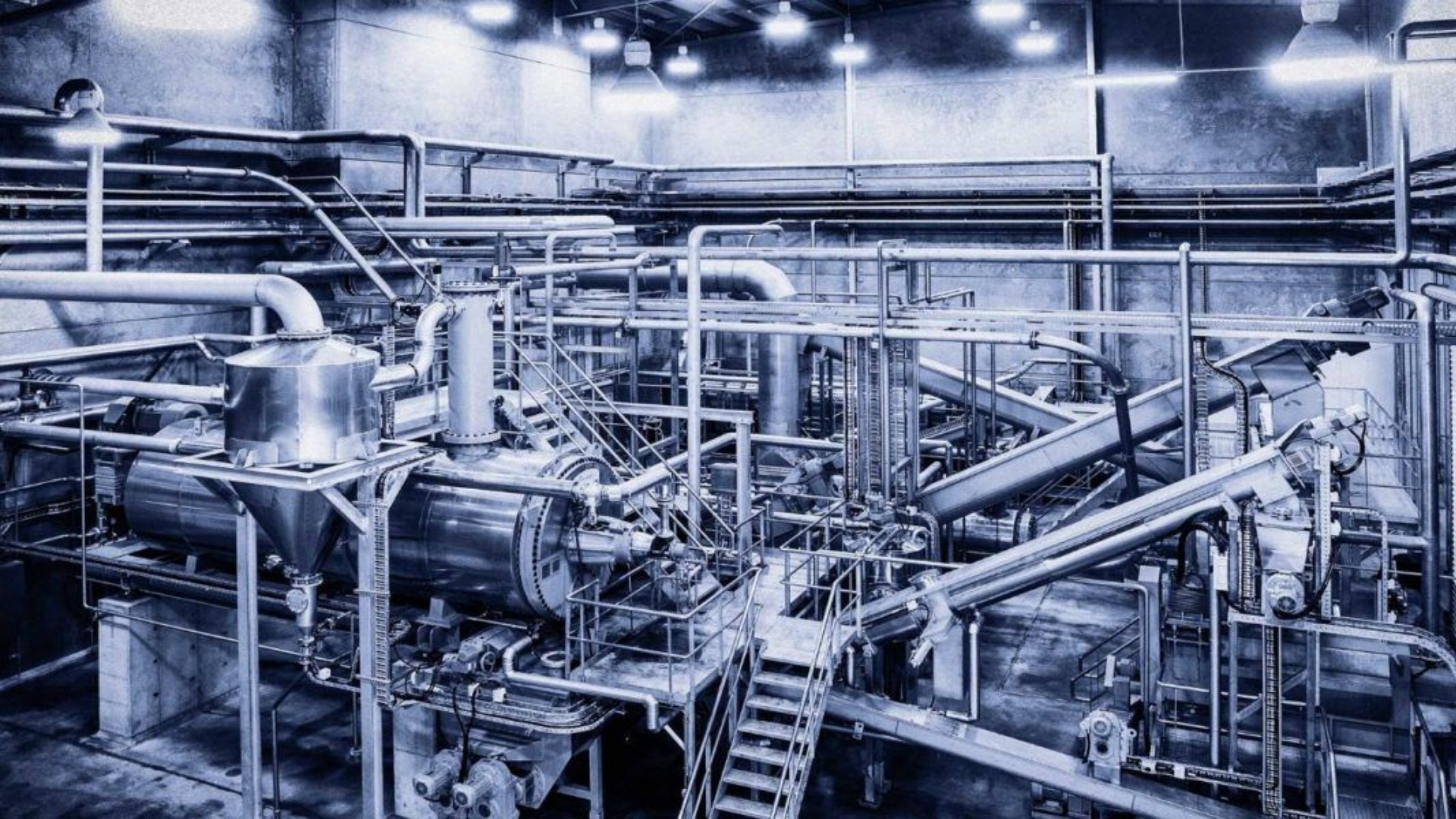


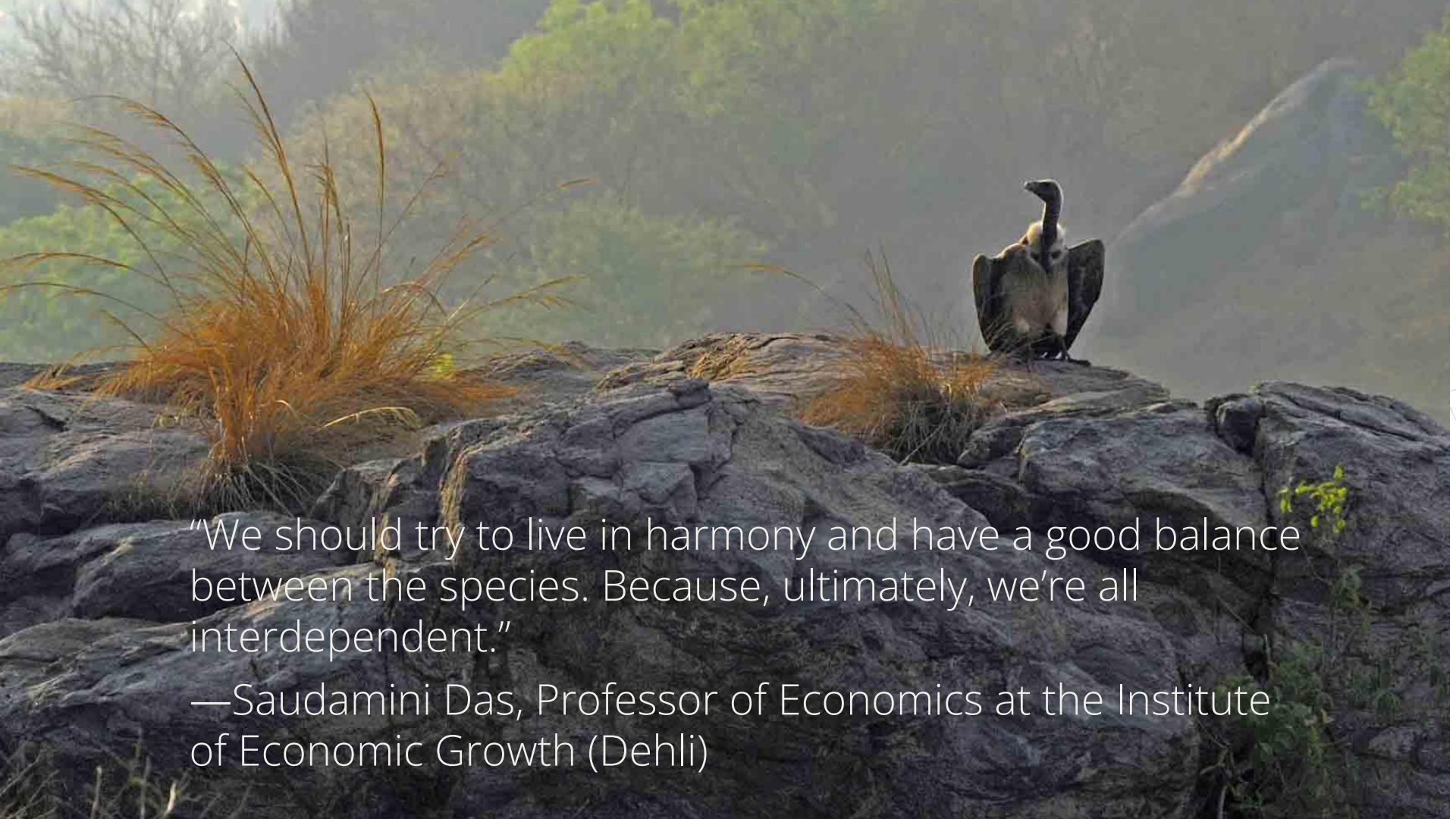
Increased
human
disease &
death



Livestock carcasses build up

Water quality decreases





“We should try to live in harmony and have a good balance between the species. Because, ultimately, we’re all interdependent.”

—Saudamini Das, Professor of Economics at the Institute of Economic Growth (Dehli)

