





University  
of Glasgow | School of  
Computing Science

Honours Individual Project Dissertation

# USING THE METAGPT FRAMEWORK TO AUTOMATE THE FUZZY FRONT END OF THE PRODUCT INNOVATION PROCESS

**Daniel Flynn**  
March 22 2024

## Abstract

Product innovation is both expensive and dependent on skilled labour. This project investigated the effectiveness of an LLM-powered automated system as an alternative approach for the first stage of product innovation, the Fuzzy Front End. This was done by emulating a human workflow in the MetaGPT multi-agent collaboration Framework. While results were varied, in one of the two innovations in which the final system was evaluated, it outperformed both human innovators and ChatGPT. The repository for this project can be found at <https://stgit.dcs.gla.ac.uk/2469113f/daniel-f-dissertation>

# Education Use Consent

Consent for educational reuse withheld. Do not distribute.

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Motivations	1
1.2	Aims	1
<b>2</b>	<b>Background</b>	<b>2</b>
2.1	MetaGPT	2
2.1.1	Large Language Models (LLMs)	2
2.1.2	GPT-series Models	2
2.1.3	Multi-Agent Frameworks for LLMs	3
2.1.4	Introducing MetaGPT	4
2.2	Product Innovation	4
2.2.1	Clarifying Innovation Vocabulary	4
2.2.2	Defining and Categorising Product Innovation	5
2.2.3	Introducing the Fuzzy Front End	6
2.2.4	Review of Existing FFE Frameworks	6
2.3	The intersection of LLMs and Product Innovation	9
2.3.1	The Potential of LLMs and Explorative Innovation	9
<b>3</b>	<b>Analysis</b>	<b>12</b>
3.1	Analysing the MetaGPT Framework	12
3.1.1	The Early Challenge of Codebase Familiarisation	12
3.1.2	Framework Analysis	13
3.2	Problem Specification	15
3.2.1	Functional Requirements	15
3.2.2	Non-Functional Requirements	16
3.2.3	Limitations	16
<b>4</b>	<b>Design</b>	<b>18</b>
4.1	Designing a Standard Operating Procedure for FFE	18
4.1.1	Stage 1 - Discover	18
4.1.2	Stage 2 - Define	19
4.1.3	Stage 3 - Develop	20
4.1.4	Stage 4 - Deliver	20
4.1.5	FFE SOP Summary	21
4.2	Modelling the SOP in MetaGPT	22
4.2.1	Innovation Scenario Template	22
4.2.2	Methods as Actions	23
4.2.3	Stages as Roles	23
4.2.4	Demonstrator Role	23
<b>5</b>	<b>Implementation</b>	<b>24</b>
5.1	Resources used	24
5.1.1	MetaGPT	24
5.1.2	LLM	24
5.2	System Details	24

5.2.1	Actions	24
5.2.2	Roles	25
5.2.3	Auxillary Features	26
<b>6</b>	<b>Evaluation</b>	<b>27</b>
6.1	Evaluation Strategy	27
6.1.1	Phase 1	27
6.1.2	Phase 2	27
6.1.3	Phase 3	28
6.2	Results	28
6.2.1	Automated FFE System vs Human vs ChatGPT Performance	28
6.2.2	Scenario 1	29
6.2.3	Scenario 2	30
6.3	Analysis of System Performance	30
<b>7</b>	<b>Conclusion</b>	<b>32</b>
<b>8</b>	<b>Appendices</b>	<b>33</b>
<b>Appendices</b>		<b>34</b>
.1	Ethics Checklist	34
.2	Surveys	37
.2.1	Phase 1 Surveys	37
.2.2	Phase 2 Surveys	48
.2.3	Phase 3 Surveys	61
<b>Bibliography</b>		<b>254</b>

# 1 | Introduction

## 1.1 Motivations

Product innovation is a difficult task. It requires a high level of expertise in numerous fields, which usually means the assembly and management of multi-disciplinary teams. The AMA/HRI Innovation Survey 2006 (as cited by American Management Association (2006, p.16)) found the top three barriers to be "insufficient resources, the lack of a formal strategy for innovation, and a lack of clear goals and priorities". The American Management Association (2006, p.16)" also highlighted the problem of "organizational structures that just aren't geared to enhance innovation". An investigation by Freel (2000) found small firms faced similar barriers, specifically inadequate financial resources stemming from the hesitancy of external financiers, unskilled labour due to a lack of internal training and low levels of collaboration with larger organisations. Another investigation by Carvache-Franco et al. (2022), this time looking at the innovation barriers present in Ecuador, again identified lack of funding and skilled labour to be the most problematic: "The main barriers to product and process innovation found in this research on Ecuadorian companies are lack of funds in the company, high costs of innovation, lack of qualified personnel in the company, and lack of qualified personnel in the country".

Given these challenges, the need in business for the creation of a cheaper and less skilled labour-dependent approach to product innovation is evident. In the field of Large Language Modelling, multi-agent collaborative frameworks such as MetaGPT (Hong et al. 2023a) have been gaining attention for their effectiveness at solving complex tasks, enabled through the emulation of existing human workflows. This project seeks to explore the effectiveness of this new technology as an alternate approach to the first stage of product innovation, where work is done to identify opportunities and generate innovation ideas. This stage of the innovation process, commonly referred to as the Fuzzy Front End (FFE), contains all the work done before physical implementation is required, making it suitable for software automation attempts.

## 1.2 Aims

Two fundamental aims underlie this project:

1. Explore the viability of LLM-powered automated systems as an alternative approach to the human teams typically used for the FFE of the innovation process.
2. Discover if the emulating of human workflows in multi-agent collaborations results in better system performance than naive LLM prompting.

## 2 | Background

### 2.1 MetaGPT

#### 2.1.1 Large Language Models (LLMs)

Developing machines capable of understanding and communicating in human language has been a long-standing challenge in research. The most successful approach to date has been Language Modelling, a family of artificial intelligence algorithms which "aims to model the generative likelihood of word sequences, so as to predict the probabilities of future (or missing) tokens" (Zhao et al. 2023, p.1). Within the field of Language Modelling, there have been four major development approach milestones: firstly the development of the original Statistical Language Models based on statistical learning methods in the 1990s; secondly, the breakthrough of Neural Language Models (NLMs), which use neural nets to capture distributed representations of words, in 2013; thirdly the rise of Pre-trained Language Models (PLMs), models pre-trained on diverse, unfocused corpora which can be fine-tuned to specific downstream tasks, in 2018; and finally Large Language Models in 2020 (Zhao et al. 2023).

Large Language Models are a division of PLMs distinguished by their large model and/or training data size. The development of LLMs is seen as a milestone in language modelling due to the significant increase in capability observed as PLMs are scaled. The increase in capability takes two forms: the first is the predictable performance increase Kaplan et al. (2020) formalise as scaling laws (power-law relationships linking increasing parameter count, dataset count, and optimised training conditions to improvements in model performance metrics), and the second is the unpredictable emergence of new abilities in downstream tasks not observed in smaller models. Many powerful abilities have been shown to emerge as PLMs are scaled; (Wei et al. 2022, p.6) identifies 23 across a range of models. These abilities are referred to as *emergent abilities* in literature. Three particularly useful emergent abilities typically observed are *in-context learning, instruction following, and step-by-step reasoning* (Zhao et al. 2023). Such emergent abilities transform the utility of LLMs from specific task solvers to general solvers for text-encoded problems, resulting in the continual discovery of an ever-expanding array of LLM application opportunities.

#### 2.1.2 GPT-series Models

The Generative Pre-trained Transformer, or GPT, series are a family of decoder-only LLMs created by OpenAI (see <https://openai.com/gpt-4>). The GPT-series is currently on its fourth major iteration; GPT-1 was released in 2018, GPT-2 in 2019, GPT-3 in 2022, and GPT-4 in 2023. The intermediate GPT-3.5 iteration was released between the latter two. GPT-1 introduced the core architecture for the GPT-series and the underlying principle used to model language: predicting the next word (Zhao et al. 2023). From then on, each iteration of the GPT series brought larger model sizes, improved architecture and new training techniques, leading to drastic improvements in the performance and capabilities of each model. Alongside the release of GPT-3, OpenAI formally introduced the concept of In-Context Learning, a training technique that enables LLMs to understand tasks in the form of natural language (Zhao et al. 2023). Accordingly, GPT-3 was the first GPT model to see success on tasks designed to require

reasoning abilities. GPT-3 models with extended capabilities from the use of techniques such as 'training on code data' and 'human alignment' were released under the nomenclature GPT-3.5 (Zhao et al. 2023). The most recent and largest GPT model, GPT-4, saw further improvement in reasoning abilities, with drastically increased performance on complex tasks (Zhao et al. 2023). The input was also extended from text only to multimodal signals (Zhao et al. 2023).

The release of the conversation model ChatGPT, based on GPT-3.5 and GPT-4, by OpenAI in November 2022 drew significant attention to the GPT series. ChatGPT "exhibited superior capacities in communicating with humans: possessing a vast store of knowledge, skill at reasoning on mathematical problems, tracing the context accurately in multi-turn dialogues, and aligning well with human values for safe use" (Zhao et al. 2023). The release of ChatGPT has transformed the general public's perception of LLMs from theoretical technology to versatile, powerful tools applicable to a range of real-life tasks.

### 2.1.3 Multi-Agent Frameworks for LLMs

While LLMs have shown impressive levels of ability as general problem solvers, they contain a number of inherent constraints that limit their ability to complete complex tasks. Three such constraints are the "lack of long-term memory, limited token length, and the lack of deterministic control over its behaviours" (Yang et al. 2023). These constraints all contribute to poor performance on long-horizon tasks (complex tasks that require an extended series of interconnected steps): the first means LLMs cannot maintain and use needed contextual information from earlier steps, the second limits both amount of contextual information that can be inputted and depth of reasoning that can be generated, and the third prevents encoding of optimised workflows (leading to unstable performance and hallucinated artefacts in outputs). One solution to these problems that has seen significant attention in recent research is Multi-Agent Frameworks (Yang et al. 2023; Wu et al. 2023; Zong et al. 2024; Liu et al. 2023; Li et al. 2024; Talebirad and Nadiri 2023).

Multi-Agent Frameworks are rooted in the Agent-Oriented Programming (AOP) paradigm (Shoham 1993), a specialisation of Object Oriented Programming where modules are extended to be agents who possess a mental state which describes their beliefs, capabilities and decisions. These agents exist within an environment which enables computations consisting of "agents informing, requesting, offering, accepting, rejecting, competing, and assisting one another" (Shoham 1993, p.56). The agents are 'autonomous' in that the action they take in response to a request depends on their mental state. The AOP paradigm is realised in Multi-Agent Frameworks through LLM-powered agents. Within a prompt you can instruct an LLM of the mental state you want it to emulate (in recent literature usually referred to as the 'role' of the agent<sup>1</sup>), and then request the completion of a task. The action the LLM-Agent takes (a.k.a the output generated) will depend on its mental state, satisfying the AOP paradigm. LLM-powered Multi-Agent Framework approaches have been successfully applied to long-horizon tasks by decomposing the task into sets of sub-tasks associated with specialised agents at various levels of abstraction. For example, Yang et al. (2023) found the open-source agent framework Auto-GPT outperformed state-of-the-art IL models in task simulation environments, while Zong et al. (2024) devised the Triad Framework, which achieved either best or competitive performance at Knowledge Based Question Answering Tasks. Multi-Agent Frameworks inherently provide practical solutions to the issues of limited token length and lack of deterministic control; agents require only contextual information relevant to their role and the task at hand, and the decomposition of the task adds some level of granular control to the process. Meanwhile, the environment that

---

<sup>1</sup>It is worth noting there are inconsistencies in the vocabulary used regarding Agents and Roles in literature. Yang et al. (2023) and Zong et al. (2024) only describe frameworks with a single LLM-based agent which emulates different roles, while Hong et al. (2023a) describe a framework with multiple agents, each with one unique role (the role is a property of an agent). This dissertation will use the latter definition, as it is Hong et al. (2023a) used later on.

facilitates communication between the agents provides a convenient opportunity to implement long-term memory solutions for information from earlier tasks.

### 2.1.4 Introducing MetaGPT

MetaGPT is an in-development open-source automated system for meta-programming implemented in a Multi-Agent Framework (referred to in this dissertation as the 'MetaGPT Framework'), created and led by Hong et al. (2023a). The novel idea behind MetaGPT is the emulation of efficient human workflows for software development in multi-agent collaborations. This is done by encoding corresponding Standard Operating Procedures (SOPs) as prompt-sequences. SOPs are documented, structured approaches to complex tasks known to result in effective solutions. An SOP consists of a sequence of steps, each with its own detailed instructions or methods. A more detailed explanation of how MetaGPT supports the encoding of SOPs can be found in Section 3.1. This approach led MetaGPT to be the, at the time of publishing, best-performing chat-based multi-agent system on collaborative software engineering benchmarks (Hong et al. 2023a, p.1). The project has gathered a large amount of attention, topping the GitHub Trending Monthly for the 17th time in August 2023, and being selected for Open100: Top 100 Open Source achievements (BenchCouncil 2023).

## 2.2 Product Innovation

### 2.2.1 Clarifying Innovation Vocabulary

In the growing body of research on innovation, the word is often defined variably depending on the context in which it is being applied. Therefore, I should clarify exactly which definition I will use in this dissertation.

A popular definition by Anderson et al. (2014) describes innovation as the second stage of a two-part improvement process. Specifically, the definition provided for the process is:

*"Creativity and innovation at work are the process, outcomes, and products of attempts to develop and introduce new and improved ways of doing things. The creativity stage of this process refers to idea generation, and innovation to the subsequent stage of implementing ideas toward better procedures, practices, or products. Creativity and innovation can occur at the level of the individual, work team, organization, or at more than one of these levels combined, but will invariably result in identifiable benefits at one or more of these levels-of analysis."*

In essence, innovation does not refer to the generation of new ideas but rather to the action of implementation itself. The first stage in which the ideas are generated is named 'Creativity', and the process in its entirety is not explicitly named but referred to as 'Creativity and innovation'. The deconstruction of the process into two stages is both consistent across research and essential to the understanding of innovation used throughout this dissertation. However, as Artificial Intelligence is also a key topic of discussion, the use of 'Creativity' as a noun and the lack of a name for the process in its entirety is problematic. In this vocabulary, 'Creativity' specifically refers to the generation of ideas regarding "new and improved ways of doing things", which clashes with existing literature in which AI and creativity intersect due to its narrow scope. For example, in (Boden 2009), creativity is defined as "*the ability to generate novel, and valuable, ideas. Valuable, here, has many meanings: interesting, useful, beautiful, simple, richly complex, and so on. Ideas covers many meanings too: not only ideas as such (concepts, theories, interpretations, stories), but also artifacts such as graphic images, sculptures, houses, and jet engines.*" While Anderson et al.'s definition would be an example case of Boden's, it would only cover a fraction of possibilities. The growing body of literature on AI's role in creative works, which primarily generates meaningful and novel ideas over improvement ideas, emphasises the need for clarity. Furthermore, the usage of 'innovation' to only refer to the second stage of the process clashes with much of the literature

on innovation referenced later in this dissertation. For example, the Design Council (2024)'s "Framework for Innovation" (discussed later) actually refers to a framework for the so-called 'Creativity' stage. To avoid confusion, this dissertation will use the less popular but more recent definition of innovation, synthesised in a review of 208 definitions by Singh and Aggarwal (2022):

*"the operationalization of creative potential with a commercial and/or social motive by implementing new adaptive solutions that create value, harness new technology or invention, contribute to competitive advantage and economic growth"*

Under this definition, *innovation* refers to the two-stage process in its entirety. The first stage of the innovation process (and focus of this dissertation) identified by Anderson et al. (2014) will be referred to as the 'Fuzzy Front End', in accordance with a common language provided by Peter Koen and Wagner (2001). This stage of the innovation process does not require the development of physical prototypes and products, making it suitable for software-based automation attempts. The following stage(s) [innovation process models that have two following stages, so three stages in total, are also typical in literature] will simply be referred to as the *latter stage* of innovation.

## 2.2.2 Defining and Categorising Product Innovation

Product innovation is innovation where the resulting "new adaptive solution" is, as the name suggests, a new product or iteration of an existing product. Product innovation is typically done for a commercial motive, although social motives such as improving environmental sustainability do exist. Different instances of product innovation can result in solutions of countless forms, which (Heany 1983) suggests viewing on a spectrum of least to most disruptive. Disruptive here refers to the degree of impact the solution would have on both the innovating business and the market being served (with the market being created in the most disruptive case). Within the spectrum Heany (1983) identifies six types of product innovation, categorised by the solutions they result in (in order of least to most disruptive):

- **Style Changes:** Changes in only the aesthetics of an existing product.
  - Example: Releasing an existing model of shoe in a new colourway
- **Product Improvements:** New models of products that are already being served to a market, with changes to one or two features/characteristics.
  - Example: A model of bike with a slightly lighter frame than the previous model
- **Product-Line Extensions:** New products that follow the same product-design principles as a business's existing products. Product-line extensions generally serve a segment of the customer base for an existing product, offering small changes in functionality to fulfil a niche need that is not yet covered.
  - Example: Adding a Quorn burger to an existing menu to accommodate vegetarians
- **New Products for the Currently Served Market:** New products that offer entirely new functionality to a business's existing products but whose targeted customers are the business' currently served markets.
  - Example: A new line of helmets created by a company whose primary product is climbing harnesses.
- **New Products for Existing Markets:** New products that offer entirely new functionality to a business's existing products and are targeted at customers in a market the business does not already compete in. Businesses that perform this type of innovation without any existing customer base are often labelled as 'start-ups'.
  - Example: A new company whose first product is a multi-platform closed-source operating system, in direct competition with Microsoft's Windows.

- **New Products for Markets as Yet Undefined and Undimensioned:** New products that are so novel and different in functionality that the market they aim to serve does not yet exist.

– Example: The home computer

More disruptive types of innovation have the potential for higher returns but carry more risk (Christensen 2013), while less disruptive types of innovations offer lower but more consistent returns. Less disruptive innovations usually involve making incremental changes to mature products, which can be hard to do due to the cost of breaking commitments made to the existing ways of doing things. Solutions with only incremental changes are also less likely to attract significant demand, as the market will already be saturated with similar products. More disruptive innovations face the challenge of developing product knowledge and know-how from scratch (American Management Association 2006, p.6), the uncertainty of how significant the demand for their new functionality will be, and the uncertainty of whether the new functionality is actually realisable.

### 2.2.3 Introducing the Fuzzy Front End

The Fuzzy Front End (FFE) is the first stage of the innovation process. It is where work is done to create the initial innovation concept, before it is implemented in the latter stages. Specifically, FFE encompasses the "Identification and evaluation of business opportunities, creation, evaluation and selection of ideas, and the development and testing of new product concepts". (Stevanovic et al. 2015, p.2). The initial input to FFE is often a notion of a business opportunity caused by a technological breakthrough or a perceived gap in the market. The notion might even be the opportunity to perform innovation itself. The result of FFE is innovation ideas; in the case of Product Innovation, this means potential new products that, if realised, are expected to perform well. It is essential the ideas generated in FFE are good, as no amount of implementation or commercialisation work in the latter stage of innovation will be able to rescue an inherently flawed idea.

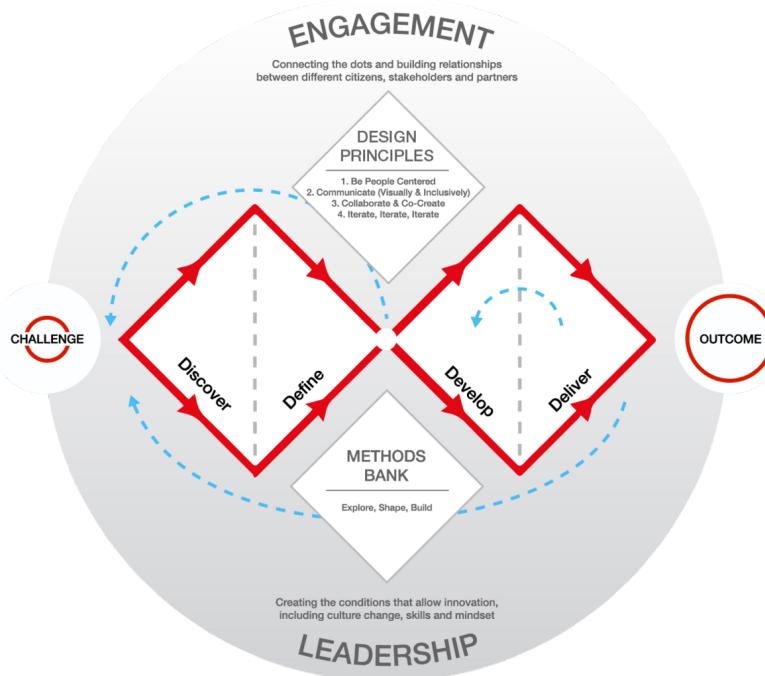
### 2.2.4 Review of Existing FFE Frameworks

The Fuzzy Front End goes by a number of names; as discussed before Anderson et al. (2014) uses 'Creativity', while Stevanovic et al. (2015, p.1) identifies two common names in literature; "it is usually known (Smith&Rainertsen, 1991, as cited by Stevanovic et al.) as Fuzzy-Front End (FFE) or (Koen, 2001, as cited by Stevanovic et al.) Front-End of Innovation( FEI)", and offers their own; "preparation of product development (PPD)" (Stevanovic et al. 2015, p.2). The ambiguous naming of the Fuzzy Front End belies its nature as a task; the optimal methodology for a given innovation case is dependent on the nature of the case, meaning it constantly changes. Despite the fuzziness of this stage, attempts have been made in both literature and industry to develop generic frameworks for innovation for either all cases or subsections of cases. The section analyses three such frameworks, identifying useful shared themes.

#### The Double Diamond based Framework for Innovation

Figure 2.1 illustrates a framework proposed by the Design Council (a United Kingdom Charity that works as an advisory body to public, private, and third-sector organisations), constructed around their methodology for design, the Double Diamond. The Double Diamond methodology takes a design challenge and produces a design outcome via a process consisting of two diamond stages, each with a convergent and divergent sub-stage. The sub-stages in order of progress are:

- **Discover:** The first sub-stage diverges from the initial design challenge, exploring the issue using participatory research involving affected individuals. The output of this stage is an array of insights into the true nature of the challenge.
- **Define:** The second sub-stage converges on a new definition of the challenge, using the various insights to re-frame the original issue.



**Figure 2.1:** A framework for innovation based on the Double Diamond Pattern, created by the Design Council (2024). Licensed under a CC BY 4.0 license

- **Develop:** The third sub-stage diverges from the finalised challenge into a plethora of potential solutions.
- **Deliver:** The final stage converges on the best solutions through small-scale testing.

Four design principles are emphasised: Being people-centred, communication, collaboration and iteration (iteration specifically over separate convergence and divergence and over the process as a whole). It identifies the need for innovation to take part in a culture where all interested parties are effectively engaged and there is effective leadership to unite the various team members. The model does describe a method bank that categorises methods into exploring, shaping and building types, however the methods themselves are private intellectual property of the Design Council.

### A Learning Model Framework

Beckman and Barry (2007) express an FFE framework as a learning model for an innovation team, constructed upon Kolb (1984)'s influential experiential learning theory. Like the Double Diamond framework, they identify four stages, each of which they assign learning type from experiential learning theory describing the type of individual best suited to the stage. For each of the four stages, they also provide a list of methods that could be used to carry out the stage. The stages, related learning types, and methods have been collated in Table 2.1.

While this framework shares the same number of stages as the Double Diamond framework, it differs in how the stages divide the FFE process. The Double Diamond Discovery stage is separated into the Observation and Frameworks stages, the first referring to the performance of user research and the latter to modelling the results in useful ways. The learning model's Imperatives stage is identical to the Double Diamond's Define stage, where imperatives derived from the previous stage's result frameworks are used to define the challenges to be solved. Finally, the Double Diamond's Develop and Deliver phase is condensed to just one Solutions stage. However, it is worth noting that the Solution stage's methods are divided into Solution

Stage	Associated Learning Type	Methods
Observations	Diverging	Participant Observation, Non-participant Observation, Formal Ethnographic interviews, Intercepts, Informant Diaries, Virtual Ethnography and Netnography
Frameworks	Assimilating	User Stories, Two-by-Two User Matrices, User Timelines
Imperatives	Converging	Extracted from Frameworks: Needs, Design Principles
Solutions	Accomodating	Solution Generation: Morphological Analysis, Brainstorming. Solution Selection Selection: Decision Matrices

**Table 2.1:** A compilation of the Stages, Associated Learning Types, and Methods found in Beckman and Barry (2007)'s Learning Model for Innovation

Generation and Solution Selection categories.

The learning types associated with each stage reflect the pattern of convergence and divergence highlighted by the Double Diamond model. The first stage requires divergent thinkers, the third convergent, and the fourth stage's accommodating thinkers are expected to perform both solution generation and selection: diverging and converging tasks. These three stages complete the Double Diamond. The most significant difference and critical takeaway from the comparison of the two models is the decision to identify a separate Framework stage. The efficacy of this stage determines the usefulness of the imperatives that can be synthesised in the succeeding stage, which in turn defines the challenge the entire innovation process looks to solve. Accordingly, any implementation of an FFE process should ensure proper attention is paid to the design of suitable models for the representation and analysis of research results.

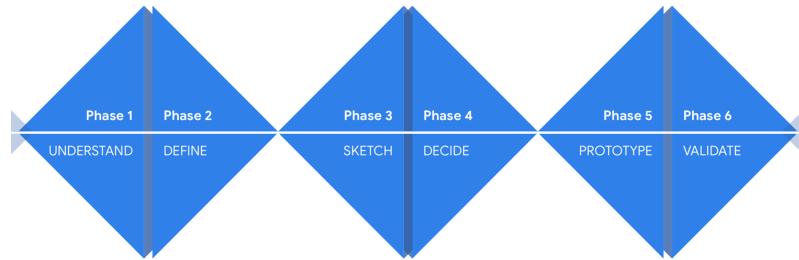
### Design Sprint Kit Framework

The Design Sprint Kit (Google n.d.) is an online open-source resource maintained by Google, centred around Google's internally developed Design Sprint methodology (illustrated by Figure 2.2). The Design Sprint is a rapid product innovation framework designed to be executed through 5-day collaborative workshops (although it is emphasised that this is flexible). There are six phases in the Design Sprint framework; however, under the definitions established previously, the final two fall under the latter stage of innovation and will be discounted. The four remaining phases (Understand, Define, Sketch, Decide) are functionally identical to the Double Diamond pattern. The independent derivation of the same framework for product innovation reaffirms its validity as an effective approach.

The Design Sprint Kit offers more than just the Design Sprint framework; the Design Sprint Kit website acts as a method repository, providing methods either created internally by Google or contributed by industry sources. These methods are designed for small teams to be able to complete internally, generally over a short period of time, and using their own knowledge rather than requiring research to be performed. This makes them particularly applicable to automation using LLMs, as they can be described succinctly in prompts requested in short sessions. There are too many methods to include here, so samples from each stage (selected on applicability) have been selected and displayed in Table 2.2.

### Framework Review Summary

Three FFE frameworks have been evaluated, and while their choices of where to divide the process differ, they all describe a two-time repeating process of divergence followed by convergence. Firstly the original challenge is re-framed, using customer-centric methods to identify new issues/principles/perspectives from which a multitude of new challenges are identified. Secondly,



**Figure 2.2:** An illustration of the six phases of the Design Sprint, created by Google (n.d.) and sourced from <https://designsprintkit.withgoogle.com/methodology/overview>

Phase	Methods
Understand	User Journey Mapping, Experience Mapping, Importance/Difficulty Mapping, Rose Thorn Bud, Job Stories
Define	Success Metrics and Signals, Design Principles, The Golden Path, Pick a Target, Assumptions Mapping
Sketch	Crazy 8's
Decide	Decision Matrix, Silent Review and Vote, Assumptions and Sprint Questions

**Table 2.2:** A sample of the methods Google (n.d.) suggest for each stage of their Design Sprint Kit Framework

one of the new challenges is selected to be the focus of the innovation process, determined by metrics such as impact and expected ease of solution development. Beckman and Barry (2007) suggest the addition of an intermediary stage between the two due to the importance and complexity of effectively modelling user research results in enabling the identification of nuanced issues/principles/perspectives. Thirdly, a multiple of innovation ideas for how to solve the chosen challenge are generated. Throughout the frameworks, this generally seems to be the most fuzzy/creative stage with the least concrete guidance and methods proposed. Finally, in the last stage, the innovation ideas are evaluated, and the best is selected to be realised in the latter stage of innovation. Two of the frameworks (Beckman and Barry (2007) and Google (n.d.)) also propose methods for each stage of FEE and Beckman and Barry (2007) identify the learning types of the individuals best suited to carrying out each stage. Each framework's stages, methods, and associated learning types have been compiled in Table 2.3, to be used as a guide and method bank in 4.1.

## 2.3 The intersection of LLMs and Product Innovation

### 2.3.1 The Potential of LLMs and Explorative Innovation

American Management Association (2006) apply the insights of March (1991) (as cited by American Management Association (2006, p.5)) on Organisation Learning to the case of innovation. March (1991) identifies two types of learning that occur in organisations: exploitative and exploratory. In the context of innovation, exploitative innovations utilise existing knowledge in clever new ways, while explorative innovations look to seek entirely new knowledge. Knowledge here is from the perspective of the organisation performing the innovation. An example of exploitative innovation in the automotive industry would be a new model of a diesel car; the

Framework for Innovation Stages	Learning Model Stages (and Associated Learning Type)	Google Design Sprint Stages	Learning Model Methods	Google Design Sprint Kit Methods
Discover	Observations (Diverging)	Understand	Participant Observation, Non-participant Observation, Formal Ethnographic interviews, Intercepts, Informant Diaries, Virtual Ethnography and Netnography	User Journey Mapping, Experience Mapping, Importance/Difficulty Mapping, Rose Thorn Bud, Job Stories
	Frameworks (Assimilating)		User Stories, Two-by-Two User Matrices, User Timelines	
Define	Imperatives	Define	Extracted from Frameworks: Needs, Design Principles	Success Metrics and Signals, Design Principles, The Golden Path, Pick a Target, Assumptions Mapping
Develop	Solutions (Accommodating)	Sketch	Solution Generation: Morphological Analysis, Brainstorming.	Crazy 8's
		Decide	Solution Selection: Decision Matrices	Decision Matrix, Silent Review and Vote, Assumptions and Sprint Questions

**Table 2.3:** A compilation of the Stages, Associated Learning Styles, and Methods found in the three reviewed FFE frameworks.

manufacturer will exploit its existing knowledge of the car industry to find ways to improve the new model from the previous. This might be improving braking technology, reducing weight, etc... An example of exploratory innovation from the automotive industry is the electric car; the production of an electric car by a manufacturer that previously specialised in diesel cars requires the exploration of an entirely new type of technology. Innovations that are exploitative tend to be incremental improvements to existing products, while explorative innovations tend to be more radical. The first three types of innovations identified in 2.2.2 are cases of exploitative innovations, while the latter three are examples of explorative; it follows then that explorative innovation is more disruptive than exploitative.

Explorative organisation learning can be deconstructed further into two types: learning done through the research and development of new science and technologies and learning done by seeking knowledge that, while already existing, is outside the company's knowledge base. The premise of this project is the hypothesis that LLMs can be used effectively as a means of innovation that utilises the latter type of explorative learning. As mentioned in 2.1.1, LLMs are PLMs trained on exceedingly large datasets. These large datasets contain expansive information on a multitude of topics. 2.1.1 also explains how the emergent abilities of LLMs have enabled their utility as general problem solvers. For organisations, exploration outside their existing knowledge base is usually a resource-intensive endeavour with no guarantee of the discovery of useful information. LLMs, however, provide a breakthrough means to search for new, relevant knowledge from a vast repository of information with incredible efficiency and at a fraction of the cost. By encoding innovation as a problem for an LLM to solve, it will hopefully be possible to exploit the information contained in an LLM's training data to significant effect.

# 3 | Analysis

## 3.1 Analysing the MetaGPT Framework

This section provides an overview of the implementation details of the MetaGPT Framework introduced in 2.1.4. It first acknowledges the early challenges faced and work done regarding codebase familiarisation before introducing the key components of the framework and how they combine to form a holistic architecture through the lens of Message Flow. Finally, it shows how the framework can be used to emulate complex human workflows via the exploration of the hypothetical system that would result from the implementation of a generic Standard Operating Procedure in MetaGPT.

### 3.1.1 The Early Challenge of Codebase Familiarisation

As mentioned previously 2.1.4, MetaGPT itself has seen continuous development alongside this project. The initial research phase and early development of my system used v0.2.1. of MetaGPT before transferring to v0.3.0 upon its release on 27<sup>th</sup> November 2023. The main branch of MetaGPT is currently on v0.7.6. The decision was made to stick with v0.3.0 as newer versions were not backwards compatible due to architecture changes, meaning the continuous work required to transfer progress was not viable. The entire version history of the MetaGPT Framework can be found here: <https://github.com/geekan/MetaGPT/releases>.

v0.2.1 was a relatively early iteration of MetaGPT, and one of the consequences of using such young software was the lack of official documentation. At the time, the only public documentation available was the architecture overview provided in Hong et al. (2023b) [MetaGPT's accompanying paper], the *README* and brief FAQ maintained in the GitHub repository, and unstructured inline comments written in a mixture of Chinese and English<sup>1</sup>. Figure 3.1 shows a sample of these comments taken from the original *manager.py* file. It is readily apparent these comments were written for developers already familiar with the codebase, with most being reminders of work to be done rather than documentation of existing code. The lack of comprehensive documentation meant a substantial amount of work was done in the early stages of

```
async def handle(self, message: Message, environment):
    """
    管理员处理信息，现在简单的将信息递给下一个人
    The administrator processes the information, now simply passes the
    information on to the next person
    :param message:
    :param environment:
    :return:
    """

    # Get all roles from the environment
    roles = environment.get_roles()
    # logger.debug(f"{{roles=}}, {{message=}}")

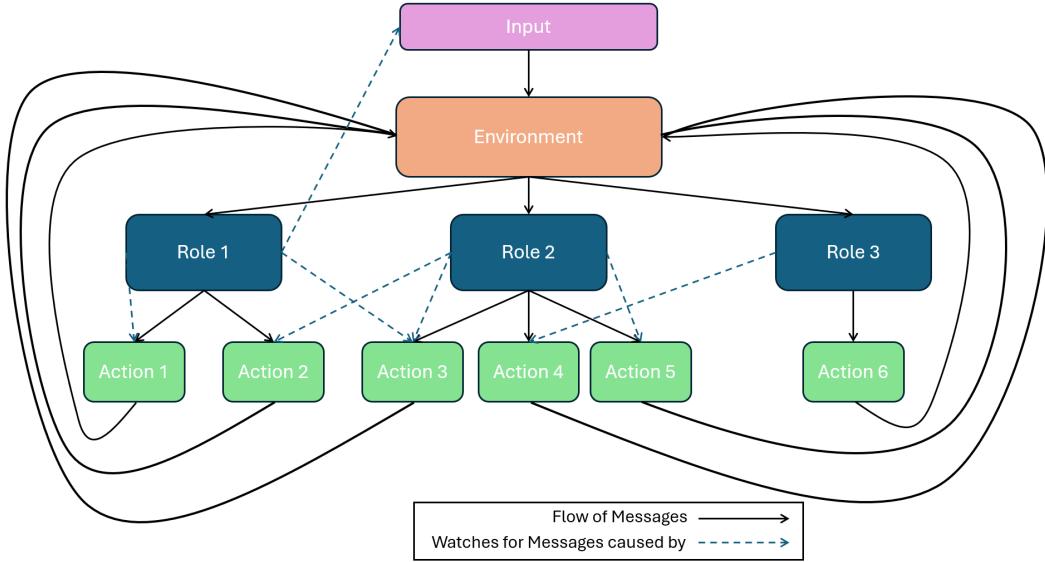
    # Build a context for the LLM to understand the situation
    # context = {
    #     "message": str(message),
    #     "roles": {role.name: role.get_info() for role in roles},
    # }
    # Ask the LLM to decide which role should handle the message
    # chosen_role_name = self.llm.ask(self.prompt_template.format(
    #     context))

    # FIXME: 现在通过简单的字典决定流向，但之后还是应该有思考过程
    # The direction of flow is now determined by a simple dictionary,
    # but there should still be a thought process afterwards
    next_role_profile = self.role_directions[message.role]
    # logger.debug(f"{{next role profile}}")
    for _, role in roles.items():
        if next_role_profile == role.profile:
            next_role = role
            break

```

*Figure 3.1: An example of the style of comments present in the v0.2.1 MetaGPT codebase*

<sup>1</sup>The first official documentation for MetaGPT was released with v0.4.0 on the 8<sup>th</sup> December 2023. By this time the codebase familiarisation had already been completed and development started. The official documentation can be found at: [https://docs.deepwisdom.ai/main/en/guide/get\\_started/introduction.html](https://docs.deepwisdom.ai/main/en/guide/get_started/introduction.html)



**Figure 3.2:** The flow of Messages in the hypothetical system created by encoding a generic SOP in the MetaGPT framework

the project on codebase familiarisation. This was done primarily through code inspection and consolidated through a practice task where MetaGPT was used to create a simple LLM-powered system for generating short stories. A combination of the existing documentation and insights from this familiarisation period, updated with knowledge gained through the primary development process, inform the framework analysis discussed below.

