ASHB
Association for Smarter Homes & Buildings

Exploring AI Use Cases to Create Value in Intelligent Buildings

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About Harbor Research

Firm History

Harbor Research was the first firm to focus on Smart Systems, Services and the Internet of Things (IoT) and first to publish groundbreaking research on new business models in the Harvard Business Review in 2004 & 2005.

Clients and Engagements

For over 30 years we have focused on identifying, analyzing and helping clients to develop or adopt emergent technologies. Every relationship we develop is enhanced by the range and depth of these experiences.

Technology Developers & Suppliers

100+ clients 400+ engagements

OEMs and Service Providers

150+ clients 600+ engagements

Offices

Denver, Colorado - USA Berlin, Germany - Europe

Overview of Harbor's Services

Research Services

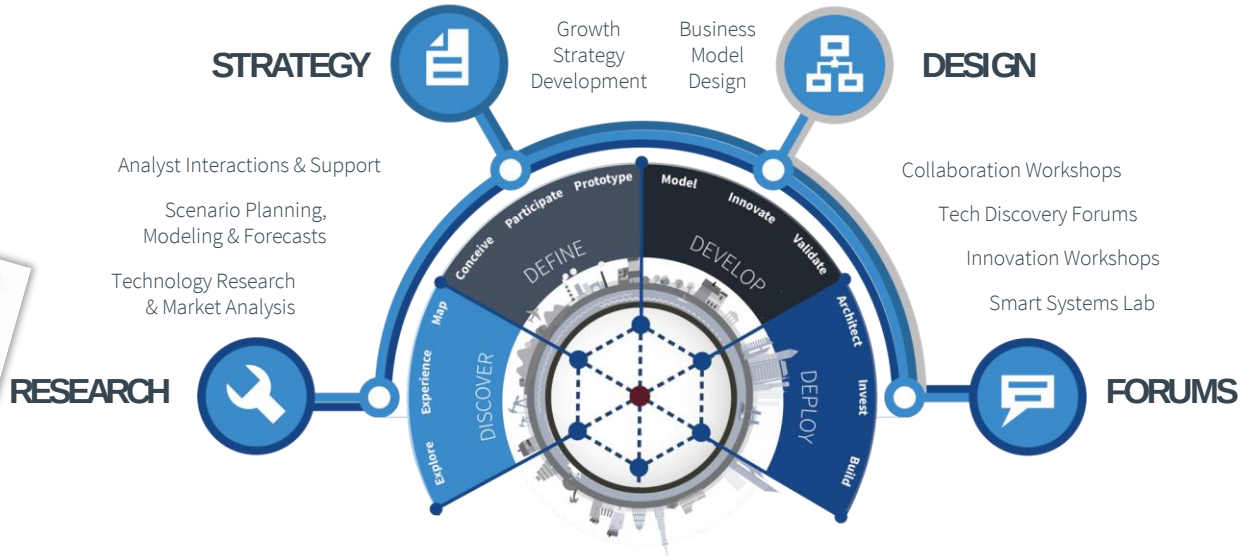
Our research, tracking, and market intelligence services provide an accessible learning environment for those who are trying to wrap their arms and minds around emerging disruptive opportunities.

Strategy Consulting

Our strategy and business development consulting services deliver creative innovation tools, practical methods and applied problem solving.

Smart Systems Lab

Our lab enables subscription-based clients to co-develop their business models, technologies, products and services in close collaboration with partners and peers, supported by our ability to design, prototype, and test new models for delivering value & differentiation.



We work best with clients who can embrace complexity and change, both in their organization and in the marketplace

Agenda

- (Quick) Introduction to AI
- Overview of AI Use Cases in Intelligent Buildings
- Example of company providing AI-enabled solutions today
- Open Discussion

