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Integrating Exergames in Physiotherapy: Business Model Insights and Strategic Recommendations

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ABSTRACT

The integration of exergames in physiotherapy has gained attention due to their potential in improving rehabilitation outcomes, particularly for the elderly population facing mobility and fall risks. This study examines how exergames can be integrated into physiotherapy practices, focusing on business model elements and stakeholder perspectives, to determine the feasibility of market entry for an exergame product. A mixed-methods approach was employed, combining a comprehensive literature review on exergame technologies and digital health frameworks with qualitative interviews from physiotherapists at public and private clinics. Additionally, a pilot project framework was designed to validate the usability, clinical efficacy, and cost implications of the exergame prior to full-scale rollout. The study identified public clinics as the primary entry point for the exergame, with private clinics and community centers following. A subscription-based revenue model was preferred to minimize upfront costs for clinics. Key success factors for adoption included customizable exercise modules, multiplayer functionality for social engagement, and simplified onboarding. Strategic partnerships with government agencies and targeted marketing were also found to be crucial for widespread adoption.

Keywords: Exergames, Physiotherapy, Business Model, Digital Health, Rehabilitation
JEL Classifications: I0, I1, Z2

1. INTRODUCTION

The background and motivation for this project assignment is an EU-funded project, called "GameUp". A common problem for the elderly is reduced physical strength and decreased balance. This problem might lead to low self-confidence in everyday activities, which can lead to reduced mobility and high risk of falling (Frihagen et al., n.d.). This vicious circle results in reduced quality of life, inactivity, and loneliness. Sustaining and enhancing mobility in older people will reduce the risk of falling and enable them to live longer at home, which ultimately may result in a better quality of life (Graves et al., 2008). The purpose of "GameUp" is to use technologies that have been proven to improve motivation to encourage the elderly to be more physically active to maintain mobility. As a part of this initiative, convenient and easy-to-use exercise and social games will be developed using low-cost motion sensors and commercial modules and products (Osterwalder, 2004). The project is a European cooperation with different partners involved, including Cyberlab. This is a company situated in Trondheim that is working with the development of simulators and simulation-based games primarily for technical education and training, but also for promotion and exemplification of technical products and services (Trondheim Kommune, n.d.). Their responsibility in the "GameUp" project is to develop the necessary exercise games using Microsoft Kinect as a sensor and input device (Microsoft, n.d).

For us to understand the exergame and its potential, we have to look at the primary motivation for the "GameUp" project. The reasons behind the game are grounded in the problems of falls in the elderly (Tanaka et al., 2012). To understand the consequences of this problem, we have done a thorough research on fall statistics and the consequences of falls. This chapter reviews statistics related to the difficulties of falls, which show how serious this event is. We will describe the game based on information from

Cyberlab. Further, we will describe an example case, showing a typical environment where exergames can be implemented.

We see physiotherapy as an interesting area. Physiotherapists are the main actors in the work of prevention and rehabilitation and are one of the first actors elderly people meet with when they are facing a physical problem (Bradley et al., 2021). This suggests that physiotherapy might be the right arena for exergames. Therefore, we will look a little deeper into the subject of physiotherapy.

Physiotherapy is a science with a focus on body, movement, and functionality to maintain, recover, and improve physical health (Högstedt, 2023). The theoretical basis is grounded in anatomy, neuroscience, and physiology. In addition to this, practical and clinical knowledge contribute to the evaluation of how injuries and pain can be treated and prevented. Physiotherapists traditionally work in municipalities, hospitals, and private institutions, and they work with both individual treatment and treatment in groups (Nicholls, 2020). The goal for physiotherapists is to make their patients' daily activities easier to manage, which is done by using manual techniques, exercises, and technical methods.

Elderly people consult physiotherapists in terms of rehabilitation after surgery, after a fall, stroke, or other injuries, or when they feel health problems make it hard to perform everyday tasks (Hordvik et al., 2023). Physiotherapy usually includes exercise with a focus on increasing the patients' flexibility, endurance, and strength. Physiotherapists set up customized training for each patient according to what kind of needs they have. Unfortunately, the time a patient spends with the physiotherapists per week is not sufficient to become stronger or to recover from injuries (Tharaldsen, 2009). Therefore, patients need to undergo additional training outside these hours. The physiotherapists may give their patients exercises they can practice at home. However, not everyone is motivated to exercise on their own, and many skip the weekly exercise that is scheduled for them.