Courtney Nash

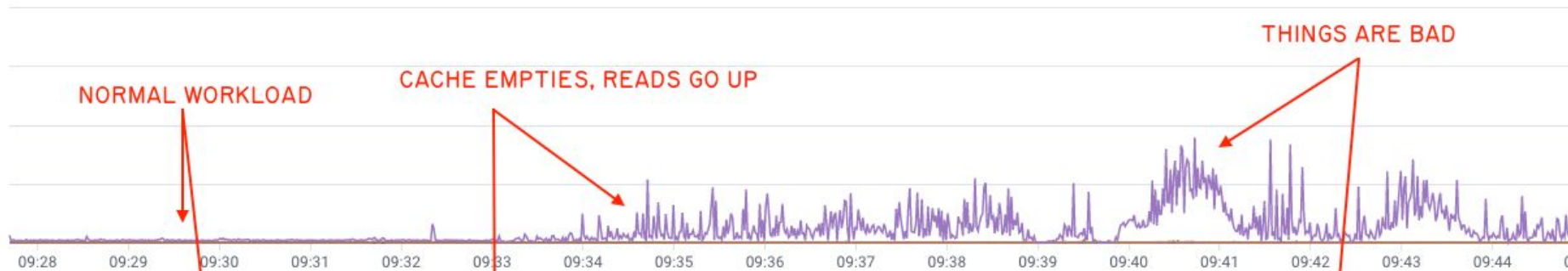
Head of The VOID



About The VOID

<https://www.thevoid.community>

COUNT

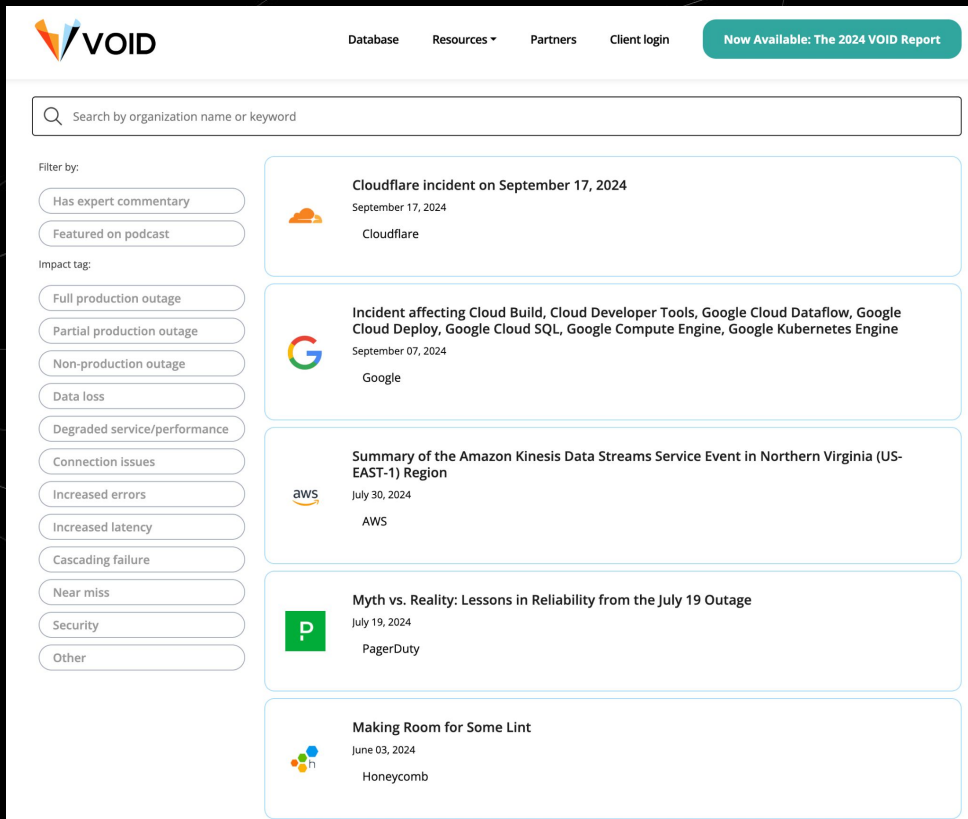


CONCURRENCY



What's In The VOID?

<https://www.thevoid.community>



The screenshot shows the VOID website interface. At the top, there is a navigation bar with links for Database, Resources, Partners, and Client login, along with a button for 'Now Available: The 2024 VOID Report'. Below the navigation is a search bar with the placeholder text 'Search by organization name or keyword'. To the left of the main content area is a 'Filter by' section with buttons for 'Has expert commentary', 'Featured on podcast', and 'Impact tag'. The 'Impact tag' section includes buttons for 'Full production outage', 'Partial production outage', 'Non-production outage', 'Data loss', 'Degraded service/performance', 'Connection issues', 'Increased errors', 'Increased latency', 'Cascading failure', 'Near miss', 'Security', and 'Other'. The main content area displays a list of incident reports, each with a company logo, title, date, and organization name.

Database Resources Partners Client login **Now Available: The 2024 VOID Report**

Search by organization name or keyword

Filter by:

- Has expert commentary
