EMBA Innovation, Digitalization & Entrepreneurship

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# Harnessing AI for Continuous Innovation: Building Sustainable Innovation Ecosystem Through Organizational Data

A Master's Thesis submitted for the degree of
“Executive Master of Business Administration”

supervised by
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Vienna, 14.01.2025

# Affidavit

I, **DAMIR GAVRIC, MSC**, hereby declare

1. that I am the sole author of the present Master's Thesis, "HARNESSING AI FOR CONTINUOUS INNOVATION: BUILDING SUSTAINABLE INNOVATION ECOSYSTEM THROUGH ORGANIZATIONAL DATA", 83 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

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## Abstract

Artificial Intelligence (AI) as a tool has the power to help companies to establish an inclusive, continuous innovation ecosystem. Such ecosystem addresses the main problems of traditional approaches that are not able to create and keep the momentum of innovation in the companies being periodic in nature and greatly affected by personal biases of the decision makers.

This thesis proposes the continuous, AI supported, innovation ecosystem where all ideas are collected, logged, supported by data and constantly re-evaluated and ranked in real time enabling that solves the main downfalls of traditional model and creates ecosystem that integrates and utilizes collective creativity of all employees.

## Contents

# 1 Introduction

## 1.1 Background and Context

Innovation is a fundamental requirement for competitiveness and growth in a modern business environment. To maintain relevance in today's rapidly evolving markets organizations are required to continuously innovate and adopt. This led to the innovation process itself no longer being limited to the Research and Development (R&D) departments but becoming an important organization-level capability deeply embedded in its structure (Tidd & Bessant, 2018). However, many companies are still struggling to develop and sustain a culture of continuous innovation due to many factors such as siloed departments, lack of internal communication, fragmented data, and lack of internal support (Birkinshaw et al. 2011).

The emergence of widely available Generative Artificial Intelligence (AI) models, ChatGPT being the first one released in November 2022, has greatly contributed to raising awareness of how powerful AI can be. The fastest adoption in the history of new technologies, with ChatGPT reaching one million users in five days compared to months of previous record holder showed that this technology is widely accepted by the people.

Companies have recognized that this new technology can be used to help them to develop and improve their innovation capabilities. The ability of Generative AI to encompass vast amounts of data generated by companies, and based on those data, generate and communicate new insights and results in an organic way easily digested by people can be utilized to drive innovation (Agrawal et al. 2019).

"The State of AI in early 2024" (McKinsey 2024) reported usage of AI in companies has reached 72% (used in at least one function) globally, while usage of Generative AI specifically has doubled from 33% in 2023 to 65% in 2024. The same report also states that there is a significant push towards further integration of AI, where the number of functions that have integrated the AI is on a constant rise with 53% of companies globally using AI in at least two functions.

AI today has transformed from being an ordinary tool and became a strategic asset that can significantly transform how companies innovate and operate. With AI integration into the innovation process companies can greatly improve innovation workflows themselves, improve on decision making and break down internal functional siloes starting cross-functional communication and collaboration. These

powerful features make AI an essential component of modern innovation ecosystems (Brynjolfsson & McAfee, 2014).

This thesis explores how can AI serve as a strategic asset that can help create and foster a system for continuous innovation. With a focus on AI's ability to collect, analyze and communicate all the organization's data, this research seeks to develop a framework for continuous data-driven and adoptable innovation framework.

## 1.2 Importance of Innovation

The dynamic global economy constantly pressuring organizations to innovate and adapt to the changing market conditions. Innovation is seen as a key component driving this adaptation of the companies, and helping them to differentiate themselves from the competition and meet the market needs (Schilling, 2019). A 2020 survey by McKinsey & Company showed that innovation is recognized as critical to business growth by 84% of executives, but only 6% are satisfied with the performance of innovations.

This discontinuity between willingness and need to innovate and actual innovation performance shows the need for the implementation of new tools and changes in innovation processes.

The modern innovation process is fueled by data. Companies today generate huge quantities of data. This data comes in different forms, it can be structured and unstructured including internal operational data, documents, internal communication, customer feedback, market trends, experiences from previous projects, different logs, etc. However, due to the overwhelming complexity and amount of this data, many companies struggle to effectively utilize them as a powerful foundation for innovation (Davenport & Ronanki, 2018).

AI as a technology has emerged as a possible solution to those challenges. With its ability to automate the process of collection and analysis of the data and its ability to communicate the results in organic and understandable ways, AI can help companies to identify in real-time patterns and trends or even changes and potential threats that may otherwise remain hidden. AI can also be used to assist in refining innovative ideas by providing real-time feedback and additional context on their feasibility and alignment with organizational business strategy and goals (Shrestha, Ben-Menahem, & von Krogh, 2019).

## 1.3 The Role of AI in Enhancing Innovation

One of the key benefits of AI integration is its ability to break down siloes inside the organization. In traditional settings, the innovation process is often obscured by fragmented, often very limited communication between departments which limits the flow of ideas and reduces their potential (Birkinshaw et al. 2011). AI can help break down these barriers by providing a centralized platform where data from all departments and all other areas of the company are collected, analyzed, and shared. This creates an overview of innovation opportunities and ensures that decisions are made based on a full understanding of the organizations resources, goals, and capabilities (Chui et al. 2018).

This environment can lead toward enhancing employee engagement with innovation simply by making the data more easily available and easier to interact with. Instead of relying to other colleagues and departments to provide the data and additional analysis and context, also implementing the subjective positions in the process, AI can provide easy-to-understand insights that are understandable even to non-technical employees. The result of this process is democratized data, easily available to the employees, encouraging them to join the innovation process and create a culture of continuous innovation (Guenole et al. 2017).

## 1.4 Purpose and Objectives of the Research

The primary objective of this research is to explore how AI can be strategically integrated into an organizational innovation process and as a result, create a sustainable continuous innovation ecosystem by addressing the following objectives:

- *Strategic AI integration:* investigate methods to integrate Generative AI into existing innovation frameworks to enhance data-driven decision-making and collaboration processes.
- *AI as a data communicator*: explore how Generative AI can be used as a tool to communicate data in an easily accessible way that supports creativity and problem-solving and enhances cross-functional collaboration across all levels of an organization.
- *Continuous innovation ecosystems:* utilize AI to ensure a continuous flow of innovation aligned with business strategies and adaptive to current market conditions.

By following these objectives, the research will contribute to the development of a strategic framework that enables organizations to utilize AI and achieve continuous

innovation. This framework will focus on practical and non-technical approaches for AI integration ensuring that AI is used as a tool to support human creativity and ingenuity rather than to replace them.

## 1.5 Structure of the Thesis

The thesis is structured as follows:

Chapter 1: Introduction: provides a foundation for further work and explains the main goals of exploration for the thesis.

Chapter 2: Literature Review: this chapter will provide a detailed literature cover of existing research on innovation management, AI in business, and data-driven innovation processes. Potential gaps in literature, related to the topic of the thesis will be presented here.

Chapter 3: AI as a Tool for Data-Driven Innovation: this chapter will explore how can Generative AI be used to manage, analyze, aggregate, and communicate organizational data with a focus on data democratization, enhancing and supporting creativity, and assisting in problems solving process.

Chapter 4: AI Supported Continuous Innovation Ecosystem Considerations: describes the main features and advantages of a continuous innovation ecosystem.

Chapter 5: Technical Components of the System: describes the necessary components of the proposed AI supported continuous innovation ecosystem describing the user space, ranking methods and providing insight of how the scoring system applies to real life cases.

Chapter 6: Key Performance Indicators (KPI's): designs a comprehensive set of KPI's to monitor the state of innovation culture in general and business results of innovations.

Chapter 7: A Strategy to Implement AI to Innovation Process: investigates the strategy that can help the companies to implement AI in their business processes and integrate it into their innovation process.

Chapter 8: Conclusions: provides an overview of key findings and provides a way forward for further study.

# 2 Literature Review

## 2.1 Overview of Innovation Management and Ecosystems

Modern understanding of innovation starts with the work of *Joseph Alois Schumpeter*, who is considered to be the father of innovation theory. In his book "*Capitalism, Socialism and Democracy*" he describes innovation as "*creative destruction*" a cyclical force that rules and drives free market economies by destroying the old reality and creating a new one (Schumpeter, J.A. 1942.).

This understanding of innovation did not change much. Tidd and Bessant (2018) define innovation as "'*the process of turning opportunity into new ideas and of putting these into widely used practice*". Innovation now evolves into a discipline that is no longer reserved for people born with a "gift" but rather a skill that can be learned and practiced (Drucker, P.F. 1985). Entrepreneurs can use this discipline as a tool to create new value.

Traditionally innovation was considered as a separate discrete process inside organizations, usually taking place inside Research and Development departments, detached from the rest of the company. This outdated approach is being replaced with modern frameworks where innovation is considered an organization-wide process with everyone contributing to the innovation process (Birkinshaw et al. 2011). These frameworks emphasize cross-functional communication and collaboration between all levels of the company, all working together on new ideas.

This change in mindset was further followed by a second major step in the evolution of innovation and from these innovation frameworks, the idea of innovation ecosystems was born. An innovation ecosystem is a concept that connects networks of different parties in a collaborative body that works together to develop and sustain innovation (Adner, 2017). Reaching beyond the internal resources and efforts, innovation ecosystems enable external collaboration, communication, and sharing of resources, knowledge, and experiences (Davila et al. 2013).

Managing these ecosystems is complex because of the nature of innovation ecosystems requiring involvement of many different actors with different objectives, capabilities, and resources. In an ecosystem setting, effective innovation management requires all involved parties to align activities and ensure that those activities are guided by and in line with an organization's strategic goals. Keeping an innovation process flexible and responsive to change and new opportunities while

staying in line with a long-term business strategy represents a key challenge in the management of innovation ecosystems (Pisano, 2019).

Modern companies generate and collect massive amounts of data. Now as a resource, those data can be analyzed and used to identify and predict trends. This concept where big data analytics is used to assist innovation is called data-driven innovation (Davenport, 2018). This data coming from different sources in different forms represents a big challenge to properly aggregate and analyze, a task that requires advanced analytical tools.

## 2.2 AI Adoption in Business Practices

The data and the AI are closely connected. Without the data to feed it, AI would only exist as a theoretical framework. The large amounts of data collected by organizations and the complexity of analyzing and utilizing those data are seen as the main forces responsible for the quick adoption of AI and its benefits (Brynjolfsson & McAfee, 2017). This, as a consequence, leaves more time and human resources to focus on strategic tasks (Chui et al. 2018).

In practical terms, AI is already highly utilized in certain elements of the value chain. Successful use is evident in Human Resources where AI is used for screening CVs and applicant tracking as part of an advanced application tracking system (ATS). In marketing and sales, AI enables more personalized approaches and customer targeting and communication. Helpdesk chatbots are replacing human agents in customer support. In financial sectors, AI is used for real-time transaction monitoring enabling institutions to identify fraud or suspicious behaviors alerting the authorities almost immediately. All of these examples demonstrate the main advantage of using AI to analyze huge datasets that would be almost impossible using a manual approach.

On top of these more analytical AI usages, generative AI (GenAI) with its ability to predict and generate new outcomes based on historical data and many different input parameters proved to be very useful in practical applications. By reducing the requirements for manual work, organizations are now able to experiment more freely. Organizations are now able to generate and investigate new products, designs, and strategies and even simulate possible outcomes in a fraction of the time compared to manual work (Kaplan & Haenlein, 2019). GenAI can create and test many potential options greatly enhancing the innovation process and general freedom of it.

The collaborative potential of AI is also very important. In a sense, AI is a tool for enhancing the collaboration between humans and machines by enabling easier more organic communication between the two, supporting human creativity instead of replacing it (Kaplan and Haenlein, 2019).

## 2.3 Data-Driven Innovation (DDI): Concept and Practice

Big data is an essential component of Data-Driven Innovation (DDI). Big data represents a diverse set of data, including both structured and unstructured data, that constantly grows. It describes the reality of modern-day companies where big amounts of data are generated on a daily level. In combination with advanced analytics tools, such AI, this data can be used to improve, add more information to, and guide the innovation process. Combining the different data sources such as internal data, current market trends, customer data, and other organizations can make more informed decisions that are in line with defined business goals (Davenport, 2018). This enhanced process eliminates things such as intuition and gut feeling and guides the decision process more toward data-supported empirical evidence.

One of the main advantages of data-driven innovation is a reduction of uncertainty in the process of innovation. In the traditional innovation process, a big part of the risk came from assumptions. These assumptions involved technical capabilities, customer needs, and market conditions. Using data-driven innovation these risks are greatly reduced. Assumptions are replaced by real data which provide a realistic and data-supported view of key components allowing an informed decision-making process to happen thus reducing the risk (Shrestha et al. 2019).

This new approach does not come free of troubles. It represents a great change in the company's workflow and change is always met with resistance. The challenge of embracing data-driven innovation involves technological and cultural adaptations.

In a technological sense, the company needs to be able to collect and store big amounts of data. This involves complex data management systems that often require a big change in organizational workflows. On the other hand, massive cultural change must happen inside the organization to embrace the new approach. Strong and committed leadership is required to support such a process from traditional toward informed and data-supported decision-making. Guenole et al. (2017) argue that to achieve this transition toward data-supported decision-making organizations must have proper infrastructure, talent, and processes. Without those key elements in

place, the company risks being overwhelmed by the volume of data available, which in that case becomes a problem rather than a tool.

Communication across different departments and timely reporting to all shareholders across the organizational structure is a necessity and a major challenge of the data-driven innovation process (Davenport, 2018). Data analytics results have no meaning unless they are communicated to the right people in a way, they can digest them easily and understand the key messages. AI implementation in this part of the process can ensure that the key messages are properly communicated and therefore, the innovation process will become an organization-level endeavor.

One of the best real-life examples of data-driven innovation is Amazon's usage of AI and machines, learning to optimize and automate its logistics and supply chain. There are four main components of their system: demand forecasting, usage of AI in the Warehouses, and optimized delivery routes. Being the e-commerce giant with more than 300 million active users worldwide, Amazon generates a vast amount of data and can collect this data at per-user level. By analyzing shopping habits, purchase histories, and browsing data Amazon can do analytical demand forecasts for specific products with great accuracy. This allows them to always provide needed products to customers with reduced stockouts. Their complex warehouses are almost completely automated utilizing robots to navigate the warehouses and deliver products to human employees optimizing the packing process and reducing errors. Delivery routes are optimized by analyzing real-time traffic conditions, weather data, and other delivery locations.

## 2.4 Challenges of Change

Changes are hard and often met with resistance, no matter how beneficial the change may be. When trying to integrate new technologies such as AI and new processes like data-driven innovation companies are often faced with problems. In this case, the issues are mostly related to company culture, detached and siloed departments and operations, and difficulties with data management.