To prevent disabilities, older adults should routinely perform exercises targeting strength, balance, coordination, endurance, and mobility (Tharaldsen, 2009). In Trondheim, weekly group fitness sessions (1–2 h) and activities such as senior dance, walking, and water gymnastics are available (Trondheim Kommune, n.d.). While these reduce fear of falling, once-weekly exercise alone does not sufficiently improve physical function and should be supplemented with home training (Tharaldsen, 2009).

Several home-based programs have demonstrated effectiveness:

- Otago Program: 30-min sessions, three times weekly, plus two walks, with biannual home visits and monthly calls (Campbell and Robertson, 2003). In 1016 participants (aged 65–97), falls and injuries dropped by 35%, especially in those over 80 or with prior falls; strength, balance, and confidence also improved.
- Fame: Builds on Otago with three group and two home sessions per week. A 36-week trial in women aged 65 with three falls/year showed a one-third reduction in fall rate; progression requires gradual increases in intensity and duration (Skelton et al., n.d.).
- Øvelsesbanken: An online platform offering customizable exercise plans derived from Otago and Fame, with printable PDFs; over 4,300 users in Scandinavia by mid-2012 (Enhet for fysioterapitjenester, n.d.)

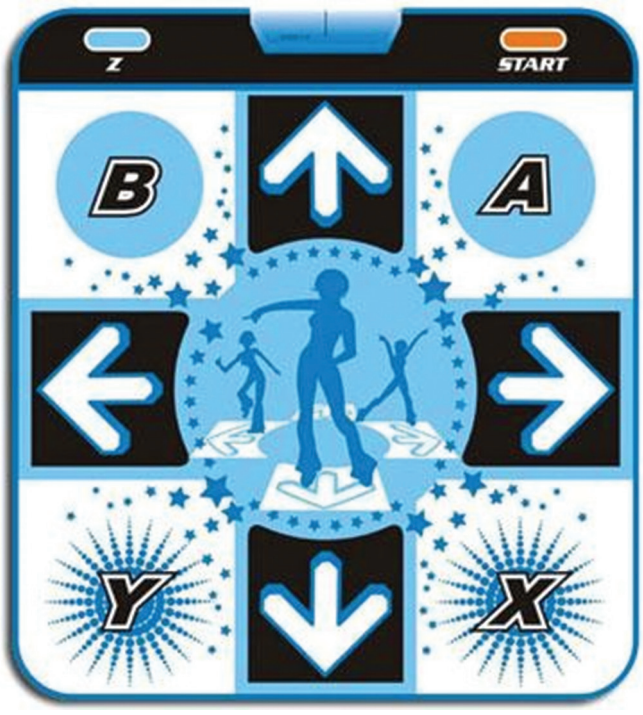
Despite proven benefits, motivating older adults remains a challenge: paper-based routines can be uninspiring, and fear of leaving home limits participation. Exergames offer a fun, home-based alternative with remote monitoring by clinicians. However, unfamiliar technology suggests initial rollout in supervised settings (clinics or community groups) to align with the sector's focus on prevention and welfare technology.

Exergames—video games that require physical movement—leverage motion sensors (e.g., Kinect, Wii Remote, EyeToy) to blend exercise with play. They are engaging, accessible, and can improve strength, balance, and mood through goal-based feedback and social interaction (Song et al., 2011). Popular platforms include Nintendo Wii, Dance Dance Revolution, PlayStation EyeToy/Move, and Xbox Kinect (Lee, 2008; Nintendo, n.d.; PlayStation Blog, n.d.; PlayStation Blog, 2010). Research shows rapid growth in exergame health applications. For seniors, exergames offer physical and psychosocial benefits, counteracting loneliness and enhancing motivation (Brox et al., 2011; Nintendo, n.d.; VentureBeat, n.d). In rehabilitation (e.g., post-stroke, spinal injury), exergames can distract from pain and provide measurable metrics. However, many commercial titles lack the precision and pacing required for therapy (Lange et al., 2011; Brox et al., 2011). Future therapeutic exergames should prioritize:

- User-friendly interfaces and clear on-screen guidance
- Real-time corrective feedback on performance
- Adjustable difficulty levels and exercise modules
- Multiplayer or social modes to boost adherence.

