Agenda

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Artificial Intelligence::
The Golden Spike that Will Shape the Railroad Industry's Future

How AI-powered digital transformation is the competitive edge that can lead your organization on the track to success

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The Golden
Spike

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The "Golden Spike" of the **PAST**

A "last spike" made of solid gold was tapped into place at Promontory Summit, UT to complete the meeting of the Union Pacific and Central Pacific Railroads, connecting the Continental United States from coast to coast on May 10, 1869

With this spike –

The **Eastern and Western** coasts of the United States were now connected, enabling new trading and economic capabilities, including the efficient distribution of goods/materials

New opportunities for settlement and development, which were previously unimaginable as connectivity enabled exponential advancements

Enabled a **more culturally diverse nation and society**, fostering community growth and establishing new towns and cities
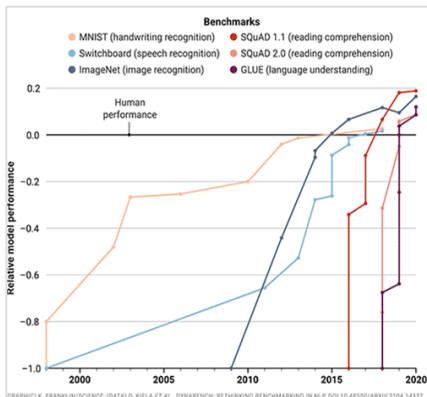
The "Golden Spike" of the **FUTURE**

Volume growth opportunities and competition from Trucking industry will require Railways to automate asset & crew scheduling using AI; **Impact – Asset Utilization, Speed to Ops Recovery**

Shortage of workforce in post-pandemic environment will require AI for transaction and decision automation; **Impact - Cost to Train Resources**

With safety becoming more data-driven based on remote monitoring capabilities, AI's real-time capabilities (predictive and prescriptive) become valuable; **Impact – Number of Incidents Avoided**

Rail companies gather machine-related information that is second to Department of Defense; AI + cloud computing now provide the scalability for real-time operational analytics; **Impact – Dwell Time, Velocity**

AI coupled with information from an ever-growing network of sensor infrastructure will enable creation of digital twin models and expedite decision-making; **Impact – Cost of Operational Risk Mitigation**

AI-enabled services (speech-to-text, NLP) to support real-time and self-service capabilities (shipment visibility and contract management) for shippers; **Impact – Cost to Service**

Intermodal

Train Operations

Digital Twins

Workforce

Safety

Customer Service

AI: Hype or Transformation Tech

AI: **Just Hype?**

Why now?

Generative AI is outperforming people today…
…and it is accelerating.

Benchmarks

- MNIST (handwriting recognition)
- Switchboard (speech recognition)
- ImageNet (image recognition)
- SQuAD 1.1 (reading comprehension)
- SQuAD 2.0 (reading comprehension)
- GLUE (language understanding)

GRAPHIC) K. FRANKLIN/SCIENCE; (DATA) D. KIELA ET AL., DYNABENCH: RETHINKING BENCHMARKING IN NLP, DOI:10.48550/ARXIV.2104.14337

* Per National Bureau of Economic Research for customer service roles

AI training costs are declining 60% YoY

By 2030, AI training costs will be $500 for the same output that cost $5M in 2020

Generative AI Platforms Boost Worker Productivity by 14%*

Productivity is much higher in keys areas across a company's value chain

MSFT has invested $10B in OpenAI

GPT-4 production in Azure will accelerate growth in Data and AI Services

ChatGPT has the largest and fastest user base than any other technology in history 100M user in 60 days!
1B monthly views in third month

ChatGPT gets an "A"

- LSAT 163 (88%)
- Bar exam 298 (90%)
- SAT score of 1410 (>90%)
- 99% GRE score
- AP Macroeconomics 84 (100%)

In 4 years, AI language systems advanced 10,000x…

…at lower costs! 67% drop
in Aug 22, and 90% drop in Mar 23.