Cultural resistance is rooted in the fear of the unknown. Although new technologies such as AI offer many benefits, employees may oppose it heavily, mostly concerned about being replaced by an AI or feeling overwhelmed by its complexity. Cultural change also means that the way people have worked traditionally is changing, requiring adoption and implementation of the new way. Westerman et al. (2014) argue that overcoming the insecurity and fear of the new technology requires that leadership

communicate to the employees about the strategic benefits of AI. The message must be clear that AI is a tool that will support their work and make it better rather than replace it. The training programs are crucial for acceptance, as they will make people more excited about the new technology and break the fear of being replaced.

An open collaborative structure between different entities within companies is a requirement for a modern innovation setting. Such environments support an open flow of ideas, information, resources, and knowledge. Although it looks like something that should exist by default in any organization, many companies are having problems achieving this. Birkinshaw et al. (2011) identify this issue as one of the major issues when it comes to innovation. In siloed structures, the data being collected and analyzed are used and serve only the purpose of that one entity without any use and consideration of the needs of others. If this structure is also traditionally how the companies were operated for a long time, and people are trained to work in such a way, already mentioned the cultural dimension is added to the problem. AI in these cases can serve as a focal point and a single source of truth making all the data democratized and available for everyone in the organization regardless of the department. Achieving this requires a cultural shift to happen.

Data management can cause a lot of challenges for a company to try to embrace a data-driven innovation. Although the company may be able to collect and store massive amounts of data, not all that data are structured and easy to analyze. A lot of data is unstructured, such as user feedback, social media, internal reports, different logs, and others depending on the specific needs of a company. To ensure that data are current and accessible to different employees, a company must implement complex data governance policies (Davenport, 2018). Guided by these policies, an AI can be used to analyze, summarize and report findings and trends based on all this unstructured data.

## 2.5 Innovation Frameworks

Innovation framework is a structured system used by companies to guide the innovation process. Its main purpose is to ensure that new ideas are developed in a way that they are aligned with strategic goals. It represents a set of rules and guidelines to take a new concept from an idea stage, in a systematic and structured way toward a new product.

Many innovation frameworks have been developed in time, each with its own way of guiding the process from idea to product.

One of the oldest innovation frameworks and still widely used is a *Stage-Gate* process (Cooper, 1990). In this framework, the innovation process is divided into stages, typically four, that involve collecting ideas, concept development, prototyping, and testing. Each stage is separated by a gate, with assigned gatekeepers, whose purpose is to either progress the idea to the next stage, modify it, or stop it (Figure 1). The advancement criteria are defined by a company. There are many variations of the Stage-Gate process developed over time but all are based on the same principle of stages and gates.

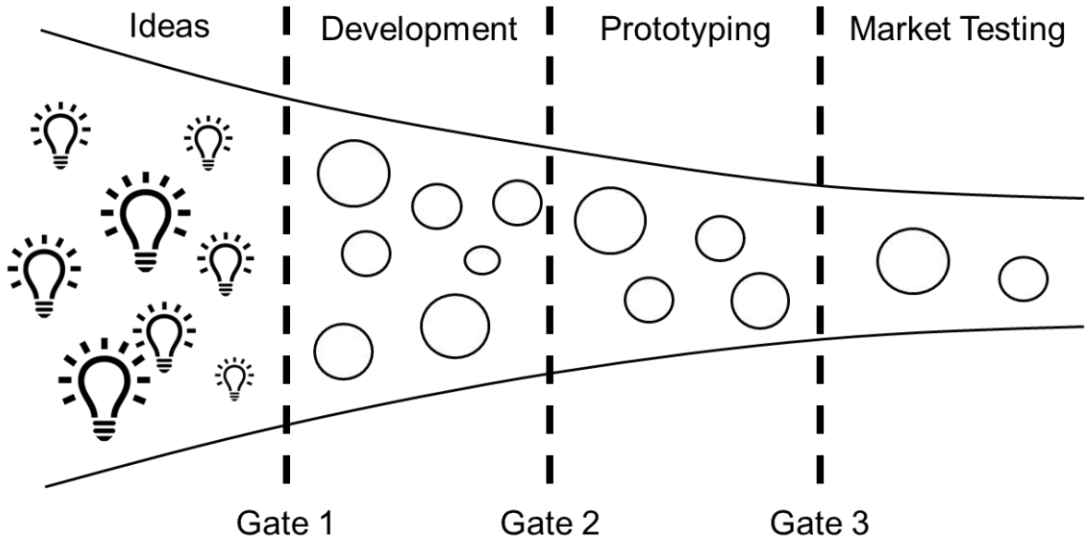


Figure 1: Stage-Gate innovation framework illustration

This framework allows a company to have full control of the process. However, the downside of this framework is that the whole process is very slow, complex, and heavy on bureaucracy. This rigid approach is not very usable in modern times where agility is required (O'Reilly & Tushman, 2016).

*Design Thinking* is a modern innovation framework, Figure 2. It is a non-linear and iterative process that involves understanding the users, challenging assumptions, and creating innovative solutions. It involves 5 stages: Empathize, Define, Ideate, Prototype and Test. This approach to innovation is recognized for its ability to deal with "wicked problems", problems that are unknown or not defined and require an out-of-the-box approach. In this framework, a deep understanding of the user's needs is required. Based on this, the process is iterative, and agile allowing quick testing of proposed solutions and further adjustments based on feedback (Brown, 2009).

Compared to the Stage-Gate process, this framework is much more effective and more suited for rapidly changing markets.

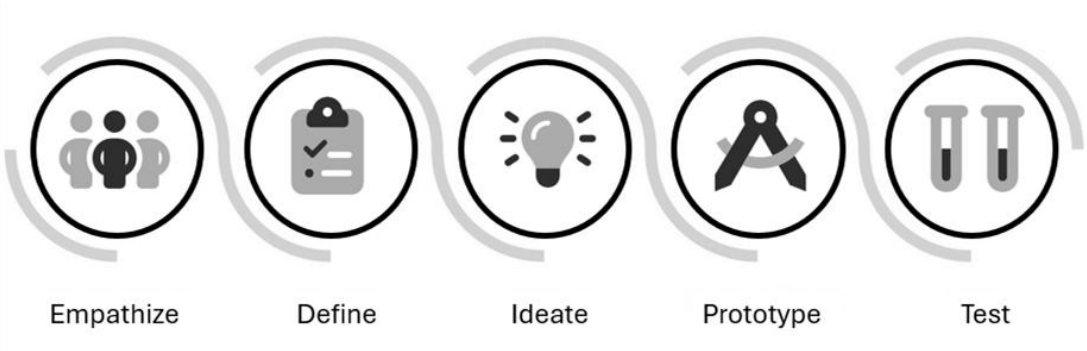


Figure 2: Design Thinking innovation framework illustration

*Lean Startup* innovation framework, designed by Eric Ries (2011), is an innovation framework popular with startups. It focuses on building a Minimal Viable Product (MVP) which helps startups to quickly test the market, get the customer feedback and then improve on the product and repeat the process. It is a very agile process that allows for quick improvements and product development with constant testing and customer feedback in mind. Lean Startup fits very well with companies operating in high-risk areas where the ability to experiment and modify the product quickly is required.

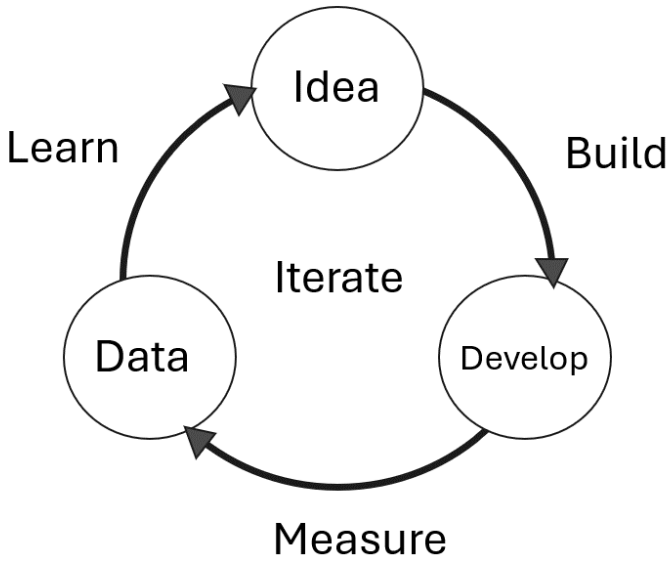


Figure 3: Lean Startup innovation framework illustration

Lean startup comes with several recognized flaws, major one being reported is that teams often loose planning and become driven with customer feedback only without a strategy in mind.

This approach is compatible with the idea of implementing AI with the innovation framework as AI can help quickly analyze customer feedback as well as general market data and competition and communicate all the results to the development team and make suggestions for improvements.

Open Innovation (Chesbrough, 2003) is an innovation framework developed to change the traditional siloed approach of R&D departments, Figure 4. It encourages cooperation with the external participants such as partners, universities, startups, customers etc. By opening their innovation process companies can benefit greatly by increasing their knowledge pool, lowering the costs of development and getting the products quicker to the market.

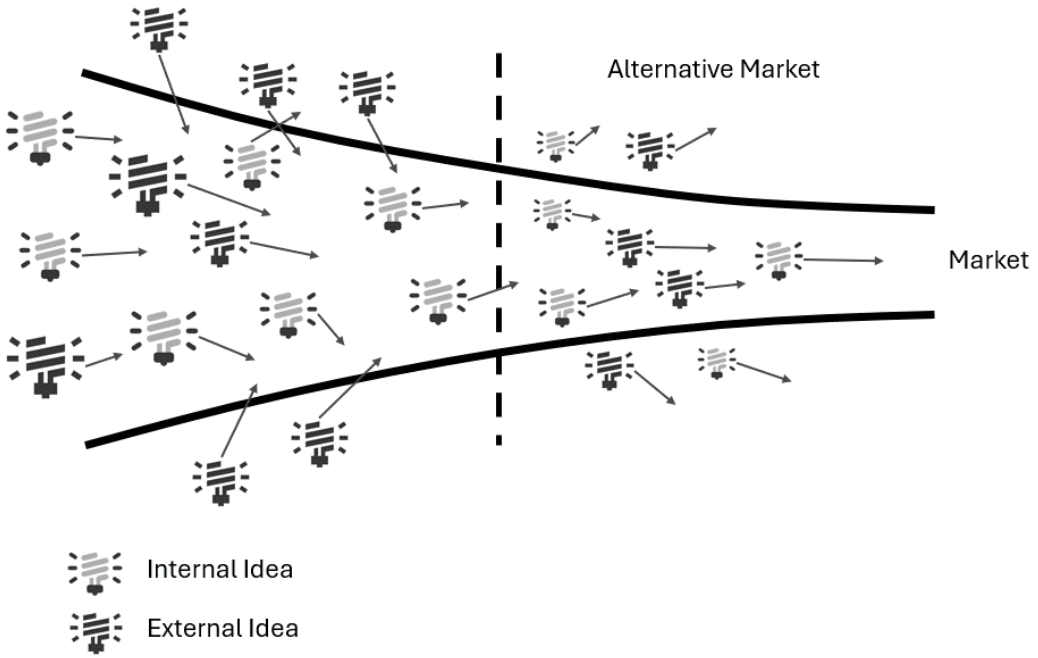


Figure 4: Open Innovation framework illustration

There are two main components of this approach: outside-in' and 'inside-out'. Outside-in is the most associated with and open innovation concept where resources are flowing from the external partners to the company. Much less used is the 'inside-out' component where the ideas and resources are allowed to flow out toward external partners. One iteration of Open Innovation is called Open Stage-Gate framework,

where the principles of Open Innovation are integrated with traditional Stage Gate process.

This framework requires big changes in both company culture and management approaches, thus also looking favorable to AI implementation which could greatly help with these main issues acting as a central hub for the project's knowledge and management.

From an AI integration perspective all of the current innovation frameworks would benefit from AI integration, as the problems of complex management and staying in course with brother business strategy and goals are shared among all of them. AI could provide insights that would help the team find the proper external support, help manage the project, increase the speed of prototyping and testing as well as handling and communicating all other aspects such as customer feedback, test results, management expectations etc.

## 2.6 Summary and Gaps in Literature

All the researchers agree that AI is a tool for the future, and with the data-driven innovation it will change the way the innovation as a process is handled. Each of the current innovation frameworks may benefit from AI integration and its way to handle, process and communicate all the data required by teams.

Yet the focus of this thesis, AI fully integrated as a center and core part of the innovation ecosystem as a tool that will enable companies to break down siloes and enhance knowledge flow and collaboration is not well documented and requires further investigation.

This gap will be addressed in this thesis by developing a strategic framework that will enable AI to be integrated as a core component and central point of an innovation ecosystem.

# 3 AI as a Tool for Data-Driven Innovation

## 3.1 Introduction

The need to capture and record data produced by companies was recognized at the very dawn of the digital age. The primary concern of the companies involved in the data industry was the growing volumes of the data and the storage cost. Another big challenge was related to the analysis of all the available data, which has surpassed the capabilities of traditional data management and analytics tools. Due to technological advancements, the cost of storing the data has fallen behind the cost of analyzing all the available data. These currents have led to the creation of Big Data followed by Artificial Intelligence.

AI, especially Generative AI, represents the next generation analytical tool capable of processing unlimited volumes of data finding current trends, extrapolating predictions and communicating the results. This chapter will explore how big data, and AI can work together and be the backbone of data-driven innovation.

## 3.2 Data Types in Organizations

The data generated by an organization can generally be categorized in three categories: structured, unstructured and semi-structured data.

*Structured data* represents highly organized, connected data that is stored in standard format in typically relational databases. It includes data such as financial data, customer data, sensors data, daily process data from sensors etc. This data is easily searchable, easy to analyze and report.

Main advantages of structured data are that they are easy to analyze and communicate the results to people. Setting up the infrastructure required to collect data is very easy with a wide variety of existing solutions. The disadvantage of structured data is that the flexibility of these databases is very low, and changing the database later in time may be very difficult. The data that can be stored in the structured database has low complexity and is limited to dates, text and numbers.

*Unstructured data* is data stored in its raw format without any modification to make it structured. This type of data includes emails, social media posts, videos, audio data, etc. In modern companies, unstructured data represents majority of total data generated by the company. The main advantages of over structured data are that the unstructured data are cheap and easy to store because there is no need to accommodate the relational database. Main disadvantage compared to structured

data is that unstructured data is expensive to process and analyze. From data security point of view, unstructured data can contain classified and sensitive data without any possibility to tag and protect those data.

Main differences between structured and unstructured data are summarized in the Table 1.

*Table 1: Summary of differences between structured and unstructured data*

| | Structured Data | Unstructured Data |
|---|---|---|
| Definition | Structured data stored in standardized form in schemas | Data stored in their original form without any structure |
| Examples of Data | Dates, numbers, addresses, names | Photos, videos, emails, social media posts |
| Storage | Relational databases | Data lakes |
| Analysis | Database query languages like SQL | Artificial intelligence, machine learning algorithms |

*Semi-structured data* represents data that are in the middle between structured an unstructured. Although it does not include rigid structure it includes certain tags or markers that allow certain level of structure.