### 3.1.2 Framework Analysis

As mentioned in 2.1.4, the MetaGPT Framework enables emulation of efficient human workflows in LLM-powered multi-agent collaborations by supporting the encoding of human Standardised Operating Procedures as prompt sequences. This section first introduces the key components of the MetaGPT framework before detailing how they come together to enable SOP encoding.

#### Key Components of the MetaGPT Framework

##### Actions:

SOPs are structured approaches to complex tasks consisting of sequences of actions that, when executed, result in effective solutions. MetaGPT models these actions using specialised action classes and executes them by prompting an LLM with text-encoded methods. The specialised action subclasses inherit from the base *Action* class, which provides the features needed to model actions as class methods, namely methods for prompting the LLM via an API, and validating and parsing the text response. It is left to the subclass to provide the prompt (in which the human method for the action must be encoded as text) and handle any external output/storage. Actions return instances of *ActionOutput*, a Pydantic (Colvin n.d.) model with fields containing the string generated by the LLM and useful meta-information.

**Roles:** In the real world, SOPs are typically executed by teams who delegate the actions to members with the most suitable skill sets (for example, in 2.2.4 stages are suggested for individuals with specific learning types). MetaGPT mimics this behaviour through LLM-Agents, each with their own specialised Role. Each Role has an associated set of Actions suited to them, which

they execute one or more of when a Message caused by an Action they are subscribed to is published in the environment (discussed next). Like with Actions, specialised roles are modelled as sub-classes of the base *Role* class. The base class primarily provides tools for watching and reacting to Messages in the Environment (discussed next), memory retrieval, execution order logic, and the publishing of Action outputs. The specialised sub-classes then provide the logic for how these tools are used, as well the text-encoding of the role's profile/domain expertise (what Shoham (1993) would refer to as the Agent's *mental state*), which is passed onto the Actions to be used in prompts. The role's profile is described using four string class attributes: *name*, *profile*, *goal*, and *constraints*.

**Environment:** The Environment is the highest-level component in the MetaGPT architecture. Roles that are to be used in an implemented SOP are added to the environment on program start-up before being run asynchronously once the initial human input is entered. The environment acts as long-term memory storage within the MetaGPT framework, storing all the Messages resulting from Action execution. Roles added to the environment constantly monitor the memory store for Messages caused by Actions they are subscribed to, and are also able to access Messages caused by non-subscribed actions if needed. The Environment is implemented as a subclass of the Pydantic (Colvin n.d.) BaseModel, with fields storing the Messages published and Roles added.

**Messages:** Instances of the *Message* class act as a unit of communication in the MetaGPT framework, created when Agents execute Actions. They contain one mandatory string attribute *content*, and six optional attributes: *instruct\_content*, *cause\_by*, *role*, *sent\_from*, *send\_to*, *restricted\_to*. In v0.3.0 of MetaGPT only the first three optional attributes are utilised. The *content* attribute contains the text generated from an Action prompting an LLM, while the optional attributes contain useful meta-data about the response. Specifically, *instruct\_content* is a structured mapping of the information in *content*, *cause\_by* contains the Action that produced the *content*, and *role* contains the Role of the agent that executed the Action.

### A Holistic View of the Framework Through the Lens of Message Flow

An effective way to gain a holistic perspective of the MetaGPT framework is by examining how Messages flow between the key components. In the MetaGPT framework, all Messages are recorded in the environment, which distributes them to active Roles. Roles monitor the influx for Messages caused by Actions they are subscribed to and react by selecting the next Action to be executed (from the set of Actions associated with that Role). Roles pass the Message onto the selected Action, appending the roles profile and any additional required information from the memory store. The Action integrates the passed Message's content into its prompt, providing the contextual information required for its text-encoded-method. The Action then prompts an LLM via an API call, and publishes the response and relevant meta-data back to the Environment as a new Message. The Role watching the Action will react, and the process repeats. This cycle continues until a Message caused by an Action not subscribed to by any Roles is published. Figure 3.2 illustrates how this flow would manifest in a hypothetical system implemented in MetaGPT.<sup>2</sup>

### How MetaGPT Emulates Human Workflows

This sub-section demonstrates how the MetaGPT framework can be used to create systems that effectively emulate human workflows, by supporting the encoding of corresponding SOPs. This is done by retroactively deriving the original SOP implemented in the hypothetical system depicted in Figure 3.2. As mentioned previously, the MetaGPT Framework models the series of steps that make up SOPs as Actions, and the team members who would execute those steps as Agents defined by specialised Roles. In the system depicted by Figure 3.2, 'Role 1' watches the Messages published by the Environment for a Message caused by the initial input (as illustrated

---

<sup>2</sup>For the sake of both brevity and clarity, the explanation of both Message flow and its corresponding illustration have been simplified. Its worth pointing out the most significance difference found in the real framework; rather than the Action directly publishing the response as a Message to the Environment, it actually returns the response to the Role as either a string of instance of the ActionOutput model. The Role then instantiates the Message, appends the response and some meta-data, and publishes it in the Environment.

by the dotted blue arrow). 'Role 1' then has to choose between 'Action 1' and 'Action 2'. For the sake of simplicity, say for all Roles in this system the Action selection logic prioritises the Action with the lower number that is yet to be executed. 'Role 1' passes the Message to 'Action 1' (appending its own profile to the contents), which uses the Message's contents as context when prompting an LLM with its text-encoded method. The generated response is published as a new Message caused by 'Action1', the subscribed Role reacts (which happens to be 'Role 1' again in this system) and so on. This is a realised version of the Message flow described in the previous sub-section. We can extrapolate this process to derive the steps of the initially encoded generic SOP:

Human Input → Action 1 (Role 1) → Action 2 (Role 1) → Action 3 (Role 2) → Action 5 (Role 2)  
→ Action 6 (Role 3)

This structure could easily be found in a real-world workflow. For example, consider handling a food order at a bar:

To implement such a workflow in MetaGPT would require two steps:

1. Create specialised subclasses of the base *Action* class for each of the human actions. Each subclass would have to text-encode a method a human would use to carry out the action.
  2. Create specialised subclasses of the base *Role* class for each human role. The subclass would require a text-encoding of the profile of the corresponding human role, and the logic for memory retrieval and action selection.

Naturally, the example workflow could not actually be emulated; there is no text-encoded method you could include in a prompt that would cause an LLM to generate a cooked meal. This highlights a prominent yet important characteristic of the MetaGPT framework: it can only emulate workflows where the SOP consists of actions that can be described with text instructions, only require the power of reasoning to complete, and can be satisfied with a text result.

### 3.2 Problem Specification

As stated in the 1.2, the goal of this project is to create an automated software solution for the Fuzzy Front End of the product innovation process by emulating human innovation teams' workflows in the MetaGPT framework. The resulting system should be a cheaper alternative to the current reliance on skilled human teams. 3.2.1 outlines the features such a system must have to satisfy this goal, while 3.2.2 outlines the characteristics such a system should have to be effective. 3.2.3 addresses the limitations the system will have due to both the technologies being used and the circumstances of this dissertation.

### 3.2.1 Functional Requirements

- **Take an Innovation Scenario as an Input:** The system must be able to receive and understand an innovation scenario passed to it. A scenario should describe the context in which the user wants the innovation to take place.
  - **Generate Product Innovation Ideas:** The primary objective of the system is to generate relevant, viable, and original innovation ideas when provided with an innovation scenario. Relevant ideas mean the generated ideas must describe ways of improving the product (or category of product) present in the innovation scenario. Viable ideas mean the generated ideas must be realisable within the parameters of the innovation scenario. Original ideas mean the generated ideas should be uniquely created for that instance of the FFE, i.e. the system should not simply choose from a store of pre-existing ideas.

- **Comprehensive Readable Output:** The system must output the generated idea in a detailed, human-friendly format. The idea should be ready for implementation in the latter stages of the innovation process.
- **Mimic Human Workflows:** The system must emulate the workflow of human innovation teams in multi-agent collaborations. This should be done by encoding the steps of a human-inspired SOP for innovation in the MetaGPT framework.
- **Output Storage:** The latter stages of the product innovation process take place over an extended period of time. The idea generated, and preferably the details of the actions that led to it, should be stored in a manner that persists past program execution so they can be referred to at a later date.

### 3.2.2 Non-Functional Requirements

- **Generate Practical Product Innovation Ideas:** Not only must a system be capable of generating relevant, originable and viable ideas as outlined in the functional requirements, but the generated ideas should also be practical. A practical product idea is an idea that, if realised in the latter stage of product innovation, would see success in its targeted real-world market.
- **Encode an Effective SOP:** The quality of the ideas a system generates will be limited by the efficacy of the workflow used to create them, which in turn will be defined by the SOP that is encoded. Not all the human methods identified in 2.2.4 will be suitable for encoding in an LLM-powered system. Therefore, a human-inspired SOP that is possible to encode in the MetaGPT framework should be designed and implemented.
- **Show Steps and Reasoning:** Technically, a system that outputs just a product innovation idea would satisfy the goals of this project. However, a human is unlikely to invest in implementing an idea without knowing the justification of why they should expect it to be successful. Furthermore, insights from the work done in the FFE of innovation are often used to inform choices made in the latter stage of innovation. Therefore, a system should display the steps taken and the reasoning done to generate the product innovation idea.

### 3.2.3 Limitations

There will be a number of limitations on the system that can be created, primarily due to two factors:

1. This dissertation has no official funding, so all API costs will be paid for by the project supervisor (Jonathan Grizou) and myself. Therefore, the number of API calls the system makes must be limited to keep the project affordable.
2. LLMs, on which this project depends, have a number of inherent constraints. They are non-deterministic, so their outcome cannot be predicted, and they only have access to information embedded within their training data.

These factors will place the following constraints on any system developed:

- **No Guarantee of Complete Execution:** The non-deterministic output of LLMs means that responses to API calls cannot be guaranteed to be formatted as expected. In worst-case scenarios, this means the system will not be able to utilise them, preventing further execution. One remedy for this would be repeating API calls until the expected format is returned, but this would cause indefinite API costs, which cannot be afforded.
- **Limited Granularity of the SOP:** Only an SOP of a limited number of actions can be encoded, as each action requires a costly API call.
- **Limited Prompt and Response Length:** Due to computational costs, LLMs can receive and generate a limited number of tokens in one interaction. However, the harsher limit

will come from API costs; the more tokens inputted or received, the higher the cost. This will limit the level of detail of instructions and the amount of context that can be included in prompts. Moreover, the size and level of detail of the LLMs' responses will also be restricted.

- **No Iterative Behaviour:** The Design Council (2024) 'Framework for Innovation' highlights the importance of iteration in the FFE. In the early stages of this project, the plan was for this to be included in the system; however, as more steps were implemented and API costs increased, it had to be abandoned for the sake of affordability.

# 4 | Design

## 4.1 Designing a Standard Operating Procedure for FFE

This section draws on the review of existing FFE frameworks performed in Section 2.2.4 to inform the design of an SOP for the Fuzzy Front End of the innovation process. The SOP will use the Double Diamond structure found in the Design Council (2024)'s 'Framework for Innovation' and draws on the methods compiled in Table 2.3. The selected methods have been chosen on the basis of being most suitable for the existing-knowledge-explorative type of innovation outlined in 2.3.1 and if they are able to be emulated in a text-based environment (in accordance with the characteristic highlighted in 3.1.2.)

### 4.1.1 Stage 1 - Discover

The first stage of the SOP diverges from the initial innovation scenario, taking a customer-centric approach to gain a broader perspective on the product (or type of product) being innovated. The knowledge gathered from this process is collated into a structured format, ready for use in the next stage. This two-step process reflects the first two stages of Beckman and Barry (2007)'s Learning Model for Innovation, 'Observations' and 'Frameworks', the importance of which was highlighted in 2.2.4, which in this case are being treated as sub-stages of the Double Diamond's Discover stage. The methods selected for this stage have been compiled in Table 4.1.

Selected Method(s)	Method Description
Existing Customer Personas	Create fictional yet realistic profiles of the business's existing customers. Customer Personas typically include attributes such as Age, Demographic, Biography, Goals, and Frustrations.
User Journey Mapping (Google Design Sprint Kit) / Timelines (Learning Model)	User Journey Mapping (or Timelines) details the experience customers go through when interacting with existing products over a period of time as structured sequences of events.

*Table 4.1: The methods selected, and their descriptions, for the Discover stage of the FFE SOP*

**Justification of Methods:** The first method, Customer Personas, is not one of the innovation methods compiled in Table 2.3. Instead, it is a technique taken from the field of product design, where it is widely utilized as a strategic tool to understand the nature of the target end-users (Miaskiewicz and Kozar 2011). The reason for its inclusion in the innovation SOP is to allow the system to conceptualise fictional versions of businesses' existing customers. In human product innovation teams, such conceptualisation is generally not needed, as they can observe real existing customers. Looking back to Beckman and Barry (2007)'s Learning Model for Innovation, this would cover the 'Observation' stage (which is being treated in this SOP as a sub-stage of the Design Council (2024) Framework for Innovation's Discover stage) for which they suggest

methods such as Participant Observation or Ethnography. While these methods rely on research to gain knowledge of the customer base, the personas approach relies on this knowledge already being present in the LLM.

The second method, User Journey Maps (Google n.d.) (or Timelines (Beckman and Barry 2007)), enables the understanding of how customers experience existing products on the market. The structured representation of customer experiences is one of the frameworks for research suggested by Beckman and Barry (2007) in the Learning Model's Frameworks stage. It is particularly useful as the decomposition of the experience into discrete events allows the easier identification of points where customer needs or wants are not met.

#### 4.1.2 Stage 2 - Define

The second stage of the SOP identifies specific opportunities for innovation within the innovation scenario. It evaluates the work done in the Discovery stage to identify customer needs that are not already satisfied by existing products on the market. Furthermore, it identifies what customers will expect from a new product by examining what existing products already provide. The methods selected for this stage have been compiled in Table 4.2.

Selected Method(s)	Method Description
Identify Pain Points (inspired by Identify Needs [Learning Model])	Identify events in the previously created Journey Map where the customer experience is not optimal
Decision Matrix (Google Design Sprint Kit)	Map pain points across two dimensions: impact and difficulty-to-address. Choose points that are both high in impact and easy to address
Identify Design Principles (Learning Model/Google Design Sprint Kit)	Identify design principles innovation ideas should follow to ensure customer expectations set by existing products are met.

*Table 4.2: The methods selected, and their descriptions, for the Define stage of the FFE SOP*

**Justification of Methods:** To theorise how to improve an existing product, you must first identify its flaws. By examining the user journey maps created in the previous stage, events where the customer experience is not optimal can be identified. These 'pain points' are opportunities for innovation; they are points where customers have needs that are not already satisfied by existing products on the market. Each customer will have a set of pain points unique to them, reflecting their unique product experience.

Not all pain points are worthwhile innovation opportunities; if they affect only a tiny proportion of customers or are likely to require a great deal of work to address, they are unlikely to generate a good return on investment. The best opportunities for innovation will be the pain points with the best ratio of high impact (pain points that affect the most customers) against low difficulty-to-address (the pain points that are likely to take the least amount of work to address). For example, consider three pain points that might be identified in a walking backpack innovation scenario:

1. Despite being lightweight, carrying the backpack still becomes tiring when worn for long periods.
2. The backpack frame is too large for children.
3. It is annoying having to repeatedly take off the backpack to retrieve a water bottle from the main pocket.

The first pain point would have high impact as most walkers wear their backpacks for long periods, but would require significant research into lighter material technology to address. The

second could likely be remedied reasonably easily using existing frame knowledge but would only be useful for a small proportion of customers. The final pain point would have high impact (all walkers need to drink water frequently) and is likely to be easy to solve (a simple solution would be adding a mesh outside pocket), making it the optimal innovation opportunity of the three. This selection process can be executed using a decision matrix (a method borrowed from the Decide stage of the Design Sprint Kit framework) with impact and difficulty-to-address on the axis and the pain points mapped on. Assuming impact is on the x-axis, and difficulty-to-address is on the y-axis, you would choose the pain points furthest towards the bottom right corner.

In addition to identifying opportunities for innovation, this stage also handles customer expectations. Customers' expectations are set by the standards and experiences they have with existing products. While innovations look to bring something new to the table, this should not be done at the expense of existing expectations. Expectations can be encoded in design principles, a set of guidelines that, when followed, ensure the positives of the existing customer experience are preserved. These design principles can be synthesised from the journey maps created in the previous stage by analysing how customers use and depend on existing products. In addition to customer expectations, design principles also offer the opportunity to encode any requirements, constraints, or company values included in the original innovation scenario.

#### 4.1.3 Stage 3 – Develop

This stage of the SOP is where the innovation ideas are generated. The generated ideas address the pain point and adhere to the design principles identified in the previous stage. The method selected for this stage has been compiled in Table 4.3.

##### Selected Methods:

Selected Method(s)	Method Description
Crazy 8's (Design Sprint Kit)	Create eight distinct solutions (innovation ideas) to the pain point selected in the previous stage

*Table 4.3: The method selected, and its description for the Develop stage of the FFE SOP*

**Method Justification:** As mentioned in 2.2.4, this is the fuzziest and most creative stage of the Fuzzy Front End, with the fewest suggested methods for its completion. The principle behind the Crazy 8s (Google n.d.) method is that generating a high volume of solutions increases the chances of discovering an idea that is both novel and effective; by looking past the first generated solution, which is usually the most conventional, you can explore more diverse and original ideas.

#### 4.1.4 Stage 4 – Deliver

The final stage of the SOP evaluates the numerous innovation ideas generated in the previous stage to decide which should be selected for realisation in the latter stage of the product innovation process. The methods selected for this stage has been compiled in Table 4.4.

Selected Method(s)	Method Description
Evaluate Technical Value	Evaluate each idea's potential technical value compared to existing products over a number of criteria by scoring them from 1-9 for each criterion.
Evaluate Market Value	Evaluate each idea's potential market value compared to existing products over a number of criteria by scoring them from 1-9 for each criterion.
Evaluate Financial Value	Evaluate each idea's potential financial value compared to existing products over a number of criteria by scoring them from 1-9 for each criterion.
Evaluate Customer Value	Evaluate each idea's potential customer value compared to existing products over a number of criteria by scoring them from 1-9 for each criterion.
Evaluate Social Value	Evaluate each idea's potential social value compared to existing products over a number of criteria by scoring them from 1-9 for each criterion.
Select The Highest Value Idea	First, calculate the mean score for each dimension of value for each idea. Then, for each idea, sum the resulting scores to calculate each ideas' final value score. Select the idea with the highest final value score.

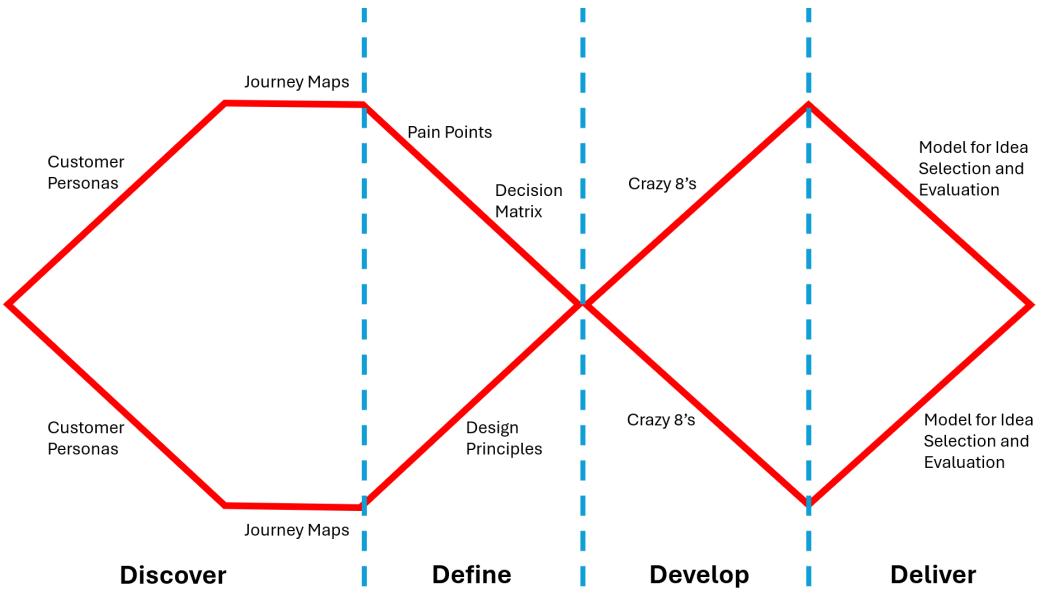
*Table 4.4: The methods selected, and their descriptions, for the Deliver stage of the FFE SOP*

**Method Justification:** While the methods identified in 2.2.4 from Beckman and Barry (2007)'s Learning Model Framework and Google (n.d.)'s Design Sprint Kit are certainly applicable to product innovation, they were not explicitly chosen or developed with product innovation in mind. The former was developed as a 'generic' framework for innovation (so in addition to product innovation, it could be applied to service innovation, organisational innovation, process innovation, etc...), while the latter, as the name suggests, is for design sprints. It makes sense then that when methods that have been developed explicitly for product innovation can be found in literature, we use those.

Stevanovic et al. (2015) provide such a method with their 'Model of Idea Evaluation and Selection For Product Innovation'. The model provides a systematic approach for the final stage of the FFE, where the innovation idea with the most potential is selected from the multitude generated in the previous stage. In this model, innovation ideas are evaluated on the technical, market, financial, customer, and social value they would have if realised in comparison to existing products. To determine an idea's value in each dimension, the model is scored from 1-9 (with a higher score indicating a higher value) over a number of criteria. The mean scores for each dimension are summed to give a final overall score for the product. The idea with the highest final score is decided to be the best.

#### 4.1.5 FFE SOP Summary

The previous four sections have introduced, described and justified methods for each stage of an SOP for the FFE of innovation, structured according to the Double Diamond pattern found in the Design Council (2024)'s 'Framework for Innovation'. Figure 4.1 illustrates where each method maps onto the Double Diamond's pattern of repeated divergence and convergence to form a cohesive workflow. The SOP begins with the generation of fictional target customers, inspired by their real-life counterparts, and corresponding journey maps that describe how they experience existing products on the market. The journey maps are then used to identify pain points, events where customer needs are not satisfied by existing products, and design principles



**Figure 4.1:** An illustration of the finalised Standard Operating Procedure for the Fuzzy Front End of the product innovation process, in the style of the Design Council (2024)'s Double Diamond Pattern

which should be followed to ensure existing customer expectations are met. The pain point that offers the best opportunity for innovation is chosen using a decision matrix, and eight product innovation ideas (a.k.a solutions) to address the pain point are generated. Finally, the best idea is selected for realisation in the latter stage of the innovation process. This decision is made by evaluating each idea's value in five dimensions and choosing the idea with the highest cumulative value.

All the selected methods can be described by text instructions, completed with reasoning and known knowledge, and satisfied with text outputs, making them, and the SOP they combine to form, suitable for emulation in an LLM-powered system.

## 4.2 Modelling the SOP in MetaGPT

This section details how the SOP defined in 4.1 will be emulated in a system implemented in the MetaGPT Framework, drawing on the analysis of MetaGPT performed in 3.1. Moreover, it describes the design decisions that have been taken so that the resulting system satisfies the requirements outlined in 3.2.1 and 3.2.2.

### 4.2.1 Innovation Scenario Template

A functional requirement mandated in 3.2.1 was that the system should be able to receive and understand the scenario in which it is performing the innovation. To ensure the users of the system consistently supply the scenario details required for the FFE SOP to be effective, an innovation scenario template was developed. The template consists of three sections: Company Background (the details of the company the innovation is to be performed for), Product Details (the details of the product being innovated), and Constraints (any restrictions the innovation idea should adhere to). Each section consisted of a mixture of non-optional fields that are required for the SOP FFE methods, and optional fields that users could fill in to enhance the relevance of the generated innovation ideas. The system will prompt the user to fill in the template on start-up,

and publish the response as a message to the environment.

#### **4.2.2 Methods as Actions**

3.1.2 describes how MetaGPT models the steps that make up human workflows as specialised subclasses of the Action base class (referred to as *Actions*). This concept can easily be applied to the FFE SOP that has been derived in the previous section; each method describes how you executed a step in the SOP and can, therefore, be modelled as an *Action*. Each method's corresponding *Action* will require a prompt containing text instructions on how to execute the method, as well as any context the LLM will require to inform its reasoning. *Actions* will handle the prompting of the LLM via an API call, and the parsing of relevant information from its response. Furthermore, it is also a non-functional requirement that the system shows the steps and reasoning used to reach the final product innovation idea. As the methods are the most granular level of the SOP, it follows that their *Actions* should handle the human-friendly formatting and output of the results of their method's execution.

#### **4.2.3 Stages as Roles**

The concept of dividing the FFE into distinct stages, as outlined in the SOP, naturally leads to the idea of assigning a role to each stage, to be filled by individuals with the most suitable skill sets for executing their corresponding stage methods. Beckman and Barry (2007)'s Learning Model for Innovation suggests a similar strategy for the four FFE stages they identify, where each stage is distributed across team members according to their particular learning style. This role-based approach mirrors the multi-agent collaboration paradigm that underpins the MetaGPT framework; instead of human individuals, roles can be filled by agents with a suitable profile who are responsible for executing their stage's set of methods. 3.1.2 describes how the profile and capabilities of agents are realised in the MetaGPT framework as specialised subclasses of the Role base class (referred to as *Roles*). Accordingly, a *Role* will be created for each of the stages of the FFE SOP, containing a text-encoding of the profile of its best-suited human counterpart and the logic for Action selection and execution.

#### **4.2.4 Demonstrator Role**

In addition to the *Roles* created for each stage of the SOP, an additional *Role* will be created that summarises the steps taken to generate the final innovation idea and the justification for why it would be effective, satisfying the comprehensive output requirement as well as contributing to showing the steps and reasoning of the system. The *Role* should format the summary in three sections: Idea Name, Idea Description, and Idea Justification.

# 5 | Implementation

This chapter gives an overview of the implementation details of the final automated system for the Fuzzy Front End of the product innovation process implemented in the MetaGPT Framework.

## 5.1 Resources used

### 5.1.1 MetaGPT

For the reasons outlined in 3.1.1, this project uses the framework found in v0.3.0 of MetaGPT (Hong et al. 2023a). The original specialised subclasses of the Action and Role subclasses used in MetaGPT to emulate a software development SOP have been removed and replaced with subclasses for emulating the FFE SOP designed in 4.1. Further modifications have also been made to some of the framework files, such as *startup.py* and *environment.py*. A full breakdown of which files are original (as in untouched from the original MetaGPT codebase), modified (MetaGPT codebase files that have been modified), or new (created from scratch for this project) can be found in the *README.md* within the project’s GitLab repository.

### 5.1.2 LLM

The system used the GPT-3.5 and GPT-4 LLMs introduced in 2.1.2 to execute the text-encoded method containing prompts found in each *Action*. The GPT-3.5 model was used for the system’s development due to its significantly lower API costs, while the GPT-4 method was used for the system’s evaluation due to its improved reasoning capabilities and larger and more up-to-date knowledge store.

## 5.2 System Details

### 5.2.1 Actions

In alignment with the design plan outlined in 4.2, a specialised subclass of the Action base class was created to model each of the methods found in the FFE SOP derived in 4.1. This section highlights how these Actions were implemented, focusing on prompt formation, iterative improvement, and response storage.

#### Prompts

When run, an *Action* prompts the LLM via an API call with step-by-step instructions on how to execute the method it models, with the required context provided by its overarching role appended. The prompts are formatted using a structure borrowed from the original MetaGPT software development Actions. The LLM is instructed to return its response in the format of a JSON object literal, where each key represents a section of the method response. The response was limited to 1500 tokens as, past this point, API costs were no longer affordable. Once returned, the JSON object is parsed by mapping the keys (and their values) to the fields of a Pydantic Model.

### **Iterative Prompt Improvement**

The prompts were improved throughout development by inspecting their responses and modifying the requirements and method instruction sections to avoid common errors or points where the reasoning performed by the LLM consistently failed. Some commonly observed errors were the ignoring of context passed with the instructions, the creation of unnecessarily flamboyant responses that did not reflect reality, and the failure to fill the JSON object with values of the correct type. It was not uncommon for the LLM to persist in making the same mistakes despite explicitly being instructed not to. As a last resort, it was found that the capitalisation of imperatives the LLM had to follow was a practical approach to guaranteeing the LLM would comply.

### **Changes to FFE SOP methods**

In addition to the iterative improvements of the prompts, some of the SOP FFE methods themselves were modified via a similar process of inspection of the results of program execution. The most significant changes were made to the *Decision Matrix* and *Crazy 8's* methods. Initially the decision matrix only returned one pain point, for which *Crazy 8's* generated eight innovation ideas. However, the LLM was not always accurate in its predictions of difficulty-to-address, sometimes leading it to select pain points that could not viably be addressed. Furthermore, the 1500 token limit was too short for the LLM to generate eight innovation ideas at an acceptable level of detail. The most effective compromise was found to be selecting the top three pain points and generating two innovation ideas to address each (so six innovation ideas in total).

### **Response Storage**

To meet the design requirement that *Actions* output the results of their method in a human-friendly format, each action formats and saves the result of their LLM call as a text file in a structured file directory. Each time the system is run, it creates a sub-directory with a unique descriptive name based on the innovation scenario within the *workspace* directory found in the MetaGPT file space. Within this sub-directory, a structured file tree is constructed, with each *Action* either modifying or creating new files (and folders if necessary) as required.

## **5.2.2 Roles**

As designed in 4.2, four specialised subclasses of the *Role* base class were created for each of the stages of the FFE SOP derived in 4.1, as well as an additional fifth role to summarise and justify the final innovation idea. This section provides an overview of how they were implemented, focusing on the profile encoding, memory management, and action selection logic.

### **Profile Encoding**

Profiles describing each role's human counterpart were implemented using the *name*, *profile*, *goal*, and *constraints* class fields introduced in 3.1.2. The *name* (in the original software development system implemented in MetaGPT this is just decorative) and *constraints* field were used to instruct the Agent to emulate the learning style suggested by Beckman and Barry (2007), the *profile* field was used to describe the human job profile that would carry out the stage in a real-world innovation team, and the *goal* field was used to describe the goal for the stage defined in the FFE SOP.

### **Action Selection Logic**

As described in 3.1.2, *Roles* in MetaGPT react to the observation of messages in the environment caused by *Actions* they are subscribed to by selecting an *Action* of their own to execute. Due to the linear nature of the FFE SOP, the selection logic required was extremely simple: once a *Role* reacts, it simply needs to execute all its associated *Actions* in order. The MetaGPT framework provided this logic in a built-in 'reaction mode': *by\_order*, which is set during class initialization.

### **Memory Management**

Each *Role* is responsible for supplying its associated *Actions* with the context required to execute their methods effectively. A downside of how the observe and react system used for action selection is implemented in MetaGPT is that, by default, Roles can only see the response of the

Action they are reacting to. This is not suitable for the FFE SOP, where many of the methods rely on the output of multiple previously executed roles. For example, the *Action* containing the *Crazy 8's* relies on the output of both the *Identify Pain Points* and *Identify Design Principles* methods. To resolve this, each Role had to be provided with functionality for manually extracting required contextual memory from the store of all memories maintained in the environment on an Action-by-Action basis.

### 5.2.3 Auxillary Features

This section briefly introduces two auxiliary features that were not required for the satisfaction of the design plan outlined in 4.2, but were implemented regardless due to the valuable functionality they both provide.

#### **Automated Product Idea Evaluation and Selection**

An alternative view of the FFE SOP developed in 4.1 is that it is a two-phase process; the first three stages describe an idea generation phase, and the final stage describes an idea evaluation and selection stage. If it is determined in the evaluation of this system that it is not capable of generating useful product innovation ideas, it would still be a powerful tool if it is capable of successfully evaluating product innovation ideas. To enable the isolation of this phase of the FFE SOP, a startup flag 'idea\_evaluator' was implemented that allows the user to directly input their innovation ideas for evaluation, skipping the idea generation phase.

#### **Example Scenario**

The completion of an innovation scenario, even if the optional fields are left blank, requires a not insignificant amount of time and effort from the user. To ease the experience of someone just curious about the system's abilities, an 'example\_scenario' flag that loads the system with a precompleted innovation scenario was implemented.

# 6 | Evaluation

The final system implemented in the MetaGPT Framework was evaluated to determine if it satisfied the two aims outlined in 1.2:

- Does it provide a viable alternative to the human teams typically used to perform the Fuzzy Front End of the Innovation Process
- Does the emulation of human workflows in multi-agent results in better performance than naive LLM prompting?

To do so, its performance was compared with that of both its human counterparts and ChatGPT (introduced in 2.1.2) across various innovation scenarios in a three-phase survey evaluation. This chapter outlines how the evaluation was conducted, presents the results, and analyses the system's performance.

## 6.1 Evaluation Strategy

As mentioned, the evaluation was carried out in three phases:

- Phase 1 – Experts were recruited to create innovation scenarios relevant to their field of expertise
- Phase 2 – The system, ChatGPT, and a group of skilled product innovators were presented with the innovation scenarios and asked to come up with a product innovation idea
- Phase 3 – The generated product innovation ideas were returned blindly to the experts for evaluation

This section describes how and why each phase was carried out, specifically touching on who was recruited, the survey design for each phase, and any additional noteworthy detail.

