Managing Innovation
ELEC60020

Group 3:
Alex Dhayaa
Ebrahim Jahangiri
Liam Browne
Marta Lopez Gallo
Nithi Sendhil
Janvid Wu

Contents:

1. Introduction

1.1 Background

Introducing LingoPal, the innovative educational tool designed to engage and educate children between the ages of 6 and 12. LingoPal is uniquely engineered to foster language learning, engaging directly with its environment to cultivate an interactive and enjoyable learning experience. Between our six founders, we speak over a dozen languages. Languages are a means for us to celebrate the diversity in our backgrounds and cultures. For children in their development years, learning a language can reap a lifetime of benefits. This shared belief led to the development of LingoPal, a fun way for children to learn different languages through their everyday lives.

Across the globe, there is a common goal for children to be taught more languages. In the UK alone, 64% of the public want a foreign language to be taught in primary schools [citation]. While in the US, only 20% of elementary schools offer the option of learning a foreign language [citation]. LingoPal seeks to address these issues by developing a self-balancing rover that interacts with its environment, creating an immersive language-learning experience for children. At base difficulty, it will be able to identify objects in the house, name them, and then teach the child the translation of the object's name in a selected language. At advanced difficulty, the robot will then be able to ask follow-up questions relevant to the object. For example, consider the case where the rover identifies a kettle. At base difficulty, it will simply teach the translation of the word 'kettle' to the child, by method of vocal repetition. At the advanced difficulty, the rover may be able to ask relevant questions, such as "do you want a cup of tea?".

The rover will connect to a mobile application that tracks the child's progress in terms of questions answered correctly and their difficulty. This will allow it to adjust the level of difficulty as the child progresses, ensuring that it remains an engaging experience for the child. Furthermore, the mobile application will be used to turn the rover on and off, select the language, implement software updates, set initial difficulty, and to help parents track the progress of the child over time with learning metrics, such as words learnt.

1.2 Market Research

LingoPal is defined as a self-servicing robot geared towards children. Market research indicated that ALLCELE, Matatalab and Miko are our main competitors, as they also offer self-servicing robots targeted at children. What differentiates LingoPal from them is the specific language-learning focus. The market for self-servicing robots is comparatively saturated with robots that teach coding and basic STEM concepts to children, but there does not appear to be any self-servicing robot that specifically aims to teach languages. We aim to exploit this market gap; especially given we are amidst an upswing in the self-servicing robot market [citation] as well as a rising demand in the language learning spheres across the developed world [citation].

The service robotics market is already worth more than £10 billion in the USA and, globally, is expected to cross the £100 billion threshold by 2030 [citation]. Forecasts expect to see double-digit CAGR in most of the developed world, including an anticipated 20.3% within China [citation]. In addition, the language learning market value is already in excess of £50 billion globally, with a projected CAGR of 20% between 2023 and 2032 [citation]. These numbers are a consequence of rapid growth in the tech industry, particularly the rise of artificial intelligence, as well as increased demand for multilingual employees due to globalisation. Finding ourselves at the crossroads of these two growing markets strengthens LingoPal's business potential, since we will be the first company to disrupt the market with a product that intertwines these two sectors.

1.3 Marketing Strategy & Revenue Model

The marketing strategy for LingoPal covers many streams. For starters, given this is an educational toy for young children, we plan to do targeted email marketing to elementary schools that offer foreign languages in their curriculums. Our strategy also involves social media advertising, striving to capture the interest of parents wanting to transform their children's learning experience. Within this comes influencer marketing, where we will aim to collaborate with individuals that are likely to attract our target demographic as their audience. Television advertising is also a marketing stream we will consider, given that many television channels are oriented towards families and adults.

LingoPal's primary revenue streams will be the sales to families and elementary schools. We plan to sell the units on our own website, as well as online shopping platforms, such as Amazon. We will also include additional in-app purchases that offer specific services, such as personalised learning plans. Finally, we plan to partner with other language learning platforms to promote LingoPal.

2. Project Planning

In order to design, develop and launch LingoPal, thorough project management strategies had to be implemented to address the technical complexity of this project. The application of project management strategies helps mitigate issues such as scheduling issues, cost overruns and communication breakdowns. Even though they do not eliminate the occurrence of such issues, even with the most robust systems in place, they are essential for the project to run as smoothly as possible and enable adaptability within the project.

2.1 Project Management Methodology

The use of the Agile and Waterfall methodologies in conjunction will allow the project to remain structured without compromising its adaptability. Agile's iterative approach enables components to be developed and tested individually before being integrated into the full system. Furthermore, using Agile with the Scrum framework means each iteration consists of a Sprint lasting two weeks. The short Sprints allow the project to regularly adapt to feedback and

changes, such that issues can be identified and rectified during development rather than afterwards. Additionally, Scrum's flat leadership structure fosters transparency and communication between teams, promoting collaboration and preventing misunderstandings regarding project objectives.

For parts of the project that require a more linear approach, such as safety certification processes or manufacturing contracts, a Waterfall methodology will be applied as it has more structured phases, maintaining necessary rigour where needed. This involves keeping, and regularly updating, detailed documentation to record the progress, decisions made and specifics throughout the project. While documentation helps manage the complexity of certain processes, such as contract negotiations, it also has legal and informing purposes. Thus, a schematic approach will be used to ensure that complex information was conveyed in a concise, intelligible manner.

After the launch of LingoPal and during company growth, the project management processes will need to evolve as the complexity of the company increases; there are more stakeholders and a greater number of areas become susceptible to risk. The project management process will need to become more formalised, including standardised documentation to ensure consistency throughout the teams as the company expands. Furthermore, communication channels and protocols will have to be more structured. This will enable the continued use of the Agile methodology, while allowing for a larger scale of operations without complications.