### 3.3 Big Data and Artificial Intelligence

Big Data may be looked on as a layer on top of all the data collected by the company, a concept that connects structured and unstructured data. It refers to extremely big data sets growing in high velocity and volume with high level of variety.

The main characteristics of Big Data are volume, velocity, variety, veracity and value, commonly known as “five V”:

1. Volume: represents a volume of data generated from different sources (daily operations, internet of things, social media).
2. Variety: the number of different data types collected (structured, unstructured and semi-structured).
3. Velocity: represents the speed at which the data is collected and needs to be processed in real time.

4. Veracity: represents the quality of the data and how reliable the data are, because decisions should be made only based on quality and reliable datasets.
5. Value: represents the possible value gained by analyzing the data. This value may be internal (optimized process based on data analysis) or external (analysis results of customer profiles).

In the context of data driven innovation, Big Data is the input while the AI is the analytical engine.

How Big Data and AI complement each other and differences in key areas:

1. Focus:
    - Big Data: contains big volumes of structured, unstructured and semi-structured data collected continuously.
    - AI: Learn based on Big Data, analyzes all available data, identifies trends, makes predictions creates new outcomes.
2. Strengths:
    - Big Data: a rich source of potential information with ability to capture and store real time data regardless of the format.
    - AI: ability to analyze in real time large volume of data, identify patterns and generate new solutions based on inputs.
3. Requirements:
    - Big Data: requires specialized storage and processing solutions to handle big diverse datasets.
    - AI: big and reliable datasets are required for proper training of the AI models.

AI will learn based on Big Data and use it to generate new outcomes, which is the most important added value for AI supported data driven innovation.

## 3.4 AI for Data Aggregation Analysis and Communication

Data aggregation refers to a process of collecting data from different sources or datasets and of different types, as well as transforming this data into structured and more usable form.

The process of data collection and aggregation involves the following steps:

- Data collection: includes collecting data from various sources which can include anything ranging from spreadsheets, websites, social media, sensors, Internet of Things and any other source required. This data can be structured, unstructured and semi-structured.
- Data cleanup and transformation: collected data may contain different inconsistencies. Cleanup process includes handling these inconsistencies before the data are transformed into standard format and stored into database. These problems include duplicate data, missing data, data of poor quality etc.
- Data integration: data collected from different sources is integrated into one dataset. Collected data are mapped and merged based on common identifiers or keys.
- Aggregation: cleaned and properly formatted data is aggregated in this step based on specific criteria. Aggregation process involves grouping of data based on specific attributes or properties, calculating statistical metrics or creating variables.
- Analysis and presentation: this is the final step of the process in which aggregated data are presented in a form easily understandable and usable by humans, such as spreadsheets, charts or reports.

The main areas where AI contributes to data aggregation:

- Data cleaning: AI can analyze data, correct errors, remove duplicates and inconsistencies, and improve general data quality.
- Data integration: AI can integrate data from different sources by identifying common attributes and properties that connect them. This can significantly reduce the time and computing requirements.
- Analysis and presentation: AI has significantly improved analysis of the data by enabling companies to analyze huge datasets, identify trends and make predictions based on collected data. The reporting is where AI can provide unprecedented flexibility allowing people to simply ask in natural language for the things of interest with AI providing results in desired format, this supporting data driven innovation.

Currently the most popular AI models are called Large Language Models such as ChatGPT. They represent advancements of older Natural Language Processing models.

### 3.4.1 Natural Language Processing

The major problem with Big Data is how to make it easily accessible to all employees regardless of their technical skill level. This higher level of data democratization can have significant influence on employees by reducing the complexity of data access, time required for the data to be available to everyone who needs it and in significant measure it could reduce the frustration of the people due to waiting on data. AI eliminates the physical middleman between the data and people and opens the door for all at their own needs.

Natural Language Processing (NLP) is a technology that can create a bridge and enable easy communication between people and a computer. The primary objective of NLP is to enable computers to understand complex human input and generate response in human language that is meaningful and useful. It translates the natural way of human communication, regardless of the format, that is full of context meaning, contaminated by various dialects, education and other complex influences and transforms it into the format that computers can process.

NLP is a process that consists of the following key steps (Figure 5)

- *Tokenization* is the first step of the process. Here the large text is broken down into small parts such as words or phrases that can be easily analyzed by algorithm.
- *Pat-of-Speech Tagging* is a process of analyzing and recognizing individual words from the text, such as nouns, verbs, adjectives, etc. This step helps the algorithms to learn and properly define how words are related to each other in the text.
- *The Named Entity Recognition* process further identifies the names in the text including names of people, organizations, places and dates. Algorithms can recognize what places or people and at which time text refers to giving it strong context.
- *Sentiment Analysis* determines the tone of the text, giving the machine understanding of the emotional context the text. This is a powerful tool that provides real time insight on emotional responses of unlimited numbers of people from different sources on the requested topic.
- *Machine Translation* removes the language boundary as it can translate the text between different languages. People can communicate with the AI in their

primary languages making it easier for them to express their requests and to understand the results communicated back to them.

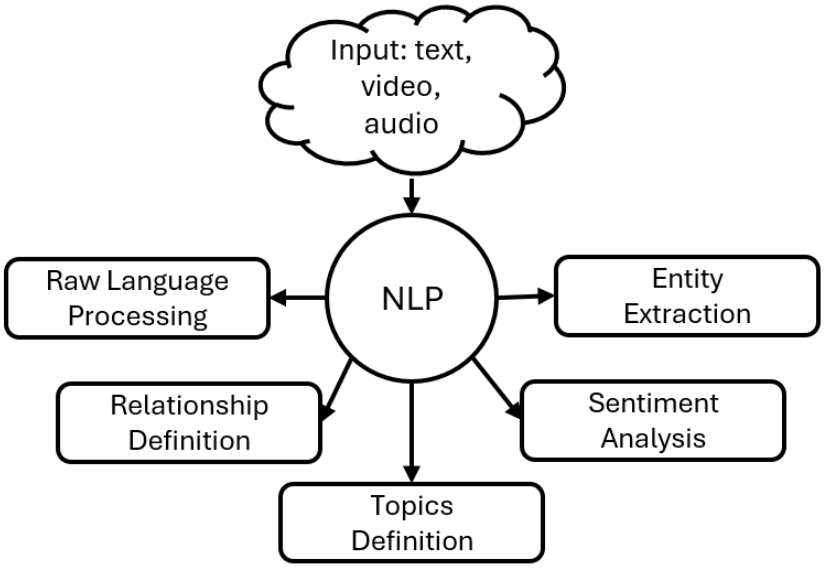


*Figure 5: NLP Illustration*

There are 4 major methods the NLP is currently used in companies: supervised, unsupervised, Natural Language Understanding (NLU) and Natural Language Generation (NLG) methods.

*Supervised NLP* is used where datasets where output data is based on a specific input. The process is first trained using a large volume of known and well-organized data, and from that it will learn how to replace missing data (to create correct output based on undefined input). Some companies use this approach to label documents based on specific tags.

*Unsupervised NLP* uses a statistical language approach to work with unlabeled data. The model will look for in the dataset for patterns and connections between the data. One example of usage of this model is autocomplete function where words and expressions are suggested based on the unlabeled input.

*Natural Language Understanding (NLU)* is a branch of NLP that analyzes the meaning of text by eliminating the impact of the structure of the text and extract true meaning of it. For example, NLU is capable of understanding that the actual meaning of he different sentences is the same, meaning that the same answer may answer a question asked in any way. It can also resolve ambiguities such as words with multiple meanings.

*Natural Language Generation (NLG)* is used to communicate to people using natural text. It is responsible for communicating the results in a human like manner. A chatbot with NLG can mimic interaction with a real human being in a customer support center.

These components can be combined in many ways, according to the needs of companies to produce specific and focused NLP models, used for different tasks. Recent trends are to integrate Supervised and Unsupervised NLP models for best performance and results.

The NLP still faces some challenges when it comes to properly understanding human language. Words that have multiple meanings and complex communication such as sarcasm still present a great challenge for NLP to properly understand.

The quality of communication coming from NLP is also very dependent on the size and the quality of data sets used for training of the model. Incomplete data sets and ones with low diversity lead toward the biased results toward the general feel of the dataset.

There are many current use cases of NLP that vary from customer relations, support centers to predictive text completions and sensitive data curating. Here are a few examples.

*Customer engagement* is a sector that is now heavily influenced by NLP technology. Chatbots and Voicebots can give human-like answers when interacting with customers or employees, at a comparably much lower cost. Companies are now able to offer chat support that is localized and centralized for world vide client base.

*Sensitive data curating* one more major application of NLP technology. It enables companies that store sensitive documents, such as legal, financial or healthcare information, to review the files and remove any sensitive data from reports. This is very important today when the governance of data is becoming stricter.

NLP is also used heavily in *business analysis* of customer feelings toward products or services. By analyzing written or spoken language, Sentiment analysis can detect and categorize words and phrases and categorize them positive, negative or neutral giving companies' context behind the customer base interaction.

### 3.4.2 Large Language Models (LLMs)

LLMs are developed as the next step of Natural Language Processing greatly improving the language-based tasks. LLMs, subset of Generative AI, go beyond

providing personalized responses based on keywords (NLP) and enable users to engage in meaningful conversations, provide answers to questions, create texts that can replicate styles of human writing.

LLMs are trained in vast datasets, on a scale of billions or nowadays even trillions of parameters from different sources. This diversity and scale of data enables them to produce many different styles and adjust the communication to people to a way they would digest the information easiest.

One important characteristic of LLMs compared to NLP is that it does not require to be trained on specific task separately. LLMs are highly agile and can perform different tasks based on the training done using the single data model.

Text ambiguity is one of the big limiting factors of NLP. Words that have the same meaning and complex communication such as sarcasm proved to be a big challenge for NLP. LLMs can understand complex language much better and can generate long texts that can follow and maintain coherence on multiple pages.

LLMs can learn new things and expand their capabilities when exposed to new data and can easily adapt to language changes.

The architecture of LLMs consists of the following foundational technologies:

- Deep learning enables LLMS to autonomously learn and make predictions using multi layered neural networks (Figure 6).

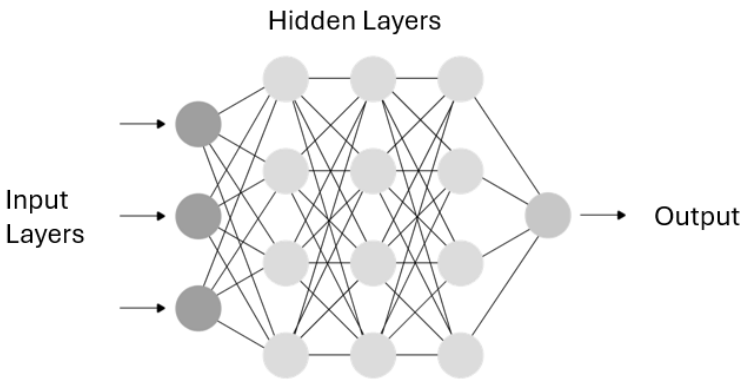


*Figure 6: Neural networks*

- Transformers architecture (Vaswani, 2017) enables the LLMs to transform an input sequence to output sequence, which also represents the origin of the name. It will learn the context of input data and generate new data based on that concept. One of the most famous and widely used transformer-based

architecture is Generative Pretrained Transformer (GPT) that powers ChatGPT.

- Self-attention mechanisms which enable LLMs to wight significance of each word in a text contribute to higher quality and relevance responses.
- Scalability is a core component and advantage of LLMs. They can be progressively trained with updated and larger datasets.

Main usage areas of LLMs are currently relying on their ability to produce coherent and relevant text. It is widely integrated today in business processes for translations, creative writing, automated reposes etc. One of the most used features is its ability to understand and summarize documents by extracting key information based on the context.

Major challenge of the LLMs can be summarized in these three categories: bias, interpretability and resource utilization:

- LLMs depend on good, clean and large datasets for training. If the dataset contains biases, the LLMs will learn about it and incorporate it in generated content.
- Complex architecture of LLMs is making it hard to understand why the system made certain decisions in a certain way, undermining the trust in the system.
- LLMs are computationally heavy to use, and the costs related are making them hard to implement in smaller organizations.

## 3.5 AI-Driven Creativity and Problem Solving

We can look at Big Data as a treasure chest of information that is not always obvious, requiring deep analysis to see the real treasures hidden inside, in this huge place full of data. AI has proven to be able to support people in navigating this space, it can open this chest and to show the treasure to all. AI and Big Data are proving to be a powerful tool helping people to get the information they need to support problem solving and creativity, both essential components of innovation process.

AI, with its deep knowledge of the entire dataset, can enhance creativity by identifying different patterns and trends and more importantly their interactions. Based on these insights it can generate a multitude of innovative proposals supported by data. Product design and the fashion industry are good examples as success is greatly influenced by current or emerging trends and the general opinions on target groups.

In product design, AI can analyze and combine knowledge such as historical success, current customer preferences, popular and emerging trends on unlimited number of sources from internal company data to social media, in real-time and generate proposals, thus helping humans in the innovation process. The same applies to the fashion industry were based on current trends and historical designs AI can greatly assist innovation process by generating multiple samples and thus supporting the creative process.

AI in both examples is greatly contributing to innovation by eliminating big part, if not all the manual work, and supporting the innovation by providing deep insights in the data that may be overlooked in traditional process.

If we look at the AI assisted problem solving the application is limitless. In complex organizations where huge volumes of data are collected, AI can help people to investigate multiple approaches by simulating different strategies in real time allowing informed data supported decisions to be made quickly and accurately. One example can be complex supply chain management. In this case AI can investigate and simulate multiple optimization solutions based on available data until the most optimal and cost-effective solution is found.

There are many examples of the integration of AI in the innovation process, especially in big companies. Walmart, the world's largest retailer, is a good example of how good big data and AI work together. Walmart collects 2.5 petabytes (2,500,000 gigabytes) of unstructured data from on average a million customers every hour, a true example of Big Data. The main goal for Walmart is to use Big Data and AI to optimize the shopping experience for its customers and to optimize its internal processes. Here are some practical examples and results:

- *More efficient pharmacies.* Walmart uses simulations to optimize staff scheduling in its pharmacies by predicting how much prescriptions of which sort is filled every day and determine the busiest time of the day. It increases efficiency and customer satisfaction.
- *Optimized checkouts.* Based on Big Data it is possible to improve checkout experience. With predictive analysis stores can predict demand at certain times and adjust the number of staff at the counters, and this is done for each store.
- *Optimized supply chains.* By using simulations Walmart can determine the number of steps and how many times the product is touched between the

unloading dock to the customer. By analyzing the data Walmart can greatly optimize transport lanes and routes taken by the supply fleet which is contributing to reduced transportation costs.