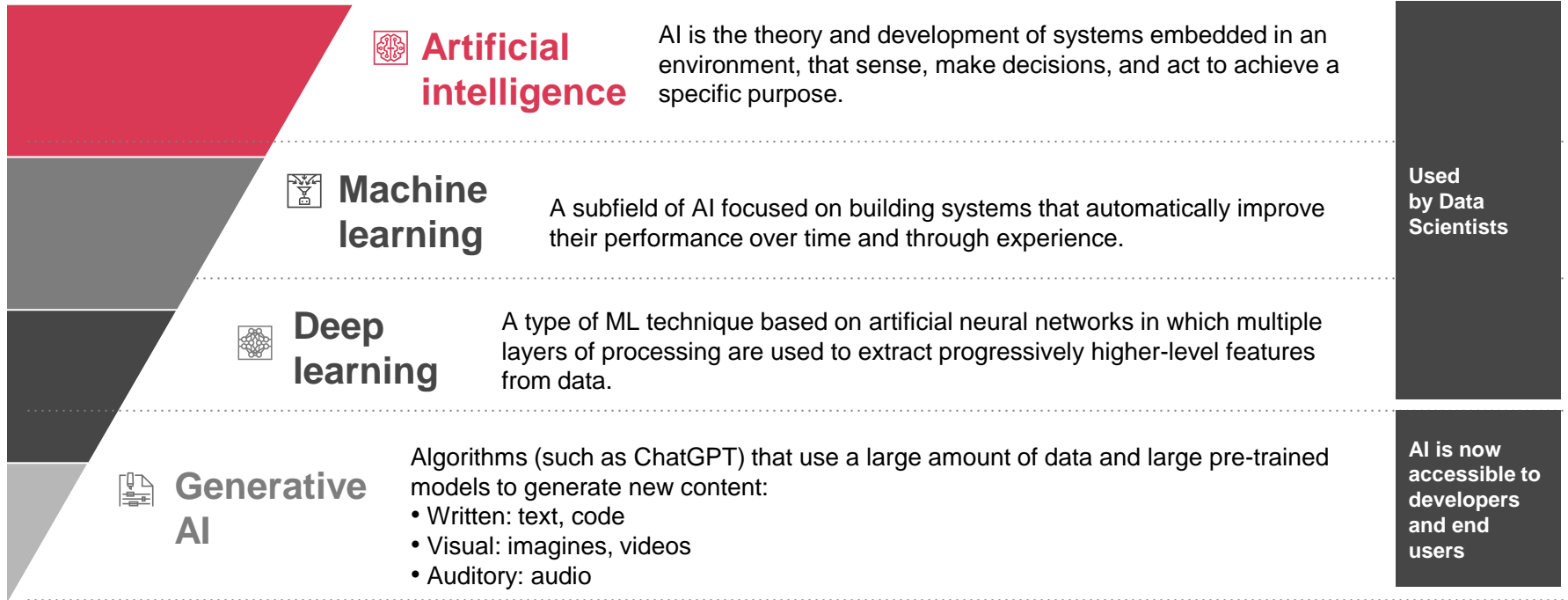**Google Has Released Bard for consumers and PaLM2 LLM.**

We are one of the first companies in the world with access

AWS announced Bedrock as their LLM and to support a range of other LLMs.
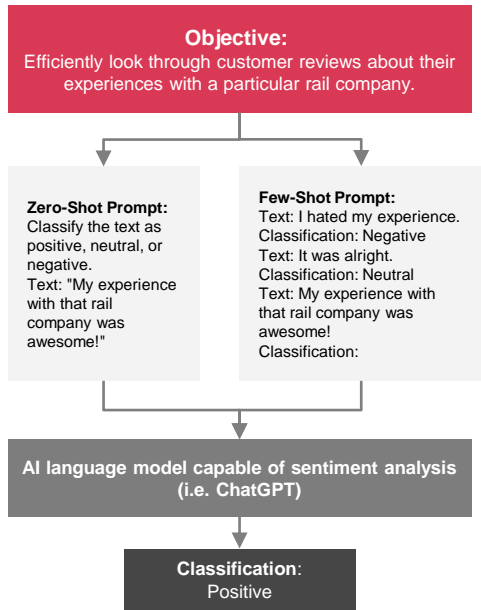
We are a pilot partner for Bedrock

So what is **Generative AI?**

Generative AI is a subset of Deep Learning that involves training a model to generate new data that is like the training data it was given. This type of AI can be used to create art, music, text and even entire virtual worlds, among other applications.