Dance Dance Revolution is a rhythm game using a pressure-sensitive dance pad (Figure 1). First released in arcades in

Figure 1: The Dance Dance Revolution dance pad



1998, it challenges players to step on arrows in time with music, providing moderate-to-vigorous exercise. By 2003, DDR sold over 6.5 million units, and by 2011 surpassed 13 million, fueled by weight-loss success stories (GameSpot, n.d; GayGamer, n.d.).

Staiano and Calvert (2011) report successful integration of exergames in gyms, schools, and clinics, with improvements in weight management, balance, and exercise adherence. Brox et al. (2011) emphasize minimalist interfaces, positive feedback, goal tracking, and social features to address seniors' cognitive and motivational needs. Clinical prototypes—such as Kinect-based balance and stepping assessments—demonstrate feasibility but require larger trials for validation (Garcia et al., 2012; Chang et al., 2011).

2. MATERIALS AND METHODS

We initially mapped four potential customer segments for the exergame: end-users (elderly), training groups, community centers, and physiotherapy clinics. After developing business-model canvases (Osterwalder and Pigneur, 2010; WiiFit. n.d.), we identified physiotherapy clinics as the primary target due to alignment with clinical workflows and payer structures. To understand this segment, we conducted qualitative research as detailed below.

2.1. Qualitative Research

We carried out semi-structured interviews with four physiotherapists (three public, one private) who serve older adults. Interviews explored:

- Clinic economics: Public clinics (municipal funding) versus private practice (owner funding).
- Patient pathways: Referral timing, barriers to home exercise, and motivation.
- Adoption criteria: Evidence requirements, ease of use, support needs.
- Procurement channels: Professional magazines, conferences, and existing suppliers.

3. RESULTS

3.1. Service Context and Barriers

Public "Seniortrim" groups (30 NOK/session) and private classes (60 NOK/session) provide social exercise but occur only a few times a week. This limits strength gains and fails to overcome mobility fears. Patients often delay therapy until problems worsen and struggle with home programs due to low motivation, poor feedback, and safety concerns.

3.2. Product Requirements

Physiotherapists emphasized:

- Validated efficacy: Clinical evidence and pilot data are essential for adoption.
- Low-threshold use: Intuitive interface, minimal setup, and quick training.
- Customization: Adjustable exercises, difficulty levels, and themes.
- Feedback: Real-time guidance to ensure correct movements and monitor progress.

3.3. Procurement Preferences

Clinics prefer trials or usage-fee models over large upfront purchases. Leasing or pilot deployments allow evaluation and evidence gathering before full investment.

3.4. Adoption Enablers

Therapist endorsement is critical, as elderly patients rely on trusted professionals. Initial roll-out in clinic settings (vs. home) ensures support, space management, and social engagement. Over time, technology familiarity and positive outcomes may drive home adoption.

3.5. Key Activities

Cyberlab's work can be described as a Value Chain, which means transforming inputs into a final product. From the knowledge and experience Cyberlab has acquired they want to make the game as good, cost efficient and price-competitive so that their customers would choose their product instead of a product with similar value. The game's development should be test-driven, meaning that they will test the product both on the end-users and the customer segment during the development, and adapt the game based on the experiences acquired during the testing (Rand et al., 2008). Activities that need to be done include research processing, development, testing, maintenance, updates, support, marketing, and administrative tasks, shown in Table 1.

Cyberlab is provided with research information from Norut, a national research group from Tromsø. Cyberlab's first task will

Table 1: Characteristics of cost structures

Type	Description
Fixed costs	Costs stay the same regardless of the volume
Variable costs	Costs depend on volume
Economies of scale	Lower cost as output increases
Economies of scope	Lower cost due to a larger scope of operations

Table 2: Different types of resources

Type of resource	Resource
Intellectual	Insights and experiences with falls in the elderly
	Programming skills
	Creativity
Physical	Premises
	Equipment, i.e., desks and computers
	Microsoft Kinect sensor
	Windows machines
	Projector and screen
	Working environment, Kinect for Windows SDK
	Internet connections
	Web page
Human	System developers, i.e., programmers and interaction designers
	Administration, i.e., for marketing, customer-related tasks
	People for the pilot project follow-up
	Support person (s)
Financial	The European Union

be to process this information to understand the requirements for the game. Cyberlab will also provide suitable exercises that professionals know are good for the end-user. Cyberlab has to find a way to build the game around these exercises. An important task is to make the game user-friendly and easy to use. Prototypes should be tested on the end-user to see if the game is easy to understand and conduct (Yampolsky and Scacchi, 2016). This includes menu choices, information feedback, and the execution of the game. The physiotherapists should also take part in this. After the game has been tested, they have to modify it according to the feedback and test it again. This should be done until every actor is satisfied.