### 6.1.1 Phase 1

Two experts were recruited for the evaluation: my supervisor, Dr Jonathan Grizou, a Lecturer for the School of Computer at the University of Glasgow, and the second, a postgraduate Product Design and Engineering student close to completing his Masters. Both were supplied with a survey that asked them to create innovation scenarios based on the field they possess expertise in, using the same template designed in 2.1.4. Dr Grizou's scenario requested innovation ideas for an affordable AI-powered robot for education use, while the postgraduate student looked to re-imagine the vegetable hand-peeler. For the remainder of the Evaluation chapter, Dr Grizou's scenario will be referred to as *Scenario 1*, while the postgraduate student's will be referred to as *Scenario 2*. The survey used for this phase can be found at Appendix .2.1

### 6.1.2 Phase 2

Undergraduate Product Design and Engineering (PDE) students were identified as suitable for the role of skilled product innovators required by Phase 2; their degree's skillset naturally lends itself to product innovation, but as they have less experience than the experts recruited in Phase 1,

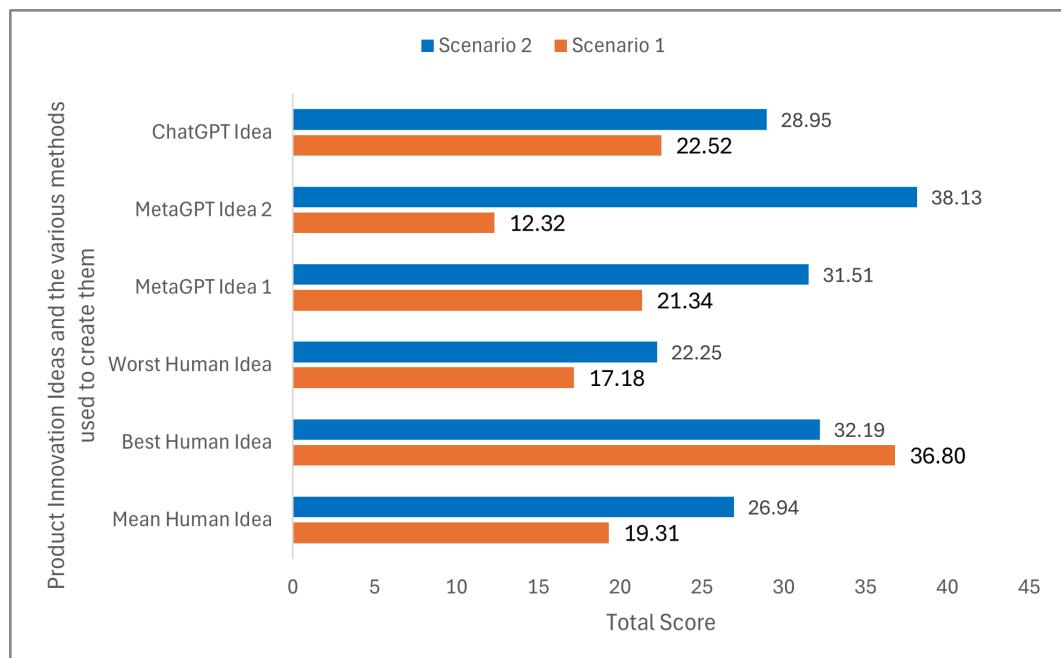
it was unlikely they would generate innovation ideas too advanced for the experts to evaluate fairly. Eight undergraduate PDE students were able to be recruited, and each was supplied with a survey containing one of the innovation scenarios created in Phase 1 (the innovation scenarios were evenly distributed). Both innovation scenarios were also supplied to ChatGPT, which was asked along with the students to come up with innovation ideas formatted using the structure utilised by the Demonstrator Role. (as designed in 4.2.4). Finally, both innovation scenarios were entered twice into the automated FFE system. The survey used for this phase can be found at Appendix .2.2

### 6.1.3 Phase 3

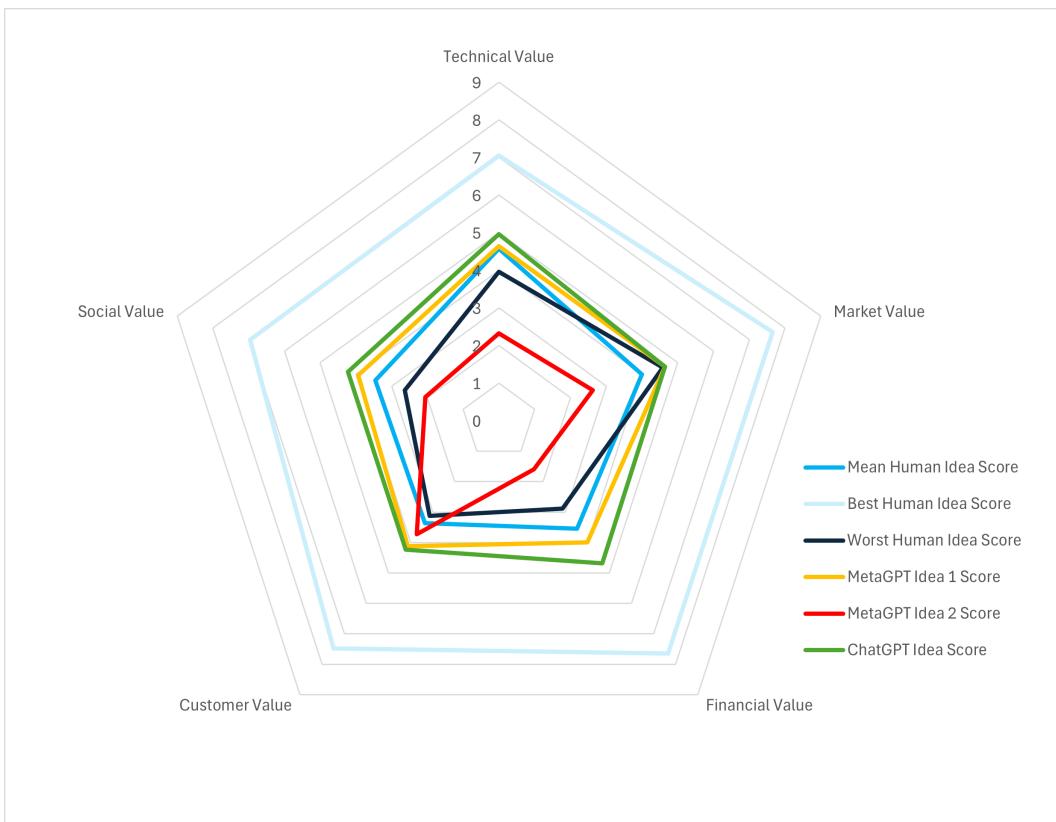
In the final evaluation phase, the innovation ideas were returned to the experts in a survey for evaluation. The survey asked the experts to score the ideas on the dimensions and criteria provided in the previously introduced Model for Idea Selection and Evaluation for Product Innovation (Stevanovic et al. 2015), the same method used in the FFE SOP to evaluate the ideas produced by Crazy 8's. The model was reused for two reasons: for one, it is a research-based systematic approach to innovation idea evaluation, making it perfectly suitable for the task, and secondly, it enables easy analysis of how effectively the automated system performs idea evaluation as a stand-alone task. The survey also offered the experts the opportunity to highlight any positive, negative, or ambiguous thoughts they had for each idea not covered by the model's criteria. However, this was made optional as the process of answering every criterion for each was already quite consuming. The survey used for this phase can be found at Appendix .2.3

## 6.2 Results

### 6.2.1 Automated FFE System vs Human vs ChatGPT Performance



**Figure 6.1:** The total scores (the sums of the mean scores for each dimension of value) for the innovation ideas evaluated by the experts in Phase 3 for each Scenario



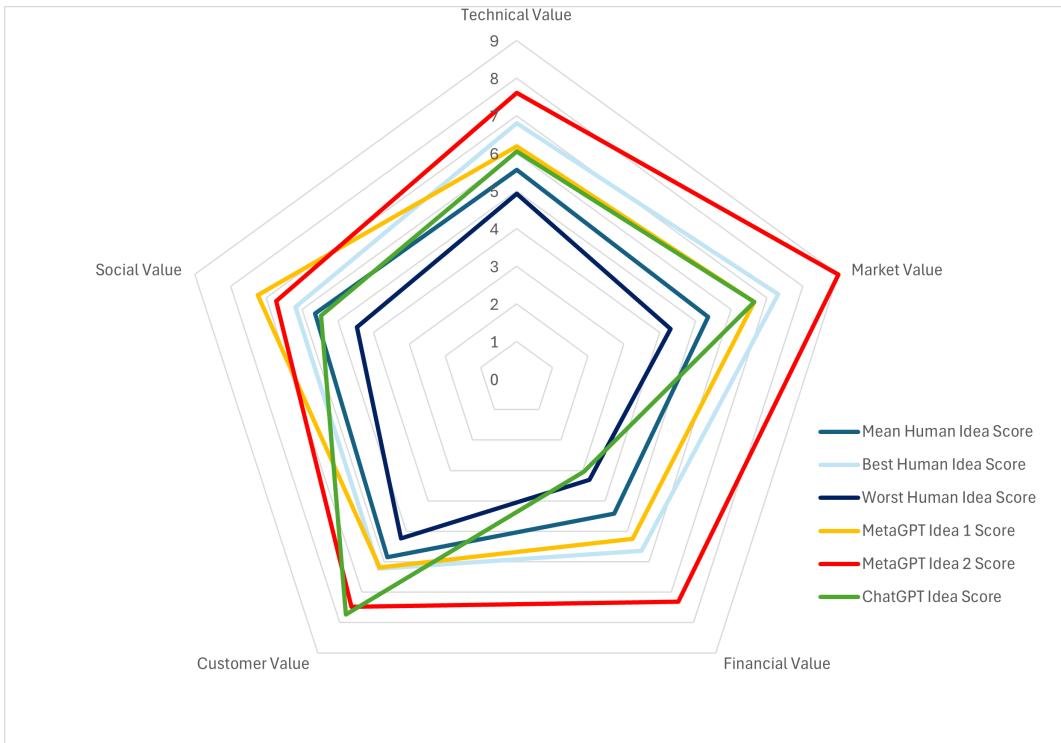
**Figure 6.2:** A radar plot of how the ideas generated by the various methods for Scenario 1 performed in each dimension of value

### 6.2.2 Scenario 1

In the results shown in Figure 6.1, all the methods used to generate innovation ideas for Scenario 1 performed relatively poorly, with the exception of the best human-generated idea, suggesting innovation in the scenario is a difficult task. The mean human idea, best MetaGPT idea, and the ChatGPT generated idea total scores were all within four of one another in the 19–23 range, a poor result compared to the possible maximum of 45. In this scenario, the automated FFE system implemented in MetaGPT actually generated the worst-performing idea, reaching an impressively low score of 12.32, meaning it only averaged a score of around 2.5 for each dimension of value out of a possible 9.

To start to explore why this occurred, we can first examine how the ideas generated by the various methods performed in each dimension of value, illustrated in Figure 6.2. The second MetaGPT idea performed poorly in almost all dimensions but saw the most success in the value it provides to customers. This potentially suggests the automated system for the FFE did not correctly balance the inclusion of luxurious functionality with the associated development costs. However, such a mistake seems unlikely to be solely responsible for such poor all-round performance.

A more significant cause for poor performance can be found in the additional qualitative comments left by Dr Grizou on the idea. He criticises the ‘tutor robot’ described in the innovation idea for being a robot that ‘does the teaching itself’ rather than being an education tool used to ‘help as an instrument during teaching’; the automated FFE system has misinterpreted the innovation scenario and innovated the wrong type of product. Interestingly, similar complaints were left for the two of the innovation ideas, which were described as ‘out of scope’ and ‘not a tool used to



**Figure 6.3:** A radar plot of how the ideas generated by the various methods for Scenario 2 performed in each dimension of value

learn via practice but a tutor meant to replace the teacher' respectively, perhaps suggesting the brief was hard to understand for not just the system but humans as well.

### 6.2.3 Scenario 2

The results shown in 6.1 show a general improvement in the quality of innovation ideas generated by all the FFE methods in Scenario 2. Most significantly, the most successful innovation idea was generated by the automated FFE system that was implemented in MetaGPT. Figure 6.3 shows the innovation idea was evaluated highly in all dimensions of value. The second idea generated by the automated FFE system also saw success, only being slightly edged out by the best human idea with a total score that was one higher. Interestingly, innovation idea generated using ChatGPT was evaluated higher than the mean score attained by human innovation ideas for the second scenario in a row.

## 6.3 Analysis of System Performance

The automated system for the FFE of the innovation process performed drastically differently in the two scenarios, making it hard to draw any concrete conclusions about how well it satisfied the aims of this project. The system failed to generate any helpful innovation ideas in the first scenario due to failure to understand the task. However, the fact that the human innovators also struggled to understand the scenario validates that it was an exceptionally complex task, perhaps beyond the capabilities of the SOP the system emulates. It is worth noting that after the single exceptionally good human innovation idea, the second best idea was generated by ChatGPT, a model trained specially for complex dialogue (as described in 2.1.2. This perhaps suggests that

further attempts to automate the FFE with LLM-powered systems should focus on training a model with similar dialogue abilities.

In the second innovation scenario, the automated FFE system was clearly the best method for generating innovative ideas, surpassing both the human innovators and the ChatGPT. At the very least, this proves that the system is a viable alternative approach to the FFE of the innovation process in place of the most basic human innovation teams. While its current effectiveness is definitely surpassed by the complex innovation teams found in real-world companies, the potential for using LLMs for product innovation seems very much worth exploring. This is emphasised even further by the consistent performance of ChatGPT across both scenarios despite its general purpose nature. Furthermore, when the system was able to understand the scenario passed to it, it outperformed ChatGPT by a significant margin, suggesting the emulation of human workflows in multi-agent collaborations is, in fact, an effective way to improve LLM performance at the complex task of product innovation.

## 7 | Conclusion

This project explored the effectiveness of an LLM-powered automated system as an alternative approach to human innovation teams for the Fuzzy Front End of the product innovation process. The Fuzzy Front End encapsulates the work done at the start of the product innovation process, where opportunities are identified and ideas are generated. The system attempted to emulate the workflows carried out by its human counterparts, with the goal of improving the performance of the system past that of naive LLM prompting. This was done by encoding a human-inspired Standard Operating Procedure for the Fuzzy Front End in the MetaGPT multi-agent collaborative framework. This dissertation details the work done to understand the MetaGPT code base, how the Standard Operating Procedure for the Fuzzy Front End was designed and how it was implemented in the MetaGPT framework. The performance of the resulting automated system was evaluated and compared to that of human innovators and ChatGPT across two innovation scenarios. While results were mixed, the impressive performance of the system in the second scenario merits further exploration of LLM-powered multi-agent systems as an approach for the Fuzzy Front End of the product innovation process.

## 8 | Appendices

## .1 Ethics Checklist

**School of Computing Science  
University of Glasgow**

**Ethics checklist form for 3<sup>rd</sup>/4<sup>th</sup>/5<sup>th</sup> year, and taught MSc projects**

This form is only applicable for projects that use other people ('participants') for the collection of information, typically in getting comments about a system or a system design, getting information about how a system could be used, or evaluating a working system.

**If no other people have been involved in the collection of information, then you do not need to complete this form.**

If your evaluation does not comply with any one or more of the points below, please contact the Chair of the School of Computing Science Ethics Committee ([matthew.chalmers@glasgow.ac.uk](mailto:matthew.chalmers@glasgow.ac.uk)) for advice.

If your evaluation does comply with all the points below, please sign this form and submit it with your project.

---

1. Participants were not exposed to any risks greater than those encountered in their normal working life.  
*Investigators have a responsibility to protect participants from physical and mental harm during the investigation. The risk of harm must be no greater than in ordinary life. Areas of potential risk that require ethical approval include, but are not limited to, investigations that occur outside usual laboratory areas, or that require participant mobility (e.g. walking, running, use of public transport), unusual or repetitive activity or movement, that use sensory deprivation (e.g. ear plugs or blindfolds), bright or flashing lights, loud or disorienting noises, smell, taste, vibration, or force feedback*
2. The experimental materials were paper-based, or comprised software running on standard hardware.  
*Participants should not be exposed to any risks associated with the use of non-standard equipment: anything other than pen-and-paper, standard PCs, laptops, iPads, mobile phones and common hand-held devices is considered non-standard.*
3. All participants explicitly stated that they agreed to take part, and that their data could be used in the project.  
*If the results of the evaluation are likely to be used beyond the term of the project (for example, the software is to be deployed, or the data is to be published), then signed consent is necessary. A separate consent form should be signed by each participant.*  
*Otherwise, verbal consent is sufficient, and should be explicitly requested in the introductory script.*
4. No incentives were offered to the participants.  
*The payment of participants must not be used to induce them to risk harm beyond that which they risk without payment in their normal lifestyle.*

5. No information about the evaluation or materials was intentionally withheld from the participants.  
*Withholding information or misleading participants is unacceptable if participants are likely to object or show unease when debriefed.*
6. No participant was under the age of 16.  
*Parental consent is required for participants under the age of 16.*
7. No participant has an impairment that may limit their understanding or communication.  
*Additional consent is required for participants with impairments.*
8. Neither I nor my supervisor is in a position of authority or influence over any of the participants.  
*A position of authority or influence over any participant must not be allowed to pressurise participants to take part in, or remain in, any experiment.*
9. All participants were informed that they could withdraw at any time.  
*All participants have the right to withdraw at any time during the investigation. They should be told this in the introductory script.*
10. All participants have been informed of my contact details.  
*All participants must be able to contact the investigator after the investigation. They should be given the details of both student and module co-ordinator or supervisor as part of the debriefing.*
11. The evaluation was discussed with all the participants at the end of the session, and all participants had the opportunity to ask questions.  
*The student must provide the participants with sufficient information in the debriefing to enable them to understand the nature of the investigation. In cases where remote participants may withdraw from the experiment early and it is not possible to debrief them, the fact that doing so will result in their not being debriefed should be mentioned in the introductory text.*
12. All the data collected from the participants is stored in an anonymous form.  
*All participant data (hard-copy and soft-copy) should be stored securely, and in anonymous form.*

---

**Project title** Using The MetaGPT Framework to Automate the Fuzzy Front End of the Product Innovation Process

**Student's Name** Daniel Flynn

**Student Number** 2469113F

**Student's Signature** Daniel Flynn

**Supervisor's Signature** Jonathan Grizou



**Date** 3/24/2024

## .2 Surveys

### .2.1 Phase 1 Surveys

## **Block 3**

# **Using MetaGPT for Product Innovation – Product Innovation Task Brief Template**

**Level 4 Project 23/24**

**Daniel Flynn 2469113f@student.gla.ac.uk**

The aim of this experiment is to investigate how well the GPT-4 LLM supported by a meta-framework performs at product innovation and evaluation. We cannot evaluate the quality of the ideas generated and the evaluations performed without a baseline for comparison. This is why we have asked you, as an expert in your field, to fill in this brief template; choosing a topic and context in which you would like to see innovation ideas. We will then provide the resulting brief to an AI-based system and design students, and ask you to evaluate the resulting ideas.

When you press next page, you will be presented with an example of a completed brief. Press next page again and

you will be presented with the first section of the brief template for you to fill in. There are three sections of the brief in total, with a mixture of optional and non-optional questions. All the non-optional questions must be answered for the brief to be used, and we highly encourage you to answer the optional questions.

There is not time limit on the completion of the brief. You can go back and review the example or change your answers at any point. If you have any questions or require any additional information, please direct an email to [2469113f@student.gla.ac.uk](mailto:2469113f@student.gla.ac.uk). Please remember that it is the system, not your choice of topic or expertise, that is being tested. While completion of the entire brief is required for it to be used, you are welcome to withdraw from the experiment at any time.

Do you agree to taking part in this experiment? If so please sign below:

x

**SIGN HERE**

---

clear

## **Block 4**

# **Example Brief**

## **Company Background**

Company Name: Scarpa

Company Profile: Scarpa, an esteemed Italian company founded in 1938, specializes in high-quality outdoor footwear. Initially focused on handcrafted shoes, it has expanded into mountaineering, skiing, rock climbing, and hiking footwear. Known for blending innovation, quality, and performance, Scarpa caters to both professional athletes and outdoor enthusiasts. The brand is globally recognized for its craftsmanship and advanced footwear technology, maintaining a strong position in the technical outdoor footwear market.

Company Mission: Scarpa's mission centres on inspiring a connection with nature through innovative and quality footwear. Emphasizing Italian craftsmanship and technological advancement, Scarpa aims to enhance outdoor performance, comfort, and safety, encouraging exploration and enjoyment of the natural world.

Current Product Range: Scarpa's product range includes mountaineering boots, ski boots, rock climbing shoes, and hiking footwear. Tailored for various expertise levels and terrains, their products range from lightweight approach shoes to advanced boots for extreme conditions.

## **Product Details**

Original Product(s)/Category of Products: Climbing shoes

Target Audiences: Outdoor boulderers who live in cold weather climates and want to be able to climb in challenging conditions

Suggested Features: The idea should combat struggles that come with climbing in the cold, such as numb limbs or loss of comfort due to shoe rigidity.

Requirements: The shoe must not lose any technicality compared to the market leaders

## **Constraints**

Budget: £300000 research and development budget

Timeframe: 3 years for first prototype

Technical and Legal Constraints: The product must be in agreement with respective safety laws and guidelines

## **Company Background**

# **Company Background**

Company Name (The name of the company the idea is being generated for. It is fine for the company to be fictional or unpopular, but if the company is known to GPT-4 its background knowledge will influence it's responses):

Company Profile (A brief description of the company. This could include its history, values, market position, primary products or services, and target customer base):

Company Mission (The company's mission or vision statement) [Optional]:



Current Product Range (The existing products or services offered by the company) [Optional]:



## **Design Brief**

## **Product Details**

Original Product(s)/Category of Products (Product or category of products to be improved. This could be a specific type of product, a category of products, or a broader scope you wish to explore):



Target Audience (The intended users or consumers of the product. This could include demographic information, user preferences, and any relevant behavioural insights)  
[Optional]:



Suggested Features (Any suggested features or direction you want to give the innovation. requirements that the product must have. This could include size, functionality, materials, sustainability considerations, etc) [Optional]



Requirements (Any essential requirements that the product must have. This could include size, functionality, materials, sustainability considerations, etc) [Optional]



## **Constraints**

# **Constraints**

Budget (Specify the budget for designing the product. This could include any limitations on development costs, production costs, or other financial constraints):



Timeframe (Provided a timeframe in which the product should be able to be fully developed and ready for market):



Technical and Legal Constraints (Any technical limitations, legal considerations, or industry regulations that must be adhered to in the design of the product) [Optional]:



Powered by Qualtrics

## .2.2 Phase 2 Surveys

# **Using MetaGPT for Product Innovation - Innovation Form**

**Level 4 Project 23/24**  
**Daniel Flynn 2469113f@student.gla.ac.uk**

The aim of this experiment is to investigate how well the GPT-4 LLM supported by a meta-framework performs at product innovation and evaluation. We cannot evaluate the quality of the ideas generated and the evaluations performed without a baseline for comparison. This is why we are asking you to innovate an idea to update a product, based off a provided design brief. Your ideas will then be evaluated and compared to the ideas generated by the AI system.

There is no word limit or maximum for your responses to any of the sections of the template, although we recommend a minimum of 75 words per section (not including the idea name). We have provided an example brief and corresponding solution to help direct your responses. You will have 15 minutes to complete the task once you have finished reviewing the example.

If you have any questions or require any additional information during the task, please ask the researcher supervising. Once the task is complete If you have any further questions, please direct an email to 2469113f@student.gla.ac.uk. All answers will be analysed using a mixture of both qualitative and quantitative methods. Please remember that it is the system, not your own ideas, that is being tested. While completion of an entire form is required for your answers to be used, you are welcome to withdraw from the experiment at any time. Do you agree to taking part in this experiment? If so please sign below:

---

## Example Brief

### Background Information:

**Company Name:** Scarpa

**Company Profile:** Scarpa, an esteemed Italian company founded in 1938, specializes in high-quality outdoor footwear. Initially focused on handcrafted shoes, it has expanded into mountaineering, skiing, rock climbing, and hiking footwear. Known for blending innovation, quality, and performance, Scarpa caters to both professional athletes and outdoor enthusiasts. The brand is globally recognized for its craftsmanship and advanced footwear technology, maintaining a strong position in the technical outdoor footwear market.

**Company Mission:** Scarpa's mission centers on inspiring a connection with nature through innovative and quality footwear. Emphasizing Italian craftsmanship and technological advancement, Scarpa aims to enhance outdoor performance, comfort, and safety, encouraging exploration and enjoyment of the natural world.

**Current Product Range:** Scarpa's product range includes mountaineering boots, ski boots, rock climbing shoes, and hiking footwear. Tailored for various expertise levels and terrains, their products range from lightweight approach shoes to advanced boots for extreme conditions. Constant innovation, athlete feedback incorporation, and a commitment to sustainability are hallmarks of their range, emphasizing eco-friendly materials and processes.

### Product Brief:

**Product:** ""Walking backpack""

**Target Audience:** New walkers who are still getting to grips with the outdoors.

**Suggested Features:** Lightweight

**Requirements:** Reasonably affordable

### Constraints:

**Budget:** £300000

**Timeframe:** 3 years

**Technical and Legal Constraints:** The product must be in agreement with respective safety laws and guidelines

## Example Solution

**Idea name:** "Removable Gear Pods",

**Idea description:** "The Removable Gear Pods are detachable storage units designed to address the lack of compartments for gear organization in the walking backpack. Each pod serves a specific purpose, such as a first aid kit pod, a snack pod, or a tech gadget pod. These pods feature clear labelling and color-coded indicators for easy identification, allowing users to efficiently organize and access their essential items. Made from lightweight yet durable materials, the gear pods maintain the overall weight and functionality of the backpack.",

**Idea justification:** "The Removable Gear Pods enhance the product's importance by offering versatile storage solutions and efficient organization for users, addressing their specific gear needs effectively. This feature emphasizes the product's adaptability and customization options, making it a standout choice for users seeking personalized organization. Users are more likely to commit to using the backpack consistently, thanks to the flexibility and convenience provided by the removable gear pods, enhancing their overall outdoor experience. Despite its added functionality, the lightweight and durable design of the gear pods ensures that the product remains reasonably affordable within the set budget. The Removable Gear Pods excel in importance, commitment, necessity, novelty, usefulness, usability, sales volume, rate of return, competition, buyer appeal, market alignment, functionality, reliability, safety, aesthetics, and technical value, making them a valuable addition that enhances the product's functionality."

## Design Brief

### Background Information:

**Company Name:** Edubot

**Company Profile:** Edubot develops educational robots for students between the age of 6 to master level.

**Company Mission:** The mission of the company is to support teachers and lecturer in developing key STEM skills, including programming, via hands-on activities outside the computer (e.g. using robots)

**Current Product Range:** They mostly sell third party robots and develop educational activities and support on top of them.

### Product Brief:

**Original Product:** With the recent AI development, they receive a lot of demand for AI educational robots but there is not many on the market that fit the needs and constraints of their typical clients (schools, universities). Most robots are too expensive or the capacity of the robot are too limited for AI education. They see an opportunity to develop their own robot given their insight into their clients need.

**Target Audience:** They want to develop one platform that could appeal to both schools and universities. For schools the need is more around a AI and Machine Learning activities that are ready to use, short, and do not require any coding. For Universities, the goal is to develop a platform that lecturers can quickly link to a coding environment and develop their own activities. For both clients, the most important constraint is price. The robot must not have a selling price above £50.

**Suggested Features:** To be engaging the robots must to be able to move itself or part of its body. To be useful for AI, there must be a variety of sensors with at least one camera for computer vision application which are the most attractive to teachers. To be programmable and fun to use, there must be a wireless link possible with a computer, this can be wifi or Bleutooth for example. It would be great if the robot could be customised in some way by the students, either its shape, or as simple as adding a name or colouring it.

**Requirements:** Retail price below £50, this usually means that total material cost must be below £15. Robots to be usable for AI demos. We expect students and staffs to have access to their smartphones and computers, or have some made available to them.

### Constraints:

**Budget:** We have £50k for this development. As the robot is made to be cheap, we also expect development cost to be low. Our team knows how to design electronics board and has access to a makerspace equipped with 3D printers, lasercutters, etc

**Timeframe:** 6months to develop the idea into a functional prototype testable with some schools. Ready for market within 2 years after some iteration with teachers, lecturers and students.

**Technical and Legal Constraints:** Shipping lithium batteries is not easy but possible in small batches without too much issues, to be considered. Younger kids are not the most delicate manipulators so the robot must be a bit robust to that.

## Solution Template

**Idea Name – A name for your idea:**

**Idea Description – A short description of what your idea is, its purpose, and roughly how it would be used to update the original product(s):**

**Idea Justification – A justification as to why your idea is a good solution to scenario outlined in the design brief. Why is it appropriate for the given company? Why will the target audience be interested? Could it reasonably be developed under the constraints given? What sets it apart from other products on the market?:**

# **Using MetaGPT for Product Innovation - Innovation Form**

**Level 4 Project 23/24**  
**Daniel Flynn 2469113f@student.gla.ac.uk**

The aim of this experiment is to investigate how well the GPT-4 LLM supported by a meta-framework performs at product innovation and evaluation. We cannot evaluate the quality of the ideas generated and the evaluations performed without a baseline for comparison. This is why we are asking you to innovate an idea to update a product, based off a provided design brief. Your ideas will then be evaluated and compared to the ideas generated by the AI system.

There is no word limit or maximum for your responses to any of the sections of the template, although we recommend a minimum of 75 words per section (not including the idea name). We have provided an example brief and corresponding solution to help direct your responses. You will have 15 minutes to complete the task once you have finished reviewing the example.

If you have any questions or require any additional information during the task, please ask the researcher supervising. Once the task is complete If you have any further questions, please direct an email to 2469113f@student.gla.ac.uk. All answers will be analysed using a mixture of both qualitative and quantitative methods. Please remember that it is the system, not your own ideas, that is being tested. While completion of an entire form is required for your answers to be used, you are welcome to withdraw from the experiment at any time. Do you agree to taking part in this experiment? If so please sign below:

---

## Example Brief

### Background Information:

**Company Name:** Scarpa

**Company Profile:** Scarpa, an esteemed Italian company founded in 1938, specializes in high-quality outdoor footwear. Initially focused on handcrafted shoes, it has expanded into mountaineering, skiing, rock climbing, and hiking footwear. Known for blending innovation, quality, and performance, Scarpa caters to both professional athletes and outdoor enthusiasts. The brand is globally recognized for its craftsmanship and advanced footwear technology, maintaining a strong position in the technical outdoor footwear market.

**Company Mission:** Scarpa's mission centers on inspiring a connection with nature through innovative and quality footwear. Emphasizing Italian craftsmanship and technological advancement, Scarpa aims to enhance outdoor performance, comfort, and safety, encouraging exploration and enjoyment of the natural world.

**Current Product Range:** Scarpa's product range includes mountaineering boots, ski boots, rock climbing shoes, and hiking footwear. Tailored for various expertise levels and terrains, their products range from lightweight approach shoes to advanced boots for extreme conditions. Constant innovation, athlete feedback incorporation, and a commitment to sustainability are hallmarks of their range, emphasizing eco-friendly materials and processes.

### Product Brief:

**Product:** ""Walking backpack""

**Target Audience:** New walkers who are still getting to grips with the outdoors.

**Suggested Features:** Lightweight

**Requirements:** Reasonably affordable

### Constraints:

**Budget:** £300000

**Timeframe:** 3 years

**Technical and Legal Constraints:** The product must be in agreement with respective safety laws and guidelines

## Example Solution

**Idea name:** "Removable Gear Pods",

**Idea description:** "The Removable Gear Pods are detachable storage units designed to address the lack of compartments for gear organization in the walking backpack. Each pod serves a specific purpose, such as a first aid kit pod, a snack pod, or a tech gadget pod. These pods feature clear labelling and color-coded indicators for easy identification, allowing users to efficiently organize and access their essential items. Made from lightweight yet durable materials, the gear pods maintain the overall weight and functionality of the backpack.",

**Idea justification:** "The Removable Gear Pods enhance the product's importance by offering versatile storage solutions and efficient organization for users, addressing their specific gear needs effectively. This feature emphasizes the product's adaptability and customization options, making it a standout choice for users seeking personalized organization. Users are more likely to commit to using the backpack consistently, thanks to the flexibility and convenience provided by the removable gear pods, enhancing their overall outdoor experience. Despite its added functionality, the lightweight and durable design of the gear pods ensures that the product remains reasonably affordable within the set budget. The Removable Gear Pods excel in importance, commitment, necessity, novelty, usefulness, usability, sales volume, rate of return, competition, buyer appeal, market alignment, functionality, reliability, safety, aesthetics, and technical value, making them a valuable addition that enhances the product's functionality."

## Design Brief

### Background Information:

**Company Name:** Portabread

**Company Profile:** Portabread is a proscit design brand which specialises in produces kitchen appliances which can be used within the customers kitchen or on the go whether that is out on an adventure or travelling to work. The brand has many product avenues but the most advanced products are within the toaster, kettle and microwave product industries.

**Company Mission:** Portabreads mussion is to give its customers the ability to choose how and where they make their breakfast whether that is at home or on the road. We wont be held back by cords

**Current Product Range:** Portable toasters, microwaves and kettles

### Product Brief:

**Original Product:** Portabread would like to explore and reimagine the original vegetable hand peeler which can be time consuming, messy and occasionally leads to accidents when used for long periods of time.

**Target Audience:** Intended consumer group would be an avid cook and love spending time in the kitchen but loves sharing that time with friends and family aswell

**Suggested Features:** Potential features could range from hands free to vegetable scale sensing. Ideally, all concepts should have an end of life consideration whether that be remanufacturability or recyclability. An added bonus would be if the product could be scaled up for industrial level food preparation.

**Requirements:** The product must have some kind of safety festu5re which prevents accidents

### Constraints:

**Budget:** The budget for the initial development of the project must not exceed £15,000. Labour and manufacturing costs can be excluded from budget for now.

**Timeframe:** Timeframe for the project will be 6 months from concept generation to manufacturing and then onto the shelf.

**Technical and Legal Constraints:** Any design or product must not infinge on patents or copy from existing products in this category already on the market.

## **Solution Template**

**Idea Name – A name for your idea:**

**Idea Description – A short description of what your idea is, its purpose, and roughly how it would be used to update the original product(s):**

**Idea Justification – A justification as to why your idea is a good solution to scenario outlined in the design brief. Why is it appropriate for the given company? Why will the target audience be interested? Could it reasonably be developed under the constraints given? What sets it apart from other products on the market?:**

### .2.3 Phase 3 Surveys

## **Introduction**

# **Using MetaGPT for Product Innovation – Evaluation Form**

**Level 4 Project 23/24**

**Daniel Flynn 2469113f@student.gla.ac.uk**

The aim of this experiment is to investigate how well the GPT-4 LLM supported by a meta-framework performs at product innovation and evaluation. We cannot evaluate the quality of the ideas generated and the evaluations performed without a baseline for comparison. This is why we have asked you, as an expert in your field, to evaluate a product idea which will either be AI generated or created by a design student.

When you press next page, you will be presented with a product idea name, description, and justification. Press next page again and you will be presented with an evaluation form for you to complete. You must complete the 1-to-9 scale questions to proceed, but the text-entry questions are entirely optional. The scale questions have a not

applicable option you can use if you believe the question is not suitable to the idea, or if you have cannot hypothesise what the effect will be. Non-applicable responses will generally be treated as neutral in analysis. Attempts at answering are always preferred, even if you are uncertain. There is no time limit on the evaluation. You can go back and review the product idea or change your answers at any point.

If you have any questions or require any additional information, please direct an email to [2469113f@student.gla.ac.uk](mailto:2469113f@student.gla.ac.uk). All answers will be analysed using a mixture of both qualitative and quantitative methods. Please remember that it is the system, not your own evaluation opinions, that is being tested. While completion of an entire evaluation form is required for your answers to be used, you are welcome to withdraw from the experiment at any time. Do you agree to taking part in this experiment? If so please sign below:

x

**SIGN HERE**

---

clear

## Block 8

# Original Scenario

### Background Information:

**Company Name:** Edubot

**Company Profile:** Edubot develops educational robots for students between the age of 6 to master level.

**Company Mission:** The mission of the company is to support teachers and lecturer in developing key STEM skills, including programming, via hands-on activities outside the computer (e.g. using robots)

**Current Product Range:** They mostly sell third party robots and develop educational activities and support on top of them.

### Product Brief:

**Original Product:** With the recent AI development, they receive a lot of demand for AI educational robots but there is not many on the market that fit the needs and constraints of their typical clients (schools, universities). Most robots are too expensive or the capacity of the robot are too limited for AI education. They see an opportunity to develop their own robot given their insight into their clients need.

**Target Audience:** They want to develop one platform that could appeal to both schools and universities. For schools the need is more around a AI and Machine Learning activities that are ready to use, short, and do not require any coding. For Universities, the goal is to develop a platform that lecturers can quickly link to a coding environment and develop their own activities. For both clients, the most important constraint is price. The robot must not have a selling price above £50.