- Featured on podcast
- Impact tag:
 - Full production outage
 - Partial production outage
 - Non-production outage
 - Data loss
 - Degraded service/performance
 - Connection issues
 - Increased errors
 - Increased latency
 - Cascading failure
 - Near miss
 - Security
 - Other

Cloudflare incident on September 17, 2024
September 17, 2024
Cloudflare

Incident affecting Cloud Build, Cloud Developer Tools, Google Cloud Dataflow, Google Cloud Deploy, Google Cloud SQL, Google Compute Engine, Google Kubernetes Engine
September 07, 2024
Google

Summary of the Amazon Kinesis Data Streams Service Event in Northern Virginia (US-EAST-1) Region
July 30, 2024
AWS

Myth vs. Reality: Lessons in Reliability from the July 19 Outage
July 19, 2024
PagerDuty

Making Room for Some Lint
June 03, 2024
Honeycomb

VOID Incident Report



Making Room for Some Lint

On June 3rd, we experienced 20 minutes of outage in the US region in querying and a small increase in ingest failures. During this time customers were unable to query their data and alerting was delayed, but less than 0.1% of data sent to us was dropped.

Honeycomb

June 03, 2024

Duration (in hours and minutes): 0:20

Technologies involved:

SQL Database

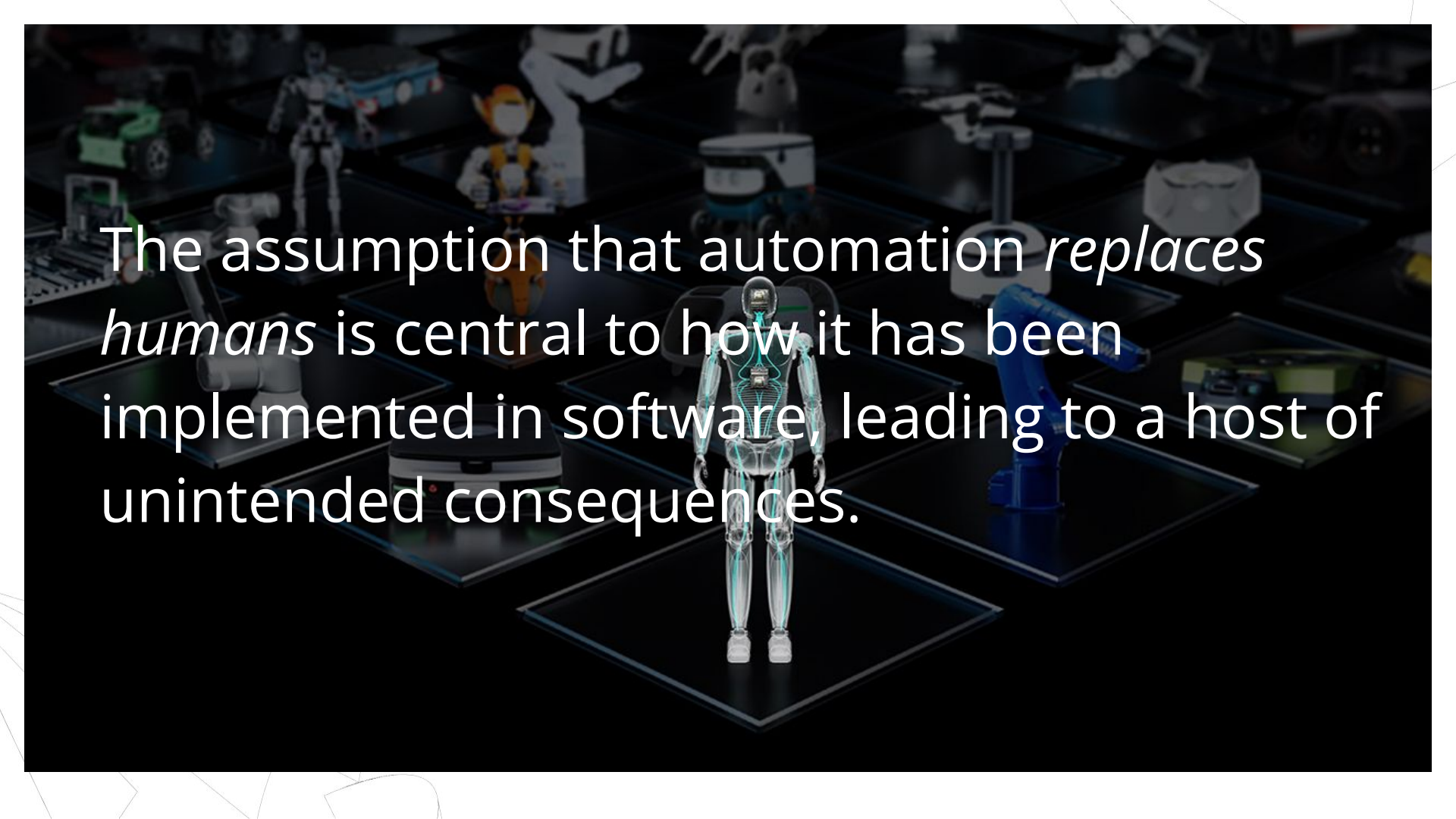
Report format:

Company post

[Read the full report](#)

The background is a solid orange color with several thin, white, curved lines that create a sense of movement and depth. These lines are scattered across the frame, some intersecting to form various shapes. A solid black horizontal bar is positioned in the center, containing the title text in white.

The Unexpected Consequences of Automation in Software

A futuristic factory floor with various robots and a central transparent robot. The scene is dimly lit with blue and green highlights. In the center, a transparent, glowing robot stands on a dark square platform. Surrounding it are several other robots: a white robotic arm on the left, a blue robotic arm on the right, a yellow robot in the background, and a white robot in the foreground. The floor is marked with glowing blue lines forming a grid pattern.

The assumption that automation *replaces humans* is central to how it has been implemented in software, leading to a host of unintended consequences.

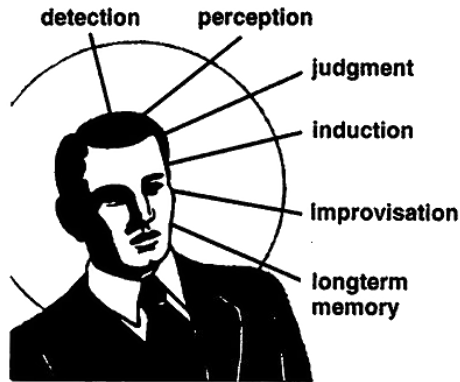
But First: Research From Other Domains



Functional Allocation & The Substitution Myth

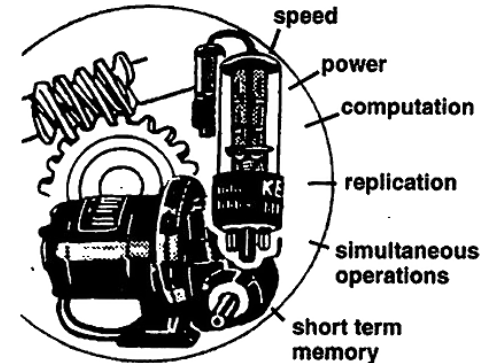
(AKA The Fitts List)

HUMANS SURPASS MACHINES IN THE:



- Ability to detect small amounts of visual or acoustic energy
- Ability to perceive patterns of light or sound
- Ability to improvise and use flexible procedures
- Ability to store very large amounts of information for long periods and to recall relevant facts at the appropriate time
- Ability to reason inductively
- Ability to exercise judgment

MACHINES SURPASS HUMANS IN THE:



- Ability to respond quickly to control signals, and to apply great force smoothly and precisely
- Ability to perform repetitive, routine tasks
- Ability to store information briefly and then to erase it completely
- Ability to reason deductively, including computational ability
- Ability to handle highly complex operations, i.e., to do many different things at once.

The Substitution Myth in Automation

Fixed Strengths and Weaknesses
Separate Tasks



Dekker & Woods, 2002

1. Designers of automation tend to **imagine the desired outcomes of automation** (e.g. lower workload, higher accuracy) and that only those desired outcomes will occur (see also Norman 1990).
2. Automation does not have access to all real-world parameters for accurate problem solving in all contexts, and may in fact make it **harder for humans to directly impact the system** in the ways they want.
3. Allocating aspects of the system to automation **creates new categories or functions that humans must take on**, such as figuring out where to find information about what the automation is actually doing.
4. Automation does not necessarily replace human weaknesses. It often **creates new human weaknesses** or requires the development of new, unanticipated strengths.

Ironies of Automation



Bainbridge, L. (1983). The Ironies of Automation. *Automatica*, 19, 775-779. (Conference proceedings).

IRONY #1

Humans design the automation and then also deal with its unanticipated, often negative consequences.