- *Product display and shell stocks in stores.* Based on customer preference and shopping patterns analysis, Walmart can optimize how to stock the shelves for each store to optimize sales.
- *Predict the needs of customers.* By analyzing the customer shopping history and other sources Walmart can predict the shopping needs of customers for the future. For example, if a customer has a baby AI can predict his need to purchase baby products and personalize the deals and offers through the mobile application thus enhancing customer experience and drive sales.

An example of Walmart shows how effective the integration of AI and Big Data is to support innovation. AI makes navigating the complexity of Big Data much easier, the data becomes democratized and ready to support and drive innovation at every level.

# 4 AI Supported Continuous Innovation Ecosystem Considerations

## 4.1 Introduction

In a traditional setting the innovation outside R&D and innovation teams is not as often in focus. Companies will periodically organize focused events such as innovation workshops, hackathons, or innovation marathons where *all employees* are encouraged to contribute with innovations. These events represent a rare opportunity for creative and innovative people to contribute to the company, represent their ideas and compete for funds or rewards. Although they can spark the innovation and creative energy they are focused, periodical, and they fail to help sustain the innovation culture and to exploit the creative pool of employees themselves. The following examples point to the challenges of these approaches.

*Innovation Workshops.* General Electrics (Govindarajan, V., & Trimble, C. (2005)) in 2004 organized an innovation support program called "Imagination Breakthroughs". The goal of the program was to encourage and motivate employees to innovate creating the innovation culture in the company in the process with the expectation of generating 100 million dollars in revenue with new products outside of GE main line of business. The workshop was held annually. The first workshop was attended by approximately 200 *executives and senior leaders* who proposed about 500 ideas. About 80 ideas were selected and brought forward for further development. At the time, GE had about 300,000 employees.

Although the workshop was reported as a major success emerging the projects such as “Ecomagination” and “Healthymagination” there are obvious downsides:

- The workshop is held annually. The employees have a long period of waiting time in between the workshops, during which time the frustration may rise, other opportunities may appear, or even the personal perception of the company may change drastically, all leading to the employees not presenting their ideas to the company or even taking them into competition.
- Limited attendance. The workshop was attended exclusively by senior management and leadership. If we compare the total workforce of General Electric, amounting to 300,000 people at the time this number is neglectable. It also means that one of the goals of the workshop referent to establishing and nurturing an innovative culture inside the company is not established simply because the approach is limited to the senior management layer, not including everyone else.

- Ideas left behind. After the event was over and the innovative ideas were selected, other ideas that were not taken further are dismissed resulting in many possibly transformative ideas being simply forgotten.

*Hackathons* are also popular innovation drivers in tech companies. The idea of a hackathon is that people investigate new ideas during short periods of time, usually 24 to 48 hours. Participants are encouraged to solve existing problems or come up with new innovative products. Hackathons are usually focused on participants solving the same problem in innovative ways. Facebook (Meta) is one of the major companies that has popularized hackathons as part of its innovation culture (Heiferman, D. 2011). Facebook Messenger and famous Like button are more famous among the results produced in these events. Although very popular, hackathons have a few major downsides:

- Focused on short term. Due to limited time duration of hackathons, they are expected to produce quick results, ones demonstrated possible at the end of the event. This also means that more complex ideas requiring time to properly design and showcase are by default not supported in these events.
- Stress risk. In a high intensity and high stress event like a hackathon a stress risk represents a real possibility.
- Limited in scope. Hackathons are usually focused events, limiting the possibility of complex and more diverse innovation to happen. Although there is an open-end format of hackathons where participants are allowed to work on any project they want, these are not so often in the industry.
- Same as in the case of a workshop, ideas and solutions that are not winning are usually left behind and forgotten.

*Innovation Marathons.* Unlike hackathons, innovation marathons are usually broader focus, with longer time duration spanning days or weeks, designed to foster deep thinking and collaboration on complex challenges. One of the more famous such event is Pfizer's annual "Pfizer Innovation Research" Initiative (Chesbrough, H. (2006)). Pfizer is a well-known pharmaceutical company that organizes the annual Innovation Marathon where employees can present their ideas. At the core of the event is Pfizer's mission to improve healthcare globally and participants are encouraged to tackle complex problems and contribute to the company mission, with the event lasting several weeks or even months. This format takes and improves on previous concepts such as workshops and hackathons. Unlike the General Electric workshop, the event is not limited to management, and compared to hackathons the

event has much longer duration and focus is only guided by company mission allowing creation of interdisciplinary teams that can produce complex innovations.

There are still downsides to the format. It shares the same problem of taking place annually in a specific time frame, not supporting continuous innovation and after the event is done only prized ideas are taken forward while others are left behind. There is also a transparency issue where people and teams may be rejected by the judges without sufficiently clear reasons being subjected to personal views and feelings leading to frustration.

## 4.2 AI Supported Continuous Innovation Ecosystem

When looking at the most impactful downsides of the current innovation systems such as focused formats, timed occurrences, limited attendance and competitive nature of these approaches it is clear that there is space for improvement. For an innovation framework to be truly integrated as a company cultural backbone it requires a ecosystem that can motivate and encourage all of the employees to contribute, to be motivated, willing to contribute freely without any fear of consequences.

There main aspects of such Continuous Innovation Ecosystem include:

- System is continuous: the innovative ideas can be submitted anytime
- System has a log of ideas: a bad idea for today may become a good idea in the future. No ideas are lost, only the ranking may change
- System has a transparent ranking system: to avoid all negative feelings and to enable and motivate people to work on improving the idea to pass the bottlenecks
- System should unlock and support creative potential of all employees: this means that the source of potential ideas is no longer limited to R&D departments, management or innovation events
- System is supported by AI: the role of AI in the system is to create a bridge between the employees, the data (including internal and external) and decision makers

In summary, Continuous Innovation Ecosystem encourages a continuous generation, logging and development of ideas in an open and transparent setting with the AI providing support on every step of the way. AI will also ensure the refinement and tracking of the entire log with live rankings updates as market conditions evolve.

### 4.2.1 Continuity as a Defining Feature

The continuous nature of the system serves several purposes. It will represent the innovation culture in the company. The message is that innovation is supported, appreciated and risk free for all employees. It also eliminates the issues rising from the episodic nature of traditional events. People are encouraged to report on innovative ideas anytime, while the ideas are still fresh, and people are motivated. There is no danger that someone must wait for a longer period to submit the idea and in the process loses interest, or for any reason chooses not to participate.

Continuity is beneficial for the employees and for the companies. It enables employees to work on their ideas from the inception point while the motivation is very high, and for the companies it will remove the danger that the innovation is simply ignored and lost between the events.

### 4.2.2 Logging of Ideas and Transparent Ranking

Every idea is logged, ranked and tracked regardless of the initial estimated value. In traditional approach the ideas may be dismissed on subjective decision making based on current feeling, lack of resources, or any other reason possible. After the idea is dismissed in such a way, it is deleted and forgotten. People who suggested the idea are left without clear answer why the ideas is rejected and abandoned leading to frustration. The company is also at a loss, because the idea is essentially deleted, and cannot be brought back for estimation if the circumstances change.

With a log system in place, every idea submitted to the system is recorded. AI support will enable continuous ranking based on real time data, providing clear and transparent feedback to the employees on why the idea is ranked in the specific way, and helping management to prioritize ideas best ranked against the real-time data.

This feature of the system will remove frustrations from the employees and contribute to rooting innovation culture inside the company.

### 4.2.3 Unlocking Creative Potential of Employees

The Continuous Innovation Ecosystem is taking the innovation outside of traditional R&D departments or other silos inside the organization and integrates every employee to contribute. In essence *every employee is an innovator*. From a warehouse worker that sees a flaw in the delivery system all the way to senior management level, everyone can contribute, no matter how small the contribution, when accumulated the impact can be significant.

The potential of the employee creative pool is often neglected. In a company with 1000 employees, if only 10% of them submit an idea it will mean that there are 100 innovation ideas for a company to consider and potentially develop.

As a successful example of the extended innovation pool, the "*Connect + Develop"* initiative from Procter & Gamble can be considered (Huston & Sakkab, 2006). The initiative originated when the company recognized that R&D alone could not support development, and a decision was made to extend the innovation pool and to get 50% of innovation from external sources. The result was that R&D productivity was boosted by 60% and many new products resulting in significant financial results for the company. The campaign was extended later to include internal employees from all levels to contribute to innovation.

### 4.2.4 AI Support

AI support is integrated in the very core of such innovation ecosystem. The enterprise-wide AI support will handle the following key tasks:

- *Enable data access.* AI can enable all the data available inside the company and relevant outside data are available to the employees and communicated in an easy-to-understand way.
  A user who has an innovative idea can start the process by simply explaining his initial idea to an AI, much like we use the popular AI models such as ChatGPT. AI, knowing what is going on inside the company can run a check and report if someone else is working on similar idea, communicate the requested data, check for existing patents, check how it fits with the current business strategy etc. Similar enterprise systems such as Cohere can already handle similar tasks but they are not orientated toward supporting innovation.
- *Break down the silos inside a company.* As a consequence of a previous point, siloed structures inside the company will be removed simply because the data they are working on are taken and made easily available to all employees. AI can be used to connect people to different teams or employees with similar interest and innovation approaches thus making them stronger and focused.
  Such unrestricted data flow will enable culture of collaboration and support among different teams, bounding the entire workforce and eliminating repeated work.
- *Manage user access permissions.* AI will manage data access based on employee's role in the organization. It will make sure to maintain data security

and at the same time provide the relevant data to support the innovation process. AI can make proposals to allow additional data access by collecting and preparing the data for access approval in a way that it is clear of what additional data are required to support the process.

- *Guide the innovation process.* AI can guide people through the entire innovation process, from the initial idea, through the formulation stage and finally submission.

  The system will make sure that all ideas are formatted in the standardized template for consistency, and to make the final submission process simpler.
- *Management reporting.* AI can summarize and create reports for management by focusing on the best ranked ideas. This will enable easier management involvement and support the innovation process.
- *Logging and tracking.* Standardized submissions will allow ideas to be logged into the registry. This step is in line with one of the foundations behind such a system which states that the idea which may not be a great one today may become valid in the future due to changing conditions.
- *Ranking and feedback.* To enable objective and unbiased ranking of the ideas is one of the main contributions of AI. It can evaluate ideas dynamically against preset KPI's such as market potential, required resources, impact to internal optimization, strategic alignment, competitor activity etc. The rankings are communicated clearly explaining the position of the idea on the list, providing insight into the ranking process and explaining potential steps how the position may be improved. Such a transparent process and feedback will promote ownership and reward the contribution to the company innovation pipeline.

## 4.3 Importance of Inclusive Innovation

There are many real-world examples of innovation originating directly from employees that were not directly involved in the innovation departments in the companies that had a significant beneficial impact on the companies showing the importance of an inclusive and open innovation framework where all employees are allowed to contribute. These examples are not limited to modern age or even to companies that have implemented models that support open innovation.

For example, Coca-Cola's Bottling Franchise Model was proposed in 1899 by two lawyers, at the time not even employed at the company. This innovative model that redefined Coca-Cola's core business by shifting from fountain soda sales to bottled soda allowed the company to expand into the giant it is today.

Post-it notes by 3M company were invented by Art Fry, an employee working outside the R&D department that recognized the potential for application of adhesive that was, at the time it was invented, considered to be useless because it did not match the R&D goals. Fry had a product idea for a note that does not leave a residue when stuck to a paper. This became one of the 3M's most successful products, revolutionizing office supplies.

To have a deeper dive to the open innovation models that support continuous innovation we will look at the currently used models such as Google's 20% Time Policy and Toyota's Kaizen (Continuous Improvement) Philosophy.

### 4.3.1 Google's 20% Time Policy

Google's 20% Time policy (Schmidt, E., & Rosenberg, J. (2014)) is a groundbreaking policy that allows employees to dedicate 20% of their work hours to work on projects that they feel passionate about. These projects can be anything the employees want to work on, already existing projects or completely new ideas. Employees are encouraged to propose new ideas and form a cross-functional team of like-minded people that are interested in the project and to bring these ideas to life.

Google supports these projects by providing access to tools and resources required to support the projects such as computing power, cloud infrastructure and technical support. Managers are also encouraged to be supportive, accepting experimentation and the possibility of failure as part of the culture.

Such a supportive environment is greatly encouraging independent and creative thinking. With the failures accepted as a part of the process and without any consequences to the employees working on them as a integrated part of the innovation culture, employees are encouraged to think without boundaries of their current job descriptions, positions and hierarchies.

Some of the more important innovative outcomes of this program are Gmail and Google News.

Gmail is the most important product of 20% Time policy. An engineer envisioned the better email service that overcomes limitations of the providers of the time being himself frustrated with the experience of using their services. The main improvement was the storage capacity, at the time Google offered 1GB of storage compared to about 10MB that required users to constantly delete messages. Also, the service was

free based on advertisement served to clients based on the content of emails. Today Gmail has about 1.8 billion active users worldwide.

Google news was as idea born after the terrorist attack on September 11, 2001. An engineer was frustrated because traditional news services were struggling to update news from different sources in such a catastrophic and rapidly developing situation. This transferred into an idea of a service that can aggregate and group up-to-date news from different sources based on the categories and provide a user with more easily accessible content. Google News was the first service outside the core business which at the time was an internet search engine.

20% Time policy has produced some of the Googles most important and iconic services. The policy and its results clearly show how open and inclusive innovation systems can be highly beneficial to their success.

### 4.3.2 Toyota's Kaizen (Continuous Improvement) Philosophy

As a contrast to the Google being modern western technology giant where innovation is assumed to be fostered there is a Toyota, Japanese car manufacturing company with its Kaizen Philosophy (Kato, I., & Smalley, A. (2010)). Kaizen can be roughly translated into “change for the better” or even when looked in the context of innovation it could be translated as "continuous self-development" which describes the philosophy and mindset of continuous innovation and improvement that involves all employees across the organization.

Kaizen is focused on small incremental innovations, based on the premise that the employees on site and close to process at every stage are the ones most likely to see the problem and propose an innovative solution. In practice Kaizen is implemented in daily operations and represents a major part of culture at Toyota through the Toyota Production System.

Employees submit thousands of ideas annually which are all collected into the Suggestion System. Company periodically holds events called “Kaizen blitz", a short-term focused event that allows teams to address specific problems. Regular reviews keep these innovations up to date thorough continuous feedback loops.

Accumulated incremental innovations at Toyota has over the years significantly impacted company’s results, helping it to keep the competitive edge and allowing every employee to feel appreciated and empowered to help the company.

A more famous example of benefits of this approach is from the 1980s from Georgetown, Kentucky where an assembly line worker has suggested to move tools closer to the line and reduce the time of using the tools. This simple and small innovation reduced the time required to build a unit and accumulated significant gains when applied to millions of units. This approach was later replicated in factories demonstrating how important even small improvements can be.