Artificial intelligence
AI is the theory and development of systems embedded in an environment, that sense, make decisions, and act to achieve a specific purpose.

Machine learning
A subfield of AI focused on building systems that automatically improve their performance over time and through experience.

Deep learning
A type of ML technique based on artificial neural networks in which multiple layers of processing are used to extract progressively higher-level features from data.

Generative AI
Algorithms (such as ChatGPT) that use a large amount of data and large pre-trained models to generate new content:
- Written: text, code
- Visual: imagines, videos
- Auditory: audio

Used by Data Scientists

AI is now accessible to developers and end users

Interacting with AI – **Prompt Engineering**

How Prompt Engineering Works

Objective:
Efficiently look through customer reviews about their experiences with a particular rail company.

Zero-Shot Prompt:
Classify the text as positive, neutral, or negative.
Text: "My experience with that rail company was awesome!"

Few-Shot Prompt:
Text: I hated my experience.
Classification: Negative
Text: It was alright.
Classification: Neutral
Text: My experience with that rail company was awesome!
Classification:

AI language model capable of sentiment analysis (i.e. ChatGPT)

Classification:
Positive

Could the US freight rail industry benefit from a marketplace for prompts tailored for railroad workers?

Key Considerations

Have clear goals: This will aid in creating appropriate prompts that align with the input data and task requirements.

Use templates: Templates can promote uniformity and streamline the process

Think about prompting best practices: Create prompts that are comprehensible

Take note of effective patterns: Discover recurring patterns which craft effective prompts.

Continue testing and refining: Evaluate the prompts and necessary adjustments

Understand the risks: Language model outputs may not always be truthful or accurate.

ChatGPT – **Killer App?**

Keyword Driven

VS.

Conversation Driven

Your Pulse
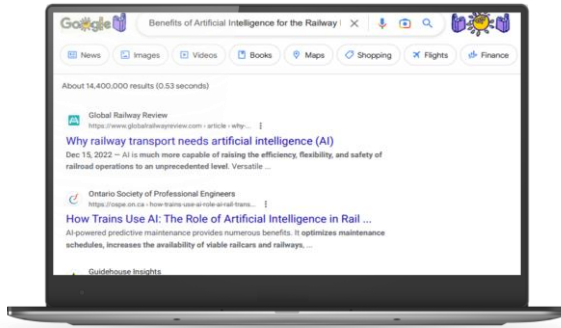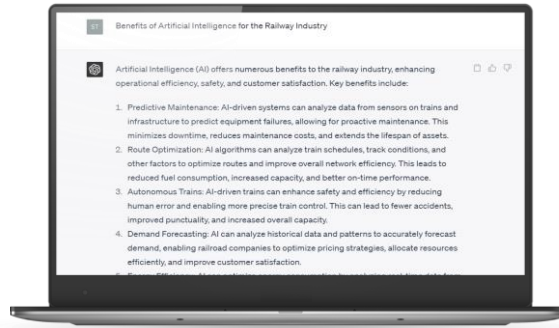