2.2 Timeline and Milestones

Before starting a project, it is vital to create an achievable schedule with clear milestones and deliverables. These will then be distributed to all teams to ensure everyone is informed. To achieve this, a Gantt chart was created, which will be updated every week to allow for changes to be made as required. This emphasises the importance of adaptability in complex projects.

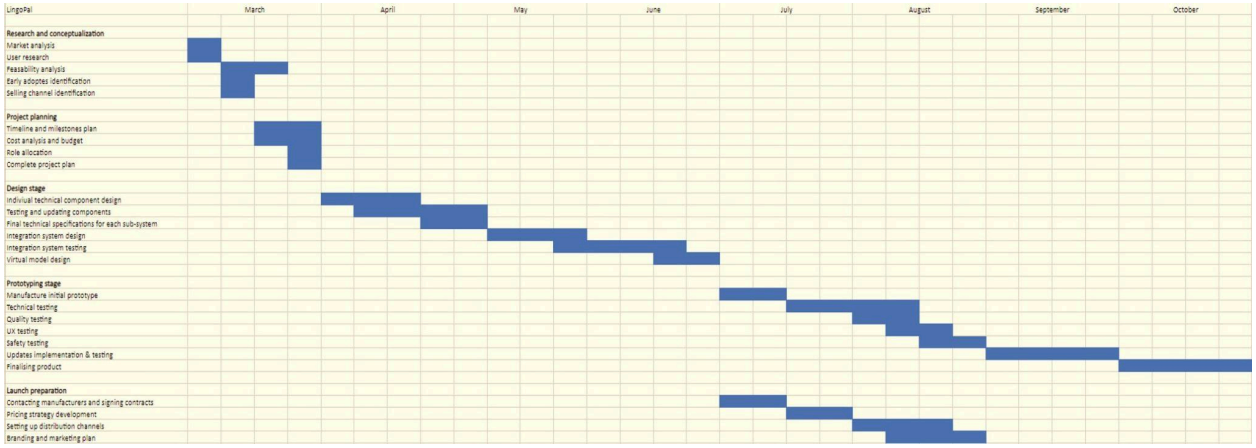

Figure 2.1: Gantt chart outlining the project's timeline.

Figure 2.1 shows that a total time of seven months has been set out to complete the project, i.e. advance from Gate II to Gate IV. Three months were allocated to the design phase and four

months to the prototyping phase. A contingency plan has also been implemented for the worst-case scenario, which consists of allocating four months to the design phase and six months to the prototyping phase. More time has been allocated to the prototyping phase due to the many iterations and refinements that are expected when testing the full prototype.

Based on the timeline, specific milestones were established, serving as a useful tool for employees to gauge the project's performance internally and for stakeholders to stay informed about its progress externally. The main milestones were sequenced as follows:

1. Market analysis and user research documentation
2. Regulatory and compliance documentation
3. Cost analysis and budget documentation
4. Complete project plan
5. Preliminary technical specifications and drawings
6. Final technical specification
7. Bill of materials
8. Virtual model (Gate III)
9. Prototype
10. Technical and user testing reports
11. Validation testing report
12. Product (Gate IV)

Before initiating the design phase, conducting market research, budgeting, and obtaining necessary regulatory documentation were crucial steps. These actions enabled the project management team to assess the project's feasibility and establish a comprehensive project plan from Gate II to Gate IV. The project plan ensures that all stakeholders are aligned and informed of the key aspects of the project, as well as serving as an internal guideline. It includes the executive summary, the scope and requirements of the project, the budget as well as the risk, communication and resource management plans. Once the plan has been distributed to all stakeholders and teams, the project will enter phase three. Phase three’s deliverables include preliminary technical specifications and drawings, any required testing documentation, the final specification, the bill of materials and a virtual model of the product. Once phase three has concluded, phase four will begin, where several prototypes will be built and tested. Testing is crucial for the project’s success. Hence, it will consist of two parts: technical testing, which includes testing for proper functionality and safety testing, as well as user experience (UX) testing. Finally, validation testing will be conducted to ensure the product meets all the requirements and objectives.

2.3 Project Team Structure

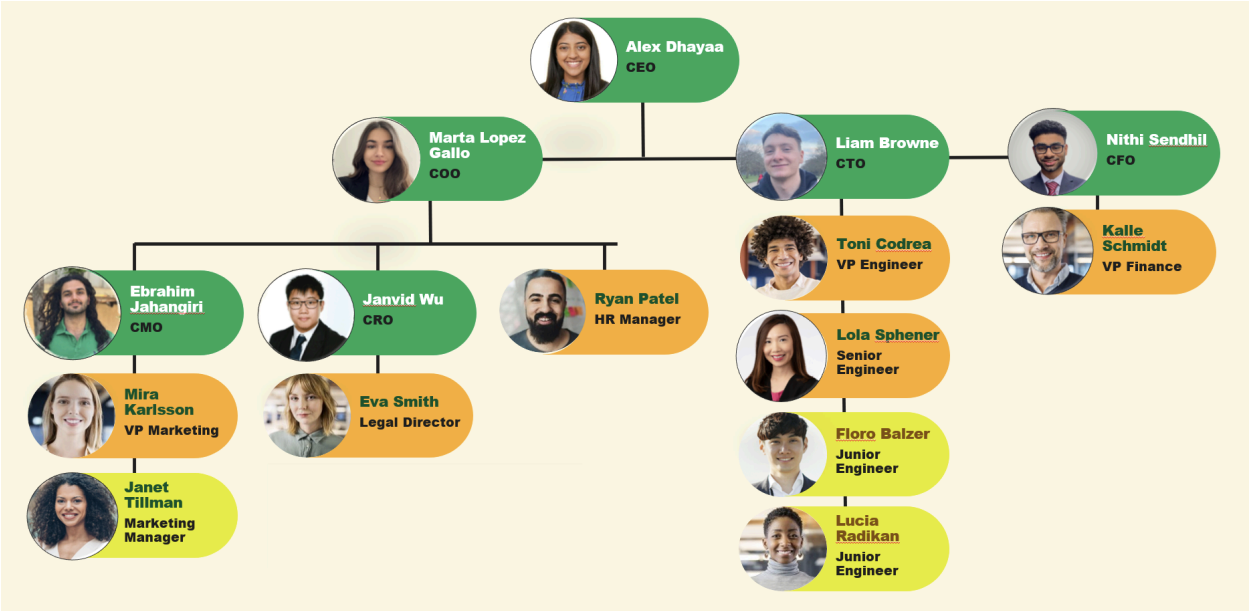

Figure 2.2: Team Organigram.