Both examples, including Google and Toyota, have shown that employees on all levels have a great innovation potential which is often not utilized by companies. By creating an environment where all can contribute, present ideas, experiment and fail without consequences is imperative to unlocking the innovative potential of the employees. Once this is achieved it can only benefit the company, proved right by many examples from the above from different times and companies operating in significantly different cultural environments.

# 5 Technical Components of the System

Technical components of such AI supported system can be grouped in the two main categories:

*User Space* which will include the place of interaction between people and the AI, for both employees and management. It includes a *portal for the employees*, *ranking list* and the comprehensive *dashboards and reporting section for the management*.

Ranking matrix designed to provide clarity and criteria for the innovation ranking. Clearly defined ranking criteria will help people to understand and accept the logic behind the final score and ranking of their ideas as well as the changes in ranking as list is dynamic and all items in it are constantly evaluated by AI against these defined criteria.

## 5.1 User Space Components

There are three main components of the user space required to create AI supported continuous innovation ecosystem:

1. An interactive portal for employees
2. AI governed dynamic open ranking list
3. Management branch including specialized dashboards and reports

### 5.1.1 Interactive Portal for Employees

*Interactive portal for employees* represents the starting point in the ideation process. Its purpose is to help employees through the ideation process by providing them with resources and AI driven support allowing users to ideate, refine and collaborate their ideas.

The key features of the portal include the following:

- *User interface* to interact with the AI and work on innovative ideas. This interface will provide user friendly place to develop and collaborate on new ideas. It will give users the possibility to interact with AI and gain access to all required data in real time.
- *Formatting and standardization* of proposals is an AI feature that will help users to properly format their work into standardized submission form.
- *Real time feedback* is AI feature that will help people to understand better their ideas. AI can provide multitude of complex feedback such as if similar ideas are already submitted in the system and initiate collaboration between

employees. It can provide additional data that can further develop the idea as well as new insights and guidance. The possibilities of this feature, which is the main feature and purpose of the employee side part of user space are endless and can be constrained only by company policies and the current limits of AI technology.

- *Collaboration tools* will enable people to form cross functional teams to work on similar interests and ideas. This is an integral part of the system imagined helping dissolve functional barriers to internal knowledge and data flows and support cross functional collaboration. It is an extension of the Real time feedback feature.
- *Progress tracker* is a feature that will help employees and teams to monitor the status of their ideas with more in-depth insight than the ranking list will provide. It will also include to highlight next steps, toward the idea development, possible collaborations opportunities with other teams, point major downsides that may occur due to recent developments such as changed market conditions, updated company strategy etc.

### 5.1.2 AI Governed Open Ranking List

The purpose of the list is to provide a transparent and public overview of all the ideas submitted into the system. The list is governed by AI and the rankings are constantly updated against the ranking criteria which will be discussed further in this chapter in more detail. The benefits of such lists are many and have been already discussed in previous chapters so here the focus will be on the essential features that such a list should have:

- Categorization of the ideas, all submitted ideas are automatically categorized by departments, a type (depending of the model used) or any other parameter or categorization system required by an organization.
- Transparency, all ideas submitted are ranked openly with a final score and the score is explained in the AI generated summary pointing out the reasons.
- Highlighting the best ideas across different parameters and categories defined by an organization.
- Dynamic updates as a key AI feature will provide dynamic updates of the rankings as well as explanations for changed ranking scores adding to the transparency of the whole system.

### 5.1.3 Reporting to Management

The management reporting component will help leadership to monitor the state of innovation and innovation culture in general across the organization and track progress with respect to company strategy goals.

This will include several dashboards focused on the following areas:

- Innovation requests dashboards to provide insight of the general innovation proposals categorized and visualized per different innovation types, departments, teams, statuses (submitted, under review, in development, implemented etc.) and in general show the state and health of the innovation ecosystem.
- Innovation KPIs dashboards with focus on operational metrics such as growth of number of submitted ideas, areas of focus of new ideas, information of positive and negative ranking criteria with most impact to final score, employee engagement in innovation trends etc.
- Business KPIs dashboards for approved innovation projects tracking the business indicators and their impact on the organization
- Trend analysis dashboards is an AI supported advanced dashboard to monitor new emerging markets and trends against the innovation direction of the organization based on the entire pipeline and including all innovation submission.
- A page for management where they can interact with AI and ask questions and draw their own analysis about the innovation list, general trends, provide feedback etc.

### 5.1.4 Component Interconnectivity

Although different components are recognized and defined, they are all interconnected and integrated seamlessly into a single system. Artificial intelligence is the underlying technology that connects all and all the modules represent essentially a communication portal between humans to AI and human to human (Figure 7).

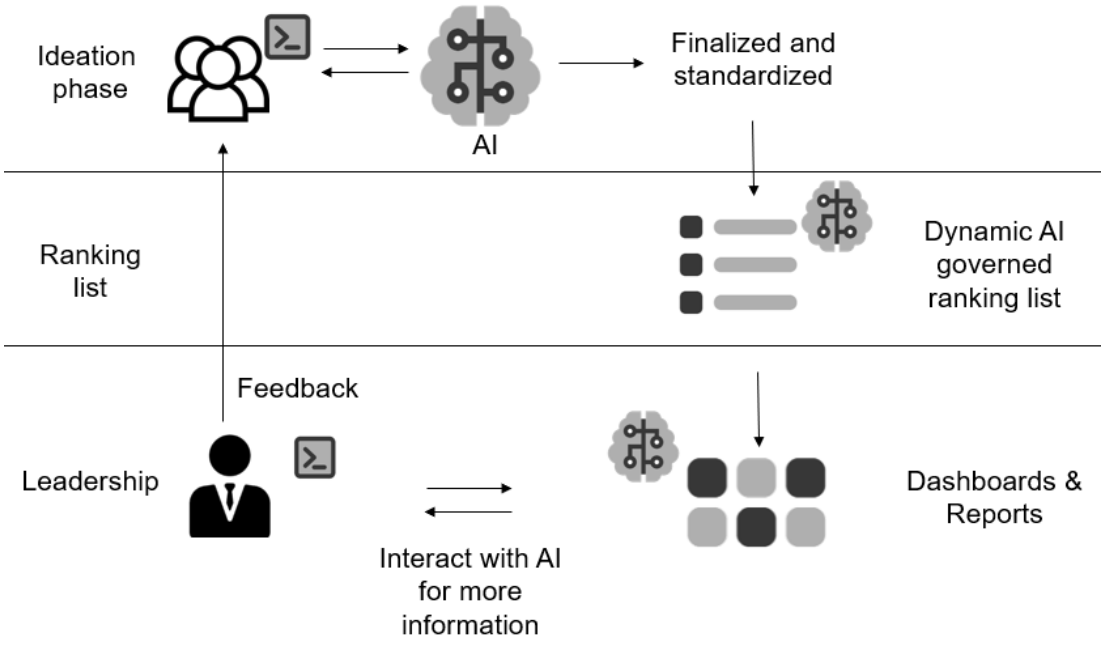


*Figure 7: Interconnectivity of components.*

## 5.2 The Idea Ranking Method and Criteria

This section proposes an innovation ranking method and criteria definition that can be used to evaluate and rank all new ideas submitted to the system. It includes multiple parameters to valuate innovation against internal capabilities, market conditions and other brother parameters such as emerging trends, sustainability, cultural impact so the management can gain multi angle estimation and properly understand the impact of proposed innovations.

The methodology is based on the following main groups of ranking criteria:

- Internal parameters
- External parameters
- Dynamic parameters
- Additional parameters

Each of the parameters belonging to one of the major groups is defined with two main indicators: a scoring factor and a wight factor. Scoring factors are assigned in range from 1-10 with 10 being the best value, indicating how well the proposed innovation is aligned with the criteria. The scores are assigned by AI to each of the criteria.

The weighting factor indicates how much each of the criteria is valued in the organization, it defines the importance of each parameter. The wight factor reflects the organizational value system.

The weight factors are used to allow the organization to control the ranking and ensure it is aligned with its values. They are customizable and they ensure flexibility as they can be adjusted in time as the organization evolves.

## 5.3 Internal Ranking Parameters

Internal parameters represent how much the organization is ready using its internal resources and capabilities to support the innovation. These parameters are chosen to provide clear understanding of how much the idea fits with the organizational business strategy and goals, and resources required to propel it forward. This group of parameters is very important and has a high combined weight factor of *40-50% of the total score*.

The following detailed criteria are included in this group:

- Alignment with business strategy (weight factor: ~10-15): a very important criteria and the one with highest wight factor assigned to it as it is very important for proposed innovation not to be outside the defined strategy and long-term vision. Does innovation impact core business or solves core challenges in the company?
  Scoring: innovations that are aligned with the company's strategy will have higher scores.
- Required funding and resources (weight factor: ~10): describes how much further development of the proposed innovation will require funding and resources. Here we ask questions about required development and operational costs and are sufficient resources available internally.
  Scoring: innovations with better cost to benefit ratio will have higher score.
- Time to market (weight factor: ~up to 10): describes the time required for the idea to be realized and put to market. This parameter can be very important as it describes ow much the idea is time-critical due to different factors such as competitors' activity etc. How critical is the timing for the success of the proposed innovation?
  Scoring: shorter time to market is better.
- Available internal expertise (weight factor: ~5-10): describes does the organization has and to what extent internal knowledge to realize proposed

innovation. If not how much time and cost is required to train them or how quickly can external help be found?
Scoring: available internal expertise or ready external partners is better.

- Implementation complexity (weight factor: ~5-10): factor relating to operational complexity for innovation realization. Does implementation require entirely new technologies and know-how?
  Scoring: innovation proposal that has high complexity requirements will have a lower score.
- Potential to enhance efficiency (weight factor: ~up to 5): factor describing the impact of the idea and its potential to improve workplace efficiency. It favors innovations that can optimize internal processes. Does the idea reduce manual labor or improve employee satisfaction?
  Scoring: increasing efficiency is better.

## 5.4 External Ranking Parameters

External parameters used in ranking process represent the parameters outside of the organization influence. They compare the proposed innovation against the current market condition and how well it fits with customer needs, competition activities as well as current regulations and existing patents and contributes typically to 30-40% of the total score.

The following parameters are included in this group:

- Market potential (weight factor: ~10-15): describes how well the proposed innovation fits with current market demands for such a product or service. It will also consider potential for growth and potential revenue. Key considerations for this parameter are questions such as estimated market size or does the demand for the proposed product exists and on which level?
  Scoring: higher market potential and existing demand is better.
- Competition activities (weight factor: ~10): compare the proposed innovation with competition activities. Is there a similar product on the market and why is one proposed better?
  Scoring: higher level of differentiation of the proposed innovative product is better.

- Long term gains potential (weight factor: ~10): describes the potential of the innovation to generate long term benefits for the organization and how much it will potentially be impacted by changing market conditions. This parameter is meant to identify sustainable innovations by targeting long term value and adaptability potential of proposed innovation. It takes into considerations questions such as how the proposed innovation can contribute to the long-term growth of the company and examines strategic advantages of the innovation.

  Scoring: innovations with higher long-term impact are scored high.
- Unique selling point (weight factor: ~5-10): describes how well the innovation compares to and stands out from other similar products. It focuses on specific problems that proposed innovation addresses and what makes it unique on the market.

  Scoring: Better unique selling point will increase the score.
- Customer persona match (weight factor: ~5-10): describes how well the innovation is expected to be received with the target customers as a brother example, and specific customer personas for more specific products. Who are the target customers and how does the proposed innovation targes their specific needs.

  Scoring: better persona match increase scoring.
- Regulations and patents (weight factor: ~5): describes the risk of potential regulatory issues and intellectual property problems. Are there existing patents that may cause legal and intellectual property issues? Are there any regulatory constraints in key markets that may affect the realization of the proposed innovation? These questions represent key considerations addressed by this parameter.

  Scoring: lower potential for legal problems leads to higher scores.

## 5.5 Dynamic Ranking Parameters

Dynamic parameters represent rapidly changing external parameters that may greatly affect the ranking of the proposed innovation. They are designed to accommodate rapid evolution and changes in things such as technological trends, market conditions etc.

The parameters included in this section are:

- Market readiness (weight factor: ~5): describes how well the market is ready for the proposed innovation and how well the innovation is in alignment with the current market conditions and trends. Is the market mature enough for the proposed innovation or is it ahead of its time? What are possible adoption challenges that may affect the proposed innovation?
  Scoring: the higher the market readiness estimation is the better the score will be.
- Current economic landscape (weight factor: ~5): describes the impact of general state of economics in both positive and negative way accounting for inflation, recession, government spendings etc. Things to consider here are how current economic conditions may impact the proposed innovation or do they represent a risk or opportunity?
  Scoring: in the downward economic landscape such as recession, a cost-saving innovation will score better than the one requiring additional spending.
- Technological trends (weight factor: ~5): examine how well the proposed innovation is in alignment with cutting edge technological trends ensuring it is not obsolete from the start.
  Scoring: innovation will have a higher score if it is aligned with current technologies such as blockchain and artificial intelligence than ones for example focused on legacy systems that are in decline or becoming obsolete.
- Value of revisitation (weight factor: ~2-5): a parameter that describes the future potential of the proposed innovation. An idea that is ahead of its time due to technological and financial constraints may become very interesting in the future with advancement of technology and lower prices. It ensures that organization is ready for changes and allows them to re-rank the ideas and stay on top of the situation as the world changes.
  Scoring: a renewable energy innovation may not be possible today due to high cost and early stage of technology (and have a low score) but with further development in time the cost will decrease and government regulations will change increasing the score and moving the innovation higher on the list.

## 5.6 Additional Ranking Parameters

Additional parameters represent a specific group of parameters that go beyond the internal and external factors. They are not oriented toward business directly and look more toward things such as innovation alignment with company core values, social trends, sustainability and the potential of proposed innovation to engage

stakeholders. These parameters also serve as a reputation management tool ensuring that the company focuses on the innovations that are helping it to build its place in the market and are aligned with its core values and current general trends.

Parameters from this group include:

- Sustainability (weight factor: ~5-10): describes how well the proposed innovation aligns itself with the company's sustainability strategy and ESG (Environmental, Social and Governance) targets.
  Scoring: an innovation with positive ESG impact may have generally higher scores in the organizations that value sustainability.
- Cultural fit (weight factor: ~5): describes the proposed innovation fit with the declared company's cultural values, mission and vision.
  Scoring: innovations that do not fit the company's values will have lower scores.
- Stakeholders buy-in and engagement (weight factor: ~5-10): describes how the proposed innovation is likely to get internal and external stakeholders engaged. It considers how do internal and external stakeholders perceive the proposed innovation and what are possible barriers that are influencing this perception.
  Scoring: stronger stakeholder engagement leads to better scores.
- Current consumer and social media trends (weight factor: ~5): describe how well proposed innovation is attractive when compared to current consumer and social media trends.
  Scoring: higher alignment with the social media trends and consumer mood and values will be scored better.