Past: Google Search

Specific keywords or queries

No ongoing context

No flexibility on communication style
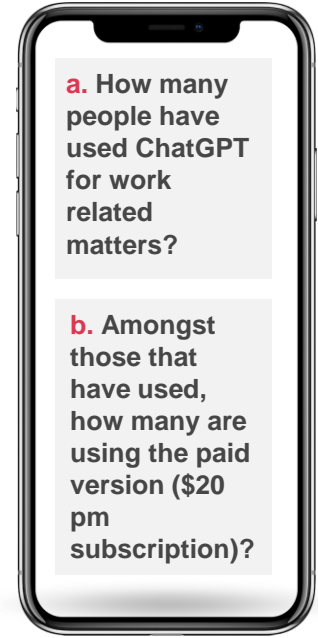
No real-time learning

Future: ChatGPT

Engages in a conversation

Maintains context / history

Adapts responses (can even be funny)

Limited by knowledge cutoff of Sept-21

a. How many people have used ChatGPT for work related matters?

b. Amongst those that have used, how many are using the paid version ($20 pm subscription)?

Let's hear from you

Scan each QR code to answer the questions and see the audience results

Have you used ChatGPT for work?

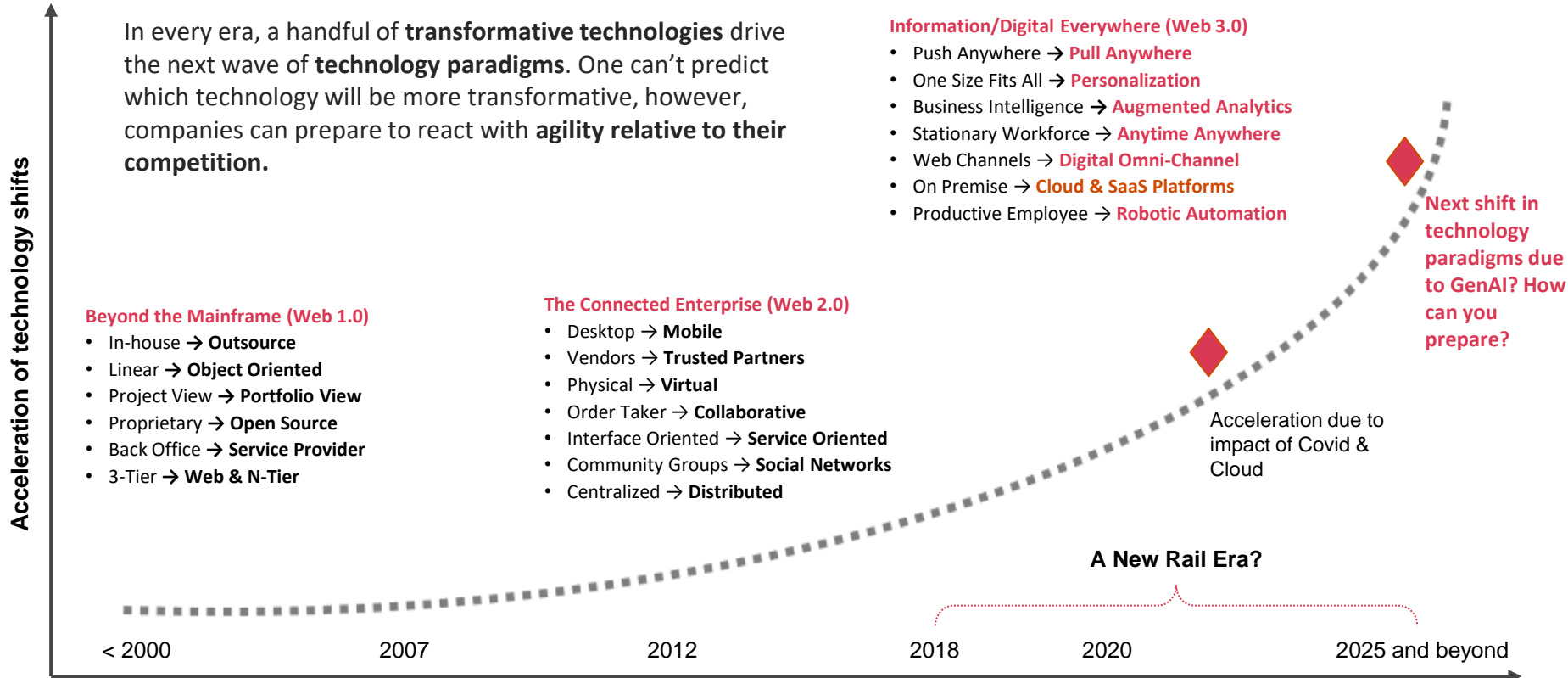**Have you used the paid version of ChatGPT?**