**Suggested Features:** To be engaging the robots must to be able to move itself or part of its body. To be useful for AI, there must be a variety of sensors with at least one camera for computer vision application which are the most attractive to teachers. To be programmable and fun to use, there must be a wireless link possible with a computer, this can be wifi or Bleutooth for example. It would be great if the robot could be customised in some way by the students, either its shape, or as simple as adding a name or colouring it.

**Requirements:** Retail price below £50, this usually means that total material cost must be below £15. Robots to be usable for AI demos. We expect students and staffs to have access to their smartphones and computers, or have some made available to them.

### Constraints:

**Budget:** We have £50k for this development. As the robot is made to be cheap, we also expect development cost to be low. Our team knows how to design electronics board and has access to a makerspace equipped with 3D printers, lasercutters, etc

**Timeframe:** 6months to develop the idea into a functional prototype testable with some schools. Ready for market within 2 years after some iteration with teachers, lecturers and students.

**Technical and Legal Constraints:** Shipping lithium batteries is not easy but possible in small batches without too much issues, to be considered. Younger kids are not the most delicate manipulators so the robot must be a bit robust to that.

## **Edubot - Human**

# **Idea to be evaluated**

**Idea Name:** Edu-bot

**Idea Description:** The robot features motors that are able to move the robot around the room. The robot has a screen interface that can interact with the children. The teacher can upload the slides that she/he has done teaching in class and after the children have completed their teachers questions the AI robot comes round and tests the children interacting just with them and giving them bonus tasks. If they get them correct they are rewarded, play a game with the robot etc. Robot can also scan paper and mark questions for the teacher saving the teacher time in the classroom and with students.

**Idea Justification:** Only one teacher for 30 pupils so if the robot can move around and teach the children maths or English and give them feedback it is less pressure on the teacher. Also motivates the pupils to do work correctly and they are rewarded with a prize (a game)ddresses its safety requirement and the replaceable blades increases the product life. The simplicity of the design will allow the design process to be completed efficiently and <£15000

## **Questions 1 – Edubot**

### **TECHNICAL/PRODUCTION VALUE EVALUATION**

**PRODUCTIVITY** – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge resources or and ideas to improve our production such can be easily found knowledge

1

2

3

4

5

6

7

8

9

Not Applicable



## FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea would not significantly reduce the functionality of the product in its original use context

The idea would effect the functionality of the product in its original use context

The idea would improve the functionality of the product in its original use context

1

2

3

4

5

6

7

8

9

Not Applicable



## RELIABILITY - How would the idea affect the reliability of a realised product compared to existing products?

The idea would not significantly effect the reliability of the product

The idea would improve the reliability of the product

Not Applicable

1      2      3      4      5      6      7      8      9



## SAFETY - How would the idea affect the safety of a realised product compared to existing products?

The idea would not significantly effect the safe of use of the product

The idea would improve the safety of the product

Not Applicable

1      2      3      4      5      6      7      8      9



## ECOLOGICALLY - How would the idea affect the environmental parameters of a realised product?

The idea would have negative impact on environmental parameters (energy, pollution ...)	The idea would not significantly effect the environmental parameters	The idea the environmental characteristics of the product (green product)	Not Applicable						
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9	
					<input type="checkbox"/>	<input type="checkbox"/>			



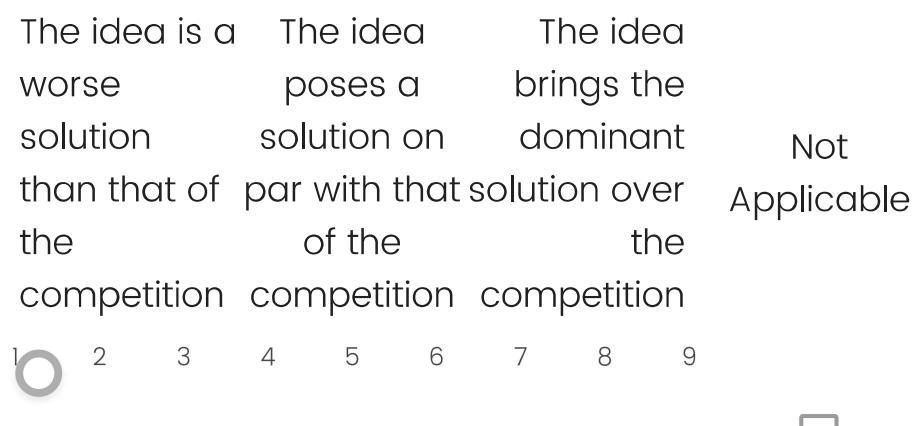
## AESTHETICS - How would the idea affect the aesthetics of a realised product?

The idea would not significantly effect the overall aesthetics of the product	The idea would improve the overall aesthetics of the product	Not Applicable							
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9	
					<input type="checkbox"/>	<input type="checkbox"/>			



## **MARKET VALUE EVALUATION**

COMPETITION - How competitive is the idea in relation to the ideas embedded in the competitor's products?



BUYER - How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations	The idea brings an expected solution to customers	The idea brings a solution above customer expectations	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9



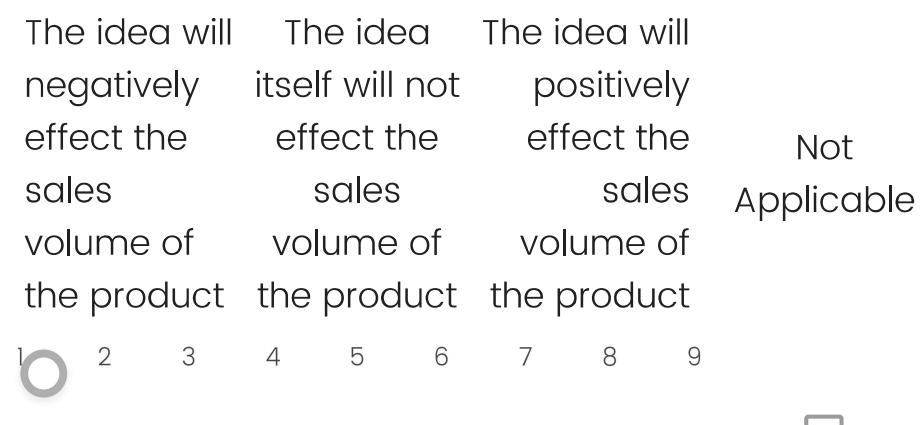
## MARKET – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market	The idea brings a solution in the rank of solutions on the market	The idea brings the solution above the expectations and needs of the market	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9

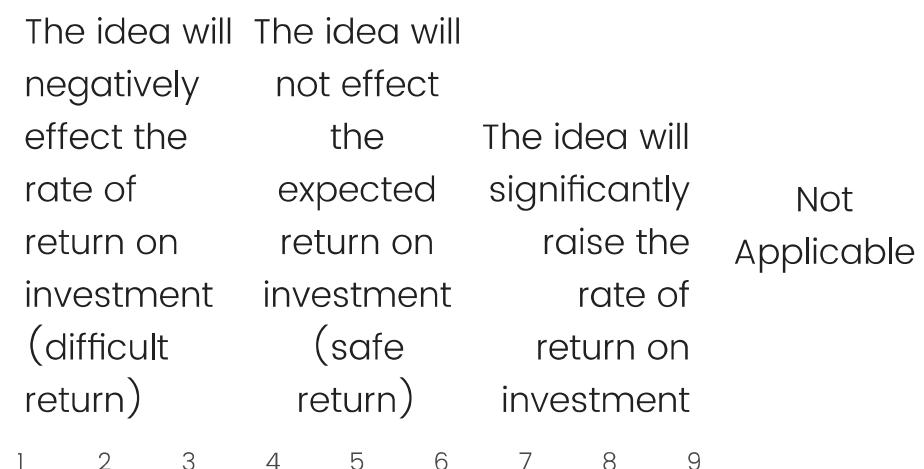


## FINANCIAL VALUE EVALUATION

SALES VOLUME – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

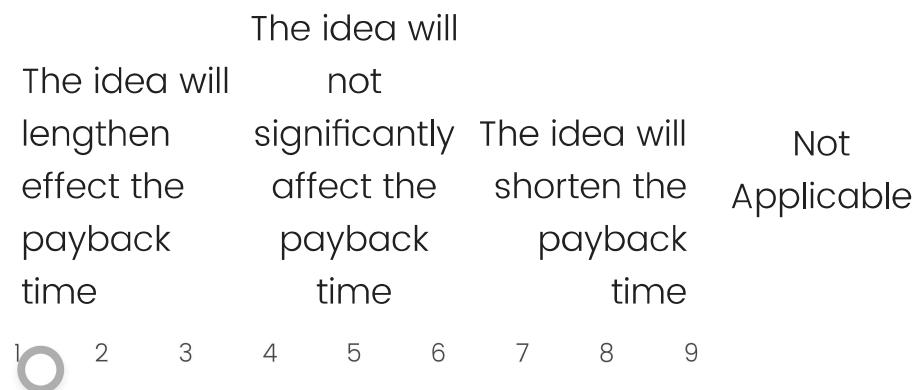


RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?



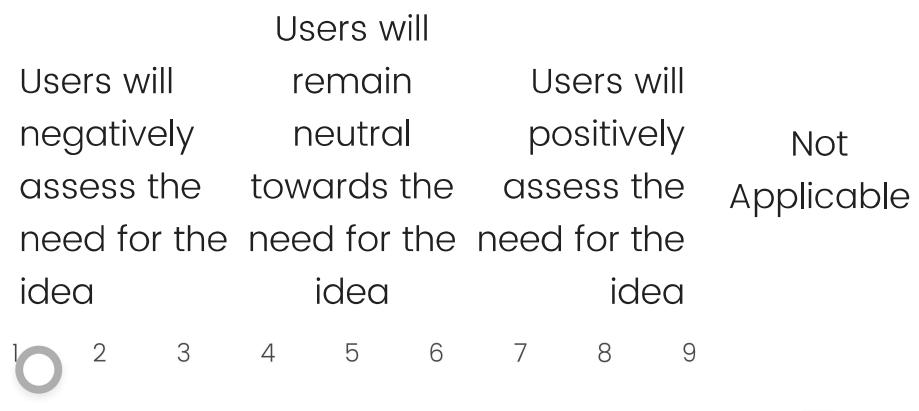


PAYBACK TIME - How will the idea affect the payback time for a realised product compared to existing products?

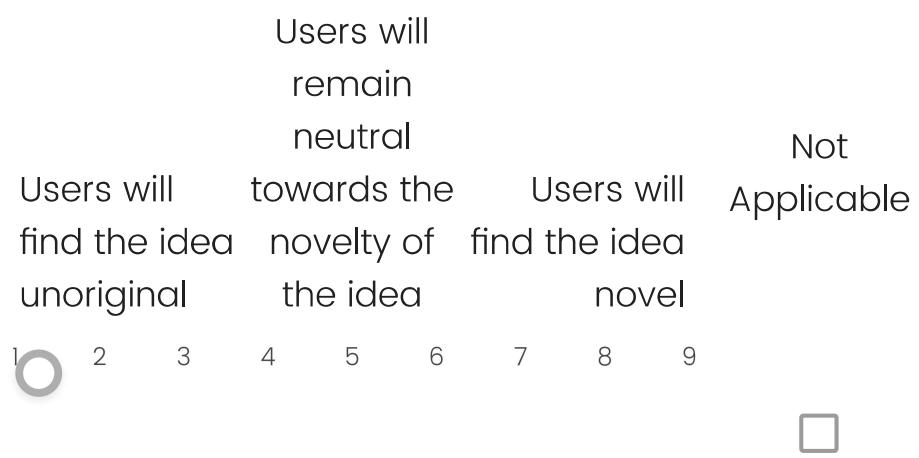


## CUSTOMER VALUE EVALUATION

NECESSITY - How will users evaluate the necessity of the idea?



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?

Users will remain neutral towards the usefulness of a product based on the idea

Users will consider the usefulness significant

Not Applicable

1 2 3 4 5 6 7 8 9

## USABILITY – How will users evaluate the usability of products using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

Not Applicable

1 2 3 4 5 6 7 8 9

## SOCIAL VALUE EVALUATION

## IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users

The idea will be on par with the expectations for importance for product's users

The idea will significantly contribute to increasing importance of products for users

Not Applicable

1    2    3    4    5    6    7    8    9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the possession of the product

The idea will highlight the negative highlighting of the possession of the product

The idea will substantially raise the highlighting of ownership of the product (self-advertising)

Not Applicable

1    2    3    4    5    6    7    8    9



## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable
---	--	--	----------------

1  2 3 4 5 6 7 8 9



## AFFORDABILITY – How much will the idea contribute to the affordability of a realised product compared to similar products?

The idea will

The idea will have no The idea will  
adversely impact on significantly  
affect the the increase the  
possibility of possibility of possibility of  
procurement procurement procurement Not  
of products of products of products Applicable  
by by by  
customers / customers / customers /  
users users users

1      2      3      4      5      6      7      8      9



Are there any additional positive aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **Kineto – Human**

# **Idea to be evaluated**

**Idea name:** Kineto

**Idea description:** A robot focused on displaying kinetic physics problems to children in the rural world. The robot is made to help kids visualise the problems that they do in their physics classes, and how changing certain parameters affects the physical system. The robot has 2 main moving parts, a spring system and pulley system which can be used with different attachments

**Idea justification:** I have no idea because the brief makes no sense? I cannot for the life of me figure what it is that this company wants?

## Questions 2 – Kineto

### TECHNICAL/PRODUCTION VALUE EVALUATION

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge or and ideas to improve our production

easily found knowledge

1      2      3      4      5      6      7      8      9



FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea

The idea would not significantly reduce the functionality of the product in its original use context

would effect the functionality of the product in its original use context

improve the functionality of the product in its original use context

The idea would improve the functionality of the product in its original use context

Not Applicable

1      2      3      4      5      6      7      8      9

**RELIABILITY** – How would the idea affect the reliability of a realised product compared to existing products?

The idea

The idea would not significantly reduce the reliability of the product

would effect the reliability of the product

improve the reliability of the product

The idea would improve the reliability of the product

Not Applicable

1      2      3      4      5      6      7      8      9

**SAFETY** – How would the idea affect the safety of a realised product compared to existing products?

<p>The idea would not significantly effect the safe of use of the product</p>	<p>The idea would improve the safety of the product</p>	<p>Not Applicable</p>
<input checked="" type="radio"/> 1      2      3      4      5      6      7      8      9		



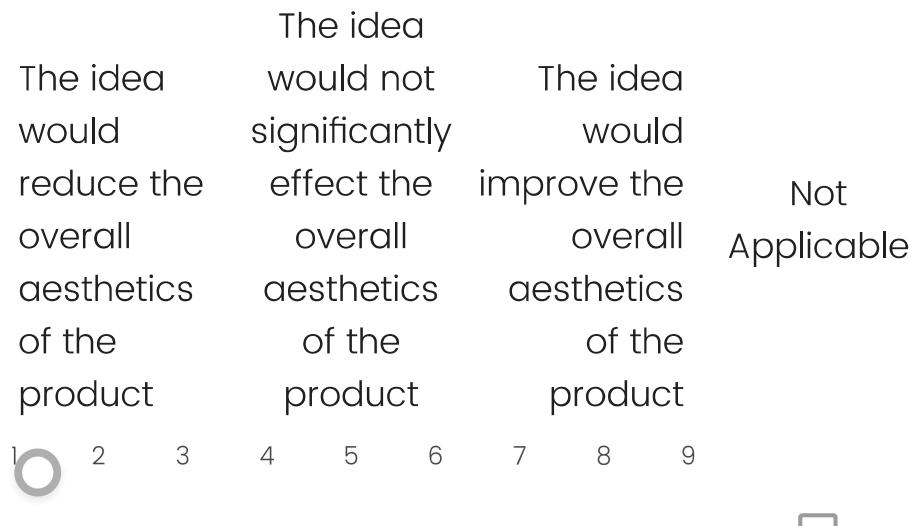
## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

<p>The idea would have negative impact on environmental parameters (energy, pollution ...)</p>	<p>The idea would not significantly effect the environmental parameters</p>	<p>The idea would contribute to the environmental characteristics of the product (green product)</p>	<p>Not Applicable</p>
<input checked="" type="radio"/> 1      2      3      4      5      6      7      8      9			



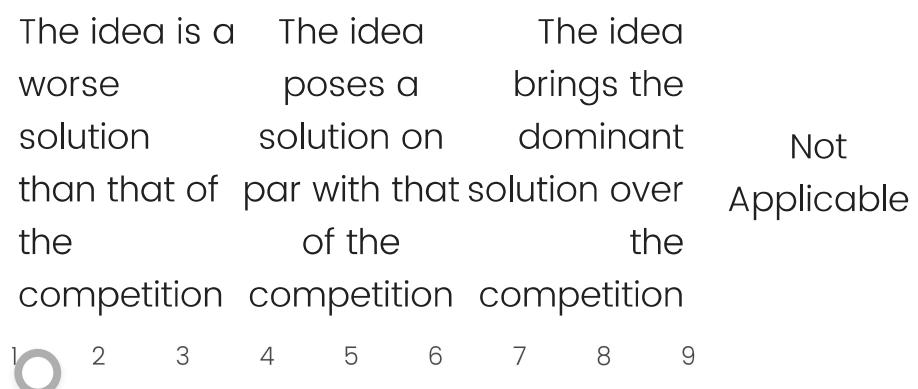
## AESTHETICS – How would the idea affect the aesthetics of a

realised product?



## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?



BUYER – How competitive is the idea with regards to customer expectations?

The idea  
brings a  
worse  
solution  
than  
customer  
expectations

The idea  
brings an  
expected  
solution to  
customers

The idea  
brings a  
solution  
above  
customer  
expectations

Not  
Applicable



**MARKET** – How would the idea compete against the expectations of the market?

The idea  
brings a  
worse  
solution  
than other  
solutions on  
the target  
market

The idea  
brings a  
solution in  
the rank of  
solutions on  
the market

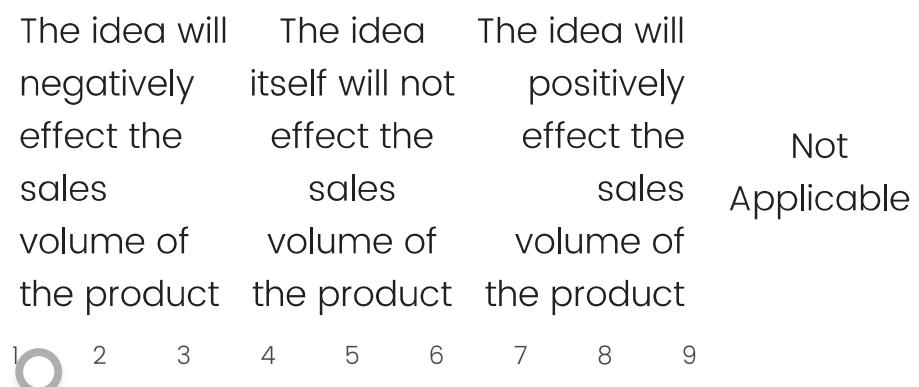
The idea  
brings the  
solution  
above the  
expectations  
and needs  
of the  
market

Not  
Applicable



## **FINANCIAL VALUE EVALUATION**

**SALES VOLUME** – What impact will the idea have on the expected sales volume of a realised product compared to existing products?



**RATE OF RETURN** – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the rate of return on investment

1      2      3      4      5      6      7      8      9



## PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will not significantly affect the payback time

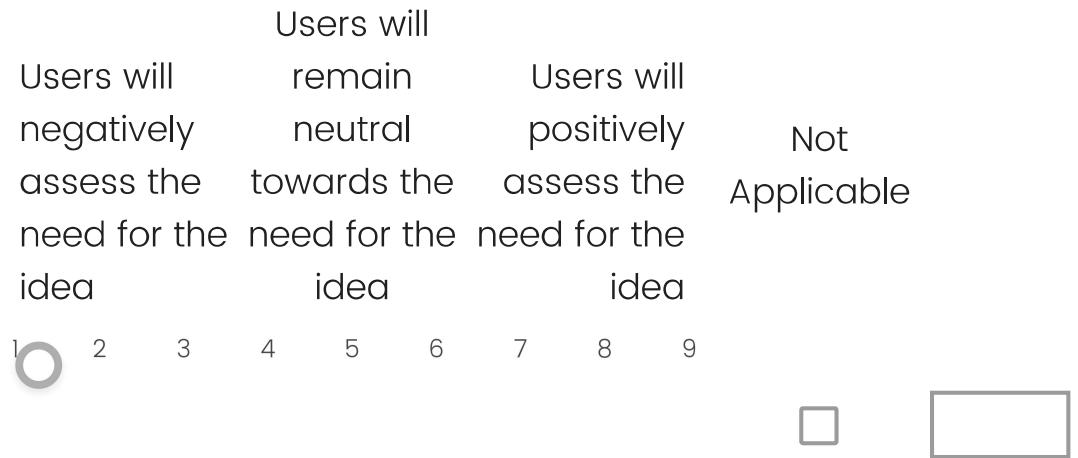
The idea will shorten the payback time

1      2      3      4      5      6      7      8      9

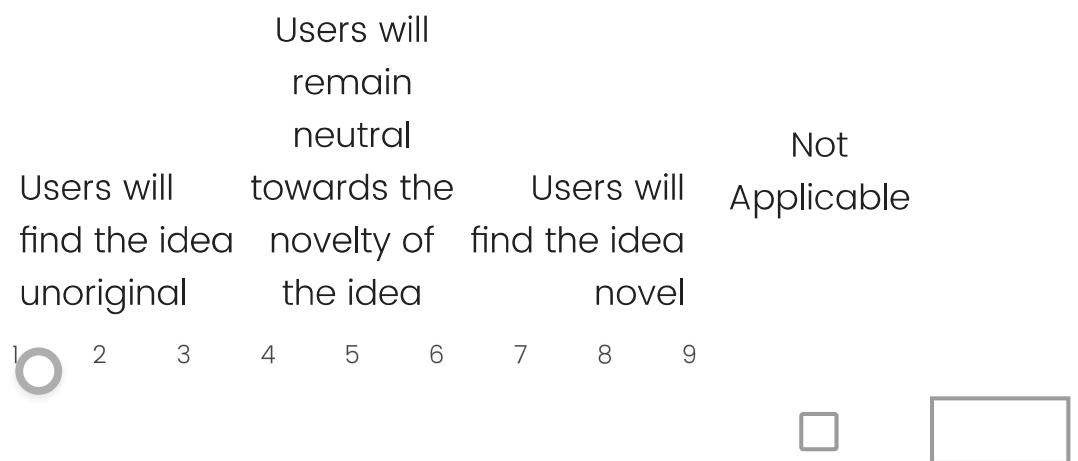


## CUSTOMER VALUE EVALUATION

## NECESSITY – How will users evaluate the necessity of the idea?



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?

Users will remain neutral towards the usefulness of a product based on the idea

Users will consider the usefulness significant

Not Applicable

1 2 3 4 5 6 7 8 9

## USABILITY – How will users evaluate the usability of products using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

Not Applicable

1 2 3 4 5 6 7 8 9

## SOCIAL VALUE EVALUATION

## IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users

The idea will be on par with the expectations for importance for product's users

The idea will significantly contribute to increasing importance of products for users

Not Applicable

1      2      3      4      5      6      7      8      9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the possession of the product

The idea will highlight the negative highlighting of the possession of the product

The idea will substantially raise the highlighting of ownership of the product (self-advertising)

Not Applicable

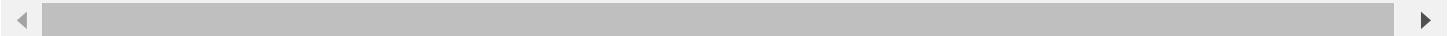
1      2      3      4      5      6      7      8      9



## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable
---	--	--	----------------

1  2 3 4 5 6 7 8 9



## AFFORDABILITY – How much will the idea contribute to the affordability of a realised product compared to similar products?

The idea will

The idea will have no The idea will  
adversely impact on significantly  
affect the the increase the  
possibility of possibility of possibility of  
procurement procurement procurement Not  
of products of products of products Applicable  
by by by  
customers / customers / customers /  
users users users

1      2      3      4      5      6      7      8      9

Are there any additional positive aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **AI Concept Demonstrator – MetaGPT**

# **Idea to be evaluated**

**Idea Name:** AI Concept Demonstrator,

**Idea Description:** The AI Concept Demonstrator is a feature that uses the robot's sensors and movement capabilities to demonstrate key AI concepts in a practical, hands-on way. The robot could use its camera to recognize objects or faces, demonstrating computer vision. It could also use its movement capabilities to navigate a maze, demonstrating pathfinding algorithms. These demonstrations could be pre-programmed into the robot, or they could be developed by teachers or students using a simple programming interface.

**Idea Justification:** The AI Concept Demonstrator is necessary to provide a practical, hands-on way for students to understand AI concepts. It emphasizes the product's value by showcasing practical applications of AI, making the product more appealing to users. This feature will be highly useful in helping students understand key AI concepts in a practical and engaging way. The usability of the product will be high as it allows for both pre-programmed demonstrations and custom demonstrations developed by teachers or students. The AI Concept Demonstrator could increase sales volume by providing a practical, hands-on way to learn AI concepts. This could be particularly attractive to schools and universities looking for engaging teaching tools. While there are many AI teaching tools available, few offer hands-on demonstrations using a physical robot. This could give the product a competitive edge. The functionality of the product would greatly increase as it would be able to demonstrate key AI concepts in a practical, hands-on way."

## Questions 3 – AI Concept Generator

### TECHNICAL/PRODUCTION VALUE EVALUATION

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge or and ideas to improve our production

easily found knowledge

1      2      3      4      5      6      7      8      9



FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea

The idea would not significantly reduce the functionality of the product in its original use context

would effect the functionality of the product in its original use context

improve the functionality of the product in its original use context

The idea would improve the functionality of the product in its original use context

Not Applicable

1      2      3      4      5      6      7      8      9

**RELIABILITY** – How would the idea affect the reliability of a realised product compared to existing products?

The idea

The idea would not significantly reduce the reliability of the product

would effect the reliability of the product

improve the reliability of the product

The idea would improve the reliability of the product

Not Applicable

1      2      3      4      5      6      7      8      9

**SAFETY** – How would the idea affect the safety of a realised product compared to existing products?

<p>The idea would not significantly effect the safe of use of the product</p> <p><input checked="" type="radio"/> 1      2      3      4      5      6      7      8      9</p>	<p>The idea would improve the safety of the product</p> <p><input type="checkbox"/> Not Applicable</p>
---	--

## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

<p>The idea would have negative impact on environmental parameters (energy, pollution ...)</p> <p><input checked="" type="radio"/> 1      2      3      4      5      6      7      8      9</p>	<p>The idea would not significantly effect the environmental parameters</p> <p>The idea would contribute to the environmental characteristics of the product (green product)</p> <p><input type="checkbox"/> Not Applicable</p>
--	---

## AESTHETICS – How would the idea affect the aesthetics of a

realised product?

The idea would not significantly reduce the overall aesthetics of the product	The idea effect the overall aesthetics of the product	The idea improve the overall aesthetics of the product	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
<input type="checkbox"/>	<input type="checkbox"/>							

## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition	The idea poses a solution on par with that of the competition	The idea brings the dominant solution over the competition	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
<input type="checkbox"/>	<input type="checkbox"/>							

BUYER – How competitive is the idea with regards to customer expectations?

The idea  
brings a  
worse  
solution  
than  
customer  
expectations

The idea  
brings an  
expected  
solution to  
customers

The idea  
brings a  
solution  
above  
customer  
expectations

Not  
Applicable



**MARKET** – How would the idea compete against the expectations of the market?

The idea  
brings a  
worse  
solution  
than other  
solutions on  
the target  
market

The idea  
brings a  
solution in  
the rank of  
solutions on  
the market

The idea  
brings the  
solution  
above the  
expectations  
and needs  
of the  
market

Not  
Applicable



## **FINANCIAL VALUE EVALUATION**

**SALES VOLUME** – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will      The idea will      The idea will  
negatively      itself will not      positively  
effect the      effect the      effect the      Not  
sales                sales                sales               Applicable  
volume of          volume of          volume of  
the product        the product        the product

1  2    3    4    5    6    7    8    9



**RATE OF RETURN** – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the rate of return on investment

1

2

3

4

5

6

7

8

9

Not Applicable



## PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will not significantly affect the payback time

The idea will shorten the payback time

1

2

3

4

5

6

7

8

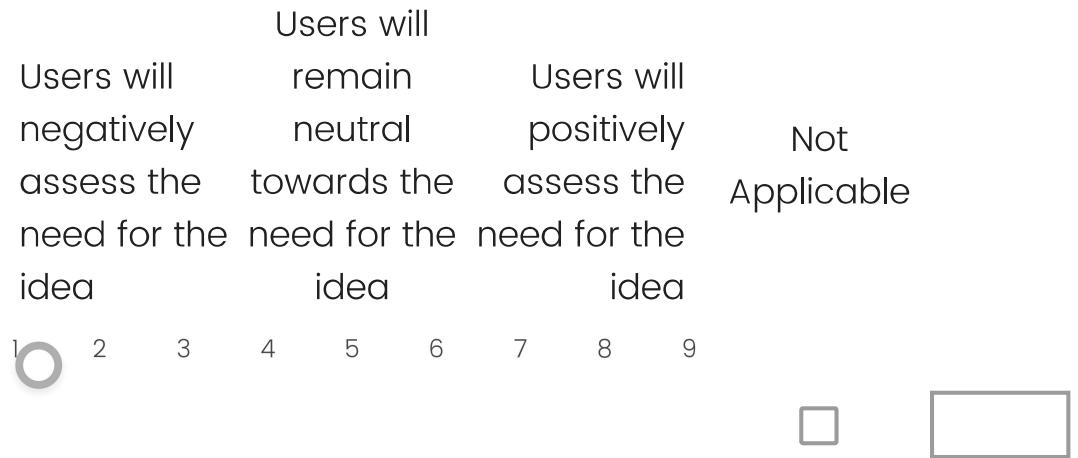
9

Not Applicable

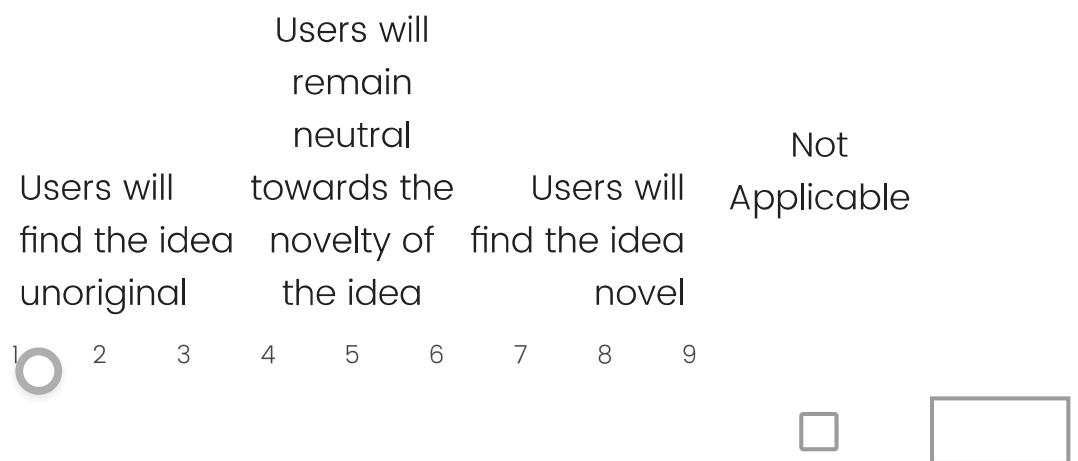


## CUSTOMER VALUE EVALUATION

## NECESSITY – How will users evaluate the necessity of the idea?



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?

Users will remain neutral towards the usefulness of a product based on the idea

Users will consider the usefulness significant

Not Applicable

1      2      3      4      5      6      7      8      9



## USABILITY – How will users evaluate the usability of products using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

Not Applicable

1      2      3      4      5      6      7      8      9



## SOCIAL VALUE EVALUATION

## IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users	The idea will be on par with the expectations for importance of product's users	The idea will contribute to increasing importance of products for users	Not Applicable
1 	2    3    4    5    6    7    8    9	<input type="checkbox"/>	<input type="text"/>

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the product	The idea will substantially raise the highlighting of ownership of the product (self-advertising)	Not Applicable
1    2    3    4    5    6    7    8    9		<input type="text"/>



## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the user to the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable
---	--	--	----------------

1 2 3 4 5 6 7 8 9



## AFFORDABILITY – How much will the idea contribute to the affordability of a realised product compared to similar products?

The idea will

The idea will have no The idea will  
adversely impact on significantly  
affect the the increase the  
possibility of possibility of possibility of  
procurement procurement procurement Not  
of products of products of products Applicable  
by by by  
customers / customers / customers /  
users users users

1      2      3      4      5      6      7      8      9



Are there any additional positive aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## AI Tutor Mode – MetaGPT

# Idea to be evaluated

**Idea name:** AI Tutor Mode

**Idea description:** The AI Tutor Mode is an innovative feature designed to simplify the teaching and learning process of AI concepts. This mode comes with pre-programmed lesson plans that align with the curriculum, providing an interactive and hands-on learning experience for students. The robot, equipped with this mode, uses its camera and sensors to interact with the students, explaining AI concepts in a simple, understandable manner. This is achieved by integrating Natural Language Processing (NLP) algorithms into the robot's system. Furthermore, the lesson plans can be updated and customized via a wireless link with a computer, providing a unique and personal learning experience for each user.

**Idea justification:** The AI Tutor Mode is a highly valuable feature that enhances the product's functionality, promotes user engagement, and remains affordable. It addresses the challenge of preparing lesson plans involving AI robots, simplifying the learning process by providing pre-programmed lesson plans and explaining AI concepts in a simple manner. The feature emphasizes ownership by allowing customization of lesson plans via a wireless link with a computer. This interactive nature of the robot increases user commitment and keeps users engaged with the product. Given the added value of the AI Tutor Mode, the product remains affordable compared to similar products in the market. The feature enhances the product's functionality without significantly increasing its cost. The AI Tutor Mode is a necessary, novel, useful, and user-friendly idea that will revolutionize AI education. It meets the needs of teachers who struggle with preparing lesson plans involving AI robots and caters to students by providing an interactive and hands-on learning experience. The AI Tutor Mode aligns with the market's demand for innovative and effective educational tools. Its ability to simplify complex AI concepts makes it a valuable asset in the educational sector. The AI Tutor Mode enhances productivity and functionality, maintains safety, and has minimal environmental impact, but reliability and aesthetics depend on the quality of the AI system and user interface.

## **Questions 4 – AI Tutor Mode**

### **TECHNICAL/PRODUCTION VALUE EVALUATION**

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products	We have the resources, necessary knowledge or and ideas to improve our production	Not Applicable
---	---	----------------

1  2 3 4 5 6 7 8 9



## FUNCTIONALITY - How would the idea affect the functionality of a realised product compared to existing products?

The idea would reduce the functionality of the product in its original use context	1 <input checked="" type="radio"/> 2 3 4 5 6 7 8 9	The idea would not significantly effect the functionality of the product in its original use context	The idea would improve the functionality of the product in its original use context	Not Applicable
	<input type="checkbox"/>		<input type="checkbox"/>	

## RELIABILITY - How would the idea affect the reliability of a realised product compared to existing products?

The idea would reduce the reliability of the product	1 <input checked="" type="radio"/> 2 3 4 5 6 7 8 9	The idea would not significantly effect the reliability of the product	The idea would improve the reliability of the product	Not Applicable
	<input type="checkbox"/>		<input type="checkbox"/>	

## SAFETY - How would the idea affect the safety of a realised product compared to existing products?

The idea  
would not  
significantly  
effect the  
safe of use  
of the  
product

The idea  
would  
improve the  
safety of the  
product

Not  
Applicable

1      2      3      4      5      6      7      8      9



## ECOLOGICALLY - How would the idea affect the environmental parameters of a realised product?

The idea  
would have  
negative  
impact on  
environmental  
parameters  
(energy,  
pollution ...)