Our management team consists of a core group of executives, where each of us has taken on a role that aligns with our personal attributes. Alex Dhayaa, our CEO, sets the strategic direction and embodies our company's vision, ensuring that all departments align with our key objectives, and maintain a collaborative and communicative working environment. Marta Lopez Gallo, our COO, ensures operational excellence and efficiency, working hands on with the day-to-day administrative and operational functions of the company, translating our company's vision into actionable plans. Working closely with Marta are Ebrahim Jahangiri, our CMO, and Janvid Wu, our CRO. Ebrahim, leads the marketing team in creating impactful strategies that drive engagement and fuel our company's growth to maintain a competitive edge in the market. Janvid heads our Risk division, ensuring that both internal and external risks are identified, analysed, and mitigated, such that our company is safeguarded against potential threats to the company's capital and earnings. Our CTO, Liam Browne, spearheads technological innovation and development, leading the charge in product design, engineering processes, and the integration of systems. And finally, Nithi, our CFO, manages the company's financial strategy, encompassing the budgeting, forecasting and financial planning necessary to maintain financial health and sustainability. A visualisation of the team structure can be seen in figure 2.2.

Under our executives, we have a variety of VPs and managers across our divisions, with the majority sitting under our Engineering division as we see the highest degree of workload will be required here in the initial stages. We also have a Legal Director and HR Manager to ensure that our company operates within legal requirements and maintains a positive, productive workplace environment. As our team grows, we look forward to hiring young talent, offering internship and graduate programmes to offer hands-on mentoring and training, enriching our talent pool, and fostering fresh perspectives on innovative ideas.

To maintain a high degree of quality and meet our internal production deadlines, we will be outsourcing work in the Engineering division, hiring external contractors such as app developers to help build the app on offer to our customers alongside the product. This will require apt communication between the different teams and requires consideration of the various culture customs at play. LingoPal sees the importance of this, and so aims to implement cultural competence training, to help employees understand the diversity of communication styles minimising misunderstandings. At LingoPal, we also recognise the evolution of workplace dynamics, particularly the move to remote working. LingoPal seeks to embrace this change, advocating for a flexible working structure, and encourages our employees to spend at least three days working from the office. We believe this hybrid approach draws on the benefits of both in-office and remote working, ensuring effective teamwork and a productive work environment for everyone.

3. Project Monitoring and Control

3.1 KPIs and Metrics

In order to track the project's progress, several Key Performance Indicators (KPIs) and metrics were defined, which allowed the performance of a specific objective to be measured.

In terms of project management, one of the KPIs set out was schedule adherence, which measures the number of tasks completed in time and the ones that were not according to the planned schedule. This ensures that time is being managed efficiently and that the project is on track. Another KPI was the budget variance, which should be minimised to ensure the efficient use of limited resources.

Product development is one of the hardest and longest parts of his project, primarily due to its technical complexity. To quantify progress, the following KPIs were implemented: feature completion rate, which measures the number of components completed and tested in the time allocated by the initial schedule, and cycle time, which measures the time taken to complete a development cycle, from planning to completion. These indicate that product development is proceeding as planned and that the desired features are being implemented.

Quality assurance is one of the key focuses of our product, and as such, also has to be closely monitored. To do so, several testing protocols have been carried out, as well as the testing being done by many teams working on the project, to better assure the quality of the product in all aspects. The metrics used for this were defect resolution time, which was the average time it took to resolve a reported issue, and user acceptance testing success rate, which measures the number of test scenarios that were accepted by users. Another thing that was done to assure quality was constantly testing the product with many types of users: early adopters, children, parents, educators, etc.

These tests with multiple users also were very important, as it allowed the start-up to see if it was fulfilling LingoPal's objectives, as well as providing the team with data that could be used to

apply improvements or features to LingoPal that had not been considered before the start of the project. This is another reason why planning for changes to the schedule or product itself is an essential part of the project management of this product. To further understand the user experience and overall market fit the following KPIs were implemented: user satisfaction score (USS) and customer effort score (CES). The former measured user satisfaction with the products through surveys and feedback and the latter measured the ease of product use for customers, which is very important for this product as the main users are children aged 6-12.

Finally, although the main focus of the project is the development and testing of the product, market trends and competitor movements are also relevant. The metrics to control these can include monitoring new features or products released by competitors, which can give insights into the wants and needs of the customers. Another important thing to monitor is market share changes, which will allow for evaluation of what is successful in the industry, and the start-up can potentially implement those successful product/features into the product.

3.2 Progress Documentation

Comprehensive and concise progress documentation is essential to detailing a project's evolution. It enables stakeholders and decision-makers to have an oversight of the project, providing crucial information to make decisions as the project progresses. Additionally, documented progress can be used as a tool to investigate events or decisions that led to deviations. This allows for past inefficiencies to be identified, so that strategies can be developed to avoid similar outcomes in future development. Furthermore, if uncompleted work is being reassigned to a different employee, or a new employee is hired, the project documentation functions as a useful reference.