During the development, they should get one or more clinics to participate in a pilot project. This should start as soon as the game is finished, but they can also be involved in the testing during the development phase. The documentation from this pilot project is essential when marketing the product. The marketing task is very important, and much thought must be put into it. An additional important part of the development is to find out how to set up the infrastructure (e.g., databases, servers, communication between entities) (McElroy, 2016). After the game is finished and delivered to the customers, it has to be maintained and enhanced. New versions and updates should be provided to maintain a good customer relationship. In addition, they must provide support to the customers. For game development, some key resources are crucial which are listed in Table 2 above.

3.6. Key Partnerships

Norut is a national research group located in Tromsø. Cyberlab depends on them because they provide it with research information. This is the only entity Cyberlab relies solely on, so this is the only key partner.

3.7. Financial Aspects

All the outgoing and incoming cash flows will be described in this section. All the previous blocks are contributing to a cost or an income. We will try to provide a realistic and detailed estimate of both cost and income, and then make an analysis of potential profit. It is essential to mention that we have made many assumptions and that not all expenses are taken into consideration.

3.8. Cost Structure

Cost structure takes into account all elements that generate costs specific to this game. Cyberlab is an already established business, and we can therefore assume that there are no additional costs associated with premises and some of the "regular" equipment (e.g., desks, chairs, computers, etc.). We will not distinguish between fixed and variable costs but look at every cost as fixed, annual costs. Variable costs are salaries associated with support and administrative tasks. Here we will assume that these tasks have been assigned a fixed workload for each year.

Further, we will distinguish between investment costs and ongoing costs. Cyberlab's costs have the characteristic economies of scale, meaning that the cost per unit will fall when output rises. This is due to a marginal cost close to 0. The cost structure of this business will be both value-driven and cost-driven. They will make a cost-efficient product that will serve all its value propositions. The game's value is vital to distinguish it from "ordinary" video games (Sung, 2011).

3.9. Investment Costs

Investment costs are all the costs associated with the development of the game. This includes salaries for the development team, the hardware and software needed to develop the game, and the pilot project cost (Garcia et al., 2022). We will assume that the game's development will take 6 months, and that they will carry out a pilot project for 6 months. This means that Cyberlab is looking at a whole year without revenue.

3.10. Hardware and Software

The commercial price for the Kinect sensor is 1,790 NOK, and the SDK (Software Development Kit) for the sensor is free. In addition, they should have a screen for testing purposes. The screen should be of significant size, so we suggest they invest in a projector and a 90" projector screen, which should be sufficient for its purpose. We found that the cost of an average screen is 895 NOK and 2,449 NOK for a projector.

3.11. Development

Cyberlab has estimated that for the development of this game, they need an FTE = 1.0, meaning that the workload is equivalent to one person working full time for a year. We assume that this will cover development, testing, and administrative tasks during the development. In addition, Norut, which provides research, has also assigned an FTE = 1.0. How many people are assigned to the project is unknown and also irrelevant for the cost prediction (assuming every employee has the same salary). We have estimated how much the cost of having an engineer with an FTE = 1.0 in the private sector in Table 3.

3.12. Pilot Project

As mentioned, we suggest that Cyberlab run a pilot project to document the effect of the game. This will also serve as a very effective way of marketing the game. We suggest that the pilot project should be carried out in one or more clinics in Trondheim for convenience, and that it should run for 6 months. The effect has to be documented both during and after the project. This documentation should be published in scientific articles and distributed to physiotherapists. The pilot project will most likely provide Cyberlab with valuable feedback on the game,

Table 3: Cost of FTE=1.0 in the Private Sector (for Cyberlab)

No.	Description	Perks and percentages	Amount in NOK
1	Gross Salary		730,000 NOK
2	Holiday Pay	12.1% of gross salary	88,330 NOK
3	Employee Fee	14.1% of Gross+Holiday	115,385 NOK
4	Pension Costs	8% of Gross Salary	58400 NOK
5	Employee Fee of Pension Costs	14.1% of Pension costs	8234 NOK
6	Insurance		2000 NOK
7	Mobile and Internet		1000 NOK
	Sum		1,003,349 NOK

where they can both test the usability in a real environment and discover bugs. This will require close monitoring from Cyberlab, so we suggest that this will require an FTE of 1/5 for 6 months (this equals FTE = 1/10 seen in a whole year). In addition, they will have to pay the physiotherapists working with the pilot project. We assume this will be the same amount as their hourly salary. For these 6 months, we recommend that the number of physiotherapists working with this be equal to an FTE=2/5 (or FTE=1/5 seen in a whole year). The investment costs are summarized in Table 4.