## 5.7 Idea Ranking Score Calculation Formula

Formula to calculate the final ranking score for a proposed innovation is presented below. It is a weighted sum of all scores assigned to each of the parameters designed to ensure the proper distribution of importance linked to each parameter. It allows companies to control and customize the impact of each parameter according to their understanding of importance for each of them.

$$Total\ Score = \frac{\sum(Parameter\ Score \times Parameter\ Weight)}{\sum Parameter\ Weights}$$

Summary of the parameters and proposed weight factors are presented in the Table 2 with assigned weight factors. Defined weight factors are not final, they are proposed approximate values to serve the purpose of illustrating how the dynamic ranking list is governed.

*Table 2: Innovation ranking parameters.*

| # | Parameter Group | Parameter | Estimated Impact | Score Range | Proposed Weight Factor |
|---|---|---|---|---|---|
| 1 | Internal | Alignment with business strategy | High | 1-10 | 10-15 |
| 2 | | Required funding and resources | High | 1-10 | 10 |
| 3 | | Time to market | High | 1-10 | 10 |
| 4 | | Implementation complexity | Medium | 1-10 | 5-10 |
| 5 | | Available internal expertise | Medium | 1-10 | 5-10 |
| 6 | | Potential to enhance efficiency | Medium | 1-10 | 5 |
| 7 | External | Market potential | High | 1-10 | 10-15 |
| 8 | | Competition activities | High | 1-10 | 10 |
| 9 | | Long term gains potential | High | 1-10 | 10 |
| 10 | | Unique selling point | Medium | 1-10 | 5-10 |
| 11 | | Customer persona match | Medium | 1-10 | 5-10 |
| 12 | | Regulations and patents | Medium | 1-10 | 5 |
| 13 | Dynamic | Market readiness | High | 1-10 | 5 |
| 14 | | Current economic landscape | Medium | 1-10 | 5 |
| 15 | | Technological trends | Medium | 1-10 | 5 |
| 16 | | Value of revisitation | Low to Medium | 1-10 | 2-5 |
| 17 | Additional | Sustainability | High | 1-10 | 5-10 |
| 18 | | Cultural fit | Low to Medium | 1-10 | 2-5 |
| 19 | | Stakeholders buy-in and engagement | High | 1-10 | 5-10 |
| 20 | | Consumer and social media trends | Medium | 1-10 | 5 |

## 5.8 Testing of the Ranking Criteria

To evaluate the applicability of the ranking criteria and dynamic nature of the innovation ranking list two approaches have been used. In first approach the ranking is evaluated for the selected and well documented products from the view of the company that developed them at the time of the proposal of the innovation.

The list of the products includes the following:

- Google Gmail: Googles email service proposed as an innovation in 2001 with a focus on improved user experience, simplicity, and large storage. It is one of the most successful products from Google.
- Google Glass: this product is selected for a specific reason because it was the first product of its kind ahead of its time offering augmented reality through a wearable technology such as glasses. Today we are witnessing a big number of very similar products ranging from Virtual Reality headsets that allows users to wear them while walking in the streets and perfuming daily tasks and more discreet glasses with a bit more limited functionalities but offering similar outcome of augmented reality as Google Glasses offered back in 2013.

The second step will focus on failed innovations with Google Glass and calculate and evaluate their scores against current market conditions and see how the final score is changing. This is done as the core functionality of the proposed innovation system is that ideas are kept on the list and constantly reevaluated against current conditions. This exercise will show the potential of those two products with reevaluated scores.

To test the possibility of the current Artificial models and simulate the potential of such technology automatically governing the ranking process, the latest ChatGPT-4o model is used to estimate rankings at the time of product creatin and to calculate the updated score against the current market conditions.

The simulation is also continued and presented in Appendix I where the full output report generated by Artificial Intelligence is generated including the scoring for each point, reason behind each score and recommendations for both the idea owner and the management. This appendix serves the purpose of confirming the capabilities and maturity of the current AI technology to govern autonomously such a process.

### 5.8.1 Ranking score of Gmail

As stated, the goal of this exercise is to use the ranking criteria and estimate the possible ranking score for a successful project such as Gmail at the time of the idea in 2001, see Table 3.

*Table 3: Ranking methodology applied on Gmail*

| Parameter | Score | Weight Factor | Explanation |
|---|---|---|---|
| Alignment with business strategy | 9 | 10 | Aligned with Google strategy of expanding into user centric services |
| Required funding and resources | 7 | 10 | Moderate resources required (prototype developed by single person) |
| Time to market | 8 | 10 | Development lasted about 3 years |
| Implementation complexity | 6 | 5 | Increased complexity due to technical requirements |
| Available internal expertise | 9 | 5 | Strong talent pool available internally |
| Potential to enhance efficiency | 8 | 5 | Gmail had a significant impact on emailing efficiency |
| Market potential | 10 | 10 | At the time there was a big market potential for better email service |
| Competition activities | 7 | 10 | Yahoo and Hotmail mail were main competitors but offered less attractive product |
| Long term gains potential | 10 | 10 | Potential of integration with other Google products into the ecosystem made long term potential very high |
| Unique selling point | 10 | 5 | Features such as large storage, spam filter and advanced search functionality |
| A customer persona match | 9 | 5 | Google targeted entire population with this easy-to-use service but included features for more demanding business orientated customers |
| Regulations and patents | 10 | 5 | Low possibility for negative impact from regulators and patents |
| Market readiness | 9 | 5 | The market was ready for free easy to use email service, hype was high |
| Current economic landscape | 8 | 5 | Economic landscape supported the development of free to use email system |
| Technological trends | 9 | 5 | Gmail was at the leading edge of email service technology |
| Value of revisitation | 6 | 2 | Moderate at best because there was no room for major improvements, only incremental |
| Sustainability | 7 | 5 | Reduced paper usage but had no direct positive impact on environment |
| Cultural fit | 10 | 2 | Well aligned with Googles innovation culture |
| Stakeholders buy-in and engagement | 10 | 5 | The project was very exciting, and stakeholders were very supportive |
| Consumer and social media trends | 8 | 5 | Aligned with the growing popularity of internet usage at the time |
| Total Ranking Score | | 8.5 | |

It is clear from the documentation about the project itself and the available data about the market conditions at the time (2001) that the project would be ranked very high. The market conditions were ready, it recognized and addressed the major issues of users with competition of the time including costly service, very limited space and unintuitive setup requirements and user experience. The required know-how was already there and the buzz it created was huge. I personally created my Gmail account at the very early days of the service, actually from the testing period when you had to have an invitation from a member to join.

The final score calculated is very high, 8.5 indicating that the weakest point of the project was narrow innovation window limited mostly by incremental innovations as it is an email service, this was before the time of a brother Google ecosystem idea was created and Gmail was a single stand application and service. Since the service has been online for a long time, even that window has narrowed even more because to change it now would affect usage habits of billion people.

### 5.8.2 Ranking score of Google Glass

Ranking matrix is applied to Google Glass as a product for a very specific reason. At the time of the idea, it was ahead of its time. No similar product existed or was announced by any of the major competitors. It offered a unique Augmented Reality (AR) experience. This product failed eventually and the main reasons for its failure include poor market readiness, privacy concerns, no clear target consumer group, high recommended price of product and social acceptance factors.

If we apply all these concerns and general state of economy and other factors as they were in 2013 to the ranking matrix (see Table 4) we get the total ranking score of 5.6/10. Having low values in many parameters across all groups indicates a wide variety of potential problems at the time. If looked closely from the perspective of 2013 this would be a high-risk Horizon 3 product, ahead of its time and without real market for it with serious privacy concerns attached to it.

If this idea was submitted to the innovation ecosystem proposed by this thesis, it would constantly be reevaluated against the changing market conditions and all other defined factors to evaluate its readiness.

If we look at the market today and see how these types of smart wearable tech products integrated with smartphones and supported by AI are well received and how high is the competition activity with big companies like Apple and Meta developing

similar products and with many other smaller companies joining the race, Glass would be positioned high on the idea ranking list.

*Table 4: Google Glass ranking from 2013 perspective*

| Parameter | Score | Weight Factor | Explanation |
|---|---|---|---|
| Alignment with business strategy | 5 | 10 | It fits well with the Google innovation policy, but Glass had no clear business impact. |
| Required funding and resources | 6 | 10 | Google had funding for the project although resources required new hirings because of new technology |
| Time to market | 5 | 10 | The required time to market was longer than actual, technology was immature at launch |
| Implementation complexity | 5 | 10 | New technology posed technical challenges |
| Available internal expertise | 7 | 10 | Hiring new people was required because Google at time was predominantly software company |
| Potential to enhance efficiency | 4 | 5 | Due to technology limits Glass provided a small efficiency increase |
| Market potential | 6 | 15 | Wearable tech market at the time was very niche |
| Competition activities | 8 | 10 | Competition was not existing at the time because the market was not ready |
| Long term gains potential | 5 | 10 | Based on market and consumer reaction at the time long term gains the possibility was very small |
| Unique selling point | 6 | 10 | Innovative unique selling point but not attractive enough for wide consumer market |
| Customer persona match | 5 | 10 | Failed to gain wide consumer interest, was more attractive for enthusiasts |
| Regulations and patents | 6 | 5 | There were high privacy concerns because of the integrated camera. |
| Market readiness | 4 | 5 | The market was not ready for wearable Augmented Reality glasses at the time. |
| Economic landscape | 6 | 5 | Stable economic conditions but high product price (1500 USD). |
| Technological trends | 8 | 5 | The wearable technology and augmented reality were at very early/concept stages of development |
| Value of revisitation | 6 | 2 | Moderate value of revisitation (from the 2013 perspective) more toward enterprises for niche use cases. |
| Sustainability | 5 | 5 | This parameter was not of much interest in 2013 |
| Cultural fit | 2 | 2 | Outside of the Googles identity. At the time Google was a software company. |
| Stakeholders buy-in and engagement | 6 | 10 | Strong internal support from management but low external reaction |
| Consumer and social media trends | 1 | 5 | Public perception was very impacted by the security concerns caused by the integrated camera. People who bought the product were called "Glassholes" |
| Total Ranking Score | | 5.6 | |

*Table 5: Google Glass ranking from 2024 (current) perspective*

| Parameter | Score | Weight Factor | Updated | Explanation |
|---|---|---|---|---|
| Alignment with business strategy | 8 | 10 | Yes | It now aligns better with a new Google strategy for AI and hardware integration |
| Required funding and resources | 10 | 10 | Yes | Google's power to assign resources has increased significantly since 2013 as it grew to be 2.4 trillion USD company |
| Time to market | 7 | 10 | Yes | The pressure to deliver the product fast is more significant due to competition |
| Implementation complexity | 8 | 10 | Yes | Google has since 2013 developed significant hardware capabilities |
| Available internal expertise | 9 | 10 | Yes | Google today has all required advanced internal expertise including hardware development and AI |
| Potential to enhance efficiency | 7 | 5 | Yes | Augmented reality wearable technologies can improve efficiency |
| Market potential | 9 | 15 | Yes | The market for AR technology has grown significantly with present high demand |
| Competition activities | 6 | 10 | Yes | Competition today is intense in this market area with major companies like Apple and Meta developing similar products |
| Long term gains potential | 8 | 10 | Yes | With integration with Android Operating System the long-term gains potential is high |
| Unique selling point | 7 | 10 | Yes | Integration with Android ecosystem and Google Workspace creates USP |
| Customer persona match | 7 | 10 | Yes | Glass today would appeal to more customers including enterprises and average Android users |
| Regulations and patents | 8 | 5 | Yes | Improved privacy regulations reduced main user concerns compared to 2013 |
| Market readiness | 8 | 5 | Yes | The market of today is much more favorable to such AR products |
| Economic landscape | 7 | 5 | Yes | Current economic situation is not perfect globally but there is a strong consumer support in spending on new technologies |
| Technological trends | 9 | 5 | Yes | AR/VR technologies integrated with AI are at the forefront of innovation |
| Value of revisitation | 9 | 5 | Yes | The strong AR/VR market contributes to high value of revisitation for such concept |
| Sustainability | 6 | 5 | Yes | The product itself can be partially built from recycled materials but itself offers no significant contribution to environment |
| Cultural fit | 8 | 2 | Yes | Glass today fits nicely with Google's culture of being a leader in innovation space now including AI and hardware |
| Stakeholders buy-in and engagement | 8 | 10 | Yes | Market interest and competition engagement would be positive for stakeholders buy-in and engagement |
| Consumer and social media trends | 8 | 5 | Yes | Current social media trends speak positively on such products |
| Total Ranking Score | | | 7.9 | |

If we look at Table 5 with ranking criteria updated for current market conditions, we can see how its total ranking score has increased to 7.9/10 from 5.6 from 2013.

We can notice an increase in ranking scores across all the parameters and how much more it would fit with the market conditions and consumers of today.

This example illustrates the power of continuous logging and evaluation of ideas as part of the innovation ecosystem as proposed in this thesis. If the Google Glass idea was part of such ecosystem, it progresses of the ranking list and it could be deployed with the right market conditions helping Google to stay on top of competition but not doing it so early that the market just rejects it because it is so ahead of its time.

# 6 Key Performance Indicators (KPI's)

A comprehensive set of KPI's is required to enable organization management to track the state of the innovation culture and performance of individual realized innovations and their impact. There are two major categories of KPI's required: Innovation specific KPI's and more business and performance orientated KPI's.

## 6.1 Innovation Specific KPI's

Innovation KPI's are designed to provide a detailed overview of the company's state of innovation culture, and in general describe how well the system is received in the company, describing the level of engagement of employees, the diversity of proposed innovations, etc. demonstrating how effective the innovation ecosystem is.

There are six groups of KPI's in this category with a total of 19 KPI's defined, see Table 1.

*Table 6: Summary of Innovation specific KPI's*

| Category | Group | KPI |
|---|---|---|
| Innovation KPI's | Submission of new ideas Diversity and focus area KPI's | Number of submitted ideas |
| | | Growth in submitted innovation proposals |
| | | Number of innovation proposals per functional unit |
| | | Frequency of innovation submissions |
| | | Focus area of submitted innovations |
| | | Distribution of proposed innovations per horizons |
| | | Origin diversity monitoring |
| | Idea evaluation results and final outcomes KPI's | Acceptance rates for proposed innovations |
| | | Reasons for low-ranking scores |
| | | Time to decision |
| | Collaboration indicators | Number of ideas submitted by teams |
| | | Number of employees that accepted to team up |
| | | Impact of collaboration on the ranking score improvement |
| | Employee satisfaction KPI's | Employee satisfaction with feedback |
| | | Employee participation in innovation |
| | | Employee motivation to participate |
| | | Recognition of contribution to innovation |
| | Long term impact KPI's | Revisiting index of submitted ideas |
| | | Lifecycle index |

*Submission of new ideas* metric, designed to monitor general engagement of employees and to provide overview of innovation pipeline. It includes the following KPI's:

1. Number of submitted ideas. This KPI will provide information about how many innovations proposals are in que in the ranking list. It is informative and important as it shows the total number of proposed innovations.
2. Growth in submitted innovation proposals. Shows the percentage of increase or decrease in the number of proposed innovations over time. It can be tuned to show comparison per year or quarterly, Year-on-Year or in any other informative way. This KPI also illustrates the engagement of the employees and motivation to think and submit new ideas.
3. Number of innovation proposals per functional unit (department, teams). The purpose of this KPI is to identify number of ideas submitted by different departments or teams. It does not point out innovation champions units, but it can also track the state of acceptance of the innovation culture inside different departments. Low score in the department may indicate possible bottlenecks inside the department such as low management engagement or low employee motivation. This score may indicate the need to work with low score units to improve engagement and acceptance of the innovation culture.
4. Frequency of innovation submissions. This KPI tracks how often, on average, employees are submitting innovation proposals. It can be presented in two ways: in time showing how many ideas per employee are submitted in the time unit such as month or year, and in average per employee. It is an important indicator of consistency of employee engagement.