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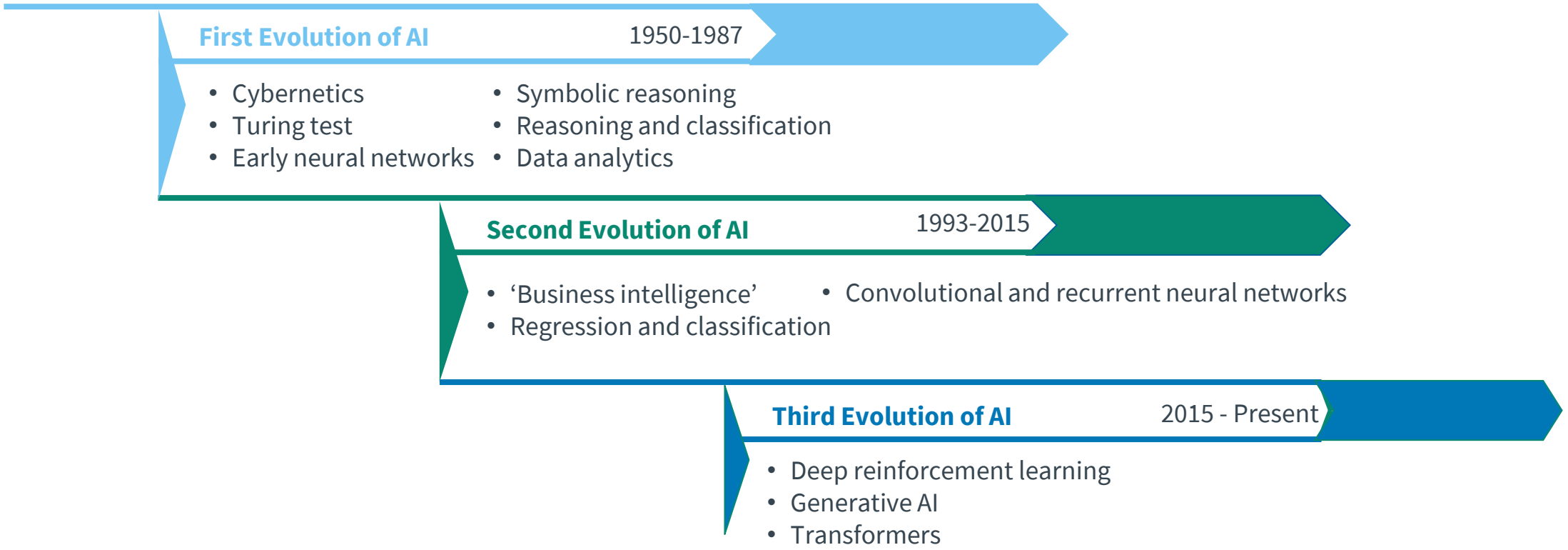
(Quick) Introduction to AI

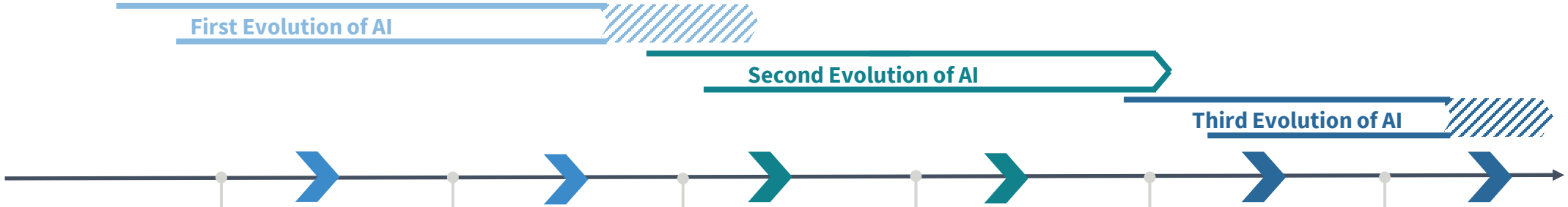
We're Currently Experiencing the Third Evolution of AI

Simple classification and regression technologies that revolutionized business and machine intelligence in the late-20th century are evolving towards deeper, unsupervised learning and Generative AI



Current way of AI benefits from the Rapid Reduction of Compute Costs

The third wave of AI innovation leverages nearly infinite computing resources to expand and extend previous-generation technologies into more advanced and Generative AI applications.