3.13. Financial Analysis

In this section, we will make a financial analysis based on the costs and the different revenue models just described. We will recommend prices suitable for the various models for Cyberlab to generate profit, while remaining competitive in the market.

3.14. The Potential Market

Before pricing the product, it is necessary to observe today's market. To understand the market, we have to look at prices on existing games and physiotherapy tools, and try to find a place in between where the game fits. We also have to predict the potential demand for this product. Demand will depend on the product's documentation, popularity within the physiotherapy community, and price. Calculating an exact demand for this product is impossible due to the lack of existing games in the same genre and information about the market. It is also hard because the game Cyberlab, which will be sold, does not exist yet, making it difficult for the customers to show their interest. Cyberlab's market potential can be roughly calculated by looking at the number of public clinics and private physiotherapy clinics with support from the government, which, from now on, are referred to as physiotherapy clinics or just clinics.

We looked at four municipalities in Norway: Oslo, Trondheim, Fredrikstad, and Tønsberg. For each, we found the number of clinics and compared that number to the population in each municipality. The average ratio we got describes inhabitants per clinic in Norway. Finding the total population in Norway and dividing this by the average ratio gave us an approximation of physiotherapy clinics suitable for Cyberlab's customer segment. Our calculation shows that Cyberlab has a potential market of approximately 1200 physiotherapy clinics in Norway.

Table 4: Investment costs (in NOK) associated with the development of the game

Investment costs	Amount in NOK
Hardware	
Kinect sensor	1,790 NOK
Projector	2,449 NOK
Screen	895 NOK
Storage	1,087 NOK
Development Team: FTE = 1	1,003,349 NOK
Research from Norut: FTE = 1	715,577 NOK
Pilot Project	
Representative (s) from Cyberlab: FTE = 1/10	100,335 NOK
Representative (s) from the physiotherapy clinic: FTE = 1/5	70,000 NOK
Sum	1,895,482 NOK

We suggest that Cyberlab should start with Trondheim as its primary focus. The product was developed in Trondheim, and they have already established relationships with some entities through the EU-funded project. This will make it convenient for Cyberlab to follow up and respond quickly to requested changes or possible errors and monitor the progression. We will now assume that the game has been developed, well-documented, received tremendous positive feedback, and has been accepted by the physiotherapy community. With these conditions in place, we believe there will be a diffusion of the game, starting slowly in Trondheim and spreading to the rest of the country as it gets more and more attention. This means it might take some time before Cyberlab generates any profit, as we will demonstrate later in this section. We can describe the diffusion of a product with an S-curve, depicted in Figure 2.

The S-curve describes how an innovation will adopt customers over time. In the introduction of a product or service, it will take some time to adopt a critical mass. There are different types of people adapting to the technology at different times. These types can be defined as innovators, early adopters, early majority, late majority, and laggards. As the actors are adapting to the technology, the market share will grow and eventually reach its saturation level, meaning it has reached all potential adopters. Most innovations

Figure 2: The S-Curve (Rogers et al., 2014)

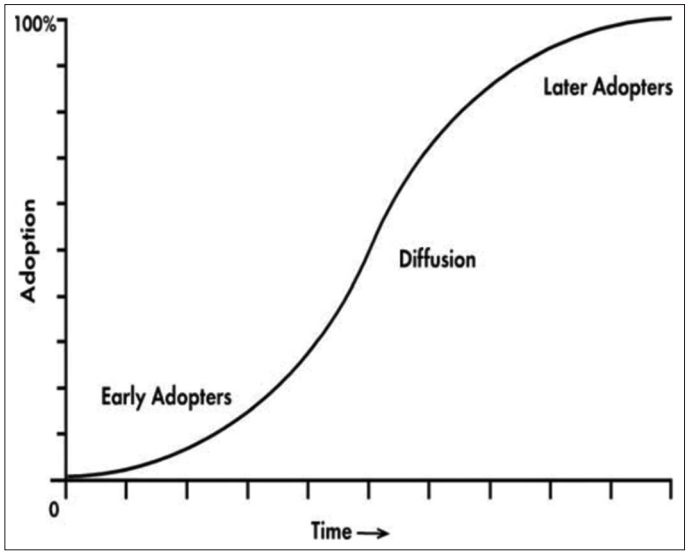


Figure 3: S-curve for the exergame. In the graph, year 0 to 1 means the 1st year after the release