Forces Impacting the Industry

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Technology Forces – **Exponential Shifts**

In every era, a handful of **transformative technologies** drive the next wave of **technology paradigms**. One can't predict which technology will be more transformative, however, companies can prepare to react with **agility relative to their competition.**

Acceleration of technology shifts (vertical axis label)

Information/Digital Everywhere (Web 3.0)
- Push Anywhere → **Pull Anywhere**
- One Size Fits All → **Personalization**
- Business Intelligence → **Augmented Analytics**
- Stationary Workforce → **Anytime Anywhere**
- Web Channels → **Digital Omni-Channel**
- On Premise → **Cloud & SaaS Platforms**
- Productive Employee → **Robotic Automation**

Next shift in technology paradigms due to GenAI? How can you prepare?

Beyond the Mainframe (Web 1.0)
- In-house → **Outsource**
- Linear → **Object Oriented**
- Project View → **Portfolio View**
- Proprietary → **Open Source**
- Back Office → **Service Provider**
- 3-Tier → **Web & N-Tier**

The Connected Enterprise (Web 2.0)
- Desktop → **Mobile**
- Vendors → **Trusted Partners**
- Physical → **Virtual**
- Order Taker → **Collaborative**
- Interface Oriented → **Service Oriented**
- Community Groups → **Social Networks**
- Centralized → **Distributed**

Acceleration due to impact of Covid & Cloud

A New Rail Era?

< 2000   2007   2012   2018   2020   2025 and beyond

People Forces - **Rapid Workforce Evolution**

A younger workforce means changing worker preferences across most job types and categories.

75% — **Of pre-pandemic blue-collar workers upskilled** - these ambitious "New Collars" are primarily millennial males who live and work in urban areas.

134% — **Increase at which Gen Z employees switch jobs** compared with pre-pandemic.

67% — **Gen Z employees who want companies where they can learn skills** to "advance their careers", including taking traditional blue-collar roles if they know there is potential to rise to executive-level and decision-making responsibilities.

73% — **Gen Z now desiring permanent flexible work options**, believing a remote / hybrid environment fosters productivity and minimizes stress drivers leading to mental health concerns.

4 years — **How long Gen Z workers have been less concentrated in bigger metros** compared to millennials seeking equivalent positions.

High attrition and increasing complexity of technology demands are taxing existing delivery capabilities.

Attrition and Growth Increase Competition for Labor
- After **20 years of relative stability**, workforce turnover among Class 1 railroads has caused **~30% turnover in last few years**
- All major railroads have initiated **significant hiring efforts over last 2 years**, increasing competition for rail-interested candidates

Today's Trains and Networks Require Increased Effectiveness
- Train lengths have **increased by 25%** since 2008 (Source)
- **Forecasting complications** during periods of increased volatility
- Need for **higher utilization** of trains, yards and other assets

Core Rail Function Modernization
- Crew planning
- Customer sales & service
- Safety components and software
- Maintenance platforms and programs

Emerging Technology Demands New Skills
- Drones and UAVs for bridge and track inspections
- Predictive algorithms and monitoring in maintenance, positioning
- Advanced connectivity along track and other assets
- AI / ML applications and POCs

Use Cases/
Examples

Use Case #1 – Automatic Train Operation (ATO)

The Challenge

Applying AI to...

