

# With Big Data Comes Big Responsibility:

## Hazard Analysis and Big Data

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## Sam Aigen, CCPSC | Principal Engineer

- 14 years of experience
- 6 years with ExxonMobil
  - Utilities, Heat Transfer
  - Distillation
  - Hydroprocessing
- 8 years with AcuTech
  - Hundreds of PHAs
  - PSM/ RMP/ Seveso Audits
  - QRA/ Facility Siting Study
  - PSM Program Development
  - Terminal Supply and Logistics Modeling
  - Big data development team

# Agenda

- Current applications of big data on PSM
- Background on hazard analyses and ways to automate
- Benefits and drawbacks of automating hazard analyses
- Where we see the future of automating hazard analyses

# Current Application of Big Data on PSM

## Numerical/ Visual Data

- Drone Remote Inspection
- Rotating Equipment Reliability
- Instrument Integrity Levels
- Digital Twin
- AR/VR Plant Tour/ Models
- Personnel Protection/  
Productivity



*Machine learning and AI improve work and process efficiency*

# Complete Automation of PSM/ Hazard Analyses?



Image: Warner Bros

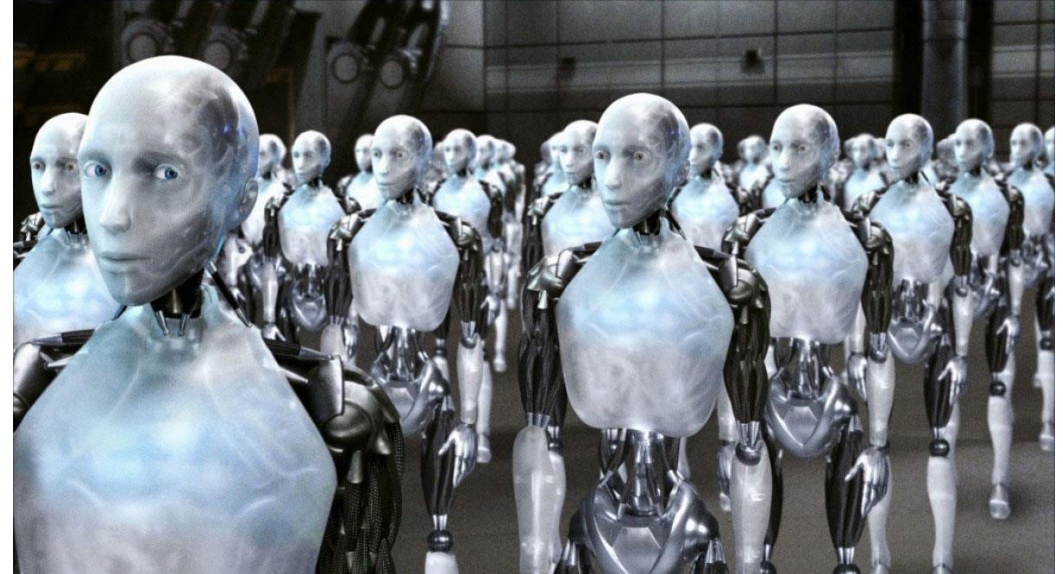


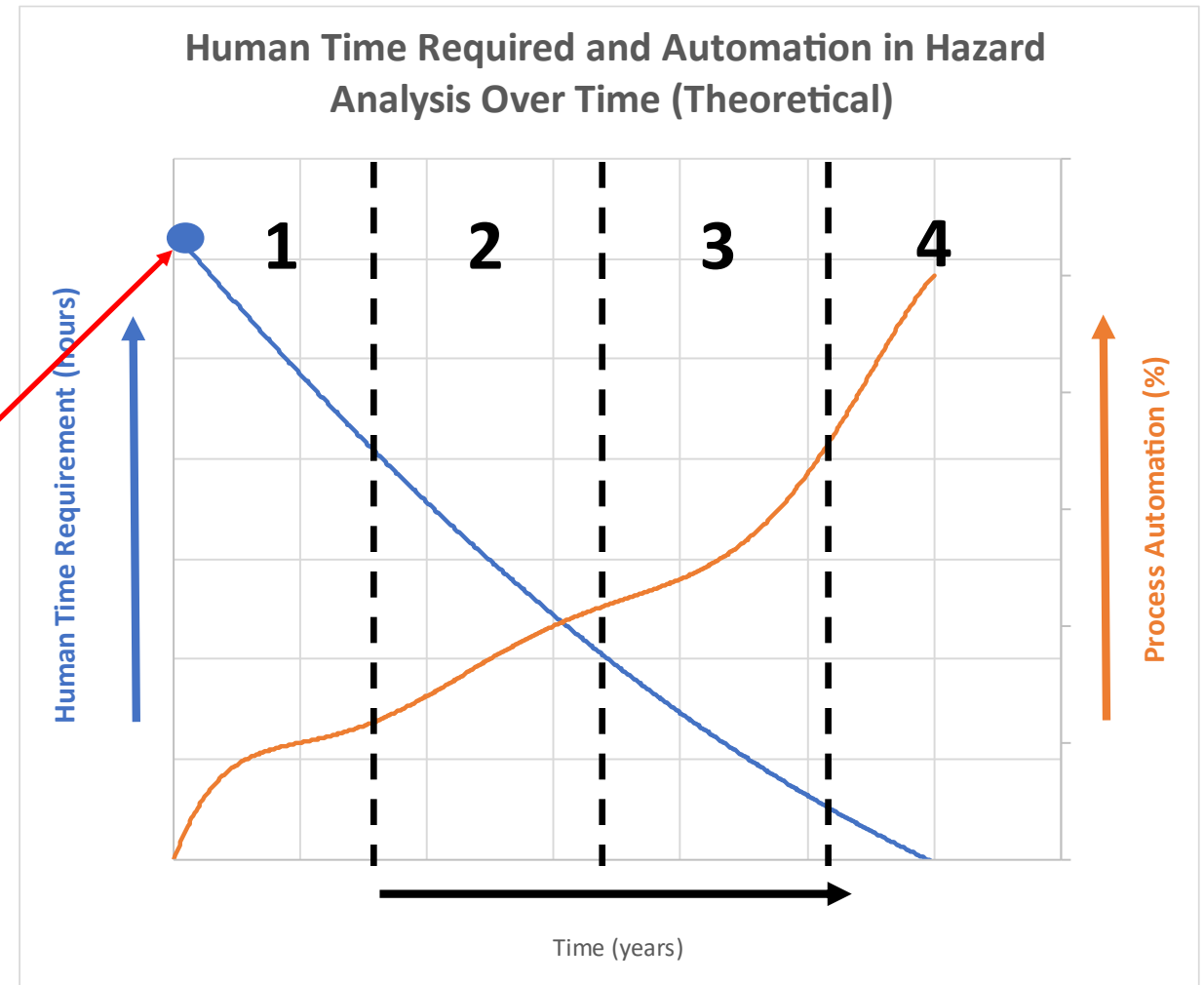
Image: Twentieth Century Fox Film Corporation

- Not all processes are ready/ meant for full automation

# Predicted Automation of Hazard Analyses

- As time progresses, human involvement will be reduced, but some human input will always be required

We are here today



# Main Elements of Hazard Analysis

## Process Hazard Analysis

- Cause
- Consequence
- Safeguard
- Risk Ranking
- Recommendations
- Recommendation/ Results Analysis

## Security Risk Assessment

- Cause
- Consequence
- Countermeasures
- Threat Ranking
- Risk Ranking
- Recommendations
- Recommendation Prioritization

# History and Progress of Hazard Analysis

## PHA

- Pre-1990s – as required by company/ Seveso I
- 1990's – PSM/ Seveso II
  - Very basic PHA
- 2000's – LOPA/ Seveso III