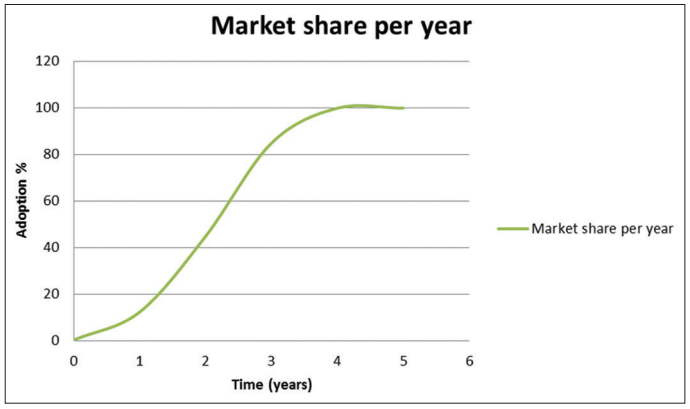
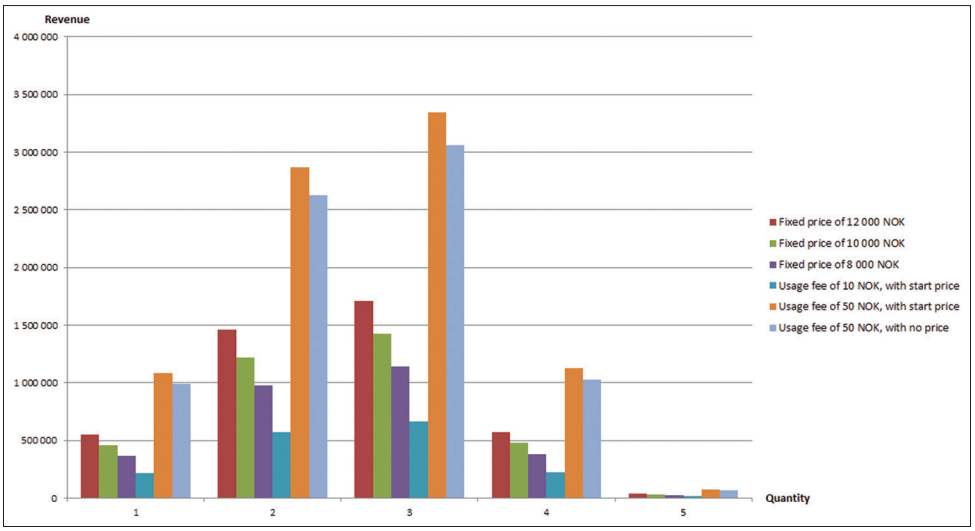


Figure 4: This graph represents several revenue examples for both the fixed price and the usage fee solution. Revenue is represented on a per-year basis



can be described with an S-curve, but the curve will look different for different innovations.

With the S-curve in mind, we will try to put a number on what we believe Cyberlab can expect to sell in each of the 5 years after the game's release. Even though the potential market consists of 1200 clinics, we do not think it is reasonable to reach out to all of them. A more realistic sales number would be to cover one-third of the potential market share, which is 400 clinics. The reason for this is that it is a great amount of uncertainty related to the exergame. The video game itself is not a new technology, but the use of video games as an equipment in physiotherapy treatment is. The market is immature and inexperienced, so the exergame could meet a great deal of doubt when launched. We have to take into consideration that there are physiotherapy clinics that do not see the need for an exergame. In one of the interviews, we were also told that physiotherapists could be a conservative group of people. It could be difficult to convince them to try something new and different from what they are already used to. It should be mentioned that the market potential can become bigger if they decide to include other customer segments.