To expand transport capacity, improve the efficiency of rail systems on existing route networks

ATO is designed to:
- Address the increasing demand for rail-bound freight transport
- Enable more throughput on systems
- Energy-optimize rail driving
- Improve punctuality of rails
- Leverage simulation data from virtual rail representations to train AI models

What they did:
- Created a software solution for training planning and capacity management
- Combined autonomous systems with existing train management services
- Streamlined future railway optimization processes

Success to Date

- **Up to 30%** more capacity throughput on shared railway tracks
- Energy savings of **up to 37%**
- **Lower operating costs** due to less stress on mechanical parts
- **15% improvement** of punctuality
- **Smoother and more comfortable rides** for passengers

Optimize operations
Understand practices to optimize fuel efficiency by identifying the most fuel-efficient acceleration and braking patterns.

Increase efficiency
Enables more frequent runs at optimal speeds, improves energy and fuel efficiency

Improve punctuality
Minimizes interruptions due to shift changes and ensures adherence to schedules

Mitigate risk
Automate braking in the event of railway obstruction to mitigate the risk of injury / death and prevent damage to trains.

Scan to view a video about this

Use Case #2 – Class 1 AI Application

| The Challenge | Applying AI to... |

The Challenge

To create more efficient processes in loading, using, and tracking rail components.

Class 1 Railway aimed to:
- Create optimized routes and load plans for the cargo loading process
- Better estimate time of arrival
- Forecast inventory levels
- Anticipate and react to rail disruptions

What they did:
- Understand key inputs of the cargo loading prep process: drivers, units, and routes
- Identify inefficiencies with the cargo loading process that limited slot utilization
- Reduce "dwell" times by predicting train ETAs, factoring in historical "dwell" time
- Plan inventory levels through in-gate forecasting in different storage facilities

Success to Date

- Shortened the average train load time by **more than 30 minutes**
- Created additional capacity for **10 daily trains= 30k annual lifts = 500k annual lifts** across the network
- Reduced route distance driven in intermodal loading process by **20 miles per train**
- Improved an intermodal train's estimated arrival time accuracy by **as much as 20%**
- Enabled railway monitoring of congestion and prediction up to **72 hours in advance**

Applying AI to...

Shorten loading routes
Develop an algorithmic assignment plan that optimizes drivers, units, and routes in the intermodal loading phase

Maximize slot utilization
Ensure that cargo is loaded correctly and efficiently by creating an automated loading plan

Predict railcar needs
Combine the history of similar trains to predict time each train needs to be refueled and/or inspected

Manage inventory flow
Predict the number of units that will be received by holding facilities 10 days in advance and factor in available capacity

Scan to read more about this

The Challenge

Potential for AI to...

Creating a long-term program for talent attraction, onboarding, and retention while meeting key hiring KPIs / metrics.

We were asked to:
- Create an apprenticeship program
- Accelerate identification and onboarding
- Onboard 1000 new mechanics in 4 years
- Increase female and POC participation
- Build sustainable, new pipelines of talent

What we did:
- Cross-functional governance of ~10 groups
- Integrated program plan
- Proactive resource planning and readiness
- Partnership sourcing
- Market research for public content
- Creation of a repeatable playbook

Success to Date

- Program **launched on-time** in two key airport stations
- Grew in 4 months to **60+ participants**
- DEI goals being met, with **2/3rds of program participants being females or POC**
- **Public events** and acknowledgement
- Playbook and pathways helped with **initial designs of programs for additional workgroups**

Attract qualified candidates
Speed up job description and posting process with AI-generated copy to fit your role's needs
Identify individuals with a high probability of engagement with a job ad based on online behavior

Reduce time-to-interview
Reduce time-to-prescreen by automating conversations between applicants and recruiters with Generative AI chatbots

Train crew members
Help crew-members-in-training visualize key scenarios such as mechanical repairs with AR/VR headsets
Efficiently create training videos with realistic avatars of company leadership from text with Generative AI