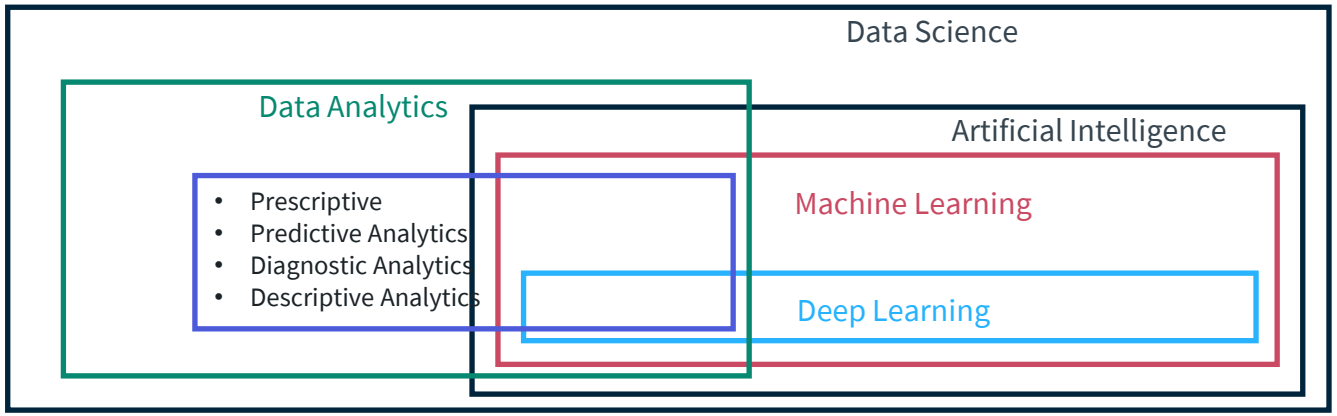


Technology	Classification	Regression	Convolutional Neural Networks	Recurrent Neural Networks	Deep Reinforcement Learning	Generative AI
Description	Outputs have a discreet set of outcomes	Outputs follow a linear path as inputs change (continuous)	Class of deep ANNs designed specifically to analyze visual imagery	Class of deep ANNs that involves directed cycles in memory	Agent learns from experience	Transformers & Deep Reinforcement Capabilities
Example Use Case	Recognizing the type of HVAC Fault that Occurred in Equip.	Building Energy Demand Forecasting Time Series Forecast	Advanced Image Recognition (2d biometric sensors) Occupant Emotion	Building or City Load Prediction	Multi – Energy System Complex decision making	Chat-based Facility Mgmt. Support – Space Utilization
Illustrative Players	SIGHT MACHINE, yelp, sparkcognition	veros, salesforce, celect	Affectiva, cortica	PRESenso, maisense, FREESCAN	ISEE, deepvu, doraboot	OpenAI, Synthesis AI

Many Overlapping Terms & Technologies

The more advanced analytics becomes, the more beneficial for data scientists to implement automation. Automated ML models can solve more complex problems than traditional analytics and data analysts can solve.

Data Science the overarching umbrella that covers a wide range of tasks performed to find patterns in large datasets, structure data for use, train machine learning models and develop artificial intelligence (AI) applications.



Data analytics is a task that resides under the data science umbrella and is done to query, interpret and visualize datasets. Data scientists will often perform data analysis tasks to understand a dataset or evaluate outcomes. Types of data analytics include:

- **Prescriptive analytics:** predicts likely outcomes and makes decision recommendations
- **Predictive analytics:** helps to identify trends, correlations and causation within one or more datasets
- **Diagnostic analytics:** helps pinpoint the reason an event occurred
- **Descriptive analytics:** evaluates the quantities and qualities of a dataset

Artificial Intelligence: Enable computers to perform complex intellectual tasks like humans, including decision making, problem-solving, perception and understanding human communication.

Machine learning, or "applied AI", is one of the paths to realizing AI and focuses on how humans can train machines to learn from multiple data sources to solve complex problems on our behalf. In other words, machine learning is where a machine can learn from data on its own without being explicitly programmed by a software engineer, developer or computer scientist. ML Provide a way for systems to synthesize data, learn from it and use the insights to improve over time.

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Overview of AI in Intelligent Buildings

Trends & Forces Driving the Market for AI in Intelligent Buildings

As the needs of building operators and occupants evolve, the following trends and forces are paving the way for Intelligent building AI and ML applications

Technology Trends

New wave of (IoT) devices sensor data everywhere processed from the edge to the cloud with a rapid decline in hardware, compute and data storage costs

80% of the worlds' data is unstructured and is set to grow from 33 zettabytes in 2018 to 175 zettabytes, by 2025(1). AI / ML can be leveraged in order to make use of this information.