The idea  
would not  
significantly  
effect the  
environmental  
parameters

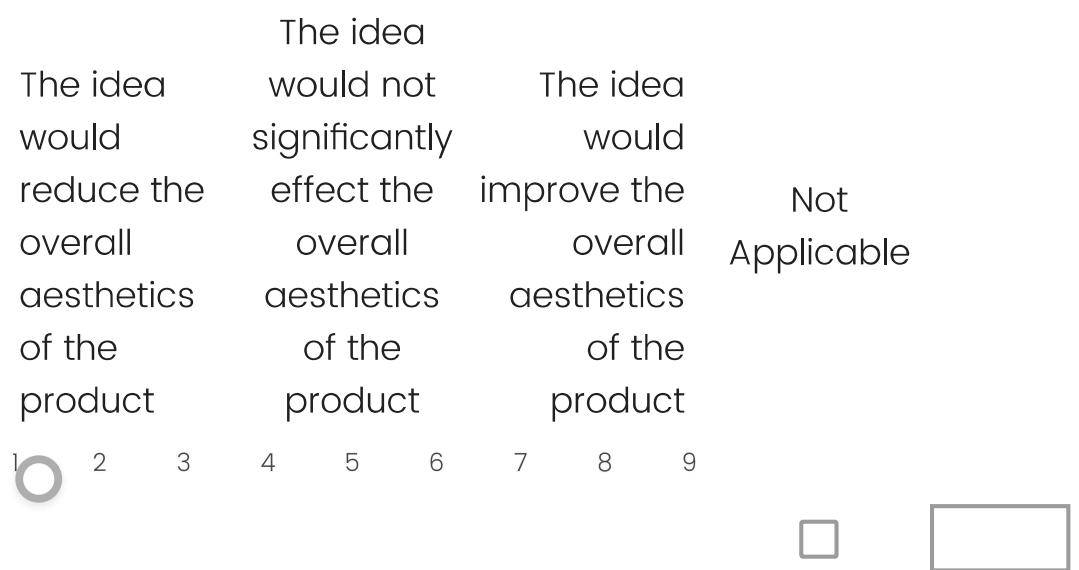
The idea  
would  
contribute to  
the  
environmental  
characteristics  
of the product  
(green  
product)

Not  
Applicable

1      2      3      4      5      6      7      8      9



## AESTHETICS – How would the idea affect the aesthetics of a realised product?



## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition

The idea poses a solution on par with that of the competition

The idea brings the dominant competition

1

2

3

4

5

6

7

8

9

Not

Applicable



## BUYER – How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations

The idea brings an expected solution to customers

The idea brings a solution above customer expectations

1

2

3

4

5

6

7

8

9

Not

Applicable



## MARKET – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market

The idea brings a solution in the rank of solutions on the market

1      2      3      4      5      6      7      8      9

The idea brings the solution above the expectations and needs of the market

Not Applicable



## FINANCIAL VALUE EVALUATION

SALES VOLUME – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will negatively effect the sales volume of the product

The idea itself will not effect the sales volume of the product

The idea will positively effect the sales volume of the product

1      2      3      4      5      6      7      8      9



RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will  
negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the return on investment

1      2      3      4      5      6      7      8      9



PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will  
lengthen effect the payback time

The idea will not significantly affect the payback time

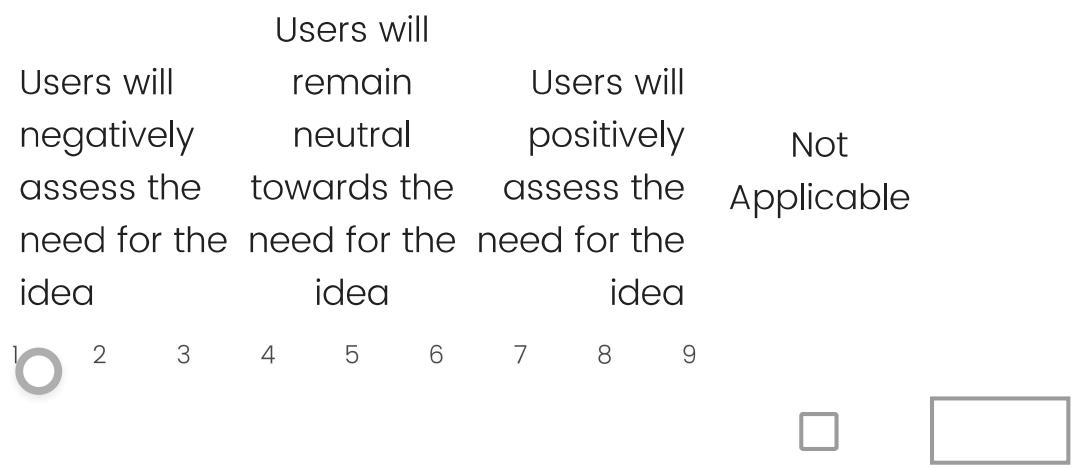
The idea will shorten the payback time

1      2      3      4      5      6      7      8      9

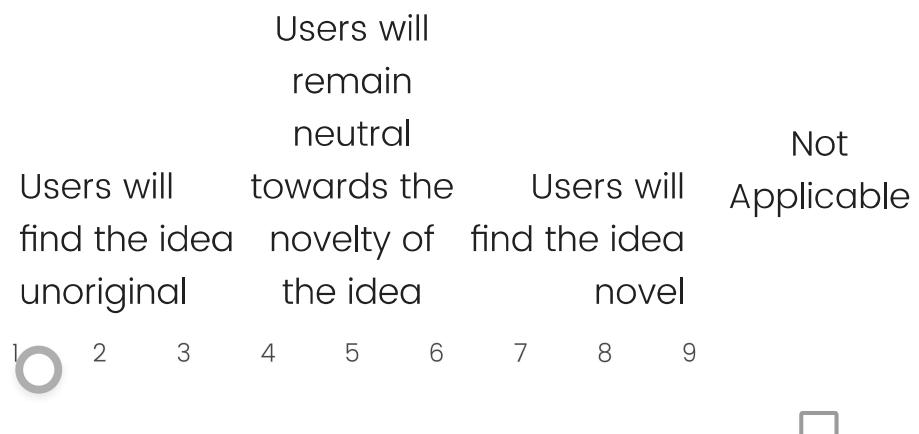


## CUSTOMER VALUE EVALUATION

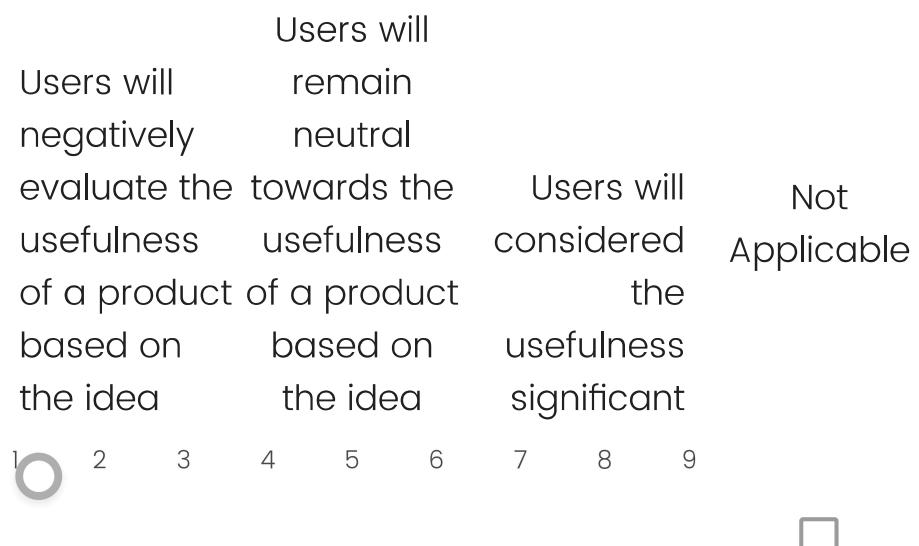
NECESSITY – How will users evaluate the necessity of the idea?



NOVELTY – How will users evaluate the novelty of the idea?



**USEFULNESS** – How will users evaluate the usefulness of a realised product using the idea?



**USABILITY** – How will users evaluate the usability of products using the idea?

<p>Users will negatively evaluate the usability of a product based on the idea</p>	<p>Users will remain neutral toward the usability of the product</p>	<p>The idea brings a substantial increase in the usability of the product</p>	<p>Not Applicable</p>					
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
1	2	3	4	5	6	7	8	9

## SOCIAL VALUE EVALUATION

**IMPORTANCE** – How much will the idea contribute to the importance of a realised product to users

<p>The idea would adversely affect the significance of the product for users</p>	<p>The idea will be on par with the expectations for importance of the product for users</p>	<p>The idea will significantly contribute to increasing importance of products for users</p>	<p>Not Applicable</p>					
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
1	2	3	4	5	6	7	8	9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the product of the manufacturer

1      2      3      4      5      6      7      8      9

Not Applicable

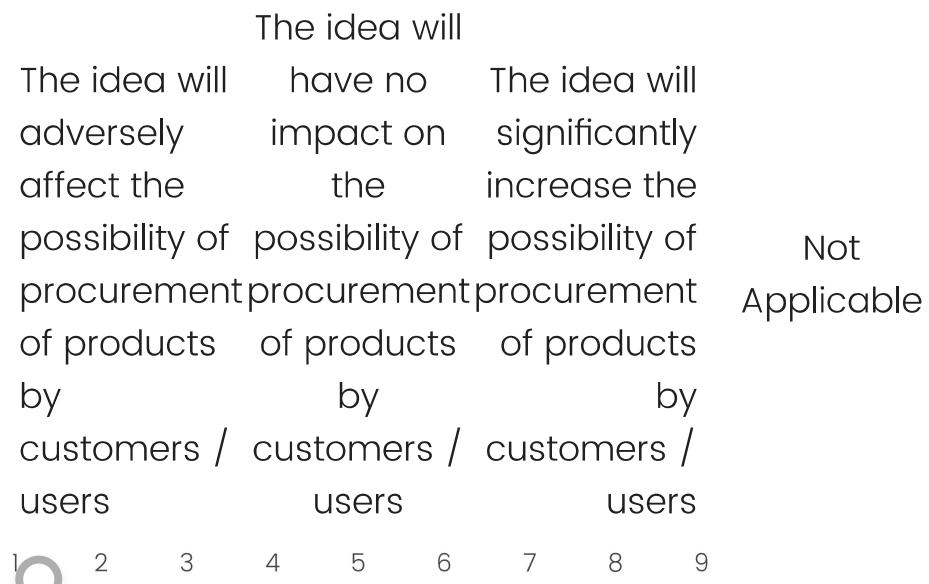
## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will not have a substantial impact on commitment of the user to the product of the manufacturer

1      2      3      4      5      6      7      8      9

Not Applicable

AFFORDABILITY - How much will the idea contribute to the affordability of a realised product compared to similar products?



Are there any additional positive aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## Untitled 1 - Human

# Idea to be evaluated

**Idea Name:** --

**Idea Description:** Program app for students phones, quizlet type python/c++ code classes, once completed they can use their knowledge to write a short program for 'challenges' to control robots movements. AI will 'mark' and rewrite it correctly if mistakes are made. It can make the robot move 1st in the intended way, then the incorrectly coded way after – the app then will explain your mistakes after and give you another chance. The robot will be a basic circuit with wheels which can move in any direction. Young students can decorate card case to have a personalised robot.

**Idea Justification:** Seeing mistakes in code and why your idea doesn't work the way you think it would is a good way to learn + change coding patterns. An educational quizlet like app is also a proven effective learning platform. Having a really simple base robot + card case means it will be cheap as well as a fun design element that could appeal to less maths driven students too.

## **Questions 5 – Untitled 1**

### **TECHNICAL/PRODUCTION VALUE EVALUATION**

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge resources or and ideas to improve our production

easily found knowledge

Not Applicable

1      2      3      4      5      6      7      8      9



## FUNCTIONALITY - How would the idea affect the functionality of a realised product compared to existing products?

The idea			The idea					
The idea would reduce the functionality of the product in its original use context	would not significantly effect the functionality of the product in its original use context	improve the functionality of the product in its original use context	The idea would improve the functionality of the product in its original use context			Not Applicable		
1	2	3	4	5	6	7	8	9

## RELIABILITY - How would the idea affect the reliability of a realised product compared to existing products?

The idea			The idea					
The idea would reduce the reliability of the product	would not significantly effect the reliability of the product	improve the reliability of the product	The idea would improve the reliability of the product			Not Applicable		
1	2	3	4	5	6	7	8	9

## SAFETY – How would the idea affect the safety of a realised product compared to existing products?

The idea  
would not  
significantly  
effect the  
safe of use  
of the  
product

The idea  
would  
reduce the  
safety of the  
product

The idea  
would  
improve the  
safety of the  
product

Not  
Applicable

1      2      3      4      5      6      7      8      9



## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

The idea  
would have  
negative  
impact on  
environmental  
parameters  
(energy,  
pollution ...)

The idea  
would not  
significantly  
effect the  
environmental  
parameters

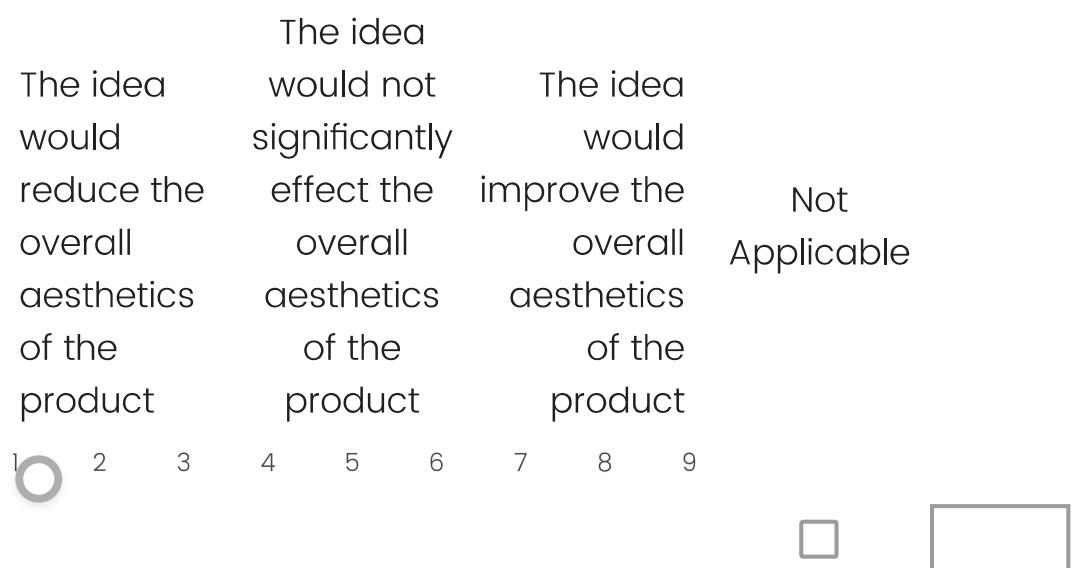
The idea  
would  
contribute to  
the  
environmental  
characteristics  
of the product  
(green  
product)

Not  
Applicable

1      2      3      4      5      6      7      8      9



## AESTHETICS – How would the idea affect the aesthetics of a realised product?



## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition

The idea poses a solution on par with that of the competition

The idea brings the dominant competition

1

2

3

4

5

6

7

8

9

Not

Applicable



## BUYER – How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations

The idea brings an expected solution to customers

The idea brings a solution above customer expectations

1

2

3

4

5

6

7

8

9

Not

Applicable



## MARKET – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market

The idea brings a solution in the rank of solutions on the market

1      2      3      4      5      6      7      8      9

The idea brings the solution above the expectations and needs of the market

Not Applicable



## FINANCIAL VALUE EVALUATION

SALES VOLUME – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will negatively effect the sales volume of the product

The idea itself will not effect the sales volume of the product

The idea will positively effect the sales volume of the product

1      2      3      4      5      6      7      8      9



RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will  
negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the return on investment

1      2      3      4      5      6      7      8      9



PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will  
lengthen effect the payback time

The idea will not significantly affect the payback time

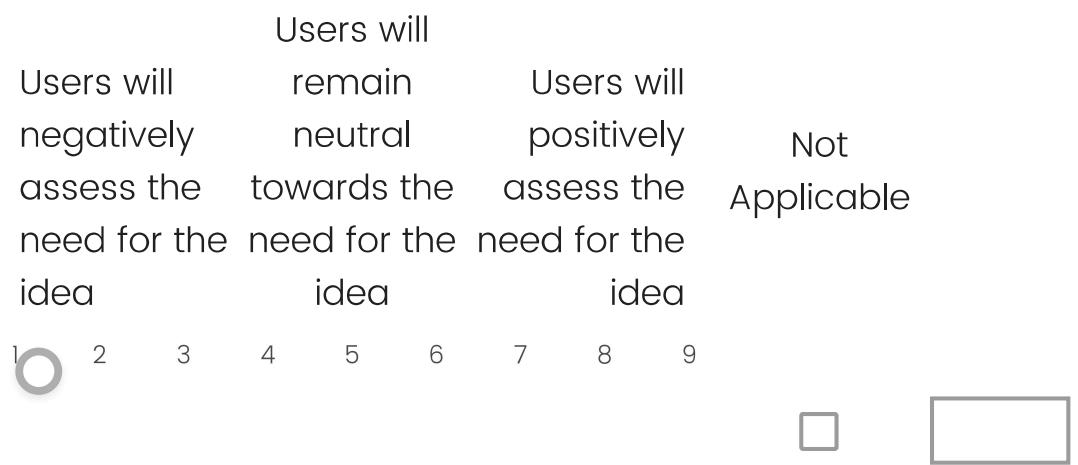
The idea will shorten the payback time

1      2      3      4      5      6      7      8      9

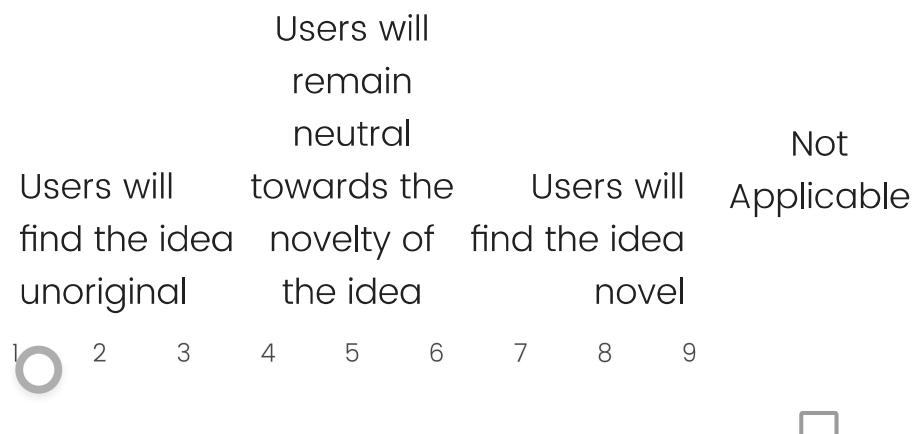


## CUSTOMER VALUE EVALUATION

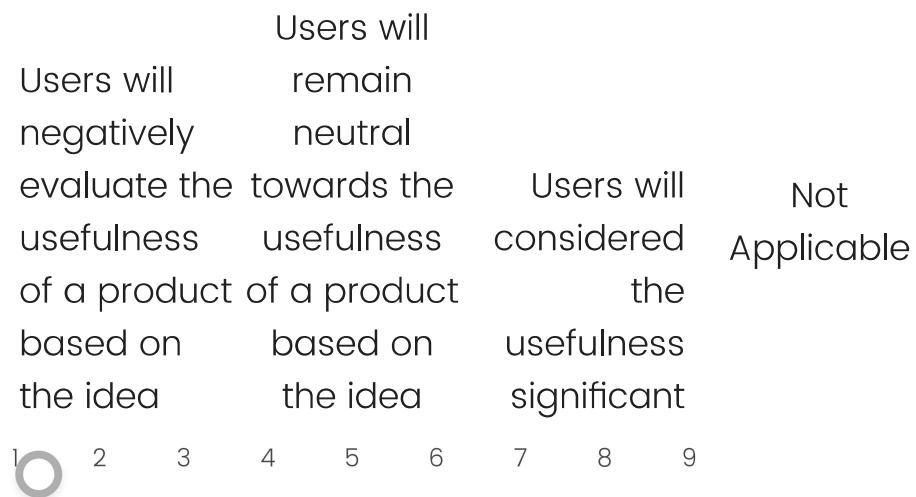
NECESSITY – How will users evaluate the necessity of the idea?



NOVELTY – How will users evaluate the novelty of the idea?



**USEFULNESS** – How will users evaluate the usefulness of a realised product using the idea?



**USABILITY** – How will users evaluate the usability of products using the idea?

<p>Users will negatively evaluate the usability of a product based on the idea</p>	<p>Users will remain neutral toward the usability of the product</p>	<p>The idea brings a substantial increase in the usability of the product</p>	<p>Not Applicable</p>					
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
1	2	3	4	5	6	7	8	9

## SOCIAL VALUE EVALUATION

**IMPORTANCE** – How much will the idea contribute to the importance of a realised product to users

<p>The idea would adversely affect the significance of the product for users</p>	<p>The idea will be on par with the expectations for importance of the product for users</p>	<p>The idea will significantly contribute to increasing importance of products for users</p>	<p>Not Applicable</p>					
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
1	2	3	4	5	6	7	8	9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be substantially neutral raise the

The idea will towards highlighting of ownership highlight the the of the possession possession product of the of the (self- product product advertising)

1  2 3 4 5 6 7 8 9

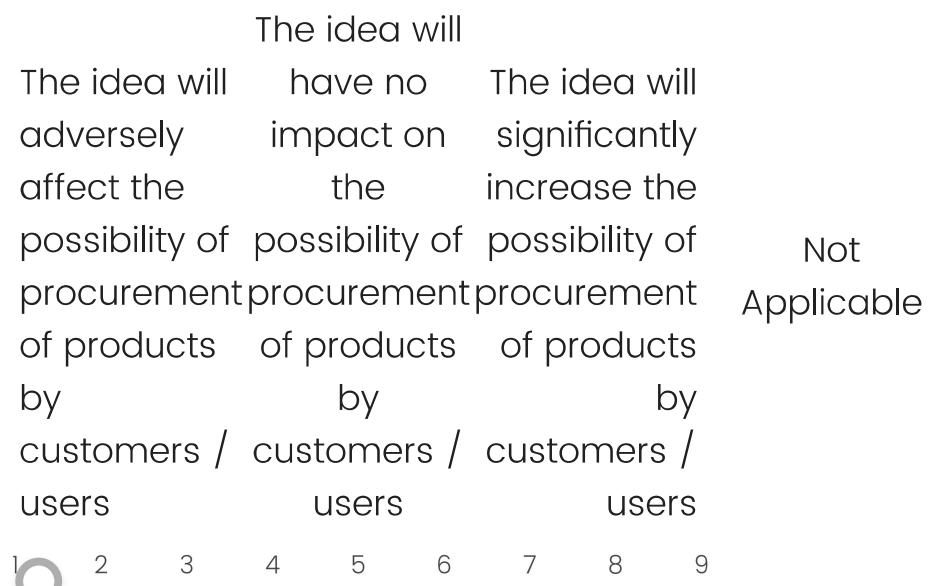
Not Applicable

## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will not have a significantly substantial contribute to impact on increase the commitment commitment commitment of the user to of the user to of the user to the product the product the product of the of the of the manufacturer manufacturer manufacturer

1 2 3 4 5 6 7 8 9

AFFORDABILITY - How much will the idea contribute to the affordability of a realised product compared to similar products?



Are there any additional positive aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **Edubot Explorer – ChatGPT**

# **Idea to be evaluated**

**Idea Name:** EduBot Explorer

**Idea Description:** : EduBot Explorer is a revolutionary educational robot designed by Edubot, aimed at transforming the way students interact with STEM subjects, particularly in the realms of Artificial Intelligence (AI) and Machine Learning (ML). This innovative robot is tailored to cater to both school and university settings, offering a versatile platform for engaging, hands-on learning. The EduBot Explorer is equipped with a set of sensors, including a camera for computer vision tasks, making it a powerful tool for AI education. It features wireless connectivity options like WiFi or Bluetooth, allowing seamless integration with coding environments for advanced users while providing ready-to-use, code-free AI and ML activities for younger students. The design of EduBot Explorer encourages customization, enabling users to personalize their robots by changing its shape or adding names and colors, thus enhancing the learning experience. Its robust construction ensures durability, making it suitable for the less delicate handling by younger students.

**Idea Justification:** The EduBot Explorer addresses the pressing demand for affordable AI educational robots in the educational sector, meeting the specific needs and constraints of Edubot's clientele. By offering a dual-purpose platform, it effectively bridges the gap between basic educational activities and more advanced, customizable programming tasks. This flexibility makes it an ideal tool for a wide range of educational levels, from primary schools to universities. The emphasis on affordability, with a target retail price below £50, aligns with the financial constraints of educational institutions and ensures accessibility to a broader audience. Additionally, the inclusion of customizable features and durable design not only enriches the educational value but also caters to the diverse needs of students and educators, fostering creativity and hands-on learning. The utilization of existing resources, such as the makerspace for development, aligns with the budget and timeframe constraints, making the EduBot Explorer a feasible and innovative solution in the educational technology market.

## Questions 6 – Edubot Explorer

### TECHNICAL/PRODUCTION VALUE EVALUATION

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products	We have the resources, necessary knowledge or ideas to improve our production	Not Applicable
---	---	----------------





## FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea  
The idea would not significantly improve the functionality of the product in its original use context

The idea would significantly effect the functionality of the product in its original use context

The idea would not improve the functionality of the product in its original use context

Not Applicable

1      2      3      4      5      6      7      8      9



## RELIABILITY – How would the idea affect the reliability of a realised product compared to existing products?

The idea would not significantly reduce the reliability of the product

The idea would improve the reliability of the product

1

2

3

4

5

6

7

8

9

Not

Applicable



SAFETY – How would the idea affect the safety of a realised product compared to existing products?

The idea would not significantly effect the safe of use of the product

The idea would improve the safety of the product

1

2

3

4

5

6

7

8

9

Not

Applicable



ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

The idea would have negative impact on environmental parameters (energy, pollution ...)	The idea would not significantly effect the environmental parameters	The idea the environmental characteristics effect the of the product (green product)	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
	<input type="checkbox"/>		<input type="checkbox"/>					

## AESTHETICS – How would the idea affect the aesthetics of a realised product?

The idea would not significantly effect the overall aesthetics of the product	The idea would improve the overall aesthetics of the product	Not Applicable						
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
	<input type="checkbox"/>		<input type="checkbox"/>					

## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition

The idea poses a solution on par with that of the competition

The idea brings the dominant solution over the competition

Not Applicable



BUYER – How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations

The idea brings an expected solution to customers

The idea brings a solution above customer expectations

Not Applicable



**MARKET** – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market	The idea brings a solution in the rank of solutions on the market	The idea brings the solution above the expectations and needs of the market	Not Applicable
1  2 3 4 5 6 7 8 9			<input type="checkbox"/> 

## **FINANCIAL VALUE EVALUATION**

**SALES VOLUME** – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will negatively effect the sales volume of the product

The idea itself will not effect the sales volume of the product

The idea will positively effect the sales volume of the product

1  2 3 4 5 6 7 8 9



RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the rate of return on investment

1  2 3 4 5 6 7 8 9



PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will  
lengthen effect the payback time

not significantly affect the payback time

The idea will shorten the payback time

1

2

3

4

5

6

7

8

9

Not Applicable



## CUSTOMER VALUE EVALUATION

NECESSITY – How will users evaluate the necessity of the idea?

Users will remain neutral towards the need for the idea

Users will positively assess the need for the idea

1

2

3

4

5

6

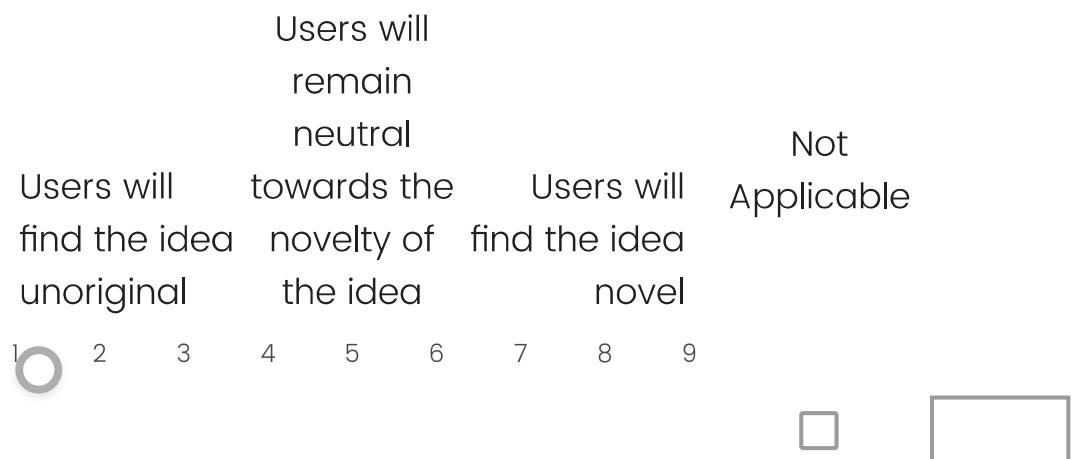
7

8

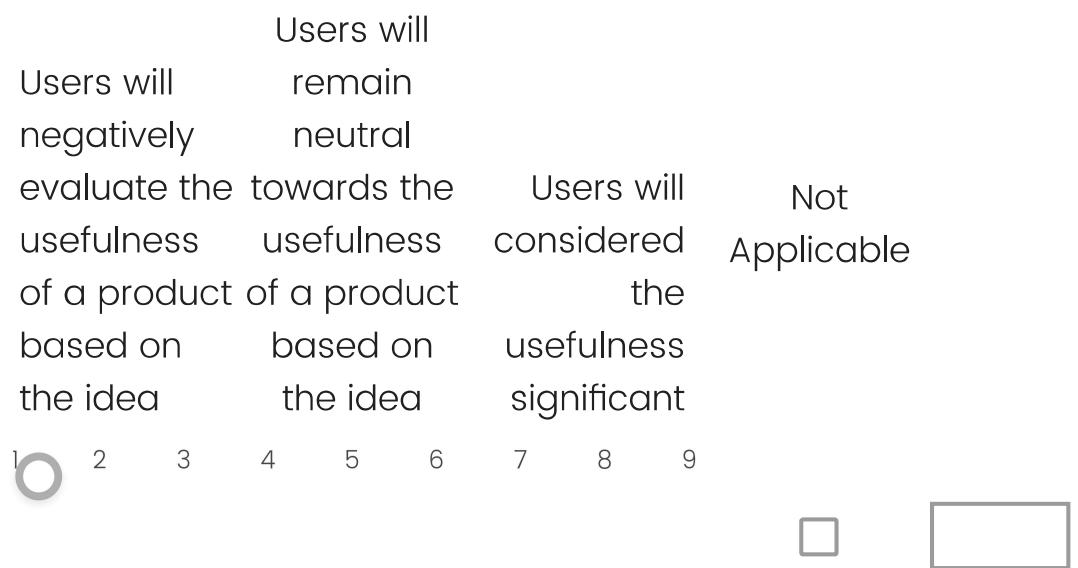
9



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?



## USABILITY – How will users evaluate the usability of products

## using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

1    2    3    4    5    6    7    8    9

Not Applicable



## SOCIAL VALUE EVALUATION

IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users

The idea will be on par with the expectations for importance of product's users

The idea will significantly contribute to increasing importance of products for users

1    2    3    4    5    6    7    8    9

Not Applicable



## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the product of the manufacturer

1      2      3      4      5      6      7      8      9

Not

Applicable



## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

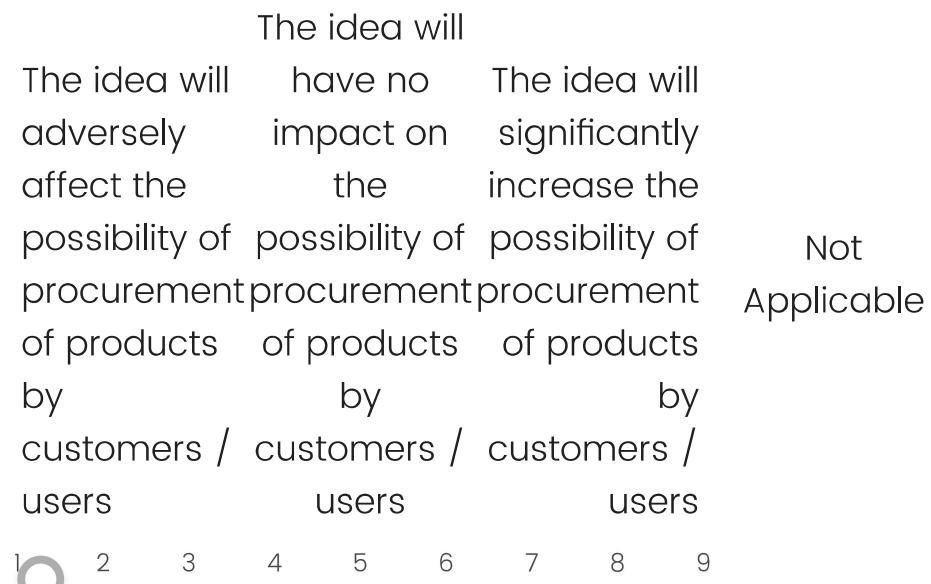
The idea will not have a substantial impact on commitment of the user to the product of the manufacturer

1      2      3      4      5      6      7      8      9

Not

Applicable

AFFORDABILITY - How much will the idea contribute to the affordability of a realised product compared to similar products?



Are there any additional positive aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **Communication Simplification Bot – Human**

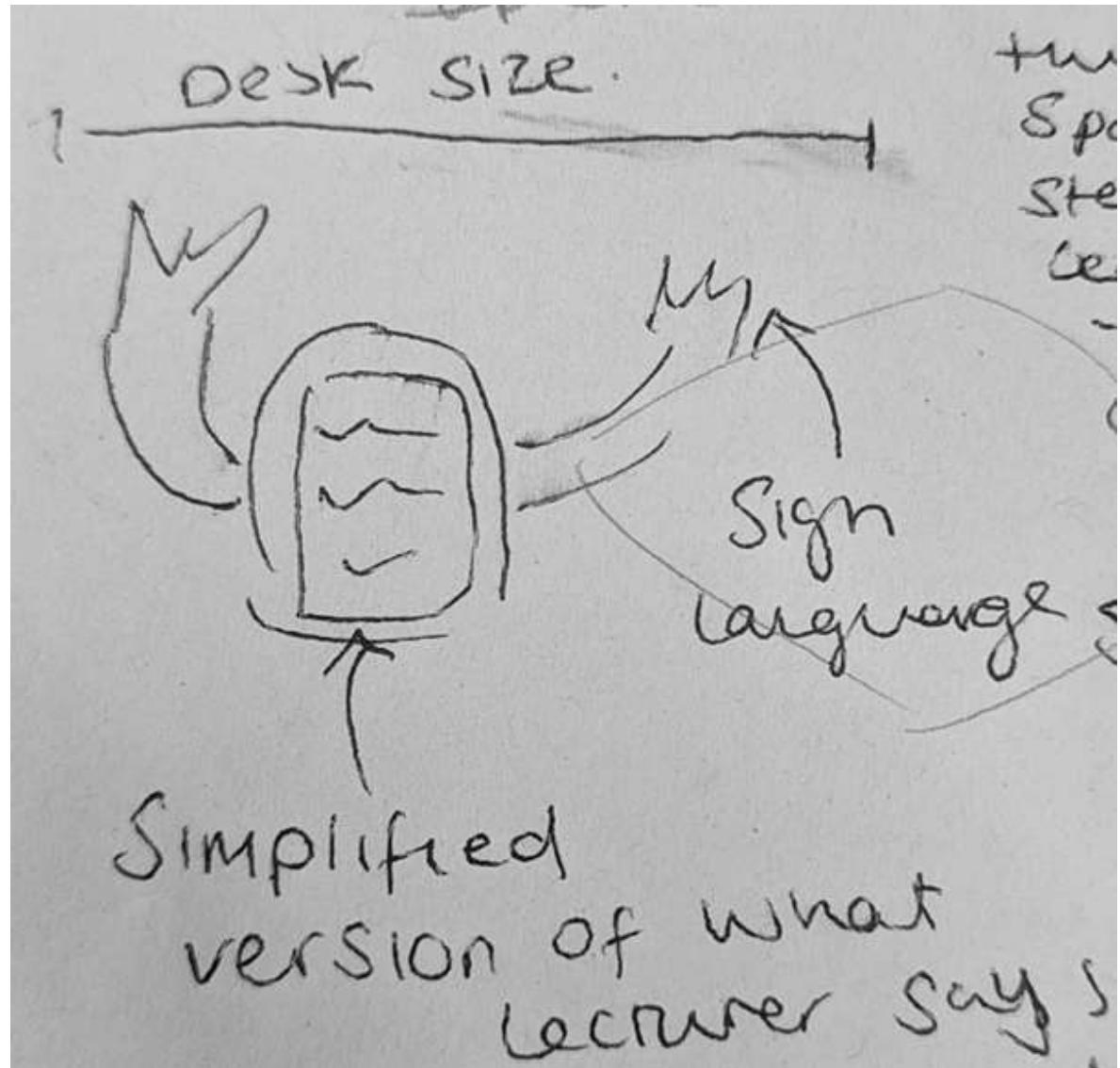
### **Idea to be evaluated**

**Idea Name:** Communication Simplification Bot

**Idea Description:** Ai generates a rewording of what a lecturer says in a lecture this is in subtitles or spoken out loud as majority of stem subjects no one understands what the lecturer says. Can able converted into sign language signalled by the robot. Students can customise Bot to be colourful and name it.