Excessive documentation can result in verbosity, resulting in the loss of valuable information in a sea of words. This also consumes the valuable time of those writing the documentation. On the other hand, too little documentation could result in the omitting of useful information. Hence, progress documentation updates will occur weekly in the form of a progress report. The weekly report will include information regarding what has been completed, what must still be done, whether the work is being completed as scheduled, what issues have emerged, plans to resolve the issues and general suggestions or comments. At the end of a Sprint, these weekly documents will be analysed and compiled into a single report. In addition to the weekly information, this report will provide suggestions on scope, deadline and resource amendment, based on the progress made, KPIs and issues encountered during the most recent Scrum.

3.3 Team Communication

Transparency and real-time communication is vital to our team's success. Hence, brief Scrum meetings will be held at the beginning of every day, fostering active discussion pertaining progress, daily targets, ideas, issues encountered or general queries. Such meetings encourage the communication of real-time information, eliminating any ambiguities and misunderstandings regarding project objectives. In addition to increasing transparency among the team, this also ensures the team functions effectively and cohesively.

Daily meetings present a valuable opportunity for team members to present any issues they may be encountering. As a result, issues are resolved collaboratively and swiftly, ensuring that no individual is left struggling for extended periods. Not only does this increase efficiency, it also strengthens interpersonal relationships, trust and promotes collaboration.

Approaches and strategies to completing work will be evaluated at the end of every Sprint during the Sprint Retrospect. This is an opportunity for the team to identify and discuss improvements to work strategies, increasing productivity in subsequent Sprints. Due to this collaborative feedback cycle, Sprints will become more efficient as the project evolves.

The communication, collaboration and clarity provided by regular meetings align with Agile beliefs. They result in a synchronised, adaptable team that is able to overcome challenges and achieve project goals as a unified entity.

3.4 Stakeholder Communication

Stakeholders will remain informed of progress, deviations and changes throughout the project by having access to the weekly progress report and the compiled version at the end of a Sprint. Additionally, stakeholders will have clear communication channels with management to request further information or state concerns. Such transparency and open-communication channels ensure alignment between the stakeholders' and the development team's project vision.

Significant changes or additions to the project's scope suggested by stakeholders will be discussed and decided during the Sprint Review.

4. Change Management

4.1 Deviation Resolution

Project deviations risk delays, scope creep and resource misallocation. Hence, they must be identified and resolved swiftly. The former will be achieved by comparing KPIs and weekly progress reports against performance targets. Once identified, deviations will be investigated and evaluated.

The investigation aims to determine and understand the issues or events that resulted in a deviation. For instance, inefficient work practises or underestimating the time and resources required to complete certain tasks. Multiple deviations may occur simultaneously, such that they cannot all be resolvable in time. Hence, they will be individually evaluated and prioritised based on their urgency, as well as potential impact on the project's scope, schedule and resources. Resolution will be achieved by adjusting deadlines, allocating additional resources or rooting out inefficient practises.

Emergency meetings will be held with stakeholders and managers if a project-jeopardising deviation is not resolvable. For instance, due to requiring budget-exceeding additional resource allocation or impossible deadline adjustments. During the meetings, extreme action plans will be considered, such as raising additional funding, delaying the product's release date or reducing the scope of the project.

4.2 Change Management Process

Each Sprint will be concluded with a Sprint Review, during which all stakeholders, managers and developers will be present. Since they will be held every two weeks, the project remains flexible and adaptable to changes. This is an opportunity for stakeholders and the development team to suggest changes to the project. Suggested changes will then be discussed, evaluated and decided. The evaluation will focus on the impact the change may have on the project's scope, schedule and resources. Furthermore, involving everyone in the decision-making process promotes a culture of transparency and ownership. This results in a more cohesive, motivated team with fewer misunderstandings regarding what has to be completed.

Provided a project's limited time and resources, excessive changes may not be realisable. In such scenarios, changes will either be deferred to a later version of the product or dismissed completely.

5. Risk Management

Effective risk management and analysis allows a business to understand key risks and uncertainties, allowing for the implementation of a strategic plan that accommodates contingencies. This ensures that the project is responsive to any challenges during the product development process, minimising the impact of potential disruptions, thus keeping the project on track.

5.1 SWOT Analysis

SWOT (Strength, Weakness, Opportunities, Threats) analysis is a technique that involves identifying and evaluating internal factors (Strengths and Weaknesses) and external factors (Opportunities and Threats) to determine the feasibility of a business proposition, its competitive positioning and any potential risks. The outcome of the analysis supports the development of a strategic plan to guide the business towards success.

Strengths:

- Interactive learning experience – Lingopal's computer vision system allows for interactions with everyday objects making language learning more fun and effective
- Encourages Conversations – LingoPal engages children in conversations related to everyday situations and therefore helps to build communication skills from an early age
- Multifunctional – LingoPal can not only teach linguistics but also enhance cognitive skills through conversations

Weaknesses and Strategies for Improvement:

- Technological Complexity – The wide range of features could present technical challenges during development and production. Ensure scope of project is clearly defined and prioritise key features to avoid unnecessary complexities.
- Learning curve and adoption – Children and parents take time to adjust to LingoPal's wide range of functions and features, potentially impacting initial adoption rates. Clear instructional videos and documentation could expedite the familiarisation process
- Price – The pricing of the product might serve as a barrier for some families, potentially limiting their willingness to purchase and adopt the product. Different versions of the product with varied materials and features could be produced to cater for different consumer budgets

Opportunities:

- Global Expansion and further customisation – Functionality of LingoPal can be expanded by offering additional language packs, educational content, or software updates, catering to a broader audience, and encouraging long-term user engagement and provide the business with long-term income
- Development of product range – Products with varied price ranges could attract a broader range of demographics

- Partnerships with educational institutions – collaborate with schools to promote wider adoption of product and integration into academic settings

Threats and mitigation strategies:

- Technological Obsolescence – Advancements in technology could lead to diminishing competitiveness and rapid obsolescence. It is important to keep up to date with technological trends and innovation through industry experts and new academic research to improve product offerings and maintain competitiveness
- Competition – The educational technology market already contains many established players potentially making the ability to gain market share more difficult. To address this issue, it is important to ensure product is well differentiated and possesses a convincing unique selling point
- Privacy Concerns – LingoPal utilises advanced technology to interact with children, which requires collection and processing of data. Therefore, there are likely to be privacy concerns that must be addressed, and strict legislation that must be adhered to such as COPPA (Children's Online Privacy Protection Act). Diligent data protection and processing practices must be implemented to instil confidence in the product

5.2 Key Risks and Mitigation Strategies

The main risks involved in the Design phase and Prototyping, Testing and Validation phases of the project can be divided into the following categories:

5.2.1 Phase 3 – Design

<u>Scope Creep:</u>

Risks:

- Changing stakeholder expectations lead to demands for more features than originally planned leading to delays and cost overruns

Risk Management Strategies:

- Ensure clear and timely communication with stakeholders to inform of changes and manage expectations
- Clearly define and document project scope
- Clearly communicate scope with all stakeholders
- Document features not included in current version of product to be used in next version
- Communicate with experts to determine the correct stage to lock scope to avoid locking too early or late and cause further issues

Intellectual Property:

Risks:

- The chances of patent rejection at this stage are higher due to the lack of a functional prototype. Key competitors could overtake in patent approval [8]
- Algorithm or design has protected Intellectual Property

Risk Management Strategies:

- Perform a freedom to operate (FTO) search to assess risk of infringing the patents of a similar product [9]
- Identify potential Intellectual Property infringements and design around identified issues
- Develop detailed diagrams and descriptions of product to clearly demonstrate proof of concept and feasibility to patent office and increase the chances of patent approval

User Acceptance:

Risks:

- Design is not appealing and fails to capture the attention of target users. This would limit market reach and lead to lower sales and lower product adoption rates
- Product is not intuitive to use which leads to low long-term adoption of product and low product retention rates
- A poorly designed product results in poor reviews which could lead to reputational damage and a reduction in sales in the long run

Risk Management Strategies:

- Facilitate regular interactions between product developers and potential customers such as through focus groups, surveys, and interviews to ensure that the product development process remains responsive to customer needs and preferences. However, it is also important to acknowledge the risk of scope creep during the product development process.

5.2.2 Phase 4 - Prototyping, Testing and Validation

Testing and Validation:

Risks:

- Tests fail to fully capture real world conditions such as terrain and
- Gate bias by internal employees lead to biased and lenient testing
- Human errors in testing
- Limited testing methodology leads to unsafe final product
- Stakeholders could be overly optimistic by initial tests results and rush to take initial prototype as final product to market. Issues could be overlooked due to rushed testing that can be passed onto final product

- Prototype fails to meet design specifications due to technical issues and thus require time and money for redesigning and adjustments

Risk Management Strategies:

- Ensure external testers are utilised to ensure fair and unbiased test of product that covers all aspects of functionality
- Establish a robust and detailed testing methodology that covers all key specifications
- Ensure that testing conforms with international/technical testing standards e.g., EN ISO, CE - ISO 8124 – “toys safety standards” to minimise potential hazards associated with LingoPal [10]
- Ensure clear and timely communication with stakeholders to inform of changes and manage expectations
- Ensure approval of gate criterion is performed by an external entity to the testing and validation performed to avoid bias
- Establish objective and transparent criterion to pass current gate stage well before arriving at the gate

Legislation and Certification:

Risks:

- The product fails to meet product legislations in intended distribution countries making selling unlawful
- Certifications and standards conformity costs exceed budgets and estimated time
- Materials used might not be compliant with local legislation regarding children's toys and electronics [11] [12]
- Regulators and customers have privacy concerns which could impact product confidence
- Product fails to comply with strict privacy legislations such as GDPR (General Data Protection Regulation) and particularly, for the target demographics which are children, COPPA (Children's Online Privacy Protection Act) [13] [14]

Risk Management Strategies:

- Ensure materials used to manufacture toy is approved in the countries we intend to sell to
- Thoroughly research legislations and product certifications in intended distribution countries to understand relevant laws that must be followed and certifications that must be obtained
- Implement robust data protection measures and ensure transparency regarding data collection and usage to build trust and confidence in product

Manufacturing preparation:

Risks:

- Suppliers and partner manufacturers are unreliable leading to delays
- Manufacturing and offshoring exposes company to external shocks such as shortages of materials, labour shortages and other economic and geopolitical effects leading to unexpected delays and extra costs. Examples include China's economic slowdown and engagement in trade wars with other countries.
- Quality control hard to enforce
- Technical issues lead to delays in producing a production ready prototype
- Technical issues encountered by manufacturer results in delays in mass production
- Cultural differences lead to misunderstandings and ineffective communication between developers, suppliers, and manufacturers

Risk Management Strategies:

- Establish a diverse network of global suppliers and manufacturing partners to diversify risk
- Clearly define quality expectations for suppliers and manufacturers by enforcing KPIs
- Develop a timeline that is planned to incorporate an element of flexibility. Ensure regular communication with technicians to locate deviations from timeline so that contingency plans can be executed, and timelines adjusted accordingly. A worst- and best-case date can be planned in advance; an approach inspired by ARM's Senior Functional Safety Manager, Peter Harrod
- Evaluate and understand where international partners lie within the 8 scales: Communicating, Evaluating, Persuading, Leading, Deciding, Trusting, Disagreeing, Scheduling and adjust interactions accordingly
- Keep minimum stocks to soften short-term supply-side shocks and issues

Document Preparation:

Risks:

- Documentation lacks clarity and information leading to limited support for product and potential misuse
- Safety Instructions lack detail and clarity making company liable for damages as a result of accidents
- Documents fail to communicate all conformities and certifications which could turn customers away from the product and potentially lead to regulatory action