Much of IoT (sensor) data is unstructured and machine learning models can be used to classify data (supervised) or discover patterns (unsupervised):

- Can now use unstructured data from sound, image, and video to predict part failure in a building,
- Detect someone who is uncomfortable with their current environment,
- Gain insights on how customer interactions with technicians (customer service can be improved)

Emerging democratization of AI & ML with no-code/low-code tools that do not require programming skills

Customer Trends

Building occupants needs and expectations are evolving and building operators must learn to identify occupant pain-points before they churn which can be solved by ML algorithms including predictive personalization

Opportunities for improved customer experience by connecting data across systems include data points from multiple people and buildings

Owner / Operators need to improve ROI while lowering costs and are more willing to use and interact with AI/ML

Shift from COVID back to hybrid work rebalances expectations from office environment

Socioeconomic Trends

Standards development and AI ethics policies are developing worldwide

Though data privacy and data ownership concerns are growing this is not reflected by a change in consumer behavior

A drive to reach Net Zero admissions and improve ROI on building systems will require human and artificial intelligence

Supplier Trends

Barriers to scaling AI & ML initiatives to drive innovation and boost revenue includes difficulties in customizing models, insufficient infrastructure, and the AI & ML skills gap

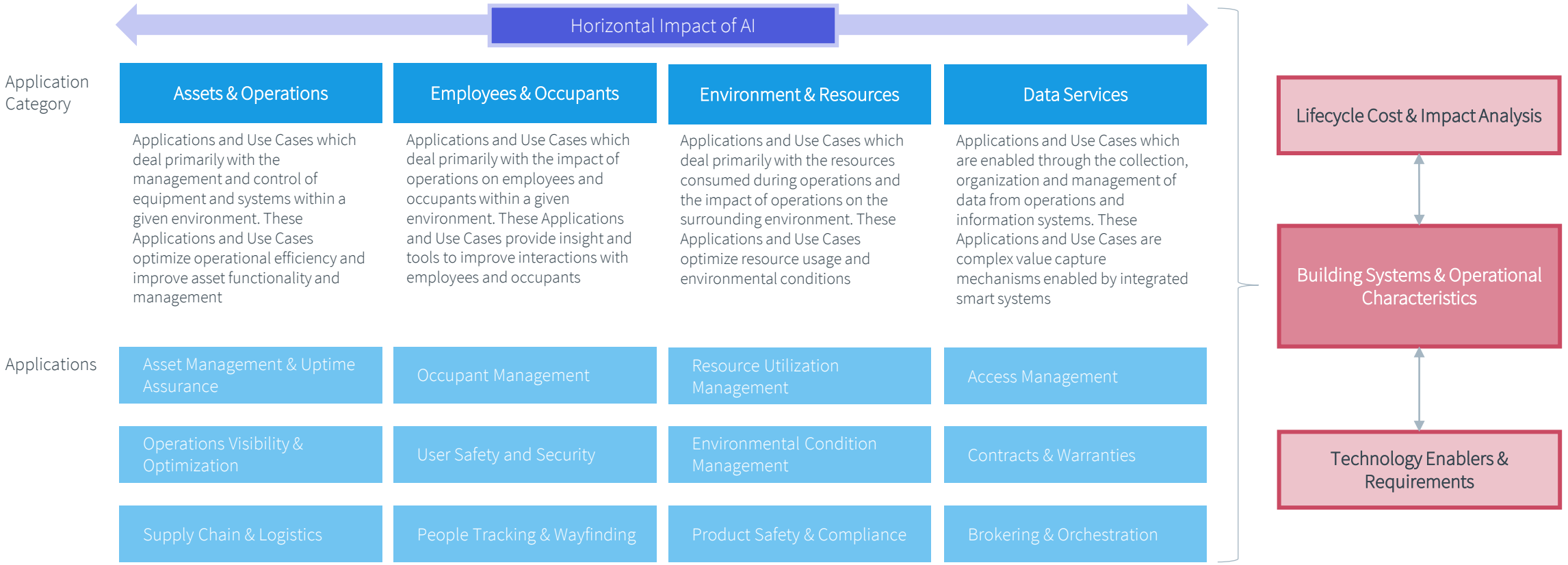
Organizations are looking to do more with their AI & ML investments than simply automate some tasks to gain efficiency:

The need to innovate, create new products, services and new lines of business, and to stay competitive in a rapidly evolving market

Recent advancements in LLMs and generative AI are allowing players to launch generative AI platforms to generate content, translate text, and provide interaction with building documents