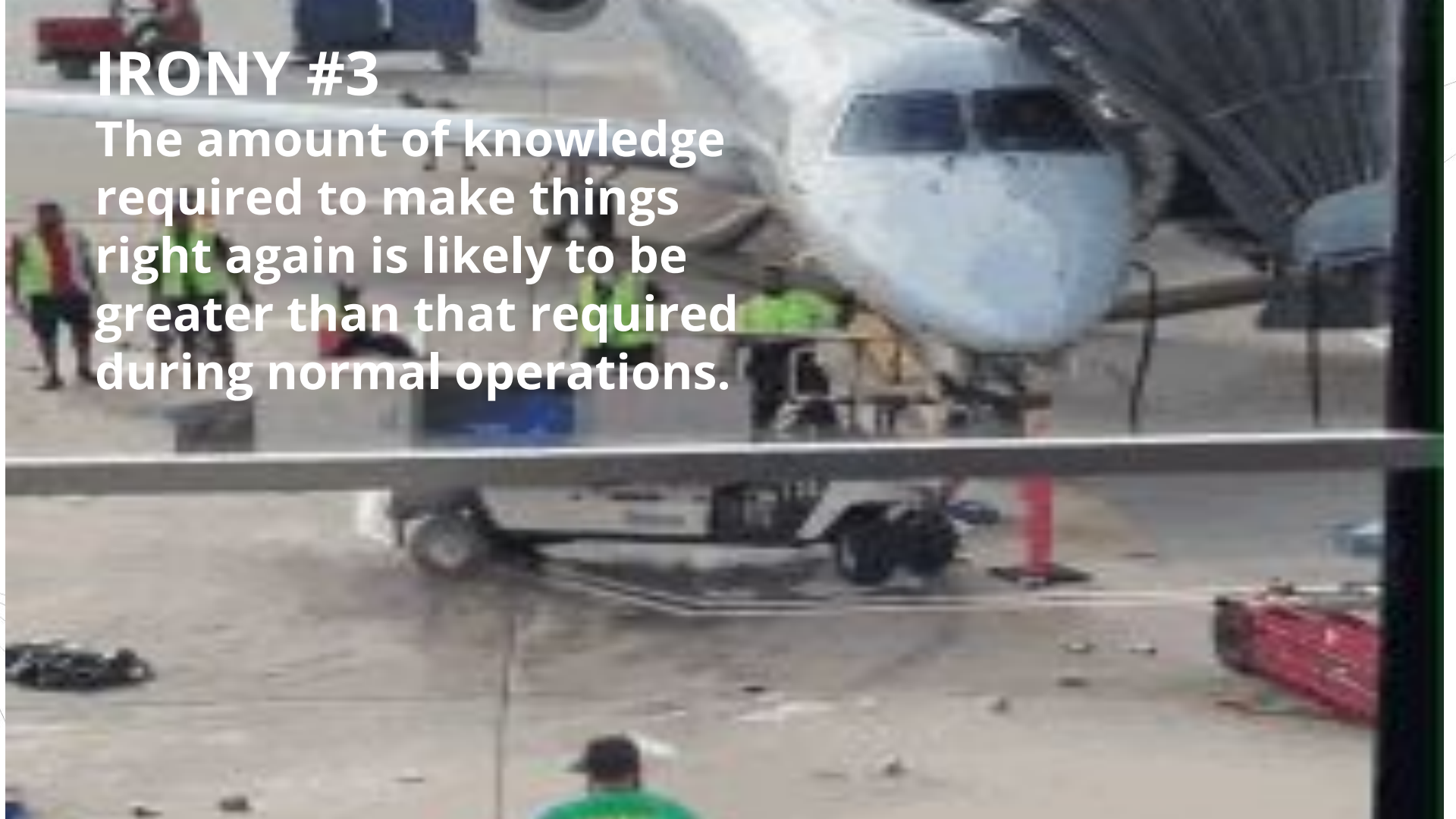
IRONY #2

Human operators have to monitor that the automation is working properly.