Risk Management Strategies:

- Ensure a declaration of conformity is included (or similar based on country) to demonstrate to customers and relevant authorities that product complies with local requirements and is safe to use [15]
- Ensure products are clearly marked and labelled with safety messages and certifications

- Develop a comprehensive risk assessment during product testing to identify potential hazards and safety concerns such as potential misuse, product design and target user demographic. Explicit warnings and cautions should be included in the documentations and on conspicuous labelling on product to draw attention to critical safety information
- Include clear and detailed instructions on correct usage of product to reduce likelihood of misuse

6. Quality Management

LingoPal seeks to produce a product that maintains a consistently high degree of quality. Usability and correct engagement is of great importance to us, and so the following quality management strategy is employed to ensure each area of LingoPal is formed at the best quality for our customers. The strategy comprises a 5-step process, encompassing each avenue of LingoPal, incorporating the advice and pointers from the subject matter experts (SMEs). We also endeavour to use ISO standards in the first two steps discussed below, as we understand these standards will help to ensure that LingoPal is safe, reliable and of high quality [16].

Step 1 begins with the rigorous testing of the product itself. This entails the testing of each individual component of LingoPal by engineering experts, from the actuators to the speaker, each element of LingoPal will be tested to ensure it meets the correct specifications and is durable and safe. The ISO standard ‘ISO/IEC 23894:2023 Information Technology: Artificial Intelligence’ [17] will be utilised to ensure LingoPal employs the correct strategies to manage risks associated with AI. Next, is to ensure that the culmination of all the LingoPal elements is of good quality – this entails product-assembly quality control measures in the warehouse to ensure each part is securely attached to the next, and post-assembly assessments to identify any defects.

Step 2 entails the UAT of the app itself. The software should enable an easy user experience for either the child, parent or schoolteacher, and so thorough testing of this feature should be undertaken, with considerations of the ISO standard ‘ISO/IEC 27001:2022 Information security, cybersecurity, and privacy protection’ [18]. This ISO standard is chosen as the app will hold personal data of the user’s home layout and personal information, thus privacy concerns may arise and so ensuring proper cybersecurity systems are in place is important to maintain a high-quality product which is safe and entrusted.

Finally, step 5 aims to address any defects or issues that arose in the previous steps. To do this, an in-depth analysis will be undertaken to determine the root cause of the issue, which will involve discussions with the relevant team members to clearly identify the issue and find potential solutions for it. This will also require continuous documentation updates, conversations with stakeholders to ensure open and honest communication, and revising previous plans. Upon implementation of these solutions, further reviews will be carried out to ensure the corrective action taken has been positive and effective.

7. Project Costing

7.1 Project Cost

The projected budget for phases 3 and 4 collectively amounts to £879,158. Phase 3 is allocated £368,783, while Phase 4 is budgeted at £510,375. These figures have been computed using a methodology inspired by Arm's project management approach, which integrates both best-case and worst-case delivery timeframes. The total-cost calculations associated with each case is shown in table 7.1.

	Phase 3			Phase 4		
Cases	**Best**	**Worst**	**Realistic**	**Best**	**Worst**	**Realistic**
Wages	£293,750	£391,667	£342,708	£382,500	£579,167	£480,833
Materials and Equipment	£10,100	£16,200	£13,150	£15,900	£27,560	£21,730
Legal and Admin	£10,650	£15,200	£12,925	£1,250	£1,875	£1,563
Testing	-	-	-	£5,000	£7,500	£6,250
Total	£314,500	£423,067	**£368,783**	£404,650	£616,102	**£510,376**

Table 7.1: Predicted costs for Phases 3 and 4. Numbers based on calculations found in appendices 1, 2 and 3.

Phase 3 is anticipated to be completed within a timeframe ranging from 3 to 4 months, with an average estimated delivery time of 3.5 months. Similarly, Phase 4's delivery duration is projected to span between 4 to 6 months, with an average anticipated completion time of 5 months.

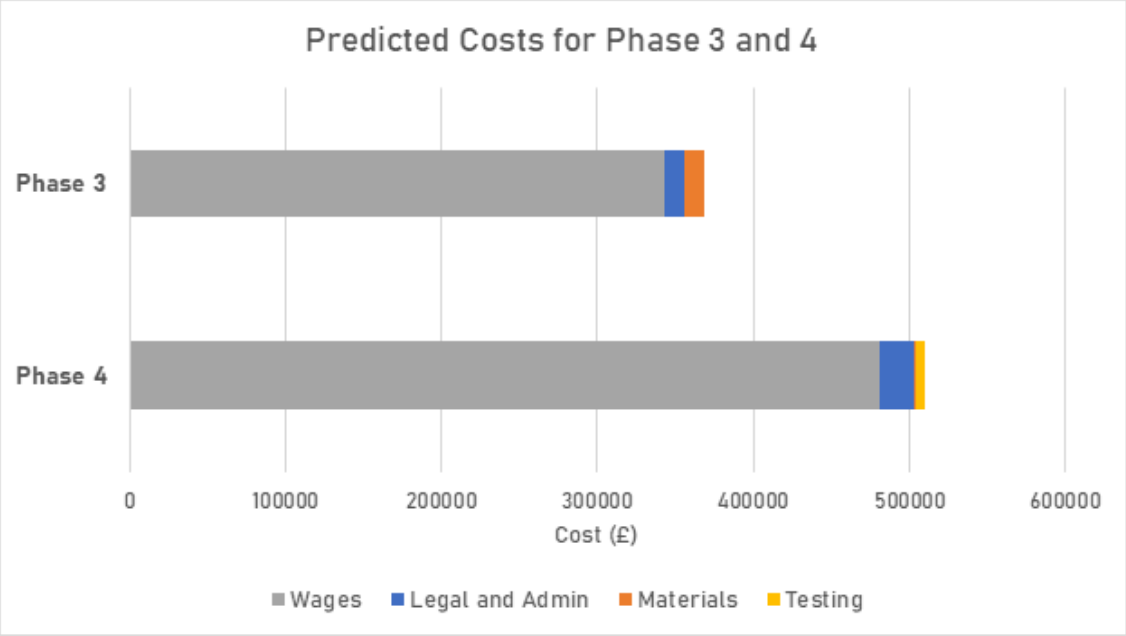

Figure 7.1: Predicted costs for Phases 3 and 4, based on Table 7.1.