**Idea Justification:** Most stem teachers struggle to communicate ideas as they can't explain as if they don't understand anything. This will break the barrier between lecturer and student allowing different ways to learn. Its inclusive.

## Illustrations:



## **Question 7 – Communication Simplification Bot**

### **TECHNICAL/PRODUCTION VALUE EVALUATION**

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge or and ideas to improve our production

easily found knowledge

Not Applicable

1      2      3      4      5      6      7      8      9



FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea

The idea would not significantly reduce the functionality of the product in its original use context

would effect the functionality of the product in its original use context

improve the functionality of the product in its original use context

Not Applicable

1      2      3      4      5      6      7      8      9

**RELIABILITY** – How would the idea affect the reliability of a realised product compared to existing products?

The idea

The idea would not significantly reduce the reliability of the product

would effect the reliability of the product

improve the reliability of the product

Not Applicable

1      2      3      4      5      6      7      8      9

**SAFETY** – How would the idea affect the safety of a realised product compared to existing products?

<p>The idea would not significantly effect the safe of use of the product</p> <p><input checked="" type="radio"/> 1      2      3      4      5      6      7      8      9</p>	<p>The idea would improve the safety of the product</p> <p><input type="checkbox"/> Not Applicable</p>
---	--

## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

<p>The idea would have negative impact on environmental parameters (energy, pollution ...)</p> <p><input checked="" type="radio"/> 1      2      3      4      5      6      7      8      9</p>	<p>The idea would not significantly effect the environmental parameters</p> <p>The idea would contribute to the environmental characteristics of the product (green product)</p> <p><input type="checkbox"/> Not Applicable</p>
--	---

## AESTHETICS – How would the idea affect the aesthetics of a

realised product?

The idea would not significantly reduce the overall aesthetics of the product	The idea effect the overall aesthetics of the product	The idea improve the overall aesthetics of the product	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
	<input type="checkbox"/>		<input type="checkbox"/>					

## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition	The idea poses a solution on par with that of the competition	The idea brings the dominant solution over the competition	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
	<input type="checkbox"/>		<input type="checkbox"/>					

BUYER – How competitive is the idea with regards to customer expectations?

The idea  
brings a  
worse  
solution  
than  
customer  
expectations

The idea  
brings a  
solution  
above  
customer  
expectations

Not  
Applicable



**MARKET** – How would the idea compete against the expectations of the market?

The idea  
brings a  
worse  
solution  
than other  
solutions on  
the target  
market

The idea  
brings a  
solution in  
the rank of  
solutions on  
the market

The idea  
brings the  
solution  
above the  
expectations  
and needs  
of the  
market



## **FINANCIAL VALUE EVALUATION**

SALES VOLUME – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will negatively effect the sales volume of the product	The idea itself will not effect the sales volume of the product	The idea will positively effect the sales volume of the product	Not Applicable					
1 <input checked="" type="radio"/>	2	3	4	5	6	7	8	9



RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the rate of return on investment

1      2      3      4      5      6      7      8      9



## PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will not significantly affect the payback time

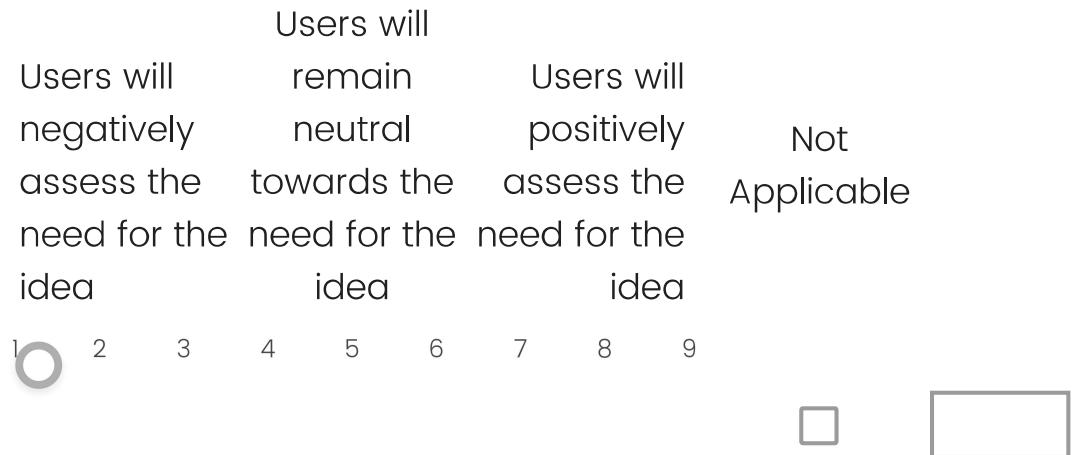
The idea will shorten the payback time

1      2      3      4      5      6      7      8      9

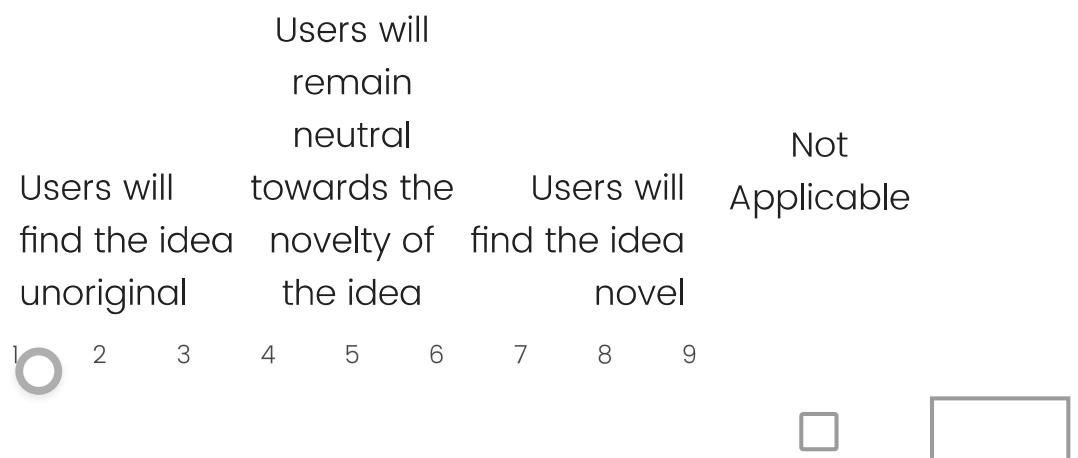


## CUSTOMER VALUE EVALUATION

## NECESSITY – How will users evaluate the necessity of the idea?



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?

Users will remain neutral towards the usefulness of a product based on the idea

Users will consider the usefulness significant

Not Applicable

1 2 3 4 5 6 7 8 9

## USABILITY – How will users evaluate the usability of products using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

Not Applicable

1 2 3 4 5 6 7 8 9

## SOCIAL VALUE EVALUATION

## IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users	The idea will be on par with the expectations for importance of the product's users	The idea will contribute to increasing importance of products for users	Not Applicable
1 	2    3    4    5    6    7    8    9	<input type="checkbox"/> 	

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the product	The idea will substantially raise the highlighting of ownership of the product (self-advertising)	Not Applicable
1    2    3    4    5    6    7    8    9		<input type="checkbox"/> 



## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the product of the manufacturer	The idea will significantly contribute to increase the product of the manufacturer	Not Applicable
---	--	--	----------------

1 2 3 4 5 6 7 8 9



## AFFORDABILITY – How much will the idea contribute to the affordability of a realised product compared to similar products?

The idea will

The idea will have no The idea will  
adversely impact on significantly  
affect the the increase the  
possibility of possibility of possibility of  
procurement procurement procurement Not  
of products of products of products Applicable  
by by by  
customers / customers / customers /  
users users users

1      2      3      4      5      6      7      8      9

Are there any additional positive aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

Powered by Qualtrics

## **Introduction**

# **Using MetaGPT for Product Innovation – Evaluation Form**

**Level 4 Project 23/24**

**Daniel Flynn 2469113f@student.gla.ac.uk**

The aim of this experiment is to investigate how well the GPT-4 LLM supported by a meta-framework performs at product innovation and evaluation. We cannot evaluate the quality of the ideas generated and the evaluations performed without a baseline for comparison. This is why we have asked you, as an expert in your field, to evaluate a product idea which will either be AI generated or created by a design student.

When you press next page, you will be presented with a product idea name, description, and justification. Press next page again and you will be presented with an evaluation form for you to complete. You must complete the 1-to-9 scale questions to proceed, but the text-entry questions are entirely optional. The scale questions have a not

applicable option you can use if you believe the question is not suitable to the idea, or if you have cannot hypothesise what the effect will be. Non-applicable responses will generally be treated as neutral in analysis. Attempts at answering are always preferred, even if you are uncertain. There is no time limit on the evaluation. You can go back and review the product idea or change your answers at any point.

If you have any questions or require any additional information, please direct an email to [2469113f@student.gla.ac.uk](mailto:2469113f@student.gla.ac.uk). All answers will be analysed using a mixture of both qualitative and quantitative methods. Please remember that it is the system, not your own evaluation opinions, that is being tested. While completion of an entire evaluation form is required for your answers to be used, you are welcome to withdraw from the experiment at any time. Do you agree to taking part in this experiment? If so please sign below:

x

**SIGN HERE**

---

clear

## Block 8

# Original Scenario

### Background Information:

**Company Name:** Portabread

**Company Profile:** Portabread is a product design brand which specialises in producing kitchen appliances which can be used within the customer's kitchen or on the go whether that is out on an adventure or travelling to work. The brand has many product avenues but the most advanced products are within the toaster, kettle and microwave product industries.

**Company Mission:** Portabread's mission is to give its customers the ability to choose how and where they make their breakfast whether that is at home or on the road. We won't be held back by cords

**Current Product Range:** Portable toasters, microwaves and kettles

### Product Brief:

**Original Product:** Portabread would like to explore and reimagine the original vegetable hand peeler which can be time consuming, messy and occasionally leads to accidents when used for long periods of time.

**Target Audience:** Intended consumer group would be an avid cook and love spending time in the kitchen but loves sharing that time with friends and family as well

**Suggested Features:** Potential features could range from hands free to vegetable scale sensing. Ideally, all concepts should have an end of life consideration whether that be remanufacturability or recyclability. An added bonus would be if the product could be scaled up for industrial level food preparation.

**Requirements:** The product must have some kind of safety feature which prevents accidents

### Constraints:

**Budget:** The budget for the initial development of the project must not exceed £15,000. Labour and manufacturing costs can be excluded from budget for now.

**Timeframe:** Timeframe for the project will be 6 months from concept generation to manufacturing and then onto the shelf.

**Technical and Legal Constraints:** Any design or product must not infringe on patents or copy from existing products in this category already on the market.

## Rotopeel - Human

# Idea to be evaluated

**Idea Name:** Rotopeel

**Idea Description:** This vegetable peeler will create ribbons of vegetables using a hand cranked mechanism. This mechanism will push the vegetable down on the metal blade while rotating the vegetable, creating lots of scrap strands. These strands will collect inside the container connected to the peeler which can be removed to easily discard the peelings. The rotating aspect will take the hand away from the blade, minimising the risk of injury. The blade will be easily replaceable, extending the life of the product.

**Idea Justification:** The product addresses all the needs of the peeler by being both a on the go/at home product. The rotating arm addresses its safety requirement and the replaceable blades increases the product life. The simplicity of the design will allow the design process to be completed efficiently and <£15000

## Questions 1 – Rotopeel

### TECHNICAL/PRODUCTION VALUE EVALUATION

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products	We have the necessary resources or and ideas to improve our production easily found	We have the resources, necessary knowledge to improve our production	Not Applicable
---	---	--	----------------

1      2      3      4      5      6      7      8      9





FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea			The idea			Not Applicable		
The idea would significantly reduce the functionality of the product in its original use context	would not effect the functionality of the product in its original use context	improve the functionality of the product in its original use context						
1	2	3	4	5	6	7	8	9



RELIABILITY – How would the idea affect the reliability of a realised product compared to existing products?

The idea would not significantly reduce the reliability of the product

The idea would improve the reliability of the product

1    2    3    4    5    6    7    8    9



Not  
Applicable

SAFETY – How would the idea affect the safety of a realised product compared to existing products?

The idea would not significantly effect the safe of use of the product

The idea would improve the safety of the product

1    2    3    4    5    6    7    8    9



Not  
Applicable

ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

The idea would have negative impact on environmental parameters (energy, pollution ...)	The idea would not significantly effect the environmental parameters	The idea the environmental characteristics effect the of the product (green product)	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
	<input type="checkbox"/>		<input type="checkbox"/>					

## AESTHETICS – How would the idea affect the aesthetics of a realised product?

The idea would not significantly effect the overall aesthetics of the product	The idea would improve the overall aesthetics of the product	Not Applicable						
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
	<input type="checkbox"/>		<input type="checkbox"/>					

## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition

The idea poses a solution on par with that of the competition

The idea brings the dominant solution over the competition

Not Applicable

1  2 3 4 5 6 7 8 9



BUYER – How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations

The idea brings an expected solution to customers

The idea brings a solution above customer expectations

Not Applicable

1  2 3 4 5 6 7 8 9



**MARKET** – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market	The idea brings a solution in the rank of solutions on the market	The idea brings the solution above the expectations and needs of the market	Not Applicable
1 	2    3    4    5    6    7    8    9	<input type="checkbox"/>	<input type="checkbox"/>

## **FINANCIAL VALUE EVALUATION**

**SALES VOLUME** – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will negatively effect the sales volume of the product

The idea itself will not effect the sales volume of the product

The idea will positively effect the sales volume of the product

1      2      3      4      5      6      7      8      9



RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the rate of return on investment

1      2      3      4      5      6      7      8      9



PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will  
lengthen effect the payback time

The idea will not significantly affect the payback time

The idea will shorten the payback time

1

2

3

4

5

6

7

8

9

Not Applicable



## CUSTOMER VALUE EVALUATION

NECESSITY – How will users evaluate the necessity of the idea?

Users will remain neutral towards the need for the idea

Users will positively assess the need for the idea

1

2

3

4

5

6

7

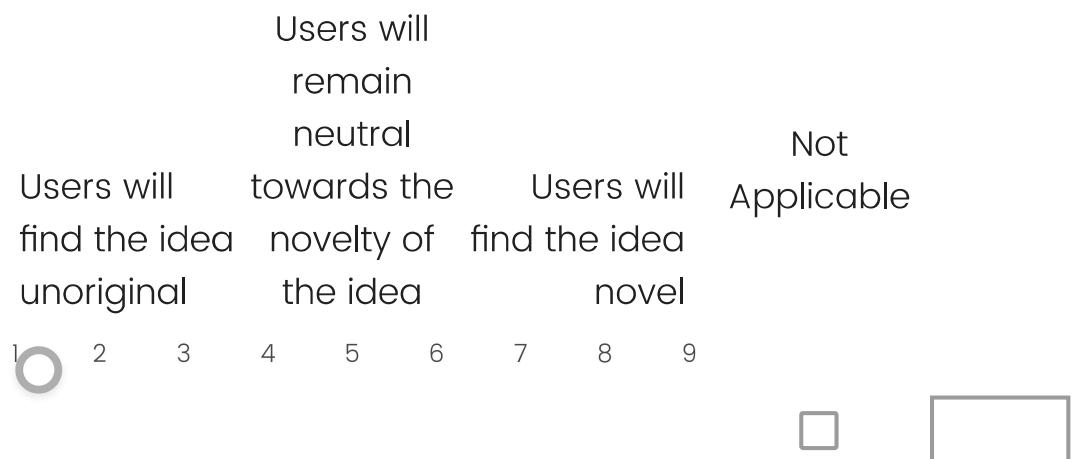
8

9

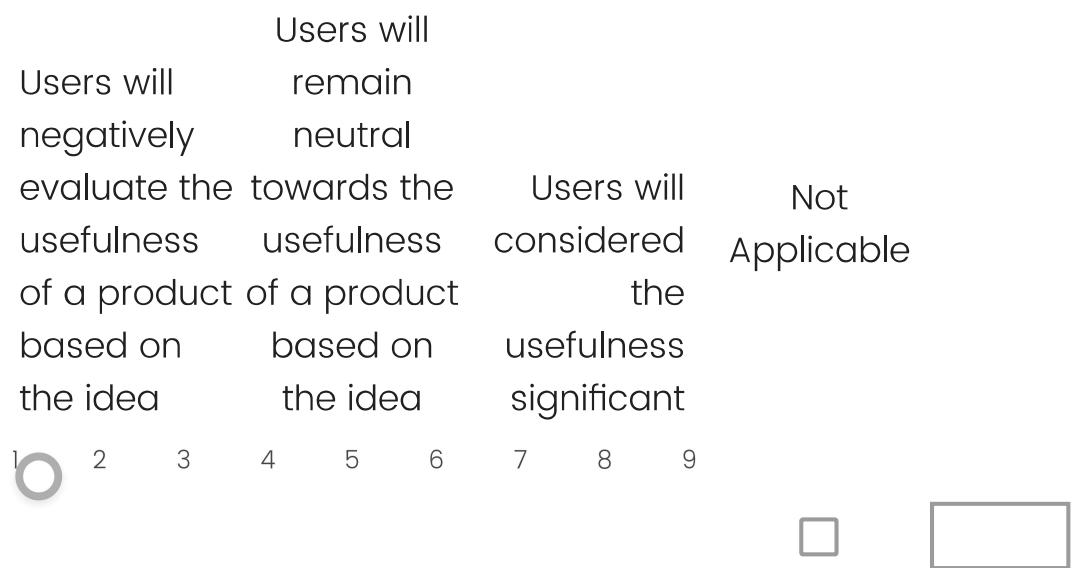
Not Applicable



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?



## USABILITY – How will users evaluate the usability of products

## using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

1    2    3    4    5    6    7    8    9

Not Applicable



## SOCIAL VALUE EVALUATION

IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users

The idea will be on par with the expectations for importance of product's users

The idea will significantly contribute to increasing importance of products for users

1    2    3    4    5    6    7    8    9

Not Applicable



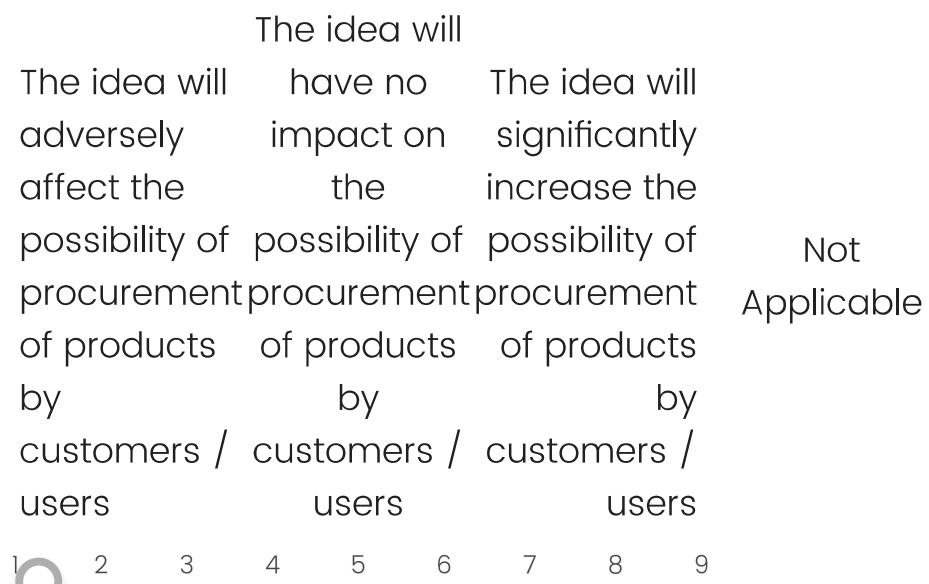
## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral	The idea will substantially raise the highlighting of ownership of the product (self-advertising)	Not Applicable
The idea will highlight the possession of the product negatively towards the possession of the product		
1 <input checked="" type="radio"/>	2    3    4    5    6    7    8    9	<input type="checkbox"/> <input type="text"/>

## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will affect the commitment of the user to the product of the manufacturer negatively	The idea will not have a substantial impact on the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable
1    2    3    4    5    6    7    8    9			

AFFORDABILITY - How much will the idea contribute to the affordability of a realised product compared to similar products?



Are there any additional positive aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **SharpVeg - Human**

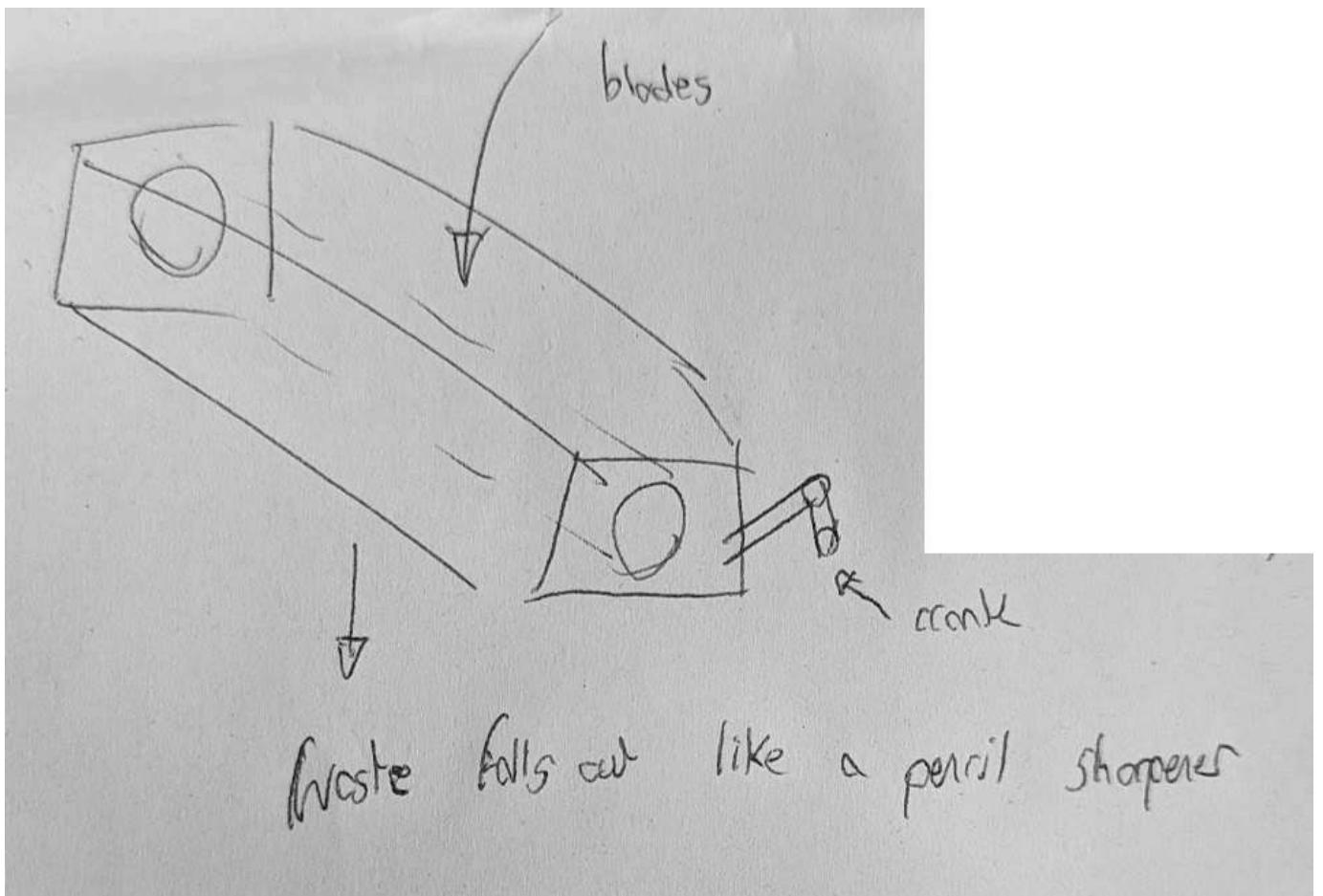
# **Idea to be evaluated**

**Idea Name:** SharpVeg

**Idea Description:** A box that you place the vegetable in. Have a crank that you can pierce the vegetable with and rotate it. As it grazes against the blades in the box it gets peeled gradually (similar to a pencil sharpener). The box has a hole at either side (the size of the funnel) that can be changed to accommodate different veg

**Idea Justification:** This idea removes the need to use your arm for peeling and transmits the mechanical power using a crank which is much easier for the user. The change in size makes it adaptable.

**Illustrations:**



## Questions 2 – SharpVeg

### TECHNICAL/PRODUCTION VALUE EVALUATION

## PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge for the resources or and ideas to improve our production

such products can be easily found

knowledge

1    2    3    4    5    6    7    8    9



## FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea would not significantly reduce the functionality of the product in its original use context

The idea would effect the functionality of the product in its original use context

The idea would improve the functionality of the product in its original use context

1    2    3    4    5    6    7    8    9





RELIABILITY – How would the idea affect the reliability of a realised product compared to existing products?

The idea would not significantly effect the reliability of the product

The idea would improve the reliability of the product

Not Applicable

1  2 3 4 5 6 7 8 9



SAFETY – How would the idea affect the safety of a realised product compared to existing products?

The idea would not significantly effect the safe of use of the product

The idea would improve the safety of the product

Not Applicable

1  2 3 4 5 6 7 8 9



## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

The idea would have negative impact on environmental parameters (energy, pollution ...)	The idea would not significantly effect the environmental parameters	The idea the environmental characteristics of the product (green product)	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



## AESTHETICS – How would the idea affect the aesthetics of a realised product?

The idea would not significantly effect the overall aesthetics of the product	The idea would improve the overall aesthetics of the product	Not Applicable						
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>





## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition

The idea poses a solution on par with that of the competition

The idea brings the dominant solution over the competition

Not Applicable



2

3

4

5

6

7

8

9



BUYER – How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations	The idea brings an expected solution to customers	The idea brings a solution above customer expectations	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9



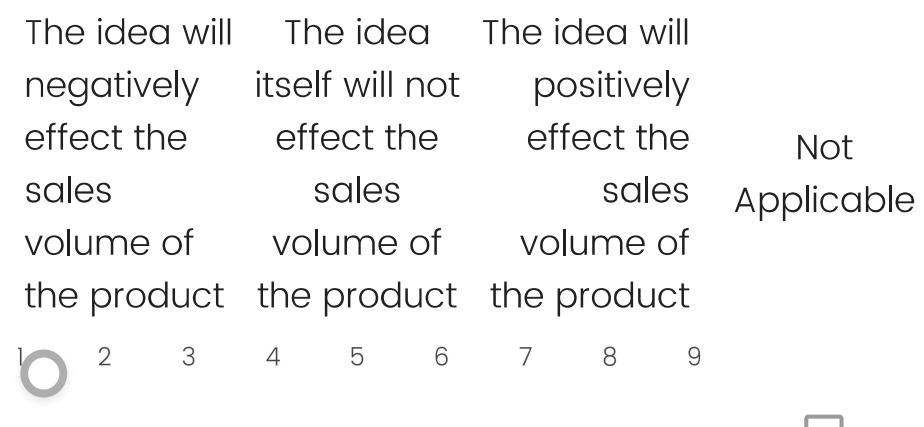
## MARKET – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market	The idea brings a solution in the rank of solutions on the market	The idea brings the solution above the expectations and needs of the market	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9

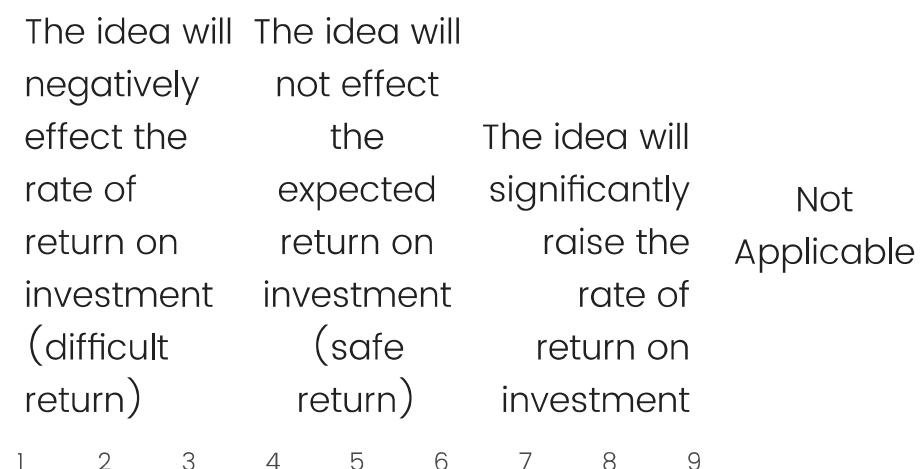


## FINANCIAL VALUE EVALUATION

SALES VOLUME – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

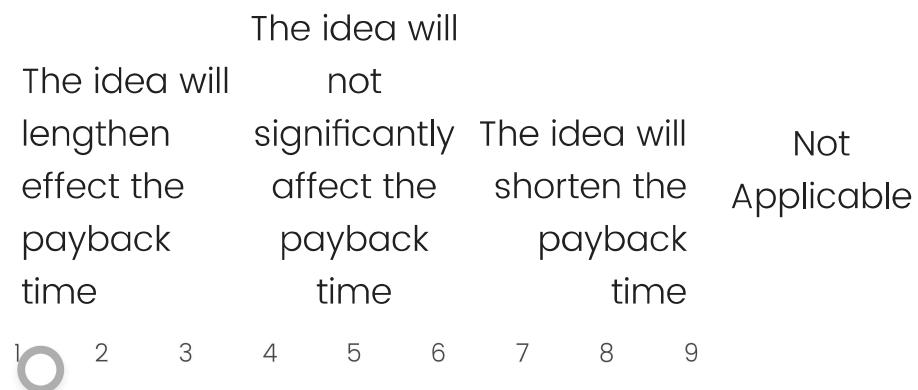


RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?



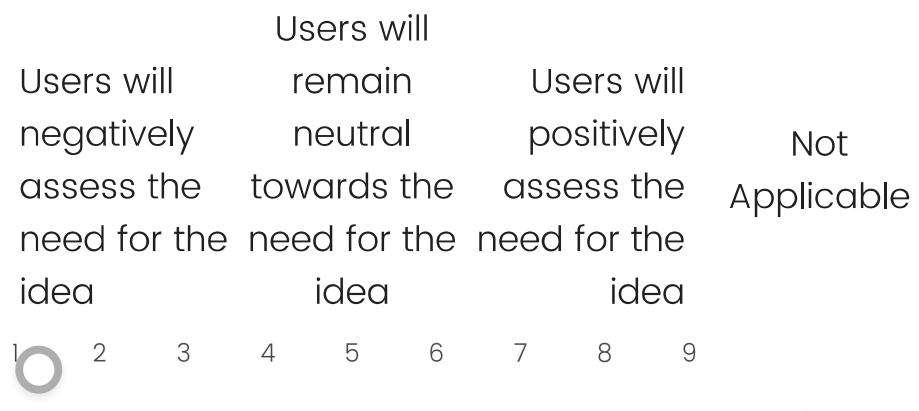


PAYBACK TIME - How will the idea affect the payback time for a realised product compared to existing products?

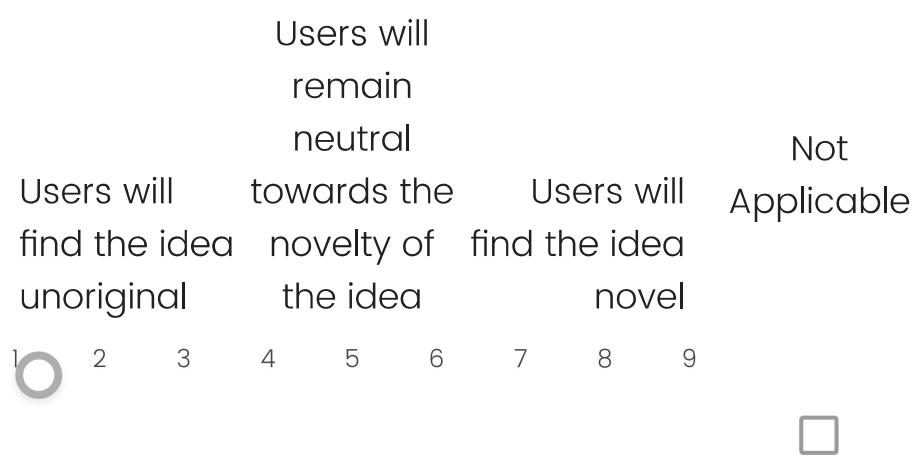


## CUSTOMER VALUE EVALUATION

NECESSITY - How will users evaluate the necessity of the idea?



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?

Users will remain neutral towards the usefulness of a product based on the idea

Users will consider the usefulness significant

Not Applicable

1 2 3 4 5 6 7 8 9

## USABILITY – How will users evaluate the usability of products using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

Not Applicable

1 2 3 4 5 6 7 8 9

## SOCIAL VALUE EVALUATION

## IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users

The idea will be on par with the expectations for importance for product's users

The idea will significantly contribute to increasing importance of products for users

Not Applicable

1    2    3    4    5    6    7    8    9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the possession of the product

The idea will highlight the negative highlighting of the possession of the product

The idea will substantially raise the highlighting of ownership of the product (self-advertising)

Not Applicable

1    2    3    4    5    6    7    8    9



## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the user to the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable
---	--	--	----------------

1      2      3      4      5      6      7      8      9



## AFFORDABILITY – How much will the idea contribute to the affordability of a realised product compared to similar products?

The idea will

The idea will have no The idea will  
adversely impact on significantly  
affect the the increase the  
possibility of possibility of possibility of  
procurement procurement procurement Not  
of products of products of products Applicable  
by by by  
customers / customers / customers /  
users users users

1      2      3      4      5      6      7      8      9



Are there any additional positive aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **Removable Blade for Maintenance – MetaGPT**

### **Idea to be evaluated**

**Idea name:** Removable Blade for Maintenance

**Idea description:** The idea involves designing a peeler with a removable blade mechanism to facilitate easy maintenance and blade replacement. Users can detach the blade unit for cleaning, sharpening, or replacement as needed, ensuring optimal peeling performance over time. This feature promotes longevity and efficiency of the peeler, allowing users to maintain the device easily without requiring specialized tools.