As already explained, the 6 months before the release will consist of the pilot project only. We assume that this will be carried out in two different clinics. This will not generate any revenue. Now we will assume that the pilot project has succeeded and the product is well-documented. In all the municipalities, there is close collaboration between the different entities in the health sector. Therefore, we can assume that other physiotherapy clinics in Trondheim will adapt to the game. In addition, the game will be adopted by innovators eager to try new things. Let us say this will count for 48 sales, or 12 percent of the potential market share of 400 clinics. As clinics start to use the game and the word spreads about a valuable and effective tool, more people will adopt it. Roughly estimated, we believe the game will reach its potential market share in its 4th year. Then, some laggards who were skeptical of the product started using it. We believe that most customers will adopt the game during the 3rd year because then it will have sufficient time to mature as depicted in Figure 3.

Figure 4 presents six revenue stream examples from both the fixed price model and the usage fee model. We have included three fixed prices, two different usage fees, and a usage fee with and without start price. We assume that Cyberlab can sell 400 units, and that the game, with the usage fee model, is used as much as estimated. The revenue streams are presented on a per-year basis, over a lifetime of 5 years. The number of units sold per year is distributed by the S-curve, described earlier in this section. We see that the solution with a usage fee model, with a start price and a fee of 50 NOK, gives the highest revenue. By using this model, Cyberlab can expect to make high profits.

4. DISCUSSION AND CONCLUSION

Exergames integrated into physiotherapy offer chances as well as obstacles for healthcare providers, mainly regarding addressing the rise in mobility and fall risks in the elderly population. The combination of gameplay and exercise in exergames makes it easier for the elderly to stay active during rehabilitation. This is in line with the main objective of the "GameUp" project: Helping seniors improve their physical and mental health by offering fun exercises using technology.

This study shows that a business model should fit the different demands of physiotherapists, the major stakeholders in this project. The interviews with physiotherapists made it clear that they need products that can be used smoothly alongside their current practices. Physiotherapists said ease of use, customizable exercises, real-time feedback, and being able to meet a patient's specific needs are key to the success of exergames in therapy. In addition, physiotherapists said that proving a product's clinical effectiveness through good documentation would be very important for its adoption.

Furthermore, physiotherapists find a subscription model the most attractive, since it reduces the financial barrier that clinics have to face at the start. This system also allows for regular updates, which is important for keeping both the developers and clinics sustainable over time. Partnering with both government groups and professional networks is key, from a strategic perspective, to build physiotherapists' trust and make sure the product adheres to clinical standards.

The study says that introducing the exergame to public clinics is the best starting point, followed by private clinics and community centers. For the exergame to be adopted, pilot projects must succeed since these tests will show how well it works and can be used in practice. Besides that, running these pilot projects will make it easier to show doctors and patients the value of this product in real clinical situations.

According to the financial analysis, it is key to recognize the expenses related to making exergames and how they will be used operationally. Having so much cash tied up in hardware, software, and hiring developers means that pricing the product well is essential to cover costs and turn a profit. Even though the market for exergames in physiotherapy is new, its potential for development is considerable, especially as it spreads and is adopted in Norway's clinics.

The product's distribution among different regions and markets is predicted to follow an S-curve pattern, where the early adopters contribute to its broader uptake. With time, as more people know about the technology and its benefits, the amount of the market covered by exergames is expected to rise and level off in the 4th year. The slow take-up of the exergame in physiotherapy shows that the healthcare sector is usually cautious and needs proof from clinical trials and practice before accepting anything new.

In brief, incorporating exergames into physiotherapy has significant advantages, such as improving rehabilitation and encouraging patients to keep doing their exercises. Still, for this technology to become widely used, it must pay close heed to physiotherapists' needs, create a sound business model, and form strong partnerships that make the product effective, sensible in cost, and suitable for the healthcare arena. Bringing this technology into physiotherapy practices could substantially shake up how seniors receive care, making life better and easier for them.

There is significant uncertainty related to the potential of this game. It is a new technological tool that will face a small and immature market. In addition, the fact that the game is not yet developed made it hard for us to understand the game, as well as describe the game to the physiotherapists that we interviewed. It was also difficult to predict a realistic demand. However, from the physiotherapists' positive attitude and with support in the Norwegian health sector's new focus, we believe that the game has potential in this market. The great amount of research that has been done on video games for health-related purposes over the last couple of years also suggests potential for the exergame. This requires Cyberlab to develop an entertaining and easy-to-use game, customized with the right exercises for the elderly, in close collaboration with the end-user and physiotherapists. If they do this, they can expect to become successful in this market and gain significant profit.

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