As shown in figure 7.1, the £368,783 for the design phase is split into predominantly wages for staff, but also capital expenditure for tables, computers and 3D printers to fit our London office. Phase 4's costs total £510,375 due to the delivery time, as well as team size, increasing – a consequence of the resource-intensive nature of prototyping and testing.

7.2 Costs per Unit

	Product (£)	Annual App Subscription (£)
Price:	100.00	47.88
Direct Materials:	25.00	-
Direct Labour:	10.00	-
Variable Shipping + Storage:	5.00	-
Fixed Costs:	6.00	2.00
Profit:	54.00	45.88

Table 7.2: Per unit price, cost and profit, respectively. Calculations based on assuming 2000 units sold. Itemisation of Direct Material Costs can be found in appendix 4.

According to table 7.2, the cost per unit was calculated by considering direct material, labour, shipping costs and also a share of overall total fixed costs. Direct material costs were derived from the detailed bill of materials, totalling £25 per unit. Labour and manufacturing tasks will be outsourced to China, leveraging their cost-effective labour market at approximately £5 per hour. Based on an estimated manufacturing, assembly and testing time of 2 hours per unit, direct labour costs were approximated to £10.

Shipping and distribution logistics will be facilitated through Amazon fulfilment centres, incurring an additional cost of £5 per LingoPal unit. Fixed costs, such as rent, were approximated and distributed across the projected sales volume of 2000 units within the first year. Overall, the calculated total cost per unit was £46, leaving a profit margin of £54, considering a targeted sales price of £100. In addition to the hardware costs, estimates for the LingoPal app were also factored in, accounting for maintenance and upgrades spread across the anticipated downloads. Assuming a monthly subscription fee of £3.99, the projected annual profit per subscriber is approximately £45.88. This comprehensive approach to cost estimation and pricing strategy ensures a robust foundation for profitability and sustainability in the market landscape.

7.3 Sales Forecast and Return on Investment

The sales forecasts have been meticulously derived from initial assessments of the total addressable market for LingoPal. Drawing upon the global interactive robot market, which stands at £100 billion, we have extrapolated that the total available market value for LingoPal amounts to £100 million on a global scale and £13 million within the UK market. To establish LingoPal's market presence, sales efforts will be concentrated within the UK market during the initial years of 2025 and 2026. This focused approach aims to solidify LingoPal's position within the domestic market landscape, laying the groundwork for subsequent global expansion initiatives post-2027.

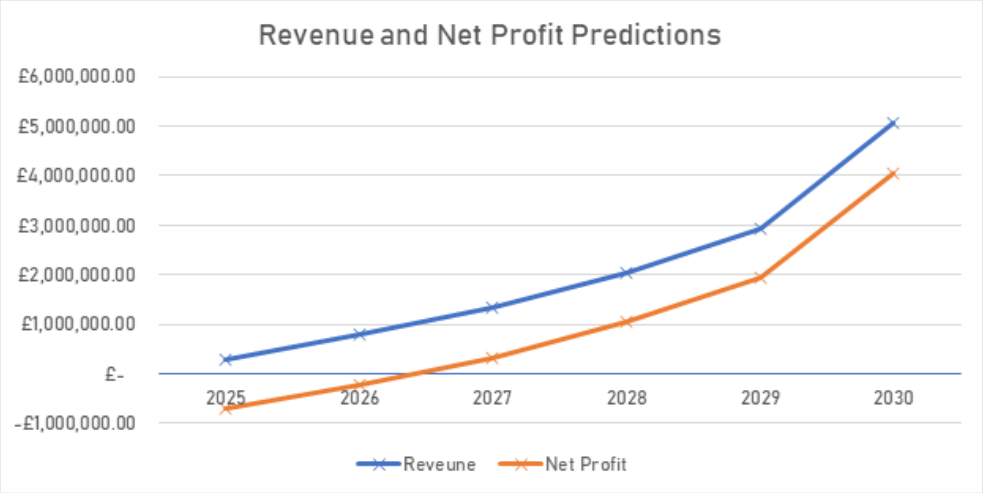

Figure 7.2: Forecasted revenue and net profit, based on calculations found in appendix 5.

As illustrated in figure 7.2, our projections indicate that LingoPal is poised to achieve sustainable profitability post-2027, with an anticipated surge in growth following its global expansion. Based on our calculations, we believe LingoPal has significant potential for long-term growth and success. Furthermore, based on an initial investment of £879,158 to fund phases 3 and 4, the IRR was calculated to be 37%.

8. Conclusion

LingoPal stands as a testament to innovative educational technology, meticulously designed to make language learning an immersive and interactive experience for children aged 6 to 12. By specialising in language acquisition, LingoPal maintains a competitive edge over competing educational rovers that predominantly focus on teaching STEM. Furthermore, LingoPal is projected to transform an initial £880,000 investment into sustainable profitability, amounting to over £1 million in annual profits, within 3 years of its launch.

Our revenue streams will consist of sales to parents and elementary schools. Due to parents and schools being the purchasing decision-makers, we will market accordingly. Parents will be marketed to through social media and cable television, while schools will be approached directly through email marketing. To raise further brand awareness, LingoPal intends to collaborate with influencers and other language-learning platforms.