**Idea justification:** The Removable Blade for Maintenance simplifies maintenance, ensuring optimal performance and longevity, which are key factors for user satisfaction. The emphasis on easy maintenance promotes user responsibility and care for the product, enhancing the overall ownership experience. Additionally, the idea encourages users to actively maintain the peeler, leading to prolonged product usage and satisfaction. The affordability aspect is also addressed, as the removable blade design facilitates cost-effective maintenance, contributing to the peeler's durability and value over time. The concept adds practical value by enabling users to maintain optimal peeling performance through easy cleaning, sharpening, and replacement, enhancing the peeler's efficiency and lifespan. The idea stands out in terms of competition, usability, and market trends, offering a strong value proposition in the peeler category. While there may be slight impacts on sales volume and return rate, the benefits in terms of functionality, reliability, and safety make it a well-rounded improvement for the product.

## **Questions 3 – Removable Blade for Maintenance**

### **TECHNICAL/PRODUCTION VALUE EVALUATION**

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of products	We have the necessary resources, necessary knowledge or and ideas to improve our production	Not Applicable
<input checked="" type="radio"/>	2    3    4    5    6    7    8    9	<input type="checkbox"/> <input type="checkbox"/>

FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea

The idea would not significantly reduce the functionality of the product in its original use context

would effect the functionality of the product in its original use context

improve the functionality of the product in its original use context

The idea would improve the functionality of the product in its original use context

Not Applicable

1      2      3      4      5      6      7      8      9

**RELIABILITY** – How would the idea affect the reliability of a realised product compared to existing products?

The idea

The idea would not significantly reduce the reliability of the product

would effect the reliability of the product

improve the reliability of the product

The idea would improve the reliability of the product

Not Applicable

1      2      3      4      5      6      7      8      9

**SAFETY** – How would the idea affect the safety of a realised product compared to existing products?

The idea would not significantly effect the safe of use of the product	The idea would improve the safety of the product	Not Applicable
<input checked="" type="radio"/> 1	2    3    4    5    6    7    8    9	<input type="checkbox"/> <input type="text"/>

## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

The idea would have negative impact on environmental parameters (energy, pollution ...)	The idea would not significantly effect the environmental parameters	The idea would contribute to the environmental characteristics of the product (green product)	Not Applicable
<input checked="" type="radio"/> 1	2    3    4    5    6    7    8    9	<input type="checkbox"/> <input type="text"/>	

## AESTHETICS – How would the idea affect the aesthetics of a

realised product?

The idea would not significantly reduce the overall aesthetics of the product	The idea effect the overall aesthetics of the product	The idea improve the overall aesthetics of the product	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
<input type="checkbox"/>	<input type="checkbox"/>							

## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition	The idea poses a solution on par with that of the competition	The idea brings the dominant solution over the competition	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9
<input type="checkbox"/>	<input type="checkbox"/>							

BUYER – How competitive is the idea with regards to customer expectations?

The idea  
brings a  
worse  
solution  
than  
customer  
expectations

The idea  
brings an  
expected  
solution to  
customers

The idea  
brings a  
solution  
above  
customer  
expectations

Not  
Applicable



**MARKET** – How would the idea compete against the expectations of the market?

The idea  
brings a  
worse  
solution  
than other  
solutions on  
the target  
market

The idea  
brings a  
solution in  
the rank of  
solutions on  
the market

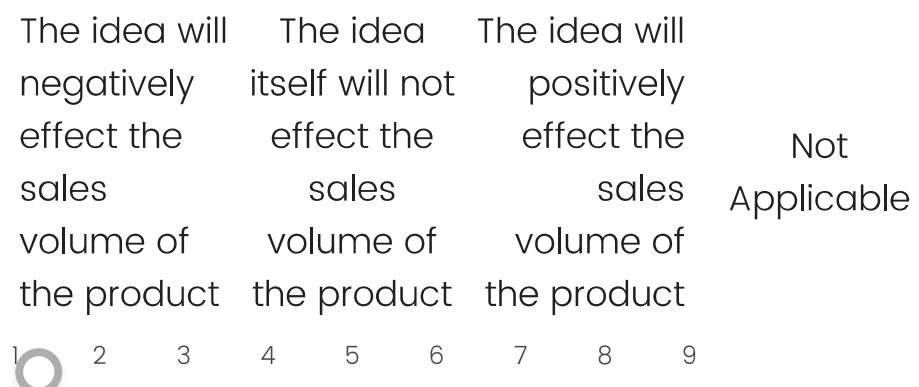
The idea  
brings the  
solution  
above the  
expectations  
and needs  
of the  
market

Not  
Applicable



## **FINANCIAL VALUE EVALUATION**

**SALES VOLUME** – What impact will the idea have on the expected sales volume of a realised product compared to existing products?



**RATE OF RETURN** – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the rate of return on investment

1      2      3      4      5      6      7      8      9



## PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will not significantly affect the payback time

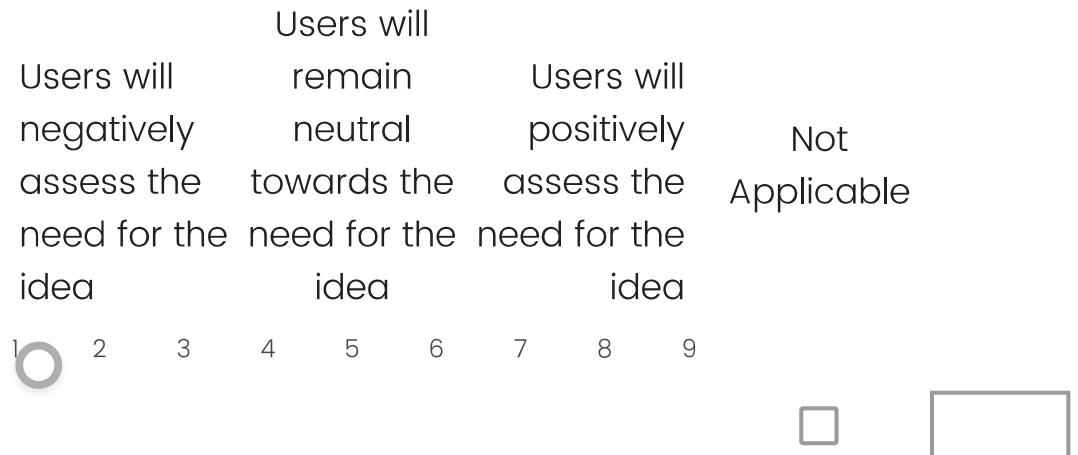
The idea will shorten the payback time

1      2      3      4      5      6      7      8      9

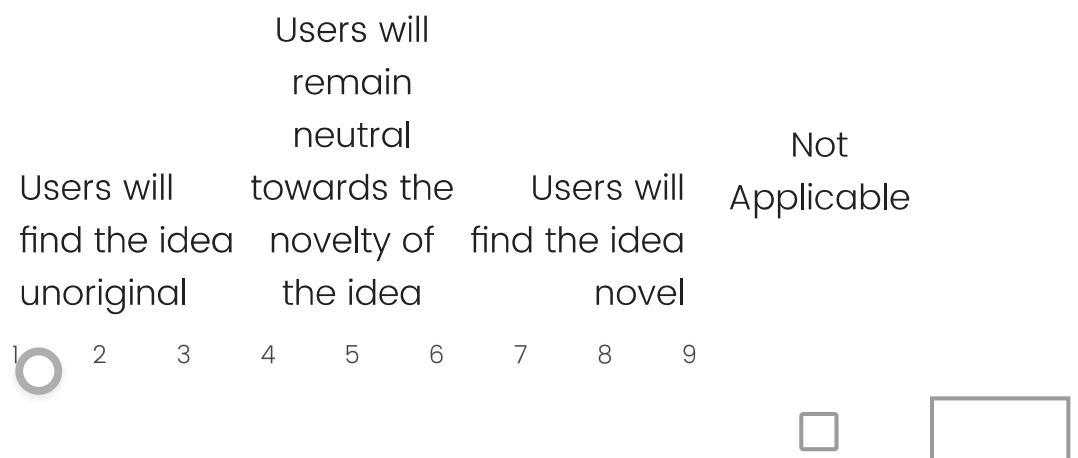


## CUSTOMER VALUE EVALUATION

## NECESSITY – How will users evaluate the necessity of the idea?



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?

Users will remain neutral towards the usefulness of a product based on the idea

Users will consider the usefulness significant

Not Applicable

1      2      3      4      5      6      7      8      9



## USABILITY – How will users evaluate the usability of products using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

Not Applicable

1      2      3      4      5      6      7      8      9



## SOCIAL VALUE EVALUATION

## IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users

The idea will be on par with the expectations for importance for product's users

The idea will significantly contribute to increasing importance of products for users

Not Applicable

1      2      3      4      5      6      7      8      9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the possession of the product

The idea will highlight the negative highlighting of the possession of the product

The idea will substantially raise the highlighting of ownership of the product (self-advertising)

Not Applicable

1      2      3      4      5      6      7      8      9



## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable
The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable

1  2 3 4 5 6 7 8 9



## AFFORDABILITY – How much will the idea contribute to the affordability of a realised product compared to similar products?

The idea will

The idea will have no The idea will  
adversely impact on significantly  
affect the the increase the  
possibility of possibility of possibility of  
procurement procurement procurement Not  
of products of products of products Applicable  
by by by  
customers / customers / customers /  
users users users

1      2      3      4      5      6      7      8      9



Are there any additional positive aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **AutoPeel – MetaGPT**

# **Idea to be evaluated**

**Idea name:** AutoPeel

**Idea description:** "AutoPeel is a hands-free vegetable peeler designed to address the time-consuming nature of peeling. The device would use a small electric motor to rotate the vegetable while a stationary blade peels the skin off. The user would simply need to insert the vegetable into the device and press a button to start the peeling process. The peeler would be equipped with sensors to adjust the peeling pressure according to the vegetable's size and hardness, ensuring efficient peeling without waste. The device would be made from durable, easy-to-clean materials and feature a safety lock to prevent accidental activation. The peeler would also include a cover for the blade. It would be powered by a rechargeable battery and come with a USB charging cable, making it portable and easy to use anywhere. The peeler would be made from recyclable materials, aligning with the company's commitment to sustainability."

**Idea justification:** AutoPeel is a practical, safe, and convenient peeling experience. AutoPeel's hands-free feature could lead to high sales volume, high rate of return, and short payback time. AutoPeel has potential to be competitive and meet customer and market expectations, but its complexity and potential cost could limit its appeal. AutoPeel shows promise in terms of productivity, functionality, and safety, but there are concerns about reliability and environmental impact. The hands-free operation will appeal to customers who value convenience, but the product's complexity may deter less tech-savvy customers. The market for kitchen appliances is increasingly leaning towards automation and convenience, which AutoPeel caters to. However, its success may be limited by its potential higher price point due to its advanced features. The use of recyclable materials aligns with the company's commitment to sustainability, but the reliance on a rechargeable battery could have environmental implications depending on the type of battery used.

## **Questions 4 - AutoPeel**

### **TECHNICAL/PRODUCTION VALUE EVALUATION**

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge or and ideas to improve our production

Not Applicable

1  2 3 4 5 6 7 8 9

FUNCTIONALITY – How would the idea affect the functionality

of a realised product compared to existing products?

	The idea would not significantly reduce the functionality of the product in its original use context	The idea would effect the functionality of the product in its original use context	The idea improve the functionality of the product in its original use context	Not Applicable
The idea would reduce the functionality of the product in its original use context				

1  2 3 4 5 6 7 8 9



Not  
applicable

**RELIABILITY** – How would the idea affect the reliability of a realised product compared to existing products?

	The idea would not significantly reduce the reliability of the product	The idea would improve the reliability of the product	
The idea would significantly reduce the reliability of the product	Not Applicable		

1 2 3 4 5 6 7 8 9



Not  
applicable



## SAFETY – How would the idea affect the safety of a realised product compared to existing products?

The idea  
would not  
significantly  
effect the  
safe of use  
of the  
product

The idea  
would  
improve the  
safety of the  
product

Not  
Applicable

1      2      3      4      5      6      7      8      9



## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

The idea  
would have  
negative  
impact on  
environmental  
parameters  
(energy,  
pollution ...)

The idea  
would not  
significantly  
effect the  
environmental  
parameters

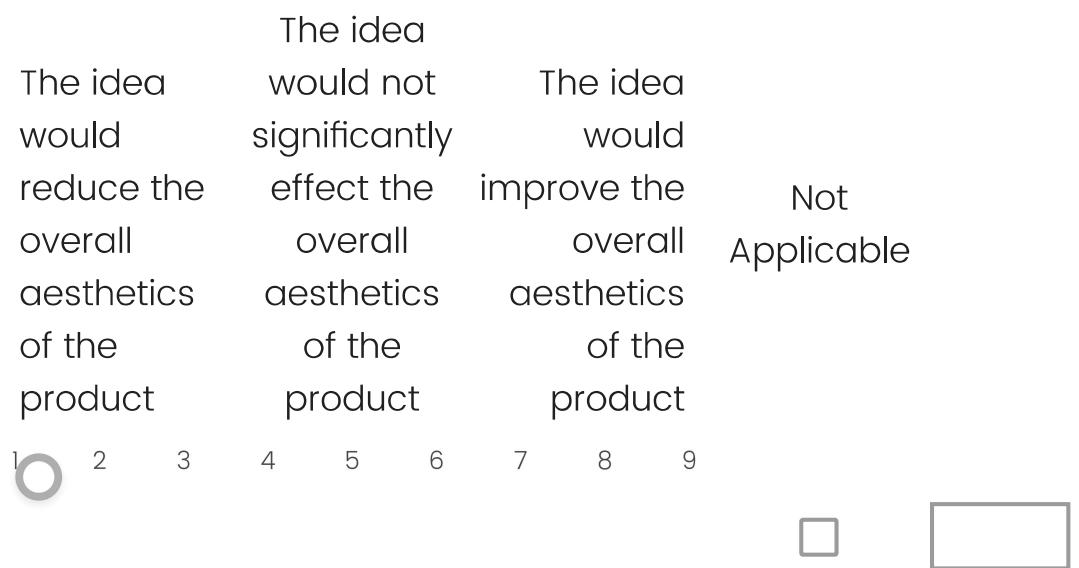
The idea  
would  
contribute to  
the  
environmental  
characteristics  
of the product  
(green  
product)

Not  
Applicable

1      2      3      4      5      6      7      8      9



## AESTHETICS – How would the idea affect the aesthetics of a realised product?



## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition

The idea poses a solution on par with that of the competition

The idea brings the dominant competition

1

2

3

4

5

6

7

8

9

Not

Applicable



## BUYER – How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations

The idea brings an expected solution to customers

The idea brings a solution above customer expectations

1

2

3

4

5

6

7

8

9

Not

Applicable



## MARKET – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market

The idea brings a solution in the rank of solutions on the market

1

2

3

4

5

6

7

8

9

The idea brings the solution above the expectations and needs of the market

Not

Applicable



## FINANCIAL VALUE EVALUATION

SALES VOLUME – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will negatively effect the sales volume of the product

The idea itself will not effect the sales volume of the product

The idea will positively effect the sales volume of the product

1

2

3

4

5

6

7

8

9



RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will  
negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the return on investment

1      2      3      4      5      6      7      8      9



PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will  
lengthen effect the payback time

The idea will not significantly affect the payback time

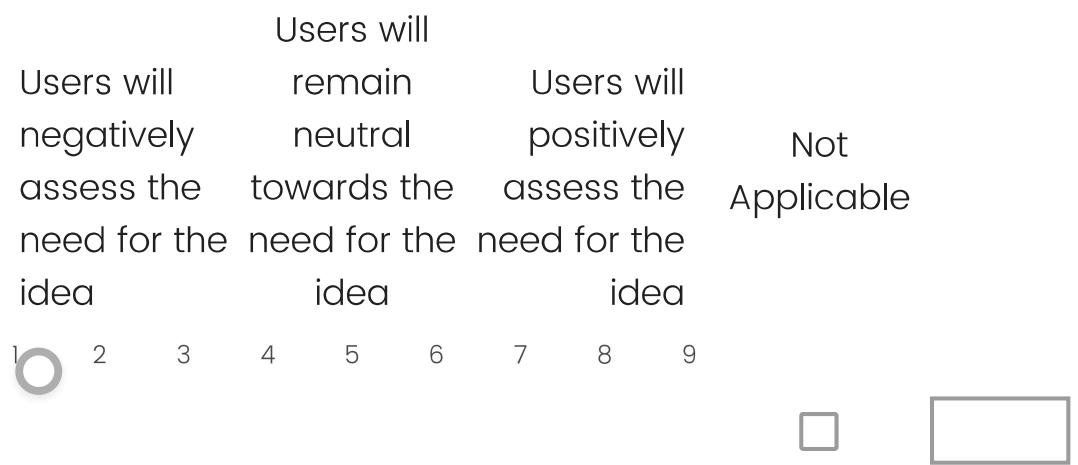
The idea will shorten the payback time

1      2      3      4      5      6      7      8      9

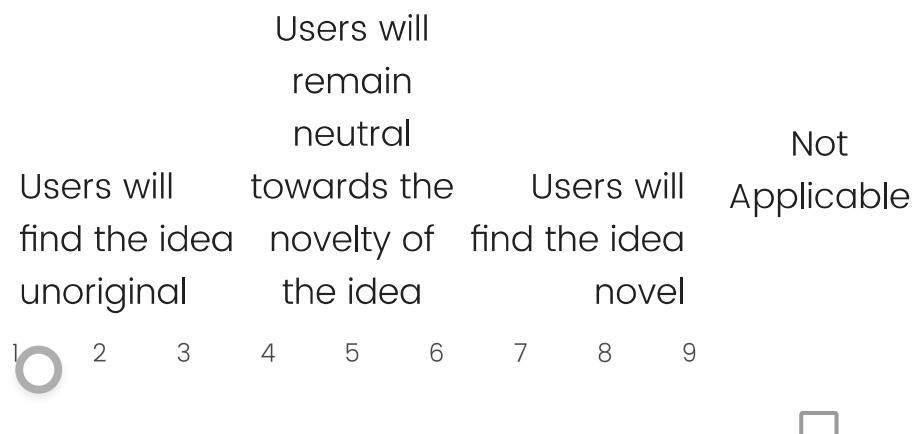


## CUSTOMER VALUE EVALUATION

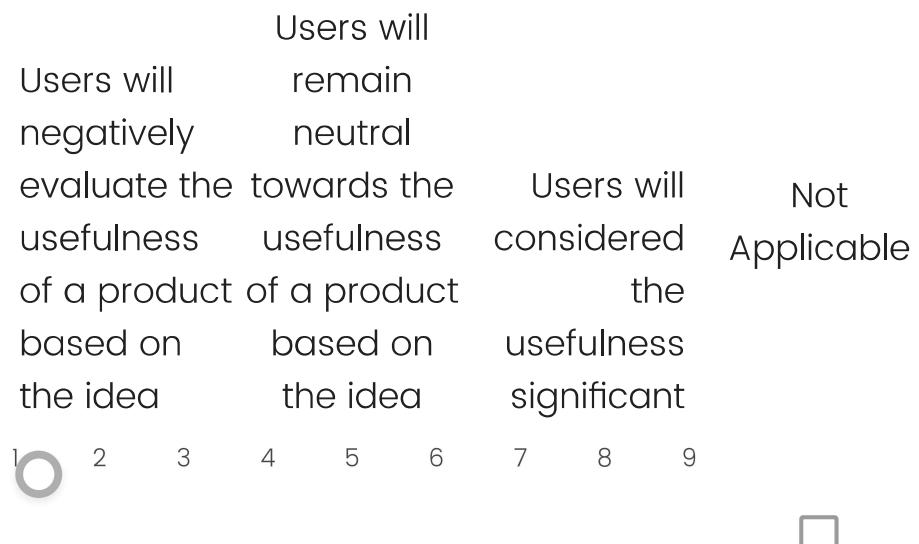
NECESSITY – How will users evaluate the necessity of the idea?



NOVELTY – How will users evaluate the novelty of the idea?



**USEFULNESS** – How will users evaluate the usefulness of a realised product using the idea?



**USABILITY** – How will users evaluate the usability of products using the idea?

<p>Users will negatively evaluate the usability of a product based on the idea</p>	<p>Users will remain neutral toward the usability of the product</p>	<p>The idea brings a substantial increase in the usability of the product</p>	<p>Not Applicable</p>					
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
1	2	3	4	5	6	7	8	9

## SOCIAL VALUE EVALUATION

**IMPORTANCE** – How much will the idea contribute to the importance of a realised product to users

<p>The idea would adversely affect the significance of the product for users</p>	<p>The idea will be on par with the expectations for importance of the product for users</p>	<p>The idea will significantly contribute to increasing importance of products for users</p>	<p>Not Applicable</p>					
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
1	2	3	4	5	6	7	8	9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the product of the manufacturer

1      2      3      4      5      6      7      8      9

Not Applicable

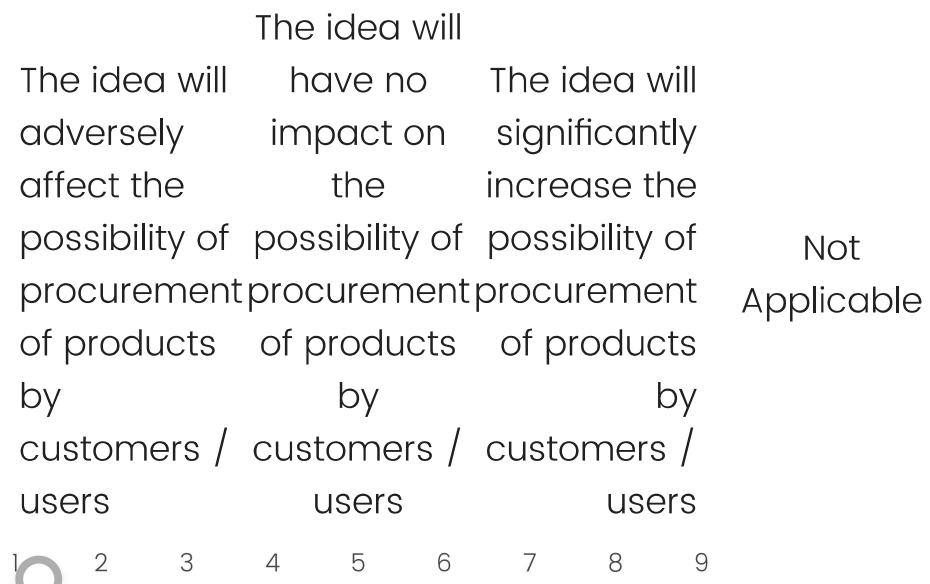
## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will not have a substantial impact on commitment of the user to the product of the manufacturer

1      2      3      4      5      6      7      8      9

Not Applicable

AFFORDABILITY - How much will the idea contribute to the affordability of a realised product compared to similar products?



Are there any additional positive aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **Veggie Shredder – Human**

# **Idea to be evaluated**

**Idea Name:** Veggie Shredder

**Idea Description:** A box like device where un-peeled vegetables can be preloaded before a machine automatically peels them one at a time. The peelings + peeled vegetables would then be drop into separate compartments for easy use (veg) or disposal/composting (peelings). The mechanism would be similar to a shredder (for notes or branches) and would need to be plugged into the wall

**Idea Justification:** Completely enclosed: Fingers cant reach sharp moving parts. Automated machine: Less time consuming/hands free. Size can be as big as you want: Opportunity to scale up for industry. Assembled with screws and no glue: Right to repair to improve end of life plan.

## **Questions 5 – Veggie Shredder**

### **TECHNICAL/PRODUCTION VALUE EVALUATION**

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge resources or and ideas to improve our production

easily found knowledge

Not Applicable

1

2

3

4

5

6

7

8

9



## FUNCTIONALITY - How would the idea affect the functionality of a realised product compared to existing products?

The idea			The idea					
The idea would reduce the functionality of the product in its original use context	would not significantly effect the functionality of the product in its original use context	improve the functionality of the product in its original use context	The idea would improve the functionality of the product in its original use context			Not Applicable		
1	2	3	4	5	6	7	8	9

## RELIABILITY - How would the idea affect the reliability of a realised product compared to existing products?

The idea			The idea					
The idea would reduce the reliability of the product	would not significantly effect the reliability of the product	improve the reliability of the product	The idea would improve the reliability of the product			Not Applicable		
1	2	3	4	5	6	7	8	9

## SAFETY – How would the idea affect the safety of a realised product compared to existing products?

The idea  
would not  
significantly  
effect the  
safe of use  
of the  
product

The idea  
would  
improve the  
safety of the  
product

Not  
Applicable

1      2      3      4      5      6      7      8      9



## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

The idea  
would have  
negative  
impact on  
environmental  
parameters  
(energy,  
pollution ...)

The idea  
would not  
significantly  
effect the  
environmental  
parameters

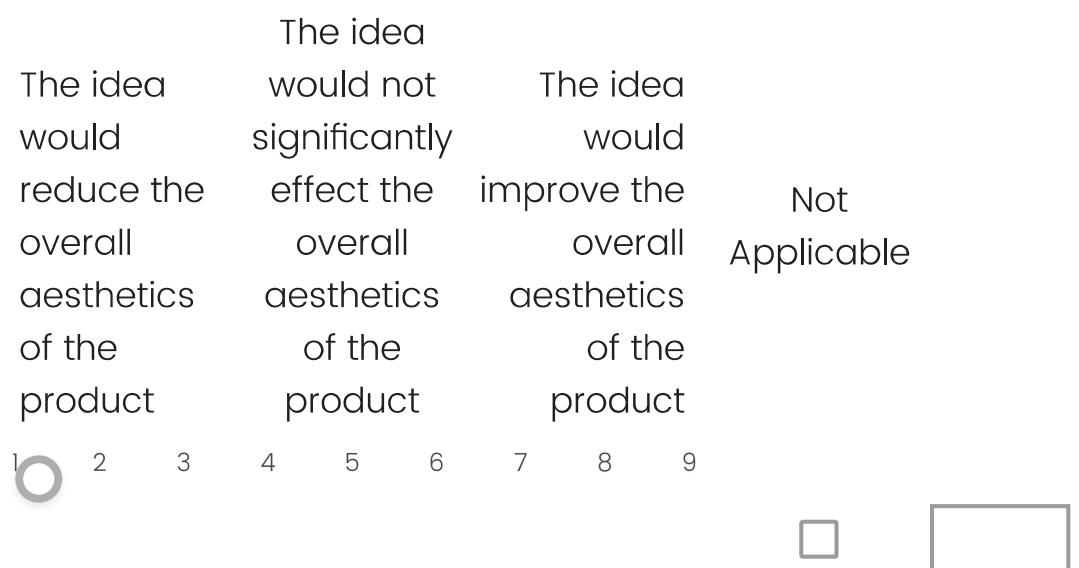
The idea  
would  
contribute to  
the  
environmental  
characteristics  
of the product  
(green  
product)

Not  
Applicable

1      2      3      4      5      6      7      8      9



## AESTHETICS – How would the idea affect the aesthetics of a realised product?



## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?

The idea is a worse solution than that of the competition

The idea poses a solution on par with that of the competition

The idea brings the dominant competition

1

2

3

4

5

6

7

8

9

Not

Applicable



## BUYER – How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations

The idea brings an expected solution to customers

The idea brings a solution above customer expectations

1

2

3

4

5

6

7

8

9

Not

Applicable



## MARKET – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market

The idea brings a solution in the rank of solutions on the market

1      2      3      4      5      6      7      8      9

The idea brings the solution above the expectations and needs of the market

Not Applicable



## FINANCIAL VALUE EVALUATION

SALES VOLUME – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will negatively effect the sales volume of the product

The idea itself will not effect the sales volume of the product

The idea will positively effect the sales volume of the product

1      2      3      4      5      6      7      8      9



RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will  
negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the return on investment

1      2      3      4      5      6      7      8      9



PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will  
lengthen effect the payback time

The idea will not significantly affect the payback time

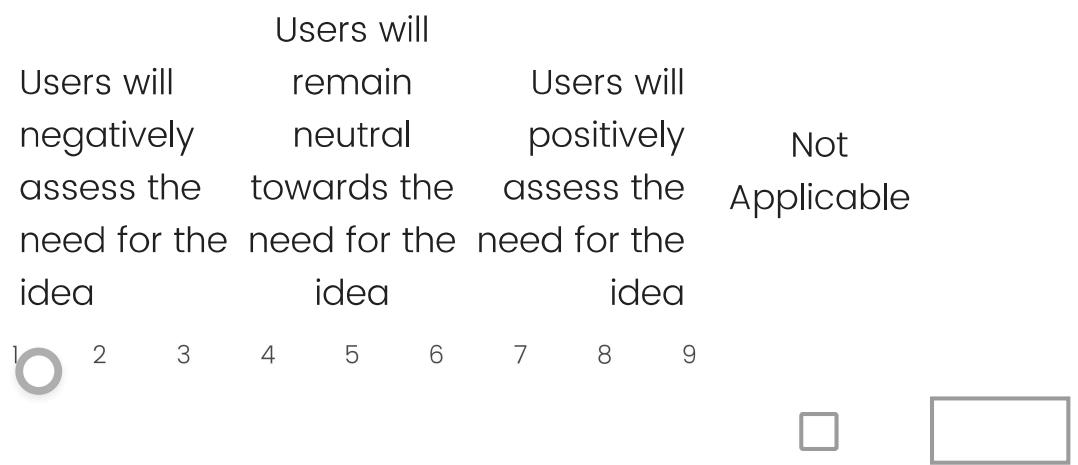
The idea will shorten the payback time

1      2      3      4      5      6      7      8      9

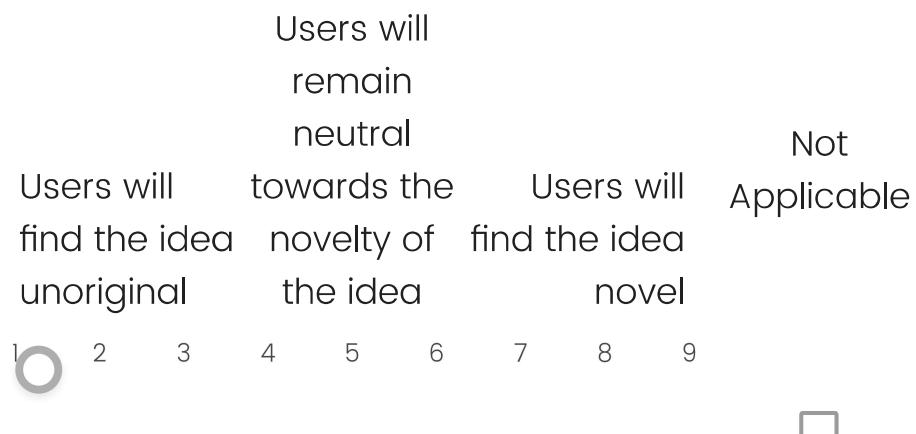


## CUSTOMER VALUE EVALUATION

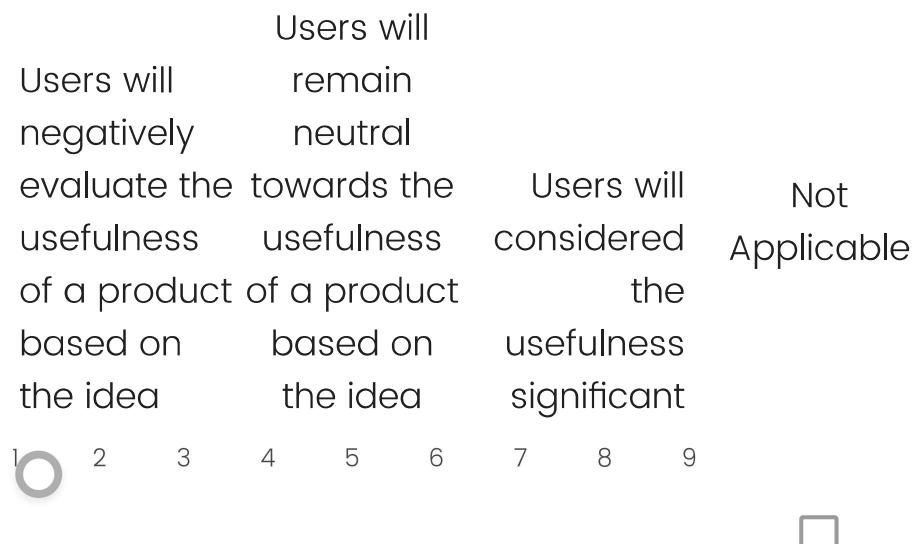
NECESSITY – How will users evaluate the necessity of the idea?



NOVELTY – How will users evaluate the novelty of the idea?



**USEFULNESS** – How will users evaluate the usefulness of a realised product using the idea?



**USABILITY** – How will users evaluate the usability of products using the idea?

<p>Users will negatively evaluate the usability of a product based on the idea</p>	<p>Users will remain neutral toward the usability of the product</p>	<p>The idea brings a substantial increase in the usability of the product</p>	<p>Not Applicable</p>					
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
1	2	3	4	5	6	7	8	9

## SOCIAL VALUE EVALUATION

**IMPORTANCE** – How much will the idea contribute to the importance of a realised product to users

<p>The idea would adversely affect the significance of the product for users</p>	<p>The idea will be on par with the expectations for importance of the product for users</p>	<p>The idea will significantly contribute to increasing importance of products for users</p>	<p>Not Applicable</p>					
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
1	2	3	4	5	6	7	8	9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the product of the manufacturer

1      2      3      4      5      6      7      8      9

Not Applicable

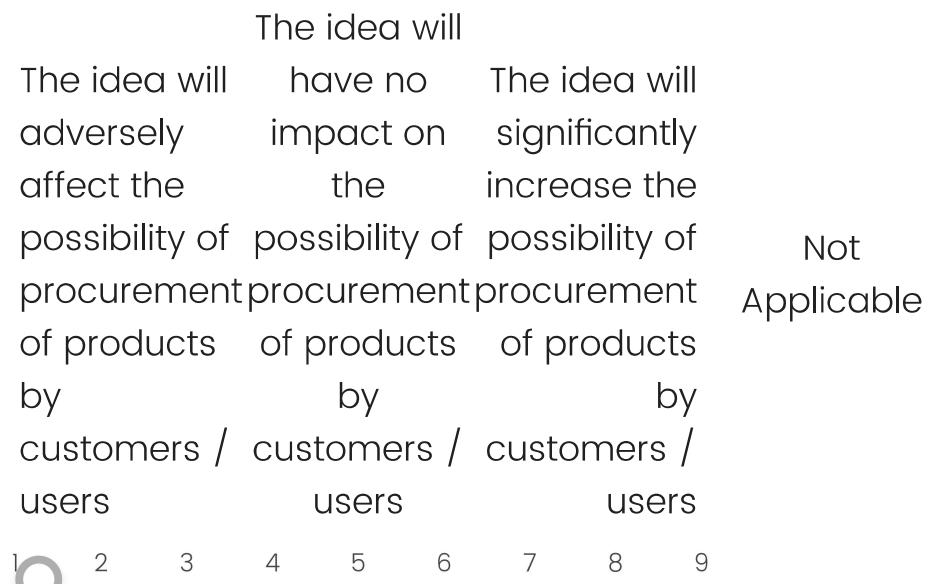
## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will not have a substantial impact on commitment of the user to the product of the manufacturer

1      2      3      4      5      6      7      8      9

Not Applicable

AFFORDABILITY - How much will the idea contribute to the affordability of a realised product compared to similar products?