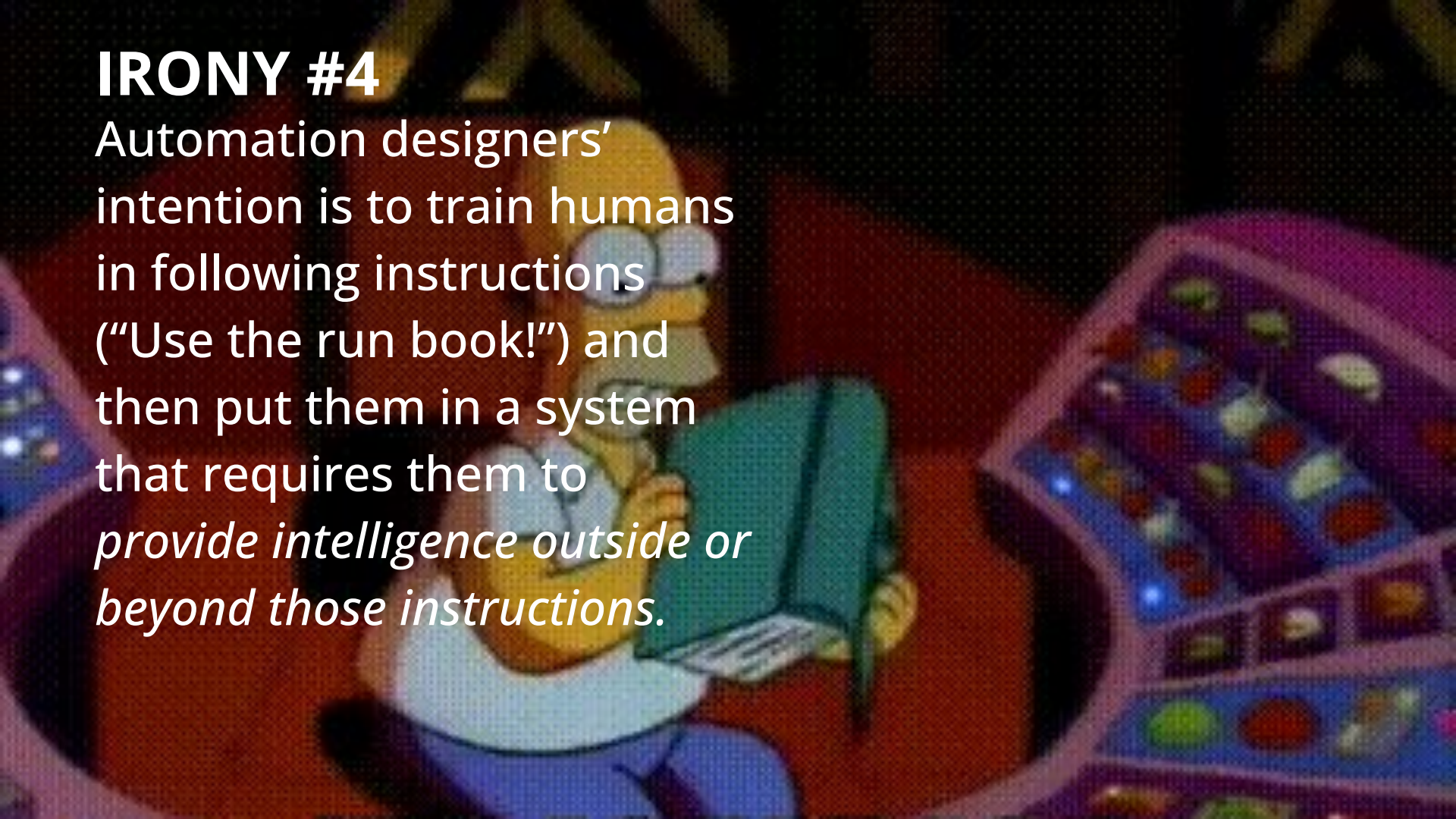
IRONY #3

The amount of knowledge required to make things right again is likely to be greater than that required during normal operations.



IRONY #4

Automation designers' intention is to train humans in following instructions ("Use the run book!") and then put them in a system that requires them to *provide intelligence outside or beyond those instructions.*



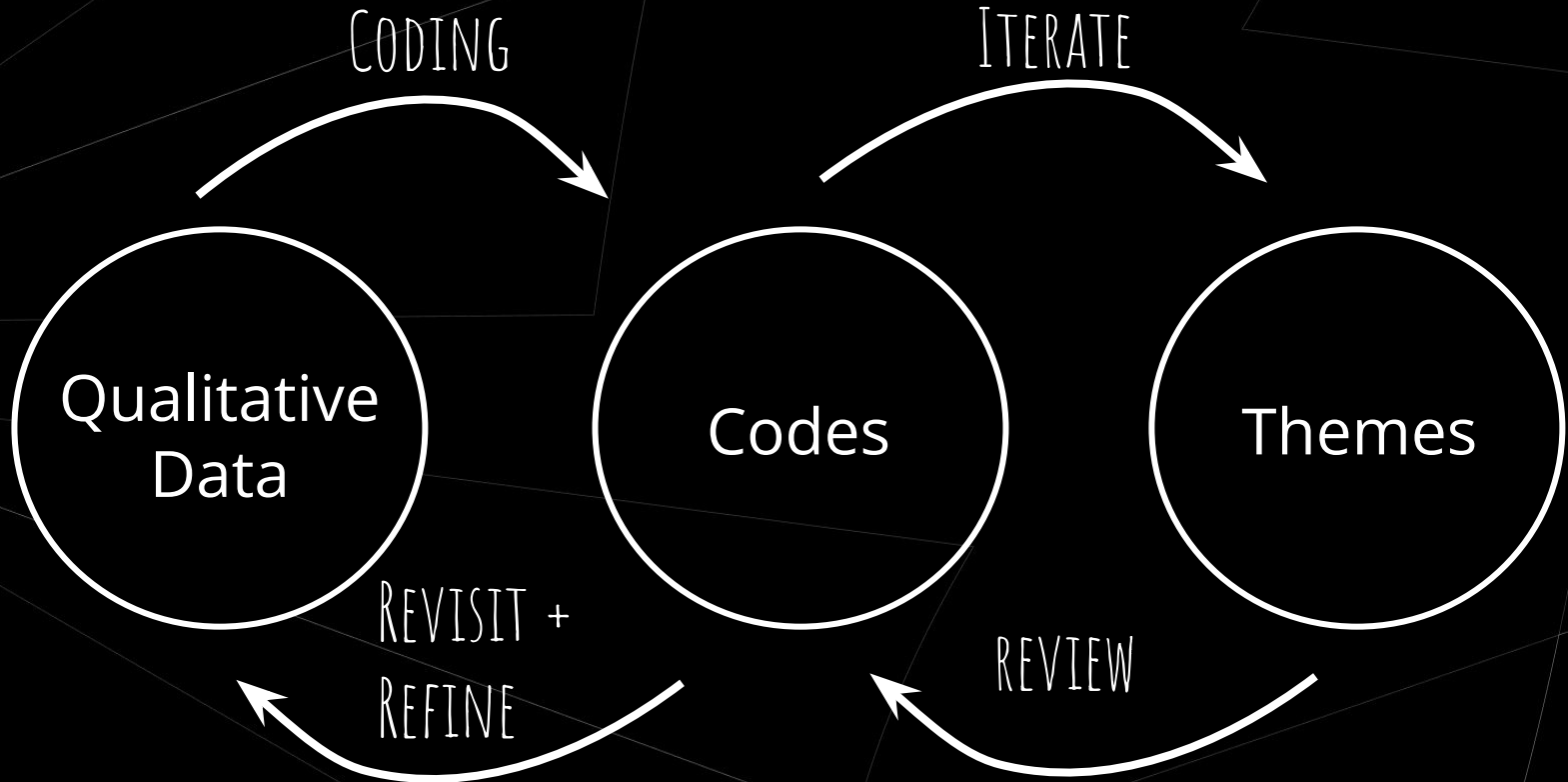
“...The more advanced a control system is, the more crucial may be the contribution of the human operator.”