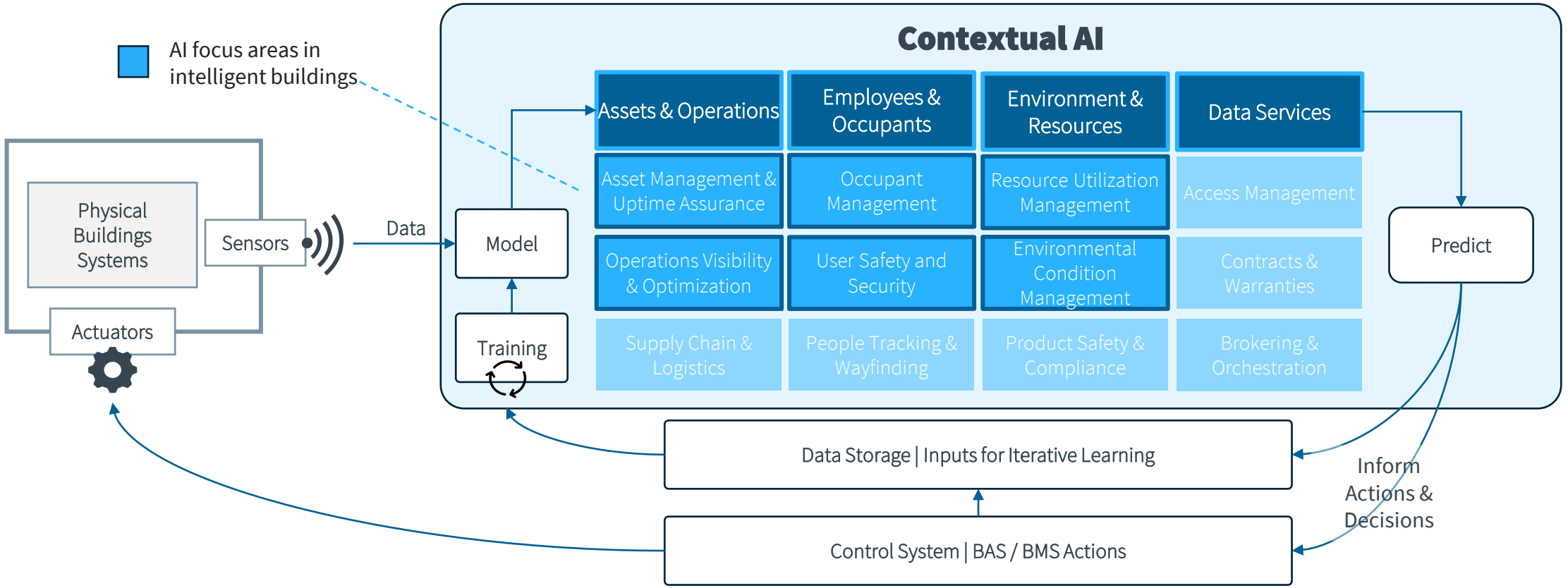
AI can have an impact across many Intelligent Building use cases

Solution development, deployment & management must be rooted in a building's core operational systems & processes



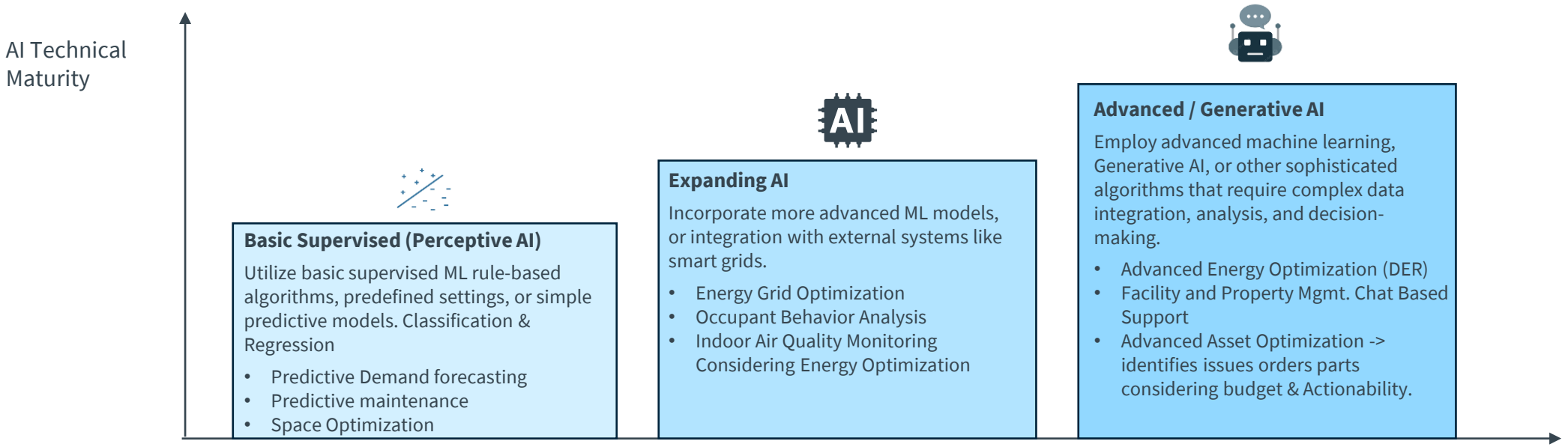
AI Value Lifecycle Across Intelligent Building Systems & Apps