Are there any additional positive aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **EcoSlice - ChatGPT**

# **Idea to be evaluated**

**Idea Name:** EcoSlice

**Idea Description:** Portabread introduces EcoSlice, a revolutionary, portable vegetable peeler designed to redefine kitchen convenience and safety. Breaking new ground, EcoSlice integrates a first-of-its-kind biometric sensor that identifies the user's grip strength and peeling motion to adjust the blade's depth and speed automatically. This intelligent adaptation prevents accidents and ensures a consistent peel, making it an ideal tool for both novice cooks and culinary experts. EcoSlice is also designed with a compact, eco-friendly charging dock that doubles as a storage unit, ensuring it is always ready for use, whether at home or on the go. The device is crafted from sustainable, recycled materials, emphasizing Portabread's commitment to reducing environmental impact. For added versatility, EcoSlice comes with interchangeable blades tailored for different vegetables and fruits, enhancing its utility and efficiency. Its design incorporates a self-cleaning mechanism that flushes out peel residues, ensuring hygiene and reducing maintenance efforts.

**Idea Justification:** EcoSlice stands out as an innovative solution by addressing key issues associated with traditional hand peelers: time consumption, messiness, and safety hazards. The integration of biometric sensors for automatic adjustment introduces a new level of user interaction and safety to kitchen gadgets, tailored to accommodate varying user abilities and peeling requirements. This personalized approach ensures that all users, regardless of their cooking experience or physical capability, can safely and efficiently peel vegetables and fruits. The focus on sustainability, from the use of recycled materials to the eco-friendly charging and storage solution, aligns with the growing consumer demand for products that support a sustainable lifestyle. EcoSlice's design for easy maintenance and hygiene further enhances its appeal in a market where convenience and cleanliness are highly valued. By offering a product that is innovative, safe, environmentally friendly, and versatile, Portabread is set to redefine the kitchen appliance industry, making EcoSlice a must-have gadget for anyone looking to streamline their cooking process without compromising on safety or environmental values, all within the constraints of the outlined budget and development timeframe.

## **Questions 6 – EcoSlice**

### **TECHNICAL/PRODUCTION VALUE EVALUATION**

**PRODUCTIVITY** – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge resources or and ideas to improve our production such can be easily found knowledge

1

2

3

4

5

6

7

8

9

Not Applicable



## FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea would not significantly reduce the functionality of the product in its original use context

The idea would effect the functionality of the product in its original use context

The idea would improve the functionality of the product in its original use context

1

2

3

4

5

6

7

8

9

Not Applicable



## RELIABILITY - How would the idea affect the reliability of a realised product compared to existing products?

The idea would not significantly reduce the reliability of the product	The idea would improve the reliability of the product	Not Applicable
<input checked="" type="radio"/> 1	2    3    4    5    6    7    8    9	<input type="checkbox"/> <input type="text"/>

## SAFETY - How would the idea affect the safety of a realised product compared to existing products?

The idea would not significantly effect the safe of use of the product	The idea would improve the safety of the product	Not Applicable
<input checked="" type="radio"/> 1	2    3    4    5    6    7    8    9	<input type="checkbox"/> <input type="text"/>

**ECOLOGICALLY** – How would the idea affect the environmental parameters of a realised product?

	The idea would contribute to the environmental characteristics of the product (green product)	Not Applicable
The idea would have negative impact on environmental parameters (energy, pollution ...)	The idea would not significantly effect the environmental parameters	



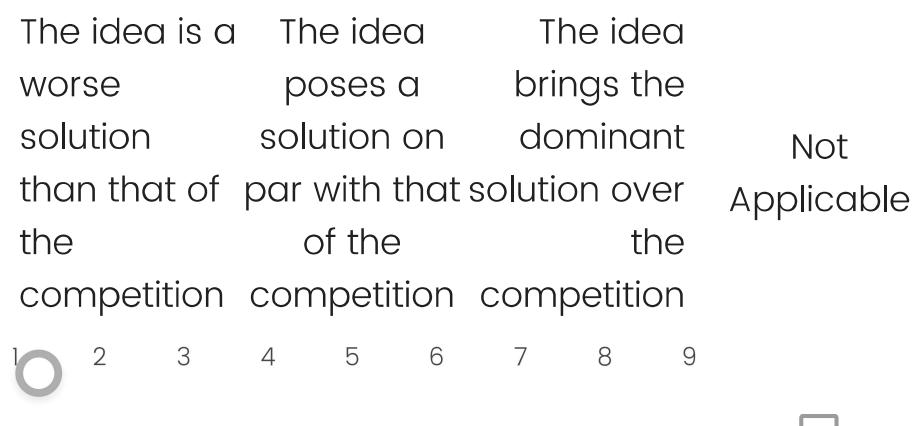
AESTHETICS – How would the idea affect the aesthetics of a realised product?

	The idea would not significantly reduce the overall aesthetics of the product	The idea would effect the overall aesthetics of the product	improve the overall aesthetics of the product	Not Applicable
The idea would reduce the overall aesthetics of the product	would not significantly reduce the overall aesthetics of the product	would effect the overall aesthetics of the product	improve the overall aesthetics of the product	Not Applicable



## **MARKET VALUE EVALUATION**

**COMPETITION** - How competitive is the idea in relation to the ideas embedded in the competitor's products?



**BUYER** - How competitive is the idea with regards to customer expectations?

The idea brings a worse solution than customer expectations	The idea brings an expected solution to customers	The idea brings a solution above customer expectations	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9



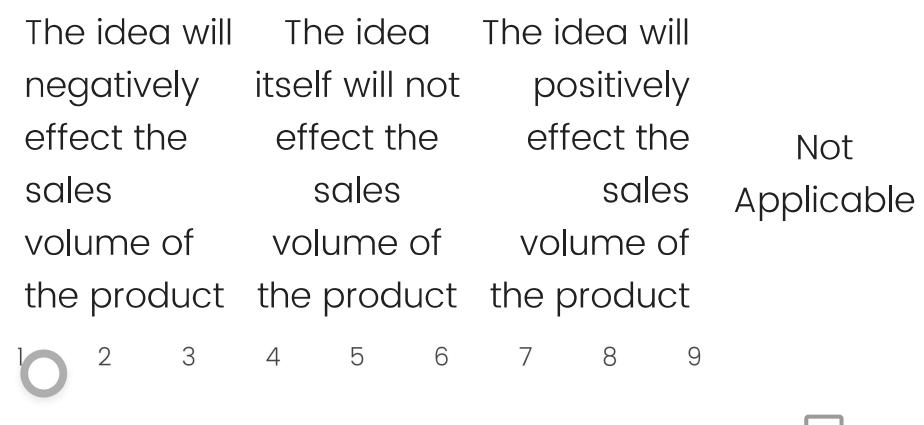
## MARKET – How would the idea compete against the expectations of the market?

The idea brings a worse solution than other solutions on the target market	The idea brings a solution in the rank of solutions on the market	The idea brings the solution above the expectations and needs of the market	Not Applicable					
<input checked="" type="radio"/> 1	2	3	4	5	6	7	8	9

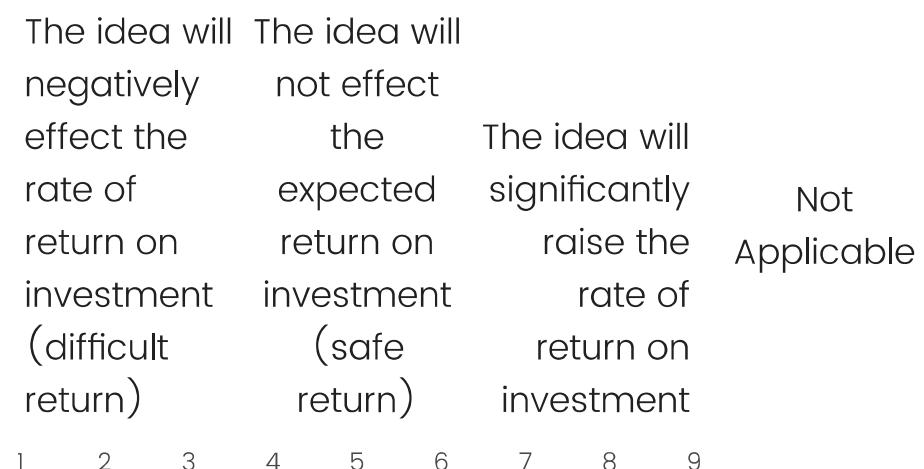


## FINANCIAL VALUE EVALUATION

SALES VOLUME – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

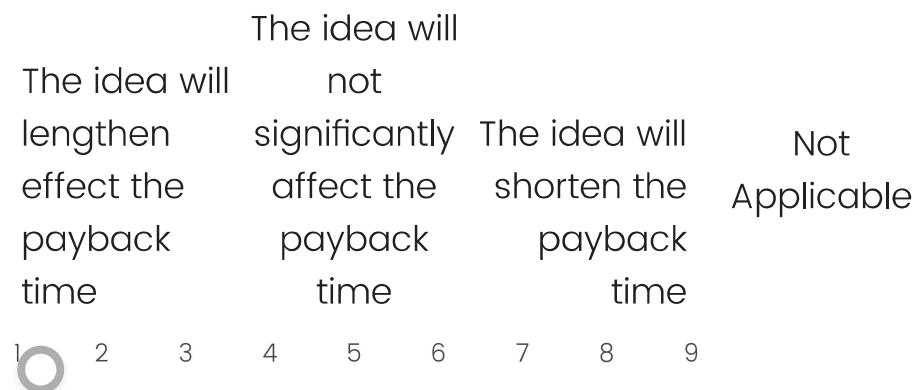


RATE OF RETURN – How will the idea affect the rate of return on investment of a realised product compared to existing products?



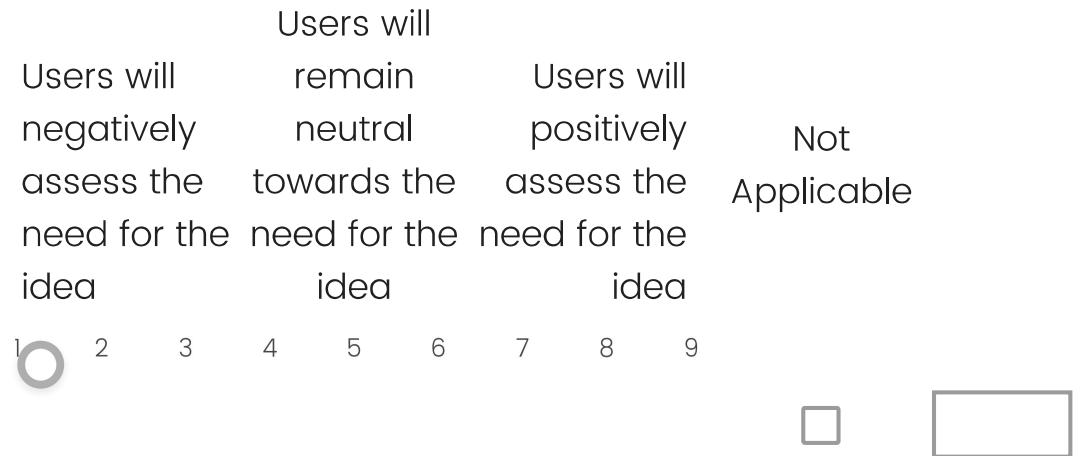


PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

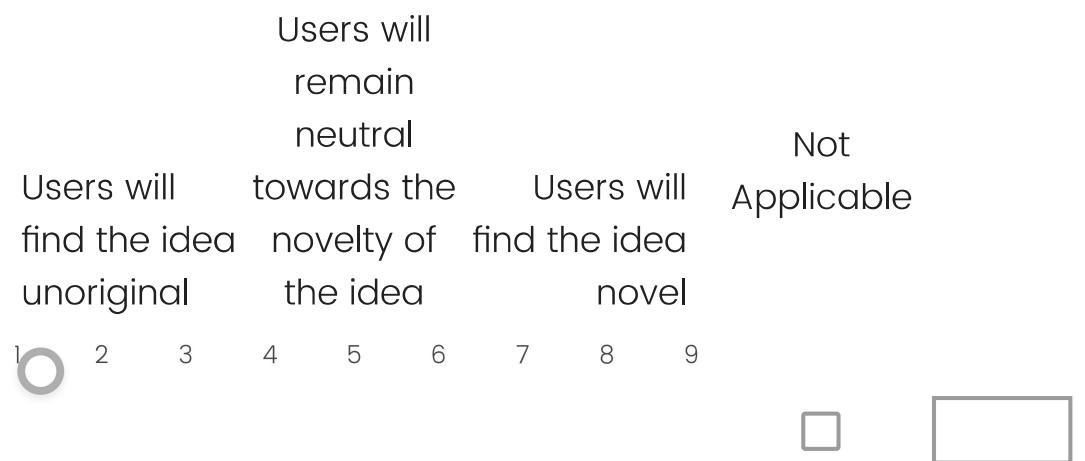


## CUSTOMER VALUE EVALUATION

NECESSITY – How will users evaluate the necessity of the idea?



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?

Users will remain neutral towards the usefulness of a product based on the idea

1      2      3      4      5      6      7      8      9

Users will consider the usefulness significant

Not

Applicable



## USABILITY – How will users evaluate the usability of products using the idea?

Users will remain neutral toward the usability of the product

1      2      3      4      5      6      7      8      9

The idea brings a substantial increase in the usability of the product

Not

Applicable



## SOCIAL VALUE EVALUATION

## IMPORTANCE – How much will the idea contribute to the importance of a realised product to users

The idea would adversely affect the significance of the product for users

The idea will be on par with the expectations for importance for product's users

The idea will significantly contribute to increasing importance of products for users

Not Applicable

1      2      3      4      5      6      7      8      9

## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

The idea would be neutral towards highlighting of ownership of the possession of the product

The idea will highlight the negative highlighting of the possession of the product

The idea will substantially raise the highlighting of ownership of the product (self-advertising)

Not Applicable

1      2      3      4      5      6      7      8      9



## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the user to the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable
---	--	--	----------------

1      2      3      4      5      6      7      8      9



## AFFORDABILITY – How much will the idea contribute to the affordability of a realised product compared to similar products?

The idea will

The idea will have no The idea will  
adversely impact on significantly  
affect the the increase the  
possibility of possibility of possibility of  
procurement procurement procurement Not  
of products of products of products Applicable  
by by by  
customers / customers / customers /  
users users users

1      2      3      4      5      6      7      8      9



Are there any additional positive aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

## **Untitled 1 – Human**

# **Idea to be evaluated**

**Idea Name:** --

**Idea Description:** The vegetable would be mounted on a vertical axis and attached at both ends for rotation. User can then swing around the peeler knife which adapts to the curvature of the vegetable. The user can then wind up or screw the mechanism like a spiralizer to move the vegetable, not the peeler knife down. The knife will stay in place. Product should include a clamp system at the bottom or suction cup to secure the system to the counter top or whatever else surface they would encounter on the go. The peeler knife arm must be detachable in order for it to be separated and washed.

**Idea Justification:** Difficult to imagine what the brand is after without images of their other products. But in my opinion, I can't really justify this design idea given the target market. I think that peelers available today are catered towards people who enjoy time in the kitchen and they are the quickest option available. The product I designed is suitable to people with disabilities maybe.

## Question 7 – Untitled 1

### TECHNICAL/PRODUCTION VALUE EVALUATION

PRODUCTIVITY – How would the idea affect the possibility to production of a realised product?

We do not have the necessary resources for the realization of such products

We have the necessary resources, necessary knowledge or and ideas to improve our production

easily found knowledge

1      2      3      4      5      6      7      8      9



FUNCTIONALITY – How would the idea affect the functionality of a realised product compared to existing products?

The idea

The idea would not significantly reduce the functionality of the product in its original use context

would effect the functionality of the product in its original use context

improve the functionality of the product in its original use context

The idea would improve the functionality of the product in its original use context

Not Applicable

1      2      3      4      5      6      7      8      9

**RELIABILITY** – How would the idea affect the reliability of a realised product compared to existing products?

The idea

The idea would not significantly reduce the reliability of the product

would effect the reliability of the product

improve the reliability of the product

The idea would improve the reliability of the product

Not Applicable

1      2      3      4      5      6      7      8      9

**SAFETY** – How would the idea affect the safety of a realised product compared to existing products?

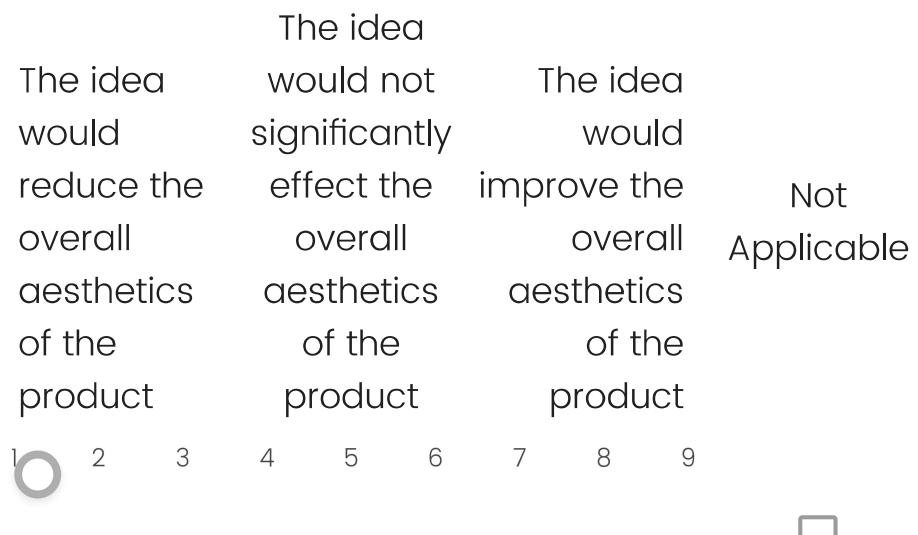
The idea would not significantly effect the safe of use of the product	The idea would improve the safety of the product	Not Applicable
<input checked="" type="radio"/> 1	2    3    4    5    6    7    8    9	<input type="checkbox"/> <input type="text"/>

## ECOLOGICALLY – How would the idea affect the environmental parameters of a realised product?

The idea would have negative impact on environmental parameters (energy, pollution ...)	The idea would not significantly effect the environmental parameters	The idea would contribute to the environmental characteristics of the product (green product)	Not Applicable
<input checked="" type="radio"/> 1	2    3    4    5    6    7    8    9	<input type="checkbox"/> <input type="text"/>	

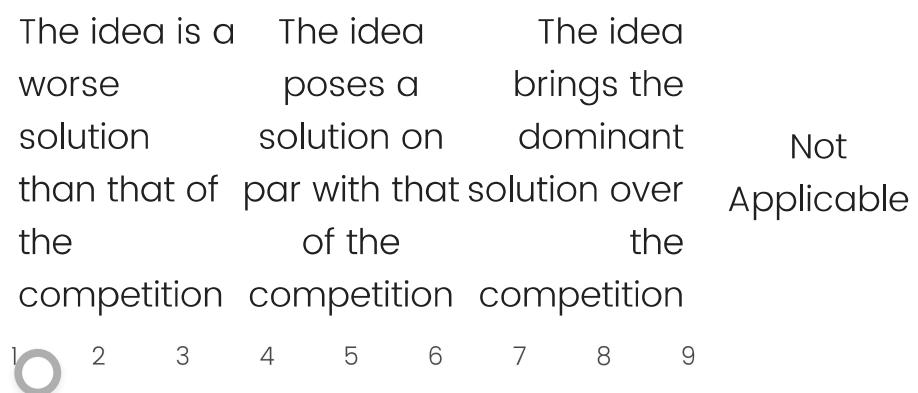
## AESTHETICS – How would the idea affect the aesthetics of a

realised product?



## MARKET VALUE EVALUATION

COMPETITION – How competitive is the idea in relation to the ideas embedded in the competitor's products?



BUYER – How competitive is the idea with regards to customer expectations?

The idea  
brings a  
worse  
solution  
than  
customer  
expectations

The idea  
brings an  
expected  
solution to  
customers

The idea  
brings a  
solution  
above  
customer  
expectations

Not  
Applicable



**MARKET** – How would the idea compete against the expectations of the market?

The idea  
brings a  
worse  
solution  
than other  
solutions on  
the target  
market

The idea  
brings a  
solution in  
the rank of  
solutions on  
the market

The idea  
brings the  
solution  
above the  
expectations  
and needs  
of the  
market

Not  
Applicable



## **FINANCIAL VALUE EVALUATION**

**SALES VOLUME** – What impact will the idea have on the expected sales volume of a realised product compared to existing products?

The idea will      The idea will      The idea will  
negatively      itself will not      positively  
effect the      effect the      effect the      Not  
sales                sales                sales               Applicable  
volume of          volume of          volume of  
the product        the product        the product

1  2    3    4    5    6    7    8    9



**RATE OF RETURN** – How will the idea affect the rate of return on investment of a realised product compared to existing products?

The idea will negatively effect the rate of return on investment (difficult return)

The idea will not effect the expected return on investment (safe return)

The idea will significantly raise the rate of return on investment

1

2

3

4

5

6

7

8

9

Not

Applicable



## PAYBACK TIME – How will the idea affect the payback time for a realised product compared to existing products?

The idea will not significantly affect the payback time

The idea will shorten the payback time

1

2

3

4

5

6

7

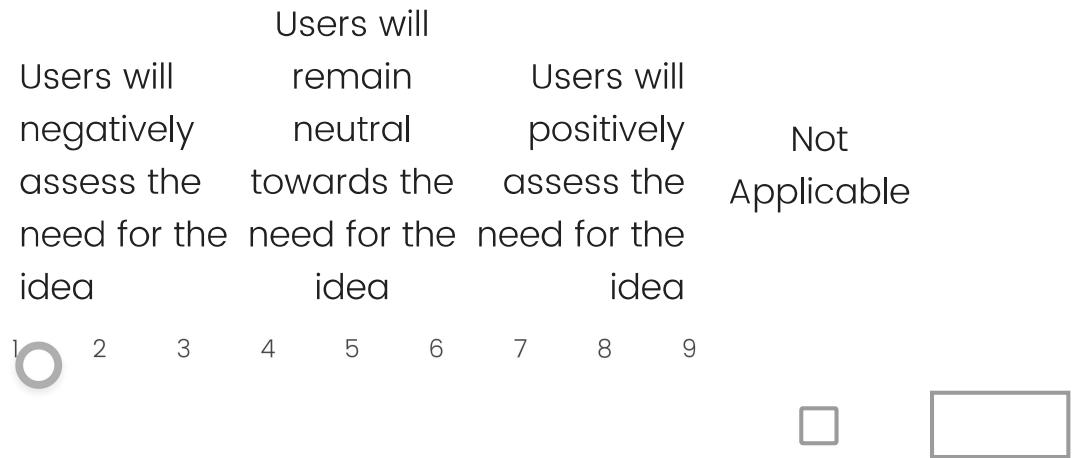
8

9

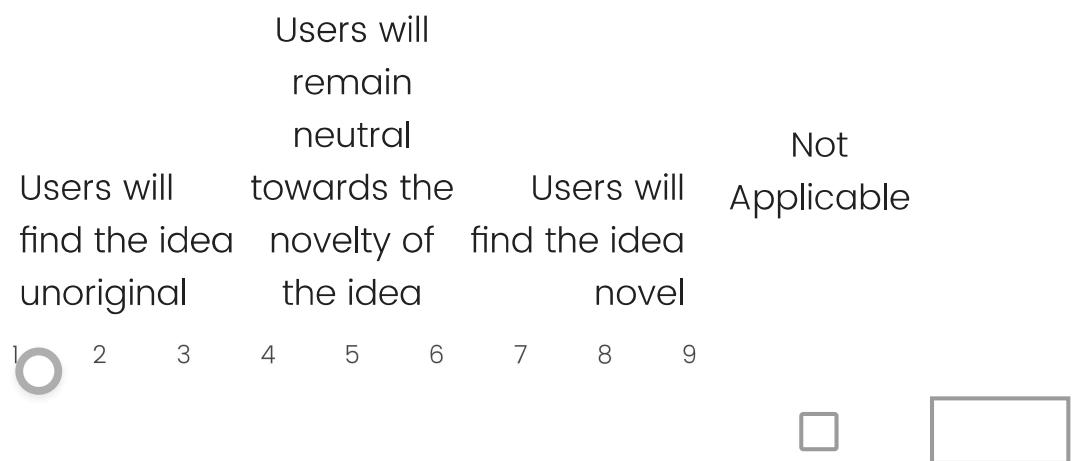


## CUSTOMER VALUE EVALUATION

## NECESSITY – How will users evaluate the necessity of the idea?



## NOVELTY – How will users evaluate the novelty of the idea?



## USEFULNESS – How will users evaluate the usefulness of a realised product using the idea?

Users will remain neutral towards the usefulness of a product based on the idea

Users will consider the usefulness significant

Not Applicable

1      2      3      4      5      6      7      8      9



## USABILITY – How will users evaluate the usability of products using the idea?

Users will negatively evaluate the usability of a product based on the idea

Users will remain neutral toward the usability of the product

The idea brings a substantial increase in the usability of the product

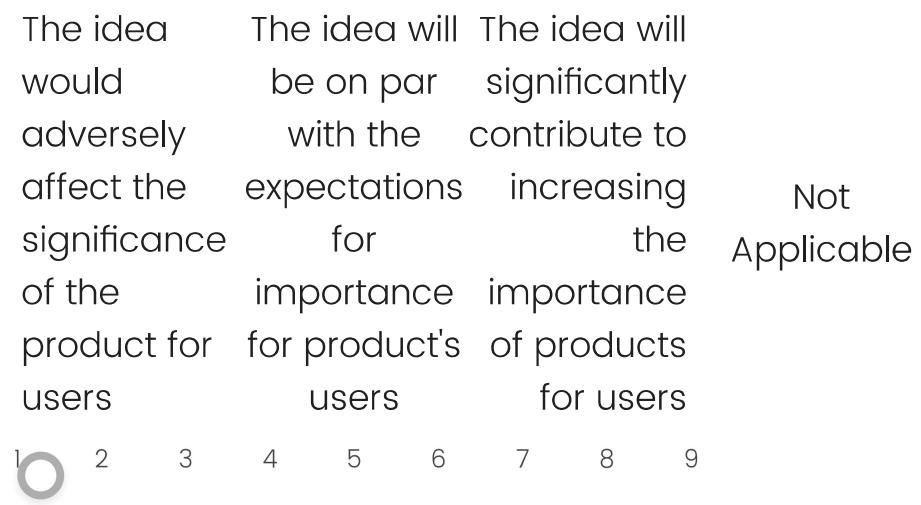
Not Applicable

1      2      3      4      5      6      7      8      9

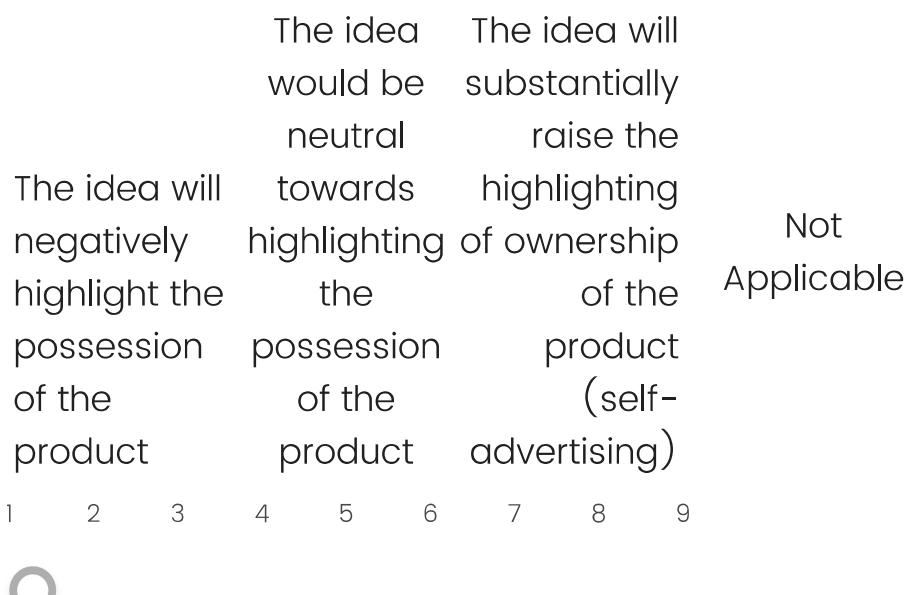


## SOCIAL VALUE EVALUATION

## IMPORTANCE – How much will the idea contribute to the importance of a realised product to users



## EMPHASIS – How will the idea contribute to highlighting ownership of a realised product?

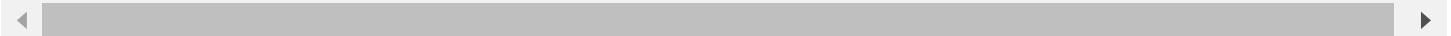




## COMMITMENT – How will the idea contribute to commitment to a realised product from the users?

The idea will negatively affect the commitment of the user to the product of the manufacturer	The idea will not have a substantial impact on the product of the manufacturer	The idea will significantly contribute to increase the commitment of the user to the product of the manufacturer	Not Applicable
---	--	--	----------------

1 2 3 4 5 6 7 8 9



## AFFORDABILITY – How much will the idea contribute to the affordability of a realised product compared to similar products?

The idea will

The idea will have no The idea will  
adversely impact on significantly  
affect the the increase the  
possibility of possibility of possibility of  
procurement procurement procurement Not  
of products of products of products Applicable  
by by by  
customers / customers / customers /  
users users users

1      2      3      4      5      6      7      8      9



Are there any additional positive aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Are there any additional negative aspects of the idea that  
have not been covered you would like to highlight?  
(Optional)

Any final comments or feedback that has not been covered in the form (Optional)

Powered by Qualtrics

## 8 | Bibliography

- American Management Association. *The Quest for Innovation: A Global Study of Innovation Management 2006–2016*. American Management Association, New York, 2006.
- N. Anderson, K. Potočnik, and J. Zhou. Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework. *Journal of Management*, 40(5):1297–1333, 2014. doi: 10.1177/0149206314527128. URL <https://doi.org/10.1177/0149206314527128>.
- S. L. Beckman and M. Barry. Innovation as a learning process: Embedding design thinking. *California Management Review*, 50(1):25–56, 2007. doi: 10.2307/41166415. URL <https://doi.org/10.2307/41166415>.
- BenchCouncil. Open100: Top 100 open source achievements. <https://www.benchcouncil.org/evaluation/opencs/annual.html>, 2023. Accessed: date.
- M. Boden. Computer models of creativity. *AI Magazine*, 30:23–34, 07 2009. doi: 10.1609/aimag.v30i3.2254.
- O. Carvache-Franco, M. Carvache-Franco, and W. Carvache-Franco. Barriers to innovations and innovative performance of companies: A study from ecuador. *Social Sciences*, 2022. doi: 10.3390/socsci11020063.
- C. M. Christensen. The innovator’s dilemma: When new technologies cause great firms to fail. 2013. URL <https://api.semanticscholar.org/CorpusID:46347949>.
- S. Colvin. pydantic. <https://github.com/pydantic>, n.d. Accessed: 2024-03-25.
- Design Council. Framework for innovation. <https://www.designcouncil.org.uk/our-resources/framework-for-innovation/>, 2024. Accessed: 2024-03-07.
- M. Freel. Barriers to product innovation in small manufacturing firms. *International Small Business Journal*, 18:60 – 80, 2000. doi: 10.1177/0266242600182003.
- Google. Google design sprint kit. <https://designsprintkit.withgoogle.com/>, n.d. Accessed: 2024-03-11.
- D. F. Heany. Degrees of product innovation. *Journal of Business Strategy*, 3(4):3–14, 1983. ISSN 0275-6668. doi: 10.1108/eb038984. URL <https://doi.org/10.1108/eb038984>.
- S. Hong, M. Zhuge, J. Chen, X. Zheng, Y. Cheng, C. Zhang, J. Wang, Z. Wang, S. K. S. Yau, Z. Lin, L. Zhou, C. Ran, L. Xiao, C. Wu, and J. Schmidhuber. Metagpt: Meta programming for a multi-agent collaborative framework, 2023a.
- S. Hong, M. Zhuge, J. Chen, X. Zheng, Y. Cheng, C. Zhang, J. Wang, Z. Wang, S. K. S. Yau, Z. Lin, L. Zhou, C. Ran, L. Xiao, C. Wu, and J. Schmidhuber. Metagpt: Meta programming for a multi-agent collaborative framework, 2023b.
- J. Kaplan, S. McCandlish, T. Henighan, T. B. Brown, B. Chess, R. Child, S. Gray, A. Radford, J. Wu, and D. Amodei. Scaling laws for neural language models, 2020.

- D. Kolb. *Experiential Learning: Experience As The Source Of Learning And Development*, volume 1. 01 1984. ISBN 0132952610.
- Z. Li, W. Hua, H. Wang, H. Zhu, and Y. Zhang. Formal-lm: Integrating formal language and natural language for controllable lm-based agents, 2024.
- Z. Liu, Y. Zhang, P. Li, Y. Liu, and D. Yang. Dynamic lm-agent network: An lm-agent collaboration framework with agent team optimization, 2023.
- J. G. March. Exploration and exploitation in organizational learning. *Organization Science*, 2(1):71–87, 1991. ISSN 10477039, 15265455. URL <http://www.jstor.org/stable/2634940>.
- T. Miaskiewicz and K. Kozar. Personas and user-centered design: How can personas benefit product design processes? *Design Studies*, 32:417–430, 2011. doi: 10.1016/J.DESTUD.2011.03.003.
- R. B. A. C. J. D. R. D. C. E. K. H. M. I. A. J. R. K. R. S. A. S. Peter Koen, Greg Ajamian and K. Wagner. Providing clarity and a common language to the “fuzzy front end”. *Research-Technology Management*, 44(2):46–55, 2001. doi: 10.1080/08956308.2001.11671418. URL <https://doi.org/10.1080/08956308.2001.11671418>.
- Y. Shoham. Agent-oriented programming. *Artificial Intelligence*, 60(1):51–92, 1993. ISSN 0004-3702. doi: [https://doi.org/10.1016/0004-3702\(93\)90034-9](https://doi.org/10.1016/0004-3702(93)90034-9). URL <https://www.sciencedirect.com/science/article/pii/0004370293900349>.
- S. Singh and Y. Aggarwal. In search of a consensus definition of innovation: a qualitative synthesis of 208 definitions using grounded theory approach. *Innovation: The European Journal of Social Science Research*, 35(2):177–195, 2022. doi: 10.1080/13511610.2021.1925526. URL <https://doi.org/10.1080/13511610.2021.1925526>.
- M. Stevanovic, D. Marjanović, and M. Štorga. A model of idea evaluation and selection for product innovation. 07 2015.
- Y. Talebirad and A. Nadiri. Multi-agent collaboration: Harnessing the power of intelligent lm agents, 2023.
- J. Wei, Y. Tay, R. Bommasani, C. Raffel, B. Zoph, S. Borgeaud, D. Yogatama, M. Bosma, D. Zhou, D. Metzler, E. H. Chi, T. Hashimoto, O. Vinyals, P. Liang, J. Dean, and W. Fedus. Emergent abilities of large language models, 2022.
- Q. Wu, G. Bansal, J. Zhang, Y. Wu, B. Li, E. Zhu, L. Jiang, X. Zhang, S. Zhang, J. Liu, A. H. Awadallah, R. W. White, D. Burger, and C. Wang. Autogen: Enabling next-gen lm applications via multi-agent conversation, 2023.
- H. Yang, S. Yue, and Y. He. Auto-gpt for online decision making: Benchmarks and additional opinions, 2023.
- W. X. Zhao, K. Zhou, J. Li, T. Tang, X. Wang, Y. Hou, Y. Min, B. Zhang, J. Zhang, Z. Dong, Y. Du, C. Yang, Y. Chen, Z. Chen, J. Jiang, R. Ren, Y. Li, X. Tang, Z. Liu, P. Liu, J.-Y. Nie, and J.-R. Wen. A survey of large language models, 2023.
- C. Zong, Y. Yan, W. Lu, E. Huang, J. Shao, and Y. Zhuang. Triad: A framework leveraging a multi-role lm-based agent to solve knowledge base question answering, 2024.