## SRA

- Pre- API-780 – early SVA methods
  - Checklist/ survey; extremely quantitative methods
- 2002 – SAFETY Act
  - Incentivize security methods and technologies
- 2013 – API 780 Recent SRAs
  - Integrating cyber security, new technological challenges

→ Throughout – software, standards, methodology



# Potential Automation of Hazard Analysis

## PHA

- Automate scenario development
  - Predefined list of cause/consequence pairs
  - From P&ID analysis
    - Cause/consequence/safeguards
  - From process simulation/RTO/ Digital twin
- Results analysis
- **We can automate the study**



## SRA

- Automate scenario development
  - Plot adversary pathways (indoor vs. outdoor)
- Countermeasures import/development (not easy to automate)
- Threat Ranking (not feasible to automate)
- Results analysis
- **We can automate *some* of study**

# Benefits and Future of Hazard Analysis Automation

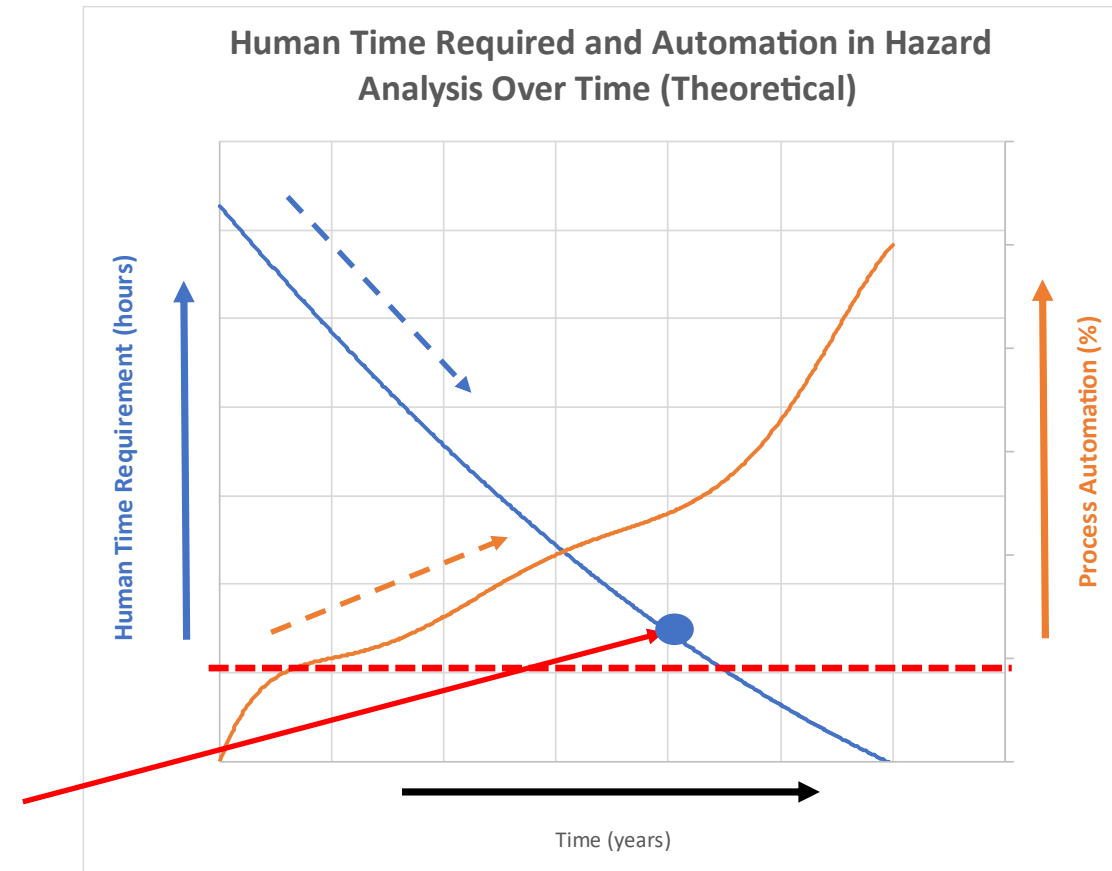
## Benefits

- Time savings
  - Minimize human time required
- Consistency
  - Cause or consequence text and description
- Accuracy
  - Upstream/ downstream Scenarios