AI is only as valuable as the quality of data, and context of deployment or usage.



AI Technologies will Evolve from Basic to Advanced Over Time

As AI proliferates, the underlying technology and value-creation mechanisms expand from basic to advanced and generative, enabling more complex, integrated, and automated applications



Utilize basic supervised ML rule-based algorithms, predefined settings, or simple predictive models. Classification & Regression

e.g., Thermostat Control, Lighting Automation, Basic Energy Monitoring, HVAC, Metering, Lighting Fault Detection, Basic Predictive Maintenance.

(Multiple Inputs, systems, layers of AI Complexity) Incorporate more advanced ML models, deep learning, or other sophisticated algorithms that require complex data integration with external systems like smart grids, analysis, and decision-making.

e.g., Deep Learning, Neural Networks, Convolutional Neural Networks, Recurrent Neural Networks, Bidirectional (RNNs), reinforcement learning or combining two basic supervised AIs together

Fuses Data and context of building systems, occupants, & outside world (internet, weather, traffic, utilities, medicine) together
e.g., Transformers (Advanced LLMs) Generative AI (Text, Image, Code), Deep Reinforcement Learning

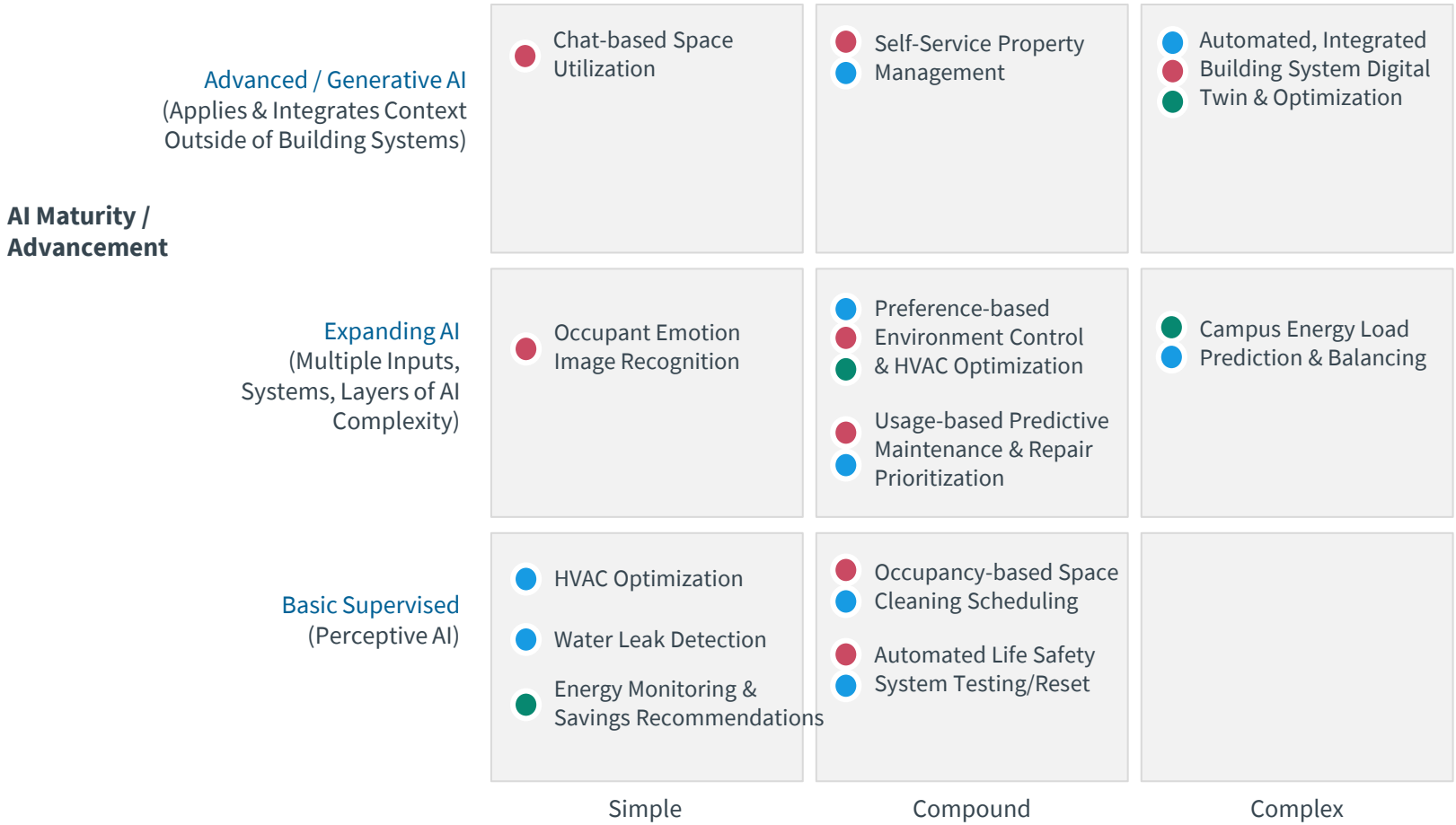
Poll #1

In which intelligent buildings applications would you expect AI to be adopted the quickest?

1. HVAC Optimization
2. Lighting Control
3. Security and Surveillance
4. Energy Management
5. Predictive Maintenance
6. Space Utilization
7. Access Control
8. Indoor Air Quality Monitoring
9. Occupant Comfort and Experience
10. Smart Grid Integration

AI Complexity Expands and New Value is Created as Multiple Systems and Layers are Integrated

Intelligent Building AI Use Case Map *with Examples*



AI can be applied to many intelligent building systems, with value potential increasing as AI improves and automatically optimizes more, integrated building systems