—Bainbridge, 1983

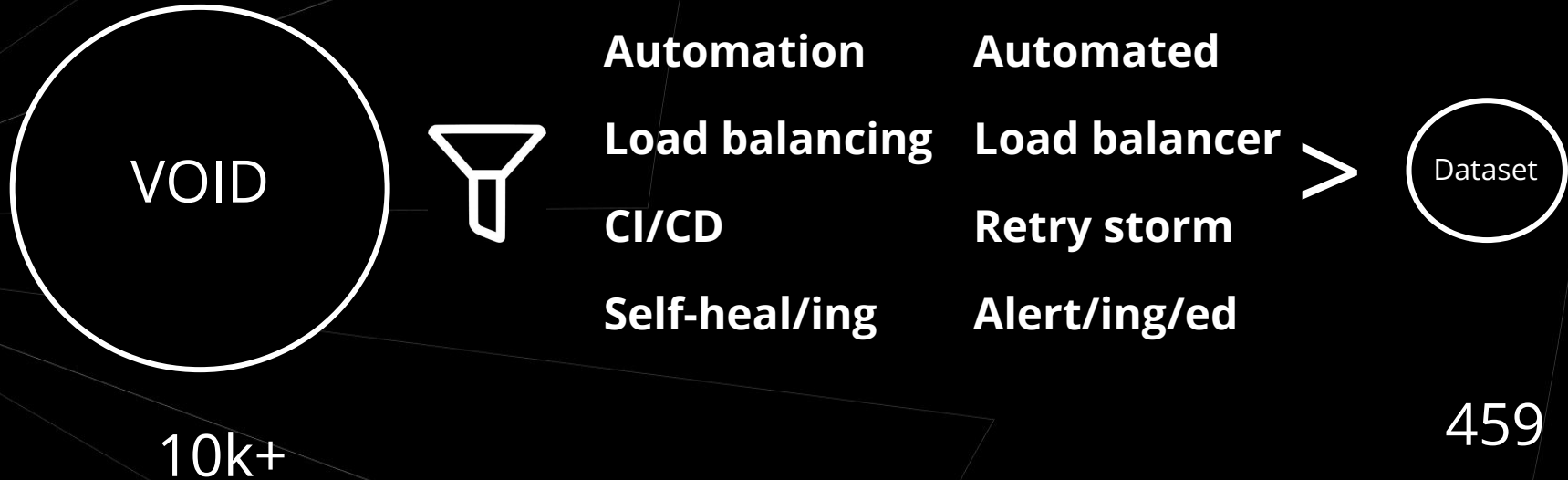
The background is a vibrant orange color with several thin, white, curved lines that create a sense of movement and depth. These lines are scattered across the frame, some intersecting to form various shapes. A solid black horizontal bar is positioned in the center of the image, containing the text.