*KPI's focusing on the diversity and focus area of submitted innovations.* These KPI's are designed to illustrate the diversity of proposed innovations by indicating the focus areas, showing the number of proposed innovations per type, and measuring the idea origin diversity.

For the purpose of this thesis the McKinsey's Three Horizons Model (Baghai, Coley, and White, 2000) of innovation is used to define the KPI's. This model groups the innovations in three horizons based on their impact on the company business. Horizon 1 ideas are innovations that provide continuous improvements to the existing business model. Horizon 2 innovations have the potential to extend the existing business model and core capabilities to new customers and markets. And Horizon 3

ideas create completely new capabilities outside the current business model being most disruptive and innovative. The following KPI's are proposed for this group:

1. Focus area of submitted innovations. This KPI indicates number of proposed innovations in each of strategic areas such as safety, optimization, cost savings, sustainability, etc. It indicates current trending areas and most important areas that require improvement from the viewpoint of employees. It is also an indicator of how well the current business strategy and defined strategic goal are resonating with the employees. If the strategy is clear and employees are aware of it there should be high alignment with proposed innovations.
2. Distribution of proposed innovations per horizons. This KPI shows how many ideas are assigned to each of the 3 horizons from McKinsey's model. This KPI is a strong indicator of the current state of innovation culture, as it is not good for the company to have a proportional spread across all horizons because this will give company a good position to be ready and adjust to changing market conditions quickly.
3. Origin diversity monitoring. This KPI indicates the origin of submitted ideas by different groups such as functional units, roles of people who have submitted the idea, tenures etc. It is another indication of employee inclusivity in the innovation ecosystem success across the organization.

*Idea evaluation results and final outcomes KPI's.* This group of KPI's has the goal to point out operational outcomes when it comes to the path of the idea from proposal to realization. They are designed to point out acceptance rates, to focus on possible common negative scoring impacts and general time required to management to make the decision about the proposed high ranking innovation proposal. The following KPI's are proposed in this group:

1. Acceptance rates for proposed innovations. This KPI shows the acceptance rate for proposed ideas across different horizons. It can be presented in different ways and is an indicator that points out which group of proposed ideas gets the most priority with management. It also indicates changes in time showing changes and trends in the company as it evolves.
2. Reasons for low-ranking scores. This KPI is based on the AI feedback on the most common current reasons that contribute to low final ranking scores of submitted ideas. This indicates a possible issue of employees' understanding of the company's strategies and set goals. The identified major groups of

potential reasons can be addressed to keep the innovation culture and efforts to a current standard.

3. Time to decision. Measures how long in average per horizon it takes for management to evaluate and progress the submitted innovation. This KPI points out the efficiency of the innovation flow. It is important because it indicates management commitment to the innovation culture, and it is one of the factors that impacts employee satisfaction in general.

*Collaboration indicators.* KPI that measures collaboration parameters including how many innovation proposals are submitted by teams and the effectiveness of collaboration.

1. Number of ideas submitted *by teams*. This KPI is important and comprehensive. It points out not only the number of new ideas submitted by teams compared to individuals but when it is observed through changes in time this number can describe the overall tendency to teamwork with employees.
2. Number of employees that accepted to team up after the recommendation is made. AI can derive the number of employees that accepted the suggestion to team up versus the total number of collaboration suggestions made by the system. It is a KPI that pairs well with the previous one indicating the state of the teamwork culture in the company. When broken down to sources it may indicate possible bottlenecks and groups of people that the company need to focus on.
3. Impact of collaboration on the ranking score improvement. This KPI indicates the general impact on the ranking score for the projects after collaboration is established. It measures positive or negative impact of collaboration on specific projects. This KPI can also indicate the willingness of teams to adjust to changed team dynamics and accept new proposals for idea improvement.

*Employee satisfaction KPI's.* Designed to monitor employee satisfaction and encouragement of employees with the state of innovation culture and process these KPI's are very important. Unsatisfied employees are rarely incentivized to think creatively and contribute to the company's wellbeing. Following KPI's are proposed to monitor employee satisfaction:

1. Monitor the employee satisfaction with feedback. KPI represents a survey result about the quality of the feedback to the submitted innovation. This does

not necessarily mean that management is obligated to provide feedback to every single submission, but certain policies need to be put in place that require periodical managerial feedback for a certain number of high focused ideas. This contributes to employee satisfaction and system transparency, which is one of the foundational requirements of this system.

2. Employee participation in innovation. Measures the number of employees actively engaged in the innovation process, participating in innovation projects generally interacting with the innovation ecosystem. It helps to determine bottlenecks within the company and pools of people that need to be empowered to contribute.
3. Employee motivation to participate. This KPI represents direct feedback from employees via survey about their motivation and engagement satisfaction with innovation system. This score shows directly the strength of the employees' feelings weather they accept the innovation culture and feel like their innovations are contributing to the company as a whole or not and reasons behind it.
4. Recognition of contribution to innovation. This KPI shows the percentage of the employees that are recognized and rewarded for their innovation contributions. It is an important number as lack of recognition for good ideas leads to frustration and hard feelings.

*Long term impact KPI's.* These indicators are proposed to provide a measure of the revisitation rate of proposed innovations and progress rate for proposed innovations that have been progressed toward the development and implementation stages. The following KPI's are included in this group:

1. Revisiting index of submitted ideas. It measures what is the percentage of high-ranking ideas that initially were not progressed to the next level, but which are discussed again in the future. It is a metric that measures the ability of the system to adapt rankings with changing market conditions described in the previous chapter.
2. Lifecycle index. KPI that measures how many innovation proposals have been progressed toward the nest stages of execution such as development and production. It will count the number of innovation proposals that are progressed and the number of realized projects identifying the stages and reason for stopping progression.

This comprehensive set of innovations specific KPI's is not final and can be extended to the level of details required by specific needs of different organizations. The intention was to propose a functional set of metrices that will provide insight and means of monitoring and measuring all the important factors that an innovation ecosystem consists of.

## 6.2 Business impact and operational KPI's

The second major category of KPI's describes different metrices to measure the impact of innovation on different areas such as security, sustainability, monetary impact, business and operations. It provides a measure of innovation and innovation culture contribution to the company's success.

The following 4 groups with a total of 17 KPI's are proposed in this category, see Table 7.

*Table 7: Summary of business and operations specific KPI's*

| Category | Group | KPI |
|---|---|---|
| Business and operational KPI's | Financial KPI's | Return on Investment (ROI) |
| | | Cost savings |
| | | Growth of revenue |
| | | Break even time |
| | | Impact on market share |
| | | Innovation investment portfolio balance |
| | Sustainability KPI's | Carbon footprint |
| | | Resource efficiency |
| | | Compliance with ESG goals |
| | | Waste reduction |
| | Security related KPI's | Incident rate reduction |
| | | Compliance with safety standards |
| | | Security breach rates |
| | | Workplace safety perception impact |
| | Business results and operational improvements | Time to implementation |
| | | Customer satisfaction |
| | | Process efficiency impact |
| | | Adoption rate impact |

*Financial KPI's.* They define financial parameters required to monitor realized innovations including the following:

1. Return on Investment (ROI). This is a basic financial instrument that shows the difference between Net Gain of the innovation minus the Cost of Innovation. It is used to track and show financial gains generated by innovation.
2. Cost savings. Focused on Horizon 1 innovation measuring direct reduction in cost of operation as a result of innovation implementation.
3. Growth of revenue. This KPI is oriented toward Horizon 2 and Horizon 3 innovations measuring the growth in revenue as a direct result of innovation.
4. Break even time. Time to break even is a metric that shows the time required to cover the investment as a direct result of savings or revenue generated by implemented innovation.
5. Impact on market share. KPI that shows impact of market share as a direct result of successful innovation realization. This KPI is most impacted by Horizon 2 and Horizon 3 innovations.
6. Innovation investment portfolio balance. This KPI shows investment numbers for innovations across all 3 horizons of proposed innovations. It is an important balance indicator that shows in a broader sense how well the investments are distributed between immediate gain (Horizon 1 innovations) medium term outlook (Horizon 2) and long-term transformational outlook of Horizon 3 innovations. It is a percentage number, for example the company is investing 40% of the funds in Horizon 1 innovations, 40% in Horizon 2 innovations and 20% for Horizon 3 projects.

*Sustainability KPI's.* A group of KPI's proposed to show contribution of realized innovation on sustainability strategy of the company. This group includes the following KPI's:

1. Greenhouse gasses emission (carbon footprint) reduction. This KPI measures the reduction of greenhouse gasses emissions internally and externally as a direct result of innovation. This is important KPI as internally if successful can have a positive impact on Scope 1 (direct) emissions for the company and Scope 3 emissions (indirect) for the clients and customers. This can also impact positively on the reputation of the company.
2. Resource efficiency. KPI that tracks impact on resource consumption such as water, electricity, raw materials, packaging, etc. as a direct result of innovation.

This is a measure of improvement on how resources are used in the company. It illustrates also the level of awareness of the company to these important environmental factors.

3. Compliance with ESG goals. This metric shows how well the innovation is in compliance with company ESG goals. This metric can point out general knowledge and acceptance of employees when it comes to ESG goals.
4. Waste reduction. With focus on Horizon 1 innovation impact this KPI measures the contribution of innovations on waste reduction in production or processes. The direct result of this activity is cost savings.

*Security related KPI's.* This group of KPIs is measuring the increase in workplace safety regarding both digital and physical as a result of implanted innovations. The following KPI's are included in this group:

1. Incident rate reduction. This KPI is intended to show one of the most important parameters when it comes to tangible results, a decrease in incident rate. It shows a percentage decrease in incident rates including workplace injuries, accidents or other hazardous situations depending on the workplace nature as a result of applied innovations. It compares the expected rate of incidents expected to happen before innovation implementation and real number of accidents after it was implemented. This is mostly impacted by Horizon 1 innovations which are incremental in nature.
2. Compliance with safety standards. A metric that helps monitor results of all safety inspections and audits intended to ensure that all implemented innovations that impact workplace safety are actually and officially compliant with all regulations. It can be measured by tracking all the certifications and accreditations gained after innovation is implemented and result from them.
3. Security breach rates. This KPI shows a measure of reduction of breaches in security, both physical and digital security as a result of implemented innovations. It can be measured by comparing the number of breaches before and after innovation implementation.
4. Workplace safety perception impact with employees. This KPI is direct feedback of perception of safety by employees after the innovation designed to improve safety is implemented. It is a survey metric where employees are asked questions about the impact of innovation on their general feeling of safety and is it improved after the changes. It is a percentage and descriptive KPI that will provide perception of results on the employee side to the

management. This KPI is intended to be tracked in time and after any innovation is implemented.

*KPI's related to business results and operational improvements.* This group of KPI's is chosen to measure important aspects of innovation process such as general implantation efficiency and customer satisfaction and adoption rates.

1. Time to implementation. Measures the time between approval of the innovation proposal and actual realization. It is an important metric as it translates to the company's ability to react quickly to market changes or demands, actions by competition and even the urgent internal requirements. If tracked across multiple different projects and group by horizons levels of proposed innovations it can help to indicate bottlenecks and optimize the process.
2. Customer Satisfaction (CSAT) and Net Promoter Score (NPS). These KPI's serve as a feedback from the customer base. They describe how, in general, implanted innovations are resonating with the customer and improve or lower their satisfaction. CSAT Is a known indicator and often used KPI. NPS will measure how high the likelihood of recommending the company is. It is calculated from survey results where percentage of supporters (positive score) is subtracted by percentage of negative score (detractors). NPS calculation formula is as follows: NPS=%Promoters−%Detractors.
3. Process efficiency impact. This KPI measures improvement results such as machine downtime reduction, energy usage or production time reduction or optimization of number of steps in the process including any other production and operation parameter depending on the nature of business.
4. Adoption rate impact. A KPI that measures a percentage of how much innovation is used internally or externally. This is an important KPI as it indicates how well received the innovation is. High numbers mean that the innovation is well received and low number mean general poor adoption. This KPI is also a time unit, meaning that it represents a percentage in time, for example: adoption rates reached 55% among employees in 6 months.

With the right balance of KPI's it is possible for a company to monitor the impact of innovation across multiple categories and be properly informed on the contribution of established innovation culture to all aspects of business.

# 7 A Strategy to Implement AI to Innovation Process

The starting point of creating an *AI Supported Continuous Innovation Ecosystem* for any organization is to develop an AI implementation strategy.

This strategy will help organizations to align all stakeholders with a common goal of implementing AI on a foundational level within the organization including the innovation process itself. This process is highly transformative, it will involve many aspects of the process and general culture, and face resistance. To stay one step ahead of potential problems, the strategy must be clear with its ambition, implementation roadmap and with clear achievable goals. These goals have to be defined in the relevant and achievable way and set within a timeframe.

Success will depend also on proactive preparation, employees must be continuously informed and educated thus creating a culture of continuous improvement and support in times of such disruptive and exponential changes.

There are three main capabilities required by organizations to establish an AI implementation strategy:

1. Cultural capabilities. Cultural capabilities emphasize the required agility of the company to adopt and embrace the changes and improvements of AI and the subsequent ability to properly utilize the possibilities. The cultural changes required, and their impact have already been discussed in the previous chapters.
2. Technical capabilities. Two main parts of technical capabilities include data management and infrastructure. Data management is critical part of AI implementation and organizations must ensure that data are cleared from errors and inconsistencies, as well to have the data from many different sources unified. Proper infrastructure is required to enable scaled and uninterrupted AI computational operations.
3. Ethical considerations. With great power comes great responsibility. This sentence first originated in 1962, advice by Uncle Ben to young Peter Parker who later became Spiderman emphasizing the possible impact he will have on the people following his transformation, and ethical issues he will encounter during his life because of it. The same advice can be applied to AI ethics. AI holds power to impact the lives of people in many ways, both positive and negative, it can improve both healthcare and weapons with practically no limits. It is important to have these implications in mind when creating the AI

implementation strategy and AI governance framework. AI governance will include the development of procedures, policies and frameworks to define ethical usage of AI as well as the accountability mechanism.