To manage the complexity of this project, Agile and Waterfall methodologies are used to allow for structure and adaptability. Combining these management strategies with comprehensive timelines and monitoring of KPIs mitigates the occurrence of scope creep, delays and budget overruns. Furthermore, clear communications channels and regular meetings ensure the alignment of objectives between stakeholders, managers and developers.

Through extensive risk management, potential threats are identified in advance, allowing for the implementation of preventative measures and contingency plans. Additionally, the risk of producing an inadequate product is addressed by effective quality management. Through extensive testing, safety checks and ISO adherence, LingoPal guarantees quality of the highest degree.

Our vision at LingoPal is to transform language-learning into an exciting, engaging experience, providing children with skills for life in the process. By using meticulous research, strategic planning and effective project management, our team is dedicated to turning this vision into a reality.

9. Appendix

Appendix 1: Wages Rationale

	Phase 3			Phase 4		
Team	Best Case (3 months)	Worst Case (4 months)	**Realistic**	Best Case (4 months)	Worst Case (6 months)	**Realistic**
Management	£163,750	£218,333	**£191,042**	£218,333	£327,500	**£272,917**
Engineering	£67,500	£90,000	**£78,750**	£67,500	£106,667	**£87,083**
Marketing	£25,000	£33,333	**£29,167**	£46,667	£70,000	**£58,333**
Other/Admin	£37,500	£50,000	**£43,750**	£50,000	£75,000	**£62,500**
Total costs	£293,750	£391,667	**£342,708**	£382,500	£579,167	**£480,833**

Appendix 2: Phase 3 Rationale – Cost Breakdown

Materials and Equipment	Best Case	Worst Case	**Realistic**
Tables	£1,400	£2,800	£2,100
Chairs	£700	£1,400	£1,050
Computers	£5,000	£7,000	£6,000

3D Printer	£3,000	£5,000	£4,000
Total	£10,100	£16,200	**£13,150**
Legal and Admin	Best Case	Worst Case	**Realistic**
IP	£3,000	£5,000	£4,000
Office Rent	£7,650	£10,200	£8,925
Total	£10,650	£15,200	**£12,925**

Appendix 3: Phase 4 Rationale – Cost Breakdown

Materials	Best	Worst Case	**Realistic**
Electronics	500	750	625
3D printing material	100	150	125
Mechanical components	500	750	625
Batteries and Power	150	225	187.5
Total Cost	1250	1875	**1562.5**
Legal and Admin	Best Case	Worst Case	**Realistic**
ICO yearly cost	0	60	30
CE certification	600	1500	1050
Freedom to Operate Search	3000	6000	4500
ISO external testing	2000	4500	3250
App stores feeds	100	200	150

Rent	10200	15300	12750
Total Cost	15900	27560	**21730**
Testing Costs	Best Case	Worst Case	**Realistic**
Overtime	3000	4500	3750
Materials	1000	1500	1250
Testing equipment	1000	1500	1250
Total Cost	5000	7500	**6250**

Appendix 4: Bill of Materials

Components	Approx. Cost (£)
Electronics	9
PCB	3
Motors	2
Wheel	2
Camera	2
Battery	1
Casing	7
Total	**25**

Appendix 5: Projected Sales and Net Profit

	Revenue	Net Profit
		-879158
2025	£295,760.00	-£704,240.00
2026	£787,280.00	-£212,720.00
2027	£1,326,680.00	£326,680.00
2028	£2,037,900.00	£1,037,900.00
2029	£2,932,910.00	£1,932,910.00
2030	£5,052,855.00	£4,052,855.00

10. References

[1]

[2]

[3]

[4]

[5]

[6]

[7]

[8] P. T. | P. R. Labs, “Do You Need a Prototype for a Patent?,” *Pacific Research Laboratories*, Feb. 02, 2021. https://www.pacific-research.com/do-you-need-a-prototype-for-a-patent-prl/#:~:text=Although%20submitting%20a%20prototype%20with

[9] Traskbritt, “How to Design Around and Avoid Patent Infringement,” *TraskBritt*, Jul. 22, 2020. https://traskbritt.com/how-to-design-around-and-avoid-patent-infringement/

[10] ISO, *Iso.org*, 2024. https://www.iso.org/obp/ui/en/#iso:std:iso:8124:-1:ed-6:v1:en

[11] Health and Safety Executive, “UK law on the design and supply of products - Work equipment and machinery,” *Hse.gov.uk*, 2014. https://www.hse.gov.uk/work-equipment-machinery/uk-law-design-supply-products.htm

[12] OPSS, “Toys (Safety) Regulations 2011: Great Britain,” *GOV.UK*. https://www.gov.uk/government/publications/toys-safety-regulations-2011/toys-safety-regulations-2011-great-britain

[13] Federal Trade Commission, “Children’s Online Privacy Protection Rule (‘COPPA’),” *Federal Trade Commission*, Jul. 25, 2013. https://www.ftc.gov/legal-library/browse/rules/childrens-online-privacy-protection-rule-coppa

[14] GDPR, “General data protection regulation (GDPR),” *General Data Protection Regulation (GDPR)*, 2018. https://gdpr-info.eu/

[15] Europa, “Technical documentation and EU declaration of conformity,” *Your Europe*. https://europa.eu/youreurope/business/product-requirements/compliance/technical-documentati

on-conformity/index_en.htm#:~:text=An%20EU%20declaration%20of%20conformity%20(DoC)%20is%20a%20mandatory%20document

[16] ISO, “ISO/IEC 23894:2023,” *ISO*. https://www.iso.org/standard/77304.html

[17] ISO, “ISO/IEC 27001 standard – information security management systems,” *ISO*, Oct. 2022. https://www.iso.org/standard/27001

[18] iChild, “Product Testing | Family & Education / iChild,” *familyandeducation.co.uk*. https://familyandeducation.co.uk/our-services/product-testing/