Research From The VOID

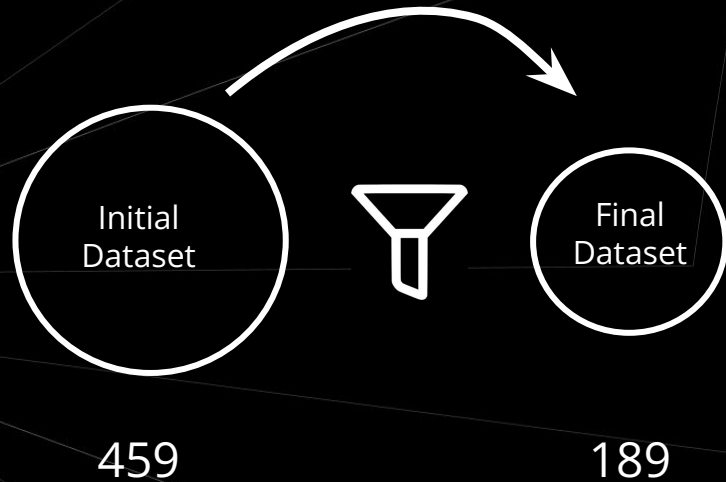
Thematic Analysis



Methodology: Keyword search

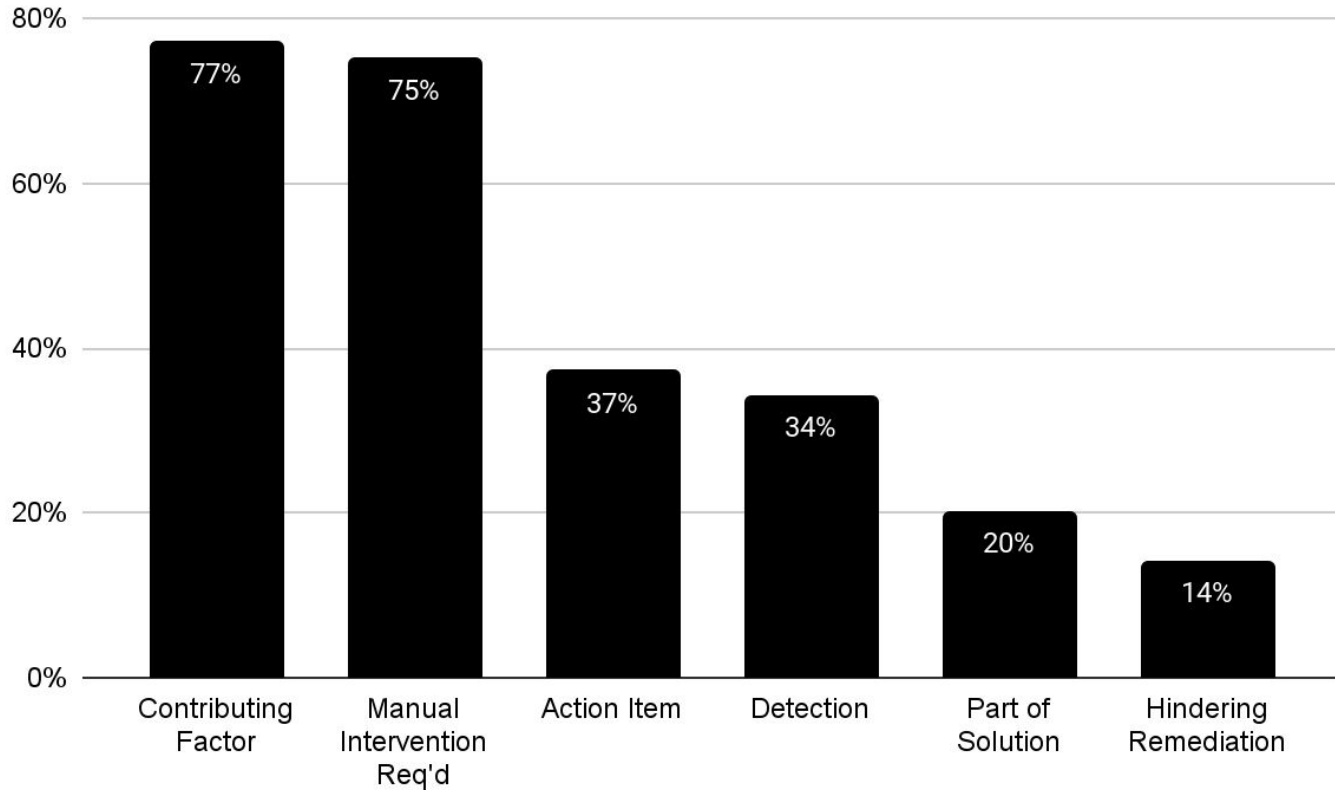


Methodology: Initial Coding



- Detection
- Contributing Factor
- Hindering Remediation
- Involved in Solution
- Manual Intervention
- Action Item

Quantitative Results



A green circuit board with several small human figures standing on it, symbolizing human intervention in automation. The figures are dressed in blue and brown, and are positioned around a central chip. The background is a blurred green, suggesting a digital or technological environment.

75% of the time, humans have
to intervene to resolve
automation-involved incidents

The image features a vibrant orange background with several thin, white, curved lines that create a sense of movement and depth. A solid black horizontal bar is positioned in the center, containing the text "Automation Themes" in a clean, white, sans-serif font.

Automation Themes



I. Automation Plays Multiple Roles in Incidents

A blurry, low-angle photograph of a bathroom. In the foreground, the top of a white toilet is visible on the left. In the center, a white washing machine or dryer is partially visible. In the background, a man and a woman are standing near a wooden cabinet or vanity. The man is wearing a dark shirt and the woman is wearing a red shirt. The image is intentionally out of focus, creating a sense of a candid, unscripted moment.

II. Automation Can Unexpectedly Make Things Worse



III. Human Intervention Remains Essential to Resolve Issues

The background features a gradient from dark orange on the left to light orange on the right. Overlaid on this are several thin, white, irregular geometric lines that create a sense of movement and structure.

Better Automation Through Joint Cognitive Systems

Automation: Expectations vs. Reality



An “un-Fitts” List for Joint Cognitive Systems

MACHINES	
Are constrained in that	Need people to
Sensitivity to context is low and is ontologically limited	Keep them aligned to context
Adaptability to change is low and recognition of anomalies is ontologically limited	Keep them stable given the variability and change inherent in the world
Adaptability to change is low and is ontologically limited	Repair their ontologies
They are not “aware” of the fact that the model of the world is itself in the world	Keep their model aligned with the world

PEOPLE	
Are not limited in that	Yet they create machines to
Sensitivity to context is high and is knowledge- and attention-driven	Help them stay informed of ongoing events
Adaptability to change is high and is driven by the recognition of anomaly	Help them align and repair their perceptions because they rely on mediated stimuli
Adaptability to change is high and is goal-driven	Effect positive change following situational change
They are aware of the fact that the model of the world is itself in the world	Computationally create their models of the world

10 Aspects of Joint Cognitive Systems

1. To be a team player, an intelligent agent must fulfill the requirements of a Basic Compact to engage in common-grounding activities.
2. To be an effective team player, intelligent agents must be able to **adequately model the other participants' intentions and actions** vis-a-vis the joint activity's state and evolution—for example, are they having trouble?
3. Human-agent team members must be **mutually predictable**.
4. Agents must be **directable**.
5. Agents must be able to **make pertinent aspects of their status and intentions obvious** to their teammates.
6. Agents must be able to **observe and interpret pertinent signals of status and intentions**.
7. Agents must be able to **engage in goal negotiation**.
8. Support technologies for planning and autonomy must **enable a collaborative approach**.
9. Agents must be able to **participate in managing attention**.
10. All team members must help **control the costs of coordinated activity**.

The image features a vibrant orange background with several thin, white, irregular lines that create a sense of movement and depth. A solid black horizontal bar is positioned in the center, containing the word "Questions?" in a clean, white, sans-serif font.

Questions?