Positive examples from real life show value in involving all stakeholders like employees, regulators and customers early in the planning stage to ensure that there are no conflicting values.

## 7.1 Implementation Roadmap

Implementation roadmap assumes that the company is not currently using AI in its processes. This makes the problem more challenging as the disruptive effect is much bigger and its impact more profound. The proposed approach is to break down the AI implementation in phases and allow the entire company and its employees to adjust in an incremental way to the new reality. The following phases are proposed as an AI implementation roadmap:

1. Assessment phase
2. Pilot and proof of concept
3. Scaling and integration
4. Continuous improvement

Assessment phase is the first step toward AI implementation. It is a phase of exploration and discovering. Its purpose is to investigate the current capabilities of the company, including technical and cultural and access the general state of readiness of the company. The cross functional teams can be formed to identify the pain points that may benefit the most from the AI implementation and stakeholder mapping process should identify potential champions and influencers to help carry the project to the next step.

Pilot and concept phase is a second stage on the AI implementation path. It is designed to select a small-scale AI testing area to test potential benefits and results of using the AI in the company. It should be focused on a small risk and high potential impact area in the company where the benefits and results are the easiest to follow and access. A set of KPI's needs to be developed to provide a clear impact of implemented AI. This stage is also the beginning of a process of building employee trust toward AI.

The scaling and integration phase is building on top of testing results from the pilot phase and aims toward gradually implementing successful pilot results into core business processes. This phase involves a lot of work that includes infrastructure

expansion, setting up governance frameworks and policies. Borad scale trainings and awareness raising actions are also a part of this phase to ensure higher acceptance levels and soften the first pushback reactions of employees. This is the point in which the AI can be integrated into the innovation process and used to transform it to be open and inclusive and fit guidelines proposed in this thesis.

The continuous improvement phase is the ongoing process of monitoring and improving the AI models to include the latest technical and regulatory developments as well as to changing the business landscape. A stage in which constant refinement and adoption is required to maintain the newly established technical capabilities as well as cultural acceptance.

By adopting this phased approach to AI implementation companies can achieve soft transition and higher acceptance rates ensuing to get most of the implementation of this powerful new technology.

## 7.2 Change Management

AI implementation into business processes is a big change with significant impact. Thus, clear change management strategy is very important to overall success of the AI implementation.

Executive willingness (sponsorship) to implement AI is a very important first step. It shows to the employees that AI becomes the priority and signals clear commitment and sets up a model to follow. Strong managerial involvement can greatly help with the adoption of the new technology.

Employee involvement from the earliest steps and transparency toward implementing AI can build a positive view and reduce the general fear of new unknown things. It is important that the company, since the AI implementation goal is set starts to inform employees using a variety of approaches such as through internal events to demonstrate the benefits, open Q&A sessions where the management can explain their vision, provide constant updates on successful application cases and any other format or event that company finds useful.

Employees need to be trained in how to use AI to be able to get the most out of it. This can be done in stages, starting in a more general way with explaining the technology and gradually building competence. This approach can again give some time for people to adapt, build confidence and get used to the new technology, reducing stress and frustrations.

In this moment it is important to establish constant feedback loops with employees to establish trust in the company and identify possible problems with adoption.

All the proposed steps in the change management process are designed to address the human factor and reduce the negative perception and possible push back from employees. They are proposed in such a way to address the fears originating from required change and the new technology.

## 7.3 Governance and Risk Management

Since there is a focus on deep integration and high level of autonomy of AI in the innovation process, comprehensive governance and risk management frameworks must be established. These frameworks will be used to ensure that the AI is used and behave according to company strategies and values.

AI governance framework needs to be set up and controlled by a body inside a company such as the Steering Committee or similar. It is a cross functional body with ownership and responsibility of how AI is used in the company. The responsibility of this committee includes also ethical considerations, a task to translate ethical principles into specific rules and ensure that they are not breached. Constant monitoring, reporting and improvements as well as regular audits falls under the responsibility of this committee.

Due to the high level of AI integration major risks that can be identified from the start include data privacy protection and access limits, technical limitations of the current AI models and problems like biases and operational uptime or disruption originating from AI implementation. For this reason, things such data handling practices and policies need to be implemented to prevent unauthorized access to high level data and similar. A model to detect biases must be established. Contingency plans need to be implemented to mitigate possible downtime to business-critical processes.

At the start, a high level of technical and practical knowledge is required to setup a risk and governance procedures and assign this responsibility to the internal committees. It may lead to realization that simply there is no internal experts that are able to properly handle it. This may create a need for external collaboration and partnership with third party experts that may bring required know-how and train internal teams to be able to handle required tasks. Collaboration with regulatory bodies is always desirable as it will help the company to stay on top and navigate complex and ever-changing regulations.

The introduction of AI into the and creating continuous innovation process is not only a technical problem or an issue of adoption of new technology. It requires changes and evolution of process and culture that remained as it is for decades in the companies. It has a deep transformational value and potential to change and improve. The proposed implantation strategy tries to address these issues by gradually building trust into the technology and at the same time building the know-how and confidence with the employees and setting up a risk and governance frameworks.

# 8 Conclusions

This thesis explores the possibility of using Artificial Intelligence as a tool and a foundational technology to enable and establish continuous innovation ecosystem. This system has the potential to transform how organizations approach the whole innovation process and radically improve the innovation culture. Traditional innovation models are essentially unable to build and keep the innovation momentum and engagement with tis periodical nature and biased decision-making risking loosing good ideas. On the other hand, this thesis proposes the continuous innovation ecosystem where all ideas are collected, logged, supported by data and constantly re-evaluated and ranked in real time enabling that solves the main downfalls of traditional model and creates ecosystem that integrates and utilizes collective creativity of all employees.

To achieve this goal, this thesis has investigated the following:

An overview of the current state and practices and approaches to innovation. Traditional models are explained and the downsides of all of them are identified. Based on that insight an idea of continuous AI supported innovation ecosystem is built upon.

Considerations of conceptual framework for integrating AI at the foundational level and requirements of such system including considerations about the main building blocks of such system such as data democratization, inclusivity, the continuous nature of the system and logging of the ideas.

AI governed comprehensive ranking matrix designed to handle unbiased and transparent ranking of the ideas. All the ideas are collected and added to the pool of ideas. Constant ranking based on defined parameters enables open and transparent ranking lists. This is a major improvement against the traditional models as it ensures that no idea is lost to time and that ideas that are most aligned to company strategy and set of defined ranking criteria, representing transparent, data-driven and up to date method of prioritization.

A monitoring framework is designed to measure the impact and contribution proposed innovation ecosystem. The proposed KPI's are developed to monitor innovation and business specific parameters such as general state of innovation culture, employee engagement, financial impact, security and sustainability.

A strategy for implementing Artificial Intelligence that gradually introduces benefits that this technology has to offer and ensures that AI is not only implemented technically but ensures high acceptance and utilization rate with employees. Cultural implementation and human factors are the big challenges addressed in this section.

## 8.1 Key Findings and Contributions

Major contributions of this thesis include the following:

*Innovation democratization and employee inclusion in the ecosystem.* A central idea of this thesis and a major problem identified with traditional innovation approach is that every employee and not only specialized departments can and should contribute to the innovation pipeline and become a part of innovation culture. To enable this, AI is used as a central point of the wider innovation ecosystem allowing employees access to the data, helping them with the ideation process and later provides unbiased open and transparent ranking of their idea in the combined innovation pipeline. AI in this ecosystem also serves as a mediator for enabling cross functional collaboration.

*Importance of data driven decisions.* AI driven ranking list and KPI framework work together to provide transparent feedback and clear message to both idea owners and management. On the side of the employees and teams that own the ideas this provides an unbiased view on why their idea is ranked in a certain way also helps them to identify the possible issues and refine the idea further. On the management side it provides clear data-supported feedback enabling data-driven decisions to be made on which ideas should be progressed further and help them on important decisions such as funds and resources allocation.

*Continuous logging and ranking updates mechanism.* Proposed AI supported ranking of all logged ideas ensures that one of the main ideas for this ecosystem is honored. A bad idea according to today's standards may resurface as a good idea with changed internal or external factors, greatly reducing missed opportunities.

*Governance and risk management.* To successfully integrate AI into innovation ecosystem and into the organization as a whole a governance and risk management frameworks are proposed. Their main role is to build and sustain stakeholders' confidence and avoid possible problems originating from such deep AI integration and autonomous AI driven processes.

## 8.2 Limitations and Further Improvements

It is clear that when it comes to the Implementation of AI into the business processes and creating and sustaining AI driven continuous innovation ecosystem there is not a single solution that may fit everyone.

All of the frameworks, KPI's and strategies discussed and proposed in this thesis are generalized as much as possible without focus on a certain industry or specific company. This allows for a future studies to take this concept and examine the possibilities of application in more specific industries such as healthcare, finance, IT industry etc.

The current state of AI evolution is also a limiting factor. AI is one of the fastest evolving technologies ever developed. This implies that future research could address the impact of technological advancement on the development of the continuous innovation ecosystem.

In this thesis the cultural and change management are recognized as important factors for adopting the proposed ecosystem. Further studies may take a closer look and develop deeper into the employee motivation and resistance toward accepting new technologies as part of a brother behavioral study.

## 8.3 Final Remarks

As presented, AI is the technology that has the power to greatly transform the innovation process. It can improve and democratize ideation process, log every proposed innovation idea and provide evidence-based data-driven transparent evaluation (ranking score).

Yet the technology is not enough on its own. Organizations must embrace the innovation culture as a core business process.

By integrating AI into the innovation process and establishing AI supported continuous innovation ecosystem they can ensure that all of the creative potential of employees is harnessed and that no idea is lost, permanently strengthening their position and ability to adapt to changing business landscape.

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# 13 Appendix I: Demonstration of AI Governed Ranking Process

The following content is entirely AI generated. It serves an important purpose of illustrating how the current AI model handles ranking process and the entire output it has generated. It proves the usability and capabilities of the current state AI models to be used for the proposed purpose.

For the purpose of this exercise ChatGPT4o model is used. The model is fed the ranking parameters, score ranges, weighting factors and the logic was explained clearly to the model.

Scenario: Workplace Safety Innovation

*Idea:* A factory worker proposes a new mechanism for machinery that would reduce the risk of accidents by 80%. The idea involves a small physical modification combined with sensor-based safety features.

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*1. Internal Parameters*

1. Alignment with Business Strategy
    - Score: 10; Reason: Workplace safety aligns closely with operational efficiency, compliance, and corporate responsibility.
2. Complexity of Implementation
    - Score: 7; Reason: The physical modification and sensor integration require moderate technical expertise and testing but are not overly complex.
3. Required Funding and Resources
    - Score: 8; Reason: The idea involves minimal investment compared to the high impact on safety and compliance.
4. Internal Expertise Availability
    - Score: 9; Reason: The factory already employs engineers and safety specialists capable of implementing the idea.
5. Time to Market
    - Score: 8; Reason: The solution could be implemented quickly within the factory environment after pilot testing.
6. Potential to Enhance Employee Efficiency
    - Score: 9; Reason: Improved safety reduces downtime from accidents and enhances worker confidence and productivity.

*2. External Parameters*

1. Market Potential
    - Score: 7; Reason: While the solution is primarily internal, it could have broader applications in other factories if commercialized.
2. Competitive Landscape
    - Score: 8; Reason: Few competitors are offering such targeted safety solutions for this machinery type.
3. Unique Selling Point (USP)
    - Score: 9; Reason: The significant 80% improvement in safety is a compelling differentiator.
4. Customer Persona Match
    - Score: 10; Reason: Factory workers and management would highly value improved safety mechanisms.
5. Regulatory and Patent Considerations
    - Score: 8; Reason: The solution adheres to safety regulations but may need a patent search to avoid conflicts.
6. Potential for Long-Term Gains
    - Score: 7; Reason: The idea delivers significant internal benefits, with potential for external revenue if marketed.
7. Market Readiness
    - Score: 9; Reason: The technology and components needed are readily available.

*3. Dynamic Parameters*

1. Current Economic Conditions
    - Score: 9; Reason: The focus on operational safety and cost-effectiveness aligns well with current manufacturing industry trends.
2. Technological Trends
    - Score: 8; Reason: Sensor-based safety solutions are becoming more popular and feasible.
3. Revisitation Value
    - Score: 8; Reason: If not immediately adopted, the idea could become relevant during future safety upgrades.

*4. Additional Parameters*

1. Sustainability Impact
    - Score: 7; Reason: Enhanced safety reduces accident-related waste (e.g., damaged equipment, medical costs), indirectly supporting sustainability.
2. Cultural Fit
    - Score: 10; Reason: Aligns perfectly with a safety-first workplace culture.
3. Stakeholder Buy-In Potential
    - Score: 10; Reason: High likelihood of support from management, employees, and regulators due to clear benefits.
4. Current Social Media and Consumer Trends
    - Score: 6; Reason: Safety innovations may not be highly visible on social media but resonate within niche industrial communities.

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*Final Score Calculation*

Using weights tailored to the organization, the AI system calculates a weighted score. For example:

- Internal Parameters Weight: 40%
- External Parameters Weight: 30%
- Dynamic Parameters Weight: 20%
- Additional Parameters Weight: 10%

Weighted Score: ~8.7/10 (High Priority)

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*Feedback to the Idea Creator*

1. Strengths:
    - Aligns strongly with business strategy and cultural values.
    - High feasibility with existing resources and expertise.
    - Significant impact on safety and operational efficiency.
2. Areas for Improvement:

- Consider patent research to ensure no conflicts.
- Explore broader commercialization potential to boost external market value.

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*Summary for Decision Makers*

*Idea Overview*

- Proposed Innovation: A factory safety mechanism combining physical modifications and sensor-based features to reduce workplace accidents by 80%.
- Primary Benefits:
  - Enhances employee safety and operational efficiency.
  - Aligns with the company's strategic goals and safety-first culture.
  - Offers potential scalability for broader application in the industry.

*Ranking Summary*

- Final Score: ~8.7/10 (High Priority)
- Key Strengths:
  - Strong alignment with business strategy, cultural values, and stakeholder expectations.
  - High feasibility using existing resources, expertise, and technology.
  - Immediate and long-term operational benefits, with potential for commercialization.
- Key Considerations:
  - Conduct a patent search to mitigate risks.
  - Assess potential for commercialization to maximize ROI.

*Actionable Recommendations*

1. Approve a pilot implementation of the safety mechanism in the factory to validate its effectiveness.
2. Assign a cross-functional team to:
   - Verify patent landscape and regulatory compliance.

- Explore potential for marketing the solution as a commercial product for other factories.

3. Utilize the AI system to:
    - Continuously monitor the idea's ranking and reassess as new data becomes available.
    - Collect feedback during the pilot to refine and improve the solution.