Assets & Operations

Employees & Occupants

Environment & Resources

Example AI Applications in Buildings

Predictive Maintenance & Optimization

HONEYWELL FORGE

Predictive Maintenance helped Amway improve gain 15% incremental increase in 'Excellent' rated zones (an increase from 23 to 29)

Johnson Controls

OpenBlue Life Sciences leveraging data analytics reduced costs, and capital expenditure and improved greater shift usage-based maintenance.

facilio

ICD Brookfield place, Dubai, future-proofs of their-state-of-the art 54 story office and retail property with Facilio's connected buildings. Facilio leverages 120+Automated FDD rules for proactive maintenance. Before there was manual intervention, and reactive maintenance directly impacting the asset health and lifecycle.

Energy Management

Hank A JLL company

Hank's AI-powered HVAC optimization solution provides a new, innovative way to reduce energy consumption and operating expenses.

SHIFT ENERGY

SHIFT Energy's, cloud-based solution uses AI to deliver autonomous optimizations automatically, working with existing building control systems and third-party data sources to cut energy consumption, costs and carbon emissions.

inteliGlas

Inteliglas leverages data from various buildings systems to developa complete picture of energy usage within the building, and incorporates machine learning to reduce and optimize energy use over time.

Occupancy, Safety & Security

Verkada

Verkada's are designed to detect and alert to potential threats in real-time. Through advanced ML algorithms, the technology continuously learns from data patterns, allowing more accurate threat identification.

PassiveLogic

Leverages physiological digital twins of occupants across additional metrics such as humidity, light levels, radiant temperature, and even clothing.