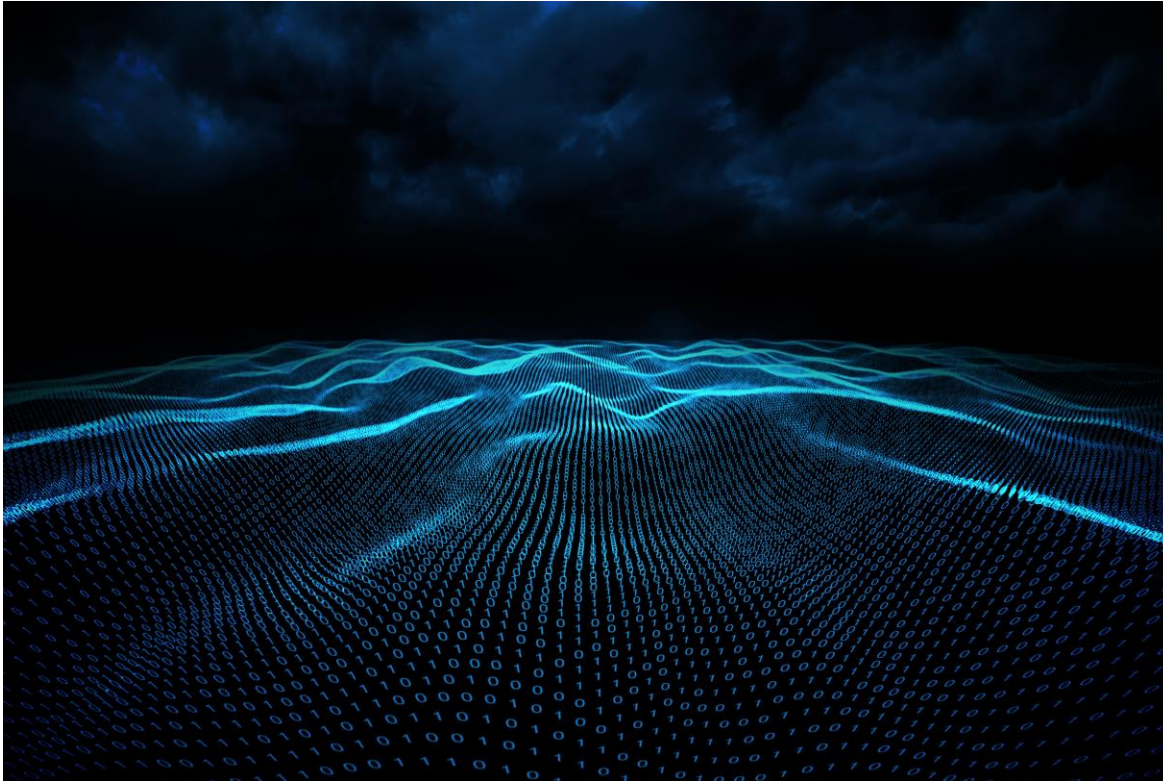
## Prediction

- Human time may be optimized, but cannot be removed altogether

We hope to get here



# Drawbacks of Over-Automating Hazard Analysis

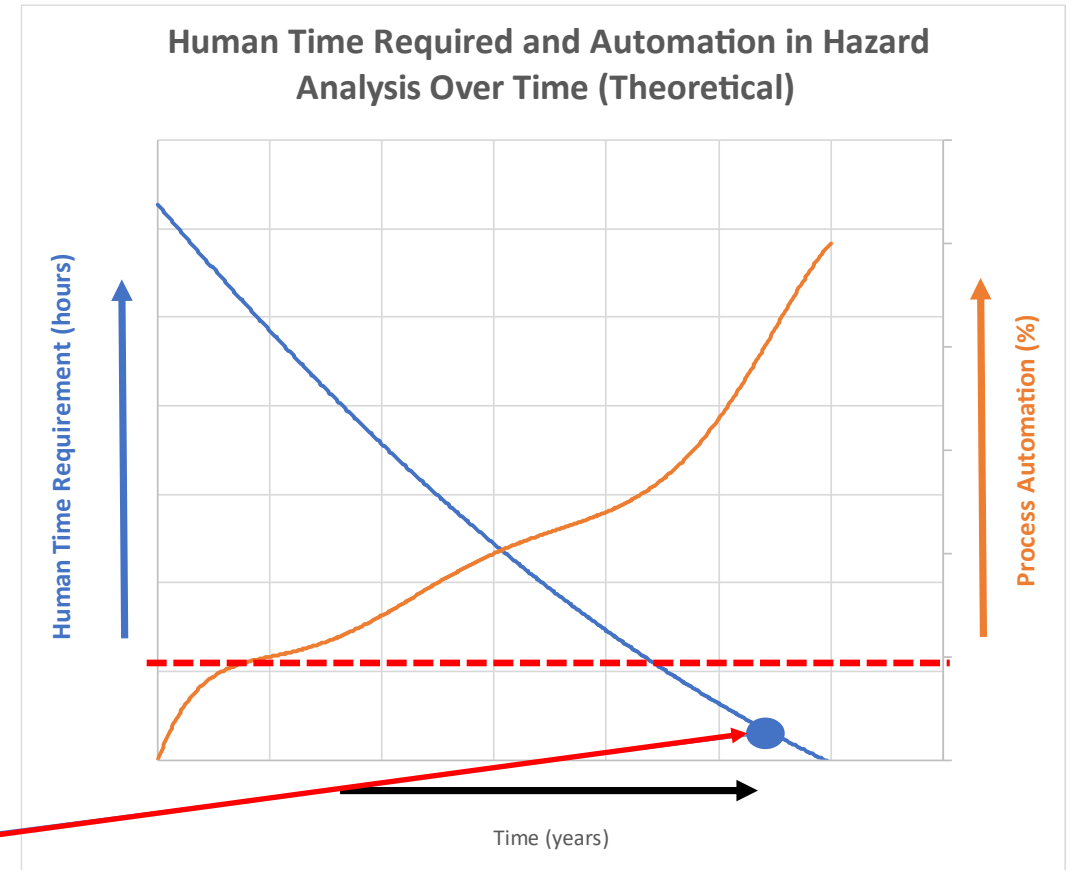


## Drawbacks

- Time commitment to build/ train model
  - Basic Model
    - Agreement on terms, descriptions etc.
    - Consequence description may vary
  - Advanced Model
    - How to identify correct consequences?
    - How to identify equipment type?
- Lacks Teamwork
  - Data Verification
    - Safeguards – interlocks/ alarms
  - Safety Culture
    - Sense of ownership

# What if We Over-Automate Hazard Analyses?

- Need minimum human input or product will not be useful
- Potential to lose knowledge of the process
  - Example: Major Pipeline (2021)
    - Extremely automated operation
    - Cyber attack caused system shutdown
    - Lost operational knowledge
    - Needed retirees to operate



What if we go too far?

# Conclusions

1. Potential ML/AI application to Hazard Analyses
  - PHA/SRA/Other
2. Benefits of applying ML/AI to Hazard Analyses
  - Consistency/ Accuracy
  - Time
3. Drawbacks of applying ML/ AI to Hazard Analyses
  - Initial time commitment
  - Current technological limitations
  - Loss of ownership/ safety culture
4. Automation + human interaction → optimized PHA



# Thank you !

- Please email me at [saigen@acutech-consulting.com](mailto:saigen@acutech-consulting.com) with any questions or more information