Retain employees
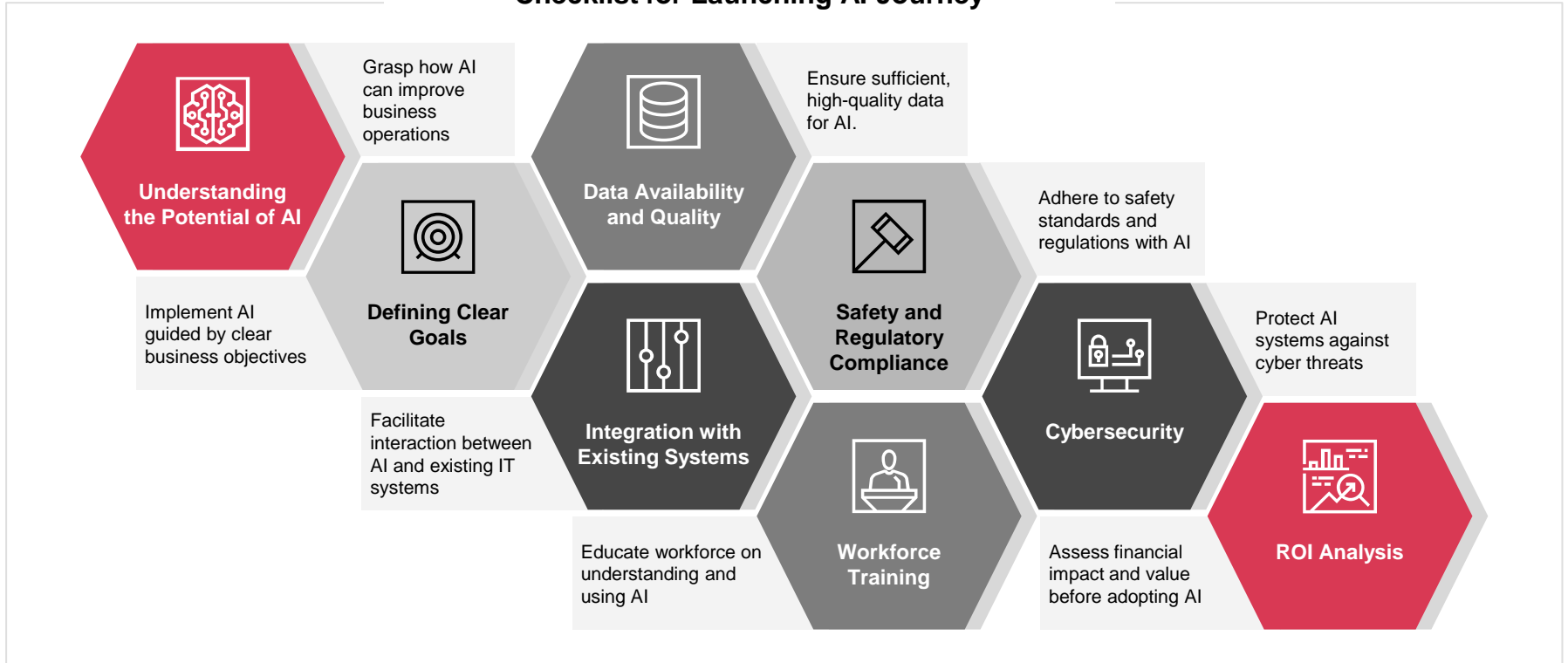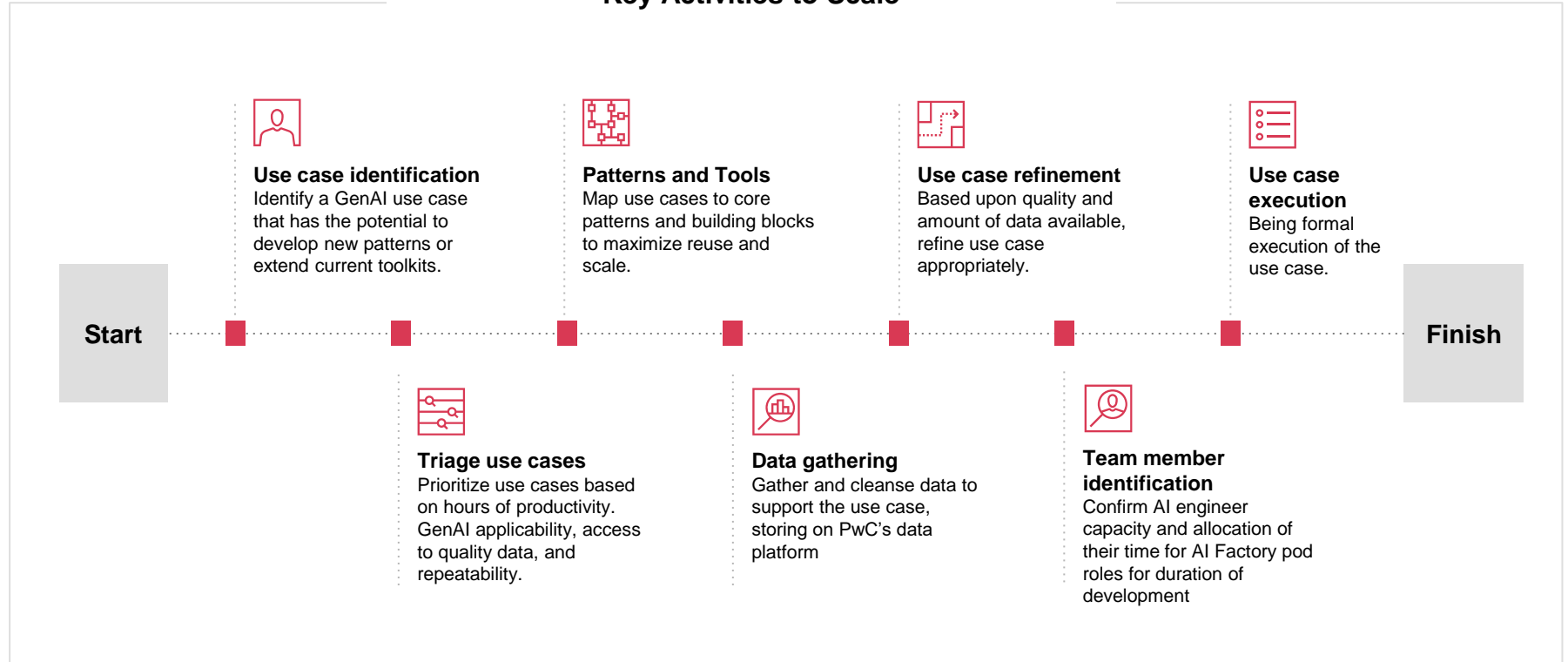Keep employees happy by listening at scale using AI systems that can automate sentiment analysis