Schneider Electric

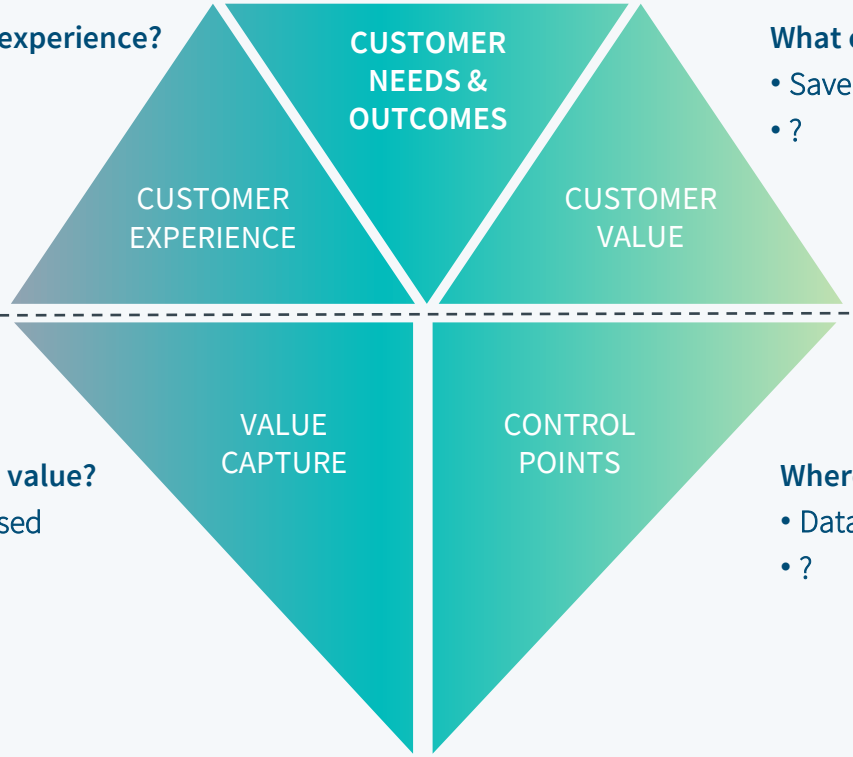
While not one of the original goals of the AI project, after evaluating the project outcomes, management discovered that by reducing the indoor temperature variation in the buildings, the AI solution was able to improve the overall occupant satisfaction in the school buildings with a **23% reduction in complaints.**

AI Solution Positioning, Value Creation and Value Capture

What do customers need?
- Save on energy costs
- ?

What is the desired customer experience?
- "Set it and forget it"
- ?

CREATING VALUE
(CUSTOMER FACING)



What creates value for customers?
- Save money
- ?

CAPTURING VALUE
(GROWTH and PROFIT)

How should suppliers capture value?
- Freemium model with app-based interactions
- ?

Where are the control points for suppliers?
- Data management and AI models
- ?

Poll #2

Is your company developing AI solutions for intelligent buildings applications?

1. Yes, we have AI solutions that are currently deployed in the market today
2. Yes, we are in the pilot testing phase.
3. Yes, we are actively developing AI solutions.
4. Yes, we have just started exploring AI solutions.
5. No, but we are in the research phase to understand AI's potential.
6. No, but we are planning to in the near future.
7. No, we currently have no plans to develop AI solutions.
8. No, but we partner with companies that do.
9. No, due to budget constraints.
10. I don’t know or am not familiar with AI in our organization

What are the biggest challenges in incorporating AI into your company’s solutions?

1. High implementation costs
2. Lack of skilled personnel
3. Data privacy and security concerns
4. Integration with existing systems
5. Unclear ROI (Return on Investment)
6. Resistance to change within the organization
7. Regulatory and compliance issues
8. Complexity of AI technology
9. Insufficient data quality
10. Long development timelines

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Open Questions for Discussion

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Intro to InteliGlas

Questions & Considerations for Discussion

Questions & Considerations

- Are customers ready for AI solutions today? If not, why not and how might suppliers better support customer development?
- Are internal AI efforts focused on optimizing internal business operations or customer-facing products and solutions? How might this evolve over time?
- What are the best opportunities to increase the value your company provides to customers? How can AI further augment that value?

Next Steps for Further Research, Analysis & Action

- **Determine specific systems and opportunities to target with AI initiatives based on current company offerings, technology assets, and customer needs to focus AI strategy.**
  - Analyze current adoption of AI in intelligent buildings to understand where customers are focused, and align with your business capabilities to determine the most attractive opportunities
- **Analyze partnership, venture building, joint venture, or corporate development opportunities for AI or IoT as it relates to intelligent buildings.**
  - Identify key partnership and development opportunities based on the available solutions in the market today and how customer needs are evolving

❮ THANK YOU! ❯

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Thank you!