What Now?

Checklist for Launching AI Journey

Understanding the Potential of AI

Grasp how AI can improve business operations

Defining Clear Goals

Implement AI guided by clear business objectives

Data Availability and Quality

Ensure sufficient, high-quality data for AI.

Safety and Regulatory Compliance

Adhere to safety standards and regulations with AI

Integration with Existing Systems

Facilitate interaction between AI and existing IT systems

Cybersecurity

Protect AI systems against cyber threats

Workforce Training

Educate workforce on understanding and using AI

ROI Analysis

Assess financial impact and value before adopting AI

Step 2 – Select Use Case & Build Once, Do Many ("How")

Key Activities to Scale

Use case identification
Identify a GenAI use case that has the potential to develop new patterns or extend current toolkits.

Patterns and Tools
Map use cases to core patterns and building blocks to maximize reuse and scale.

Use case refinement
Based upon quality and amount of data available, refine use case appropriately.

Use case execution
Being formal execution of the use case.

Start

Finish

Triage use cases
Prioritize use cases based on hours of productivity. GenAI applicability, access to quality data, and repeatability.

Data gathering
Gather and cleanse data to support the use case, storing on PwC's data platform

Team member identification
Confirm AI engineer capacity and allocation of their time for AI Factory pod roles for duration of development

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Thank you!